CHAPTER TWO

THE NYPD RISK-TIERING SYSTEM

All buildings face a variety of risks, from weather to fire to seismicity to terrorism. Since terrorism risk varies from building to building, any coherent set of protective security design recommendations should be based on a building-specific risk assessment. In determining a given building's terrorism risk level, industry experts often employ a variation of an equation incorporating three important factors – threat, vulnerability, and impact.[1]

Risk = Threat x Vulnerability x Impact

This equation reflects an underlying assumption of risk analysis: terrorism risk only exists when a person or group has the capacity and intent to present a *threat* of attack, on a *vulnerable* target, in a manner that would produce a discernible *impact*.

New York City's unique risk environment is characterized by dense concentrations of people, buildings, and resources, including some of the largest underground transportation and utility systems in the world. Accordingly, in developing a risk assessment system, the NYPD has tailored the standard equation to meet the City's particular needs. Specifically, the NYPD's risk assessment system sets out nine sub-factors categorized by threat, vulnerability, and impact. "Threat" is defined by a building's threat profile and its attractiveness as a terrorist target. "Vulnerability" is determined by a building's adjacency, accessibility, and structural performance. "Impact" is based on a building's maximum occupancy or height, economic criticality, transportation criticality and proximity, and critical infrastructure proximity. Each building receives a score of Limited, Moderate, or Significant for

Figure 3: NYPD Risk Factors	
Threat	1) Threat Profile 2) Target Attractiveness
Vulnerability	1) Adjacency 2) Accessibility 3) Structural Performance
Impact	1) Maximum Occupancy or Height 2) Economic Criticality 3) Transportation Criticality and Proximity 4) Critical Infrastructure Proximity

each sub-factor. The NYPD takes the scores determined for each of the nine sub-factors together to calculate a building's overall risk tier – Low, Medium, or High. Appendix A elaborates on this risk assessment and risk-tiering system and includes a worksheet to assist in performing the relevant calculations.

The NYPD recommends that after determining the appropriate risk tier, the owner of a Medium or High Tier building should follow the specific recommendations outlined in subsequent chapters to better protect the building and its occupants. For this reason, building owners should conduct a risk assessment and risk-tier calculation during the design process, prior to construction. In general, Medium and High Tier buildings will warrant protective security design features that go beyond those set out in municipal codes.

The NYPD offers its risk assessment system as a first step in the protective security design process. Building owners should enlist the help of protective security design experts to conduct more refined and detailed assessments.

Risk Assessment

Threat

The first factor in the NYPD risk assessment is the "threat" of attack a particular

building faces, measured by its threat profile and target attractiveness. These sub-factors attempt to quantify threat levels in a systematic way.

Threat Profile. A building's threat profile is determined by the various threats that affect it, including past and present threats, and possible future trends. Such information is often available from open sources. Law enforcement may be able to provide access to more sensitive materials.

Engineering Security distinguishes between two types of threats: specific threats, targeting particular buildings, by terrorists individuals or groups with the capacity to cary out an attack; and general threats, targeting types of institutions, structures, networks, or neighborhoods, based on their nature of occupancy or operation.[2] To determine a building's threat profile, owners should work in concert with law enforcement to evaluate both the credibility of specific threats and the applicability of general threats.

The vast majority of buildings in New York City have limited threat profiles, meaning they face no general or credible specific threats and have no threat history. A building with a moderate threat profile currently is or has been the subject of a past or present general threat, but is not and has not been the target of a credible specific threat. A building with a significant threat profile currently is or has been the target of one or more credible specific threats.

Target Attractiveness. A building's attractiveness as a terrorist target depends on its level of visibility. Terrorists generally select targets that possess at least one of the following characteristics: widely recognizable architectural design, high-profile occupants, and essential services. Buildings that are widely recognizable for their architectural design tend to be fixtures of the New York City skyline. Buildings that have high-profile occupants or essential services include certain government facilities, prominent commercial or financial institutions, and transportation hubs.

