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Train Wrecks and Track Attacks: An Analysis of Attempts by Terrorists and Other Extremists to Derail Trains or Disrupt Rail Transportation

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LEAD UNIVERSITY OF

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TRAIN WRECKS AND TRACK ATTACKS: AN ANALYSIS OF ATTEMPTS BY TERRORISTS AND OTHER EXTREMISTS TO DERAIL TRAINS OR DISRUPT RAIL TRANSPORTATION

Brian Michael Jenkins
Bruce R. Butterworth

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Attempts to sabotage rails and deliberately derail passenger trains have a long history in conventional and guerrilla warfare as well as during some particularly bitter labor disputes in the past. Since the 1970s, political fanatics have become a major adversary. Terrorists have sought to derail trains to achieve high-casualty events, while anarchists and issue oriented extremists have attacked rails to attract attention to their causes and impose economic damage.

In the following report, we examine the more than a thousand attempts to derail trains and to attack rail infrastructure to discern overall patterns and trends. We then look at four subsets of attacks in greater detail: those by India's Maoist guerrillas; those by separatist insurgents in Thailand; those by various jihadist groups worldwide; and those by an assemblage of anarchists, environmental and similar cause-oriented extremists in Europe. How do these adversaries compare in terms of tactics, success rates, lethality, and other factors? Do their different objectives and circumstances affect their actions? Perhaps most important, is there evidence that they become more effective and lethal over time?

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EXECUTIVE SUMMARY

In July 2017, both the Islamic State of Iraq and (greater) Syria (ISIS) and al Qaeda in the Arab Peninsula (AQAP) exhorted their followers around the world to derail trains. AQAP included in its online magazine detailed instructions on how to make a derailment device. According to the database maintained by the Mineta Transportation Institute (MTI), in the nearly 12 months since the two leading jihadist groups suggested derailing trains, there has been no noticeable uptick in attempts.

MTI's database shows that between 1970 and the end of 2017, there were 282 attempts to deliberately derail trains and 817 additional attacks on railway infrastructure, including tracks, bridges, tunnels, signaling, and other right-of-way equipment. Of the 282 attempts to derail trains, 118 (or 42%) resulted in a derailment.

Derailments are intended to cause casualties, while attacks on tracks and other right-of-way infrastructure are primarily intended to cause disruption and attract attention.

South Asia leads in the number of derailment attempts with 57.8% of the attempts, followed by the countries of Western Europe, and the Middle East and North Africa. South Asia also accounts for 54.4% of the fatalities. While Western Europe accounts for 10.6% of the attacks, it accounts for less than one percent of the fatalities. The overall average number of fatalities per attack (FPA) is 3.8. (A similar measure of lethality used in the charts is for injuries, stated as injuries per attack, or IPA).

Improvised Explosive Devices (IEDs) were used to derail trains in 75.7% of the cases. Mechanical means of sabotage (by removing bolts or rails, loosening plates, or tampering with switches) were employed in nearly all the remaining cases.

Mechanical means of derailments have a higher lethality rate per attack than do derailments using IEDs. Derailments caused by IEDs account for 23.6% of the total number of deaths. Mechanical means of sabotage account for 48.8% of the fatalities. Mechanical derailments are by far the most lethal form of attacking the passenger train network.

Attackers placed a total of 279 IEDs in the attacks, 58.1% of which detonated on target. The remainder were discovered before detonation and rendered safe, or they malfunctioned. In the remaining cases, the device exploded but was not placed correctly.

The deadliest attacks were those which combined derailments with armed assaults. These accounted for 27.6% of total fatalities, but a single episode in Angola killing 259 accounts for a large share of these fatalities. Excluding this incident, the figures shift somewhat, but the conclusion remains the same. Derailments caused by mechanical sabotage account for 64.4% of the fatalities; derailments by bombings alone account for 31.1% of the fatalities.

The rate of bomb-caused and mechanical derailments have both increased over time, with bomb attacks showing the greater increase. Lethality, however, has increased only slightly overall. This appears due mainly to the declining lethality of derailment attacks involving bombs, whereas the lethality of mechanical attacks appears to have increased significantly.

Derailment attacks have not increased nearly as much as all other attacks on all passengers in all surface transportation targets (including passenger trains and stations, buses and bus stations and stops, and passenger ferries and ferry terminals). This suggests that adversaries are increasingly going after surface transportation targets, but are concentrating on easier modes of attack. *The lethality of derailment attacks is increasing slightly, however, while the lethality of all other attacks against passenger targets, and then train passenger targets, is decreasing – a significant finding.*

Track attacks are also increasing, although this may be the result of improved reporting. 80.9% of the attacks were directed at railway tracks, bridges and tunnels, and not other infrastructure such as signaling and power systems.

Most track attacks are designed to disrupt, not to kill. Only 48 persons were killed and 268 injured in 817 attacks. Most of the deaths derived from attacks where security and maintenance personnel working on the tracks were targeted.

Bombing is the most common tactic in track attacks, accounting for 85.9% of the attacks, followed by mechanical sabotage and arson. Remarkably, 26.7% of the IEDs were discovered before they detonated.

In order to examine differences in motives, objectives, and modes of operating, the researchers looked at four specific groups of perpetrators: an assemblage of anarchist and environmentalist extremists in Europe; Maoist guerrillas in India; separatist insurgents in southern Thailand; and jihadists worldwide. These particular attackers were chosen because they have engaged in continuing campaigns which account for a large share of recent attacks where the perpetrators have been identified.

European extremists, who carried out attacks on tracks and right-of-way infrastructure in four countries (Germany, Italy, United Kingdom, and France) relied primarily on mechanical means of sabotage (45%) and improvised incendiary devices (42%) rather than explosive devices. There were no casualties in any of the attacks.

India’s Maoist or Naxalite guerrillas were the most prolific attackers, accounting for 37 derailment attempts and 135 track attacks. Their derailment attacks had the second highest lethality ranking after the jihadists. Over the long run, their attacks appear to be increasing in volume and lethality.

Separatist insurgents in southern Thailand accounted for 44 attacks (both attempted derailments and track attacks). Although competent bombmakers (95% of their devices detonated on target), they placed a distant third in the lethality of their derailment attempts, suggesting self-imposed constraints.

The jihadists are not the most prolific attackers and not the most competent bombmakers, but have achieved the highest lethality — their fatalities-per-attack score for derailments is nearly four times that of the Maoist guerrillas and seven times more than the average for all derailment attempts.

I. ATTEMPTS TO DERAIL PASSENGER TRAINS AND DISRUPT RAIL TRANSPORTATION

Attempts to sabotage rails and deliberately derail passenger trains have a long history in conventional and guerrilla warfare as well as during some particularly bitter labor disputes in the past. Since the 1970s, political fanatics have become a major adversary. Terrorists have sought to derail trains to achieve high-casualty events, while anarchists and issue-oriented extremists have attacked rails to attract attention to their causes and impose economic damage.

In the following report, we examine the more than a thousand attempts to derail trains and to attack rail infrastructure to discern overall patterns and trends. We then look at four subsets of attacks in greater detail: those by India's Maoist guerrillas; those by separatist insurgents in Thailand; those by various jihadist groups worldwide; and those by an assemblage of anarchists, environmental and similar cause-oriented extremists in Europe. How do these adversaries compare in terms of tactics, success rates, lethality, and other factors? Do their different objectives and circumstances affect their actions? Perhaps most important, is there evidence that they become more effective *and* lethal over time?

THE LATEST JIHADIST APPEALS

As the Islamic State steadily lost ground to counterterrorist offensives in Iraq and Syria, ISIS followers discussed various ways to cause catastrophes and impact Western economies, including derailing high-speed commuter trains and blowing up oil and gas pipelines. Since its emergence in 2013, ISIS has issued a torrent of exhortations and appeals to its followers to take action wherever they are, often suggesting specific forms of attack. Much of this is propaganda calculated to impress followers and frighten foes. However, the 2015 attempted armed assault on passengers in a high-speed train traveling between Amsterdam and Paris, the bombing attacks on the subway system in Brussels in 2016 and on its central train station in 2017, and an attack on train passengers in Germany in 2016 by ISIS supporters, made it clear that public surface transportation presents an enticing target to jihadists.

At nearly the same time, AQAP featured the idea of derailing trains in the 17th issue of its online magazine *Inspire*. A lead article by Ibrahim ibn Hassan al-Asri discusses the utility of attacks on transportation systems in general.[1] A Saudi jihadist who is believed to be AQAP's lead bomb maker and considered responsible for building the devices used by the Underwear bomber in 2009 as well as for another plot to sabotage airliners uncovered in 2012, al-Asri seems to have become the group's Chief Technology Officer, a sort of terrorist Tom Swift, inventing new schemes for attack. While articles like the one in *Inspire* fuel jihadist fantasies, they also are intended to encourage the kind of audacious scenarios and spectacular actions jihadist leaders want and, therefore, they are indicators of intent.

In the article, al-Asri argues that with few resources, it is possible to achieve great results by attacking transportation systems. Attacks on transportation will cause alarm and affect people in all walks of life, he writes, giving the appearance "of looming danger everywhere."

Increasing security measures, he points out, only "increases the feeling of insecurity and fear among the people." Such attacks are "disastrous to the economy," especially "if they occur regularly."

Derailing trains to achieve mass casualties has attracted al Qaeda's planners for years. Computer files recovered during the 2011 raid on Osama bin Laden's hideout in Pakistan indicated that at the time of his death, the leader of al Qaeda was looking for ways to carry out a major terrorist attack in the United States in order to demonstrate that the jihadist enterprise was still in business ten years after 9/11. Reportedly, his proposed plan, which dated back to February 2010, was to derail a passenger train as it crossed a high bridge, sending the coaches plunging into a river or deep valley, potentially killing hundreds.

Al-Asri goes on to describe two ways to target rail lines. The first is to destroy rail lines to create delay and disruption. The second is to destroy the line just "minutes before the train arrives, so as to derail the train." In this report, we have divided railway attacks into attacks on rails and other infrastructure intended to cause disruption and attacks intended to cause derailments of passenger trains.

Trains careening into ravines are a common terrorist fantasy. We do not know what may have inspired Osama bin Laden's 2010 scenario. Deadly accidents have sometimes provided ideas for terrorists. In Pakistan, bin Laden would have been able to read about the numerous accidents as well as incidents of sabotage that affected both Pakistan and India. Derailments, accidental or deliberate, are not uncommon in these two countries. Together, India and Pakistan account for 56 percent of both track and derailment attacks, and more than 50 percent of attempted derailments.

Issue 17 of *Inspire* displays a timeline of train major derailments in America dating back to 1904. None of these were the result of sabotage, but are offered as evidence of the significant casualties that are possible when a train derails. The feature story of Issue 17 provides a plotted history of transportation in the modern world followed by a discussion of how trains stay on rails. It illustrates a portable derailer, which is used by railroads in situations where it is necessary to ensure that unauthorized train movements or unattended rolling stock do not accidentally proceed beyond some point.

The magazine then describes a "design concept for the homemade derail tool," using reinforced concrete, and provides step-by-step instructions for making one and advice on how to place it to cause maximum death and destruction. It notes that the "lone Mujahid (or warrior) will have to be aware of train routes and traffic patterns and should try to place the device about ten minutes before the targeted train passes." To assist, the magazine includes a list of the major passenger train routes in America and a map displaying railroad lines by ownership.

The information on routes is readily available on the Internet and far too general to be operationally useful, while the operation called for is more challenging than the article implies. Some of the techniques things described in previous issues of *Inspire* probably would not work, and it is not clear that the derailing device as described would derail a speeding train or instead be knocked off the tracks or pulverized by the wheels.

As with all propaganda, terrorist propaganda is aimed primarily at the home front—would-be jihadists. The objective of such articles is to motivate followers to do things that are theoretically within their reach, but also to enable its readers to fantasize that, even if they don't build derailers, which few will do, they are in on the jihad. Rather than boring sermons on ideology or theoretical discussions of tactics, illustrated instructions on how to build terrorist devices, beyond any instructional value, are a means of engaging the intended audience (at least vicariously) in the armed struggle. It introduces eager readers into the realm of violence, encouraging them to think as if they themselves were engaged in "the real thing," a dangerous and exciting campaign of death and destruction. It is terrorist porn.

A third objective is to enable the jihadist organizations to claim credit for events that subsequently occur. It makes no difference if an attack was actually inspired by the jihadist appeal—a tactic was proposed, and an attack took place.

MTI'S 2010 STUDY OF DELIBERATE DERAILMENTS

This is not a new area of MTI inquiry. In a 2010 report, MTI published the results of an analysis of the 181 derailment attempts then in its database, most of them by terrorists, including environmental extremists, as well as other adversaries; 170 of these occurred after 1970. (The 11 other cases, which took place between 1920 and 1969, were set aside because of lack of data during this period about anything but the most spectacular and lethal attacks.)

In the eight years since the 2010 study, MTI has updated its database, has added some incidents previously missed or about which little information was available at the time, and was able to obtain additional details on other incidents. All of this enabled the authors to take a more detailed look at these tactics. The following brief review of the 2010 findings points out further changes to the earlier analysis.

This 2010 analysis found that derailment attacks overall between 1970 and the end of 2009 accounted for 10.5 percent of the all attacks on public surface transportation and 9.5 percent of all fatalities.[2]

South Asia accounted for roughly a third of events, followed by Western Europe, Russia and the NIS (Newly Independent States of the former Soviet Union), the Middle East, and Southeast Asia.[3] By country, India, Russia, Pakistan, United Kingdom, and Thailand lead the list. The distinction between the "developed" and "developing" world is blurring and these terms are used less frequently, but dividing the world according to this old concept it appears that the majority of the attacks occurred in the "developing" world, again led by India and Pakistan, which together accounted for about a third of all incidents. The average number of fatalities per attack in the "developed" world was 2.3 compared to 4.7 fatalities per attack in the "developing" world.

Bombs were the most common method employed. Bombs were placed on (near or under) the tracks in 149 of the 181 cases, for a total of 82.3 percent. Mechanical means of sabotage (removing bolts, tracks, etc.) were used in 27 incidents (or 14.9 percent) of the cases. The five remaining cases involved other means.

Terrorists and other adversaries may attempt to derail trains by placing improvised explosive devices (IEDs) next to the tracks or burying them beneath the rails. We refer to these devices in the database as “track bombs.” Alternatively, saboteurs may attempt to derail trains by removing spikes; loosening or removing the spikes, bolts and plates that hold the rails in place; or removing portions of the track itself. In a few cases, saboteurs have attempted to derail trains by placing concrete blocks or other objects on the rails. We refer to these various methods here as “mechanical means.”

When there are no bombs, it is not always clearly established that a derailment is deliberate. In a few cases where operators have claimed or authorities have suspected sabotage, allegations also have been made that operators were trying to avoid responsibility for poor maintenance by blaming imaginary saboteurs.

The 2010 study did not try to count track attacks as a separate category from derailment attempts. It focused exclusively on derailment attempts, although the authors noted that in a few cases it was not always clearly established that a derailment was the objective. This was especially true in cases where mechanical sabotage was involved, or instead the attempt was intended simply to disrupt the railway system. (We have since reexamined these cases, imposing a tighter definition on apparent derailment attempts. As a result, we have recategorized 10 of the cases as being disruptive attacks rather than attempted derailments, leaving 171 derailments or attempted derailments to be included in the present study.)

The adversaries succeeded in derailing a train in 69 cases. In 40 more cases, they clearly intended to derail a train, but the train passed over but failed to detonate the bomb; the bomb detonated but failed to derail the train; or the train was able to stop before reaching the point where an explosion had occurred. The intent of the remaining 72 cases is not clear. Some appear to have been attempted derailments, but authorities discovered the bomb before it detonated. In other cases, the attack may have been intended to merely cause disruption, and these have been recategorized as track attacks in the present study.

Although bombs were almost four times more likely to be used than mechanical means of sabotage, the latter proved more effective in derailing trains than bombs. In 149 bomb attacks, terrorists were able to derail all or a portion of 47 trains. However, when we limited the cases to those where it was clearly the intent of adversaries to derail a train, then in 81 attempted derailments they succeeded 47 times or 58 percent of the time. In contrast, of 22 attempted derailments using mechanical means, the adversaries succeeded 19 times or 86.4 percent of the time.

Mechanical means of sabotage also caused more casualties per incident. Events involving explosives resulted in an average of four fatalities per event, while events involving mechanical sabotage involved an average of 15 fatalities per event.

In sum, attempted derailments accounted for about a tenth of all incidents and fatalities. Most of the attacks and the deadliest attacks occurred in the developing world. Bombs were used more often than mechanical sabotage, but mechanical sabotage was more effective than explosives in derailing trains and causing casualties. We will see how the new study alters these findings.

II. THE CURRENT ANALYSIS

This current of analysis covers events between 1970 and December 31, 2017. In addition to adding the cases that occurred between 2010 and the end of 2017, the analysis encompasses a broader array of attacks compared to the 2010 report discussed above.

The researchers have now included attacks designed to destroy or damage railway infrastructure, designed more broadly to include not just attacks against railway tracks, bridges and tunnels, but against another set of railway infrastructure targets. These include the following targets: (1) Railway Signals, Communications (abbreviated in charts as "Comm.") and Power Systems; (2) Train Service Facilities or Equipment; (3) Maintenance or Inspection Trains; (4) Railway Personnel or Company Offices, (5) Track-related Personnel Security; and (6) Construction Sites. There are 817 attacks in the time period studied.

As mentioned above, we recently reclassified a number of the incidents included in the 2010 report, and the number of derailment attacks for the 1970 to 2009 period decreased from 181 to 171. The current analysis, however, includes 111 additional derailment attacks for a total of 282. Using the revised figure for the 1970 to 2009 period and comparing it to the increased figure for 1970 to 2017, we see that derailment attacks account for roughly the same percentage of attacks on public surface transportation as shown in Table 1.

