A Unified Localizable Emergency Events Scale

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ABSTRACT

Managers of emergencies face challenges of complexity, uncertainty, and unpredictability. Triadic constraints imply requisite parsimony in describing the essence of the emergency, its magnitude and direction of development. Linguistic separation increases as the crisis management organization is more complex and made up of diverse constituents. Therefore, a standard objective emergency scale is vital to quantify and unambiguously communicate the nature of any emergency. Previous work laid the foundations for an objective measurable emergency event scale. This article proposes a unified emergency scale based on a mathematical model, accompanied by several examples spanning local to national events.

Keywords: Complexity, Dynamical Systems, Emergence, Emergency Management, Emergency Scale

INTRODUCTION

The American Heritage College Dictionary defines emergency as “a serious situation or occurrence that happens unexpectedly and demands immediate action” (American Heritage Dictionary 2000). There are numerous scales that attempt to define degrees of emergencies. These scales tend to describe the characteristics of the event itself rather than the consequences. Such scales are ill-suited to describe emergencies in a way that is meaningful for response. People assume there is a positive relationship between the magnitude of an event and the magnitude of the emergency it causes, but this is not always the case. For example, a strong earthquake in a deserted area may create a smaller emergency compared to a moderate earthquake in a densely populated area. A useful emergency scale should accurately describe the nature and magnitude of the crisis.

The need for a unified, emergency scale is vital to facilitate clear communication and mutual understanding of the nature of the emergency, by the public, government agencies, and responding organizations. It has been stated that “50% of the problems with communication are due to individuals using the same words with different meanings. The remaining 50% are due to individuals using different words with the same meanings” (Appleby, Forlin et al. 2003). They further discuss how legislation still has not provided definitions of “disaster” or “emergency”, as well as the difference in impact and immediacy of response. An objectively
calculable emergency scale should therefore quantify and clearly communicate the notion of “emergency”. This article proposes such an emergency scale that could be understood and used at different scopes and by various clientele – internationally, nationally, regionally, at the municipality level, as well as by global companies through local organizations. Further, the proposed model satisfied all five roles of system science (Warfield 2003): it describes the physical world and portrays the results of interactions among a few of its components; it proposes a generic design; it is a constituent of “science of complexity” as it enlarges the domain of demonstrable results in the service of humanity; and, it is actionable, as it has linguistic clarity and a model that suggests clear direction of actions essential to resolve emergencies. Our model addresses several of Warfield’s Twenty Laws of Complexity (Warfield 2002). It does not require humans to process more than three components at a time (triadic constraint). The model renders a parsimonious description of any emergency. It addresses the challenge of vertical incoherence as it can show the right aggregated level to decision makers at different organizational levels. Similar to the CRISSI project (Asproth and Håkansson 2007) we consider all relevant factors of emergencies in a balanced fashion. However, while CRISSI limits itself to flooding, our abstract model can be applied to any emergency.

Related Work

Scales relating to natural phenomena that may result in an emergency are numerous. This section provides a review of emergency related scales. We concentrate mainly on weather and environmental scales that provide a common understanding and lexicon with which to understand the level of intensity and impact of a crisis. Some scales are used before and/or during a crisis to predict the potential intensity and impact of an event and provide an understanding that is useful for preventative and recovery measures. Other scales are used for post-event classification. Most of these scales are descriptive rather than quantitative, which makes them subjective and ambiguous.

1805: The Beaufort Wind Scale

One of the oldest weather related scales still in use is the Beaufort Wind Scale. It was created in 1805 by British Rear-Admiral, Sir Francis Beaufort and classifies wind based upon both its speed and the observed effects the wind has on the sea and land. This ranked scale, with 12 levels, goes from calm (Beaufort number 0) to Hurricane (Beaufort number 12) and thus is used in all conditions, not just emergencies. Each level has an observed effect associated with it together with a wind speed and wave height. Therefore, one can estimate the wind speed by visual inspection (NOAA 2006). This scale is used as a dimension within other emergency scales.

1931: Modified Mercalli Intensity Scale

The Modified Mercalli Intensity (MMI) scale is used to describe the intensity of visible damage by comparing the damage recorded after the event to a set scale of possibilities. The set scale of possibilities has twelve possible categories which all events must fall under. For example – “light”, “moderate”, “violent” (State of California 2003). The scale has no mathematical basis and therefore can vary greatly depending on the individual who is interpreting the damage (Bolt 1993).

1935: Richter Scales

The Richter Magnitude Scale developed by Charles F. Richter in 1935 (USGS 2006) is used to measure the magnitude of earthquakes. The United States Geological Survey takes great care to clearly define the differences between intensity and magnitude as there are two different scales used to determine each.

Intensity is based on the observed effects of ground shaking on people, buildings, and natu-
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