A Report by NATO's
Joint Analysis and Lessons Learned Centre

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NATO INTEROPERABILITY VERIFICATION & VALIDATION

ANALYSIS OF KEY EVENTS PROVIDING CIS INTEROPERABILITY VERIFICATION & VALIDATION OPPORTUNITIES

THE CUSTOMER FOR THIS PROJECT IS HQ SACT CAPDEV C2DS ACOS

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FOREWORD FROM THE COMMANDER

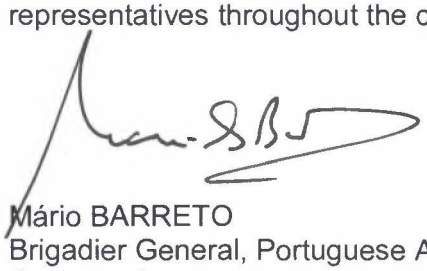
I am pleased to present this report on the analysis of key NATO and multinational events providing opportunities to Allies and Partners for Communication and Information Systems (CIS) Interoperability Verification and Validation (IV&V). The Joint Analysis and Lessons Learned Centre (JALLC) was tasked with this analysis by Supreme Allied Commander Transformation (SACT) in order to make recommendations for a greater harmonization of such events, and to support the further development of the SACT Command & Control (C2) Focus Area. In this endeavour, the JALLC project team analysed the CIS IV&V opportunities, objectives, elements supporting the achievement of these objectives, and IT tools employed for eight key events as requested by our customer, HQ SACT C2DS ACOS.

From my perspective, the most encouraging conclusion of this study is that the eight key events provided CIS IV&V opportunities that were beneficial to nations and that increased participation is foreseen going forward.

The analysis conducted led the team to several more conclusions that will certainly benefit NATO, the Allies, and Partners related to the following aspects; cyber; use of terminology; exploitation of the outcomes; Governance of the events; and, interoperability of supporting IT tools. Based on these conclusions, the project team were able to make several recommendations that are intended to contribute to a greater harmonization of such events and further support the development of the SACT C2 Focus Area.

I wish to note that this detailed analysis would not have been possible without substantial contributions from the Directors of the reviewed events and the numerous Subject Matter Experts consulted. Among the latter, I would like to highlight the particular dedication of staff from HQ SACT C2DS, SHAPE J6 and NATO HQ C3 Staff who provided much salient information during many interviews and interactions. Moreover, the NATO HQ C3 Staff's support in distributing the project team's survey to nations is much appreciated and contributed to a solid and reliable information base.

I also wish to recognize the fruitful dialogue and interaction with the customer and his representatives throughout the course of the project.



Mário BARRETO
Brigadier General, Portuguese Air Force
Commander

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This project was executed by:

Project Manager:	SEVILLA, Marcos – CDR USA N – Military Analyst
Analysts:	FARDELLI, Marcello – CDR ITA N – Military Analyst
	OLARU, Stefan – ROU NIC – Research Analyst
With cooperation from:	REDMAYNE, John – GBR NIC – PORA
	LAZELL, Jodie – GBR NIC – Editor

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Joint Analysis and Lessons Learned Centre

AVENIDA TENENTE MARTINS, MONSANTO
1500-598 LISBON
PORTUGAL

TEL: +351 21 771 7002

FAX: +351 21 771 7098

www.jallc.nato.int

EXECUTIVE SUMMARY

BACKGROUND AND MISSION

Interoperability is critical to every aspect of Communication and Information Systems (CIS) capability development, from initial concept through to operational use. Consequently, CIS Interoperability Verification and Validation (IV&V) is a prerequisite in achieving the appropriate level of interoperability to ensure the effectiveness of Alliance Forces—and in particular the NATO Response Force—across the full spectrum of Alliance missions. In this context, several events are available to NATO Allies and Partner nations that afford CIS IV&V opportunities; and effective coordination and synchronization of these events is necessary to permit the effective exploitation of their outcomes to the benefit of NATO, the Allies, and Partners.

Against this background, Supreme Allied Commander Transformation (SACT) tasked the Joint Analysis and Lessons Learned Centre (JALLC) to conduct an analysis of the events that provide the main CIS IV&V opportunities and make recommendations for a greater harmonization of them. The task, reflected in a Joint Analysis Requirement, was included in the JALLC Programme of Work for the first semester 2016, and was also identified as an opportunity to support further development of the SACT Command & Control (C2) Focus Area.

Joint Analysis Requirement: Review key NATO and multinational events that provide the main opportunities for CIS IV&V and make recommendations for greater harmonization of these events relating to, inter alia, CIS IV&V objectives, elements supporting the achievement of these objectives, and supporting tools, in order to support the further development of the SACT C2 Focus Area.

METHODOLOGY

The JALLC project team first conducted a detailed review of CIS IV&V policies and directives and of relevant documents related to the iterations during the period 2014 - 2016 of the following eight events: TIDE (Technology for Information, Decision and Execution Superiority) Sprint; CWIX (Coalition Warrior Interoperability eXploration, eXperimentation, eXamination, eXercise); BOLD QUEST (BQ); UNIFIED VISION (UV); FMN (Federated Mission Networking) CIAV (Coalition Interoperability Assurance and Validation); CYBER COALITION (CC); STEADFAST COBALT (SFCT); and TRIDENT JUNCTURE (TRJE). The literature review was complemented, where necessary, by discussions with Subject Matter Experts (SME).

Subsequently, the project team observed the execution phases of SFCT16, CWIX16, and TRJE16, as well as the Final Planning Conference of CYBER COALITION 16. Additionally, the project team conducted interviews with over 75 key personnel involved in the reviewed events.

Finally, in order to validate some of the preliminary findings, a survey was distributed via the NATO HQ Consultation, Command, and Control (C3) Staff to NATO C3B members and the seven Non-NATO Nations.

MAJOR CONCLUSIONS

The overarching conclusion of the analysis is encouraging; the CIS IV&V opportunities afforded by the reviewed events (2014 - 2016) were beneficial to nations, meeting their needs, and increased participation is foreseen for the next three years (2017 - 2019).

Specifically with regard to CWIX, although there are significant recognized benefits for the participating nations, there is an increased willingness to have more tangible benefits for NATO as the enterprise providing the CWIX framework.

The objectives of the reviewed events as currently promulgated show delineation between the events without significant overlap. However, there is a need to plan the events in a more coordinated manner in order to de-conflict timelines and ensure that outputs (tests performed, test results, lessons, etc.) are exploited from one event to another, in order to deliver the desired end-state of assured CIS interoperability with efficient use of resources.

All the reviewed events have a cyber element that may be further harmonized in order to provide increased benefits.

There is a need to review current CIS IV&V terminology in order to ensure a common baseline is used during the conduct of events.

SMEs from NATO, Allies and Partners demonstrated willingness for a common Governance of the events; however, Governance of the events is presently implemented in a distributed way that appears to satisfy current requirements. It is considered that a more detailed and standardized regulatory framework is needed to better identify the entities and delineate the roles and responsibilities for governance and management.

An advisory function and a coordination function would support the Governance entities of the reviewed events in their efforts towards increased harmonization of the events.

There are a significant number of different IT tools employed in the reviewed events, some of which are not interconnected at the appropriate level to support effective NATO Interoperability testing.

KEY RECOMMENDATIONS

In light of the conclusions drawn from the analysis, the project team makes a number of recommendations which are further detailed in this report. The following recommendations are considered key in the context of this study and are offered for the consideration of HQ SACT as the appropriate tasking authority:

a. Initiate the development of a CIS IV&V Portfolio as an Annex in the Military Training and Exercise Programme (MTEP) and include this portfolio in the Allied Command Transformation (ACT) Key Deliverables Plan/ACT Capacity Post Warsaw Summit.

b. Conduct a study on cyber IV&V opportunities, in order to identify ways for their increased harmonization.

c. Engage with appropriate authorities to review the requirements for a suitable Interoperability Testing solution and further support the approval of Capability Package (CP) 9C0102 as requested by the Strategic Commanders.

d. Engage with appropriate authorities for development of a *Governance Directive/Overarching Guidance* for each event, detailing the structures and delineating the roles and responsibilities between Governance and management entities. Such documents should be seen as long-term provisions and may be complemented by *Terms of Reference* for the management entities.

e. Engage with appropriate authorities in order to formalize an advisory function supporting the Governance structures; and to formalize a coordination function with representatives at management level from all events.