Table 1. Derailments as % of Train Passenger Attacks

Time Period	Derailment Attacks	% of All Passenger Train Attacks	% of All Attacks
1/1/1970 - 12/31/2009	171	22.2%	5.9%
1/1/1970 - 12/31/2017	282	24.0%	5.3%

Looking at the regions of the world, South Asia leads in the number of derailment attempts, with 57.8 percent of the attacks, followed by Western Europe and the Middle East and North Africa (see Table 2). The distribution of fatalities has South Asia accounting for 54.4 percent of the total number of fatalities, followed by sub-Saharan Africa, and the Middle East and North Africa. While Western Europe accounts for 10.9 percent of the attacks, it accounts for less than one percent of the fatalities worldwide. The overall average of fatalities per attack (FPA) is 3.8. Sub-Saharan Africa has the highest FPA average at 56.2. Putting aside one exceptionally deadly incident in Angola, which drives this figure, the region still has an FPA of 15.6. By contrast, western Europe has an FPA of 0.02.

Table 2. Derailment Attacks by Region

Region	Attacks	% Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
South Asia	163	57.8%	581	3.6	0.0	1,882	11.5	0.0
Western Europe	30	10.6%	6	0.2	0.0	56	1.9	0.0
Middle East and North Africa	27	9.6%	58	2.1	0.0	177	6.6	1.0
Russia and the NIS	26	9.2%	42	1.6	0.0	318	12.2	0.0
Southeast Asia	19	6.7%	41	2.2	0.0	177	9.3	1.0
Sub-Saharan Africa	6	2.1%	337	56.2	10.0	345	57.5	9.0
Eastern Europe	4	1.4%	0	0.0	0.0	17	4.3	2.5
South America	3	1.1%	2	0.7	0.0	9	3.0	0.0
North America	2	0.7%	1	0.5	0.5	65	32.5	32.5
East Asia	2	0.7%	0	0.0	0.0	0	0.0	0.0
All Regions	**282**	**100.0%**	**1,068**	**3.8**	**0.0**	**3,046**	**10.8**	**0.0**

Notes:

[1] FPA = Fatalities per attack.

[2] IPA = Injuries per attack.

Turning to individual countries, India alone accounts 29.1% of the attacks, followed by Pakistan with 23.4%, and then the Russian Federation with 7.8% (see Table 3). In terms of fatalities, India accounts for 45.8 percent of all fatalities from derailments, followed by Angola, which had one spectacular case involving 259 fatalities. Pakistan comes next with 6.3 percent of the fatalities. Once again, the overall FPA is 3.8, and other than Angola and Mozambique, which also had a single derailment killing 58 people, the above average FPAs were attained in Cambodia (9.3), Algeria (7.3) and finally India (6.0), with a surprisingly lower FPA in Pakistan (1.0). The lethality of derailments in Western Europe was very low, with the highest being Italy (0.9).

Table 3. Derailment Attacks by Country

Country	Attacks	% Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
India	82	29.1%	489	6.0	0.0	1,334	16.3	0.0
Pakistan	66	23.4%	67	1.0	0.0	361	5.5	0.0
Russian Federation	22	7.8%	42	1.9	0.0	318	14.5	0.0
Turkey	11	3.9%	6	0.5	0.0	59	5.4	1.0
Bangladesh	10	3.5%	25	2.5	0.0	179	17.9	7.0
Thailand	10	3.5%	4	0.4	0.0	71	7.1	0.5
Algeria	7	2.5%	51	7.3	8.0	97	13.9	20.0
Italy	7	2.5%	6	0.9	0.0	54	7.7	0.0
United Kingdom	7	2.5%	0	0.0	0.0	1	0.1	0.0
Germany	6	2.1%	0	0.0	0.0	1	0.2	0.0
France	5	1.8%	0	0.0	0.0	0	0.0	0.0
Israel	4	1.4%	0	0.0	0.0	3	0.8	0.5
Spain	4	1.4%	0	0.0	0.0	0	0.0	0.0

Country	Attacks	% Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
Sri Lanka	4	1.4%	0	0.0	0.0	8	2.0	2.0
Cambodia	3	1.1%	28	9.3	13.0	85	28.3	5.0
Myanmar	3	1.1%	9	3.0	0.0	9	3.0	2.0
Georgia	3	1.1%	0	0.0	0.0	0	0.0	0.0
Angola	2	0.7%	278	139.0	139.0	167	83.5	83.5
Peru	2	0.7%	2	1.0	1.0	9	4.5	4.5
Syria	2	0.7%	1	0.5	0.5	18	9.0	9.0
United States	2	0.7%	1	0.5	0.5	65	32.5	32.5
Egypt	2	0.7%	0	0.0	0.0	0	0.0	0.0
Indonesia	2	0.7%	0	0.0	0.0	12	6.0	6.0
Mozambique	1	0.4%	58	58.0	58.0	160	160.0	160.0
Zambia	1	0.4%	1	1.0	1.0	12	12.0	12.0
Argentina	1	0.4%	0	0.0	0.0	0	0.0	0.0
Czech Republic	1	0.4%	0	0.0	0.0	0	0.0	0.0
Djibouti	1	0.4%	0	0.0	0.0	6	6.0	6.0
Ethiopia	1	0.4%	0	0.0	0.0	0	0.0	0.0
Iraq	1	0.4%	0	0.0	0.0	0	0.0	0.0
Ireland	1	0.4%	0	0.0	0.0	0	0.0	0.0
Japan	1	0.4%	0	0.0	0.0	0	0.0	0.0
Kosovo	1	0.4%	0	0.0	0.0	5	5.0	5.0
Lithuania	1	0.4%	0	0.0	0.0	0	0.0	0.0
Macedonia	1	0.4%	0	0.0	0.0	0	0.0	0.0
Malaysia	1	0.4%	0	0.0	0.0	0	0.0	0.0
Nepal	1	0.4%	0	0.0	0.0	0	0.0	0.0
North Korea	1	0.4%	0	0.0	0.0	0	0.0	0.0
Poland	1	0.4%	0	0.0	0.0	12	12.0	12.0
All Countries	**282**	**100%**	**1,068**	**3.8**	**0.0**	**3,046**	**10.8**	**0.0**

Notes:

[1] *FPA = Fatalities per attack.*

[2] *IPA = Injuries per attack.*

Bombs were the preferred method of derailing trains, accounting for 212 (or 75.7 percent) of the 282 attempts. Ten additional incidents saw derailments using explosives combined with subsequent armed assaults on the passengers, bringing the total of bombings to 75.9 percent.

Fatalities from derailments caused by mechanical means, however, account for 48.8 percent of the deaths. Mechanical means of sabotage had an FPA of 9.8, more than eight times the FPA of those caused by bombings, with an FPA of 1.2. Derailments from bombings accounted for only 23.6 percent of the total number of deaths.

The deadliest attacks were those which combined derailments with armed assaults. These accounted for 27.6 percent of total fatalities, but again a single episode in Angola drives these figures up. If this incident is excluded, the figures shift somewhat, but the conclusion remains the same. Derailments caused by mechanical sabotage account for 64.4 percent of the fatalities, while derailments by bombings alone account for 31.1 percent of the fatalities.

Comparing mechanical derailments with broader sets of data shows how lethal they are. For example, looking at attacks against passenger train targets, which *includes* train stations, mechanical derailments are the 3rd most lethal attack method. If we exclude two incidents involving multiple weapon combinations (one of which involves a derailment in Angola killing 259, and the other an attack in Cambodia killing 150), however, it becomes clear that mechanical derailments are in fact *the most lethal passenger train attack method*. If we look *only* at passenger trains with these same exclusions, and also exclude arson (heavily weighted by the 198 people killed by a suicidal arsonist in South Korea in 2003, and a single attack involving dynamite on a train in China in 1989), the same conclusion applies. Mechanical derailment is very lethal.

Looking more closely at bomb and mechanical derailments, several points need to be made. Mechanical derailments most typically involve removing tracks, sabotaging switches, or placing metal objects in the train's path. Sixteen out of 53 mechanical sabotage attacks resulted in fatalities. Of the nine mechanical derailments that killed five or more persons, six took place in India, one in Pakistan, and one in Bangladesh. The three most lethal mechanical attacks took place in India. Indian train systems feature very crowded trains, which means that derailments are likely to cause heavy casualties, and sometimes it is not clear whether a mechanical derailment was a terrorist act or an accident. This may affect the high lethality seen in mechanical derailments.

III. HOW MANY DERAILMENT ATTEMPTS ARE SUCCESSFUL?

This is a difficult question to answer with precision, but some estimates can be made. There are several approaches.

First, for bomb derailments it is possible to determine in how many cases a device or mechanical sabotage was detected beforehand, which is, of course, a failure if the intent is derailment rather than mere disruption. In 27 (or 10 percent) of the 282 attempts, a device was found or tampering with the tracks was discovered and the attack was prevented. In most cases, it is unclear who discovered the sabotage or found the explosive device, but in 18 (6.4%) of the attacks it is known who stopped the attack or found the bomb. These percentages are about the same as for attacks against all public surface transportation targets. For derailments, the action was taken by security officials or police in five attacks (1.8%), transit employees in five attacks (1.8%), members of the public in five attacks (1.8%), and drivers or crew in three attacks (1.1%).

We can also looked at the outcome of the bombs placed. Table 4 indicates that 279 devices were used in the 222 attacks involving bombs (often more than one device is used in a bomb attack). Of the 279 devices, 162 (58.1%) detonated at the right time and on target, while 116 (41.6%) failed to detonate, malfunctioned or detonated early, or were found and rendered safe. There is a difference, however, between detonating the bomb on target and on time, and a resulting derailment. The bomb may not have been placed properly, or the explosion was not powerful enough. Therefore it is incorrect to assume that in the 141 or exactly 50% of the attacks where at least one device detonated on time and on target, the train actually derailed.

It is more difficult to determine the success rate of mechanical sabotage. Some acts of mechanical sabotage may be disguised to appear as maintenance flaws or employee errors. The reverse is also true—saboteurs may falsely claim responsibility for accidents.

It is also difficult to determine whether terrorists face greater challenges derailing trains with explosive devices or employing mechanical means of sabotage. Explosive devices require knowledge and experience to build. Bombmakers are a precious commodity in terrorist organizations. The placement and timing of the detonation have to be precise. Even large quantities of explosives may not suffice to derail a train. Mechanical means also require a degree of knowledge, which not all attackers possess. Inside knowledge is especially valuable.

Table 4. Outcome of Devices

Device Outcome	Devices	% of Total	Fatalities	Average FPD[1]	Median FPD	Average FPDE[2]	Injuries	Average IPD[3]	Median IPD	Average IPDE[4]
Detonated or Released on Target	162	58.1%	532.0	3.3	0.0	3.3	1,699.8	10.5	1.0	10.5
EOD[5] Successful, Rendered Safe	58	20.8%	7.0	0.1	0.0	0.0	12.7	0.2	0.0	0.0
Detonated Early or Away from Target, or Malfunctioned	53	19.0%	5.0	0.1	0.0	0.0	9.0	0.2	0.0	0.0
Failed to Detonate or Release	5	1.8%	3.0	0.6	0.0	0.0	15.5	3.1	0.3	0.0
Unknown	1	0.4%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
All Devices	**279**	**100%**	**547**	**2.0**	**0.0**	**3.4**	**1,737**	**6.2**	**0.0**	**10.7**

Notes:

[1] FPD = Fatalities per device.

[2] FPDE = Fatalities per device exploded.

[3] IPD = Injuries per device.

[4] IPDE = Injuries per device exploded.

[5] EOD = Explosive ordinance disposal.

We did review each derailment attempt and made a judgment as to whether the passenger train entirely, or at least in part, left the tracks—in other words, actually derailed (see Table 5). The findings are notable: the train derailed in 118 cases (41.8%), and in another 39 cases (13.8%) a bomb exploded but the train did not derail. By contrast, the derailment failed (usually because the timing was wrong or the device or mechanical sabotage simply did not work) in 92 cases (32.6%). In another 26 cases (9.2%), the derailment was prevented by employees, citizens, drivers or security officials or police who detected the attempt and stopped the train. The remaining seven cases (2.6%) involve instances where it was not clear whether a derailment occurred or not.

Looking further at the rate of successful derailments only when bombs or mechanical means were used, we find that in the 222 attempts involving bombs, 76 or 34.2 percent resulted in actual derailments. In the remaining 60 instances where mechanical derailments were attempted, 42 or 70 percent resulted in derailments, a much higher percentage, recognizing however as mentioned previously, some accidents are claimed as derailments, and some terrorist derailments are claimed as accidents.

Table 5. Outcome of Derailment Attempts

Outcome	# of Attempts	% of Total
Derailed	118	41.8%
Derail Failed	92	32.6%
Derail Failed but Bomb Exploded near Train	39	13.8%
Derail Prevented	26	9.2%
Derail Unclear but Bomb Exploded near Train	7	2.5%
All Outcomes	**282**	**100.0%**

TRENDS OVER TIME

The 2010 study viewed time as flat—it did not explore trends over time. This new analysis does examine the derailment attempts over time to see what trends might be discernible. As Figure 1 shows, the rates of bomb-caused and mechanical (shortened in the graph to be “mech”) derailments have both increased over time, with bomb attacks showing the greater increase. Multiple weapon attacks (where a derailment is followed by an armed assault on the derailed train) have remained static and few in number.

Lethality, however, has increased only slightly (see Figure 2). The reason for a slight (rather than large) increase appears due mainly to the declining lethality of derailment attacks involving bombs, whereas the lethality of mechanical attacks appears to have increased significantly.

When considering lethality, the situation reverses, to a degree. Figure 4 traces overall fatality per attack (FPA) rates over time. Here we see that while lethality is declining for all other attacks on all passenger targets (trains, buses, ferries), and all other attacks on passenger train alone, lethality in derailment attacks alone is actually increasing slightly.

Attacks on tracks have a very low FPA, which remains low. We caution, however, that it may be that the declining FPAs merely reflect better reporting or that more low-level attacks are taking place now than in the 1970s and 1980s.

What this seems to be indicating is that while derailments are increasing, they are not increasing as fast as other groups of attacks. However, their lethality is increasing, albeit slightly, while the lethality of other attack methods is actually decreasing, a significant finding.

