

Roxel UK

Project Proposal

Designing a small-missile point-defence for land and sea assets

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[Date]

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1. Introduction

The purpose of this project will be to design an inexpensive short-range missile-based point defence system against incoming missiles, drones, or small craft/vehicles. The idea being that a small rocket with a fragmentation warhead should be able to quickly intercept the threats and the fragmentation either disabling or outright destroying it.

The idea is a small sized, simple missile system where batteries of twenty or so missiles could be set up around an asset facing outwards so they can quickly be fired without having to adjust too much to intercept.

Part of the aim is to make the product less expensive than using large missiles systems e.g., Sea-ceptor [1]/Sky-Sabre [2] which are also used to defend Sea and Land based assets. Both systems are anti-air missiles with medium range (~25km) however are quite large and while they can take down drones and the likes, they are a little expensive to be using on a small drone. These two missiles are like ASRAAM which was used to shoot down a drone in 2021 [3], had there been a cheaper alternative a £200,000 missile would not have been needed.

Prevention of loss of assets e.g., ships and Forward Operating Bases (F.O.B.) is a high priority in any military situation, especially given the number of lives that would be protected.

2. Background

Current technology: Point defence systems [4] are according to Aldridge; a system for defending something like a missile silo. Valuable assets which will be the target of attacks by hostile forces.

Threats: The use of missiles has become more prevalent due to the range, speed, accuracy, and destructive power they have. There are also drones which can be used for spying or delivering payloads [5]. Finally, there are small craft and vehicles which might approach the asset (e.g., a small boarding craft or a tactical vehicle) which would have people who would try to take over the asset.

RIM-116 Rolling Airframe Missile (RAM) [6]; A short to medium range missile system for engaging Anti-Ship cruise missiles. The article written by Elko et al. covers the development, testing and evaluation conducted for this missile system, some of these might include what needs to be done for the respective stages of this project. This is like the platform this project intends to design albeit more expensive and the intended range of this project is closer to the asset. There will also be a difference in the targeting system.

CIWS – Close in Weapons system [7]; a ship mounted gun platform which engages threats which get too close to the ship, usually with high rate of fire to destroy the target. These use a barrage of high calibre bullets to destroy targets.

3. Aims and Objectives

The overarching aim of this project is to design and test a new point defence system which will use small rockets with fragmentation warheads which will be able to destroy incoming missiles, drones, small craft/vehicles.

- Compare current Point defence systems for pros and cons
- Decide specifications for a new point defence systems using small High Explosive fragmentation missiles
- Designing the basic structure of the missile (propellant, main charge, guidance system)

4. Experimental Design

4.1 Outline of Experimental Procedure

The experimental procedure will consist of:

- i. Designing the missile,
- ii. Running tests on the 3D models of the missile
- iii. Designing a test regime for the missile,
- iv. Testing individual aspects of the missile (i.e., Guidance/targeting system, Warhead, Propulsion) against the test regime,
- v. Altering any issues found during the first test phase, and repeating step iv until satisfactory
- vi. Testing the missile as a whole.

4.2 Data Collection

There will be two parts to the data collection: Theoretical and practical

Theoretical data will be generated by the use of 3D modelling e.g, Abacus [8].

Practical data collection will need to be done by the trials team conducting the tests. This will need to include things such as:

- i. Performance against expectations
- ii. Yield/thrust/burn rates
- iii. Electrical testing

4.3 Data Evaluation

Data evaluation will need to be carried out on all the data acquired. Appropriate software (e.g., MatLab [9]) will be used to analyse it.

4.4 Risks & Limitations

Risks typically associated with explosives:

- Death
- Injury
- Damage

A risk assessment will need to be kept as part of this project; it will need to be updated at regular intervals to incorporate the design of the motor once it has been decided. It will also need to be used during the design process to prevent unnecessary risks during manufacture, testing, deployment, and disposal.

Other risks will include such things as lack of resources available. This can include people needed for part of the project not being able to work on it. It can also include weather as performing tests of the system will require specific conditions and a thunderstorm would prevent work being conducted.