DISTRIBUTION

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JCGISR

NCIA Independent Verification and Validation Line

JWC COS

JFTC COS

CONTENTS

1 INTRODUCTION

BACKGROUND

1. The challenges of the current emerging security environment require NATO to modernize and adapt in order to achieve its objectives. An important factor contributing to this achievement is the smooth and close cooperation between national, multinational, and NATO assets that leads to interoperability, *"…the ability to act together coherently, effectively and efficiently to achieve Allied tactical, operational and strategic objectives."*[1]

2. From a Consultation, Command and Control (C3) perspective, there are three principles that ensure the development and effective use of C3 capabilities across the three main dimensions of interoperability (technical, human, and procedural). One of these principles is the, *"Verification and validation of interoperability solutions through testing."*[2]

3. Communication and Information Systems (CIS) interoperability is critical to every aspect of capability development, from initial concept through to operational use. From this perspective, there are several events that allow CIS Interoperability Verification and Validation (IV&V) opportunities,[3] available both to NATO Allies and Partner nations, to prepare for operational readiness of the NATO Response Force (NRF) and for future operations. However, these events do not appear to be coordinated and synchronized to allow an effective exploitation of their outcomes and a greater contribution to NATO's Transformation.

4. In this context, Supreme Allied Commander Transformation (SACT) tasked the Joint Analysis and Lessons Learned Centre (JALLC) in its Programme of Work 2016/1 (Reference C) to conduct an analysis of the events that provide the main CIS IV&V opportunities, and their benefits for capability development and operational readiness that will eventually strengthen NATO's military posture.

5. A strong deterrence and defence posture is critical to the Alliance's military and political credibility. To be militarily credible, such posture must rely on a solid and modern foundation—*NATO's Capacity*—that SACT is approaching as a system of systems based on six Focus Areas. One of these Focus Areas is Command and Control (C2) which as stated in Allied Command Transformation's (ACT) 2015 Annual Report (Reference D), is identified as the backbone of NATO's Capacity and the main driver for offsetting any advantage potential adversaries may have.

6. In this context, as CIS IV&V opportunities are directly linked to C2, the customer identified this study as an opportunity to support further development of the SACT C2 Focus Area.

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[1] NATO Interoperability Policy; Page 1-1 (Reference A).

[2] Alliance C3 Interoperability Policy / Alliance C3 Policy; Page 5-2 (Reference B)

[3] The events reviewed in the context of this study allow for CIS interoperability opportunities that span testing for Exploration; Examination; Experimentation; Verification; Validation; Confirmation; and Certification. The project team notes that some of these terms relate only to a specific event and not all of them have official NATO definitions. Moreover, such terms appear to often be used interchangeably with the general phrase *Interoperability Verification and Validation* by the CIS community. In this report *Interoperability Verification and Validation* and its acronym *IV&V* will be used to cover the full spectrum of what is being tested at such events.

JOINT ANALYSIS REQUIREMENT AND RESEARCH QUESTIONS

Joint Analysis Requirement: Review key NATO and multinational events that provide the main opportunities for CIS IV&V and make recommendations for greater harmonization of these events relating to, inter alia, CIS IV&V objectives, elements supporting the achievement of these objectives, and supporting tools, in order to support the further development of the SACT C2 Focus Area.

7. For the purposes of this study, and as agreed with the customer, the key events providing CIS IV&V opportunities to be included in the analysis are listed below.[4] The review of these events is limited to the period 2014-2016.

a. Technology for Information, Decision, and Execution Superiority (TIDE) Sprint;

b. Coalition Warrior Interoperability eXploration, eXperimentation, eXamination, eXercise (CWIX);

c. BOLD QUEST (BQ);

d. UNIFIED VISION (UV);

e. Federated Mission Networking (FMN) Coalition Interoperability Assurance and Validation (CIAV);

f. CYBER COALITION (CC);

g. STEADFAST COBALT (SFCT); and

h. TRIDENT JUNCTURE (TRJE).

8. The project team developed the following Research Questions (RQ) based on the Joint Analysis Requirement:

RQ1. What are the CIS IV&V opportunities provided by these events?

RQ2. What are the objectives of these events and how can their harmonization be increased?

RQ3. How do Governance structures and processes impact the harmonization of the reviewed events?

RQ4. What are the elements that support the achievement of these objectives and how do they impact this achievement?

RQ5. What are the IT tools supporting these events and how can they be harmonized?

PURPOSE OF THE REPORT

9. The purpose of this report is to present the project team's findings after reviewing and analysing the events and to make recommendations to: improve the nations' ability to participate more effectively in CIS IV&V related events; and contribute to the further development of SACT's C2 Focus Area. Additionally, the findings may benefit those stakeholders involved in planning and conducting the reviewed events.

SACT C2 Focus Area

10. SACT has developed the *C2 Vision 2030* to address, "… *interconnectivity and interoperability between and synchronization of three fundamental phases: collecting,*

[4] For the purposes of this report, the project team refers to each event by its most commonly used name. However, in tables, figures, etc., the appropriate acronym or abbreviation may be used for ease of reference.

decision-making, and effecting."[5] These phases were further developed and depicted, resulting in a six-step C2 vision model—connecting, sensing, processing, sense making, deciding, and effecting—as detailed in the 2030 Vision and Roadmap in Tidepedia (Reference E).

11. As described in the SACT C2 Focus Area in Tidepedia, SACT has identified three interrelated strategies, aiming to improve today's NATO C2 Legacy Capabilities (Strategy 1); to develop a future C2 Vision (Strategy 2); and to develop a C2 Roadmap (Strategy 3). In the short term, Strategy 1 aims to create an inventory of C2 Legacy Capabilities in order to enhance training and exercises; create greater coherence for the development of C2 capabilities while emphasizing the readiness, responsiveness, and interoperability of existing ones; and harmonize, restructure, and accelerate the current C2 programmes. This report directly supports Strategy 1 by providing an inventory of CIS IV&V opportunities; by analysing the objectives, Governance, tools, and other relevant aspects of reviewed events; and by providing recommendations for greater harmonization of CIS IV&V events.

STRUCTURE OF THE REPORT

12. The findings from the analysis of the events were numerous and diverse. The project team has structured this report in order to optimize the presentation of these findings. Therefore, the following chapters of this report provide a high-level overview of the key points and do not purport to convey the complete findings from the analysis relating to the relevant chapter's topic. For the full set of findings and additional context, the discerning reader must also read the related supporting Annex(es). In this respect the following four topics are presented in this report in the relevant chapters and supporting annexes:

a. Overview of Key Events: Chapter 2 provides a brief description of the eight key events reviewed in the context of this study. There are no supporting annexes to this chapter.

b. CIS IV&V Opportunities and Objectives: Chapter 3 sets out the CIS IV&V opportunities and objectives related to the events.

- Annex C then goes into detail regarding the relationship between events with regard to what opportunities they provide in terms of the frequency of the event, the Capability Lifecycle, the main benefits and the relevant venues where such benefits can be achieved.
- Annex D takes a closer look at how event objectives (general and specific) potentially overlap and what factors are, or should be, contributing to (improved) harmonization of these objectives.

c. Governance: Chapter 4 presents an overview of the relevant event governance structures, what the impact of the current governance structures is on harmonization of the events, and what needs to be done to improve governance structures accordingly.

- Annex E presents the review of the decision making process per event and provides additional conclusions and recommendations in this respect.

d. Elements supporting the achievement of the objectives: Chapter 5 summarizes the analysis of the various elements of an event that work together to achieve the objectives: Processes; Information; People; and Technology.

