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Cost-Benefit Analysis as a Possible Decision-Support Tool in Defence Conditions

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Abstract

This paper explores the potential applications of cost-benefit analysis in the evaluation of investments in military technology. The study assesses the limitations of cost-benefit analysis (CBA) in the defence sector and discusses ways to adapt its methodology so that it better reflects the specific characteristics of defence planning, the uncertainty of the security environment, and the operational realities of the armed forces. Using selected simplified model examples, the paper demonstrates that CBA cannot serve as a mechanical tool for optimal decision-making; however, it can significantly contribute to structuring the decision-making problem, transparently comparing alternatives, and supporting allocation-rational decision-making, including the monetization of intangible outputs in the context of defence.

KEY WORDS: *army, cost-benefit analysis; department of defence, defence spending, expected loss avoided, investment, monetization, value of statistical injury, value of statistical life, willingness to pay.*

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1. Introduction

In the context of defence sector allocation decisions, three levels of assessment must be considered: political, military, and economic. Although political representatives ultimately decide on the size and structure of defense spending [1], these decisions should be based on defence and military-technical requirements as well as a realistic assessment of available resources. The key question, therefore, is what value the state, the Ministry of Defence, and the armed forces obtain for the funds spent through the acquisition of new weapon systems and military equipment. A methodological challenge arises from the fact that the benefits of these investments are often intangible, stochastic, and probabilistic in nature. This manifests itself primarily in increased combat effectiveness of units, reduced own casualties, minimized damage to protected infrastructure, or enhanced deterrent effect.

Decisions regarding the introduction of new military technologies into the armed forces' inventory are made under conditions of high uncertainty, limited budgetary resources, and growing pressure for transparency and efficiency in public spending [2]. In this context, cost-benefit analysis (CBA) appears to be an attractive tool that allows for a structured comparison of alternative investment options and provides rational support for decision-making processes within the defence sector. Investments in new military technologies thus become not only a matter of modernization, but above all a tool for maintaining deterrence and the capacity for effective defence in conditions of uncertainty [3]. However, the economic justification for these investments is increasingly confronted with the methodological limitations of traditional evaluation tools [11].

While the costs associated with the development, acquisition, and operation of military equipment are generally relatively easy to identify and quantify, the key challenge lies in defining and valuing their benefits. In the defence sector, these benefits are often neither tangible nor market-based, and their value is manifested more in terms of risk reduction, increased soldier survival rates, reduced equipment losses, or improved operational effectiveness of units. A further distinctive feature of the assessment of military technologies is that a significant proportion of their benefits are realised only in crisis or combat situations, the occurrence, intensity and nature of which are difficult to predict in advance. This asymmetry between relatively precisely quantifiable costs and difficult-to-measure, often probabilistic benefits presents a fundamental methodological challenge for the application of standard cost-benefit analysis in the context of the military and the Department of Defence [4]. In the context of an increasing likelihood of crisis situations or armed conflicts, a tension arises between the requirement for economic rationality in decision-making and the necessity of making investment decisions whose true value will only become apparent under extreme and difficult-to-predict conditions.

2. The method of investigation

Utilising a historical-logical approach, the authors conducted a comprehensive analysis of the evolution of cost-benefit analysis in general. A comprehensive literature review and an analysis of the findings of foreign studies were conducted to obtain specific information on its application in the context of defence and the armed forces.

The research then focused on selecting an appropriate classification tool for identifying the costs and benefits associated with the introduction of new military technologies. The typology presented in the works of Musgrave and Musgrave was chosen as the classification framework [5]. The research also involved identifying the most appropriate methods for valuing the costs and benefits associated with the introduction of new military equipment and weapon systems that cannot be directly monetized. In this context, five of the most suitable monetization methods were identified. Subsequently, three of them were used to assess the intangible benefits of introducing new military technology and weapon systems. To verify the applicability of CBA in defence and military contexts, two simplified model case studies were conducted using a standard algorithm for performing CBA (project cash flow, PV, NPV, PB).

The input data used in the analysis combines actual and modelled values. The factual portion is based on publicly available information, such as data on damage caused by attacks on military bases in Iraq and Afghanistan [6], information on the M1E3 Abrams system [7], data on similar foreign acquisitions [8], and accepted parameters for monetary valuation, particularly VSL and VSI. Other values, primarily the probabilities of combat scenarios, expected losses of equipment and personnel, operational savings, and strategic security benefits, are model assumptions. They serve to demonstrate the CBA process and to create a consistent probabilistic model, not to provide an accurate forecast of the actual economic and security impacts of acquiring the system in question.

3. Cost-benefit analýza a možnosti jejího využití v podmínkách obrany

Cost-benefit analysis (CBA) is a standard economic tool used to evaluate the effectiveness of public policies and investment decisions. The fundamental principles of the approach are concerned with financial quantification and valuation of all costs and benefits relevant to the issue, and their subsequent comparison in terms of social welfare. However, within the domain of defence and military applications, the implementation of “pure" CBA confronts a series of methodological and normative challenges. Defence, in this sense, generates a particular type of output – namely, security, deterrence, sovereignty, or political stability – which is characterised as a public good. The benefits of this type of output are challenging to measure and even more challenging to monetise.

3.1. The present state of knowledge regarding the application of cost-benefit analysis in the defence sector

It is widely acknowledged that Bénard's *“Public Economics”* (Volume III) is regarded as a seminal work, which laid the foundations for the modern cost-benefit analysis. It defines its theoretical foundations and presents practical examples of its application. [9] Musgrave builds upon this work, defining a different method of classifying the costs and benefits provided by public projects. [5] The ability to identify and classify all significant costs and benefits associated with a public investment project is a prerequisite for a relevant economic analysis, particularly in the context of the defence sector.
The primary reference for the study of CBA in defence is the *publication “Military Cost–Benefit Analysis: Theory and Practice”* by Melese, Richter, Solomon. [4] In this work, the authors systematically define military CBA as a specific application of standard welfare economics that must account for extreme uncertainty, strategic interaction with an adversary, and non-monetary benefits. A key contribution of this literature is the observation that the problem with military CBA does not lie in the absence of economic rationality, but in the nature of the “output” produced—security—which is latent, context-dependent, and often realized only in the form of averted losses.

The origins of this approach can be traced back to the work of the RAND Corporation during the Cold War, particularly as outlined in Hitch and McKean's book *“The Economics of Defence in the Nuclear Age”* [10]. The objective of these authors was to systematically rationalise defence spending through economic analysis. They emphasised the need to compare defence costs with alternative uses of resources in the civilian economy. Despite the fact that their work does not yet employ the modern welfare CBA framework, it explicitly poses a question that remains relevant today: how to economically evaluate investments whose benefit is manifested primarily by the fact that "nothing happens".

