Defining Operational Equipment State Level 2 using PRISM

(Probabilistic Recombination Integrated Survivability Model)

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ASC
ANALYSIS SUPPORT CONSTRUCT

Aim

UK Army HQ required evidence-based analytical rigour to underpin the development of protection measure requirements for Combat Service Support (CSS) vehicles, to improve equipment standardisation for vehicles deployed on contingent operations (those activities of an intensity greater than routine peacekeeping, but less than full-scale warfighting). Atkins, working through the Analysis Support Construct framework, designed and developed an analysis tool, PRISM (Probabilistic Recombination Integrated Survivability Model), and used it to produce a set of evidenced recommendations.

Scope

Recommendations on appropriate protection measures for contingent operations were required for the following vehicle types:

- Support vehicles from the MAN HX and MAN SX ranges
- Oshkosh Combat Support Tankers (CSTs)
- Light/ Heavy Equipment Transporter (LET/ HET)

Methodology

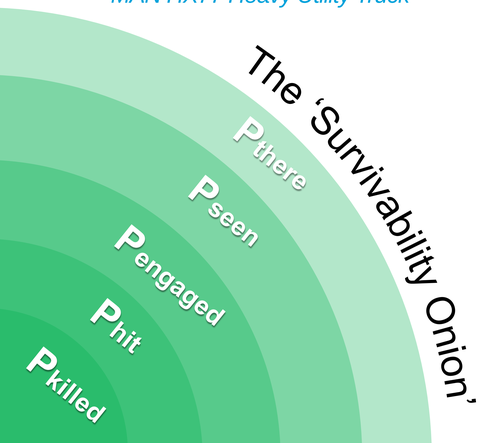
A **baseline survivability rate** was established for each vehicle, for representative scenarios and vignettes. Protection measure effectiveness could then be assessed by quantifying the **effect of these on the survivability rate for each vehicle type**.

MAN HX77 Heavy Utility Truck

Oshkosh Wheeled Tanker

Bar armour

Smokescreen



Variables

What could affect the vehicle survivability?

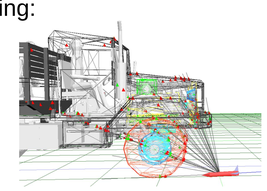
- Scenario and Vignette?
- Engagement range?
- Threat type?
- Cabin type and armour?

Which layers of the Survivability Onion would these affect?

Inputs

From a variety of sources, including:

- TARVIEW weapon modelling software
- NATO protection standards (STANAG 4569)
- Military Judgement Panels



Threat Category	1) Small arms		2) HMGs and cannon		3) AT weapons		
Threat	Assault Rifle (5.45mm)	Assault Rifle (7.62mm)	Medium Machine Gun (12.7mm)	Heavy Machine Gun (14.5mm)	MPUG (Single HEAT warhead)	MPUG (Tandem HEAT warhead)	ATGW (Tandem HEAT warhead)
Scenario 1	XX%	XX%	XX%	XX%	XX%	XX%	XX%
Scenario 2	XX%	XX%	XX%	XX%	XX%	XX%	XX%
Scenario 3	XX%	XX%	XX%	XX%	XX%	XX%	XX%
Scenario 4	XX%	XX%	XX%	XX%	XX%	XX%	XX%

Threat picture development (dummy values)

Outputs

PRISM combines information on a number of influencing factors to establish the level of threat posed to CSS vehicle crews on contingent operations and to suggest the most effective protection measures.

Option A (countermeasure pack 1)	Scenario 1			
Vehicle type	Vignette 1	Vignette 2	Vignette 3	Vignette 4
Vehicle Type 1 (no additional armour)	95.0%	91.0%	75.0%	87.0%
Vehicle Type 1 (basic additional armour)	96.0%	95.0%	77.0%	92.0%
Vehicle Type 1 (advanced additional armour)	96.0%	98.0%	81.0%	99.0%
Vehicle Type 2 (no additional armour)	88.0%	85.0%	72.0%	86.0%
Vehicle Type 2 (. . .)	90.0%	96.0%	75.0%	97.0%

Survivability probability output table (dummy values)