[5] 2030 Vision and Roadmap / Tidepedia; https://tide.act.nato.int/tidepedia (Reference E); 29 April 2016; Last accessed- 25 January 2017. Tidepedia is an online information repository and platform for the TIDE community.

- Annex F presents more details on each of the elements as identified by the project team from their review of the events. Additional conclusions and recommendations are also made in this annex.
- Annex G takes an in depth look at the project team's findings from analysis of the relevant tools used in support of the events: those relating to Community Interaction and those relating to Testing.

METHODOLOGY

13. The project team first conducted a detailed review of approximately 76 CIS IV&V-related documents (see reference list and additional bibliography). This literature review was complemented, where necessary, by email correspondence and telephone conferences with Subject Matter Experts (SME). The project team then observed the execution phases of SFCT16, CWIX16, and TRJE16 as well as the Final Planning Conference of CYBER COALITION 16. Additionally, semi-structured interviews with key personnel (more than 75, of whom 23 were at senior level[6]) involved in the reviewed events were conducted by the project team. In order to validate some of the initial findings, a survey was sent to the members of the NATO C3 Board (NC3B) and to the seven Non-NATO Nations (7 NNN).[7] From a possible total of 26 responses, a total of 16 NATO member and Partner nations responded, a return rate of 62%. The project team did not carry out any further inquiry to compensate for the missing responses. A copy of this survey is provided in Annex H. Qualitative data analysis was carried out in order to support the project team in providing recommendations and good practices for the harmonization of the events.

FACTORS AFFECTING THE ANALYSIS

14. The timeframe for completing the data collection and analysis for this project was from May to December 2016. Given the one-year planning cycle of the reviewed events (see the directive of the two Strategic Commands (Bi-SC) 075-003 on the Exercise Reporting Process (Reference F) in this respect) it was not possible for the project team to attend all of the meetings and conferences associated with these events, resulting in potential gaps in the data collected. However, the project team was able to fill these gaps through interviews with relevant SMEs, additional literature review and through the conducted survey (see the Methodology section in this chapter).

OTHER FACTORS OBSERVED

15. The project team identified that there are concomitant projects and staff work in other HQs that deal with topics which are related to this project;[8] suggesting there is a real interest in the harmonization of the events providing main CIS IV&V opportunities within NATO. The findings resulting from these other activities may contribute to the validation of the findings, conclusions, and recommendations presented in this report.

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[6] For the purposes of this report, OF-5 and personnel in directors' positions (both civilian and military) are considered to be *senior level*.

[7] The 7 NNN refers to the group of Non-NATO Nations with whom NATO has a special relationship: Australia, Austria, Finland, Ireland, New Zealand, Sweden, and Switzerland.

[8] For example: NATO HQ C3 Staff (NHQC3S) are conducting an assessment of *Governance of Experimentation and Exercises Activities in the C3 Technical Interoperability Landscape*; NCIA Independent Verification & Validation Line is investigating solutions for Interoperability Testing tool(s); FMN Governance and Management were analysed by NHQC3S and International Military Staff (IMS). Where appropriate, the project team refer to these projects and staff work in the context of the study.

2 OVERVIEW OF KEY EVENTS

INTRODUCTION

16. Interoperability of NATO or coalition military capabilities is critical for operational readiness. Operational and technical performance of these capabilities must therefore be assured prior to their deployment in order to accomplish a given mission. This is especially true in the current multinational environment where many Partner nations and Non-NATO Entities (NNE) are involved.

17. CIS is a key element of any military capability; therefore, assured CIS interoperability is an essential part of capability interoperability. CIS interoperability is verified and validated in various events that are open to NATO Allies and Partner nations.

18. The following section briefly describes the eight key events which were recommended by the customer as the key events with regard to CIS IV&V and formed the basis for the analysis. These events cover the CIS IV&V testing along the full capability lifecycle and are presented in order of their relationship to the maturity within the relevant capability development.

SUMMARY OF KEY EVENTS

TIDE Sprint

19. TIDE Sprints are think-tank events seeking to create an environment that allows for improvement of interoperability between the deployable communication and information services of disparate systems/components and related technology. As described in the TIDE Sprints portal / Tidepedia (Reference E), these events benefit nations by bringing together a diverse group of scientists, engineers, managers, and coordinators to share information, develop transformational concepts, and synchronize activities. Moreover, *"TIDE Sprint participants are a coalition of the willing or a grass root movement under the guidance of Allied Command Transformation (ACT) but without a strong top-down infrastructure or complicated agreements".*[9]

CWIX

20. According to MCM-0106-2014, which provides the overarching guidance to the CWIX exercises, (Reference G), CWIX is a North Atlantic Council (NAC) endorsed, Military Committee (MC) directed and the C3B guided Bi-SC annual programme designed to support the continuous improvement in interoperability of the Alliance. According to the Military Training and Exercise Programme (MTEP) (Reference H), CWIX benefits nations by providing an environment for CIS technical verification and validation in the area of Research and Development (R&D); Experimental, Developmental, and Fielded CIS. Furthermore, CWIX is an FMN Confirmation event, enabling enrolled FMN Affiliates to test their FMN Readiness against technical, procedural, and operational requirements.

FMN CIAV events

21. FMN CIAV events are simulations of the circumstances and problems encountered on Mission Networks. These events are executed in the Coalition Verification and Validation

[9] TIDE Sprints – Introduction / Tidepedia; https://tide.act.nato.int/tidepedia; 23 January 2017; Last accessed – 25 January 2017 (Reference E).

Environment (CV2E)[10] and benefit nations by seeking solutions to interoperability issues, in order to improve information exchange in support of NATO and coalition missions. These events are, *"…thoroughly planned and scripted to ensure they recreate the desired operational and network environments, include all the necessary systems in the appropriate network labs, and capture the data required to understand the interoperability issue or problem."*[11] All these events are conducted under the authority of the FMN CIAV Working Group (WG), which is part of the FMN management structure. FMN CIAV WG is, *"…the authoritative body for interoperability assurance, verification and validation of capabilities that are added, removed or modified in the FMN portfolio for all FMN environments..."*[12] These capabilities are defined in the NATO FMN Implementation Plan (NFIP) (Reference K).

BOLD QUEST

22. As described in the BOLD QUEST Governance and Management document (Reference L), the US Joint Staff-sponsored Coalition Capability Demonstration and Assessment series (commonly known as BOLD QUEST) is a collaborative Joint and Multinational enterprise in which various entities leverage their resources for capability development, demonstration, analysis, and assessment in a coalition operational context. It benefits nations by providing opportunities for interoperability testing for both fielded and developmental capabilities as well as being recognized as an FMN instantiation.

UNIFIED VISION

23. UNIFIED VISION is a trial event aiming to test the information exchange interoperability of Intelligence, Surveillance, and Reconnaissance (ISR), C2, and Targeting systems. According to the MTEP (Reference H), it benefits nations by providing a proof of concept of NATO Joint ISR (JISR) operational and technical architectures while testing and validating NATO doctrine and Tactics, Techniques, and Procedures in an operational environment. This venue also presents an opportunity to improve interoperability between NATO and national contributions to the NRF.

CYBER COALITION

24. According to the MTEP, CYBER COALITION is an annual ACT guided exercise that brings together NATO and National Cyber Defence Capabilities to include civilian and military organizational structures. The exercise is based on a scenario which involves significantly increased cyber threats and activities. It benefits nations through its objectives, which reflect a cyber defence exercise with emphasis on decision-making processes, technical and operational procedures, and collaboration between all participants.