The average building in New York City has limited target attractiveness, meaning that neither its architectural design nor the nature of its occupancy or

operations is recognizable on a local or national level. Moderate target attractiveness applies to buildings with occupants or operations that are nationally recognizable. Significant target attractiveness applies to buildings with architectural design that is nationally recognizable.

Vulnerability

The second factor in the NYPD risk assessment is a building's "vulnerability," which accounts for the circumstances that make a building susceptible to damage or destruction from a terrorist attack.[3] A building is particularly vulnerable when a successful attack is capable of producing a disproportionately large effect because of a physical or functional weakness or lack of redundancy. Vulnerability is measured by adjacency, accessibility, and building design.

Adjacency. Adjacency takes into account the risk levels of structures in a building's immediate vicinity because a building may suffer collateral damage from an attack on a neighbor. For example, on September 11, 2001, debris from the attack on and collapse of WTC1 ignited fires in neighboring WTC7, ultimately causing the building's collapse.[4]

The average building in New York City has limited adjacency, meaning that there are no High Tier buildings located within 300 feet of it. A building has moderate adjacency when there is at least one High Tier building located less than 300 feet, but more than 150 feet from it. A building has significant adjacency when there is at least one High Tier building located within 150 feet of it.[5]

Accessibility. Accessibility refers to the ease with which people and vehicles can approach or access a building. Generally, building accessibility depends upon: the amount of available standoff distance; the type of screening, detection, and access control systems employed; and the presence of hard or soft perimeters.

A building has limited accessibility when the movement of people in it is controlled to a significant degree, including limited access to sensitive areas, and vehicles cannot enter the building and must be screened or otherwise obstructed before approaching. A building has moderate accessibility when the

movement of people in a building is controlled, or vehicles are screened or otherwise obstructed before approaching. If vehicles are able to enter the building (e.g., through an internal parking garage or, in a handful of cases, on a street that cuts through the building), the building is considered moderately accessible when vehicles are screened prior to entry. A building has significant accessibility when the movement of people in a building is not controlled or controlled only to a limited degree and vehicles are neither obstructed nor screened before approaching or entering.

Structural Performance. Structural performance refers to a building's capacity to physically withstand an attack that presents abnormal loading. For this reason, it is measured by assessing the blast loads that structural elements can withstand at varying amounts of standoff.

A building has limited structural performance vulnerability when: for threats from the true perimeter, its primary structural elements satisfy M3 standards; and for threats from a contact charge, its columns satisfy M1 standards. A building has moderate structural performance vulnerability when: for threats from the true perimeter, its primary structural elements satisfy M3 standards; or for threats from a contact charge, its columns satisfy M1 standards. A building has significant structural performance vulnerability when: for threats from the true perimeter, its primary structural elements do not satisfy M3 standards; and for threats from a contact charge, its columns do not satisfy M1 standards.

Structural performance is perhaps the most adjustable component of the risk equation because building designers and engineers have the ability to "build-in" features, such as hardened columns or increased standoff from specific building elements, which may make a building less vulnerable to attack.

Impact

The third factor in the NYPD risk assessment is the "impact" of an attack on a particular building, measured by the building's maximum occupancy or height, economic criticality, transportation proximity and criticality, and critical infrastructure proximity.

Maximum Occupancy or Height. The maximum occupancy and height of a building can be used to predict the human costs of a successful terrorist attack, including fatalities and serious injuries. The terms "maximum occupancy" and "height" are often correlated – taller buildings tend to have higher occupancy levels – and therefore they are categorized together.

Engineering Security contemplates three types of occupancies: those that are consistent over time (e.g., commercial high-rises); those that are event-driven (e.g., public assembly venues); and those that depend on transient populations (e.g., train stations). The gradations identified in the following paragraph apply equally to all three.

The majority of buildings in New York City fall into the limited tier: they have maximum occupancy levels of fewer than 5,000 people and are shorter than 600 feet in height. Buildings that fall into the moderate tier have maximum occupancy levels that range from 5,000 to 10,000 people or measure between 600 and 800 feet in height. Finally, buildings that fall into the significant tier have maximum occupancy levels of more than 10,000 people or are taller than 800 feet in height.