Huxtable et al. (2021) present an extensive analysis that explores ways to assess the contribution of the defence sector to the prosperity of the United Kingdom. The focal point of the study is an evaluation of multiple monetisation channels (valuation tools) for the primary benefits provided by national defence. The extant literature focusing on the application of CBA in a defence context primarily focuses on several main monetisation approaches.

3.1.1. The Value of a Statistical Life and Reducing the Risk of Its Loss

One of the most robust monetization approaches is to quantify the reduction in the risk of loss of life and health using the concept of the Value of a Statistical Life (VSL) [13]. In the civilian sector, VSL is routinely used in the evaluation of safety and environmental measures; in the defence sector, its application is more sensitive, though methodologically feasible. The work by Kniesner et al. "*The Military VSL*" represents an explicit attempt to adapt VSL to a military context. The authors demonstrate that, in decisions concerning force protection, training safety, protective technologies, or medical support, the reduction in the probability of death or injury to members of the armed forces can be monetized in a manner consistent with welfare economics. This literature is key to the argument that **at least some of the defence benefits are fully compatible with CBA** when it comes to personnel protection and risk management. Expressing the utility of B_{VSL} using this method is then possible as follows:

$$B_{VSL}=\Delta q \text{ x } VSL \tag{1}$$

where:

- Δq … a reduction in the expected number of statistical deaths per year
- VSL … value of a statistical life

3.1.2. The Value of Injuries and Health Consequences – Monetizing Avoided Injuries

The second approach involves monetizing the benefits of defence in terms of the expected injuries and health consequences that are prevented. This is known as the Value of Statistical Injury (VSI) [13,14]. Methodologically, this approach is based on the same logic as VSL, but instead of deaths, it values minor and severe injuries, permanent health consequences, disability, or long-term reductions in quality of life. VSI is usually expressed as a fraction of VSL or a combination of treatment costs, lost productivity, reduced quality of life, and willingness to pay for a reduction in injury risk. The utility B_{VSI} can then be expressed as follows using this method:

$$B_{VSI} = \Delta q \cdot VSI \tag{2}$$

where:

- Δq … a reduction in the expected number of injuries of various types
- VSI … statistical injury value

3.1.3. Valuing Security and Defence as a Public Good – WTP Approaches

A third significant approach is the valuation of defense through willingness-to-pay (WTP) for increased security. This approach is based on public goods theory and employs stated preference methods (contingent valuation, discrete choice experiments) [12]. Empirical studies, particularly the work of Salmai Qari (2024), show that citizens are able to express the monetary value of specific defence policies (e.g., strengthening air defence or increasing defence spending) [15,16,19] These results allow defence investments to be interpreted as a source of social utility measurable in monetary terms, and thus potentially suitable for CBA. At the same time, however, this literature highlights a fundamental limitation: WTP is strongly dependent on threat perception, political context, and question formulation. Consequently, it is primarily suitable for **marginal policy changes** (e.g., modernization projects), not for evaluating *"existential"* decisions regarding the state's very ability to defend itself. The utility B_{WTP} can then be expressed in the following manner using this method:

$$B_{WTP}=WTP \text{ x } N \tag{3}$$

where:

- WTP … average willingness to pay per person per year
- N … target population

3.1.4. Expected Avoided Losses – Monetization of Avoided Losses

The fourth approach, which is frequently used in practice, is the monetization of defence benefits as expected losses avoided (Expected Loss Avoided) [17,4]. Here, the **benefit is defined as the difference between the expected value of losses in the absence of a given capability and the expected value of losses in its presence**. This approach is particularly relevant for capabilities such as infrastructure protection, air defence, cyber defence, or base protection. The literature shows that if the probability of an attack and the economic impact of its success (destruction of assets, production outages, restoration costs) can be realistically estimated, it is possible to conduct a relatively standard CBA. The advantage of this approach is that it avoids the direct monetization of abstract concepts such as "deterrence" and instead works with concrete economic damages. The utility B_{ELA} can then be expressed as follows using this method:

$$B_{ELA} = (p_0 \text{ x } L_0) - (p_1 \text{ x } L_1) \tag{4}$$

kde:

- p_0, p_1 … probability of an adverse event with/without the project
- L_0, L_1… monetary loss resulting from an incident

3.1.5. *"Insurance"* interpretation of the defense

This approach, whilst perhaps less well-known, is nonetheless a fully legitimate method of valuing intangible benefits in the context of defence [17,12]. In the context of the so-called "insurance" interpretation of defence, the value of defence capabilities is derived from their ability to reduce the probability or magnitude of catastrophic losses. Defence expenditures, incorporating investments in military modernisation, are thus conceptualised as a form of insurance against future security risks. The benefit B_{VSI} can then be expressed as follows using this method:

$$B_{INS} = \pi \times L - C_{risk} \tag{5}$$

where:

- π … reducing the likelihood of a disaster
- L… the magnitude of losses caused by a catastrophic/crisis scenario
- C_{risk} … risk premium (risk aversion)

As illustrated in Table 1, the primary sources for applying cost-benefit analysis are outlined, with the main focus of specific studies described and the methods used to value intangible costs and benefits, including their limitations, also outlined.

Table 1.

An overview of possible methods for valuing intangible benefits when applying CBA to the introduction of new technologies within the military and the Department of Defence [4,10,12,13,15]

Author/Source	Relevance for CBA in Defence	Monetisation Approach	Main Limitation / Boundary
Melese, Richter, Solomon – *"Military Cost–Benefit Analysis: Theory and Practice"*	Comprehensive framework for military CBA and practical applications	Mixed approaches (expected losses, VSL, probabilistic valuation)	High uncertainty and adaptive adversaries limit universal applicability
Hitch & McKean – *"The Economics of Defense in the Nuclear Age"*	Classical defence economics and systems analysis	Avoided losses and counterfactual benefits	Cold War context; limited applicability to modern hybrid threats
Kniesner et al. – *"The Military VSL"*	Defence adaptation of the Value of Statistical Life (VSL) concept	VSL / mortality risk monetisation	Ethical sensitivity and parameter dependence
Qari - *"The value of national defense"*	Defence as public good, public valuation of defence policy options	WTP / Discrete Choice Experiments (DCE)	Strong dependence on framing and threat perception
Huxtable et al. – *"Understanding the Ministry of Defence's Wider Contribution"*	How (not) to measure the primary benefits of defense: VSL, DCE/WTP, insurance-based approaches, proxies	VSL, DCE/WTP, insurance-style approaches	No single method captures the full defence output

In real-world applications, the so-called **combined project benefit** (B_{Total}) is ultimately applied, whereby individual valuation approaches are selectively used when assessing a given modernization project or defense benefit. The total benefit of the project can then be expressed as follows:

$$B_{Total} = B_{ELA}+B_{VSL}+B_{VSI}+B_{WTP} \tag{6}$$

This approach will also be used in the example problems provided later in the text.