4.5 Ethical Issues

Security is of utmost importance so strict ethics are needed. If someone working on the project could be bribed, then secrets could be outed, and countermeasures could be developed.

An ethics form has been completed for this.

5. Resources and Planning

- a. Physical resources and costs: Currently costs are unknown as the design of the product has not been decided, however things which will need to be considered are:
 - Cost of materials – all aspects of the missile will need to be evaluated individually to make sure they work, and it will all need to be evaluated before the motor is qualified.
 - Any specific tooling – There is a potential that specialist tooling will be needed to make certain parts.
 - Cost of test apparatus and location – testing explosives requires high precision equipment to assess and record the data from any tests. They also require a suitable place to detonate them with enough space and precautions to mitigate any risks.
 - Software – the price of any software needed to complete the project.
- b. Human resources: Other than the author of this project there will be a need for other people to help:
 - Safety – HSE must be followed and as this project is being completed as part of a works-based project the SHE team will need to be involved.
 - Purchasing – to get materials and tooling etc. the purchasing department will be involved.
 - Trials team – When testing the product an appropriately trained range officer and any other team members will be needed, again to mitigate risks.
 - Training – there might be need for training to use software or equipment.
- c. Other resources: Ethics Form/Gantt Chart [10] (Appendixes)

6. References

- [1] MBDA, "Sea Ceptor." <https://www.mbda-systems.com/product/sea-ceptor/> (accessed May 22, 2022).
- [2] MBDA, "CAMM (Land Applications)." <https://www.mbda-systems.com/product/camm/> (accessed May 22, 2022).
- [3] "RAF Typhoon blows away hostile drone," *Key Military*, Jan. 19, 2022. <https://www.keymilitary.com/article/raf-typhoon-blows-away-hostile-drone> (accessed May 22, 2022).
- [4] R. C. Aldridge, *First Strike!: The Pentagon's Strategy for Nuclear War*. Boston, MA: South End Press, 1999.
- [5] D. Robitzski, "Marines Are Testing Tiny Drones That Carry Explosive Grenades," Jul. 14, 2021. <https://futurism.com/the-byte/marines-testing-drones-grenades> (accessed May 22, 2022).
- [6] E. C. Elko, J. W. Howard, R. C. Kochanski, T.-P. T. Nguyen, and W. M. Sanders, "Rolling Airframe Missile: Development, Test, Evaluation, and Integration," *Johns Hopkins APL Technical Digest*, vol. 22, no. 4, p. 573, 2001.
- [7] D. Alexander, "Close in Weapons System," *Military Technology*, vol. 36, no. 4, pp. 17–20, 2012, Accessed: Jan. 03, 2022. [Online]. Available: <https://web-s-ebscohost-com.ezproxy.uwtsd.ac.upds>
- [8] "Abaqus FEA, 2021HF8 (6.21-9), [Software]." Dassault Systèmes, Vélizy-Villacoublay, France, 2021.
- [9] "MATLAB 9.9.0.1570001 (R2020b) Update 4, [Software]." The MathWorks, Inc, Natick, Massachusetts, USA, 2021.
- [10] Vertex42.com, "Simple Gantt Chart." https://www.vertex42.com/ExcelTemplates/simple-gantt-chart.html?utm_source=ms&utm_medium=file&utm_campaign=office&utm_content=text (accessed May 21, 2022).

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APPLICATION FOR ETHICAL APPROVAL

In order for research to result in benefit and minimise risk of harm, it must be conducted ethically.

The University follows the OECD Frascati manual definition of **research activity**: “creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications”. As such this covers activities undertaken by members of staff, postgraduate research students, and both taught postgraduate and undergraduate students working on dissertations/projects.

The individual undertaking the research activity is known as the “principal researcher”.

This form must be completed and approved prior to undertaking any research activity.

