pronex

ENGINEERING SIMPLIFIED

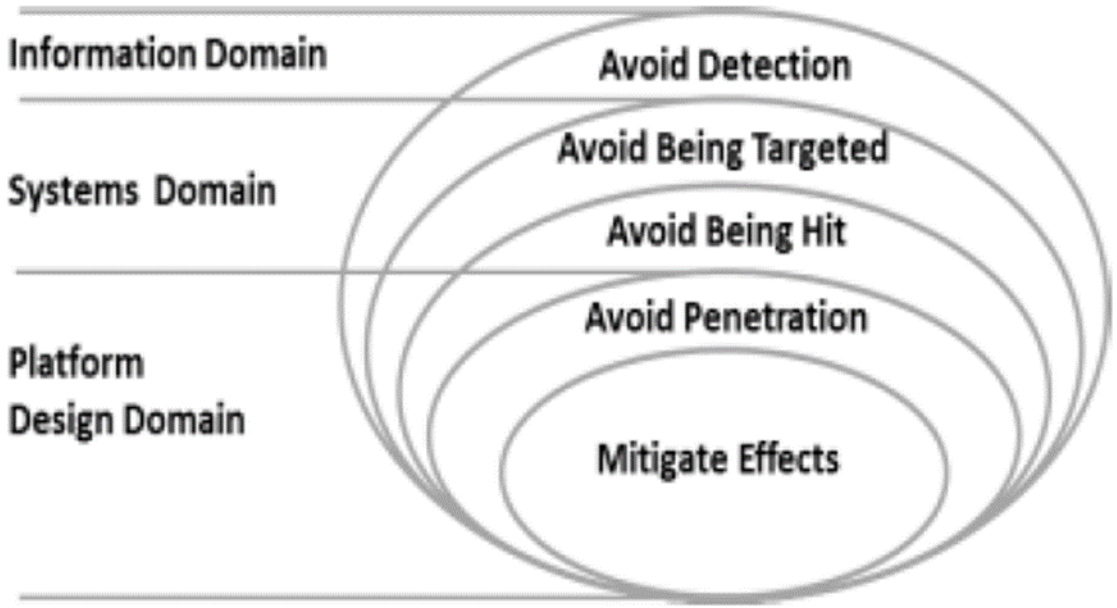
Survivability Modelling Capability

ONION LAYER

The “onion layer” model is widely accepted for exploring armoured land vehicle survivability.

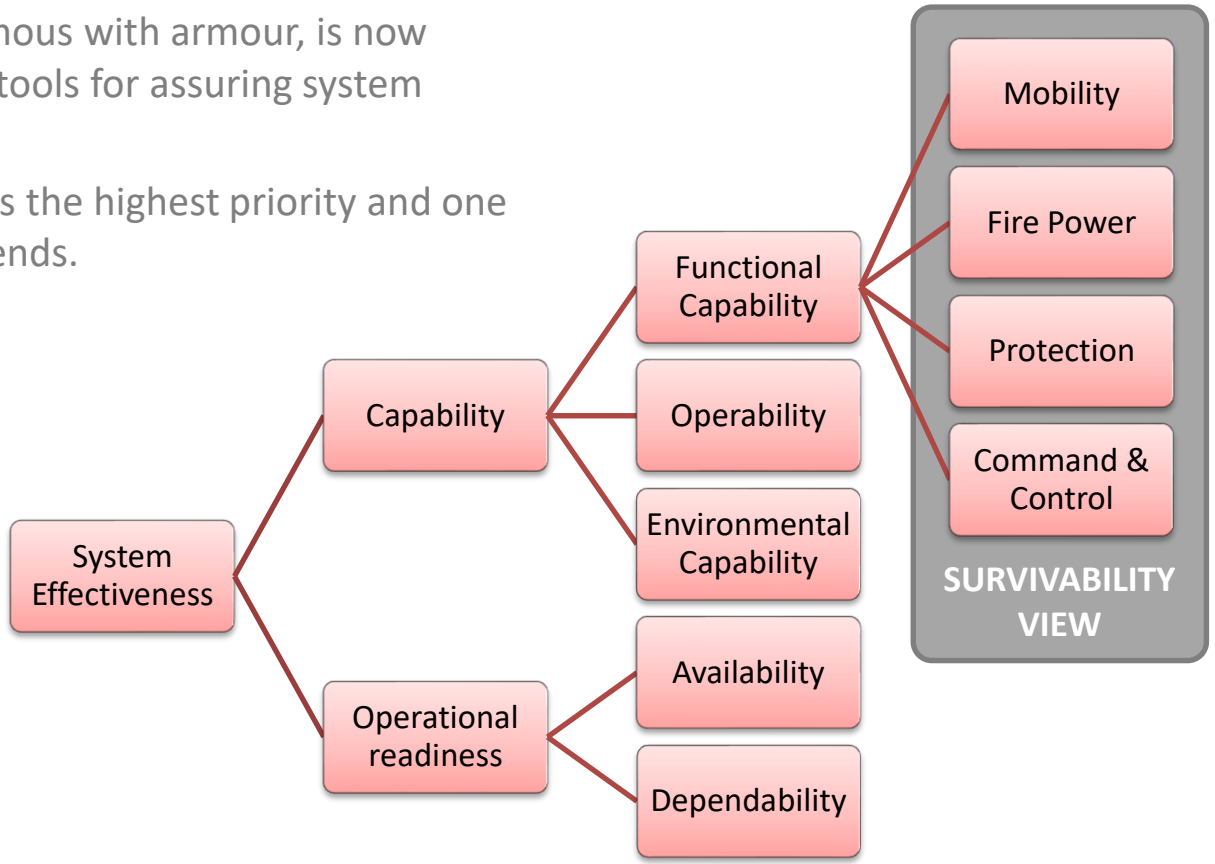
If a land vehicle is required to be in an area of threat then, in this model, survivability will next depend on the ability of the system to:

- Avoid detection;
- If detected, avoid being targeted;
- If targeted, avoid being hit;
- If hit, avoid being penetrated;
- If penetrated, mitigate the effects.



HOLISTIC APPROACH TO SURVIVABILITY

- A holistic approach is being followed to address the capabilities and challenges of the modern armoured vehicle.
- Protection, once synonymous with armour, is now simply one aspect of the tools for assuring system survivability.
- Crew survivability remains the highest priority and one of the most significant trends.



WHY SURVIVABILITY MODELLING?

DESIGN SUPPORT

- What if analysis
- Value for money analysis

OPERATIONAL VALUE FOR APPLIED TECHNOLOGIES

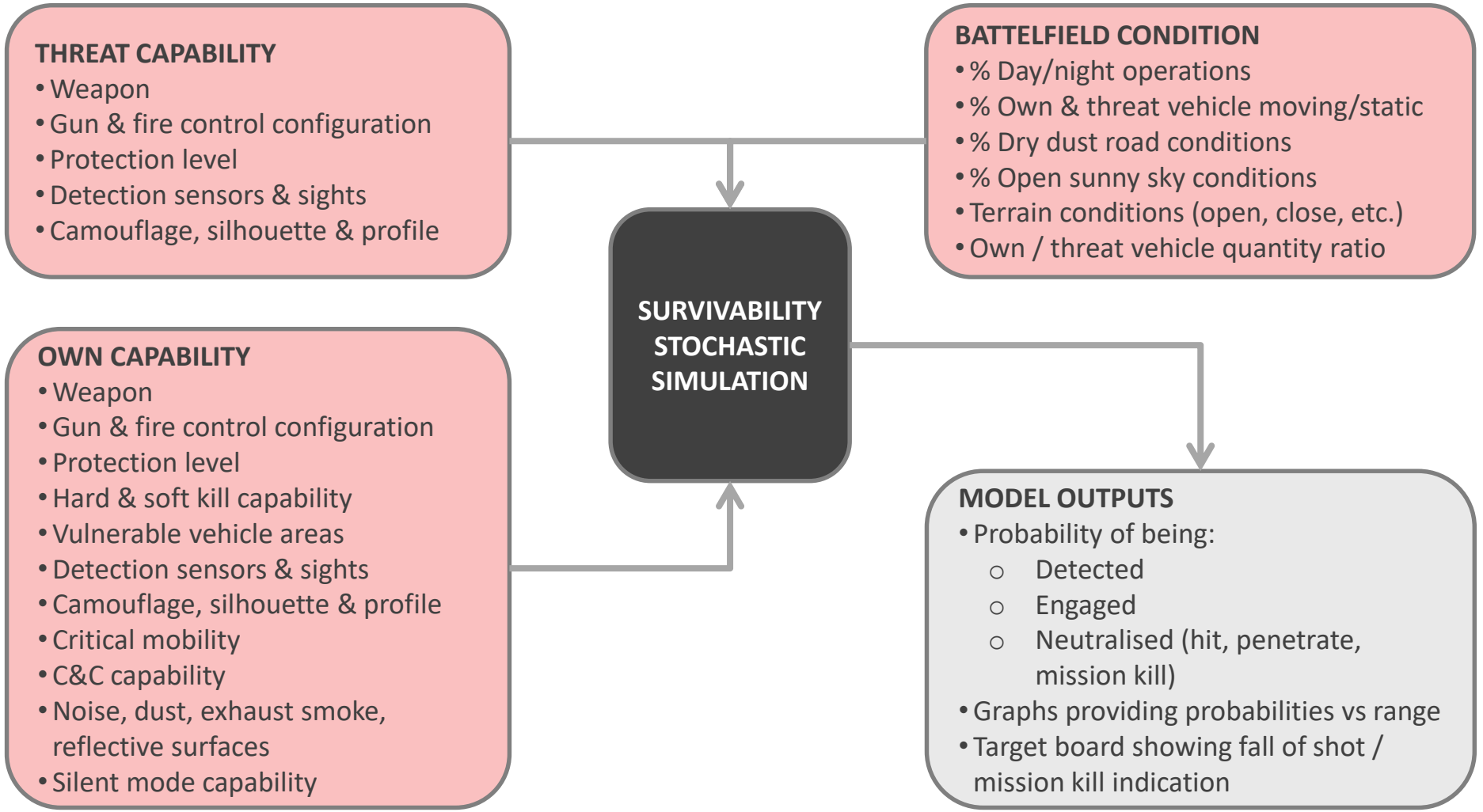
- Concept decision support – determining the added operational value for applied technologies

OPERATIONAL ASSESSMENT AGAINST IDENTIFIED THREATS

- Analysis of own vehicle survivability against specified threat vehicle for a specified operational scenario.

SURVIVABILITY MODEL OVERVIEW

HIGH LEVEL CONCEPT MODEL



HIGH LEVEL MATHEMATICAL MODEL