3.2. A Methodological Proposal for Applying Cost-Benefit Analysis to a Defence Project

The essence of cost-benefit analysis is to compare different options for addressing a given problem or project (e.g., improving training safety, securing ammunition depots, or introducing a new type of military equipment) and to quantify them using indicators that reflect the benefits and costs associated with their implementation. A characteristic feature of CBA is that these benefits and costs are expressed in monetary units. The fundamental prerequisite for the success of CBA is therefore the analytical team's ability to identify and describe all the costs and benefits of the project and subsequently convert them into monetary units using an appropriate method [4]. In the next step, the project or alternative is also evaluated through the lens of the time value of money. Table 2 provides a general overview of what a possible CBA procedure might look like in the context of defence.

Table 2.

CBA implementation procedure in a defence context

Procedure	Name	Description
Step 1	Definition of the problem variants	Definition of the baseline scenario and at least two additional scenarios; identification of beneficiaries (important for quantifying benefits and costs).
Step 2	Identification of all costs and benefits	Identification of all costs and benefits using the recommended classification, followed by the determination of the relevant costs and benefits for valuation purposes.
Step 3	Creating a probabilistic model	Estimation of the probabilities of relevant negative events in each scenario (reducing the probability of equipment destruction, increasing a soldier's chances of survival, etc.).
Step 4	Monetization of relevant costs and benefits	Converting benefits and costs into monetary units and discounting them.
Step 5	Calculation of criterion indicators and sensitivity analysis	Calculation of so-called criteria-based indicators (present value, net present value, payback period, etc.).
Step 6	Evaluation of results and explicit definition of limits	The final decision on the project. This may involve rejection, a recommendation, or a note that the results are not 100% conclusive due to the unavailability of certain important information or data.

The selection of an appropriate classification of costs and benefits is instrumental in identifying all relevant costs and benefits of the project, thereby ensuring that the analyst does not adopt a narrow or one-sided perspective of the problem.

3.3. Advantages, Disadvantages, and Limitations of Applying Cost-Benefit Analysis to Defence Contexts

The primary advantage of CBA is its ability to use various methodological approaches to quantify the intangible outputs, benefits, and costs generated by various public projects. It appears particularly well-suited to the context of the Department of Defence and the military, where the intangible nature of benefits clearly predominates. Conversely, this advantage can be considered a weakness, as individual approaches may be challenged for insufficient relevance and validity. Another challenge is the availability of necessary data on both past and future impacts of the projects under assessment. It is also important to be able to identify all entities that will be the intended beneficiaries of the intangible benefits of these projects (recipients of defence and security benefits).

The applicability of CBA is acceptable when it comes to marginal changes in capabilities rather than the *"existence of the state"*, so WTP or risk models are not logically absurd. It is possible to create a probabilistic risk model (threat × vulnerability × impact) and assess the impact in terms of damages, restoration, or losses. The benefit is largely *"internal"*—typically training safety, personnel protection, security features, logistics, infrastructure, etc. In contrast, the use of CBA is problematic if the benefit is not a stable function of the investment and involves, for example, emergent deterrence (the deterrent effect emerges only at the level of the entire defence system, not as the sum of individual weapons or units; deterrence does not arise directly from individual capabilities but emerges only through their combination, interaction, and the way the adversary perceives them). Another limitation is so-called *"fat-tail"* catastrophic scenarios. These are situations where results are extremely sensitive to probabilistic assumptions and discounting. Finally, the absence or unavailability of data and information poses a significant risk. The CBA has been demonstrated to be most effective in cases involving "*immediate"* and "*measurable"* benefits (VSL, damage to assets, outages), and less efficacious in scenarios of pure deterrence. Conducting a CBA to assess the level of defence spending or the mix of capabilities is more difficult, but feasible when using a WTP approach or estimating macro-level damages (avoided GDP losses, replacement costs, asset values, etc.).

3.4. Examples of the Use of Cost-Benefit Analysis in the Defence Sector

The following simplified examples have been selected to illustrate the potential applications of cost-benefit analysis in the defence sector. The first example concerns a project to enhance the protection of a military base against drone attacks (C-UAS), while the second is based on a plan to replace the current main battle tank with a more modern successor (N-MBT).

3.4.1. Protection of Military Bases Against Drone Attacks (C-UAS)

Step 1 The objective of the CBA is to assess the acceptability of enhanced protection for the military base compared to its current security status. The zero option means that we are willing to accept the risk of a successful attack on the base (the so-called "do nothing" approach). Option 1 represents an investment intended to enhance the base's security against this type of attack. This involves the acquisition of a C-UAS system (detection + jamming + sensors), including the reinforcement of passive protection. [20]

Step 2 The Costs and benefits are defined in accordance with Musgrave's typology (1994). Direct material costs are represented by the total investment value (I_0); indirect material costs are the operating costs for maintenance and servicing of the *"anti-drone"* C-UAS (Counter-Unmanned Aircraft Systems) system; other intangible costs may include reputational and strategic impacts (however, these will not be considered). Table 3 provides a simplified descriptive overview of the costs and benefits associated with enhancing the protection of a military base.

Table 3.

Classification and definition of project costs and benefits (selected costs and benefits)

		Costs	Benefits
Direct	Tangible	Capital expenditure/costs (CAPEX)	-
	Intangible	Service/mission interruption	Reduction in the number of fatalities (VSL) Reduction in the number of injuries (VSI) Reduction in infrastructure damage (ELA)
Indirect	Tangible	System operating costs (OPEX)	-
	Intangible	Reputational and strategic implications	-

Step 3 Development of a probabilistic model and definition of key variables. The CBA will be based on a comparison between the *"do nothing"* scenario and making the investment. The data relevant to the calculations include the probability of fatalities, the costs associated with injuries, and the extent of damage to infrastructure. In summary, the key factors for the CBA are the probability of a successful attack and the extent of damage if it succeeds.

Model Variables

- p_0 – annual probability of a successful drone attack (without countermeasures, baseline scenario)
- p_1 – annual probability of a successful drone attack (with countermeasures, investment option)
- $\Delta p = p_0 - p_1$ – reducing the risk of a successful drone attack
- N – average number of people at risk in a single attack
- f – probability of a fatal outcome per person
- i – probability of injury per person during an attack
- VSL – value of a statistical life (monetizes the reduction in the risk of death)
- VSI – statistical injury value (quantifies the reduction in injury risk)
- C_0 – capital expenditures for acquiring the system (CAPEX)
- $C_{O\&M}$ – operating and maintenance costs (OPEX)
- L_0, L_1 – the financial value of property damage caused by the attack
- r – discount rate used to calculate the benchmark indicators

Table 4.

