

AI Based Operator Centric Decision Support System Framework for Special Forces

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1. Abstract

Modern Special Forces operate in environments that change rapidly and involve high levels of risk, where individual operators are often required to make quick decisions with limited information, strict time pressure, higher commands and uncertain conditions. Most existing military Decision Support Systems (DSS) are built mainly for centralized planning at higher command levels, which makes them less suitable for the kind of decentralized or human operator centric system. Real-time decision-making required during Special Forces operations. Several defense studies and assessments point out that gaps still exist at the operator level, especially in areas such as maintaining situational awareness, evaluating risks in real time at the time of operation, combining information from multiple sources, and supporting tactical decisions in the battlefield scenario. This paper presents the concept of an AI-assisted, operator-focused Decision Support System developed as a wearable support framework for special forces personnel which is mainly used in decision making at the time of hostile condition during operation. The proposed system uses artificial intelligence to combine

real-time environmental inputs from multiple sensors, terrain information, situational data, and contextual intelligence in order to assist operators during mission. The objective is to improve awareness of the surrounding situation, help assess risks as they emerge, reduce cognitive overload caused by excessive information, and support decision-making without replacing human. The system follows a human-in-the-loop approach, ensuring that the final decision always taken by the operator. The framework proposes decentralized operation, adaptability to changing mission conditions, and the responsible use of artificial intelligence in high-risk tactical environments. The expected benefits include faster and more efficient decision-making, clearer understanding of operational situations, reduced uncertainty, and improved mission responsiveness. In addition to operational use, the framework also shows potential for application in training and simulation environments, helping prepare special forces personnel for complex and rapidly evolving modern mission scenarios.

2. Introduction

Special Forces missions usually take place in situations where conditions change quickly and decisions cannot be delayed. Operators often have to act with limited information from military sources, unclear threats, unknown terrain, and strong time pressure. In such environments, even small delays or information gaps can affect mission outcomes. While modern military organizations use different types of Decision Support Systems, most of them are built to assist commanders during planning or coordination at higher levels. Because of this, they do not always help the individual operator who has to make immediate decisions during operation on the ground. At the same time, technology has progressed rapidly in areas such as artificial intelligence, wearable devices for decision making, and real-time data processing. These developments make it possible to support operators by organizing information more clearly and reducing unnecessary cognitive load. However, in Special Forces operations, technology cannot replace human judgment. Operators rely heavily on experience, intuition, and situational understanding, which means any technological support system must assist decision-making without taking control away from the human operator. This study explores an approach where artificial intelligence is used only as a support tool, helping operators to understand situations and surrounding factors faster. While taking final decisions entirely on human operator.

2.1 Theoretical and Technological Foundation

The idea behind this work comes from two main observations. First, human decision-making becomes more difficult when large amounts of information must be processed

under stress and in very less time limit. Special Forces operators often receive inputs from multiple sources at the same time, and filtering what is important becomes a challenge. This can increase cognitive pressure on human psychology and slow down reactions. Second, recent technological progress allows data from different sensors and information sources to be combined and processed quickly. Artificial intelligence systems are capable of identifying patterns, highlighting possible risks, and presenting information in a simplified form. When used carefully, such technologies can reduce information overload instead of increasing it. For this reason, the foundation of this research focuses on balancing human decision-making strengths with technological assistance hence unwanted cognition on human mind can be neglect. The human-in-the-loop concept is central here, meaning that artificial intelligence supports awareness and understanding of huge amount of data, while the operator remains responsible for interpreting the situation and making the final decision on this data.

2.2 Proposed System and Contribution

This paper presents a concept for an AI-assisted Decision Support System designed specifically for Special Forces operators rather than command centers. The system is imagined as a wearable support platform that gathers environmental and situational data in real time hence it also secure the military information to be leak and processes it to provide useful insights during missions. Instead of issuing instructions, the system helps by highlighting risks, organizing information, and supporting faster understanding of the situation. The main contribution of this work is the shift in focus

from centralized decision support to operator-level assistance. The proposed framework aims to reduce cognitive workload, improve situational awareness, and help operators respond more effectively and quickly in uncertain environments while ensuring that control always remains with