The probability of survivability is calculated as follows:

$P_{SURVIVE} = 1 - [P_D \times P_E \times P_H \times P_P \times P_K]$

$= 1 - [P_D \times P_E \times P_N]$

P_D = Probability to be detected ("seen")

P_E = Probability to be engaged

P_H = Probability to be hit

P_P = Probability to be penetrated

P_K = Probability to be killed

$P_N = P_{Neutralise}$

The model applies **stochastic simulation** principles

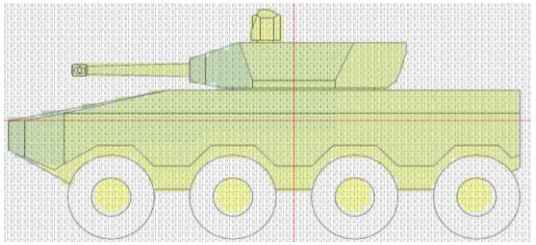
SURVIVABILITY MODEL OVERVIEW

INPUTS TO MODEL

Threat level

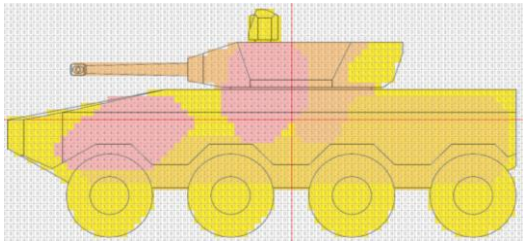
STANAG 4569 **KE** Threats associated with protection levels 1 to 6

Protection levels



STANAG 4569 Protection Levels 1 to 6

Vulnerability areas



Damage, mobility kill, fire power kill or human kill

BATTELFIELD CONDITIONS	
Day time operations	50%
Night time operations	50%
Own vehicle moving	50%
Own vehicle static	50%
Threat vehicle moving	50%
Threat vehicle static	50%
Dry dust road conditons	10%
Open skies (sun) conditons	70%
Terrain conditons (visual)	Semi-open
Terrain conditons (noise)	Semi-open