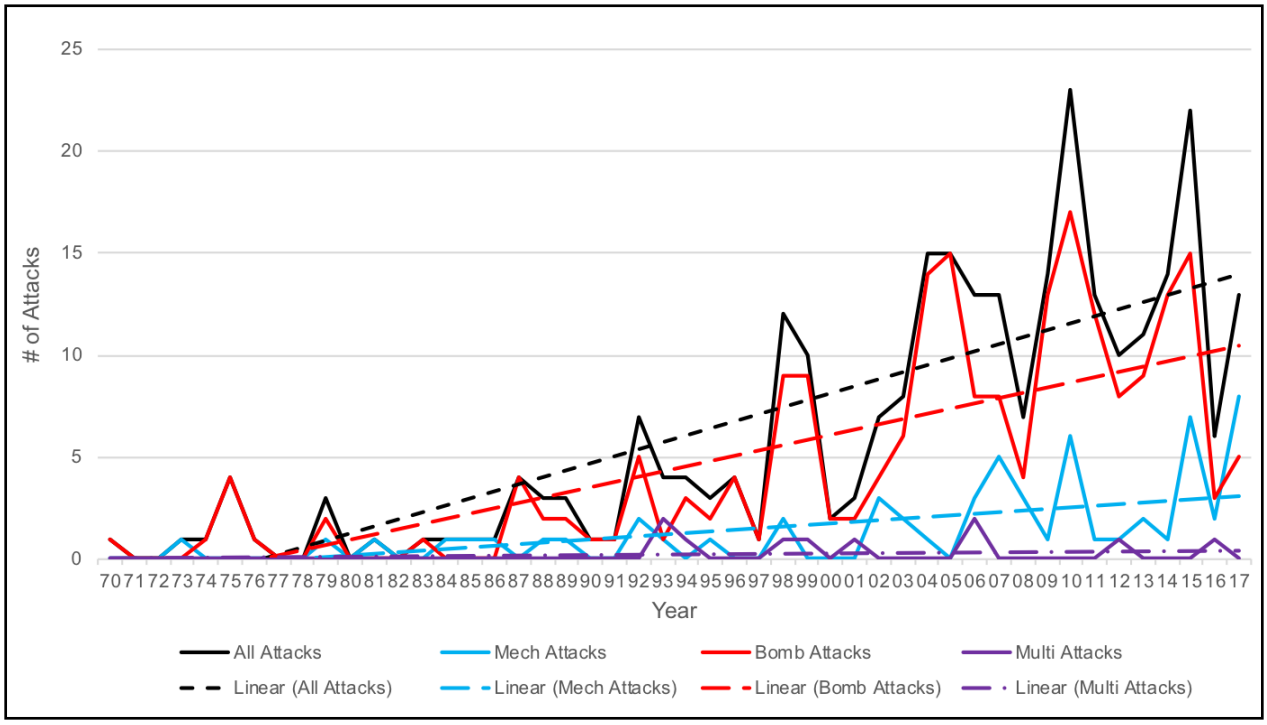

Figure 1. Derailment Attack Types Over Time

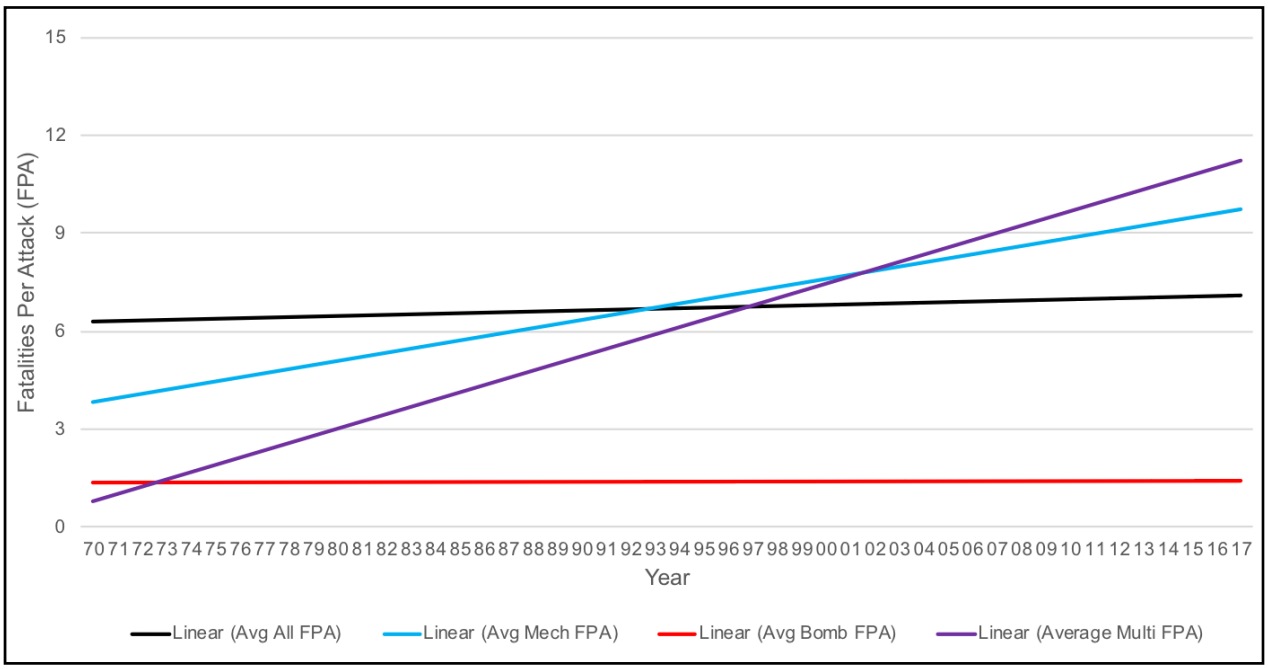

Figure 2. Derailment Lethality Over Time

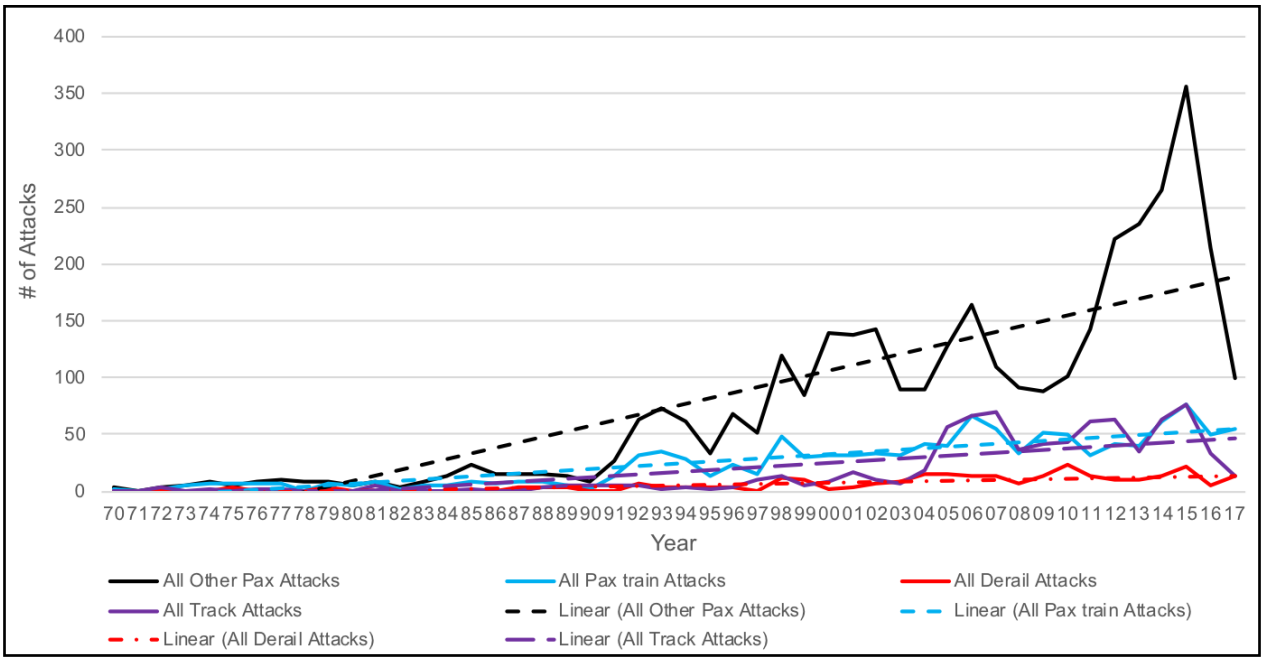

Figure 3. Comparison of Different Attacks on All Passenger Public Surface Transport Targets Over Time

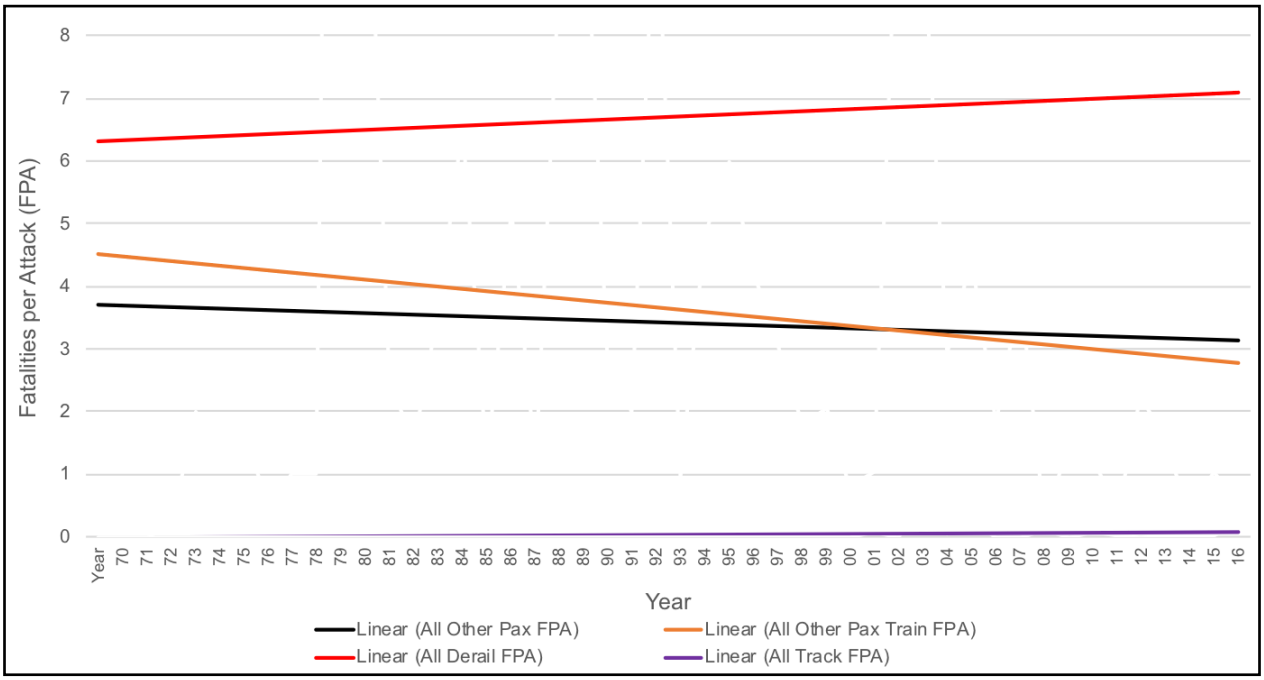

Figure 4. Comparison of Different Attack Lethality on All Passenger Public Surface Transport Targets Over Time

IV. TRACK ATTACKS—FREQUENT BUT NOT LETHAL

As already shown, the lethality of attacks on railway infrastructure is very low. These attacks are designed to disrupt, not to kill. Only 48 persons were killed and 268 injured in 817 attacks.

The targets that make up railway infrastructure are mostly railway tracks, bridges and tunnels, but they also include other targets, such as power, communications and signaling systems, service facilities and equipment, office buildings, construction sites, and others. Security personnel (typically guarding tracks) are also included in this category. Table 6 shows how attacks are spread amongst the various targets. It is no surprise that the highest lethality is achieved when offices or construction sites are attacked, followed by attacks on rail security personnel, sometimes with bombs or incendiaries, and also with automatic or semi-automatic weapons. Although these incidents are included in the category of railway infrastructure, it is clear that sometimes the targets are people, not things.

Table 6. Track Attacks by Target

Target	Attacks	% Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
Railway Tracks	661	80.9%	22	0.0	0.0	193	0.3	0.0
Railway Bridge	57	7.0%	0	0.0	0.0	2	0.0	0.0
Railway Signals, Communications, or Power Systems	46	5.6%	0	0.0	0.0	0	0.0	0.0
Railway Personnel or Railway Company Office	14	1.7%	4	0.3	0.0	10	0.7	0.0
Train Service Facility or Equipment	11	1.3%	1	0.1	0.0	18	1.6	0.0
Construction Site	10	1.2%	15	1.5	0.0	33	3.3	0.5
Multiple Targets, Track	7	0.9%	0	0.0	0.0	0	0.0	0.0
Security Personnel	5	0.6%	5	1.0	0.0	11	2.2	1.0
Railway Tunnel	3	0.4%	0	0.0	0.0	0	0.0	0.0
Maintenance or Inspection Train	2	0.2%	1	0.5	0.5	1	0.5	0.5
Other, Track	1	0.1%	0	0.0	0.0	0	0.0	0.0
All Targets	**817**	**100.0%**	**48**	**0.1**	**0.0**	**268**	**0.3**	**0.0**

Notes:

[1] FPA = Fatalities per attack.

[2] IPA = Injuries per attack.

Looking at the same attacks, Table 7 shows them broken down into four groups. Of the 817 attacks, 721 (88.2%) are against railway tracks, bridges and tunnels; another 59 (7.2%) are against other rail infrastructure such as railway signals, communications or power systems; 29 (3.5%) are against operating and security personnel and their facilities, and eight (1.0%) were against unspecified track targets. With the exception of attacks against security or operating personnel (where the average fatality per attack is 0.8), the rest of the attacks killed only 22 people, suggesting that the intent of these attacks was mainly disruption.

Table 7. Track Attacks by Target Group

Target Group	Attacks	% Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
Railway Tracks, Bridges and Tunnels	721	88.2%	22	0.0	0.0	194.5	0.3	0.0
Other Railway Infrastructure	59	7.2%	2	0.0	0.0	19.0	0.3	0.0
Operating or Security Personnel and Facilities	29	3.5%	24	0.8	0.0	54.0	1.9	0.0
Unspecified	8	1.0%	0	0.0	0.0	0.0	0.0	0.0
All Target Groups	**817**	**100.0%**	**48**	**0.1**	**0.0**	**267.5**	**0.3**	**0.0**

Notes:

[1] FPA = Fatalities per attack.

[2] IPA = Injuries per attack.

Looking at attack methods (see Table 8), attacks involving explosive devices (IEDs, mines, grenades, dynamite, and other devices) predominate, accounting for 702 incidents or 85.9 percent of the attacks, followed by mechanical sabotage and arson. Mechanical sabotage—removing bolts and tracks—accounts for a mere 1.8 percent of the total number of infrastructure attacks or just 2.0 percent of the 721 attacks on railway tracks, tunnels and bridges. This contrasts with mechanical sabotage, accounting for 18.8 percent of the derailment attacks. It suggests that some cases of mechanical sabotage may go unreported as such unless they lead to a derailment. (It should be noted that there were two instances of a train derailment included in track attacks. However, these were attacks on maintenance or inspection trains and therefore are not counted as passenger train derailments).

The mechanical cases involved zero casualties, which is not surprising since the only way they would cause casualties is if they led to a derailment. The highest lethality was achieved in attacks involving automatic and semi-automatic weapons, explosives (including VBIEDs – Vehicle-Borne Improvised Explosive Devices), and RPGs (Rocket-Propelled Grenades) deliberately directed at human targets—construction crews, company officials, and security personnel.

Table 8. Track Attacks by Weapon and Method of Attack

Attack and Weapon	Attacks	% of Total Attacks	Fatalities	Average FPA	Median FPA	Injuries	Average IPA	Median IPA
IED, Unspecified	669	81.9%	28	0.0	0.0	218	0.3	0.0
Sabotage, Other	41	5.0%	0	0.0	0.0	0	0.0	0.0
Arson	22	2.7%	0	0.0	0.0	0	0.0	0.0
IID (Improvised Incendiary Device)	17	2.1%	0	0.0	0.0	0	0.0	0.0
Bolts/Tracks Removed	15	1.8%	0	0.0	0.0	0	0.0	0.0
Grenade	7	0.9%	0	0.0	0.0	5	0.7	0.0
Mine	7	0.9%	0	0.0	0.0	0	0.0	0.0
Dynamite	6	0.7%	0	0.0	0.0	0	0.0	0.0

Attack and Weapon	Attacks	% of Total Attacks	Fatalities	Average FPA	Median FPA	Injuries	Average IPA	Median IPA
Assault, Automatic or Semi-Automatic Weapons	5	0.6%	16	3.2	1.0	17	3.4	1.0
IED, Hoax Device	4	0.5%	0	0.0	0.0	0	0.0	0.0
Assault, Unspecified or Other	3	0.4%	0	0.0	0.0	5	1.7	0.0
Kidnapping	3	0.4%	0	0.0	0.0	0	0.0	0.0
Multiple Weapons, IED/IID & Other	3	0.4%	0	0.0	0.0	0	0.0	0.0
Unknown	3	0.4%	0	0.0	0.0	0	0.0	0.0
Derailment, Track Bomb-IED, Unspecified	2	0.2%	1	0.5	0.5	1	0.5	0.5
IED, Other	2	0.2%	0	0.0	0.0	0	0.0	0.0
Multiple Weapons, IED/IID & Automatic or Semi-Automatic Weapons	2	0.2%	0	0.0	0.0	0	0.0	0.0
Armed Robbery	1	0.1%	0	0.0	0.0	0	0.0	0.0
Assault, RPG	1	0.1%	0	0.0	0.0	2	2.0	2.0
Assault, Stabbings	1	0.1%	0	0.0	0.0	14	14.0	14.0
IED, Bicycle-Borne	1	0.1%	3	3.0	3.0	6	6.0	6.0
Mortar	1	0.1%	0	0.0	0.0	0	0.0	0.0
VBIED[3]	1	0.1%	0	0.0	0.0	0	0.0	0.0
All Attacks and Weapons	**817**	**100.0%**	**48**	**0.1**	**0.0**	**268**	**0.3**	**0.0**

Notes:

[1] FPA = Fatalities per attack.

[2] IPA = Injuries per attack.

[3] VBIED = Vehicle-Borne Improvised Explosive Device.

There seems to be some correlation between where derailment attacks take place and where track attacks take place, as can be seen in Table 9 for regions, followed by Table 10 for countries. Again, Western Europe comes in second in terms of the volume of track attacks, but there are no fatalities and only a few injuries associated with these. The volume of attacks owes mainly to the terrorist campaigns of the Irish Republican Army (IRA) in the United Kingdom and the Basque separatists in Spain.[4] Both campaigns against rail targets were largely disruptive rather than intended to cause heavy casualties. There is no meaningful difference in lethality between regions, which is low overall.

Table 9. Track Attacks by Region

Region	Attacks	% Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
South Asia	482	59.0%	23	0.0	0.0	118	0.2	0.0
Western Europe	126	15.4%	0	0.0	0.0	3	0.0	0.0
Russia and the NIS	71	8.7%	13	0.2	0.0	77	1.1	0.0
Southeast Asia	40	4.9%	7	0.2	0.0	26	0.7	0.0
Middle East and North Africa	31	3.8%	4	0.1	0.0	27	0.9	0.0
North America	21	2.6%	0	0.0	0.0	0	0.0	0.0
South America	19	2.3%	0	0.0	0.0	2	0.1	0.0
Sub-Saharan Africa	11	1.3%	1	0.1	0.0	15	1.4	0.0
East Asia	9	1.1%	0	0.0	0.0	0	0.0	0.0
Eastern Europe	5	0.6%	0	0.0	0.0	0	0.0	0.0
Central Asia	2	0.2%	0	0.0	0.0	0	0.0	0.0
All Regions	**817**	**100.0%**	**48**	**0.1**	**0.0**	**268**	**0.3**	**0.0**

Notes:
[1] FPA = Fatalities per attack.
[2] IPA = Injuries per attack.

As seen in Table 10, Pakistan and India trade first and second place in terms of their overall share of total attacks, but together account for 57.6 percent of the railway infrastructure attacks as opposed to 52.5 percent of the derailment attacks. The United Kingdom replaces Russia for third place.