SECTION A: About You (Principal Researcher)

1	Full Name:	Peter Kenrick
2	Student Number:	1910613
3	Email address:	1910613@student.uwtsd.ac.uk
4	Programme of Study:	OME
5	Director of Studies/Supervisor:	Kapilan Radhakrishnan

SECTION B: Internal and External Ethical Guidance Materials

	Please list the core ethical guidance documents that have been referred to during the completion of this form (including any discipline-specific codes of research ethics, location-specific codes of research ethics, and also any specific ethical guidance relating to the proposed methodology). Please tick to confirm that your research proposal adheres to these codes and guidelines. You may add rows to this table if needed.		
1	UWTSD Research Ethics & Integrity Code of Practice		☒
2	UWTSD Research Data Management Policy		☐
3			☐

SECTION C: Details of Research Activity

1	Indicative title:	Designing a small-missile point-defence for land and sea assets		
2	Proposed start date:	23/05/2022	Proposed end date:	13/09/2024
	Introduction to the Research (maximum 300 words in each section) Ensure that you write for a <u>Non-Specialist Audience</u> when outlining your response to the three points below: • Purpose of Research Activity • Proposed Research Question • Aims of Research Activity • Objectives of Research Activity			

ETHICS FORM – OME STUDENTS ONLY

	Demonstrate, briefly, how Existing Research has informed the proposed activity and explain - What the research activity will add to the body of knowledge - How it addresses an area of importance.
3	Purpose of Research Activity Designing a weapons platform for defending land and sea assets (this box should expand as you type)
4	Research Question Can a cheaper weapon system be designed to protect assets (this box should expand as you type)
5	Aims of Research Activity A fully functional missiles system to intercept threats to the assets (this box should expand as you type)
6	Objectives of Research Activity Comparing current systems and designing something as a cheaper alternative. (this box should expand as you type)
	Proposed data collection methods (maximum 600 words) Provide a brief summary of all the methods that may be used in the research activity to collect data, making it clear what specific techniques may be used. If methods other than those listed in this section are deemed appropriate later, additional ethical approval for those methods will be needed. You do not need to justify the methods here, but should instead describe how you intend to collect the data necessary for you to complete your project.
7	This should describe how you intend to collect data. It should not include a discussion of the theoretical basis for your data collection methods. Please note, that if you intend to collect any audio/video recordings of interviews with participants then these will be are classified as Personal Data under GDPR/DPA2018. If you intend to use these then note this in section H. Data for this will be collected by performing experiments on prototypes using test equipment and video recording. (this box should expand as you type)

SECTION D: Scope of Research Activity

	Will the research activity include:	YES	NO
1	Use of a questionnaire or similar research instrument?	☐	☒
2	Use of interviews?	☐	☒
3	Use of focus groups?	☐	☒
4	Use of participant diaries?	☐	☒
5	Use of video or audio recording?	☒	☐
6	Use of computer-generated log files?	☒	☐
7	Participant observation with their knowledge?	☐	☒
8	Participant observation without their knowledge?	☐	☒
9	Access to personal or confidential information without the participants' specific consent?	☐	☒

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10	Administration of any questions, test stimuli, presentation that may be experienced as physically, mentally or emotionally harmful / offensive?	☐	☒
11	Performance of any acts which may cause embarrassment or affect self-esteem?	☐	☒
12	Investigation of participants involved in illegal activities?	☐	☒
13	Use of procedures that involve deception?	☐	☒
14	Administration of any substance, agent or placebo?	☐	☒
15	Working with live vertebrate animals?	☐	☒
16	Procedures that may have a negative impact on the environment?	☒	☐
17	Other primary data collection methods. Please indicate the type of data collection method(s) below.		
	Details of any other primary data collection method: Experimentation and test firing. (this box should expand as you type)	☒	☐

If you have ticked NO to every question then the research activity is (ethically) low risk and you may skip section E and continue to section F.

If YES to any question, then no research activity should be undertaken until full ethical approval has been obtained.