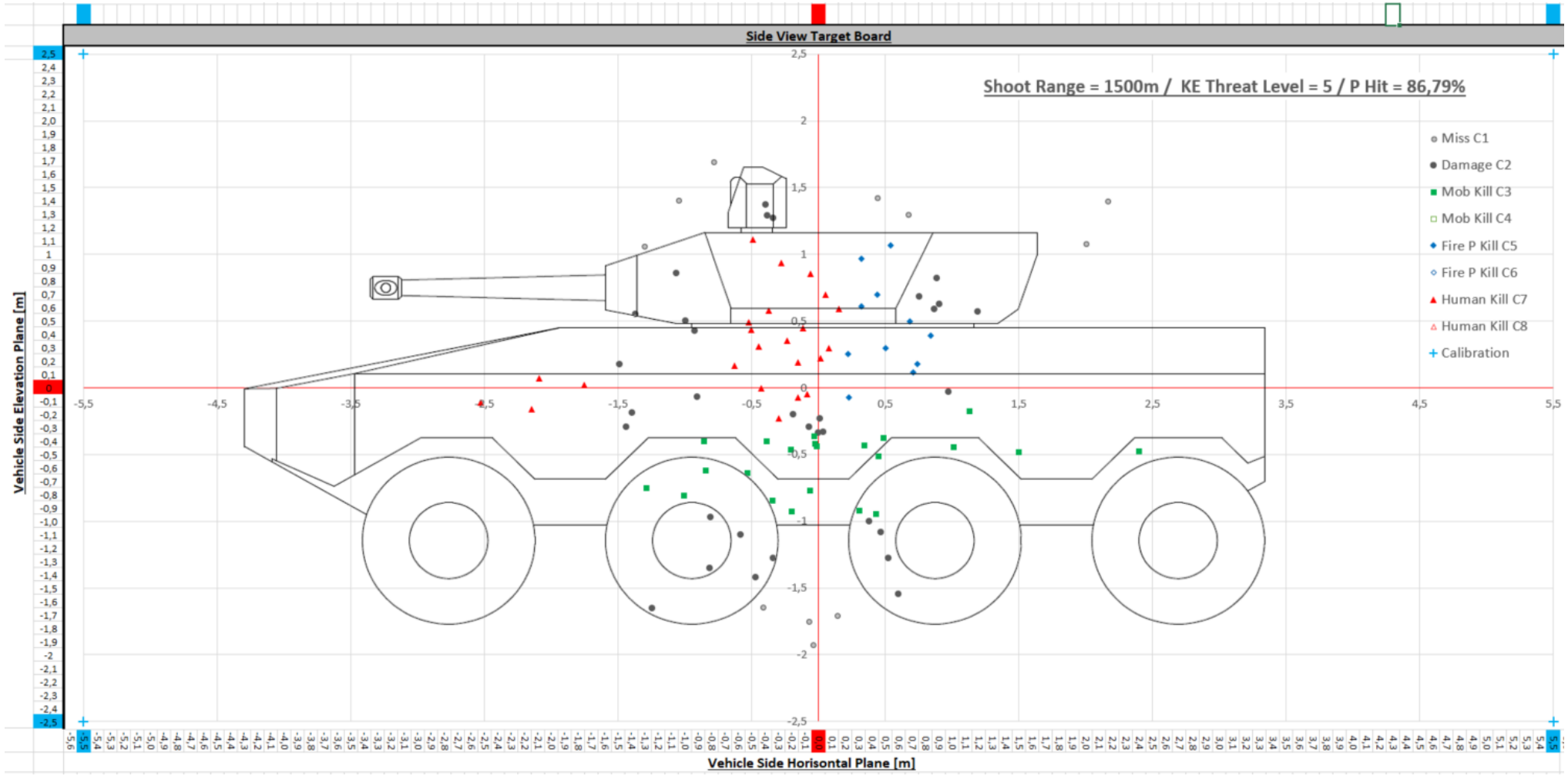
DETECTION SENSORS	Detection	Stabilisation
Threat day sight DRI capability	Medium	No
Own day sight DRI capability	Medium	No
Threat TI sight DRI capability	Medium	No
Own TI sight DRI capability	Medium	No
Threat radar capability	None	n.a.
Own radar capability	None	n.a.