Probabilistic model for expected annual loss

Damage to infrastructure	Casualties	Injuries sustained
Estimated property damage from a single successful attack $E_{ELA0} = p_0 \times L_0$ (unprotected) $E_{ELA1} = p_1 \times L_1$ (with protection)	Expected casualties/deaths from a single successful attack $E_{VSL} = f \times N$	Expected injuries per successful attack $E_{VSI} = i \times N$
Annual savings from prevented losses $B_{ELA} = (p_0 \times L_0) - (p_1 \times L_1)$	Estimated number of deaths per year $E_{VLS0} = p_0 \times N \times f$ (unprotected) $E_{VLS1} = p_1 \times N \times f$ (with protection)	Estimated number of injuries per year $E_{VSI0} = p_0 \times N \times i$ (bez ochrany) $E_{VSI1} = p_1 \times N \times i$ (s ochranou)
	Annual benefit of statistical life $B_{VSL} = (p_0 - p_1) \times N \times f \times VSL$	Annual benefit of a statistical injury $B_{VSI} = (p_0 - p_1) \times N \times i \times VSI$

Table 5 lists the values of individual parameters (prerequisites**)** that are important for performing a cost-benefit analysis. Some values reflect actual conditions, while others have been determined by experts for the purposes of the model calculation.

Table 5.

Values of key variables for performing calculations within the CBA

Item	Value	Item	Value	Item	Value
p_0	0,06	i	0,30	OPEX	10 mil. USD
p_1	0,01	VSL	11,8 mil. USD	L_0	300
N	140	VSI	25 % VSL	L_1	150
f	0,08	CAPEX	80 mil. USD	t	10 years
r	3 %				

Step 4 Monetization/Valuation of Project Costs and Benefits. In the case of base protection, the benefits will be quantified based on the reduction in loss of life, the number of injuries, and the reduction in damage to infrastructure. Costs will consist of the capital costs associated with the acquisition of the C-UAS and the annual operating costs of the system, including personnel expenses.

Table 6.

Calculation of the project's total benefits and costs

B_{ELA}	B_{VSL}	B_{VSI}
Reducing damage to infrastructure	**Casualties**	**Injuries sustained**
Estimated property damage from a single successful attack $E_{ELA0} = p_0 \times L_0$ (unprotected) $E_{ELA0} = 0{,}06 \times 300 = 24$ mil. USD $E_{ELA1} = p_1 \times L_1$ (with protection) $E_{ELA1} = 0{,}01 \times 150 = 1{,}5$ mil. USD	Expected casualties/deaths from a single successful attack $E_{VSL} = f \times N$ $E_{VSL} = 0{,}08 \times 140 = 11{,}2$	Expected injuries per successful attack $E_{VSI} = i \times N$ $E_{VSI} = 0{,}3 \times 140$ $E_{VSI} = 42$
Annual savings from prevented losses $B_{ELA} = (p_0 \times L_0) - (p_1 \times L_1) = 24 - 1{,}5$ **B_{ELA} = 22, 5 mil. USD**	Estimated number of deaths per year $E_{VLS0} = p_0 \times N \times f$ (unprotected) $E_{VLS0} = 0{,}06 \times 140 \times 0{,}08 = 0{,}672$ $E_{VLS1} = p_1 \times N \times f$ (with protection) $E_{VLS1} = 0{,}01 \times 140 \times 0{,}08 = 0{,}112$ $\Delta q = E_{VLS0} - E_{VLS1} = 0{,}672 - 0{,}112$ $\Delta q = 0{,}56$	Estimated number of injuries per year $E_{VSI0} = p_0 \times N \times i$ (unprotected) $E_{VSI0} = 0{,}06 \times 140 \times 0{,}3 = 2{,}52$ $E_{VSI1} = p_1 \times N \times i$ (with protection) $E_{VSI1} = 0{,}01 \times 140 \times 0{,}3 = 0{,}42$ $\Delta p = E_{VSI0} - E_{VSI1} = 2{,}52 - 0{,}42$ $\Delta p = 2{,}1$
	Annual benefit of statistical life $B_{VSL} = \Delta q \times VSL = 0{,}56 \times 11{,}8$ **B_{VSL} = 6,6 mil. USD**	Annual benefit of statistical injury $B_{VSI} = \Delta p \times VSI = 2{,}1 \times 2{,}95$ **B_{VSI} = 6,195 mil. USD**
	$B_{total} = B_{ELA} + B_{VSL} + B_{VSI}$ $B_{total} = 22{,}5 + 6{,}6 + 6{,}2$ **B_{total} = 35,3 mil. USD**	
	C_{total}	
C_0 = 80 mil. USD		$C_{O\&M}$ = 10 mil. USD/year

Step 5 Calculation of criteria indicators and sensitivity analysis. In this step of the calculation, the project's cash flow will be presented, and key performance indicators will be calculated that take into account the time value of money and indicate the acceptability of the analyzed project option. Table 6 shows the expected annual balance and the overall balance of the costs and benefits generated by the implemented project. This table does not yet use discounted values, but it provides initial information on the relationship between the project's costs and benefits. The values listed represent the financial expression of all relevant items and may include all significant benefits and costs of the project variant under consideration. For simplicity, a constant annual balance of costs and benefits is assumed.

Table 7.

Cash-flow project (t =10 years)

Year	**t_0**	**t_1**	**t_2**	**t_3**	**t_4**	**t_5**	**t_6**	**t_7**	**t_8**	**t_9**	**t_{10}**
Benefits	0	35,3	35,3	35,3	35,3	35,3	35,3	35,3	35,3	35,3	35,3
Costs	80	10	10	10	10	10	10	10	10	10	10
Annual balance	-80	25,3	25,3	25,3	25,3	25,3	25,3	25,3	25,3	25,3	25,3
Total balance	**-80**	**-54,7**	**-29,4**	**-4,1**	**21,2**	**46,5**	**71,8**	**97,1**	**122,4**	**147,7**	**173**

Two facts are evident from the project's cash flow: first, the project's **annual balance is positive**; and second, by its third year, its **total cumulative balance turns positive**. However, this is merely a *"static"* view; the actual feasibility of the project will be determined by the values of the individual criteria indicators. We will now calculate the criteria indicators, which will also take into account the time value of money; the calculations will include discounting of values (accounting for inflation and interest rates).