Table 10. Track Attacks by Country

Country	Attacks	% Attacks	Fatalities	Average FPA	Median FPA	Injuries	Average IPA	Median IPA
Pakistan	262	32.1%	6	0.0	0.0	63	0.2	0.0
India	208	25.5%	17	0.1	0.0	55	0.3	0.0
United Kingdom	41	5.0%	0	0.0	0.0	0	0.0	0.0
Russian Federation	37	4.5%	13	0.4	0.0	77	2.1	0.0
Thailand	34	4.2%	7	0.2	0.0	25	0.7	0.0
Italy	29	3.5%	0	0.0	0.0	3	0.1	0.0
Ukraine	28	3.4%	0	0.0	0.0	0	0.0	0.0
Spain	26	3.2%	0	0.0	0.0	0	0.0	0.0
Germany	19	2.3%	0	0.0	0.0	0	0.0	0.0
United States	19	2.3%	0	0.0	0.0	0	0.0	0.0
Egypt	13	1.6%	1	0.1	0.0	7	0.5	0.0
Colombia	12	1.5%	0	0.0	0.0	0	0.0	0.0
Japan	9	1.1%	0	0.0	0.0	0	0.0	0.0
South Africa	6	0.7%	1	0.2	0.0	1	0.2	0.0
Sri Lanka	6	0.7%	0	0.0	0.0	0	0.0	0.0
Turkey	6	0.7%	2	0.3	0.0	20	3.3	0.5
Algeria	5	0.6%	0	0.0	0.0	0	0.0	0.0

Country	Attacks	% Attacks	Fatalities	Average FPA	Median FPA	Injuries	Average IPA	Median IPA
Georgia	5	0.6%	0	0.0	0.0	0	0.0	0.0
Bangladesh	4	0.5%	0	0.0	0.0	0	0.0	0.0
France	4	0.5%	0	0.0	0.0	0	0.0	0.0
Iraq	3	0.4%	1	0.3	0.0	0	0.0	0.0
Ireland	3	0.4%	0	0.0	0.0	0	0.0	0.0
Kosovo	3	0.4%	0	0.0	0.0	0	0.0	0.0
Syria	3	0.4%	0	0.0	0.0	0	0.0	0.0
Argentina	2	0.2%	0	0.0	0.0	0	0.0	0.0
Cambodia	2	0.2%	0	0.0	0.0	0	0.0	0.0
Chile	2	0.2%	0	0.0	0.0	1	0.5	0.5
Czech Republic	2	0.2%	0	0.0	0.0	0	0.0	0.0
Ethiopia	2	0.2%	0	0.0	0.0	0	0.0	0.0
Myanmar	2	0.2%	0	0.0	0.0	0	0.0	0.0
Nepal	2	0.2%	0	0.0	0.0	0	0.0	0.0
Peru	2	0.2%	0	0.0	0.0	1	0.5	0.5
Austria	1	0.1%	0	0.0	0.0	0	0.0	0.0
Belgium	1	0.1%	0	0.0	0.0	0	0.0	0.0
Brazil	1	0.1%	0	0.0	0.0	0	0.0	0.0
Canada	1	0.1%	0	0.0	0.0	0	0.0	0.0
Greece	1	0.1%	0	0.0	0.0	0	0.0	0.0
Indonesia	1	0.1%	0	0.0	0.0	0	0.0	0.0
Israel	1	0.1%	0	0.0	0.0	0	0.0	0.0
Kenya	1	0.1%	0	0.0	0.0	14	14.0	14.0
Lithuania	1	0.1%	0	0.0	0.0	0	0.0	0.0
Mexico	1	0.1%	0	0.0	0.0	0	0.0	0.0
Philippines	1	0.1%	0	0.0	0.0	1	1.0	1.0
Switzerland	1	0.1%	0	0.0	0.0	0	0.0	0.0
Tajikistan	1	0.1%	0	0.0	0.0	0	0.0	0.0
Uzbekistan	1	0.1%	0	0.0	0.0	0	0.0	0.0
Zambia	1	0.1%	0	0.0	0.0	0	0.0	0.0
Zimbabwe	1	0.1%	0	0.0	0.0	0	0.0	0.0
All Countries	**817**	**100.0%**	**48**	**0.1**	**0.0**	**268**	**0.3**	**0.0**

Notes:

[1] FPA = Fatalities per attack.

[2] IPA = Injuries per attack.

Table 11 shows the delivery and concealment method for explosive or incendiary devices, with 91.8 percent of the devices placed on railroad tracks, a bridge or a tunnel.

Table 11. Track Attacks by Bomb Delivery Method

Concealment and Delivery Method	Devices	% of Total Devices	Fatalities	Average FPD[1]	Median FPD	Average FPDE[2]	Injuries	Average IPD[3]	Median IPD	Average IPDE[4]
Placed on Railroad Track or Bridge, or Near a Train	958	91.8%	17	0.0	0.0	0.0	129	0.1	0.0	0.2
Placed Near Target, Unspecified	57	5.5%	12	0.2	0.0	0.2	90	1.6	0.0	1.8
Physically Thrown	9	0.9%	0	0.0	0.0	0.0	2	0.2	0.0	0.3
Concealed/Placed inside of Building or Office	6	0.6%	0	0.0	0.0	0.0	1	0.2	0.0	0.2
Concealed/Placed inside Station, Unspecified or Other	4	0.4%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Unknown	4	0.4%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Concealed/Placed outside of Building or Office	3	0.3%	3	1.0	0.0	1.0	6	2.0	0.0	2.0
Vehicle Placed Near Target	2	0.2%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Concealed/Placed in Non-Pax Compartment	1	0.1%	0	0.0	0.0	0.0	2	2.0	2.0	2.0
All Cotainment and Delivery Methods	**1,044**	**100.0%**	**32**	**0.0**	**0.0**	**0.0**	**230**	**0.2**	**0.0**	**0.3**

Notes:

[1] FPD = Fatalities per device.

[2] FPDE = Fatalities per device exploded.

[3] IPD = Injuries per device.

[4] IPDE = Injuries per device exploded.

How successful were the saboteurs? As Table 12 indicates, 71.3 percent of their devices detonated on target. Another 1.9 percent failed to detonate, were improperly placed, or malfunctioned. Interestingly, 26.0 percent of the devices were found and rendered safe while another 0.7 percent were detonated during unsuccessful attempts to disarm them. This means that 26.7 percent of the devices were discovered before they were supposed to explode. This is a remarkable number and merits closer examination.

Table 12. Track Attacks by Bomb Outcome

Device Outcome	Devices	% of Total Devices	Fatalities	Average FPD[1]	Median FPD	Average FPDE[2]	Injuries	Average IPD[3]	Median IPD	Average IPDE[4]
Detonated or Released on Target	744	71.3%	28	0.0	0.0	0.0	217	0.3	0.0	0.3
EOD Successful, Rendered Safe	271	26.0%	0	0.0	0.0	0.0	7	0.0	0.0	0.0
Detonated Early or Away from Target, or Malfunctioned	10	1.0%	1	0.1	0.0	0.0	1	0.1	0.0	0.0
Failed to Detonate or Release	9	0.9%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Detonated during Unsuccessful EOD	7	0.7%	3	0.4	0.0	0.0	5	0.7	0.3	0.0
Unknown	3	0.3%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
All Device Outcomes	**1,044**	**100.0%**	**32**	**0.03**	**0.0**	**0.0**	**230**	**0.2**	**0.0**	**0.3**

Notes:

[1] FPD = Fatalities per device.

[2] FPDE = Fatalities per device exploded.

[3] IPD = Injuries per device.

[4] IPDE = Injuries per device exploded.

Another way of looking at devices is to see how many were found before they detonated. As Table 13 indicates, the attackers provided warnings to the authorities in only 0.4 percent of the total number of devices cases, while intelligence efforts led to just another 0.1 percent of the devices being located and rendered safe (although we only know of cases in which intelligence are reported to be involved—there may be more). Police, military personnel, other security officials, drivers, crew, and other employees, passengers and ordinary citizens were responsible for finding 96 (or 9.2 percent) of the devices. The circumstances are unknown in 13.5 percent of the cases. Looking at only devices detected before an attack took place, 238 or 23% of the total were detected, which is about 7 percent higher than the average for all public surface transportation targets combined (15.6%) and about eight percent higher than for all attacks against all passenger targets (14.4%).

Table 13. Track Bombs Detected Before Attacks

Devices Detected Before Attacks	Devices	% of Total Devices	Fatalities	Average FPD[1]	Median FPD	Average FPDE[2]	Injuries	Average IPD[3]	Median IPD	Average IPDE[4]
Not Detected	715	68.5%	31	0.0	0.0	0.0	214	0.3	0.0	0.3
Unknown	141	13.5%	1	0.0	0.0	0.3	3	0.0	0.0	0.8
EOD after Some Devices Detonated in Attack	86	8.2%	0	0.0	0.0	0.0	9	0.1	0.0	0.2
Police	31	3.0%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Security Officials	26	2.5%	0	0.0	0.0	0.0	2	0.1	0.0	1.0
Transit Employees	14	1.3%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Citizens	13	1.2%	0	0.0	0.0	0.0	2	0.2	0.0	0.0
Attacker Warning to Authorities	4	0.4%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Driver or Crew	4	0.4%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Military	4	0.4%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Passengers	3	0.3%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Combination	1	0.1%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
EOD after No Device Detonated in Attack	1	0.1%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Intelligence	1	0.1%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
All Devices Detected Before Attacks	**1,044**	**100.0%**	**32**	**0.0**	**0.0**	**0.0**	**230**	**0.2**	**0.0**	**0.3**

Notes:

[1] FPD = Fatalities per device.

[2] FPDE = Fatalities per device exploded.

[3] IPD = Injuries per device.

[4] IPDE = Injuries per device exploded.

V. ANALYSIS OF FOUR DIFFERENT GROUPS USING DERAILMENT AND TRACK ATTACKS

Treating all attacks as a single universe can be misleading. It portrays all of the perpetrators as a single generic adversary. The MTI database confirms that diverse individuals and groups have carried out track attacks and attempted to derail trains, including the Irish Republican Army in the United Kingdom, neofascists in Italy, Marxist guerrillas in Colombia, anarchists, environmental extremists, extortionists, and mentally disturbed individuals in Europe and elsewhere. Many attacks are one-offs. Others are part of long-running campaigns of sabotage. This section examines the derailment and track attacks by four sets of adversaries who have such campaigns, some long-running: first, the least lethal group -- an assemblage of European anarchists and environmental extremists; next, Maoist, sometimes referred to Naxalite, guerrillas in India; third, Islamic separatists in southern Thailand; finally, operatives motivated by jihadist ideology—by far the most lethal group. These groups illustrate significant differences in motives, objectives, and modes of operating. This shows up vividly in a comparison of both the frequency and the lethality of their attacks, which will be shown in Tables 14 and 15.

First, however, some caveats are in order. Together, the attacks carried out by the four groupings reviewed here comprise 57 (24%) of the 282 attempted derailments, and 209 (26%) of the 817 attacks against rail infrastructure recorded in the MTI database between 1970 and the end of 2017. While the Internet has improved access to information about incidents that occur, no claim can be made that all attacks are captured. This is truer of derailments and rail infrastructure attacks conducted using mechanical sabotage, rather than those that involve bombings, which may be more widely covered in the media. It is especially true if there were few if any fatalities, particularly in developing countries. In some developing countries there may be an effort to minimize the particular terrorist threats, leading some governments, such as India, to downplay public reporting of the actual number of incidents. At the same time, there are also reports that in these same countries, railroad officials may blame saboteurs for derailments or track problems that were due to poor maintenance.

The MTI database deliberately excludes incidents that occur in war zones during active military hostilities. We monitor these conflicts, but exclude them from the statistical analysis. This decision reflects a concern that the high volumes of all forms of violence connected with the war would distort the data and lead to conclusions that would not be relevant to transportation operators or authorities charged with security in the rest of the world. Obviously, judgments may vary as to what counts as a war zone. We exclude events in Afghanistan, but not in Pakistan. Finally, we require a high level of confidence in attributing attacks to specific adversaries—there is either a credible claim or enough evidence to reasonably surmise that a specific group was responsible. That means some incidents, which may be the work of the four groups examined here, are omitted.

As a result of these limitations, the numbers presented below should be seen as illustrative of the activity rather than representing the entire universe of actions.

As indicated in Table 14 below—which includes derailment-only attacks—India's Maoist guerrillas have carried out the most attacks. In addition to the 37 derailment attacks known (32) or presumed (five) to have been the work of the Maoists, the MTI database records another 45 derailment attacks in India. Some of these are attributable to other groups such as separatists in Assam or Bodoland, but in some cases no certain attribution was possible, and some of these may have been carried out by Maoist guerrillas. Also, Jihadists are identified as the perpetrators in 10 derailment attacks but may in fact be responsible for some of the other non-attributed attacks in Pakistan, where there have been 66 derailment attacks.

Similarly, some of the attacks in Russia may fall into the jihadist category. Russia's Chechen rebels initially were categorized as separatists. Over time, the guerrillas who continued to operate in the Caucuses became increasingly dominated by jihadist extremists. It is difficult to attribute a precise date to what was an evolutionary development. Somewhat arbitrarily, we have chosen to include under the jihadist label only those attacks in Russia since October, 2009.

Table 14. Derailment Attacks by Attacker Type – Frequency

Attacker Type - Derailment Attacks	Attacks	% of Total Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
All Other Groups	213	75.5%	651	3.1	0.0	2,145	10.1	0.0
Maoist	37	13.1%	199	5.4	0.0	443	12.0	0.0
Jihadist	10	3.5%	208	20.8	0.0	320	32.0	0.0
Thai Islamic Separatists	10	3.5%	4	0.4	0.0	71	7.1	0.5
Criminal	8	2.8%	6	0.8	0.0	55	6.9	0.0
Unknown	3	1.1%	0	0.0	0.0	0	0.0	0.0
Mentally Disordered	1	0.4%	0	0.0	0.0	12	12.0	12.0
All Attacker Types - Derailment Attacks	**282**	**100.0%**	**1,068**	**3.8**	**0.0**	**3,046**	**10.8**	**0.0**

Notes:

[1] FPA = Fatalities per attack.

[2] IPA = Injuries per attack.

Table 15 on derailment attacks ranks the attacker types by lethality rather than frequency, and shows that jihadists are clearly the most lethal of the groupings, followed by India's Maoist guerrillas, with Thailand's Islamic separatists in third place. Europe's anarchists and environmental extremists do not appear in these charts because they have not attempted any derailments.

Table 15. Derailment Attacks by Attacker Type – Lethality

Attacker Type - Derailment Attacks	Attacks	% of Total Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
Jihadist	10	3.5%	208	20.8	0.0	320	32.0	0.0
Maoist	37	13.1%	199	5.4	0.0	443	12.0	0.0
All Other Groups	213	75.5%	651	3.1	0.0	2,145	10.1	0.0
Criminal	8	2.8%	6	0.8	0.0	55	6.9	0.0
Thai Islamic Separatists	10	3.5%	4	0.4	0.0	71	7.1	0.5
Unknown	3	1.1%	0	0.0	0.0	0	0.0	0.0
Mentally Disordered	1	0.4%	0	0.0	0.0	12	12.0	12.0
All Attacker Types - Derailment Attacks	**282**	**100.0%**	**1,068**	**3.8**	**0.0**	**3,046**	**10.8**	**0.0**

Notes:
[1] FPA = Fatalities per attack.
[2] IPA = Injuries per attack.

We can take another look at the relative lethality of the groups we have examined by looking only at derailment attacks (since lethality in track attacks is almost always zero or extremely low), and comparing them only to each other and to their combined total. As Table 16 illustrates, the jihadists (with an average FPA of 20.8) are 3.9 times more lethal than the next most lethal group, the Maoists (with an average lethality of 5.4 FPA), and the jihadists are nearly three times more lethal than the overall average of 7.2 when looking only at these groups.

Table 16. Comparison of Derailment Lethality for Three Groups

Derailment Attacks for 3 Groups Derailing Trains	Attacks	% of Total Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
Jihadist	10	3.5%	208	20.8	0.0	320	32.0	0.0
Maoist	37	13.1%	199	5.4	0.0	443	12.0	0.0
Thai Islamic Separatists	10	3.5%	4	0.4	0.0	71	7.1	0.5
All Derailment Attacks for 5 Groups Derailing Trains	**57**	**100.0%**	**411**	**7.2**	**0.0**	**834**	**14.6**	**0.0**

Notes:
[1] FPA = Fatalities per attack.
[2] IPA = Injuries per attack.

Table 17 shows only track attacks. Since lethality is very low for all groups, we only show frequencies. Of the four groups we examined, India's Maoist guerrillas lead with the most (135) attacks, followed by Thailand's Islamic separatists, Europe's anarchists and environmental extremists, and then jihadists. Combining derailment attempts and track attacks shows the intensity of the operations of these four groupings. India's Maoist guerrillas have been responsible for 135 track attacks and 37 attempted derailments,

for a total of 172 incidents, and perhaps more. Thailand's Islamic separatists have been responsible for 34 track attacks and 10 derailments, a total of 44 incidents. The European grouping carried out 33 track attacks. Once again, the lethality of the track attacks was very low for all of the groups.

Table 17. Track Attacks by Frequency

Attacker Type - Track Attacks	Attacks	% of Total Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
All Other Groups	571	69.9%	38	0.1	0.0	232	0.4	0.0
Maoist	135	16.5%	0	0.0	0.0	8	0.1	0.0
Thai Islamic Separatists	34	4.2%	7	0.2	0.0	25	0.7	0.0
European Anarchist Environmental	33	4.0%	0	0.0	0.0	0	0.0	0.0
Unknown	16	2.0%	0	0.0	0.0	0	0.0	0.0
Criminal	11	1.3%	0	0.0	0.0	0	0.0	0.0
Tribal	10	1.2%	2	0.2	0.0	2	0.2	0.0
Jihadist	7	0.9%	1	0.1	0.0	1	0.1	0.0
All Attacker Types - Track Attacks	**817**	**100.0%**	**48**	**0.1**	**0.0**	**268**	**0.3**	**0.0**

Notes:

[1] FPA = Fatalities per attack.