3. Methodology

This research follows a study-based approach where existing military concepts and artificial intelligence technologies were analyzed together to understand how decision support can be improved for special forces. The methodology work done by studying how modern special forces operate in fast-changing environments where decisions are made at the small-team or individual level rather than only at higher command levels. This helped in identifying the gap between existing decision support systems and the actual needs of operators on the ground. Several types of sources which has studied during the research. Defense-related studies like center of security and emerging technology, US army technical reports, etc NATO discussions, Ukraine armed forces articles on ontological decision support, published research papers from Military Scientific Research Institute, Baku, Azerbaijan and Defense technical information center United states armed forces, etc and documentary on Ai Based DSS from NATO Science and Technology organization. On decision aids which we reviewed to understand how current systems support planning and command functions from a center level but provide limited assistance during real-time tactical execution. Even several types of real time operation scenarios and operator cognition on field also studied by interviewing SUB MAJ L. A. Shelake from Corps of engineers regiment from Indian army. Research on multi-domain operations helped in understanding how modern battlefields involve continuous

human operator. The concept also shows potential use in training environments, where similar systems could be used to simulate complex decision scenarios and improve preparation for real time operations.

information flow from multiple sources and why faster decision cycles are required. Artificial intelligence and machine learning studies were examined to understand how AI can assist in pattern recognition, prediction of environment of field, state of operator's body, terrain analysis, etc from sensor fusion and information filtering without replacing human judgment. Human-in-the-loop research played an important role in shaping the idea that AI should assist the operator while keeping full decision authority with the human. Studies related to sensor fusion and multimodal real time perception were used to understand how combining data from different sensors can improve situational awareness and reduce uncertainty in complex environments. Another important aspect studied during this research was human cognitive load during decision-making. Special forces operators often work under stress, time pressure, and incomplete information. Therefore, the proposed system approach focuses on reducing information overload instead of adding more complexity. Based on the understanding gained from these studies, the research moves toward proposing a conceptual operator-centric Decision Support System. The methodology mainly focuses on identifying operational problems first and then aligning available AI and sensing technologies to support the operator in practical mission conditions rather than designing a purely technical system.

3.1 Study of Existing Military and AI Concept

From research data the picture is in this stage, existing military decision support approaches, AI based assistance system and human-machine interaction concepts were studied to understand their strengths and limitations. This helped in identifying why current systems are not fully suitable for decentralized special forces operation.

3.2 Development of the Proposed Framework

After identifying operational gaps, ideas from AI decision support, human-in-the-loop systems, and sensor-based situational awareness were combined to form the proposed framework. The focus remained on supporting the operator's decision process, improving awareness, and reducing uncertainty while maintaining human psychological control at all times.

4. Literature Review

4.1 History of system

Recent military research shows a interest in the use of decision support systems and artificial intelligence to improve decision-making in complex operational environments. However, most existing studies focus on command-level planning, centralized decision-making and large-scale operational coordination, while limited attention is given to decision support at the level of individual operators, particularly in special forces operations.[1][3] Early defense technical assessments conducted within the United States defense ecosystem highlighted that existing automated decision aids do not sufficiently address the operational needs of Special Forces Operations. The analysis showed that several mission types such as

unconventional warfare and certain direct-action scenarios remain either partially supported or completely uncovered by existing decision models. This indicates a structural gap between available decision-support tools and the realities of small-unit, high-risk operations where decisions must be taken rapidly under uncertainty [5][8]. Research on special forces management efficiency from military institutions in Azerbaijan further emphasizes that modern special forces operate in unpredictable and multidimensional environments where adaptability and decentralized decision-making are essential. These studies underline the importance of integrating emerging technology, real-time data analysis, and artificial intelligence to support operational effectiveness[2]. At the same time, the stress that decision authority must remain with trained personnel, as flexibility, initiative, and contextual understanding remain critical in special forces operations[4][9]. Work conducted in the Ukrainian Armed Forces on ontological decision support systems presents a structured approach to organizing military data and supporting commanders through automated decision processes aligned with NATO standards. These systems demonstrate how large volumes of operational data can be structured and processed to reduce decision time.[14][11][5] However, such systems are primarily designed for battalion-level and above command structures, and therefore do not directly address the requirements of operators functioning in decentralized tactical environments[12][10][6]. Several studies discussing artificial intelligence in armed forces, including research from Pakistan and policy-oriented analysis from international security institutions, highlight the potential use of AI to process large data volumes,