STEADFAST COBALT

25. SFCT is an Allied Command Operations (ACO) scheduled exercise, part of the NRF preparation cycle, that benefits nations by serving as a venue to test, improve, evaluate, and confirm Command, Control, Communications, and Computers (C4) ISR interoperability. According to the MTEP, SFCT assesses and documents the level of C2 Information Systems (C2IS) interoperability for NRF deployed forces, joint and component commands, and

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[10] CV2E is a platform that allows verifying and validating the interoperability of coalition partner Command, Control, Communications, Computers and Cyber (C5) Intelligence Surveillance and Reconnaissance (ISR) services in preparation of a mission network supporting a future operation, according to FMN CIAV; Coalition Verification and Validation Environment (CV2E) Concept of Operations (CONOPS); 24 Nov 2014; FMN CIAV Version 4.0; UNCLASSIFIED (Reference I).

[11] CV2E CONOPS; Page 6 (Reference I).

[12] Internal Terms of Reference FMN Coalition Interoperability Assurance and Validation Working Group; Page 2 (Reference J).

deployable Joint C2 Capabilities (JC2C). The exercise provides key aspects of the NRF and JC2C certification process, taking into account the related Combined Joint Statement of Requirements and allowing identification of shortfalls and recommendation of capability projects and developments within a FMN environment. As such, SFCT provides the CIS preparation and building block of exercise TRJE while enabling standardized training for CIS operational planners. Further, SFCT is an FMN Confirmation event, enabling enrolled FMN Affiliates to test their FMN readiness against technical, procedural, and operational requirements.

TRIDENT JUNCTURE

26. TRJE is an ACT-sponsored Command Post Exercise (CPX) / Live Exercise (LIVEX) for the NRF components and non-NRF forces allocated to the exercise. As described in the MTEP (Reference H), TRJE benefits nations by exercising the planning and conducting of NRF / Very High Readiness Joint Task Force (VJTF) operations, primarily involving high-intensity war fighting capabilities in the early phases of such operations. For TRJE, HQ SACT and the Joint Warfare Centre (JWC) coordinate on the inclusion of experimentation and other activities to ensure the achievement of transformational objectives without detriment to the training and certification of forces.

OPPORTUNITIES AND OBJECTIVES

27. Based on analysis of these events, the project team was able to identify CIS IV&V opportunities and objectives, as well as review the related Governance. The findings from this analysis are presented in the following chapters (3 and 4). The project team notes that Annexes C, D, and E to this report are also of relevance in understanding the CIS IV&V opportunities, objectives and Governance and should be read in conjunction with their respective chapters.

3

OVERVIEW OF CIS IV&V OPPORTUNITIES AND THEIR OBJECTIVES

INTRODUCTION

28. In order to answer the requirement related to the harmonization of the events' objectives, the project team first identified the main CIS IV&V opportunities afforded by the events described in chapter 2. These opportunities are summarized in the next section, including the feedback from nations on how these opportunities satisfied their needs. Subsequently, the project team presents the events' objectives, looking at how these objectives are established and distributed across the CIS IV&V spectrum. The project team's findings are presented in each section. Conclusions and associated recommendations for a CIS IV&V Portfolio and for a review of cyber IV&V opportunities are presented at the end of the chapter.

OVERVIEW OF OPPORTUNITIES

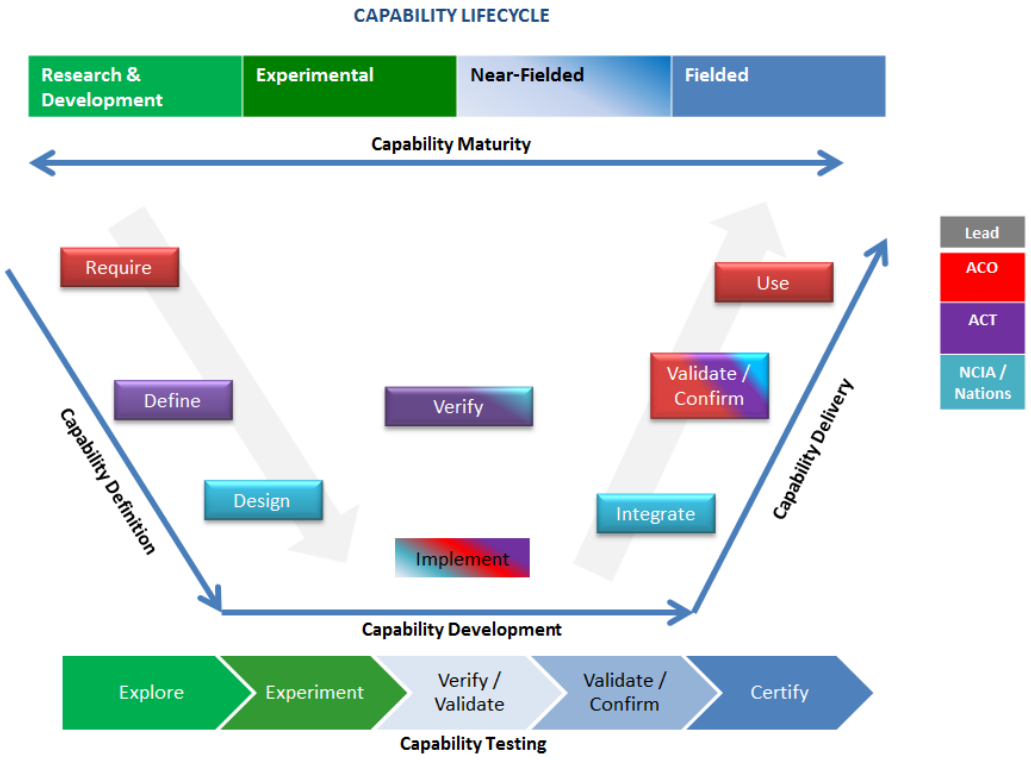

Figure 1: Capability Development Continuum

Features of the Events' Opportunities

29. Each of the reviewed events allows for specific CIS IV&V opportunities. These opportunities result from a combination of the events' frequency and their relevance to the maturity of the Capability Lifecycle (R&D, Experimental, Near Fielded, and Fielded) and the reason for testing the capability (Exploration, Experimentation, Verification, Validation, Confirmation, and Certification), as well as the events' benefits and the ways they are delivered. All these opportunities are presented in more detail in Table 4 at Annex C.

30. The CIS IV&V opportunities range, in a Capability Lifecycle, from new ideas supporting an operational requirement to NRF-certified Fielded capabilities. One way of representing their distribution is detailed in the project team's *V* model of Capability Development Continuum,[13] as illustrated in Figure 1.

31. Analysis after applying this V Model to the reviewed events, reveals that the CIS IV&V opportunities focus on CIS solutions related to the event Capability Maturity and Testing which range from R&D (with testing in Exploration) at TIDE Sprint through to Fielded capability (with testing for Certification) at TRJE. Moreover, CIS IV&V opportunities are available at every stage of the Capability Lifecycle - from Capability Definition during R&D; Capability Development during Experimental and Near Fielded; to Capability Delivery in Fielded.

32. The CIS IV&V opportunities provided by the different events allow NATO Allies and Partner nations to pick and choose their level of participation in each event according to their needs. Interviews and national feedback showed that the choices made by nations to participate in events take into account various factors, including: the capability being tested and its Capability Lifecycle stage; the timing and location of the event; the cost of attending; competing priorities; and available human resources.

National Feedback

33. A survey distributed to NATO Nations and the 7 NNNs was used to elicit feedback on the nations' perception of events and the CIS IV&V opportunities such events afford. One question requested an overall assessment of how beneficial participation in the 2014-2016 iterations of the events was to the respective nation. The aggregate results are presented below in Figure 2.