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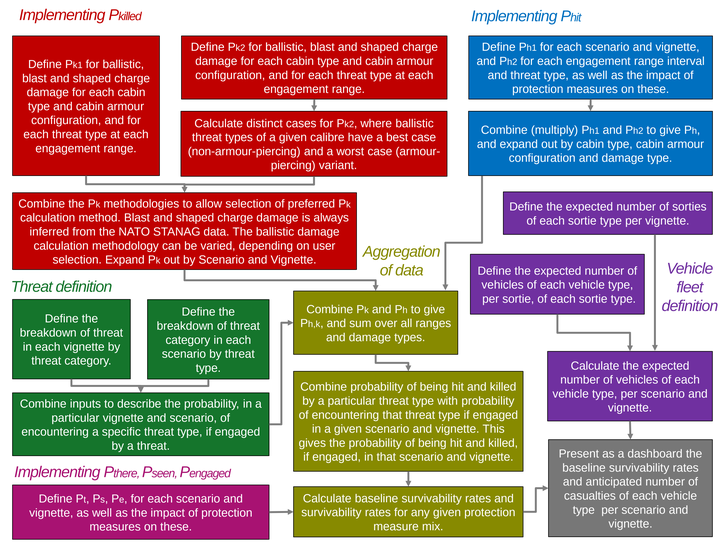
The model logic



Dashboard display of outputs

Terminology

Term	Definition	Description
P_{k1}	Probability of being killed, if hit by a specific threat type (calculation method 1)	Defined for ballistic, blast and shaped charge damage, using NATO protection level standards to describe both protection and threat levels (STANAG 4569, Edition 2).
P_{k2}	Probability of being killed, if hit by a specific threat type (calculation method 2)	Defined for ballistic damage, using inputs from TARVIEW to describe both protection and threat levels .
P_k	Probability of being killed, if hit by a specific threat type	P_k uses P_{k1} for all P_k calculations, apart from those involving direct-fire ballistic weapons, where the user is able to select between P_{k1} and P_{k2}.
P_{h1}	Probability of being hit by a specific threat type, if engaged (calculation element 1)	If a generic vehicle type is engaged, the probability of it being at any given range, for each scenario and vignette. (P_{h1} values sum to 100% for each scenario / vignette, over all ranges.)
P_{h2}	Probability of being hit by a specific threat type, if engaged (calculation element 2)	If engaged at a specific range, by a specific threat type, the probability of a generic vehicle type being hit.
P_h	Probability of being hit by a specific threat type, if engaged	The probability of a generic vehicle type being hit at any given range by any given threat type in any given scenario and vignette. P_h is calculated by multiplying P_{h1} by P_{h2}.
$P_{h,k}$	Probability of being hit and killed by a specific threat type, if engaged	The probability of a specific vehicle type being hit and killed at any given range by a specific threat type in any given scenario and vignette. $P_{h,k}$ is calculated by multiplying P_k by P_h in each instance.
Threat definition	Probability of encountering a specific threat type, if engaged	The probability of a generic vehicle sortie, if engaged by a threat in a particular vignette and scenario, encountering a specific threat type.
P_e	Probability of being engaged, if seen by a generic threat	The probability of a generic vehicle sortie being engaged by a generic threat during a specific vignette in a specific scenario, if seen by it.
P_s	Probability of being seen, if 'there' by a generic threat	The probability of a generic vehicle sortie being seen by a generic threat during a specific vignette in a specific scenario, if in the vicinity of it.
P_t	Probability of being 'there', by a generic threat	The probability of a generic vehicle sortie being in the vicinity of a generic threat during a specific vignette in a specific scenario.
$P_{t,s,e,h,k}$	Probability of being 'there', seen, engaged, hit and killed	The vehicle type-specific probability of being 'there', seen, engaged, hit and killed by any threat type during a specific vignette in a specific scenario.

Vehicle picture source: http://www.military-today.com

Bar armour picture source: https://aw.my.com/en/forum/showthread.php?90108-Norinco-VT-5/page2

Smoke screen picture source: https://en.wikipedia.org/wiki/Smoke_screen#/media/File:Smoke_screen.jpg

RPG and launcher picture source: https://en.wikipedia.org/wiki/Rocket-propelled_grenade#/media/File:RPG-7_detached.jpg