[2] IPA = Injuries per attack.

ENVIRONMENTAL EXTREMISTS AND ANARCHISTS IN EUROPE

This is not a single group waging an ongoing campaign, but rather an assemblage of groups pursuing their own agendas. As seen in Figure 5, left-wing groups and anarchists along with various environmentalist and issue-oriented extremists have been responsible for a number of track attacks and other acts of sabotage in Europe, especially since 1996. Antinuclear extremists were involved or suspected of involvement in six of the attacks. The "Hekla Reception Committee—Initiative for More Social Eruptions," a left-wing group in Germany named after a volcano in Iceland, protesting the participation of German troops in Afghanistan, claimed responsibility for as many as seven track attacks in the database. These are part of a campaign of attacks using improvised incendiary devices (IIDs—17 used in all) against communication and switching systems in the German railway system, including inside stations. Groups protesting high-speed rail lines, such as the NO-TAV (*Treni di Alta Velocita)* in Italy, are responsible for eight of the 33 attacks. The other 12 attacks were carried out by a variety of informal anarchist or environmental activists. The number of all incidents peaked in 2011, which saw eight attacks.

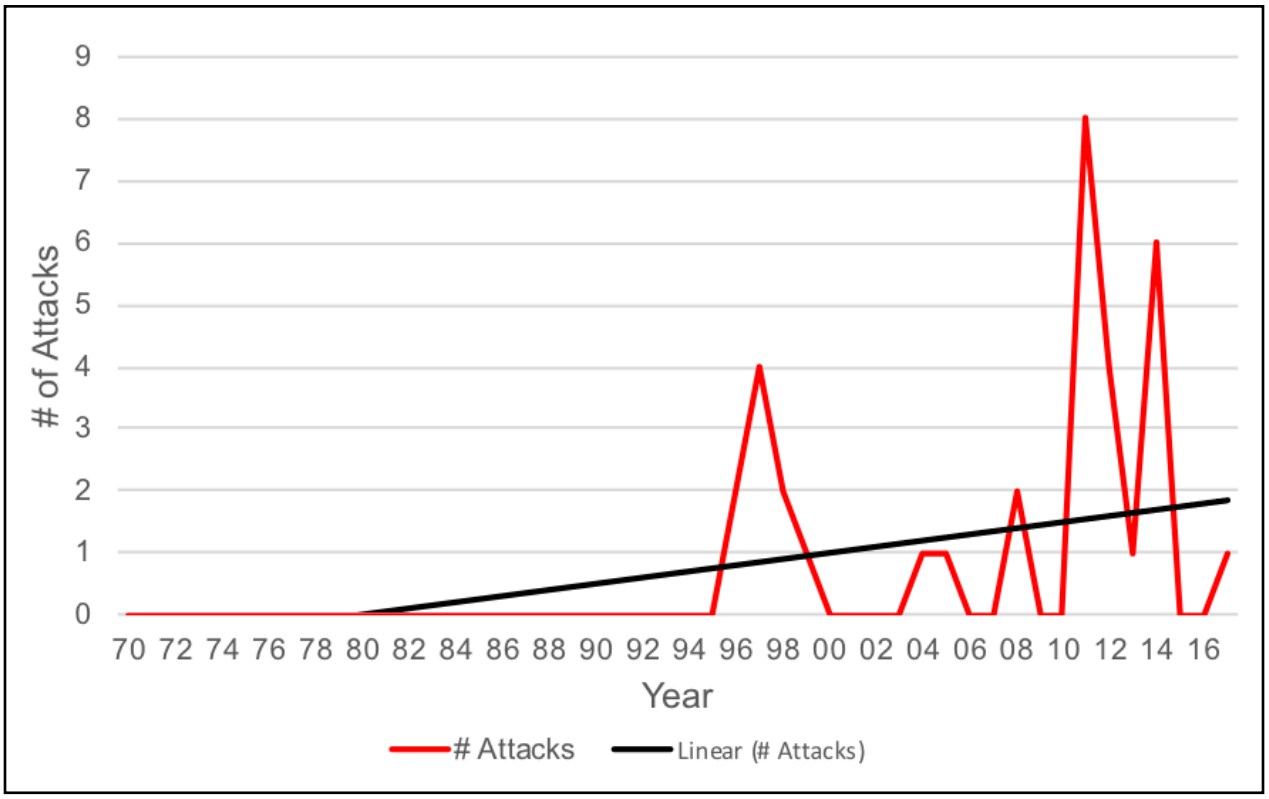

Figure 5. European Anarchist/Environmental Attacks Over Time

Most of the attacks occurred in Germany (45 percent of the attacks), Italy (39 percent of the attacks), the United Kingdom (9 percent of the attacks), followed by France (with the remaining 6 percent). In a few instances, it appears that anarchist cells in France, Belgium, Germany, and Italy were trying to coordinate their attacks across the continent.

According to Table 18, the attackers rarely used explosives (only one attack), and instead relied heavily on mechanical sabotage (45%) and improvised incendiary devices (IIDs) (42%). While worldwide IIDs such as petrol bombs are usually thrown, all here were placed near the intended target. In a number of cases where the rail system runs on overhead electricity, the perpetrators attached hooked metal bars to high-voltage electricity lines—a passing locomotive would snag the bar, thereby ripping up the power lines. The attackers also cut cables or tampered with switches.

Table 18. European Environmental or Anarchist Attacks by Weapon

Attacker Type - Track Attacks	Attacks	% of Total Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
Sabotage, Other	15	45.0%	0	0.0	0.0	0	0.0	0.0
IID (Improvised Incendiary Device)	14	42.0%	0	0.0	0.0	0	0.0	0.0
Arson	2	6.0%	0	0.0	0.0	0	0.0	0.0
IED, Hoax Device	1	3.0%	0	0.0	0.0	0	0.0	0.0
IED, Unspecified	1	3.0%	0	0.0	0.0	0	0.0	0.0
All Attacker Types - Track Atatcks	**33**	**100.0%**	**0**	**0.0**	**0.0**	**0**	**0.0**	**0.0**

Notes:
[1] FPA = Fatalities per attack.
[2] IPA = Injuries per attack.

Overall, 55 percent of the attacks were directed at railway signaling, power and communications systems, and 30 percent at railway tracks or railway tunnels (see Table 19). There were also two attacks against construction sites for high-speed rail projects.

Table 19. European Environmental or Anarchist Attacks by Target

Attacker Type - Track Attacks	Attacks	% of Total Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
Railway Signals, Comm. or Power Systems	18	55.0%	0	0.0	0.0	0	0.0	0.0
Railway Tracks	9	27.0%	0	0.0	0.0	0	0.0	0.0
Construction Site	**2**	6.0%	**0**	**0.0**	**0.0**	**0**	0.0	0.0
Multiple Targets, Track	**2**	6.0%	**0**	**0.0**	**0.0**	**0**	**0.0**	**0.0**
Other, Track	1	3.0%	0	0.0	0.0	0	0.0	0.0
Railway Tunnel	1	3.0%	0	0.0	0.0	0	0.0	0.0
All Attacker Types - Track Attacks	**33**	**100.0%**	**0**	**0.0**	**0.0**	**0**	**0.0**	**0.0**

Notes:
[1] FPA = Fatalities per attack.
[2] IPA = Injuries per attack.

Only 25 devices (64 percent of the total) are known or presumed to have detonated or initiated on target. That is considerably less that the average rate of success (77 percent) for all attacks on passenger targets. Other devices were discovered or failed to detonate; 36 percent were detected before the attack, which is more than twice as high as for all passenger attacks (15%). The higher failure and higher detection rate suggest adversaries with limited operational capabilities, which may be true, but it may also be that security is better, or that some of the devices were put in obvious places and intended to be found merely to add to the overall disruption.

None of these attacks resulted in fatalities or injuries. That is not the intent. The attackers instead sought to attract publicity, cause damage, inconvenience and widespread disruption, and impose heavy economic costs on society. In November 2008, for example, anarchists targeting four rail lines caused the delay of nearly 160 high-speed trains, including the Eurostar service between Paris and London, leaving thousands of passengers stranded.

THE ISLAMIST INSURGENCY IN SOUTHERN THAILAND

The current insurgency in southern Thailand began as a separatist guerrilla movement in the 1940s, although the origins of the dispute reach back into the 18th century when the Muslim majority southern provinces of Thailand were part of the independent Sultanate of Patani, which was conquered by Kingdom of Siam in 1785. Rebellions continued in the 19th century. Resistance flared again in the early 20th century in reaction to a concerted assimilation effort by the government in Bangkok. In the 1960s, the resistance adopted the then current leftist leanings and language of a national liberation front, calling itself the Patani National Liberation Front. The insurgency subsided in the 1980s, but surged again at the beginning of the 21st century. Changing its name in 1986 to the Islamic Liberation Front of Patani, its ideology has also become less nationalistic and more militantly Islamist. (The change from Marxist to Islamist rhetoric may reflect how persistent local conflicts with deep historical roots reflect, adapt, and connect themselves with broader worldwide movements.) Although the violence began to escalate in 2001, most sources date the current insurgency from 2004.

There is no single insurgent organization, but rather a host of political entities and armed formations separated by degrees of commitment to hardline Salafi Islamist beliefs. Estimates of the total number of insurgents vary widely from hundreds to more than 10,000.[5]

The attacks on rail lines and trains are a minor component of the armed struggle in which nearly 7,000 people have died since 2004 (see Figure 6). The killing reached a peak of more than 700 deaths in 2006, subsided somewhat, but then resurged in 2011, which saw more than 500 deaths. The violence has become more indiscriminate, with insurgents setting off bombs in public areas.

Attacks on the rail system roughly reflect the overall trajectory of violence. The first attacks occur in 1993 and then peak in the 2004 to 2007 period with 19 attacks. Attacks against railway infrastructure have increased more than derailment attempts (see Figure 6). As in other case studies, the lethality of the infrastructure attacks remains very low, while the lethality of the derailment attacks has increased slightly (see Figure 7).

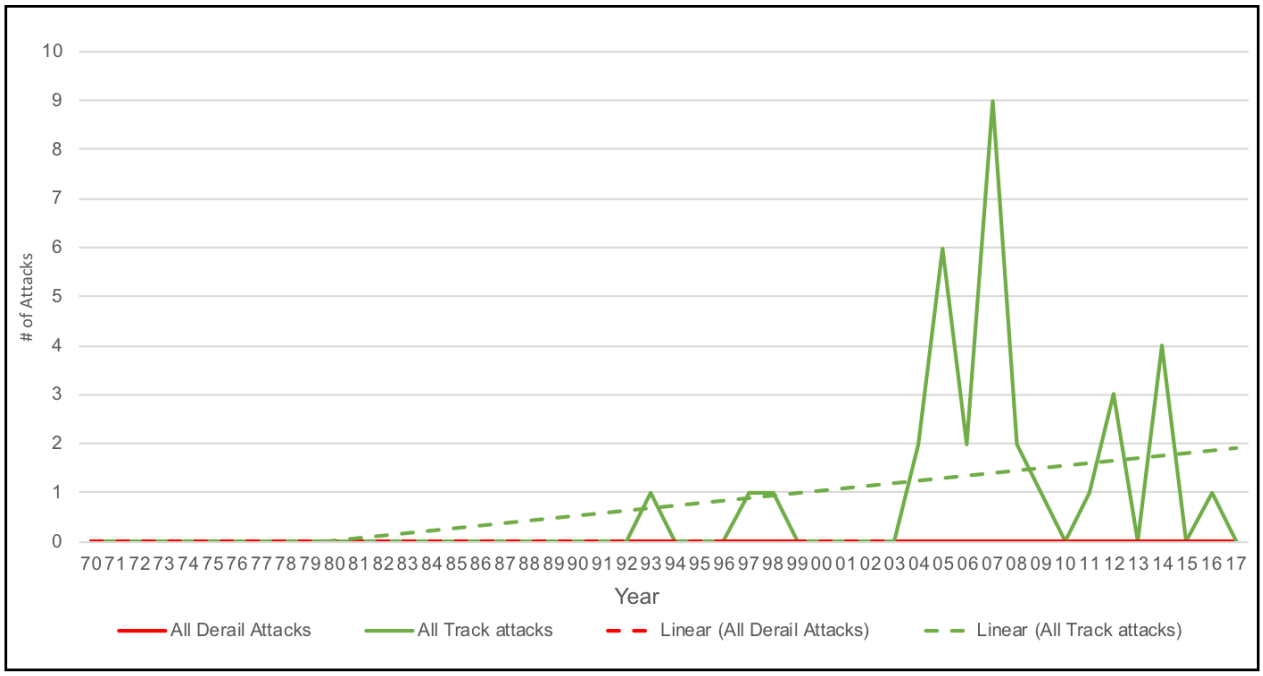

Figure 6. Thai Islamic Separatist Attacks Over Time

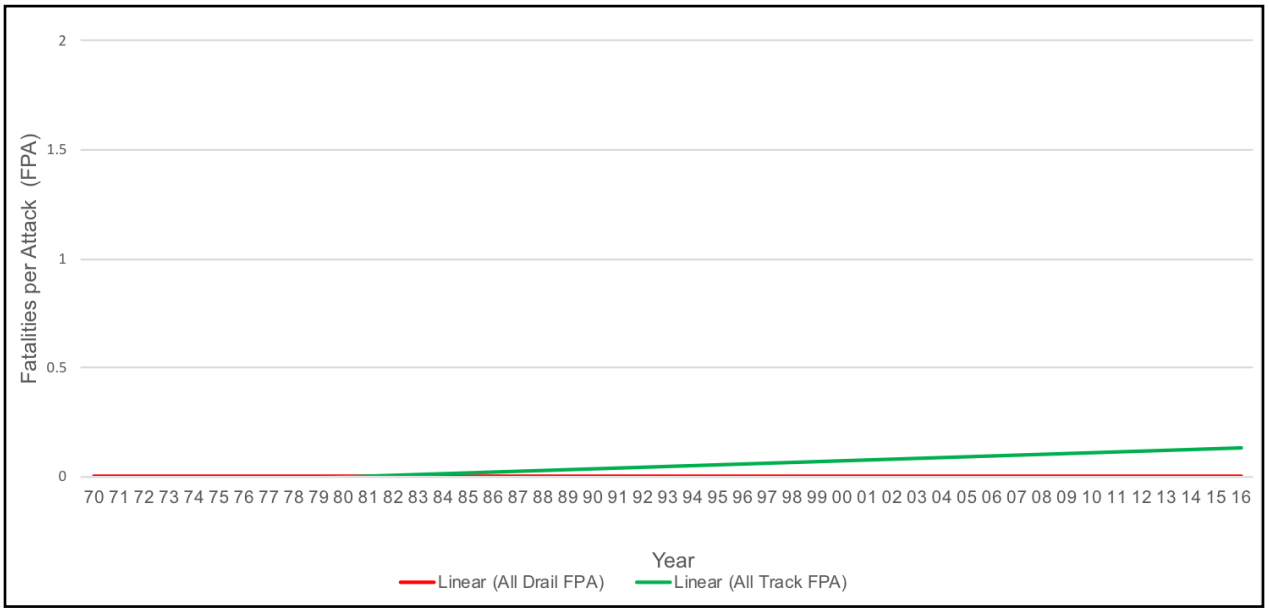

Figure 7. Thai Islamic Separatist Lethality Over Time

Looking at the attacks by target (see Table 20) shows that most of the attacks (28 or 63.6%) were directed against railway tracks and bridges; four attacks were directed at security personnel guarding railway tracks; and two attacks were against railway service facilities or equipment. There were 10 attempts to derail passenger trains. Few were successful, and only four people were killed in the derailment attempts and another seven in the track attacks. Comparing these low casualties to the total volume of violence in the insurgency suggests that the insurgents' campaign against the rail system is a low-level sideshow intended to be primarily disruptive and divert government forces to rail protection duties. The fact that local residents comprise the bulk of the passengers may also constrain the adversaries. Attacking other targets may allow the separatists to be more discriminate.

Table 20. Thai Islamic Separatist Attacks by Target

Target	Attacks	% of Total Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
Railway Tracks	24	54.5%	2	0.1	0.0	6	0.3	0.0
Railway Bridge	4	9.1%	0	0.0	0.0	1	0.3	0.0
Security Personnel	4	9.1%	5	1.3	1.0	9	2.3	0.5
Train Service Facility or Equipment	2	4.5%	0	0.0	0.0	9	4.5	4.5
All Track Attacks	**34**	**77.3%**	**7**	**0.2**	**0.0**	**25**	**0.7**	**0.0**
Train, Passenger (Intercity or Commuter) Targets	**10**	**22.7%**	**4**	**0.4**	**0.0**	**71**	**7.1**	**0.5**
All Targets	**44**	**100.0%**	**11**	**0.3**	**0.0**	**96**	**2.2**	**0.0**

Notes:

[1] FPA = Fatalities per attack.

[2] IPA = Injuries per attack.

As Table 21 shows, explosives predominate. IEDs account for five of the 10 derailment attempts and 25 of the 34 track attacks, although one has to suspect that there are many more unreported instances of mechanical sabotage. (There was also one attack in which a bomb derailed a train, followed by an attack with automatic weapons, killing three.)