Payback period PB(C-UAS)

$$PB(C-UAS) = \frac{I}{CF_t} = \frac{80}{25{,}3} = 3{,}2\ roku \tag{7}$$

Present value of the project PV (C-UAS)

(8)

$$\text{PV (C-UAS)} = \sum_{t=1}^{n} \frac{CF_{\text{t}}}{(1+r)^t} = \sum_{t=1}^{10} \frac{25{,}3}{(1+0{,}03)^t} = 216 \text{ mil. USD}$$

Net present value of the project NPV (C-UAS)

$$\text{NPV (C-UAS)} = \text{CF}_0 + \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} = \text{CF}_0 + PV\ (C-UAS) = PV - I = 216 - 80 = 136 \text{ mil. USD} \tag{9}$$

Project profitability index Ri (C-UAS)

$$Ri = \frac{\left[\sum_{t=0}^{n} \frac{CF_t}{(1+r)^t}\right]}{(-CF_0)} = \frac{PV(C-UAS)}{I} = \frac{216}{80} = 2{,}7 \tag{10}$$

Step 6 Evaluation of Results. A preliminary investigation into the cash flow of the C-UAS project reveals that the project generates a positive annual cash flow. Given the initial investment, the project indicates a relatively rapid "return on investment". Concurrently, other indicators (PB, PV, NPV, Ri) demonstrate that the project's implementation is acceptable from both the perspective of the cost-benefit ratio and the time value of money. The benefits generated by the project to enhance the protection of the military base exceed its costs (capital, operating, and maintenance). This example demonstrates that a CBA is a viable undertaking; however, the result is sensitive to the threat and the parameters of protection effectiveness. The monetisation of benefits can be conceptualised as a reduction in financial losses, as well as a diminution in the probability of mortality and injury.

3.4.2. Replacing the outdated main battle tank with a new one (N-MBT)

Step 1 The objective of the CBA is to assess whether it is socially and fiscally justified to introduce the new M1E3 Abrams main battle tank compared to alternatives such as continuing to use the existing Abrams tanks and modernizing them, purchasing another western tank, or postponing the acquisition. The fundamental decision-making question might be: *"Do the overall societal, security, and military benefits of introducing the M1E3 Abrams outweigh its total life-cycle costs, taking into account risks, uncertainties, and alternative uses of public funds?"*

The *"zero option"* means that the military will not procure the new M1E3 Abrams tank and will continue to bear the risks associated with an older or less modern tank platform. This option entails: greater logistical demands, higher fuel consumption, a four-person crew, lower protection against drones, inferior sensor and network capabilities, and higher expected losses of equipment and personnel in the event of a conflict. The investment option involves the acquisition of 54 M1E3 Abrams tanks, including training, ammunition, spare parts, simulators, and a service and logistics package. The technical basis for the benefits is drawn from an article on the M1E3 Abrams. It highlights, in particular, a three-person crew thanks to an automatic loader, lower weight, open digital architecture, AI features, anti-drone capabilities, a hybrid powertrain, and up to 50% fuel savings [7,8].

Step 2 The definition of costs and benefits is consistent with Musgrave's typology [5]. Direct tangible costs are defined as the total investment value (I_0) of purchasing 54 new tanks. Indirect tangible costs, meanwhile, are understood to be the operating costs associated with maintenance, servicing and modernisation. The introduction of a more powerful, lighter, quieter, and more fuel-efficient tank with a longer service life constitutes a direct intangible benefit. As illustrated in Table 7, a concise, descriptive and partial review of the financial implications associated with the procurement of a new main battle tank is provided.

Table 8.

Typology and definition of project costs and benefits (selected costs and benefits)

		Costs	Benefits
Direct	Tangible	Capital expenditures for the purchase of tanks, training, ammunition, simulators, and spare parts (CAPEX)	Lower expected equipment losses
	Intangible	Transition to a new system, change in doctrine, training workload	Greater combat effectiveness Fewer casualties and injuries (greater crew protection means fewer casualties and fewer injuries)
Indirect	Tangible	System operating costs (OPEX)	Fuel savings (lower fuel consumption – hybrid propulsion) Staff savings (a crew of three instead of four) Reduced logistical demands (fewer supply convoys, lower logistical vulnerability)
	Intangible	Cyber and technological risks, supplier dependency	Strategic security benefits – greater deterrence and defensive capability

Step 3 Development of a probabilistic model and definition of key variables. To simplify the entire model calculation, we will work only with the summary values calculated by the authors. The main focus will be on the benefits derived from the technical parameters of the new tank (the new tank is to have a hybrid drive, be up to 50% more fuel-efficient, have an automatic loader, a three-member crew, lower weight, open architecture, AI support, advanced sensors, and anti-drone capabilities), as well as benefits related to lower losses of equipment (tanks), human casualties and injuries, and the share of benefits related to strategic security benefits.

Model Variables

- p_0 – annual probability of a loss-making combat scenario for the zero option
- p_1 – annual probability of a loss-making combat scenario for the M1E3 variant
- L_0 – property damage in the loss scenario for the zero option
- L_1 – property damage in the loss scenario for the M1E3
- N_0 – number of people at risk under the baseline scenario
- N_1 – number of people at risk in M1E3
- f_0, f_1 – probability of fatal outcomes (without M1E3, with M1E3)
- i_0, i_1 – probability of injury (without M1E3, with M1E3)
- VSL – value of a statistical life
- VSI – statistical injury value
- C_0 – capital costs for purchasing the system (CAPEX)
- $C_{O\&M}$ – operating and maintenance costs (OPEX)
- r – discount rate
- t – evaluation period
- Δp_j – reducing the likelihood of scenario j
- S_j – extent of damage in scenario j

Table 9.

Probabilistic model for expected annual loss

Equipment losses	**Casualties**	**Injuries sustained**	**Strategic security benefit**
Annual savings from reducing material losses $B_{ELA} = (p_0 \times L_0) - (p_1 \times L_1)$	Estimated number of deaths per year $E_{VLS0} = p_0 \times N_0 \times f_0$ (baseline scenario) $E_{VLS1} = p_1 \times N_1 \times f_1$ (M1E3 variant)	Estimated number of injuries per year $E_{VSI0} = p_0 \times N_0 \times i_0$ (baseline scenario) $E_{VSI1} = p_1 \times N_1 \times i_1$ (M1E3 variant)	$B_{STR} = \sum_{j=1}^{m} \Delta p_j \; x \; S_j$
	Annual benefit from reducing fatalities $B_{VSL} = (E_{VSL0} - E_{VSL1}) \times VSL$	Annual benefit of a statistical injury $B_{VSI} = (E_{VSI0} - E_{VSI1}) \times VSI$	

Table 10.