Economic Criticality. Economic criticality represents the potential economic losses resulting from a successful terrorist attack, including: the specific costs incurred by building owners and occupants, such as lost revenue due to disruption of normal business operations; and the effects on local, regional, or national economies more broadly, including declines in tourism and disruption of financial markets.

A building has limited economic criticality if a successful attack is capable of impacting the local or regional economy, with limited or no effect on the national economy (total economic losses estimated at less than $1 billion). A building has moderate economic criticality if a successful attack is capable of considerably impacting the local or regional economy, or affecting the national economy in the immediate aftermath of the attack (total economic losses estimated between $1 billion and $10 billion). Finally, a building has significant

economic criticality if a successful attack is capable of severely impacting the local or regional economy, or affecting the national economy for an appreciable period of time beyond the immediate aftermath of the attack (total economic losses estimated in excess of $10 billion).[6]

Transportation Criticality and Proximity. Transportation criticality and proximity are used to measure the effect of a successful attack on casualties to the commuter population and patterns of mobility. Specifically, transportation criticality and proximity refers to New York City's extensive network of underground transit lines, which comprise its subway and rail systems, as well as tunnels and bridges used by motor vehicles.

Proximity takes into account how close a building is to transit lines, hubs, stations, tunnels, or bridges. Given the shallow depth of underground transit tunnels in New York City, proximity often reflects vertical distance: a building is considered proximate if a subway or rail line or vehicle tunnel runs underneath it, regardless of the location of the relevant transit station. Proximity also reflects horizontal distance: a building is considered proximate if it is adjacent to the footprint of a transit station, hub, or entrance to a bridge.

Criticality takes into account a building's proximity to sets of transit lines; its significance increases as the number of sets grows. A "set of lines" is defined as those lines running through the same tunnel or along parallel tracks. For example, the No. 4/5/6 subway lines in Manhattan comprise a single set of lines. Similarly, a stand-alone line, such as the No. 7 line, is also referred to as a single set of lines.

Passengers navigate a crowded transit hub.

A building with limited transportation criticality and proximity sits atop as many as one set of lines, or is located adjacent to the footprint of a

Box 3: New York City Transit System

The New York metropolitan area is served by a massive public transportation system, including a subway and bus system run by NYC Transit and MTA Bus Company, as well as ferries and several commuter rails, namely Amtrak, Metro-North, Port Authority Trans-Hudson (PATH), New Jersey Transit (NJ Transit), the Long Island Railroad (LIRR), and the Staten Island Railroad. Approximately 10 million riders use these systems on an average weekday.

New York City has one of the most extensive and complex subway networks in the world. The subway carries approximately 1.563 billion riders annually and over 5 million riders on an average weekday. By contrast, U.S. passenger aircraft across the United States carry approximately 2 million riders on an average weekday. The Lexington Avenue subway line alone has a daily ridership of 1.3 million, which is greater than the combined riderships of the Boston, Chicago, and San Francisco subway systems. The New York City subway system includes an extensive network of 26 express and local subway lines serving 468 subway stations, only 35 fewer stations than the combined total of all other subway systems in the United States. The system comprises 660 miles of in-passenger service track, and an additional 180 miles of track used for non-revenue purposes. Laid end to end, the tracks would stretch from New York City to Chicago.

NJ Transit, Metro-North, and LIRR account for three of the four largest commuter rails in the nation, carrying approximately 800,000 passengers on an average weekday. The PATH, which connects New Jersey to Manhattan, serves 250,000 commuters daily. These commuter rails are served by several major transit hubs, including Penn Station, Grand Central Station, and Jamaica Station. Penn Station, the main terminal for LIRR and NJ Transit, is the busiest rail station in the western hemisphere, serving 550,000 passengers per day, more than LaGuardia, John F. Kennedy, and Newark airports combined. Manhattan is also home to Grand Central Station, a major commuter rail hub, and the Times Square subway station, the busiest subway station in the United States. Jamaica Station in Queens and Atlantic Terminal/Flatbush Avenue in Brooklyn each serve as major hubs for the LIRR.