Table 21. Thai Islamic Separatist Attacks by Attack Method

Attack Method	Attacks	% of Total Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
IED, Unspecified	25	56.8%	7	0.3	0.0	16	0.6	0.0
Derailment, Track Bomb-IED, Unspecified	5	11.4%	0	0.0	0.0	4	0.8	0.0
Bolts/Tracks Removed	4	9.1%	0	0.0	0.0	0	0.0	0.0
Derailment, Bolts/Tracks Removed	4	9.1%	1	0.3	0.0	31	7.8	6.5
Sabotage, Other	4	9.1%	0	0.0	0.0	0	0.0	0.0
Assault, Automatic or Semi-Automatic Weapons	1	2.3%	0	0.0	0.0	9	9.0	9.0
Derailment, Multiple Weapons-IED & Assault with Automatic or Semi-Automatic Weapons	1	2.3%	3	3.0	3.0	36	36.0	36.0
All Track Attacks Total/ Average/Median	**34**	**100.0%**	**7**	**0.2**	**0.0**	**25**	**0.7**	**0.0**
All Derailment Attacks Total/Average/Median	**10**	**100.0%**	**4**	**0.4**	**0.0**	**71**	**7.1**	**0.5**
All Attack Methods	**44**	**100.0%**	**11**	**0.3**	**0.0**	**96**	**2.2**	**0.0**

Notes:

[1] FPA = Fatalities per attack.

[2] IPA = Injuries per attack.

Looking only at attacks using explosive or incendiary devices, 97% of the 34 devices were placed on railroad tracks. Only single devices were used, making the count of devices the same as the count of attacks. As Table 22 shows, of these, 28 (or 82.4 percent) detonated on target. The remaining six devices (or 17.6 percent) were discovered and rendered safe or, in one case, detonated during disarmament.

Table 22. Thai Separatist Bombs by Outcome

Device Outcome	Devices	% of Total Devices	Fatalities	Average FPD[1]	Median FPD	Average FPDE[2]	Injuries	Average IPD[3]	Median IPD	Average IPDE[4]
Detonated or Released on Target	28	82.4%	5	0.2	0.0	0.2	15	0.5	0.0	0.5
EOD Successful, Rendered Safe	5	14.7%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Detonated Early or Away from Target, or Malfunctioned	1	2.9%	2	2.0	2.0	0.0	1	1.0	1.0	0.0
All Device Outcomes	**34**	**100.0%**	**7**	**0.2**	**0.0**	**0.3**	**16**	**0.5**	**0.0**	**0.6**

Notes:

[1] FPD = Fatalities per device.

[2] FPDE = Fatalities per device exploded.

[3] IPD = Injuries per device.

[4] IPDE = Injuries per device exploded.

The high percentage of bombs detonated on target suggests that the attackers know how to make and place bombs that work. The low number of casualties, therefore, may reflect self-imposed constraints, not lack of competence.

THE NAXALITE-MAOIST INSURGENCY IN INDIA

The Naxalite-Maoist insurgency in India began in 1967 as an armed movement aimed at overthrowing the Indian state and replacing it with a Communist regime. It traces its origins to schisms in the Indian Communist movement and emergence of more militant Maoist factions in the 1960s. The Maoists are often called Naxalites after the village Naxalbari in West Bengal where the Maoists initiated their armed struggle. The insurgency found strength among the marginalized tribal people and poorest peasants. In response to the growing violence, India mounted a massive counterinsurgency effort in 1971 that suppressed but did not eliminate the movement. The violence never entirely subsided and the insurgency escalated again at the beginning of the 21st century. The beginning of the current rebellion is put at 2004 when the insurgents reorganized themselves as the Communist Party of India (Maoist), with its armed wing called the People's Liberation Guerrilla Army, which is estimated to have 8-10,000 members.

The insurgency spread across the country with insurgent attacks taking place in nearly half of India's states, but it remains strongest in India's so-called "red corridor" of Jharkand, West Bengal, Orissa, Bihar, Chhattisgarhm Madhya Pradesh, and Andra Pradesh. These are among the poorest, least developed parts of India with high populations of tribal people and sharp caste divisions. The Maoists claim they are fighting on behalf of neglected, displaced and impoverished populations.[6]

As illustrated in Figure 8, the insurgency expanded, steadily achieving its largest area of influence roughly between 2009 and 2012. In 2011, there were a reported 1,760 incidents. Casualties climbed from 1996 on, reaching a high point in 2010 with more than 1,100 fatalities. Depending on whether one counts from 1996 or 1980, the total death toll of the insurgency lies somewhere between 12,000 and 20,000. Civilians account for a majority of the casualties. Government development programs and counterinsurgency operations have reduced the area affected and total casualties in recent years, but the conflict continues.

In compiling the following figures, we have included all of the attacks claimed by the Maoists. The data also include attacks in the states affected by the insurgency that were not attributed to other groups on the reasonable assumption that they were Maoist, because there are no other groups operating in these areas. This brings the total number of Maoist attacks against train and railway targets during the period covered to 244 (or 43 percent) of the 564 attacks recorded in India. Narrowing the inquiry to include only derailment attempts and attacks on rail infrastructure gives a total of 290 attacks, of which 172 (or 59 percent) were carried out by Maoists.

As seen in Figure 8, the first recorded attack occurs in 1989, but the surge in activity begins in 1991, reaching a high point in 2007 with 20 attacks, and again in 2010 with 24 attacks. From 2007 to 2016, there were 142 attacks. This corresponds roughly with the high point of insurgency activity overall.

As seen in the other case studies, Figure 9 shows that the lethality of track attacks remains very low. However, in contrast to the worldwide trend, the lethality of derailment attacks has increased. This may reflect a single spectacular incident.

The lethality follows a familiar pattern. Lethality for derailments is going up, while the lethality of track attacks, designed to create disruption and not loss of life, remains low.

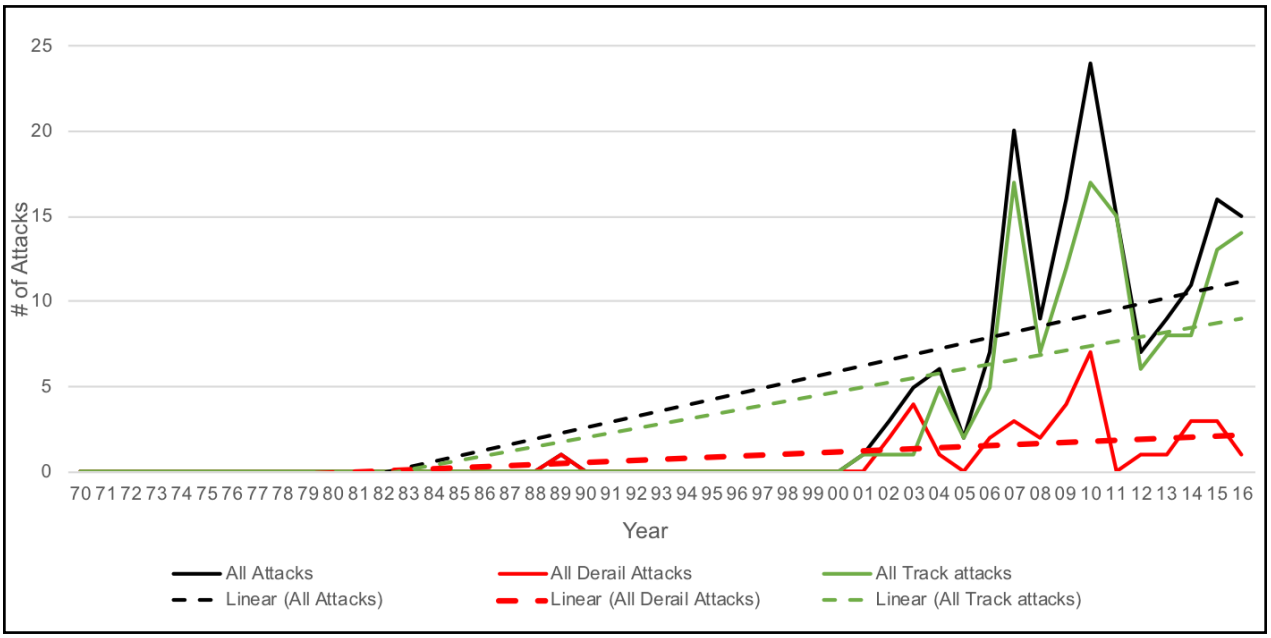

Figure 8. Maoist Attacks Over Time

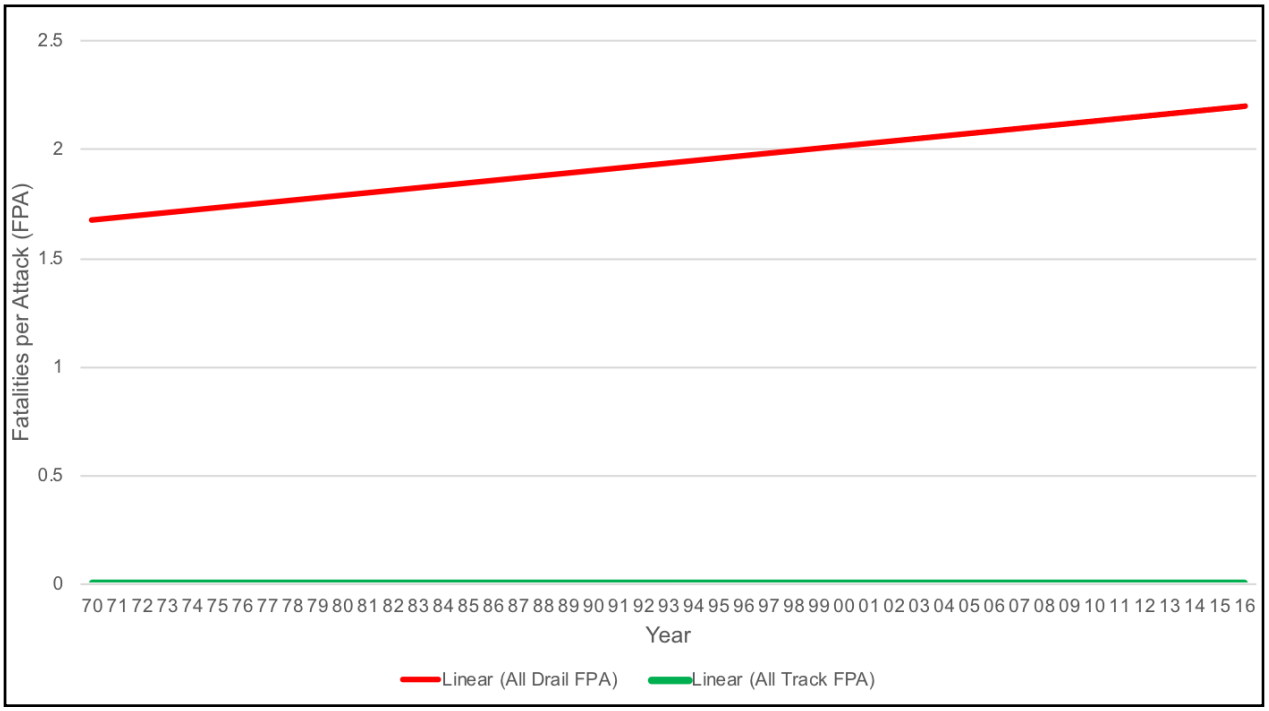

Figure 9. Lethality of Maoist Attacks Over Time

As for targets, Table 23 shows that 135 out of the 172 attacks (or 78 percent) are against railway infrastructure. A majority of these attacks—126 (or 73.3 percent) were directed against the tracks or bridges, with the remainder targeting construction sites, signals, communications and power systems, equipment and facilities, or other targets. These attacks on infrastructure generated no deaths or injuries, and probably were intended to support a campaign of disruption and economic warfare while diverting government counterinsurgent forces to security functions. As for the derailments, all 37 attacks (22 percent of the total) were aimed at intercity passenger or commuter trains. Of these attacks, only five were lethal, but the worst—a derailment, which killed 114 people in 2010 through mechanical sabotage—drove the lethality rate or FPA for all derailments upwards.

Table 23. Maoist Attacks by Target

Target	Attacks	% of Total Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
Railway Tracks	125	72.7%	0	0.0	0.0	8	0.1	0.0
Train, Passenger (Intercity or Commuter)	37	21.5%	199	5.4	0.0	443	12.0	0.0
Railway Personnel or Railway Company Office	3	1.7%	0	0.0	0.0	0	0.0	0.0
Multiple Targets, Track	2	1.2%	0	0.0	0.0	0	0.0	0.0
Train Service Facility or Equipment	2	1.2%	0	0.0	0.0	0	0.0	0.0
Construction Site	1	0.6%	0	0.0	0.0	0	0.0	0.0
Railway Bridge	1	0.6%	0	0.0	0.0	0	0.0	0.0
Railway Signals, Comm. or Power Systems	1	0.6%	0	0.0	0.0	0	0.0	0.0
All Track Target Attacks	**135**	**78.0%**	**0**	**0.0**	**0.0**	**0**	**0.0**	**0.0**
Derailment Target Attacks	**37**	**22.0%**	**199**	**5.4**	**0.0**	**443**	**12.0**	**0.0**
All Targets	**172**	**100.0%**	**199**	**1.2**	**0.0**	**451**	**2.6**	**0.0**

Notes:

[1] FPA = Fatalities per attack.

[2] IPA = Injuries per attack.

Because the number of attacks is larger than in the other sets examined, the attack methods shown in Table 24 are broken out into three separate sets of targets: (1) intercity passenger and commuter trains, which were the targets of 37 attacks with all of the fatalities coming from mechanical derailments; (2) railway tracks, tunnels and bridges; (3) other railway infrastructure such as serving equipment or facilities; and (4) operational and security personnel.

Table 24. Maoist Attacks by Target Group

Target Group	Attacks	% of Total Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
Railway Tracks, Bridges and Tunnels	126	73.3%	0	0.0	0.0	8	0.1	0.0
Passenger Trains	37	21.5%	199	5.4	0.0	443	12.0	0.0
Operating or Security Personnel and Facilities	4	2.3%	0	0.0	0.0	0	0.0	0.0
Other Railway Infrastructure	3	1.7%	0	0.0	0.0	0	0.0	0.0
Unspecified	2	1.2%	0	0.0	0.0	0	0.0	0.0
All Target Groups	**172**	**100.0%**	**199**	**1.2**	**0.0**	**451**	**2.6**	**0.0**

Notes:

[1] FPA = Fatalities per attack.

[2] IPA = Injuries per attack.

In the following three tables we look at the attack methods used (Tables 25, 26 and 27). Table 25 looks only at attack derailments. Explosives predominate, but mechanical methods proved more lethal.

Table 25. Maoist Attacks – Train Derailments Only

Atttack and Weapon (Derailment)	Attacks	% of Total Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
Derailment, Track Bomb-IED, Unspecified	20	54.1%	6	0.3	0.0	61	3.1	0.0
Derailment, Bolts/Tracks Removed	11	29.7%	193	17.5	0.0	382	34.7	0.0
Derailment, Other or Unknown	3	8.1%	0	0.0	0.0	0	0.0	0.0
Derailment, Track Bomb-Dynamite	2	5.4%	0	0.0	0.0	0	0.0	0.0
Derailment, Track Bomb-Mine	1	2.7%	0	0.0	0.0	0	0.0	0.0
All Attacks and Weapons	**37**	**100.0%**	**199**	**5.4**	**0.0**	**443**	**12.0**	**0.0**

Notes:

[1] FPA = Fatalities per attack.

[2] IPA = Injuries per attack.

Table 26 examines the methods of attack on railway tracks, tunnels, and bridges. Explosives play an even greater role, but, as indicated before, there are zero casualties.

Table 26. Maoist Attacks on Railway Tracks, Bridges and Tunnels

Attack and Weapon (Railway Tracks, Bridges, and Tunnels)	Attacks	% of Total Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
IED, Unspecified	105	83.3%	0	0.0	0.0	8	0.1	0.0
Bolts/Tracks Removed	6	4.8%	0	0.0	0.0	0	0.0	0.0
Mine	4	3.2%	0	0.0	0.0	0	0.0	0.0
Multiple Weapons, IED/IID & Other	2	1.6%	0	0.0	0.0	0	0.0	0.0
Sabotage, Other	2	1.6%	0	0.0	0.0	0	0.0	0.0
Unknown	2	1.6%	0	0.0	0.0	0	0.0	0.0
Assault, Unspecified or Other	1	0.8%	0	0.0	0.0	0	0.0	0.0
Dynamite	1	0.8%	0	0.0	0.0	0	0.0	0.0
Grenade	1	0.8%	0	0.0	0.0	0	0.0	0.0
Multiple Weapons, IED/IID & Automatic or Semi-Automatic Weapons	1	0.8%	0	0.0	0.0	0	0.0	0.0
VBIED[3]	1	0.8%	0	0.0	0.0	0	0.0	0.0
All Attacks and Weapons (Railway Tracks, Bridges, and Tunnels)	**126**	**100.0%**	**0**	**0.0**	**0.0**	**8**	**0.0**	**0.0**

Notes:

[1] FPA = Fatalities per attack.

[2] IPA = Injuries per attack.

[3] VBIED = Vehicle-Borne Improvised Explosive Device.

Table 27 looks only at attacks on other infrastructure (such as signaling systems) and on operating and security personnel and the facilities they use, which is why kidnapping is included. The attack methods vary, but even here there were no fatalities.

Table 27. Maoist Attacks on Other Infrastructure Targets

Attack and Weapon (Other Railway Infrastructure and Operating and Security Personnel)	Attacks	% of Total Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
Arson	2	28.6%	0	0.0	0.0	0	0.0	0.0
Kidnapping	2	28.6%	0	0.0	0.0	0	0.0	0.0
Assault, Unspecified or Other	1	14.3%	0	0.0	0.0	0	0.0	0.0
IED, Unspecified	1	14.3%	0	0.0	0.0	0	0.0	0.0
Multiple Weapons, IED/IID & Automatic or Semi-Automatic Weapons	1	14.3%	0	0.0	0.0	0	0.0	0.0
All Attacks and Weapons (Other Railway Infrastructure and Operating and Security Personnel)	**7**	**100.0%**	**0**	**0.0**	**0.0**	**0**	**0.0**	**0.0**

Notes:

[1] FPA = Fatalities per attack.