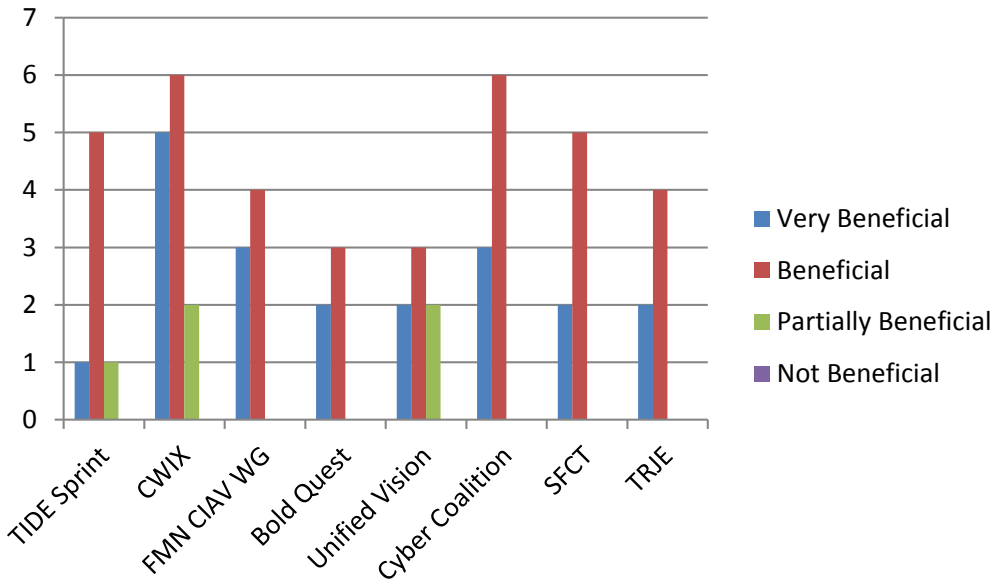

Figure 2: Participation Benefits

34. It is worthwhile to note that, of the 16 nations responding to the survey, not one reported that an event was not beneficial, i.e. all respondents stated that every event was at least partially beneficial. According to the responses received, opportunities for FMN

[13] The *V* model was developed by the project team updating the *Capability Development Continuum* slide produced by HQ SACT/C2 Deployability and Sustainability (C2DS), available in Tidepedia (Reference E). The *V* model may be seen as a representation of one of the key objectives of NATO's Enterprise Architecture discipline, as described in NATO Enterprise Architecture Policy, Paragraph 5.2 (Reference M).

confirmation, NRF certification, JISR capability development, cyber awareness, and national C2IS implementation were specifically mentioned as reasons for event participation.

35. However, because there are many events allowing for CIS IV&V opportunities, several interviewees indicated that some nations are increasingly re-evaluating which NATO, multinational, and national events provide the most effective CIS IV&V opportunities at the lowest cost/resource commitment. This re-evaluation appeared to be especially important for some NATO Nations where, participation in events is often driven by strategic decisions (such as participation in NRF) and resource availability. Some Partner nations also noted that such re-evaluation would be important where they may become mission partners in the future, but are precluded from some events because they do not satisfy the event eligibility criteria.[14]

36. In order to understand the participation trend for 2017-2019, the project team included in the survey a question related to nations' intent to participate in future iterations of the reviewed events. The responses are presented in Figure 3 below.

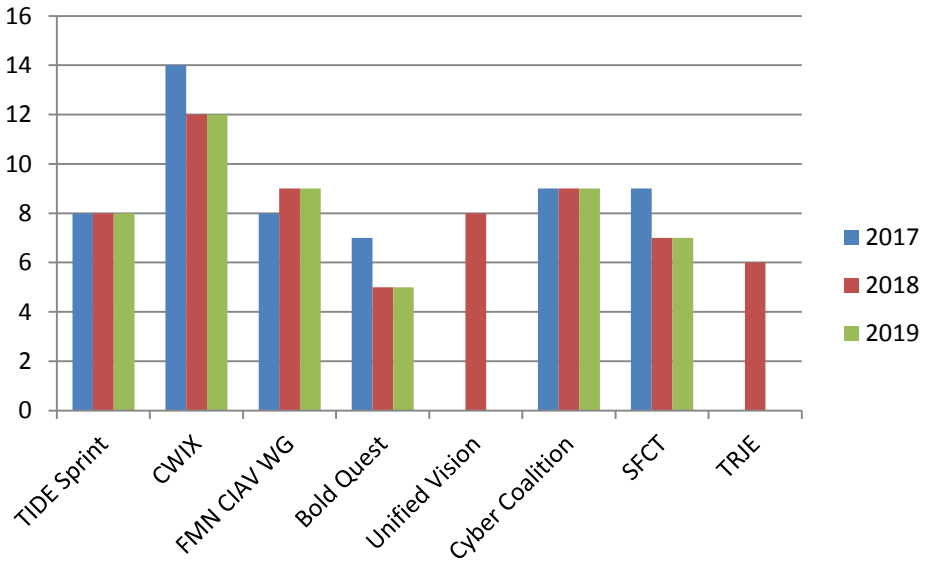

Figure 3: Participation Intention

37. Although the planning and final decision-making processes regarding future participation were important caveats for respondent nations regarding their actual participation in future events, the intent to maintain or increase participation between 2017 and 2019 was clearly expressed. A comparative analysis of participation in iterations of the reviewed events from 2014–2016 (Figure 2) and the intention to participate in the next three years (Figure 3) showed a possible 19 % overall increase in total participation for the period 2017–2019.

38. The survey also set out two questions designed to:

a. understand national perspectives regarding interoperability aspects not covered by the CIS IV&V-related events that nations would wish to have included; and

b. identify potential areas to be withdrawn or improved upon.

39. The responses received showed general satisfaction with the IV&V opportunities provided and nothing notable was reported as either an omission or a suggestion for improvement.

[14] The eligibility criteria for Partner Nations are established based on the provisions of NATO ETEE Policy (Reference N) and MTEP (Reference H).

Key Takeaway

40. The overview of CIS IV&V opportunities, current national participation, and the expressed intent for further participation shows that the current level of CIS IV&V opportunities being provided at the reviewed events is generous and that most of the respondent nations are willing to make use of all such opportunities that may benefit national CIS interoperability capabilities.

Overview of Objectives

41. After review and analysis of related planning documents and results from reports of iterations of the reviewed events over the period 2014-2016, the project team identified that the event objectives can be split in two types: general and specific:

a. **General objectives** relate to each reviewed event ***series*** and are defined using terminology, such as *goals*, *purpose*, or *aim*. For example, a general event aim for TRJE is to *"…plan and conduct NRF crisis response operations primarily involving high intensity war fighting capabilities in the early phases of such operations."*[15]

b. **Specific objectives** relate to a reviewed event ***iteration***, covering the exercise and training objectives as well as the objectives of the *focus areas*/*track areas* for that specific event iteration. For example, a specific objective for TRJE16 is to, *"…exploit the NATO Federated Mission Networking construct (as exercised in SFCT16) and practice CIS planning."*[16]

General Objectives

42. Table 1 below presents the **general objectives** as extracted from the relevant event governing documents in the context of testing during the Capability Lifecycle—Exploration, Experimentation, Verification, Validation, Confirmation, and Certification—and the three interoperability dimensions—technical, human, and procedural.

Table 1: Distribution of General Objectives

Event	Capability Lifecycle Testing	Interoperability Dimension
TIDE Sprint	Exploration	Technical; Human
CWIX	Experimentation; Verification; Validation; Confirmation	Technical; Human; Procedural
FMN CIAV	Verification; Validation; Confirmation	Technical
BQ	Demonstration; Verification; Validation	Technical; Human
UV	Experimentation; Verification; Validation	Human; Procedural
CC	Verification; Validation	Technical; Human; Procedural
SFCT	Verification; Validation; Confirmation	Technical; Human; Procedural
TRJE	Certification; Experimentation	Technical; Human; Procedural

[15] MTEP 2017; Page C-45 (Reference H).

[16] Exercise TRIDENT JUNCTURE 2016 (TRJE16) - Exercise Specification; Page 5 (Reference O).

43. Although Table 1 gives a perception of overlapping areas among the events, the different systems employed, mission requirements, and training audiences that each event addresses must be taken into consideration in this respect.