ENGAGEMENT GENERAL CONSIDERATIONS	
Threat force number of vehicles	1
Own force number of vehicles	1
Threat gun & fire control configuration	Conf 2
Own gun & fire control configuration	Conf 2
Own weapon level	5
Threat vehicle protection level	4
Own vehicle critical mobility	Medium
Own soft kill capability	Manual
Own APFSDS hard kill capability	No
Hard kill minimum range (m)	n.a.
Threat vehicle average width [m]	2,4

CAMOUFLAGE & PROFILE	
Threat visual camouflage capability	Medium
Own visual camouflage capability	Medium
Threat IR camouflage capability	Medium
Own IR camouflage capability	Medium
Threat vehicle silhouette line	Smooth
Own vehicle silhouette line	Smooth
Threat vehicle effective height [m]	2,40
Own vehicle effective height [m]	2,40

OWN VEHICLE GENERAL CONSIDERATIONS	
Own vehicle idling noise (vehicle static)	Low
Own vehicle silent mode % (vehicle static)	40%
Own vehicle noise (moving)	Low
Own vehicle average width [m]	2,4
Own vehicle reflective area [m^2]	0,045
Own BMS capability	Basic
Own exhaust smoke:	Non-issue
Own dust skirts:	No

EXAMPLES OF MODELLING RESULTS



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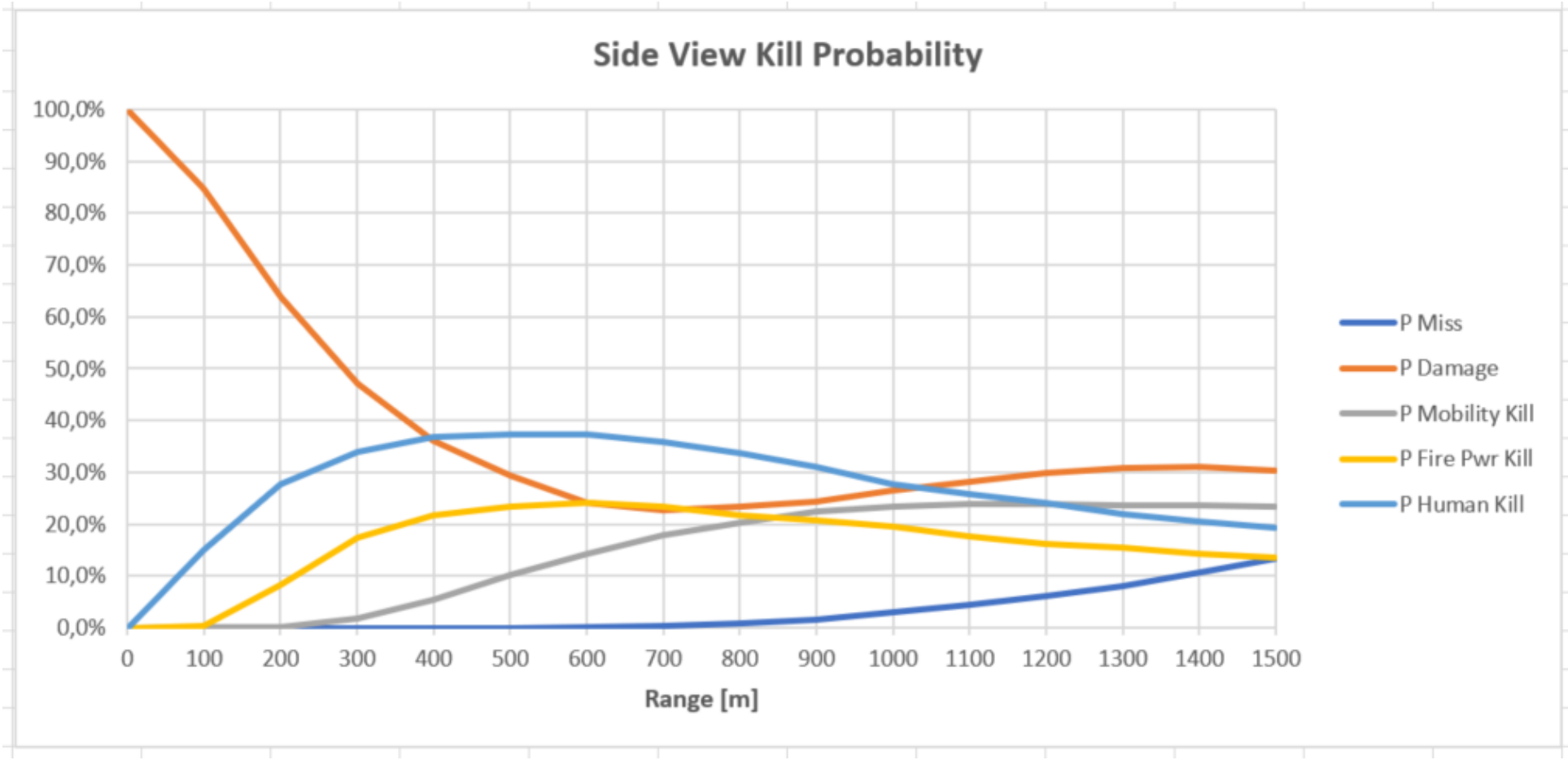
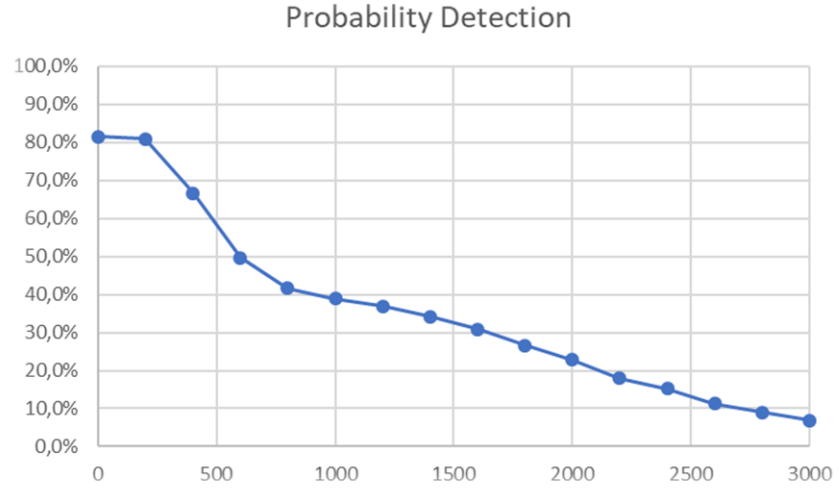
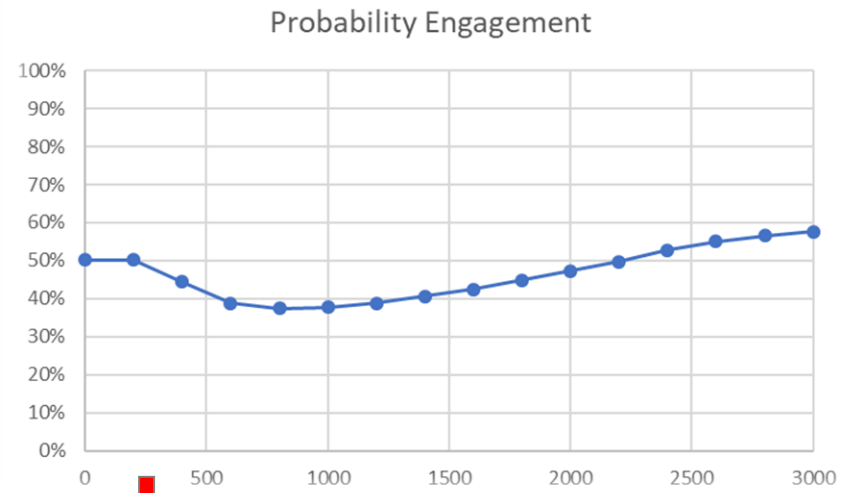
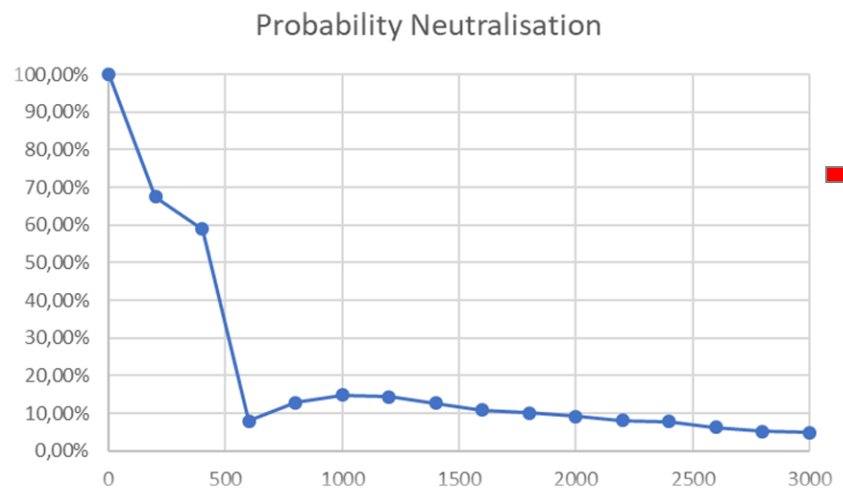