Values of key variables for performing calculations within the CBA

	Value	**Item**	**Value**	**Item**	**Value**
number of tanks	54 pcs	p_0	0,06	f_0	0,25
C_0	2 783 mil. USD	p_1	0,04	f_1	0,20
$C_{O\&M}$	85 mil. USD/year	L_0	1 200 mil. USD	i_0	0,35
t	30 years	L_1	700 mil. USD	i_1	0,30
r	3 %	N_0	44 persons /11 tanks hit x 4 persons/	N_1	24 persons /8 tanks hit x 3 persons/
VSL	11,8 mil. USD	VSI	2,95 mil. USD		

Note: Values p_0, p_1, L_0, L_1, N_0, N_1, f a i are **scenario-based expert assumptions**. This is not empirically verified data for M1E3. It allows for the probabilistic quantification of the reduction in expected losses.

Step 4 Monetization/Valuation of Project Costs and Benefits. Publicly available data from previous acquisitions are used to estimate CAPEX: Romania has begun negotiations to acquire 54 M1A2 SEPv3 Abrams tanks and related equipment for an estimated **$2.53 billion**; Poland had a package approved for 250 M1A2 SEPv3 tanks and related equipment for **$6.0 billion**. [7], [8], [21] Since the M1E3 is technologically more advanced than the M1A2 SEPv3, a **10% technology premium** is applied to the calculation.

$$C_0 = 2\,530 \times 1{,}10 = \mathbf{2\,783\ mil.\ USD}$$

Table 11.

Calculation of the project's benefits – reduced losses of equipment, lives, injuries

Reducing material losses in equipment	Reducing loss of life	Reducing losses due to injuries
$B_{ELA} = (p_0 \times L_0) - (p_1 \times L_1)$ $B_{ELA} = (0{,}06 \times 1200) - (0{,}04 \times 700)$ $B_{ELA} = 72–28$ **B_{ELA} = 44 mil. USD/year**	Baseline scenario $E_{VSL0} = p_0 \times N_0 \times f_0$ $E_{VSL0} = 0{,}06 \times 44 \times 0{,}25$ $E_{VSL0} = 0{,}66$	Baseline scenario $E_{VSI0} = p_0 \times N_0 \times i_0$ $E_{VSI0} = 0{,}06 \times 44 \times 0{,}35$ $E_{VSI0} = 0{,}924$
	M1E3 variant $E_{VSL1} = p_1 \times N_1 \times f_1$ $E_{VSL1} = 0{,}04 \times 24 \times 0{,}20$ $E_{VSL1} = 0{,}192$	M1E3 variant $E_{VSI1} = p_1 \times N_1 \times i_1$ $E_{VSI1} = 0{,}04 \times 24 \times 0{,}30$ $E_{VSI1} = 0{,}288$
	Reduction in expected deaths $\Delta E_{VSL} = 0{,}66 - 0{,}192$ $\Delta E_{VSL} = 0{,}468$	Reduction in expected injuries $\Delta E_{VSI} = 0{,}924 - 0{,}288$ $\Delta E_{VSI} = 0{,}636$
	$B_{VSL} = 0{,}468 \times 11{,}8$ **B_{VSL} = 5,52 mil. USD/year**	$B_{VSI} = 0{,}636 \times 2{,}95$ **B_{VSI} = 1,88 mil. USD/year**

Table 12.

Calculation of performance based on the technical parameters of the M1E3

Benefits derived from the technical specifications of the M1E3	Annual benefit
Fuel savings	4,5 mil. USD
Staff savings thanks to a three-person crew	7,0 mil. USD
Smaller logistics footprint	18,0 mil. USD
Faster / more effective training	4,0 mil. USD
More affordable upgrades thanks to open architecture	20,0 mil. USD
Domestic service and technological effects	15,0 mil. USD
B_{OP}=4,5+7+18+4+20+15	
B_{OP} = 68,5 mil. USD/year	

Note: Due to the length limit of this post, only the final amounts for each item are listed, without showing the calculation process.

Table 13.

Calculation of the Project's Strategic Security Benefits

Strategic security benefit			
$B_{STR} = \sum_{j=1}^{m} \Delta p_j \ x \ S_j$			
Scenario	**Probability reduction Δp_j**	**Extent of damage in the scenario S_j**	**Annual benefit**
Regional security crisis	0,0010	20 000 mil. USD	20 mil. USD
Limited conflict	0,0008	70 000 mil. USD	56 mil. USD
High-intensity conflict	0,0002	300 000 mil. USD	60 mil. USD
B_{STR}=20+56+60			
B_{STR}= 136 mil. USD/year			

The strategic security benefit is assessed using the expected avoided loss method. The assumption underpinning this approach is that the acquisition of new tank capabilities serves to reduce the probability of the occurrence of selected security scenarios. The annual benefit is calculated as the sum of the products of the probability reduction for each scenario and the estimated damage of those scenarios. As the reduction in probability of conflict cannot be determined empirically with any degree of precision, this item is evaluated on a scenario-by-scenario basis and subjected to a sensitivity analysis.

Table 14.

Total annual benefits of the project

Item	Annual benefit (mil. USD)
Reduction of material losses B_{ELA}	44,00
Reducing loss of life B_{VSL}	5,52
Reduction in serious/light injuries B_{VSI}	1,88
Operational and logistics benefits B_{OP}	68,50
Strategic security benefit B_{STR}	136,00
$B_{TOTAL/YEAR}$ = 44+5,52+1,88+68,5+136	
Total annual benefits $B_{TOTAL/YEAR}$ = 255,90	

Table 15.

Costs of project	
Item	**Cost (mil. USD)**
CAPEX C_0	2 783
OPEX $C_{O\&M}$	85
Annual balance before discounting	
Annual balance = $B_{TOTAL/YEAR} - C_{O\&M}$	
Annual balance = 255,9 − 85	
Annual balance = 170,9	

Step 5 Calculation of criteria indicators and sensitivity analysis

Table 16.

Cash-flow project (t =30 year) – a segment of the entire duration

Year	**t_0**	**t_1**	**t_2**	**t_3**	**t_{10}**	**t_{15}**	**t_{17}**	**t_{18}**	**t_{25}**	**t_{30}**
Benefits	0	255,9	255,9	255,9	255,9	255,9	255,9	255,9	255,9	255,9
Costs	2 783	85	85	85	85	85	85	85	85	85
Annual balance	-2 783	170,9	170,9	170,9	170,9	170,9	170,9	170,90	170,9	170,9
Total balance	**-2 783**	**-2 612,1**	**-2 441,2**	**-2 270,3**	**-1 074**	**-219,5**	**122,3**	**293,20**	**1 489,5**	**2 344**

Note: The table lists only selected years of the project's duration for the sake of clarity and efficiency.