New York City's public and private bus system is the largest in the nation, serving more than 2.5 million riders daily. An extensive maritime-based public transportation operation also serves the metropolitan area, with the Staten Island Ferry and numerous private ferry companies carrying nearly 100,000 riders around New York Harbor daily.

transportation station servicing as many lines. A building with moderate transportation criticality and proximity sits atop two to four sets of lines or is located adjacent to the footprint of a transportation station servicing as many lines. Finally, a building with significant transportation criticality and proximity sits atop five or more sets of lines or is located adjacent to the footprint of a transportation hub or transfer point servicing as many lines; in addition, a building that sits atop a vehicle tunnel or adjacent to the entrance to a bridge is considered to have significant transportation criticality and proximity.

Critical Infrastructure Proximity. Critical infrastructure proximity is used to measure damage to critical infrastructure caused by a successful attack against a building. For purposes of this document, critical infrastructure is defined as major utility systems, including gas, oil, electricity, water, steam, and telecommunications. These systems provide essential services and therefore any collateral damage to them must be considered in a risk assessment.

A building has limited critical infrastructure proximity if it is not located so close to critical infrastructure that a successful attack against the building would affect service beyond the building itself. A building has moderate critical infrastructure proximity if it is located so close to critical infrastructure that a successful attack against the building would have implications for – but would not severely disrupt – service beyond the building itself. A building has significant critical infrastructure proximity if it is located so close to critical infrastructure that a successful attack against the building would severely disrupt service beyond the building itself.

Risk-Tiering System

The NYPD's risk-tiering system weights the importance of threat, vulnerability, and impact differently. Threat is the least heavily weighted factor, largely because terrorists are thought to be strategic thinkers that will pick targets based on perceived impact and vulnerability levels. Impact is more heavily weighted than vulnerability because in free and open societies, there is greater variation in impact than in vulnerability. In addition, protective security design measures that address vulnerabilities mitigate the potential impact of an attack.

Box 4: New York City Water, Electricity, and Steam Systems

Water
The New York City water supply system provides more than 1.3 billion gallons of water daily to approximately eight million City residents and one million residents in Westchester, Putman, Ulster, and Orange counties. The system's watershed includes a complex network of reservoirs, controlled lakes, dams, and tunnels that sit on approximately 2,000 square miles in New York State. Water from the 19 reservoirs is divided into three separate systems and water reaches the City through two major tunnels, completed in 1917 and 1936. Construction of a third tunnel commenced in 1970, with completion scheduled for 2020.

Electricity
New York City is considered a "transmission load" area for electricity because in-City generation resources by themselves are not sufficient to meet peak electricity demand. Although the City imports most of its electrical power, for reliability purposes it maintains sufficient local generation capacity to meet at least 80 percent of peak electricity demand. The City's distribution network includes 94,000 miles of underground cable, 264,000 manholes and service boxes, 35,000 underground transformers, 36,500 miles of overhead cable, 207,500 utility poles, 47,000 overhead transformers, and 60 substations.

Steam
New York City's steam system is the largest steam system in the world, generating approximately 30 billion pounds of steam per year. Its capacity is more than double that of Paris' steam system, which is the largest such system in Europe. The New York City steam system includes 105 miles of steam mains and service pipes, 3,000 manholes, and seven generating plants.

Members of the NYPD Threat Reduction Infrastructure Protection Section survey construction progress of City Water Tunnel No. 3.

The failure of a 24-inch steam pipe caused an explosion in Midtown Manhattan on July 18, 2007, killing one person and injuring more than 40 others.

A mathematical process for assessing the scores for threat, vulnerability, and impact, and then converting those scores into an overall risk tier is outlined in Appendix A. Determining a building's risk tier is the first step toward implementing protective security design. Subsequent chapters set out a series of recommendations specific to Medium and High Tier buildings.