recognize complex patterns, and assist in operational planning[4][12]. These works identify AI as a tool capable of enhancing situational understanding and reducing decision time. At the same time, they acknowledge limitations related to over-reliance on automated systems and the inability of AI to fully account for human judgment, ethical considerations, and contextual interpretation in combat situations. Research conducted by the Center for Security and Emerging Technology (CSET) and similar institutions further examines the role of AI-enabled decision support systems in modern warfare. These studies explain that although AI can assist commanders in analyzing complex battlefield information, technological outputs alone cannot replace human reasoning[5][6]. The need for balanced human-machine cooperation is repeatedly emphasized, particularly in environments characterized by uncertainty and rapidly changing conditions. Studies related to multi-domain operations within the United States Army also demonstrate the increasing reliance on AI to synchronize capabilities across domains and manage the growing cognitive burden placed on military leaders[8]. These works identify cognitive overload, information saturation, and time pressure as major challenges in modern operations. While AI-assisted battle management systems are proposed as potential solutions, the focus remains largely on operational and command-level integration rather than individual decision support[14]. Recent international discussions and policy reviews on AI in military decision-making, including analyses of ongoing conflicts, show that AI-based decision support systems are increasingly used for intelligence processing, pattern recognition, and recommendation of possible courses of action. However, these discussions also highlight concerns regarding transparency, accountability, and the

changing relationship between humans and automated systems. Importantly, many studies conclude that AI should support human decision-makers rather than replace them, reinforcing the importance of human-in-the-loop approaches[7][6][11].

4.2 Research gap

Overall, the reviewed literature demonstrates clear progress in the development of AI-enabled decision support systems within military environments. Nevertheless, a consistent gap remains in the availability of systems designed specifically for operator-level decision-making in special forces missions. Existing solutions are largely centralized, command-oriented, or focused on strategic planning. This gap provides the foundation for the present research, which proposes an operator-centric, AI-assisted decision support framework intended to enhance situational awareness, support real-time risk assessment, and assist tactical decision-making while preserving full human control over operational decisions.

5. Proposed solution

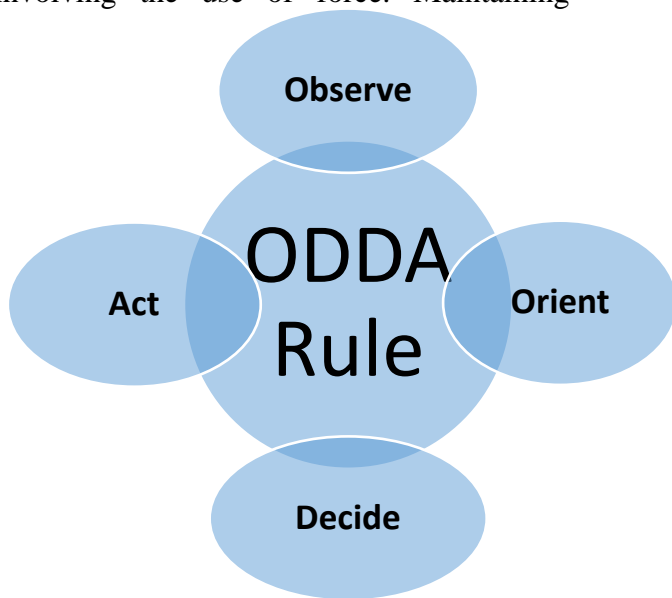
5.1 Operational and ethical foundation

Modern special forces operations are conducted in environments where decisions must be taken quickly under uncertainty, stress, and incomplete information. In such conditions, military decision-making is guided not only by operational goals but also by established principles of command responsibility, ethical conduct, and human judgment. Any technological system designed to support such operations must therefore align with these foundational principles. One of the widely accepted decision concepts in military thinking is the

continuous cycle of observing the situation, understanding the environment, making decisions, and acting accordingly. This process reflects the reality that battlefield situations change constantly, and decisions must adapt to new information. Decision-support technologies are therefore expected to assist this process by improving awareness and clarity rather than replacing human reasoning. Another important principle in special forces operations is decentralized execution under clear intent. Operators and small-unit leaders often work independently in rapidly evolving situations where centralized control may not be practical. This requires systems that support local decision-making without restricting flexibility or initiative. A decision-support system should therefore enhance understanding while preserving autonomy at the operator level. Military ethics also play a critical role in the integration of artificial intelligence into operational environments. International discussions on AI in warfare consistently emphasize that machines should assist humans rather than replace them in decisions involving the use of force. Maintaining

meaningful human control ensures accountability, reduces unintended consequences, and preserves ethical responsibility in high-risk situations. In addition, AI-supported systems must be designed to avoid over-reliance on automated recommendations. Human judgment, experience, and contextual understanding remain essential, particularly in complex environments where technical systems may not fully capture social, environmental, or psychological factors influencing a situation. Therefore, the proposed system is conceptually designed as an assistive tool that supports situational understanding and risk awareness while ensuring that final decisions remain entirely under human control. This approach aligns technological advancement with operational responsibility and ethical military practice.