SECTION E: Intended Participants

	Who are the intended participants:	YES	NO
1	Students or staff at the University?	☐	☒
2	Adults (over the age of 18 and competent to give consent)?	☐	☒
3	Vulnerable adults?	☐	☒
4	Children and Young People under the age of 18? (Consent from Parent, Carer or Guardian will be required)	☐	☒
5	Prisoners?	☐	☒
6	Young offenders?	☐	☒
7	Those who could be considered to have a particularly dependent relationship with the investigator or a gatekeeper?	☐	☒
8	People engaged in illegal activities?	☐	☒
9	Others. Please indicate the participants below, and specifically any group who may be unable to give consent.		
	Details of any other participant groups: Complete this only if your participants cannot give consent. This includes animals (this box should expand as you type)	☐	☒

	Participant numbers and source Provide an estimate of the expected number of participants. How will you identify participants and how will they be recruited?	
10	How many participants are expected?	Ballpark figures are fine, but make sure that you explain how you will identify and contact your participants. N/A (this box should expand as you type)

ETHICS FORM – OME STUDENTS ONLY

11	Who will the participants be?	N/A <i>(this box should expand as you type)</i>
12	How will you identify the participants?	N/A <i>(this box should expand as you type)</i>

	Information for participants:	YES	NO	N/A
13	Will you describe the main research procedures to participants in advance, so that they are informed about what to expect?	☐	☐	☒
14	Will you tell participants that their participation is voluntary?	☐	☐	☒
15	Will you obtain written consent for participation?	☐	☐	☒
16	Will you explain to participants that refusal to participate in the research will not affect their treatment or education (if relevant)?	☐	☐	☒
17	If the research is observational, will you ask participants for their consent to being observed?	☐	☐	☒
18	Will you tell participants that they may withdraw from the research at any time and for any reason?	☐	☐	☒
19	With questionnaires, will you give participants the option of omitting questions they do not want to answer?	☐	☐	☒
20	Will you tell participants that their data will be treated with full confidentiality and that, if published, it will not be identifiable as theirs?	☐	☐	☒
21	Will you debrief participants at the end of their participation, in a way appropriate to the type of research undertaken?	☐	☐	☒
22	If NO to any of above questions, please give an explanation			
	You should be able to tick YES for all of these questions. If not, then explain why not in this box. No participants <i>(this box should expand as you type)</i>			

	Information for participants:	YES	NO	N/A
24	Will participants be paid?	☐	☐	☒
25	Is specialist electrical or other equipment to be used with participants?	☐	☐	☒
26	Are there any financial or other interests to the investigator or University arising from this study?	☐	☐	☒
27	Will the research activity involve deliberately misleading participants in any way, or the partial or full concealment of the specific study aims?	☐	☐	☒
28	If YES to any question, please provide full details			
	You should be able to tick NO for most of these questions. For any cases that you have ticked YES then provide details in this box. If you are using cameras/voice recorders to record interviews then please state that in this box. No participants <i>(this box should expand as you type)</i>			

SECTION F: Anticipated Risks

	Outline any anticipated risks that may adversely affect any of the participants, the researchers and/or the University, and the steps that will be taken to address them.
1	Risks to participants