The project's cash flow analysis demonstrates an annual surplus; however, the project does not achieve a positive annual balance until halfway through the planned useful life of the equipment being installed. The subsequent calculation of key performance indicators will furnish supplementary information to facilitate the final decision-making process, as it will illustrate the project's parameters from the perspective of the time value of money.

Payback period PB (N-MBT)

$$PB(N - MBT) = \frac{\mathrm{I}}{CF_t} = \frac{2783}{170{,}9} = 16{,}3\ roku \tag{11}$$

Present value of the project PV (N-MBT)

$$\text{PV (N-MBT)} = \sum_{t=1}^{n} \frac{CF_{\mathrm{t}}}{(1+r)^t} = \sum_{t=1}^{30} \frac{170{,}9}{(1+0{,}03)^t} = 3\,350 \text{ mil. USD} \tag{12}$$

Net present value of the project NPV (C-UAS)

$$\text{NPV (N-MBT)} = \mathrm{CF}_0 + \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} = \mathrm{CF}_0 + PV\ (N - MBT) = PV - I = 3\,350 - 2\,783 = 567 \text{ mil. USD} \tag{13}$$

Project profitability index Ri (N-MBT)

$$Ri = \frac{\left[\sum_{t=0}^{n} \frac{CF_t}{(1+r)^t}\right]}{(-CF_0)} = \frac{PV(N - MBT)}{I} = \frac{3\,350}{2\,783} = 1{,}21 \tag{14}$$

Given that the most sensitive component of the analysis is the strategic security benefit, a sensitivity analysis will be conducted to demonstrate how the CBA results change with different values B_{STR}.

Table 17.

Sensitivity analysis of the N-MBT project with respect to possible size B_{STR}

Strategic security benefit B_{STR} (mil. USD/year)	**Total annual benefits $B_{TOTAL/YEAR}$**	**PV benefits**	**PV costs**	**NPV**	**BCR Benefit/Costs Ratio**	**Note**
0	119,9	2 350,1	4 449,0	−2 098,9	0,53	Project not accepted
50	169,9	3 330,1	4 449,0	−1 118,9	0,75	Project not accepted
100	219,9	4 310,2	4 449,0	−138,8	0,97	Project not accepted
136	255,9	5 015,8	4 449,0	+566,8	1,21	Project accepted
150	269,9	5 290,2	4 449,0	+841,2	1,19	Project accepted
200	319,9	6 270,2	4 449,0	+1 821,2	1,41	Project accepted strongly

Note: The present value of costs is calculated using the formula PV_{cost} (N-MBT) = $\mathrm{CF}_0 + \sum_{t=1}^{n} \frac{C_{O\&M}}{(1+r)^t} = 2783 + \sum_{t=1}^{30} \frac{85}{(1+0{,}03)^t} = 2783 + 1666 = 4\,449 \text{ mil. USD}$ (15)

Evaluation of Results. An initial cash flow analysis of the N-MBT project shows that the project's annual cash flow is positive. In the case of this project, its *"payback period"* is halfway through the useful life of the equipment being purchased, at which point a partial upgrade is expected to meet future operational needs. However, other parameters (PB, PV, NPV, Ri) indicate that the project's implementation is acceptable both in terms of the cost-benefit ratio and the time value of money. At the same time, it is necessary to highlight the role of the Strategic Security Benefit (B_{STR}), which represents a significant variable whose magnitude can influence the final assessment of the project's acceptability, as indicated by the sensitivity analysis performed.

4. Discussion and Limitation

An analysis of the literature and the current state of knowledge suggests that CBA is methodologically justifiable primarily for decisions concerning the reduction of measurable risks that have localized and quantifiable impacts and represent marginal changes to existing capabilities. Conversely, in the case of strategic deterrence, decisions regarding the overall mix of capabilities, or scenarios with low probability and extreme impacts, CBA quickly becomes speculative and can lead to a false impression of objectivity. This means that when monetizing benefits, the most appropriate method must be very carefully selected and used with caution. Determining the costs of the projects under consideration is easier if information on total life-cycle costs (TLCC/LCC) is available. At the same time, intangible costs must also be taken into account; these must be included in the calculations, and one of the existing methods must be used to value them.

The model examples presented of applying CBA to defence scenarios (protecting a military base from a *"drone"* attack, modernizing a main battle tank) suggest that its successful implementation can offer valuable insights into the decision-making process regarding future investments. However, it is clear that there are limitations related to the availability of reliable and usable information and data, which would subsequently allow for the monetization of intangible costs and benefits. The more of this data and information that is available, the more reliable and useful CBA can be in the allocation and decision-making process within the defence sector.

In the case of the military base protection project, the benefits of its modernisation were assessed in terms of damage to the base's infrastructure that was prevented, as well as reduced loss of life and injuries. The monetisation of these benefits is an acceptable practice and can yield reliable data. The CBA conducted for this project can be used without major limitations.

In the acquisition of a new main battle tank, the project's utility was assessed by evaluating the benefits derived from its technical characteristics, reduced equipment losses, fewer casualties and injuries, and strategic security benefits. The analysis shows that the acquisition of a new tank cannot be justified solely by fuel savings, a smaller crew, or lower logistics costs. While these savings are real, they are small relative to the purchase price. The primary economic justification must be that modernizing a mechanized unit significantly reduces the security risk to the state. The economic justification rests almost exclusively on the value of deterrence, the reduction of expected war damages, and the enhancement of the state's defence capabilities. The monetization of the first four benefits mentioned (B_{OP}, B_{ELA}, B_{VSL}, B_{VSI}) is feasible and can be reliable. The assessment of the strategic security benefit (B_{STR}) is linked to the issue of emergent deterrence (see Section 3.3) and must be given careful consideration. Without strategic security utility, the project could not be successful in a purely financial sense, although B_{VSL} and B_{VSI} may also play a positive role; however, this is common and expected in defence projects. B_{STR} represents the so-called "bottleneck" of the project, and the valuation of this benefit is the most contentious (difficult causality, unclear value of damages, high sensitivity to small changes in probability).

5. Conclusions

Cost-benefit analysis has a limited but analytically significant role to play in the defence sector. Its value lies primarily in providing a disciplined framework for decision-making at the level of specific projects, rather than in replacing strategic considerations. Provided its limitations are transparently acknowledged, CBA can help make defence planning more rational, even in the context of the current security environment.

