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New defence disciplines to increase energy security through life cycle assessment and material flow analysis

Background

The defence sector, with its significant material capacity and high-energy operations, has substantial environmental impacts. While comparable to other industries, the sector's energy demands require exceptional ruggedness and durability, particularly for equipment operating in challenging climates and terrains.

Historical data reveals economic losses caused by climate-related events, emphasising the need for resilience. The defence sector, crucial for maintaining stability, faces direct and indirect impacts of climate hazards. Noteworthy is the sector's dependency on critical energy infrastructure, making it vulnerable to climate-related damages.

The energy sector, responsible for significant greenhouse gas emissions, is also susceptible to climate hazards. Concerning the defence sector, energy consumption data from European Defence Agency (EDA) members reveals significant electricity, heating, and transportation energy use, with potential risks related to dependency on non-EU countries. Material usage in the defence sector involves specialised high-performance processed materials critical for manufacturing defence applications. This CF SEDSS research study identifies various materials with exceptional properties, such as high durability, lightweight, and corrosion resistance, which are essential for specific defence applications. However, the end-of-life treatment of composite materials poses challenges, necessitating innovation for disposal aligned with circular economy principles.

Scope and Objectives

The study aims to investigate impact assessment in the defence sector across EU Member States by utilizing **life cycle assessment** (LCA) and **material flow analysis** (MFA) approaches. The objective is to enhance the defence sector's understanding of its energy and environmental impacts and promote adopting sustainable practices and technologies. **Through LCA,** the sector will evaluate the comprehensive impact of its products and processes, aligning with the European Green Deal and circular economy strategies. Additionally, **a detailed MFA** will quantitatively assess inputs and outputs, enabling efficient monitoring and reduction of CO_2 emissions, waste accumulation, and better management of discarded items.

The study's specific objectives include assessing knowledge levels about LCA and MFA in the defence sector, identifying existing initiatives and gaps, estimating the sector's environmental impact, evaluating strengths and weaknesses, and providing pathways for monitoring and mitigating environmental and energy impacts. The study also includes recommendations for training on LCA and MFA application in the defence sector.

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Problem Analysis

Creating a standardised pan-European defence LCA and MFA methodology is essential for a sustainable transition in the sector. However, challenges such as data accessibility, system complexity, regulatory hurdles, and diverse national interests must be addressed. Harmonising LCA and MFA concepts across EU member states is complicated by varying defence priorities, budgets, and military-industrial complexes. The lack of transparent and accurate data, due to confidentiality concerns and insufficient repositories, hinders effective analysis.

A common methodology based on life cycle inventory (LCI), SWOT analysis, or multicriteria analysis should be developed to overcome these obstacles. This would facilitate data sharing and build trust between member states, enabling effective management of environmental and energy issues in the defence sector.

Methodology

This study employs LCA and MFA approaches in EU Member States' ministries of defence (MoDs). The approach includes an audit utilising a survey to assess the knowledge and application of LCA and MFA within the defence sector, gathering data on environmental and energy impacts, and identifying strengths, weaknesses, opportunities, and threats (SWOT) associated with the harmonisation of LCA and MFA.

An illustrative example enhances understanding, demonstrating how LCA and MFA can be applied in the defence sector. At the same time, educational materials are developed, including a syllabus, learning outcomes, references, relevant links, PowerPoint presentations, and interactive activities to facilitate the application of LCA and MFA in the defence sector. The aim is to create a first-level resource for comprehensive learning.

The literature review follows the PRISMA declaration, a systematic review and meta-analysis methodology. The proposed approach aims to enhance understanding, establish a robust methodology, provide practical examples, and develop educational resources for implementing LCA and MFA in the defence sector within EU Member States.

Proposed Solution

Upon completing the initial phase, the study focuses on sharing insights with MoDs. The aim is to foster cross-interests and collaboration among EU MoDs. Key actions include training for defence personnel, standardising LCA and MFA guidelines, collaborating with experts, establishing data-sharing protocols, integrating methodologies into policies, fostering cross-entity collaboration, initiating joint research projects, securing leadership commitment, and implementing monitoring mechanisms. These steps ensure a sustained effort toward environmental impact assessment and sustainability in the European defence sector.

Impact and Opportunities

The defence sector has significant opportunities to embrace a green approach and enhance its societal standing. This includes transforming the sector's operational practices to control energy and environmental impact effectively, monitoring greenhouse gas emissions and energy-saving initiatives, and developing new skills within existing MoDs staff. Integrating these efforts with sustainability, climate, and energy policies signifies a holistic approach. Furthermore, the commitment to long-term sustainability, along with a shared blueprint strategy for member states, positions the defence sector to undertake impactful pilot demonstration projects. These opportunities, complemented by internal strengths, create a robust framework for advancing the defence sector's commitment to a green philosophy.

Challenges and Risks

Excessive bureaucracy within MoDs poses a threat to streamlined processes. The limited presence of educated staff in the realm of LCA and MFA, coupled with frequent key personnel transfers, may impede the continuity of initiatives. The absence of motivation, a lack of a common EU strategy, and potential reservations from MoDs at the political level to share data pose additional threats.

Internally, the absence of a mandatory obligation to measure energy and environmental impact within MoDs is also a weakness. The lack of well-established logistics to control existing practices, coupled with the absence of a blueprint focused on circular economy strategy, energy,

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and environmental impact assessment, further diminishes the sector's readiness. The absence of specific targets or agreements between MoDs to reduce greenhouse gas emissions, along with a lack of political commitment and guidance, weakens the overall approach.

Way Ahead

The unique organizational cultures, traditions, and operational priorities in the defence sector necessitate a profound shift in mindset and organizational culture to integrate environmental and energy considerations into decision-making processes.

Key actions include raising awareness, building capacity, and fostering collaboration between defence entities, environmental experts, and academia. Surmounting challenges requires a multidimensional approach, including resource allocation, political alignment, and cultural adaptation.

Capacity-building through training, standardised guidelines, collaboration with experts, efficient data collection, and policy integration is essential for LCA/MFA integration.

Developing a harmonised strategy requires cross-entity collaboration, policy alignment, information exchange, joint research initiatives, and securing leadership commitment.

Implementation options include pilot projects, workshops, policy framework development, research funding, monitoring mechanisms, stakeholder engagement, and policy advocacy.

Successful execution relies on phased implementation, stakeholder dedication, and continuous evaluation.

Recognising long-term advantages, aligning political will, and encouraging collaboration contribute to a more ecologically sustainable approach to defence planning, fostering a greener future.

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