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	For example: sector-specific health & safety, emotional distress, financial disclosure, physical harm, transfer of personal data, sensitive organisational information. If you have identified in section D that there are no participants then enter N/A and go skip to question 3.	
	Risk to participants: There are always risks. Do not write N/A unless you have no participants. N/A <i>(this box should expand as you type)</i>	How you will mitigate the risk to participants: <i>(this box should expand as you type)</i>
2	If research activity may include sensitive, embarrassing or upsetting topics (e.g. sexual activity, drug use) or issues likely to disclose information requiring further action (e.g. criminal activity), give details of the procedures to deal with these issues, including any support/advice (e.g. helpline numbers) to be offered to participants. Note that where applicable, consent procedures should make it clear that if something potentially or actually illegal is discovered in the course of a project, it may need to be disclosed to the proper authorities	
	N/A <i>(this box should expand as you type)</i>	
3	Risks to the investigator For example: personal health & safety, physical harm, emotional distress, risk of accusation of harm/impropriety, conflict of interest	
	Risk to the investigator: There are always risks. Do not write NA. Risk of injury, death Risk of damaging property <i>(this box should expand as you type)</i>	How you will mitigate the risk to the investigator: Appropriate safety measures i.e. PPE Following correct procedures for conducting tests. <i>(this box should expand as you type)</i>
4	University/institutional risks For example: adverse publicity, financial loss, data protection	
	Risk to the University: There are always risks. Do not write NA. Public adversity – working on weapons <i>(this box should expand as you type)</i>	How you will mitigate the risk to the University: Preventing breaches and leaks of data <i>(this box should expand as you type)</i>
5	Environmental risks For example: accidental spillage of pollutants, damage to local ecosystems	
	Risk to the environment: Harmful chemicals being released during testing <i>(this box should expand as you type)</i>	How you will mitigate the risk to environment: Minimising the amount of testing done and following HSE guidelines <i>(this box should expand as you type)</i>

SECTION G: Feedback, Consent and Confidentiality

If you have identified in section D that there are no participants then enter skip this section and continue to section H.

1	Feedback What de-briefing and feedback will be provided to participants, how will this be done and when? You don't need to email your participants with your final report. A good alternative is to set up an email address that they will be able to contact for further details or results. <i>(this box should expand as you type)</i>
2	Informed consent Describe the arrangements to inform potential participants, before providing consent, of what is involved in participating. Describe the arrangements for participants to provide full consent before data collection begins. If gaining consent in this way is inappropriate, explain how consent will be obtained and recorded in accordance with prevailing data protection legislation.

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	If you are using a paper questionnaire then you should have the participants sign an appropriate consent form. These forms will count as personal data and should be noted as such in section J. If you are using an online questionnaire, then you should have a screen before the questions start that acts as a consent form, informing participants that by clicking on the NEXT button they are providing consent. <i>(this box should expand as you type)</i>
3	Confidentiality / Anonymity Set out how anonymity of participants and confidentiality will be ensured in any outputs. If anonymity is not being offered, explain why this is the case.
	Do not collect names unless you really need them. Do not name participants or organisations in any research publications (including the thesis) without their explicit permission. <i>(this box should expand as you type)</i>

SECTION H: Data Protection and Storage

	Does the research activity involve personal data (as defined by the General Data Protection Regulation 2016 “GDPR” and the Data Protection Act 2018 “DPA”)?	YES	NO
1	“Personal data” means any information relating to an identified or identifiable natural person (‘data subject’). An identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person. Any video or audio recordings of participants is considered to be personal data.	☐	☒
	If YES, provide a description of the data and explain why this data needs to be collected:		
2	This includes audio/video data of participants, but can also include IP addresses and usernames. Names, addresses and emails also count, as do consent forms. <i>(this box should expand as you type)</i>		
	Does it involve special category data (as defined by the GDPR)?	YES	NO
3	“Special category data” means sensitive personal data consisting of information as to the data subjects’ – (a) racial or ethnic origin, (b) political opinions, (c) religious beliefs or other beliefs of a similar nature, (d) membership of a trade union (within the meaning of the Trade Union and Labour Relations (Consolidation) Act 1992), (e) physical or mental health or condition, (f) sexual life, (g) genetics, (h) biometric data (as used for ID purposes),	☐	☐
	If YES, provide a description of the special category data and explain why this data needs to be collected:		
4	What counts as ‘sensitive’ will differ between cultures. Any information on behaviour that is not in accordance with cultural norms would count as sensitive personal data. <i>(this box should expand as you type)</i>		

	Will data from the research activity (collected data, drafts of the thesis, or materials for publication) be stored in any of the following ways?	YES	NO
5	Manual files (i.e. in paper form)?	☒	☐

