

## Spatial Analysis of Terrorism Vulnerability Spatial Analysis of Terrorism Vulnerability

Konstantin Greger<sup>1\*</sup>  
GREGER, Konstantin<sup>1\*</sup>

<sup>1</sup>University of Tsukuba

<sup>1</sup>University of Tsukuba

Terrorists are no lunatics. While their ideologies and goals, as well as their means to get there, are hardly to relate to, and out of question in their brutality and furtiveness, they are better organized and purposive as public discussion is often willing to admit. In contrast to natural disasters, which follow the law of nature alone, and technological disasters, which can be perceived as random in their occurrence, acts of terror will always pursue a certain objective. This objective is governed by a greater aim or agenda, which differs from perpetrator to perpetrator. Yet, one element all terrorist agendas share is the most basic root of terrorism: exercise fear, also known as terror. Hence, it is sensible to ask what we should be afraid of, what not. Or to put it more precisely: what can be expected to happen, and where?

As complete safety from terrorism can not be guaranteed, there is a necessity for a methodological framework to identify the places at highest risk for being the target of a terrorist attack, to quantify those risks, and ultimately to prioritize them by their risk in order to make sure the means spent for the counter-terrorism activities are invested in the most promising and effective outcomes.

This research tries to establish a spatially grounded methodological framework for the analysis of vulnerability to terrorism within urban areas. While little focus has been put on the topic of vulnerability to terrorism so far, it is equally definitive for any threat as is risk. Therefore it has to be better understood in order to be able to grasp the threat of terrorism as a whole, and to give recommendations for policy makers and the public likewise. The outcome of this research can be a map showing the geographical distribution of vulnerability to terrorism.

Three categories of targets have been identified: buildings (including the special case of key assets such as nuclear power plants, which require special attention), infrastructures, and public space. This paper covers only the analysis of infrastructures.

The framework builds upon the concept of Geographic Valued Worth by Patterson & Apostolakis (2007), which evaluates how important each element of an infrastructure (e.g. water valve, electric switch, gas pipe) is to the decision maker, and thereafter analyzes for spatially collocated elements. The importance of the elements is determined by performance indices, based on certain performance measures (e.g. physical property damage, impact on people, impact on the environment) that are used to operationalize the decision maker's objectives regarding a terrorist threat (e.g. impact on health and safety, economic impact). The weighting of those performance measures as well as their disutility functions are defined per stakeholder (modeled by user categories, e.g. residential, commercial, industrial) and infrastructure.

This importance measure aside the framework also accounts for the susceptibility of an infrastructure element to being successfully attacked by a terrorist, which will lead to the failure of said element. The framework presented here is thereby a holistic approach to quantify vulnerability and analyze its spatial distribution.

キーワード: terrorism, vulnerability, spatial analysis, risk, infrastructure, GIS

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