Operational Analysis Utilizing a Risk Assessment Framework

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ABSTRACT

The NATO Science and Technology Organization (STO) Applied Vehicle Technology (AVT) 329 "NexGen Rotorcraft Impact on Military Operations" assessed the potential impact on military operations from developments in applicable science and technology (S&T) in the 2035+ timeframe. The assessments employed risk based Subject Matter Expert (SME) judgment during two Operational Analysis (OA) assessments of projected future missions.

Using defined mission vignettes, participant SMEs identified risks to achieving each mission using current NATO military helicopter capabilities. Each risk was then assessed for likelihood of occurrence and impact to achieving the mission. For each risk, mitigations identified included the application of technology, changes in tactics, and other measures. The operational impact of risk mitigation measures identified were subsequently evaluated for their military worth.

The risk-based assessment framework enabled a qualitative OA by SMEs from multiple NATO and partner nations with expertise in military operations, requirements, and technology. Since all the participants were previously familiar with the risk assessment process, the framework was easily adapted to conducting the OAs for trade space operational needs and key technologies.

1.0 INTRODUCTION

A significant proportion of the current NATO rotorcraft fleet is expected to reach the end of its programmed life between 2035 and 2055 and will require update or replacement. The NATO Next Generation Rotorcraft Capability (NGRC) is a High Visibility Project aimed at the development of a future medium multi-role rotorcraft that will replace multiple legacy types in this timeframe. AVT 329 is a Long Term Scientific Study (LTSS) assessing the impact on military operations from developments in applicable Science and Technology (S&T) between 2035 and 2055. Results from the AVT 329 studies provides valuable trade space information that will be used to support decisions within NGRC. This information was collected through a first Operational Assessments (OA) at the unclassified and then sequentially at a second more detailed OA.

Significant activities undertaken by AVT 329 include:

- 16-20 September 2019 Multi-National Exercise (MNE) (Reference 1)
- 23-25 November 2020 1st Operational Assessment (Reference 2)
- 20-24 June 2022 2nd Operational Assessment (Reference 3)
- 31 December 2022 Final Report to STO

The initial activity under AVT 329 was to undertake a Multi-National Exercise (MNE) in September 2019. This took place at the Joint Air Power Competence Centre (JAPCC); a NATO accredited Centre of Excellence for Joint Air & Space, based in Kalkar, Germany. The MNE brought together representatives from NATO organizations and national subject matter experts on applicable future operational environments,

technologies, acquisition, needs, modelling and analysis, and wargaming / operational evaluation. The MNE report (Reference 1) formed the basis for the plan to conduct the operational assessments.

The MNE was followed by an OA at NATO Unclassified (NU) level that was conducted virtually from 23-25 November 2020. The assessment used generic mission vignettes, risks, identification of mitigation strategies, and a broad assessment of military worth. The NU OA was the first employment of the risk based assessment process and produced an unclassified report (Reference 2)

The next stage of the LTSS was to effectively repeat the OA conducted in 2020 using endorsed NATO information relating to the projected threat environment, mission vignettes, and specific geographic locations for the missions assessed. This OA was conducted from 20-24 June 2022 at JAPCC and will produced a more detailed report (Reference 3).

The output from the OA provides a qualitative assessment of the impact of advanced technologies embodied in a next generation rotorcraft on military operations. This information will support the trade space assessment within AVT 329 and inform partner nations on the risk of current rotorcraft in the 2035+ operational environment and military effectiveness of the next generation rotorcraft.

2.0 ANALITICAL METHODS

The assessment process employed a risk-based assessment methodology of future medium multi-role rotorcraft operating in projected 2035+ environments. The approach used vignettes to frame missions, identification of risks to achieving the missions, mitigation of risk using technology, changes in tactics, and subsequent evaluation of the military worth of the resultant mitigation.

2.1 Supporting Information

Prior to OA execution, annexes were generated to document the projected state of applicable technology and operational environment in the 2035+ timeframe for the next generation rotorcraft. The data in these annexes allowed a consistent view of future parameters in support of the operational assessment.

2.1.1 Technical Annex (NU)

Unclassified supporting technical data appeared in the Technical Annexes (References 4 and 5). The Technical Annex describes the projected technology which will be available for the next generation rotorcraft). Sections contained in this annex include:

1. Projection of Military Power - quantitative data for flight characteristics achievable by future rotorcraft platforms. Supporting data shows platform performance for different configurations (e.g. helicopter, compound, tilt rotor).

2. Enhanced Capabilities - qualitative assessment of future capabilities achieved from current and projected investments.

2.1.2 Operational Annex

The 2nd OA included an annex (Reference 6) with sections for the operational environment, vignette derived from an existing NATO operational scenario, and detailed results linked to the main report risk assessment results.

2.1.3.1 Operational Environment

The Operational Environment section contains data for the OA geographic locations, environmental conditions, and briefly the trend of threat systems for the 2020-2030, 2030-2040, and 2040+ time periods. This information was used in conjunction with the rotary wing vignettes derived from the NATO scenario to provide a common basis for the operational assessment.