[2] IPA = Injuries per attack.

Table 28 turns to the 222 devices used in the 172 attacks in terms of method of delivery and placement. It appears that 97 percent of the devices were placed on the tracks.

Table 28. Maoist Devices by Concealment and Delivery Method

Concealment and Delivery Outcome	Devices	% of Total Devices	Fatalities	Average FPD[1]	Median FPD	Average FPDE[2]	Injuries	Average IPD[3]	Median IPD	Average IPDE[4]
Placed on Railroad Track or Bridge, or Near a Train	215	96.8%	6	0.0	0.0	0.0	69	0.3	0.0	0.5
Placed Near Target, Unspecified	3	1.4%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Vehicle Placed Near Target	2	0.9%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Concealed/Placed inside Station, Unspecified or Other	1	0.5%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Concealed/Placed outside of Building or Office	1	0.5%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
All Concealment and Delivery Outcomes	**222**	**100.0%**	**6**	**0.0**	**0.0**	**0.0**	**69**	**0.3**	**0**	**0.5**

Notes:

[1] FPD = Fatalities per device.

[2] FPDE = Fatalities per device exploded.

[3] IPD = Injuries per device.

[4] IPDE = Injuries per device exploded.

Turning to what happened to these same devices, Table 29 shows that 68 percent exploded on target, while an unusually high number (27 percent) were discovered and rendered safe, suggesting high security awareness. The remainder malfunctioned or detonated too early.

Table 29. Maoist Devices by Outcome

Device Outcome	Devices	% of Total Devices	Fatalities	Average FPD[1]	Median FPD	Average FPDE[2]	Injuries	Average IPD[3]	Median IPD	Average IPDE[4]
Detonated or Released on Target	150	67.6%	6	0.0	0.0	0.0	63	0.4	0.0	0.4
EOD Successful, Rendered Safe	61	27.5%	0	0.0	0.0	0.0	4	0.1	0.0	0.0
Detonated Early or Away from Target, or Malfunctioned	7	3.2%	0	0.0	0.0	0.0	1	0.1	0.0	0.0
Detonated during Unsuccessful EOD	4	1.8%	0	0.0	0.0	0.0	1	0.2	0.2	0.0
All Device Outcomes	**222**	**100.0%**	**6**	**0.0**	**0.0**	**0.0**	**69**	**0.3**	**0.0**	**0.5**

Notes:

[1] FPD = Fatalities per device.

[2] FPDE = Fatalities per device exploded.

[3] IPD = Injuries per device.

[4] IPDE = Injuries per device exploded.

Finally, Table 30 shows how many of these devices were found, where we see that 22% were actually detected before an attack by alert drivers, crew and transit employees, the public, and by police and security officials, which is a robust percentage compared to other sets of attacks. Another 14% were detected in the course of investigations following explosions, indicating that the attackers planted multiple devices. The detected devices resulted in no fatalities and possibly were intended to slow down repair and recovery operations.

Table 30. Maoist Devices Detected

Devices Detected Before Attacks	Devices	% of Total Devices	Fatalities	Average FPD[1]	Median FPD	Average FPDE[2]	Injuries	Average IPD[3]	Median IPD	Average IPDE[4]
Not Detected	142	64.0%	6	0.0	0	0.0	62	0.4	0.0	0.5
EOD after Some Devices Detonated in Attack	31	14.0%	0	0.0	0	0.0	3	0.1	0.0	0.3
Unknown	20	9.0%	0	0.0	0	0.0	0	0.0	0.0	0.0
Driver or Crew	8	3.6%	0	0.0	0	0.0	0	0.0	0.0	0.0
Citizens	6	2.7%	0	0.0	0	0.0	2	0.3	0.3	0.0
Police	6	2.7%	0	0.0	0	0.0	0	0.0	0.0	0.0
Security Officials	5	2.3%	0	0.0	0	0.0	2	0.4	0.5	0.0
Transit Employees	4	1.8%	0	0.0	0	0.0	0	0.0	0.0	0.0
All Devices Detected Before Attacks	**222**	**100.0%**	**6**	**0.0**	**0**	**0.0**	**69**	**0.3**	**0.0**	**0.5**

Notes:

[1] FPD = Fatalities per device.

[2] FPDE = Fatalities per device exploded.

[3] IPD = Injuries per device.

[4] IPDE = Injuries per device exploded.

JIHADIST ATTACKS WORLDWIDE

The armed struggle inspired by the ideology of groups like al Qaeda and ISIS is a global enterprise. In addition to preparing centrally directed attacks and assisting foreign recruits to return and carry out attacks in their countries of origin, jihadist groups and their affiliates also urge followers abroad to carry out attacks wherever they are using whatever means they can. Surface transportation targets figure prominently in jihadist plots and attacks.[7] Many of these have been directed against passengers on subways or commuter trains or at train stations. The terrorist bombings of commuter trains in Madrid in 2004, the bombing of London Transport in 2005, the bombing of a commuter train in Mumbai in 2006, and the bombing of the Metro in Brussels in 2016 are some of the more dramatic examples. These attacks were aimed at causing mass casualties—the four attacks mentioned killed nearly 500 people and injured more than 3,000.

As is the case with Islamist separatists in Thailand and India's Maoist guerrillas, derailments and rail infrastructure attacks represent only a small portion of what jihadist do.

The database records only 17 jihadist attacks against railway infrastructure or attempts to derail trains. There were 10 derailment attempts and seven track attacks. The derailment attacks were, however, the most lethal of all the groups we have examined, with an average of 20.8 fatalities per attack, which is *3.9 times more lethal* than the next most lethal group (Maoists, with an average of 5.4), and *5.5 times more lethal* than the average (3.8), considerably above the other groups. At the same time, we note that jihadist groups operating in the developing world also carry out attacks on railway infrastructure not designed to kill, but to disrupt. This is an interesting aspect of a group which typically looks for high body counts.

The breakdown of attacks and lethality of derailment attacks against intercity and commuter passenger trains (seven of which used bombs, and three of which were mechanical), and against railway track targets, is shown in Table 31 below.

Table 31. Jihadist Attacks by Target

Target	Attacks	% of Total Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
Railway Tracks	5	29.4%	1	0.2	0.0	1	0.2	0.0
Railway Bridge	2	11.8%	0	0.0	0.0	0	0.0	0.0
All Track Targets	**7**	**41.2%**	**1**	**0.1**	**0.0**	**1**	**0.1**	**0.0**
Train, Passenger (Intercity or Commuter) Targets	**10**	**58.8%**	**208**	**20.8**	**0.0**	**320**	**32.0**	**0.0**
All Targets	**17**	**100.0%**	**209**	**12.3**	**0.0**	**321**	**18.9**	**0.0**

Notes:

[1] FPA = Fatalities per attack.

[2] IPA = Injuries per attack.

Despite Osama bin Laden's personal interest and continuing jihadist exhortations to conduct mechanical derailments in the West, jihadists have made only few attempts to derail trains. As Table 32 shows, only three of the 10 derailment attempts involved mechanical sabotage. However, two spectacular mechanical derailments that we have attributed to jihadists drive the lethality of this method up—*way up*. These three attacks killed a total of 168 and injured 205, driving the average lethality per attack up to 56.0. This is *9.8 times the lethality of derailments involving explosives*, in which seven attacks killed 40 for an average lethality of 5.7—still high, but not spectacularly high. In fact, this set of three attacks is by far the most lethal combination of an attacker and a derailment method of any group in the MTI database.

Table 32. Jihadist Derailments by Attack Method

Attack and Weapon	Attacks	% of Total Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
Derailment, Track Bomb-IED, Unspecified	7	70.0%	40	5.7	0.0	115	16.4	0.0
Derailment, Bolts/Tracks Removed	3	30.0%	168	56.0	20	205	68.3	80
All Attacks and Weapons	**10**	**100.0%**	**208**	**20.8**	**0.0**	**320**	**32.0**	**0.0**

Notes:

[1] FPA = Fatalities per attack.

[2] IPA = Injuries per attack.

The most lethal of these took place in the early morning hours on November 20, 2016, in which 14 carriages of the Indore-Patna Express derailed near the city of Kanpur in Uttar Pradseh State, India killing 148 and injuring 125. While the event was at first thought to be caused by a mechanical problem, Indian authorities have now stated that they suspect an ISIS module operating in the area.[8,9] The second most lethal was six years earlier on November 27, 2009 when the Nevsky Express (a high-speed rail train running between Moscow and St. Petersburg) was derailed, killing 27 and injuring 95.

All of the attacks against railway tracks and bridges were conducted with IEDs, killing only one person.

Thus far, the geography of the jihadist derailment and track attacks is also not particularly focused on the West. In fact, the jihadist attacks occur almost exclusively in the Russian Federation and developing countries, with the exception of two nonfatal attacks: one against a high-speed train in Spain, and the other an unsuccessful attempt by Algerian extremists to derail a French TGV in 1995. Table 33 shows the location of the derailment and track attacks by country.

Table 33. Jihadist Attacks by Country

Country	Attacks	% of Total Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
India	7	41.2%	168	24.0	0.0	206	29.4	0.0
Russian Federation	4	23.5%	27	6.8	0.0	95	23.8	0.0
Iraq	2	11.8%	1	0.5	0.5	0	0.0	0.0
Algeria	1	5.9%	13	13.0	13.0	20	20.0	20.0
France	1	5.9%	0	0.0	0.0	0	0.0	0.0
Pakistan	1	5.9%	0	0.0	0.0	0	0.0	0.0
Spain	1	5.9%	0	0.0	0.0	0	0.0	0.0
All Countries	**17**	**100.0%**	**209**	**12.3**	**0.0**	**321**	**1.0**	**18.9**

Notes:
[1] FPA = Fatalities per attack.
[2] IPA = Injuries per attack.

The highest FPA rates were attained in India, Algeria and then Russia. It is important, however, to put this lethality into context. Adversaries in Russia and Algeria fielded large guerrilla organizations, capable of ambitious operations.

The Russian situation poses a challenge to the analysis. Over the years, Chechen rebels can be said to have morphed into jihadists; there is no precise date of this change. We have included only those attacks since the last two months of 2010—four in total, killing 27 in all. Including all Chechen attacks since the beginning of the Second Chechen War in 1999 under the jihadist label would add another five derailment attacks in Russia, which killed 12. Including the conflict in neighboring Dagestan would add another nine derailment attacks, which killed three persons. As seen in Table 34, including these attacks would considerably reduce Russia's average FPA from 6.8 to 2.3. (Of course, adding these same attacks would reduce the overall FPA for all jihadist attacks from 12.3 to 7.2, and for derailment attacks alone, from 20.8 to 9.3).

Table 34. Chechen and Dagestan Attacks Added to Russian Jihadist Attacks

Russian Attack Subset	Attacks	Fatalities	FPA[1]
India	4	27	6.8
Russian Federation	5	12	2.4
Iraq	9	3	0.3
All Russian Attacks Subset	**18**	**42**	**2.3**

Notes:
[1] FPA = Fatalities per attack.

Our analysis confirms the assertion that Jihadist attacks frequently aim for high body counts and tend to be more lethal than other groups. Considering jihadist attacks against passenger trains and train stations since 1970, Table 35 shows how various modes of

jihadist attack against a variety of these targets compare with one another. Even holding to the narrower and more lethal boundaries of jihadist attacks in Russia, the figures show that mechanical derailments are by far the most lethal jihadist attack method (56.0 FPA,) more than three times the overall average of 15.0. Furthermore, even though bomb derailments at 3.3 are considerably below that same average, when combined with mechanical derailments, the derailment total becomes 25.9, well above the average. Certainly, high lethality can be achieved in operations that may be less technically challenging than derailing trains, such as shootings or bombings in crowded spaces. Derailments are very lethal, however, and offer the additional advantage of achieving high body counts without the necessity of carrying out a suicide attack.

Table 35. All Jihadist Attack Methods Against Passenger Trains and Train Stations

Attack And Weapon	Attacks	% of Total Attacks	Fatalities	Average FPA[1]	Median FPA	Injuries	Average IPA[2]	Median IPA
Derailment, Bolts/Tracks Removed	3	5.2%	168	**56.0**	20.0	205	68.3	80.0
IID (Improvised Incendiary Device)	2	3.4%	66	33.0	33.0	18	9.0	9.0
Assault, Automatic or Semi-Automatic Weapons	3	5.2%	59	19.7	0.0	120	40.0	12.0
IED, Unspecified	40	69.0%	553	13.8	0.0	3,936	98.4	11.5
VBIED	1	1.7%	7	7.0	7.0	20	20.0	20.0
Derailment, Track Bomb-IED, Unspecified	4	6.9%	13	3.3	0.0	20	5.0	0.0
Assault, Stabbings	3	5.2%	2	0.7	0.0	5	1.7	0.0
Arson	2	3.4%	0	0.0	0.0	0	0.0	0.0
All Attacks and Weapons	**58**	**100.0%**	**868**	**15.0**	**0.0**	**4,324**	**74.6**	**9.0**

Notes:

[1] FPA = Fatalities per attack.

[2] IPA = Injuries per attack.

Moreover, it is important to note that jihadists remain among all attackers of passenger train targets the most lethal adversaries. Ranked in terms of average deaths per attack, the relatively few jihadist attacks are 2.2 times more lethal than the next most lethal set of attackers, individuals who are mentally disordered, with an average lethality of 6.7. *More significantly*, they are 5.8 times more lethal than the average (2.6) of all the other terrorist groups in the MTI database combined.

Turning back to the immediate small set of derailment and rail infrastructure attacks, the data show that the number and lethality of jihadist derailments and rail infrastructure or track attacks have been increasing over time, as Figures 10 and 11 illustrate. (The scale for attacks in Figure 11 is the same as in those charts used for Maoist and Thai Islamic separatist attacks for comparison.) Likewise, the scale for lethality had to expand significantly (in Figure 12) to capture the increased lethality of jihadist derailments.

