Representing the classification model for critical infrastructure vulnerability using fuzzy logic

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ABSTRACT

Critical infrastructures are one of the most important parts in every country. So that one country with damaged critical infrastructure will not be able to protect itself against other country. So this part is paid attention by governments. Protecting and ensuring the resiliency of the critical infrastructure and key resources is essential to the nation's security, public health and safety, economic vitality, and way of life. Identification of vulnerability size can be useful in decision making and planning, and management will be able to do the fit reaction in against of dangerous. One of the best methods to identify is classification. There are different methods for classification, one of which is fuzzy set theory. Fuzzy set theory generalizes ordinary or classical sets in an attempt to model and simulate human linguistic reasoning in a domain characterized by incomplete, imprecise, uncertain and vague data. This article tries to present a model for critical infrastructure reliability and vulnerability. The results showed this model is very strength in classification and by virtue of this model has a high efficiency.

Keywords: classification, critical infrastructure, vulnerability, fuzzy logic.

INTRODUCTION

The National Strategy adopted the definition of "critical infrastructure" in P.L. 107-56, providing the following list of specific infrastructure sectors (and its assets) falling under that definition which sectors include [1]: (i) agriculture and food production, (ii) banking and finance, (iii) chemical production, (iv) critical manufacturing, (v) communications, (vi) emergency services, (vii) energy, (viii) government facilities, (ix) information technology, (x) nuclear energy and facilities, (xi) postal shipping, (xii) public health and healthcare, (xiii) transportation and logistics services, (xiv) water and wastewater treatment, and key resources include: (xv) defense industrial base, (xvi) commercial facilities, (xvii) dams, and (xviii) National monuments and icons.

Infrastructure systems produce services that are essential for the well-being of a nation and its citizens, these systems are becoming more interconnected and complex, which increases their vulnerability to different types of disruptors, preventing the proper functioning of the infrastructure systems, and leading to negative impacts on several aspects of society [2].

Critical information infrastructure protection is the subject "du jour" [3]. Critical infrastructure systems are exposed to a myriad of operational threats, each with a unique ability to disrupt operations [4].

Threats against critical infrastructures are becoming more and more asymmetric. Even selective impact on an individual infrastructure may lead to disturbances of government, economical or public life [5].

Defining critical infrastructures vulnerability is due to many nonlinear factors that can vary dramatically from case to case. Furthermore, there are several levels of possible interactions among the components of large, complex infrastructure networks [6]. Another problem encountered when system behavior is often dependent on low-level technical details. A small change in a technical detail can have a significant impact on overall system behavior, however, it is difficult – if not impossible – to model a system down to its lowest level [6].

There are many other useful decision analysis frameworks and typologies. One typology characterizes decisions in relation to external conditions of uncertainty and conflict [7], which include [8]:

(i) Decision under certainty, (ii) decision under risk, (iii) decision under uncertainty, and (iv) decision under conflict.

There are several approaches to representing and managing uncertainty in the decision analysis process. The decision maker may choose to ignore uncertainty or consider it explicitly. In decision analysis, probability and scenarios are