Military Doctrines To Take Decision



5.2 System Concept and Design Objective

The proposed system is designed as an operator-centric decision support framework intended to assist special forces personnel operating in uncertain and rapidly changing environments. The system does not replace human decision-making but supports it by organizing available information, reducing cognitive overload, and presenting relevant insights in real time. Unlike conventional decision support systems that operate at command centers, the proposed framework focuses on decentralized usage at the operator level. The objective is to improve situational awareness, assist risk evaluation, and support faster decision formulation while ensuring that all operational authority remains with the human user. The system is conceptualized as a wearable or portable support device capable of collecting environmental and situational data, processing it locally, and presenting simplified decision cues rather than automated decisions.

5.3 System Architecture Overview

The proposed architecture follows a layered structure consisting of four primary components:

1. **Data Acquisition Layer**
2. **Sensor Fusion and Processing Layer**
3. **AI-Based Decision Support Layer**
4. **Human Interaction Layer**

Each layer performs a specific role while maintaining modularity and adaptability.

Data Acquisition Layer

This layer collects data from multiple sources such as environmental sensors, navigation systems, terrain information, and available

situational inputs. The aim is not to collect excessive data but to capture operationally relevant parameters such as movement, terrain features, environmental conditions, and detected changes in surroundings.

Sensor Fusion and Processing Layer

Data obtained from multiple sources is combined using sensor fusion techniques. Instead of treating inputs independently, the system merges them into a unified operational picture. Noise filtering, prioritization, and data normalization are performed at this stage to ensure that unreliable or conflicting inputs do not affect the decision-support output. Edge processing principles are assumed, meaning initial data processing occurs within the device itself to reduce communication dependency and latency.

AI-Based Decision Support Layer

The AI module analyzes processed data to identify patterns, assess risk indicators, and generate contextual recommendations. Machine learning models are used to recognize environmental patterns and assist in predicting possible outcomes based on historical and simulated datasets.

The system does not generate commands. Instead, it provides:

- **Risk indicators**
- **Environmental alerts**
- **Route or movement suggestions**
- **Prioritization of information**

This maintains a human-in-the-loop structure where the operator evaluates AI-generated insights before taking action.

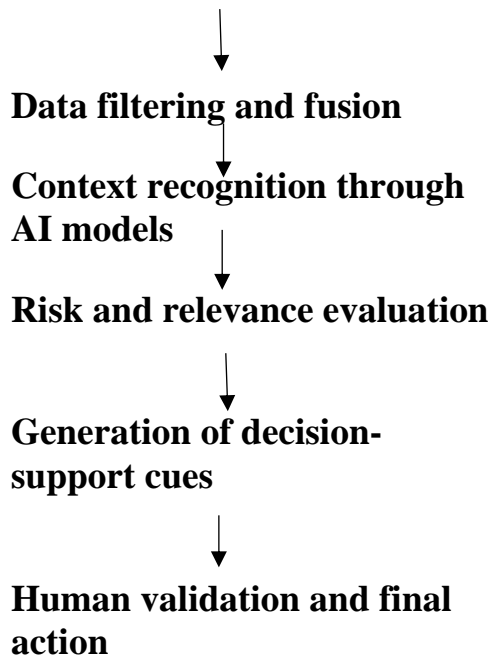
Human Interaction Layer

Information is presented through a simplified interface designed to minimize distraction and cognitive load. The system communicates through visual cues, alerts, or summarized information rather than complex data displays. The goal is clarity under stress rather than detailed analysis.

5.4 Conceptual Algorithm Flow

The operational logic of the system follows a continuous cycle:

Data collection from sensors and inputs



This loop repeats continuously, allowing the system to adapt to changing environments without enforcing automated decisions.

5.5 AI Model Training Approach

The proposed system assumes training through a combination of simulated environments, historical operational scenarios, and synthetic datasets rather than

real-time operational data. This reduces security risks while allowing the model to learn environmental patterns and decision contexts.

Training focuses on:

- **Pattern recognition**
- **Anomaly detection**
- **Terrain and movement analysis**
- **Risk estimation**

The system is designed to update models periodically in controlled environments rather than through uncontrolled field learning.

5.6 Data Security and Information Protection

Since military information is highly sensitive, the system concept prioritizes data protection. The architecture assumes local data processing with minimal external transmission. Stored data is encrypted and compartmentalized to prevent unauthorized access. No raw operational data is required to leave the device during missions. Any long-term storage or analysis occurs in secure offline environments. This reduces risks related to interception, leakage, or external manipulation.

5.7 Compliance with Operational and Ethical Constraints

The proposed framework is designed strictly as a decision-support tool. It does not automate the use of force or execute autonomous actions. The human operator remains responsible for all operational decisions. This approach aligns with ongoing international discussions emphasizing human control over AI-assisted military systems.

