Chapter 7.11
# Mission–Critical Group Decision–Making:
## Solving the Problem of Decision Preference Change in Group Decision–Making Using Markov Chain Model[1]

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## ABSTRACT

Review on group decision support systems (GDSS) indicates that traditional GDSS are not specifically designed to support mission-critical group decision-making tasks that require group decision-making to be made effectively within short time. In addition, prior studies in the research literature have not considered group decision preference adjustment as a continuous process and neglected its impact on group decision-making. In reality, group members may dynamically change their decision preferences during group decision-making process. This dynamic adjustment of decision preferences may continue until a group reaches consensus on final decision. This article intends to address this neglected group decision-making research issue in the literature by proposing a new approach based on the Markov chain model. Furthermore, a new group decision weight allocation approach is also suggested. A real case example of New Orleans Hurricane Katrina is used to illustrate the usefulness and effectiveness of the proposed approaches. Finally, the article concludes with the discussion on the proposed approaches and presents directions for future research.

## INTRODUCTION

Mission-critical events such as hurricanes, terrorist attacks, fires, and earthquakes require different governmental departments to work together to respond to those emerging crises and reach consensus quickly to make effective decisions within a short time period. Traditional group decision support systems (GDSS) have not specifically addressed this important issue in the research literature (Fjermestad & Hiltz 1999; Huang, 2003; Huang & Wei, 2000; Huang, Wei, & Lim, 2003; Tan, Wei, Huang, & Ng, 2000; Zigurs, DeSanctis, & Billingsley, 1991; Vogel, Martz, Nunamaker, Grohowski, & McGoff, 1990). A special type of GDSS, mission-critical GDSS (MC-GDSS), can be designed to support this group decision-making process.

Mission-critical group decision-making has some important characteristics that are different from conventional group decision-makings (Belardo & Wallace, 1989; Beroggi, Mendonça, & Wallace, 2003; Huang & Li, 2007; Limayem, Banerjee, & Ma, 2006; Mendonca, Beroggi, Gent, & Wallace, 2006; Wallace & DeBalogh, 1985): (1) decision-makers have to make nearly real-time decision. Decision-making on emergency response has to be made within a short time because of the nature of critical mission, (2) mission-critical decision-making problem is unstructured, fuzzy and unexpected in nature, and (3) information available to decision-makers is insufficient and not always accurate because complete information may not be collected in a short time, thus the decision makers can only rely on such incomplete information to making decisions. Therefore, conventional decision support approaches may not well solve decision problems of mission-critical events.

Prior research studies mission-critical decision-making from different perspectives. LaPorte and Consilini identify two emergency response patterns based on frequency and scene information respectively (LaPorte & Consilini, 1991). Ody

thinks that crisis decision-making task, one type of mission-critical decision-making tasks, consists of three segments, pre-incident identification of hazards, the use of agreed communications, and the introduction of a third party to promote the coordination of decision makers (Ody, 1995). Wilkenfeld, Kraus, Holley, and Harris design a decision support system, GENIE, and demonstrate the usefulness of GENIE to help decision makers maximize their objectives in a crisis negotiation. Experimental results show that GENIE users, as compared to non-users, are more likely to identify utility maximization as their primary objective and to achieve higher utility scores (Wilkenfeld, Kraus, Holley, & Harris, 1995). Papazoglou and Christou propose a method on optimization of the short-term emergency response to nuclear accidents, which seeks an optimum combination of protective actions in the presence of a multitude of conflicting objectives and under uncertainty (Papazoglou & Christou, 1997). Bar-Eli and Tractinsky explore psychological performance crises under time pressure towards the end of basketball games (Bar-Eli & Tractinsky, 2000). Zografos, Vasilakis, and Giannouli present a methodological and unified framework for developing a decision support system (DSS) for hazardous materials emergency response operations (Zografos, Vasilakis, & Giannouli, 2000). Weisaeth, Knudsen, and Tonnessen discuss how psychological stress disturbs decision making during technological crisis and disaster, at an operative level of emergency response and at the strategic and political level respectively (Weisaeth, Knudsen, & Tonnessen, 2002). Chen, Sharman, and Rao et al. develop a set of supporting design concepts and strategic principles for an architecture for a coordinated multi-incident emergency response system based upon emergency response system requirement analysis (Chen, Sharman, & Rao et al., 2005).

As Arrow points out, based on the construction of group preference, group decision-making is a procedure of synthesizing the preferences of each

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