44. From further analysis of the general objectives, the project team noted that all of the reviewed events included various cyber elements. The analysis shows that there may be an opportunity for increased cross-event harmonization of these cyber elements, in order to ensure that the relevant cyber outcomes benefit other events as well. For example, although a Lesson Identified in the Crisis Management Exercise (CMX) 2012 Post Exercise Report (Reference P) specifies that there is no need to link CYBER COALITION to CMX, the project team considers that although it is appropriate to have the events conducted separately, some CYBER COALITION products (e.g. storylines) could be exploited in CMX to contribute to the cyber play.

45. In addition, the project team also noted that the general objectives of CWIX, SFCT and TRJE support the final certification process in a coordinated series of events – CWIX is a de-risking event for the following year's SFCT iteration which in turn assures the NRF and JC2C CIS for the year after. For example, CWIX 15 provides CIS interoperability test results that are analysed (in conjunction with FMN CIAV relevant reports) and further applied to build NRF C4ISR Architecture. After verification and validation in SFCT16, this NRF C4ISR Architecture is utilized for NRF 17 certification in TRJE16. This linking and coordination of the three events is good practice and is in line with the principles embodied in NATO's Smart Defence and Connected Forces Initiatives.

46. A review of the reports and documents produced following the completion of the relevant reviewed event showed that the general objectives were always achieved.

Specific Objectives

47. The project team identified that specific objectives are established following either a top-down or bottom-up approach.

a. For events such as SFCT and TRJE, the specific objectives are established at Governance level—within Exercise Specifications (EXSPECs) and Exercise Plans (EXPLANs)—and further developed by the management entity of the event, following a top-down approach.

b. For the remaining reviewed events—TIDE Sprint, CWIX, FMN CIAV, BOLD QUEST, UNIFIED VISION, and CYBER COALITION—the specific objectives are mainly established following a bottom-up approach, based on the participants' requirements.

48. In some cases, event reports and documents indicate that some specific objectives were not fully achieved, but this did not affect the overall outcome of the related event.

49. During interviews with SMEs, some SMEs indicated that the current way of establishing specific objectives was valid, while others indicated the need for a review of the current approach. The main reasons given by the SMEs expressing the need for review were related to:

a. testing similarities; and

b. the lack of some mandatory services to be tested in CWIX; these should be defined by NATO as the enterprise providing the CWIX framework.

Testing Similarities

50. The project team identified testing similarities for activities related to: ISR; Friendly Force Tracking (FFT); and Cyber/Cyber Defence.[17] These similarities are described in more detail in Annex D.

Testing of Mandatory Services in CWIX

51. Regarding the possible lack of some services to be mandatorily tested, some SMEs stated that CWIX should allow NATO to gain more tangible benefits while enabling nations to further coordinate their planning and decision-making related to the capabilities employed in CWIX. Tangible benefits to NATO could be realized by defining the critical services (in accordance with C3 Taxonomy) to be mandatorily tested in CWIX. Such an approach would not only provide NATO with the opportunity to articulate its critical CIS interoperability needs in support of future operations, but would also allow nations to understand NATO trends to help align their national priorities.

52. However, some interviewees indicated that NATO already benefits by conducting its own testing in CWIX (e.g. Land C2IS; Core Enterprise Services Cross-Domain Binding). Additionally, it was stated that as the nations pay their participation costs, it would not be possible to impose mandatory testing requirements unless consensus was reached.

53. To complement the data collected during SME interviews, the testing of mandatory services was addressed in the survey sent to nations by posing the question: *To what extent do you agree or disagree with the following statement: The guidance provided by NC3B in its 'NATO CWIX Exercise – Overarching Guidance' should specify the list of critical services from the NATO C3 Taxonomy to be mandatorily tested during each CWIX*. Figure 4 presents the responses received.

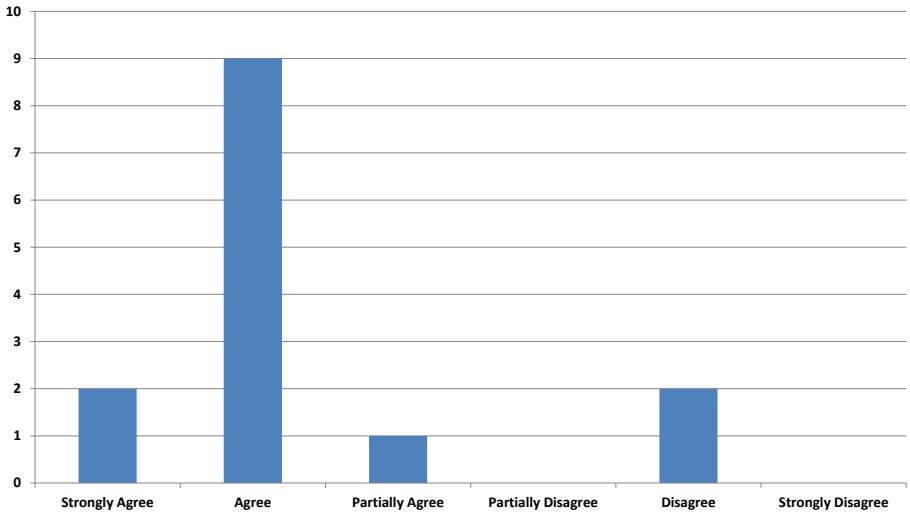

Figure 4: Mandatory Testing in CWIX

54. Figure 4 shows that 12 out of 14 respondents agreed (to varying extents) on the need to establish a list of critical services to be mandatorily tested during CWIX. The majority of respondents further indicated that such a list could be beneficial for: the coherence of the testing process; improved time management; and testing prioritization. On the other hand, respondents indicated that with regard to CWIX, *nothing should be mandatory*; and another two respondents noted that the list should only provide general guidance on *hot* areas that nations should further focus on while developing testing requirements.

[17] Although it may be argued that FMN confirmation is conducted in three different venues, the project team does not identify this as a potential duplication as it is the affiliates' responsibility to choose the FMN instantiations that allow the most suitable CIS IV&V opportunity.

55. In order to examine NATO's approach to testing in CWIX, further analysis was conducted on the testing data for CWIX16 (as further detailed in Annex D). The project team considers that although there is a willingness to have a list of critical services defined by NATO to be mandatorily tested in CWIX, a more thorough analysis is necessary before firm conclusions can be reached.

CONCLUSIONS

56. CIS IV&V opportunities afforded by the reviewed events (2014-2016) were beneficial to nations, meeting their needs to the extent that increased participation is foreseen for 2017-2019.

57. The general objectives as currently developed show sufficient delineation between the reviewed events (without significant overlapping) to allow for valid CIS IV&V opportunities. However, more effective participation in these events and a more efficient and effective employment of resources could be achieved if all key events allowing CIS IV&V opportunities are programmed in a coordinated and harmonized manner.

58. There is a need for a more detailed review of the IV&V opportunities provided by the cyber elements in the reviewed events in order to ensure that they are conducted in a coordinated manner, so that the cyber-related outcomes can be further exploited from one event to another.

59. There is a willingness for some nations to have NATO define the critical services to be mandatorily tested by NATO and nations during CWIX. However, further analysis is required in order to validate the potential benefits and identify appropriate implementation mechanisms.

RECOMMENDATIONS

60. In light of the above conclusions, the project team makes the following recommendations for the consideration of HQ SACT as the appropriate tasking authority.

a. The development of a CIS IV&V Portfolio (as further explained in Annex D) as per the provisions of paragraph 7.4 of Alliance C3 Interoperability Policy (Reference B) should be initiated. This CIS IV&V Portfolio should be an Annex to the MTEP, utilizing a similar construct to the *Concept Development and Experimentation Annex* (Reference H). Additionally, include the development of the CIS IV&V Portfolio in the *task & deliverable* for Item number 12 – Future Exercise Study from the ACT Key Deliverables Plan/ACT Capacity Post Warsaw Summit (Reference Q).[18] A potential model for the portfolio is provided in Annex D.

b. A study on cyber IV&V opportunities in order to identify ways for increased exploitation of the outputs among the events should be considered.

c. The need for a defined list of critical services to be mandatorily tested during CWIX should be investigated, with the appropriate authorities as required.

