



B87 The Bomb Maker Project: How Human Factors Affect the Characteristics and Interpretation of Explosives Evidence

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Learning Overview: After attending this presentation, attendees will understand: (1) the design, materials, and construction of improvised explosive devices (IEDs), and (2) how those factors may affect the way IEDs are examined in a forensic science laboratory.

Impact on the Forensic Science Community: This presentation will impact the forensic community by discussing the design and construction of improvised explosive devices (IEDs) and how that may influence the eventual results of laboratory examinations.

The examination of IEDs that have been either rendered safe or functioned as designed is conducted in numerous forensic science laboratories across the United States. Although IEDs vary in complexity and lethality, the typical device encountered in domestic bombings consists of some sort of rigid container, a fusing system, low explosive filler and occasionally shrapnel. The identification and comparison the explosive and components of an IED involve well-known analytical techniques that are applied to items such as tape, fuses, wires, batteries, etc. Overall, associating the materials from a device to the same type of materials possessed by a suspect has clear probative value and this is one of the main drivers for using forensic chemists in post-blast investigations.

The Bomb Maker Project seeks to study the circumstances of actual bombings and evaluate the design, materials and construction of IEDs and how those factors may affect the way IEDs are typically examined in a forensic science laboratory. Note that this study is not concerned with offender background, psychological profiles, motives or any other behavioral aspects. Furthermore, the focus of the project is on criminal bombings rather than terrorist events. Criminal bombers are much more likely to be the subject of investigations worked by state, local and federal forensic chemists in the United States.

The authors surveyed open source accounts of bombings and gathered as much information as possible regarding the explosive used, container, initiation systems, and materials used in other componentry. They have carried out internet searches of open-source news outlets, examined legal records, and searched a subscription-based service that compiles media reports of explosive incidents (globalincidentmap.com). Several thousand explosive incidents have been found thus far, but careful filtering is needed to remove incidents with hoax devices, bomb threats, and other events that lack an actual explosive device. Once a potential subject is located, they attempt to gather as much background information on their case as possible, including copies of the probable cause affidavit, trial transcript and any copies of appellate decisions. Ultimately, the information on attempted and/or actual bombings are described by a series of categories, as shown below:

Characteristic	Main Categories	Sub-Categories
Target	Residential	N/A
	Commercial	
	Governmental	
	Educational	
	Transportation	
	Mailbox	
	Vehicle	
Explosive Charge	Low explosive	Inorganic
		Organic
	High explosive	Inorganic
		Organic
Container	Concealment Container	Soft
		Rigid
	Confinement Container	Soft
		Rigid
Fuzing System	Non-electrical	Mechanical



		Chemical
	Electrical	Power source
		Conductor
		Load
		Switch

Given that the data consists of categorical rather than continuous variables, Categorical Principal Components Analysis (CATPCA) is being used for data analysis. This technique allows for the inclusion of categorical variables into PCA and does not assume that linear relationships exist among the data. The data is not required to be multi-variate normal in distribution. A closely related method that is also being explored is Multiple Correspondence Analysis (MCA). MCA is the equivalent of CATPCA when all the variables undergo a procedure known as multiple nominal quantitation.

The outputs of the statistical analysis include the following:

- Symmetric plots showing a projection of the observations (explosive incident) and/or the original variables in terms of the principal coordinates. This will visually indicate the degree of similarity/dissimilarity between the observations. It also indicates the extent to which the variables are correlated with one another.
- Asymmetric plots that use the principal coordinates for the variables and the standard coordinates for the observations. This will indicate how the observations are positioned relative to the category vectors.
- A quantitative report of the contributions (weight) of each variable to the principal coordinates.

The findings are then used to discern which specific explosives and components are more likely to be used in IEDs, to what extent different components are correlated with one another. Overall, this research seeks to improve the ability of practicing forensic chemists to place their findings in context more reliably, guide the selection of their methods and inform decisions regarding exemplar collections.

Explosives, Improvised Explosive Device, Device Components