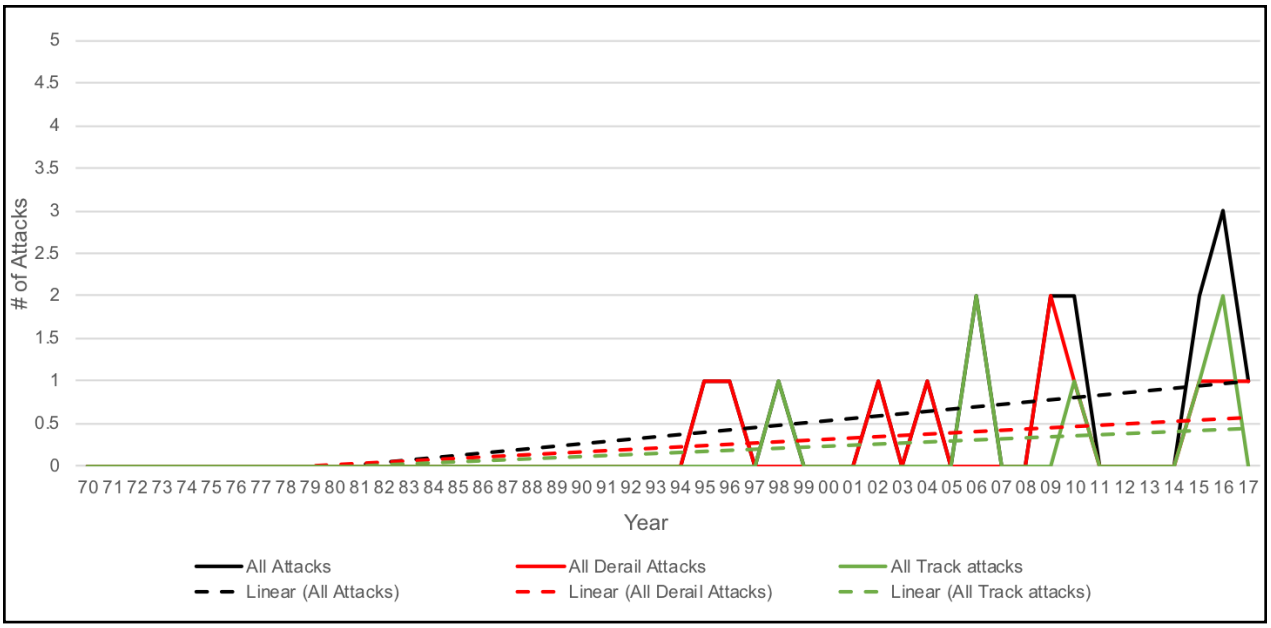

Figure 10. Jihadist Attacks Over Time – Scale Adjusted

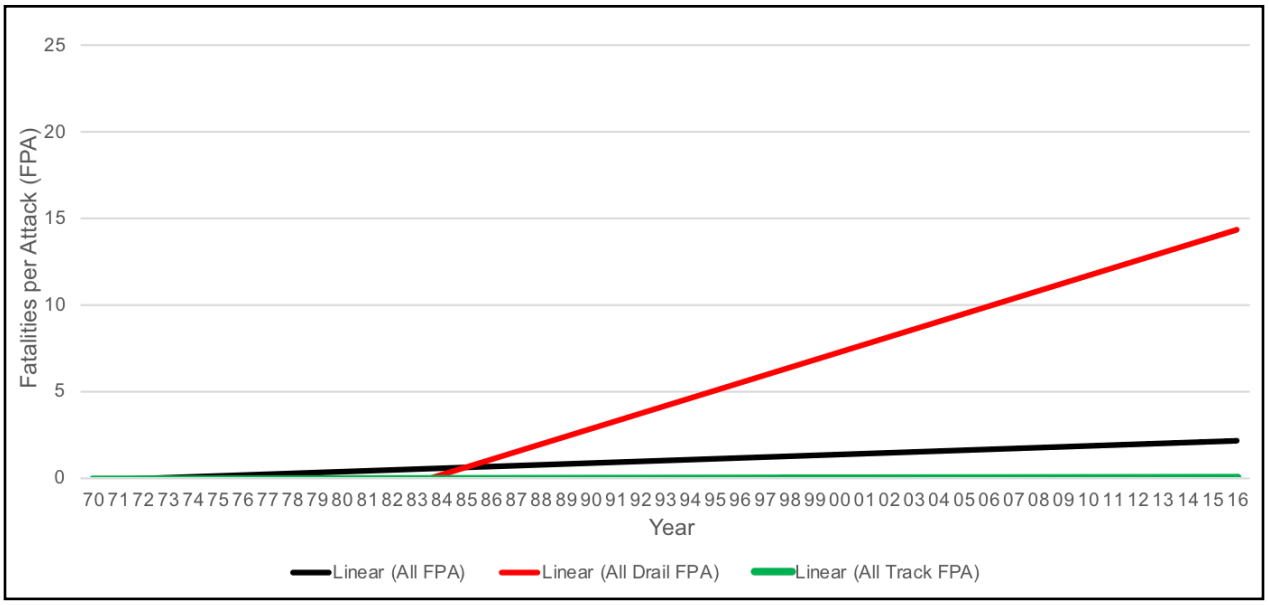

Figure 11. Jihadist Lethality Over Time – Scale Constant

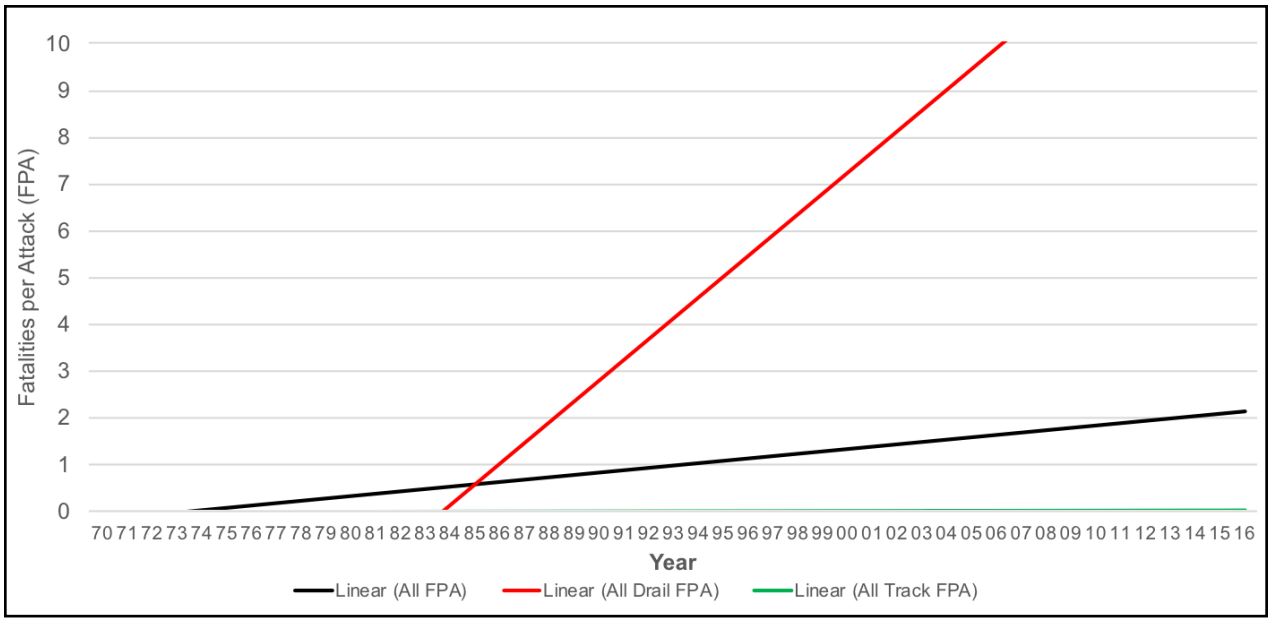

Figure 12. Jihadist Lethality Over Time – Scale Adjusted

Looking at the explosive devices used by the jihadists in their attacks offers some surprises. Jihadists used 11 devices in seven derailment attempts and also 11 devices in seven track attacks for a total of 22 devices in 14 attacks. (The other three derailment attacks involved mechanical means of sabotage.) All but one of the devices used in both derailment attempts and rail infrastructure attacks were placed on the tracks.

That is no surprise. What is surprising is the low success rate for the 11 devices used in the derailment attempts—5 out of 11, or 46% of these, were discovered before the attack (all by civilians) and rendered safe. For track attacks, 6 out of the 11 (56%) were discovered, this time by security officials. In track attacks the devices not found all detonated on target, and for derailments only 3 of the 6 did.

For all devices used in both derailment attempts and track attacks, only 9 (or 41 percent) detonated on target on time, as seen in Table 36 below. This is the poorest performance record of the four groups examined.

Table 36. Jihadist Devices by Outcome

Device Outcome	Devices	% of Total Devices	Fatalities	Average FPD[1]	Median FPD	Average FPDE[2]	Injuries	Average IPD[3]	Median IPD	Average IPDE[4]
EOD Successful, Rendered Safe	10	45.5%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Detonated or Released on Target	9	40.9%	41	4.6	0.0	5.0	116	12.9	0.0	12.9
Detonated Early or Away from Target, or Malfunctioned	1	4.5%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Failed to Detonate or Release	1	4.5%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Unknown	1	4.5%	0	0.0	0.0	0.0	0	0.0	0.0	0.0
All Device Outcomes	**22**	**100.0%**	**41**	**1.9**	**0.0**	**4.6**	**116**	**5.3**	**0.0**	**12.9**

Notes:

[1] FPD = Fatalities per device.

[2] FPDE = Fatalities per device exploded.

[3] IPD = Injuries per device.

[4] IPDE = Injuries per device exploded.

VI. CONCLUSION

These four campaigns provide an opportunity to more closely analyze a subset of track attacks and derailment attempts. The objectives and *modus operandi* of the four sets of adversaries differ. How they attack tracks and trains reflects their overall strategy.

The European groups have sought to attract public attention to their issues that motivate them and cause disruption. Their actions resulted in inconvenience, but no casualties.

Attacks on tracks and trains have been a minor component of the insurgency in Southern Thailand. The primary objectives of the insurgents in these attacks appear to have been to cause disruption and divert government security personnel to protecting rail lines. While the insurgents did not flinch at inflicting casualties on civilians, the attacks on railroads produced few casualties either because of the limited capabilities of the insurgents or because of self-imposed constraints.

India's Maoists are engaged in protracted guerrilla war. Their aims included creating spectacular attacks with high casualties, economic disruption, and the diversion of security resources to protecting the railways. The high percentage of explosive devices found suggests a robust security effort. Given the length of the campaign, one would look for evidence of growing technical proficiency, but this is hard to discern. However, Maoist attack have increased over time in volume and in lethality.

Jihadists are clearly the most lethal attackers, which is consistent with overall jihadist strategy and other forms of attack on transportation systems. Moreover, the volume and lethality of jihadist derailment attacks appear to be increasing. Derailments, however, are not the jihadists' deadliest mode of attack. Bombings in crowded subways, commuted trains, train stations and bus depots are easier to do and are more lucrative in terms of casualties, although they generally expose the attackers to higher risks.

Track attacks to create disruption are easy, serve a variety of adversary goals, and no doubt will continue as a mode of protest and economic warfare. Spectacular derailments, however, will remain a terrorist quest.

ABBREVIATIONS AND ACRONYMS

AQAP	Al Qaeda in the Arab Peninsula
Comm.	Communications
EOD	Explosive Ordinance Disposal
FPA	Fatalities per Attack
FPD	Fatalities per Device
FPDE	Fatalites per Device Exploded
IEDs	Improvised Explosive Devices
IIDs	Improvised Incendiary Devices
IPA	Injuries per Attack
IPD	Injuries per Device
IPDE	Injuries per Device Exploded
IRA	Irish Republican Army
ISIS	Islamic State of Iraq and (greater) Syria
Mech	Mechanical
MTI	Mineta Transportation Institute
NIS	Newly Independent States of the former Soviet Union
NO-TAV	No Trena di Alta Velocita (Italian group protesting high-speed rail lines)
Pax	Passengers
RPG	Rocket-Propelled Grenade
VBIED	Vehicle-Borne Improvised Explosive Device

ENDNOTES

1. Ibrahim Ibn Hassan Al-Asiri. "Targeting Means of Transportation."*Inspire*, Issue 17, Summer 2017.

2. Brian Michael Jenkins, Bruce R. Butterworth, and Jean-Francois Clair, *Off the Rails: The 1995 Attempted Derailing of the French TGV (High-Speed Train) and a Quantitative Analysis of 181 Rail Sabotage Attempts* (San Jose, CA: The Mineta Transportation Institute, 2010).

3. The authors realize that the term "Western Europe" lost its historical meaning with the fall of the Berlin Wall and the end of the Soviet Union. However, they use it here to apply geographically to the countries of the western part of Europe. These were the theaters of the terrorist campaigns of the last quarter of the 20th century and have continued to be the principal venue for terrorist attacks since the 1990s. There are comparatively few attacks in the eastern countries of Europe, with the exception of Russia.

4. A detailed discussion of the IRA's campaign against surface transportation in the United Kingdom can be found in Brian Michael Jenkins and Larry N. Gersten, *Protecting Public Surface Transportation Against Terrorism and Serious Crime: Continuing Research on Best Security Practices,* (San Jose, CA: Mineta Transportation Institute, 2001), https://transweb.sjsu.edu/research/protecting-surface-transportation-systems-and-patrons-terrorist-activities

5. For general accounts of the insurgency in Southern Thailand, see: Zachary Abuza, *A Conspiracy of Silence: The Insurgency of Southern Thailand,* (Washington DC: The United States Institute of Peace, 2009); Zachary Abuza and National Defense University, *The Ongoing Insurgency in Southern Thailand: Trends in Violence, Counterinsurgency Operations, and the Impact of National Politics,* (CreateSpace Independent Publishing Platform, 2012); Mohd Mizan Aslam, "The Southern Thailand Insurgency: Ideological and Identity Challenges," *Jati* 13 (2008): 79-93, https://www.researchgate.net/publication/265270788_THE_SOUTHERN_THAILAND_INSURGENCY_IDEOLOGICAL_AND_IDENTITY_CHALLENGES; and Peter Chalk, *The Malay-Muslim Insurgency in Southern Thailand* (Santa Monica, CA: The RAND Corporation, 2009).

6. For general accounts of India's Maoist Insurgency, see: E. N. Ram Mohan, Brigadier Amrit Pal Singh, and Gp. Capt. A.K. Agarwal, *Maoist Insurgency and India's Internal Security Architecture* (New Delhi: VIJ Books, 2012)*;* Bhashkar Sarkar VSM, *Tackling the Maoist Insurgency* (New Delhi: Atlantic Publishers, 2012); and T.N. Marwah, *Beyond Naxalbari Maoist Insurgency and Counterinsurgency in India* (Delhi: Gaurav Book Centre Pvt. Ltd, 2017).

7. Previous discussions of jihadist attacks on surface transportation can be found in: Brian Michael Jenkins and Joseph Trella, *Carnage Interrupted: An Analysis of Fifteen Terrorist Plots against Surface Transportation* (San Jose, CA: Mineta Transportation Institute, 2012), https://transweb.sjsu.edu/research/carnage-interrupted-analysis-

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8. Business Standard, "ISI behind Train Derailments, NIA Finds Merit in Bihar Police's Claim," (January 27, 2017), http://www.business-standard.com/article/current-affairs/isi-behind-train-derailments-nia-finds-merit-in-bihar-police-s-claim-117012700373_1.html (accessed June 28, 2018).

9. The Times of India, "Police Suspect Pakistan's Spy Agency ISI Hand in Two Rail Accidents in Uttar Pradesh," (January 18, 2017), https://timesofindia.indiatimes.com/india/police-suspect-pakistans-spy-agency-isi-hand-in-two-rail-accidents-in-uttar-pradesh-that-killed-151-passengers/articleshow/56634949.cms (accessed June 28, 2018).

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BRIAN MICHAEL JENKINS

Brian Michael Jenkins is the director of the Mineta Transportation Institute's National Transportation Center and since 1997 has directed the Institute's continuing research on protecting surface transportation against terrorism and other serious forms of crime.

He received a Bachelor of Arts degree in fine arts and a Masters degree in history, both from UCLA. He also studied at the University of Guanajuato, Mexico, and in the Department of Humanities at the University of San Carlos, Guatemala, where he was a Fulbright Fellow and received a second fellowship from the Organization of American States.

Commissioned in the infantry at the age of 19, Mr. Jenkins became a paratrooper and ultimately a captain in the Green Berets. He is a decorated combat veteran, having served in the Seventh Special Forces Group in the Dominican Republic during the American intervention and later as a member of the Fifth Special Forces Group in Vietnam (1966–1967). He returned to Vietnam on a special assignment in 1968 to serve as a member of the Long Range Planning Task Group; he remained with the Group until the end of 1969, receiving the Department of the Army's highest award for his service. Mr. Jenkins returned to Vietnam on an additional special assignment in 1971.

In 1983, Mr. Jenkins served as an advisor to the Long Commission, convened to examine the circumstances and response to the bombing of the U.S. Marine barracks in Lebanon. In 1984, he assisted the Inman Panel in examining the security of American diplomatic facilities abroad. In 1985–1986, he served as a member of the Committee of the Embassy of the Future, which established new guidelines for the construction of U.S. diplomatic posts. In 1989, Mr. Jenkins served as an advisor to the national commission established to review terrorist threats following the bombing of Pan Am 103. In 1993, he served as a member of the team contracted by the Port Authority of New York & New Jersey to review threats and develop new security measures for the World Trade Center following the bombing in February of that year. In 1996, President Clinton appointed Mr. Jenkins to the White House Commission on Aviation Safety and Security. From 1999 to 2000, he served as an advisor to the National Commission on Terrorism, and since 2000, he has been a member of the U.S. Comptroller General's Advisory Board.

Mr. Jenkins serves as a Senior Advisor to the President of the RAND Corporation. He is a Special Advisor to the International Chamber of Commerce (ICC) and a member of the advisory board of the ICC's investigative arm, the Commercial Crime Services. Over the years, he has served as a consultant to or carried out assignments for a number of government agencies, including the Department of Homeland Security. As part of its international project to create a global strategy to combat terrorism, the Club of Madrid in 2004 appointed Mr. Jenkins to lead an international working group on the role of intelligence. Mr. Jenkins is the author of numerous published research reports, books, and articles on terrorism and security.

BRUCE ROBERT BUTTERWORTH

Bruce Butterworth has had a distinguished government career, working at congressional, senior policy, and operational levels. Between 1975 and 1980, as a professional staff member for the House Government Operations Committee, he ran investigations and hearings on many transportation-safety issues, particularly in aviation. He spent 11 years in the Department of Transportation, eight of them in the Office of the Secretary. He managed negotiations on air and maritime services in the General Agreement on Tariffs and Trade (GATT) (now the World Trade Organization [WTO]), chaired U.S. delegations to United Nations committees, dealt with transport and aviation issues related to border inspections, and was part of the response to the bombing of Pan Am 103.

Mr. Butterworth held two executive posts in aviation security and in both worked closely with Congress as the informal but primary liaison. He was Director of Policy and Planning (1991–1995), establishing strategic, long-term, and contingency plans and federal rules. As Director of Operations (1995–2000), he was responsible for federal air marshals, hijacking response, and 900 field agents; he worked to improve security and the performance of security measures at U.S. airports and by U.S. airlines worldwide. He ran the FAA's aviation command center, successfully managing the resolution of hijackings and security emergencies. He launched a successful program of dangerous-goods regulation and cargo security after the 1995 ValuJet crash, oversaw the conversion of the air-marshal program to a full-time program with high standards, was a key player in the response to the ValuJet and TWA 800 accidents, and was a frequent media spokesperson. He worked closely with Congress, the National Security Council staff, the intelligence community, law enforcement agencies, and authorities of other nations.

From 2000 to 2003, he was an associate director at the U.S. Holocaust Memorial Museum, responsible for security and building operations. He designed and implemented a "best practice" procedure to deal with mail that could contain anthrax, and he developed and conducted new, comprehensive emergency planning procedures and exercises. Between January 2003 and September 2007, he was one of two deputy directors in a 1,300-person engineering directorate at NASA's Goddard Space Flight Center, managing workforce planning, budgeting, and human-capital management for complex robotics space missions, substantially reducing overhead and improving workplace safety there. He also worked with the Department of Homeland Security (DHS) on information sharing.

Mr. Butterworth is a research associate at the Mineta Transportation Institute. In this capacity, he has co-authored several reports with Brian Michael Jenkins, including one for the State of California on security risks created by highway-borne hazardous materials. In February 2009, he published with Mr. Jenkins an opinion piece on information sharing, and on March 23, 2010, he published an article in the Washington Post on intelligence and aviation security.

In 2011, his leading role in creating MTI's unique database of attacks on public surface transportation and in creating and delivering nearly all the briefings to the Transportation Safety Administration's (TSA's) front-line bomb-appraisal officers was recognized in a DHS High Impact award.

Mr. Butterworth received a Master of Science degree from the London School of Economics in 1974 and a Bachelor of Arts degree from the University of the Pacific in 1972 (magna cum laude). He was a California State Scholar and a Rotary Foundation Fellow. He has received numerous special achievement and performance awards.

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