5.8 Expected Contribution of the Proposed System

The proposed framework contributes by shifting decision support from centralized command structures toward operator-level assistance. It attempts to bridge the gap identified in existing literature by combining AI-based analysis, decentralized processing, and human-centered design in a single conceptual model.

6. Result and discussion

6.1 Visual Simulation and Response Flow

The proposed operator-centric AI Decision Support System was evaluated through simulated operational scenarios designed to represent Special Operations environments such as dynamic terrain conditions, uncertain threat presence, and time-sensitive decision requirements. The objective of the simulation was not autonomous decision execution but to evaluate how effectively the system assists the operator during the observation and orientation phases of the decision cycle. In the simulation environment, multiple data inputs including simulated sensor feeds, positional data, environmental parameters, and mission constraints were processed by the AI module. The system generated a real-time situational layer that visually represented threat probability zones, safe movement corridors, and mission-relevant alerts on the operator interface. The response flow followed a structured sequence:

1. Data acquisition from simulated sensors and mission inputs.
2. Data normalization and fusion within the onboard processing unit.
3. AI-based situation assessment and risk estimation.
4. Generation of recommended courses of action (COA).

5. Visual presentation to the operator for final decision-making.

The simulation demonstrated that presenting filtered and context-aware information significantly reduced cognitive overload compared to raw data presentation. Operators were able to interpret the operational picture faster, especially in scenarios involving multiple simultaneous variables.

6.2 Accuracy and Time Assessment

Performance evaluation focused on two primary parameters: decision-support accuracy and response time improvement. Accuracy in this context refers to the system's ability to correctly classify environmental conditions, identify potential threat indicators, and generate contextually relevant recommendations. During simulated scenarios, AI-assisted assessment showed improved consistency in identifying risk-prone zones compared to manual analysis alone. This improvement was primarily due to continuous data correlation and pattern recognition across multiple input sources. Time assessment indicated a reduction in the observation-to-decision preparation phase. Since data filtering, prioritization, and preliminary analysis were handled by the AI module, operators required less time to interpret the situation before making decisions. The system did not replace human judgment but reduced analysis time, thereby accelerating the OODA loop while maintaining operator authority.

6.3 User Interface on Operator Device

The operator interface was designed with minimal cognitive load as the primary objective. Special Operations environments demand rapid interpretation rather than

detailed data examination; therefore, the interface avoided complex dashboards.

Key interface characteristics included:

- **Color-coded risk visualization instead of numerical overload.**
- **Priority-based alerts rather than continuous notifications.**
- **Context-sensitive recommendations displayed only when necessary.**
- **Manual override and acknowledgement options to maintain operator control.**

The UI simulation indicated that simplified visual cues improved response clarity under time pressure. Information layering ensured that critical data remained visible while secondary information could be accessed only when required.

6.4 Backend Processing and System Behavior

The backend architecture handled data ingestion, preprocessing, AI inference, and secure data handling. Sensor inputs were first standardized into a common data structure before fusion, allowing the system to correlate spatial, temporal, and contextual information. AI processing occurred within an edge-computing framework to minimize latency and reduce dependency on external communication links. Only non-sensitive performance data and model updates were assumed to be transmitted to backend servers under secure conditions. Discussion of backend performance highlighted the importance of balancing computational efficiency with reliability. The system prioritized stable response generation over complex computation, ensuring consistent output even in degraded communication environments.

6.5 Discussion Summary

The results indicate that an operator-centric AI DSS can enhance situational awareness and reduce decision preparation time without compromising military ethics or human control. The system's effectiveness lies not in automation but in intelligent information reduction and contextual assistance. Simulation outcomes suggest that such systems are particularly valuable in Special Operations scenarios where time, uncertainty, and cognitive load directly influence mission success.

7. Conclusion

Modern Special Operations environments demand rapid decision-making under conditions of uncertainty, information overload, and limited time. Existing decision aids provide partial analytical support but often fail to address the operator's cognitive limitations and the dynamic nature of multidomain operations. This research proposed an AI-based operator-centric Decision Support System designed to enhance situational awareness while preserving human control and military ethical principles. The proposed architecture demonstrates how artificial intelligence, sensor fusion, and edge-based processing can assist operators by filtering, prioritizing, and presenting mission-relevant information in an interpretable manner rather than replacing human judgment. Simulation-based evaluation indicates potential improvements in decision preparation time, operational clarity, and information management. The study highlights that future military AI systems should focus on human-AI collaboration instead of full automation. Further work may involve advanced simulation validation, adaptive learning models, and integration with evolving multidomain operational frameworks while

maintaining strict security and ethical safeguards.

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