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References

1. **Odehnal, J., Neubauer, J.** Economic, Security, and Political Determinants of Military Spending in NATO Countries. Defence and Peace Economics, 2020, 31(5), 517-531. ISSN 1024-2694. IF 2,361. doi:10.1080/10242694.2018.1544440
2. **Šlouf, V., Blaha, M., Müllner, V., Brizgalová, L., Pekař, O.** An Alternative Model for Determining The Rational Amount of Funds Allocated to Defence of The Czech Republic in Conditions of Expected Risk. Obrana a strategie, 2023, 2023(1), 149-172. ISSN 1214-6463. IF 0,300. doi:10.3849/1802-7199.23.2023.01.149-172
3. **Müllner, V., Nečas, K.** The Bucharest Nine Part of NATO's Eastern Flank: an Analysis of Military Investment on Equipment. Vojenske rozhledy-Czech Military Review, 2024, 33(3), 3-26. ISSN 1210-3292. IF 0,300.

doi:10.3849/2336-2995.33.2024.03.003-026
4. **Melese, F.; Richter, A.; Solomon, B.** (eds.). Military Cost–Benefit Analysis: Theory and practice. Routledge, 2015, Available online: https://www.routledge.com/Military-Cost-Benefit-Analysis-Theory-and-practice/Melese-Richter-Solomon/p/book/9781138495388.
5. **Musgrave, R. A.; Musgrave, P. B.** Public Finance in Theory and Practice (fifth ed.). New York: Tata McGraw-Hill, 2018. 617 p. ISBN 978-0-07-059693-1.
6. **Bush, D., Brown, P., Murray, A.** Iranian strikes on bases used by US caused $800m in damage, new analysis shows. Available online: https://www.bbc.com/news/articles/cddq7j48p35o (accessed on 7 May 2026).
7. **Smělý, K.** Američané řídí tanky jako konzole: Tank budoucnosti má ovladač jako XboxAvailable online: https://www.techzpravy.cz/americane-ridi-tanky-jako-konzole-tank-budoucnosti-ma-ovladac-jako-xbox/ (accessed on 30 April 2026).
8. **Defense Security Cooperation Agency.** Romania – M1A2 Abrams Main Battle Tanks. Available online: https://media.defense.gov/2024/Dec/09/2003604176/-1/-1/0/PRESS%20RELEASE%20-%20ROMANIA%2023-71%20CN.PDF (accessed on 30 April 2026).
9. **Bénard, J.** Veřejná ekonomika III. Ekonomický ústav, ČSAV, Praha, Československo, 1991; 142 p.
10. **Hitch, C. J.; McKean, R. N.** The Economics of Defense in the Nuclear Age (RAND R-346). RAND Corporation / Harvard University Press, 1960, Available online: https://www.rand.org/content/dam/rand/pubs/reports/2005/R346.pdf
11. **Enthoven, A.** How Systems Analysis, Cost-Effectiveness Analysis, or Benefit-Cost Analysis First Became Influential in Federal Government Program Decision-Making. Journal of Benefit-Cost Analysis, 2019, 10(2), 146–155, DOI: 10.1017/bca.2019.23, Available online: https://www.cambridge.org/core/journals/journal-of-benefit-cost-analysis/article/how-systems-analysis-costeffectiveness-analysis-or-benefitcost-analysis-first-became-influential-in-federal-government-program-decisionmaking/3184B347F6D651938F2CF322ACD20285
12. **Huxtable, L.; Cox, K.; Black, J.; Hartley, K.; Smith, R. E.; Uttley, M.; Wilkinson, B.; Rohr, C.; Lu, H.** Understanding the Ministry of Defence's Wider Contribution to UK Prosperity: Measuring Defence Output (RR-A638-1). RAND Corporation, 2021, DOI: 10.7249/RRA638-1, Available online: https://www.rand.org/pubs/research_reports/RRA638-1.html
13. **Kniesner, T. J.; Sullivan, R.; Viscusi, W. K.** The Military VSL. Journal of Benefit-Cost Analysis, FirstView, 2025, 1–28, DOI: 10.1017/bca.2025.10045, Available online: https://www.cambridge.org/core/journals/journal-of-benefit-cost-analysis/article/military-vsl/1433C497D7698C2E8F460F90DA8D5DB5
14. **Willis, H. H.; LaTourrette, T.** Using probabilistic terrorism risk modeling for regulatory benefit-cost analysis: application to the Western Hemisphere Travel Initiative in the land environment. Risk Analysis, 2008, 28(2), 325–339, DOI: 10.1111/j.1539-6924.2008.01022.x, Available online: https://pubmed.ncbi.nlm.nih.gov/18419652/
15. **Qari, S.; Börger, T.; Lohse, T.; Meyerhoff, J.** The value of national defense: Assessing public preferences for defense policy options. European Journal of Political Economy, 2024, 85, 102595, DOI: 10.1016/j.ejpoleco.2024.102595, Available online: https://www.sciencedirect.com/science/article/pii/S0176268024000971
16. **Börger, T.; Lohse, T.; Meyerhoff, J.; Qari, S.** Threat Perceptions and the Valuation of Defence Policy Instruments (CESifo Working Paper No. 11976). CESifo, 2025, Available online: https://www.ifo.de/DocDL/cesifo1_wp11976.pdf
17. **Willis, H. H.; Morral, A. R.; Kelly, T. K.; Medby, J. J.** Estimating Terrorism Risk (MG-388-RC). RAND Corporation, 2005, DOI: 10.7249/MG388, [on-line] https://www.rand.org/pubs/monographs/MG388.html
18. **Best, K. L.; Greenfield, V. A.; Bond, C. A.; Edenfield, N.; Hvizda, M.; Jackson, J. C.; Long, D.; Willcox, J.** Beyond Cost-per-Unit: Economic Analysis and Metrics in Defense Decisionmaking (RR-A1802-2). RAND Corporation, 2024, Available online: https://www.rand.org/pubs/research_reports/RRA1802-2.html
19. **Bolouri, A. A.; Lohse, T.; Qari, S.** Interdependent Preferences for Financing and Providing Public Goods—The Case of National Defense. Kyklos, 2025, 78, 807–821, DOI: 10.1111/kykl.12442, Available online: https://opus4.kobv.de/opus4-hwr/files/4511/Bolouri_Lohse_Qari_2025.pdf
20. **Bilmes, L.** Why is the war in Iran so expensive? Available online: https://www.hks.harvard.edu/faculty-research/policy-topics/international-relations-security/why-war-iran-so-expensive (accessed on 4 May 2026).
21. **Adamowski, J.** Poland signs $4.75 billion Abrams tank deal as Russia's war speeds procurements. Available online: https://www.defensenews.com/global/europe/2022/04/05/poland-signs-475-billion-abrams-tank-deal-as-russias-war-speeds-procurements/ (accessed on 8 May 2026).
22. **Rojoef M.** Poland Accepts First M1A2 Abrams Tanks From US. Available online: https://thedefensepost.com/2025/01/21/poland-first-abrams/ (accessed on 8 May 2026).