[18] This document presents the top priority tasks for the ACT Command Group for the period August 2016 – January 2018, as sent by Chief of Staff HQ SACT to Director General IMS.

4 GOVERNANCE

INTRODUCTION

61. According to the C3 Policy Glossary / Alliance C3 Policy (Reference R), Governance is defined as, "…*the structures and processes for decision-making, accountability, control and behaviour within organizations.*"[19]

62. As requested by the customer, the project team reviewed and analysed how Governance structures and processes, specific to each event, impact on the harmonization of the events. This chapter presents an overview of Governance structures as well as the conclusions and recommendations to further support the reviewed events' harmonization. The corresponding decision-making process is presented in Annex E. The project team notes that, for the purposes of this report and with reference to the definition of Governance given above, the accountability, control, and behaviour-related processes all fall outside the scope of this project and are not discussed in this chapter.

OVERVIEW OF GOVERNANCE STRUCTURES

63. Table 2 below details the permanent and temporary structures that play a role in the Governance of the eight reviewed events. Additionally, in order to understand how the Governance decisions are executed, the table also presents the structures involved in the management of the events. The information presented in Table 2 was compiled from three generic sources: review of general documentation (the MTEP (Reference H), relevant event EXSPECs, and Final Exercise Reports (FER), etc.); review of available overarching guidance documents and Terms of Reference (ToR); and interviews with senior level SMEs.

Table 2: Governance Structures Overview[20]

Event	Governance					Management		
	Approve	Endorse	Direct / Guide	Sponsor	OSE / Schedule	Management Entity	Lead Entity	OCE / Conduct
TIDE Sprint	-	HQ SACT	-	-	HQ SACT / C2DS	Track Leaders	COORD (HQ SACT / C2DS)	HQ SACT / C2DS
CWIX	-	NAC	MC / C3B	-	HQ SACT	SMG	HQ SACT / C2DS	SMG
FMN CIAV	-	MC in FMN Framework	FMN MG	-	FMN CIAV WG	FMN CIAV WG or FMN MG	FMN MG	FMN Affiliates
BQ	US Joint Staff	-	US Joint Staff / DIR J6	US Joint Staff	Deputy DIR C5I	MT	MT	JFD / DB

[19] C3 Policy Glossary; Page 1-5 (Reference R).

[20] Acronyms first used in this table can be found in the Glossary of Acronyms in Annex A to this report.

Event	Governance					Management		
	Approve	Endorse	Direct / Guide	Sponsor	OSE / Schedule	Management Entity	Lead Entity	OCE / Conduct
UV	NAFAG / JCGISR	NATO JISR CAM JISR IMS Senior COORD	-	NAFAG / JCGISR	JCGISR	NAFAG / JCGISR / TE	EAG	TMT
CC	NAC*[21]	MC*	-	-	MC	EPG CPT	ACT / C2DS FWD	HQ SACT
SFCT	NAC*	MC*	-	-	SACEUR	EPG CPT EVAL Group EXDIR Staff	SHAPE	NCISG
TRJE	NAC*	MC*	-	HQ SACT	HQ SACT	EPG CPT	HQ SACT / JFT	JFC

64. Table 2 shows that the range of actors with Governance and management responsibilities for the different events is diverse; a result of the various roles performed. For example, for CWIX, Governance seems to be distributed between the NAC, MC, and C3B, while for FMN CIAV, Governance is more compact at FMN Management Group level. For UNIFIED VISION Trials, although some documents—JCGISR all Source Intelligence Integration Sub Group / ToR (Reference S) and Trial Unified Vision 2016 (Reference T)—present Governance at JCGISR level, from the reporting documents (e.g. NATO Industrial Advisory Group (NIAG) SG177 Final Report of UNIFIED VISION 2014; Reference U) and from interviews it appears that the Conference of National Armaments Directors (CNAD) plays a significant role in the Governance of these events.

65. Another aspect observed during the analysis was that, for several of the reviewed events, the provisions relating to Governance are dispersed over several documents. By contrast, others events (such as BOLD QUEST, FMN CIAV, and CWIX for example) have single documents providing the Governance.

66. Additional data related to Governance of the reviewed events were collected through interviews and the following question in the survey: *To what extent do you agree or disagree with the following statement: Common Governance for all NATO CIS IV&V related events may lead to an improved harmonization of such events*. Figure 5 below (next page) presents the responses to this question.

67. During interviews, many SMEs indicated that common Governance of all the reviewed events would likely lead to increased harmonization and effectiveness thereof. Additionally, survey responses related to Governance show that 12 out of 16 respondents assess that common Governance would improve the harmonization of the reviewed events, while three others partially agreed as depicted in Figure 5 (below).

[21] The MC* and NAC* are included, assuming a certain level of participation by Partner nations and NNEs.

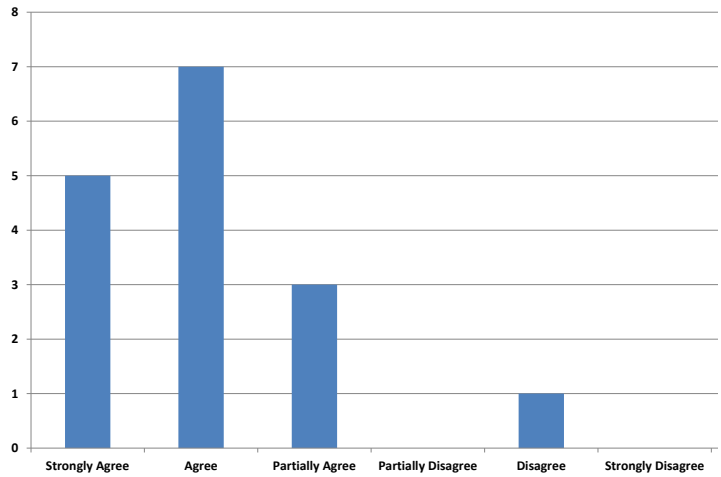

Figure 5: Common Governance

68. However, based on the current definition of Governance and analysis of the interviews and relevant documents, the project team **does not** consider having **common** Governance as a feasible solution to achieving greater harmonization of the reviewed events for three reasons:

a. not all events are NATO led;

b. in such a complex CIS IV&V environment, common Governance and unique decision-making may conflict with the level of flexibility needed, specific to each community participating in the CIS IV&V-related events; and

c. the control, reporting, and accountability for common Governance may lead to all the required staff work becoming the responsibility of a single entity, thereby overloading those members of staff.[22]

69. Conversely, the project team identifies that having **diverse** Governance, exercised by the NATO organization which best represents the interests of the events' specific community, maintains an appropriate level of flexibility in decision-making. **Overarching guidance** detailing delineated roles and responsibilities at Governance and management levels may be a feasible way forward. Additionally, in order to facilitate informed decision-making between events, such diverse Governance needs to be supported by an **advisory function** and a **coordination function**.

70. These three elements—the provision of overarching guidance supported by an advisory function and a coordination function—are expanded upon in the following sections.

Overarching Guidance

71. CIS IV&V-related events are regulated through several specific documents: the NATO Interoperability Policy (Reference A); the Alliance C3 Policy (the first batch contains nine policies, while an additional six policies are expected in the second batch) (Reference V); the NATO Education, Training, Exercise and Evaluation (ETEE) Policy (Reference N); and Bi-SC Directive 075-003 (Reference F). However, these documents state high level provisions and do not contain the granularity required for improved harmonization of the reviewed events. However, the desired level of detail could be provided through a series of implementing directives/overarching guidance related to each event, further complemented with ToR for the various entities involved in the events.

[22] All these findings should be seen in conjunction with the NHQC3S Assessment to Improve Governance of Experimentation and Exercise Activities in the C3 Technical Interoperability Landscape (Reference W) and the FMN Governance and Management Analysis Interim Report (Reference X).