2.1.3.2 Mission Vignettes

The mission vignettes provided a common vision of the Next Generation Rotorcraft employment. These missions employed data from the Operational Environment and with projected NGRC technical solutions. Development of the mission vignettes was directly based on an existing NATO wargaming scenario. For this operational assessment, the scenario was applied to three distinct geographic locations for:

- Cold conditions
- Littoral conditions
- Highly urban conditions

2.1.3.3 Detailed Results

Detailed results were generated during the assessment process for each of the identified risks. This section is an expansion of the summary information main report from the OA. For each risk, the additional details are organized by the same categories used in the summary results matrix in the main report (template appears as Figure 1).

- Explanation of Risk
- Risk Assessment
    - Probability of Occurrence
    - Impact
- Mitigation
- Impact of Mitigation

2.2 Assessment Process

2.2.1 NU Operational Assessment Process and Report

The NU OA occurred virtually from 23-25 November 2020 with a pre-release of the final report dated 22 April 2021 (Reference 2). Results of the NU OA directly contributed to the 2nd OA. Main contributions included:

- Unclassified risk identification, assessment, mitigation and evaluation of military worth
- Verification of the risk based assessment process, framework and methodology for conducting the OA
- Final report development and organization

2.2.2 2nd Operational Assessment Process and Report

The 2nd OA occurred from 20-24 June 2022 at JAPCC. The OA used a risk based approach refined from the previous NU OA. Using a NATO operational mission with a focused rotary wing vignette, participants identified operational risks and then proceeded to assess each risk for probability and impact, operational consequence, mitigation, and military worth of mitigation. Results were documented in a summary matrix and as detailed results in the Operation Annex (refer to section 2.1.2). Information contained in the Detailed

Results annex expands on the condensed summary table contained in the base report with supporting data and details.

The mission vignettes were evaluated for three geographic locations by two workgroups. These results were consolidated into the final report Summary Results and Detailed Results.

- Workgroup 1 –
  - Physical Environment
  - Comms and Sensor Denial
  - Positive ID of Objective
  - Cyber
  - Directed Energy
  - CBRN
- Workgroup 2 –
  - Physical Environment
  - Air To Air Threats
  - Air Defense Threat: Unguided
  - Air Defense Threat: SHORAD / MANPAD
  - Air Defense Threat: AAA and Hybrid
  - Air Defense Threat: IADS

Each workgroup populated the summary results matrix for their associated risk areas with a qualitative risk assessment:

- Risk Identification – for each geographic location, risks were identified that may impact future operations in the relevant military environment

- Risk Assessment – each identified risk (based on current rotorcraft systems), was evaluated for Probability of Occurrence and Impact

- Mitigation – potential mitigation methods to reduce the effect of the risk through changes to doctrine, procedures or technology

- Military Worth – each identified risk was assessed for its consequence to military operations and the value of mitigation measures

For each risk, the Probability, Impact, and Military Worth was evaluated using a relative scale as HIGH, MODERATE, or LOW. These results were collected into a common matrix format as given in Figure 1. As noted previously, additional data for each risk was expanded upon in the Detailed Results section of the Operational Annex.

The assessment considered application of the NATO operational scenario into three different geographic locations. The locations, or Physical Environments included Cold, Littoral (Sea), and Highly Urban. These depict emerging conditions which may require large scale NATO military operations in the future. For each location, three different timeframes for threat systems / capabilities included 2020-2030, 2030-2040, and 2040+.

- Physical Environment based on Geographic Region
  - Cold
  - Littoral
  - Highly Urban

- Threat System / Capabilities Timeframes
  - 2020-2030 current threats
  - 2030-2040 projected threats
  - 2040+ postulated threats

For each geographic location, a common results matrix and colour scheme was used to depict the relative level of the Probability, Impact, Mitigation, and Military Worth of Mitigation for NATO rotorcraft in the future operational environments. This included a colour scheme of Red – High, Yellow – Moderate, and Green - Low. Figure 1 depicts the matrix template that was used through the 2nd OA.