ETHICS FORM – OME STUDENTS ONLY

6	University computers?	☒	☐
7	Private company computers?	☒	☐
8	Home or other personal computers?	☐	☒
9	Laptop computers/ CDs/ Portable disk-drives/ memory sticks?	☒	☐
10	“Cloud” storage or websites?	☒	☐
11	Other – specify:	☐	☒
12	For all stored data, explain the measures in place to ensure the security of the data collected, data confidentiality, including details of backup procedures, password protection, encryption, anonymisation and pseudonymisation:		
	If possible, save your data on computers that are secure and regularly backed up. Many cloud services only provide GDPR-compliant storage for business customers. An example of suitable text is given below. <i>All data will be kept in password protected cloud storage on the University Office 365 system which will not be shared. Audio/visual data will be transcribed and would be shown to participants to check accuracy of reporting. Any USB sticks used to store or transfer data will be password protected. All participants will be given a unique identifier to ensure confidentiality and this list will be kept securely in the password protected folder.</i> (this box should expand as you type)		

Data Protection			
	Will the research activity involve any of the following activities:	YES	NO
13	Electronic transfer of data in any form?	☒	☐
14	Sharing of data with others at the University outside of the immediate research team?	☐	☒
15	Sharing of data with other organisations?	☐	☒
16	Export of data outside the UK or importing of data from outside the UK?	☐	☒
17	Use of personal addresses, postcodes, faxes, emails or telephone numbers?	☐	☒
18	Publication of data that might allow identification of individuals?	☐	☒
19	If YES to any question, please provide full details, explaining how this will be conducted in accordance with the GDPR and Data Protection Act (2018) (and/or any international equivalent):		
	This includes data such as drafts of your thesis as well as experimental or survey data. An example of suitable text is given below. <i>All data will be encrypted and kept in password protected cloud storage on the University Office 365 system which will not be shared. Any USB sticks used to store or transfer data will be password protected. All data transfers will be encrypted and password protected. All participants will be given a unique identifier to ensure confidentiality and this list will be kept securely in the password protected folder. The data will be stored until the completion of the project and then deleted. In accordance with the DPA2018, participants will have the right to ask to see what data is held relating to them, and this data will be deleted immediately if the participant requests this, in which case the data will not be used in the project.</i> (this box should expand as you type)		
20	List all who will have access to the data generated by the research activity:		
	Normally the principal researcher, possibly also the supervisor and, if the project has an industrial partner, a representative of that partner. Possibly also external examiner or second marker?		

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	My Employer - Roxel <i>(this box should expand as you type)</i>	
21	List who will have control of, and act as custodian(s) for, data generated by the research activity:	
	Usually the principal researcher. My Employer - Roxel <i>(this box should expand as you type)</i>	
22	Give details of data storage arrangements, including security measures in place to protect the data, where data will be stored, how long for, and in what form.	
	<i>All data will be encrypted and kept in password protected cloud storage on the University Office 365 system which will not be shared. Any USB sticks used to store or transfer data will be password protected, and will be reformatted at the end of the project in order to destroy the data. The data will be stored until the completion of the project and then deleted.</i> <i>(this box should expand as you type)</i>	
22	Confirm that you have read the UWTSD guidance on data management (see https://www.uwtss.ac.uk/library/research-data-management/)	☒
23	Confirm that you are aware that you need to keep all data until after your research has completed or the end of your funding	☒

SECTION I: Declaration

	The information which I have provided is correct and complete to the best of my knowledge. I have attempted to identify any risks and issues related to the research activity and acknowledge my obligations and the rights of the participants. In submitting this application I hereby confirm that I undertake to ensure that the above named research activity will meet the University's Research Ethics and Integrity Code of Practice which is published on the website: https://www.uwtss.ac.uk/research/research-ethics/		
1	Signature of applicant:	Peter Kenrick	Date: 22/05/2022
2	Director of Studies/Supervisor:		Date:
3	Signature:		

FOR INTERNAL USE ONLY:

	Ethical approval given		
1	Signature of assessor:		Date:
2	Name:		
3	Role:		