WP59

Cost Benefit Comparisons for Security Measures against Terrorist Incidents

Methodology, Data, Main Results

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Introduction

General Definition:

Cost-Benefit Comparison is the comparison

Complete costs of a security measure (all kinds of costs during the lifetime)

Amount of avoided damage
  • either in the case of one incident or
  • for an expected number of incidents (in different dimensions during the lifetime)
There are several specific conditions in the context of PROTECTRAIL:

• Normally only a system of security measures with personnel support can protect against a given threat.
• One installation protects one asset of given type (e.g. one station hall), but a national level protection requires all assets to be protected.
• The national railway infrastructures are very different, especially their sizes.
• Information about terrorist incident probability is difficult.
Definition to apply for Railway Security Measures:

Cost-Benefit comparison is the country oriented comparison (related to a given threat)

Complete costs of a defined set of security measures against a given threat for a defined time period in a country wide installation. Amount of country wide avoided damage in the case of one incident or for an expected number of incidents in the same time period.
Goals to reach

• Four national railway infrastructures have been considered:
  – France, Germany, Italy, Poland

• Three different threat scenarios and associated sets of security measures have been investigated:
  – Attack within a station hall (person tracking), Intrusion into a train depot, CBRNe on-board attack.

• Two different types of cost-benefit comparisons (used in the scientific literature) have been applied:
  – Direct ratio of amount of benefits of one incident and costs, e.g. (number of saved lives) / (Million € costs) -> CEA
  – Expression of all benefits in € and then calculate a number of incidents for which the security measures are economically viable -> CBA
Goals to reach

Countries
- France
- Germany
- Italy
- Poland

Attack types
- Station Hall
- Depot Intrusion
- CBRNe On-board

Analysis types
- CEA: e.g. saved lives per M€ investment after one attack
- CBA: Minimum number of attacks which make investment economically viable

Additionally: calculation variants concerning average/worst case and more
How to achieve the goals

The following classes of **cost related** data had to be acquired:

**Data Class**
- Suitable set of threat scenarios and associated sets of security measures
- Complete costs for one installation per set
- Number of necessary installations, depending on the country specific infrastructure

**Data Source**
- PROTECTRAIL demonstrations, scenario descriptions including security measures
- Providers, PROTECTRAIL partners
- WP partners, Official RU documents, Internet

Keep in mind: The collected costs are not necessarily representative!
The following classes of **benefit related** data had to be acquired and structured:

<table>
<thead>
<tr>
<th>Data Class</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Amount of damage after a successful attack, numbers of deaths and injuries, economic losses</td>
<td>• Historical databases, analytic tool from TNO, reports from catastrophic events</td>
</tr>
<tr>
<td>• Effectivity of each set of technical security measures, relationship with human actions</td>
<td>• Plausible assumptions, accepted calculation methods</td>
</tr>
</tbody>
</table>
## Calculation methods

### A calculation example for the analysis type CEA (blue path)

<table>
<thead>
<tr>
<th>Country</th>
<th>Italy</th>
</tr>
</thead>
</table>
| Attack scenario | Station Hall  
               | Person Tracking |
| Complete Costs for country wide protection | 142 M€ |

**After a completely prevented attack:**

<table>
<thead>
<tr>
<th>Saved lives absolutely</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>per M€ security investment</td>
<td>0,18</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Avoided injuries absolutely</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>per M€ security investment</td>
<td>0,84</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Avoided economic loss absolutely</th>
<th>30 M€</th>
</tr>
</thead>
<tbody>
<tr>
<td>per M€ security investment</td>
<td>0,28 M€</td>
</tr>
</tbody>
</table>
Calculation methods (cont‘d)

Calculation method for the analysis type CBA

Prerequisite: All considered benefits (avoided damages) can be expressed in €. Then, according to a usually applied definition:

NetBenefit :=
AttackFrequency * AvoidedDamages * MeasureEffectivity – TotalCosts > 0

Problem: AttackFrequency can hardly be identified for terrorist attacks (HILP)

But transformation of the above formula yields:

NetBenefit > 0 ⇔ AttackFrequency > TotalCosts/(AvoidedDamages*MeasureEffectivity)

Threshold attack frequency for economic viability
## A calculation example for the analysis type CBA (brown path)

<table>
<thead>
<tr>
<th>Country</th>
<th>Poland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attack scenario</td>
<td>Depot Intrusion</td>
</tr>
<tr>
<td>Total Costs for country wide protection</td>
<td>26,5 M€</td>
</tr>
<tr>
<td>After a completely prevented attack:</td>
<td></td>
</tr>
<tr>
<td>Sum of avoided monetizable damages (calculated from data)</td>
<td>29,5 M€</td>
</tr>
<tr>
<td>Measure effectivity (calculated from plausible assumptions)</td>
<td>0,6</td>
</tr>
<tr>
<td>Threshold attack frequency for economic viability (in 10 years)</td>
<td>26,9 M€/(29,5 M€*0,6) = 1,49</td>
</tr>
</tbody>
</table>
Calculation methods (cont‘d)

Explanation concerning **Sum of avoided monetizable damages**
In the previous calculation:

Monetizable damages contain several categories:
- Material damages
- Liability costs
- Loss of revenue
- Lost lives
- Injuries

The last two categories are used by transforming a human life or an injury into a money value via a concept known as “Value of a statistical life”, VSL.

-> Sometimes criticized for ethical reasons
-> but used within the EU and within different EU country administrations.
CBA Calculations

Overview of all calculations with CBA:
Threshold attack frequencies for economic viability in 10 years

<table>
<thead>
<tr>
<th>Country Scenario</th>
<th>France</th>
<th>Germany</th>
<th>Italy</th>
<th>Poland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Station Hall</td>
<td>1.39</td>
<td>1.27</td>
<td>1.38</td>
<td>0.32</td>
</tr>
<tr>
<td>Depot Intrusion</td>
<td>1.91</td>
<td>1.84</td>
<td>2.14</td>
<td>1.49</td>
</tr>
<tr>
<td>On-board CBRNe</td>
<td>0.85</td>
<td>0.97</td>
<td>0.93</td>
<td>0.17</td>
</tr>
</tbody>
</table>
Intangible Costs and Benefits

All methods and calculations so far refer to tangible costs and benefits (= can be characterized by numerical values).

- An overview in chapter 6 of the report shows that comparable systematic approaches for intangible costs and benefits are very rare.

- One approach has been developed in an FP7 security project ValueSec.

- This approach consists of
  - Identifying a large number of social, political, ethical, legal and other assessment criteria
  - Structuring them in a 2 or 3-level hierarchy (groups)
  - Assigning scaling values (-10 to +10) to each criterion
  - Assigning relative weights to each criterion and to each group

- Problem of the approach: How to find the right experts to assign realistic values to the criteria.

- Approach was not applied to the PROTECTRAIL security measures.
Conclusions

The report provides:

- Based on accepted general econometric methods
  - A transparent methodology for structuring and calculation of security costs in a country wide infrastructure
  - A transparent methodology for structuring and calculation of benefits in different dimensions
  - Application of these methodologies for two types of cost-benefit comparisons related to the issues of Protectrail and with data collected here.

- For professional users the option to apply the methodology
  - To other countries and/or other security measures in the railway area
  - To other country wide infrastructures (after appropriate adjustments)

- Hints how intangible costs and benefits could be dealt with (without detailed calculations)