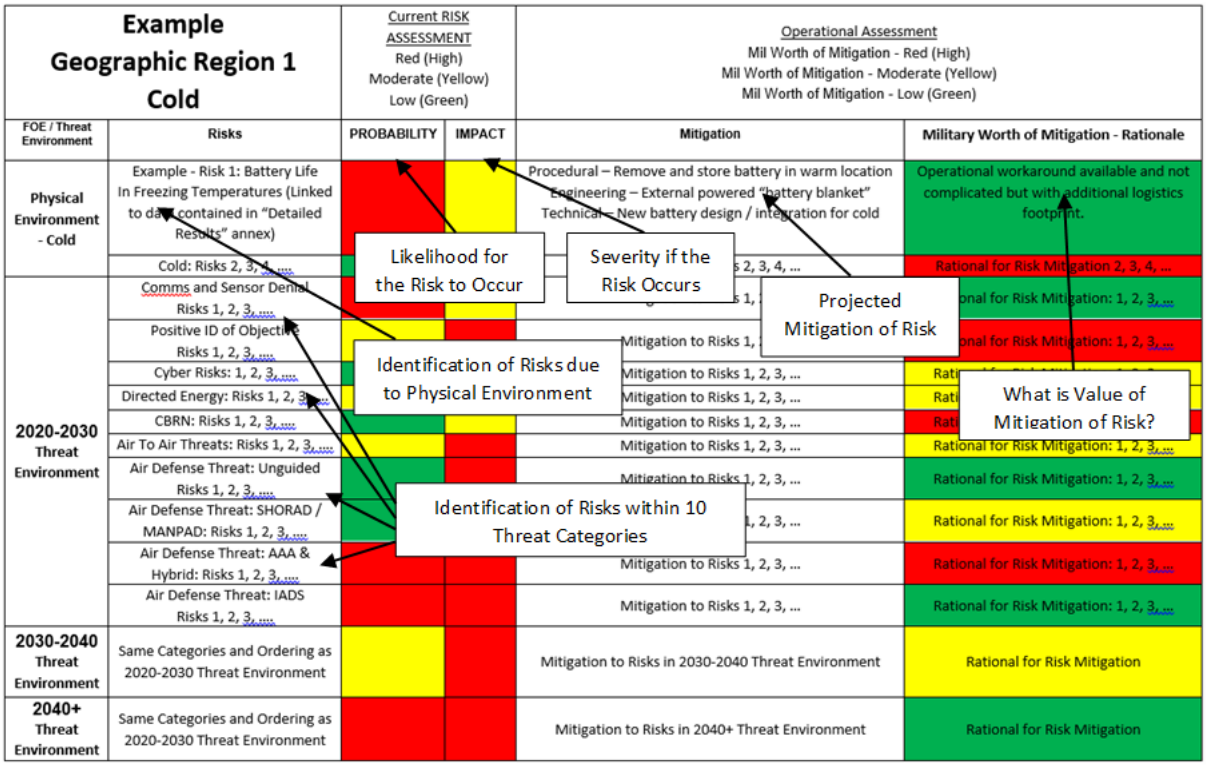

Figure 1: Summary Results Matrix

3.0 RESULTS

The 2nd OA produced a summary matrix for each of the three geographic location as well as supporting detailed data. Within the solution space (i.e. mitigation), projected technology advancements are leveraged by the next generation rotorcraft. Rotary wing focused mission vignettes effectively portrayed the scenario, geographic locations, and operational timeframes found within the operational annex. For each of the identified mission risk, SMEs across a broad set of backgrounds and expertise could conduct a consensus operational assessment.

The OA considered military missions with variations for operational environment for:

- Geographic Location 1 – Cold
  - Physical Environment
  - Threat Environment Timeframe
    - 2020-2030
    - 2030-2040
    - 2040+

- Geographic Location 2 – Littoral
  - Physical Environment
  - Threat Environment Timeframe
    - 2020-2030
    - 2030-2040
    - 2040+
- Geographic Location 3 – Highly Urban
  - Physical Environment
  - Threat Environment Timeframe
    - 2020-2030
    - 2030-2040
    - 2040+

Each of the geographic locations (Cold, Littoral, Highly Urban) produced a summary matrix with supporting detail contained within the operational annex.

4.0 CONCLUSION

The OA used a risk based assessment process common across the participating nations and NATO organizations. This enabled framing discussions and organization of results so SMEs were readily able to utilize the process during the OA. The OA focused on rotary wing aircraft and corresponding threat systems within the operational context for the future rotorcraft. Summary results contained an identification of the risk, risk assessment (probability and impact), mitigation, and military operational value of the mitigation. For each risk, detailed results elaborated on the summary results. For each risk, the assessment used a qualitative assessment for:

- Risk identification of current rotorcraft platforms in future operational environment
- Probability of risk to be realized
- Impact of risk occurrence on mission capability
- Identification of mitigation measures
- Evaluation of impact of the mitigation measures

5.0 REFERENCES

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2. NexGen Rotorcraft Impact on Military Operations, Operational Assessment (NU), Final Report, AVT-LTSS-329 Technical Memo, 22 April 2021.
Distribution – NU + EOP + CHE + JPN + KOR + NZL

3. NexGen Rotorcraft Impact on Military Operations, Operational Assessment, Final Report, AVT-LTSS-329 Technical Memo, Pending publication.

4. NexGen Rotorcraft Impact on Military Operations, Operational Assessment (NU), Technical Annex, AVT-LTSS-329 Technical Memo, 22 April 2021.
Distribution – NU + EOP + CHE + JPN + KOR + NZL

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Distribution – NU + EOP

6. NexGen Rotorcraft Impact on Military Operations, Operational Assessment, Operational Annex, AVT-LTSS-329 Technical Memo, Pending publication.

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