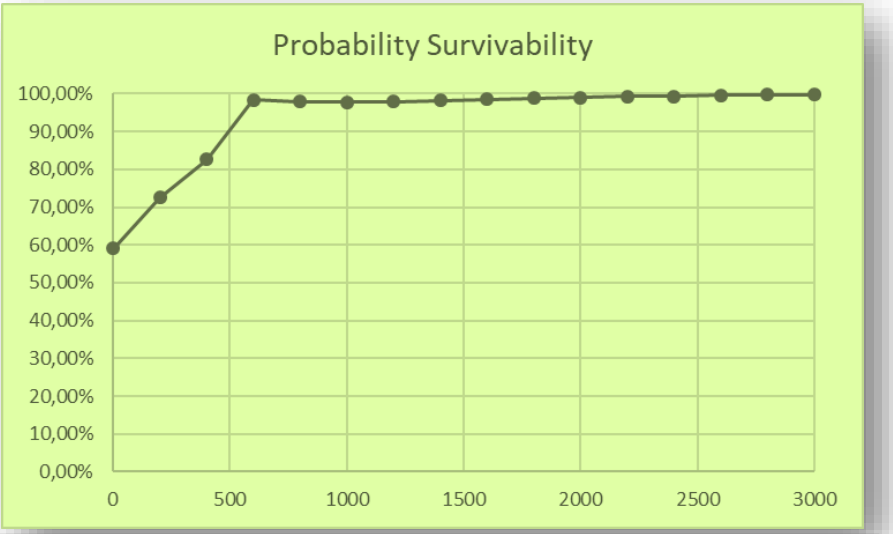
SURVIVABILITY MODEL OVERVIEW

EXAMPLES OF MODELLING RESULTS









DEFINITIONS AND ABBREVIATIONS

Mobility kill

Loss of tactical mobility resulting from damage that cannot be repaired by the crew on the battlefield. A vehicle has sustained mobility kill when it is incapable of executing controlled movement on the battlefield. Mobility kill will occur when damage is inflicted upon any of the components that contribute the propulsion and control of the vehicle.

Firepower kill

Loss of tactical firepower resulting from damage that cannot be repaired by the crew on the battlefield. A vehicle has sustained firepower kill when it is incapable of directing controlled fire from its main armament. This will occur when any components in the armament or turret systems are damaged and disabled.

Personnel kill

Human kill is defined as **killing or injuring any one of the crew** to such an extent that he/she will not be able to carry on with his/her tasks.

Stochastic simulation

A stochastic simulation is a simulation that traces the evolution of variables that can change stochastically (randomly) with certain probabilities. With a stochastic model a projection is created which is based on a set of random values. Outputs are recorded and the projection is repeated with a new set of random values of the variables. These steps are repeated until a sufficient amount of data is gathered. In the end, the distribution of the outputs shows the most probable estimates as well as a frame of expectations regarding what ranges of values the variables are more or less likely to fall in.