72. Many of the interviewed SMEs recommended the MCM-0163-2014 / CWIX Overarching Guidance (Reference G) as an example of a best practice to be taken forward in this respect and used as a template for other events affording CIS IV&V opportunities.[23] Although it may be argued that each event is adequately addressed in the existing documentation, the project team identifies the CWIX Overarching Guidance as a comprehensive document, with an appropriate format and the necessary level of detail related to the distribution and delineation of roles and responsibilities.

73. In addition to delineated roles and responsibilities, overarching guidance for each event would also address the consequences of the bottom-up approach to establishing the objectives of some events, which is perceived by many interviewed SMEs as leading to disconnected objectives and outcomes among the events. Such overarching guidance could also address, among other things: the decision making mechanisms; the operational aspects that justify the CIS IV&V opportunities; the clarification of security aspects (e.g. mission network accreditation); the subsequent correction of interoperability shortfalls; and aspects relevant to change management.

Advisory Function

74. The second need identified by the project team is for a function that can advise the Governance structures of each event on those aspects that lead to more coherent, efficient, and cost effective CIS IV&V opportunities. Such aspects were identified during the project team's review of key documentation in this respect and were confirmed by most of the interviewed SMEs. Functions include:

a. reviewing the regulatory frameworks of the events and recommend changes to the Governance structure, in accordance with CIS IV&V needs.

b. reviewing the reports that follow the events allowing CIS IV&V opportunities and advise the Governance structures on the impact of identified IV&V shortfalls and the recommendations to address such shortfalls.

c. providing advice on the CIS IV&V Portfolio to be included as an Annex to the MTEP, as discussed in Chapter 3;

d. providing the Governance structure of each event with reports and assessment of the needs and benefits of the events, to determine priorities and inclusion of events in the CIS IV&V Portfolio; and

e. advising on the use of NATO and national Technical Interoperability Testing capabilities.

75. The concept of having an advisory function supporting Governance structures is not new and has previously been initiated when the NATO C3B issued the ToR (2013)—for the NATO Interoperability Assessment Team (NIAT) (Reference Y).[24] Although through this document, NIAT was seen as performing more than an advisory function and some of its defined responsibilities may duplicate FMN CIAV WG responsibilities, the need for such an advisory function was nonetheless confirmed by many SMEs in the context of this project.

76. A specific question was included in the survey to examine national support for a functional NIAT. Figure 6 presents the responses.

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[23] The project team identified that this document requires review and has already provided comments at the appropriate staff level.

[24] NIAT derived its authority from NATO C3 Interoperability Testing Policy (Reference Z)—which is no longer valid. Through the ToR for the NIAT (2014) (Reference AA), the NIAT ToR was postponed until C3B will make a decision about the future of the NIAT. The reader should avoid confusing this acronym with the use of NIAT to mean *NATO Intelligence Assessment on Terrorism*.

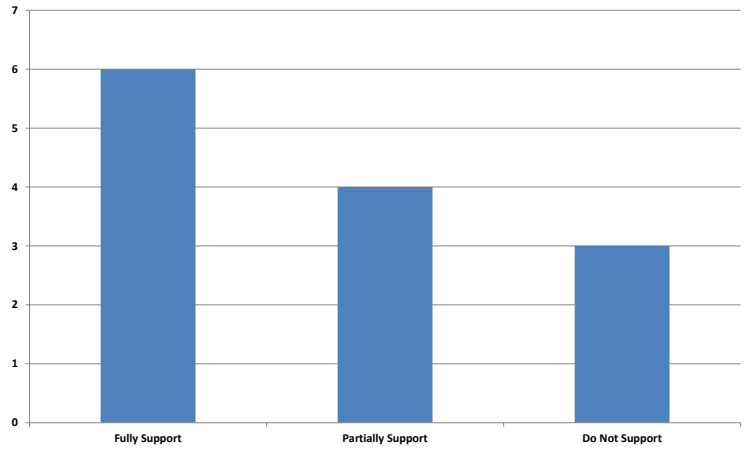

Figure 6: Advisory Function

77. The chart shows that, from a national perspective, 10 out of 13 respondents indicated full or partial support for a NIAT. However, some caveats were expressed, mainly concerning a clear delineation between NIAT and FMN CIAV WG responsibilities.

78. The project team identifies that reviewing the NIAT concept as the advisory function is a possible solution to support Governance for a coherent, efficient, and cost effective CIS IV&V Portfolio. The project team identifies that this advisory function should involve SMEs from NHQC3S, the NATO Standardization Office (NSO), the NATO Communication and Information Agency (NCIA) Independent Verification and Validation Service Line, HQ SACT, and SHAPE. The advisory function should be activated under the lead of NHQC3S and based on specific ToRs that describe its roles, responsibilities, and working mechanisms. Having such an advisory function should provide an effective contribution to the harmonization of the events and is in line with the provisions of paragraph 11.4 of C3 Capabilities and ICT Services Lifecycle Management Policy / Alliance C3 Policy (Reference AB).

Coordination Function

79. The third need identified by the project team is for a coordination function for CIS IV&V-related events. The absence of such a function to ensure effective coordination of the events has the following consequences:

a. similar tests are performed in different events, resulting in potential duplication of effort and resources;

b. overlapping or proximity in time of different phases of events resulting in resource challenges for NATO and nations; and

c. minimal and uncoordinated sharing of information between events, so that there is a limited use of the tests and test results from one event to the other.

80. A majority of interviewed SMEs expressed their concerns in this respect and highlighted the need for a coordination function that would be responsible, among other things, for:

a. coordinating the timeline for planning and execution of the events;

b. coordinating the goals and objectives of the events, avoiding duplication of efforts and fragmentation of the intended CIS IV&V Portfolio;

c. coordinating the exploitation of the test results from one event to the other;

d. coordinating and redistributing testing priorities among the events;

e. ensuring a coordinated way of exploiting the available technology for the testing, assessment, and evaluation process;

f. coordinating information sharing and the use of standardized terminology;

g. providing the advisory function with coordinated details related to the events, in order to facilitate coherent advice for Governance; and

h. ensuring coordination and appropriate representation between the transformational (ACT), operational (ACO), and technical (NCIA) communities involved in events.

81. The concept of a coordination function for CIS IV&V-related events has been discussed in the past at the C3B level and implemented by establishing the Exercise Directors Board as a senior level coordination body comprising Directors and SMEs from the management level of some events. Although this Exercise Directors Board met on several occasions, the project team has not been able to find its ToRs—only specific agendas for its meetings—or establish the reasons why these meetings were terminated.

CONCLUSIONS

82. Although there are arguments for common Governance of CIS IV&V-related events, the existing diverse Governance distribution satisfies current requirements.

83. An authoritative document, identifying the structures and detailing delineated roles and responsibilities (at Governance and management levels) would enhance the existing diverse Governance structures to improve and harmonize decision-making.

84. An overarching advisory function to the CIS IV&V event Governance structures would facilitate informed decision-making among the events and therefore improve their harmonization. The NIAT concept may be further reviewed for development of an advisory function.

85. An overarching coordination function to de-conflict and synchronize CIS IV&V-related events by considering, among other things, event objectives, processes, information, resources, and IT tools, would improve the harmonization of CIS IV&V-related events.

RECOMMENDATIONS

86. In light of the above conclusions, the project recommends that HQ SACT as the appropriate tasking authority engages:

a. with appropriate authorities for development of a *Governance Directive/Overarching Guidance* for each CIS IV&V-related event, detailing the structures and delineated roles and responsibilities between Governance and management entities. The documents should consider long-term provisions, developed in a similar construct (e.g. who approves, who endorses, who leads, who schedules, who conducts, etc.) and should be complemented by Terms of Reference for the management entities;

b. with the appropriate authorities in order to formalize a CIS IV&V advisory function; and

c. with NHQC3S to review the Exercise Directors Board status and Terms of Reference as well as to continue the staffing process in order to formalize the Exercise Directors Board as a CIS IV&V coordination function.

JALLC Model for CIS IV&V Event Governance

87. To support the implementation of these recommendations in a coordinated manner, Figure 7 presents a potential implementation roadmap as developed by the project team.

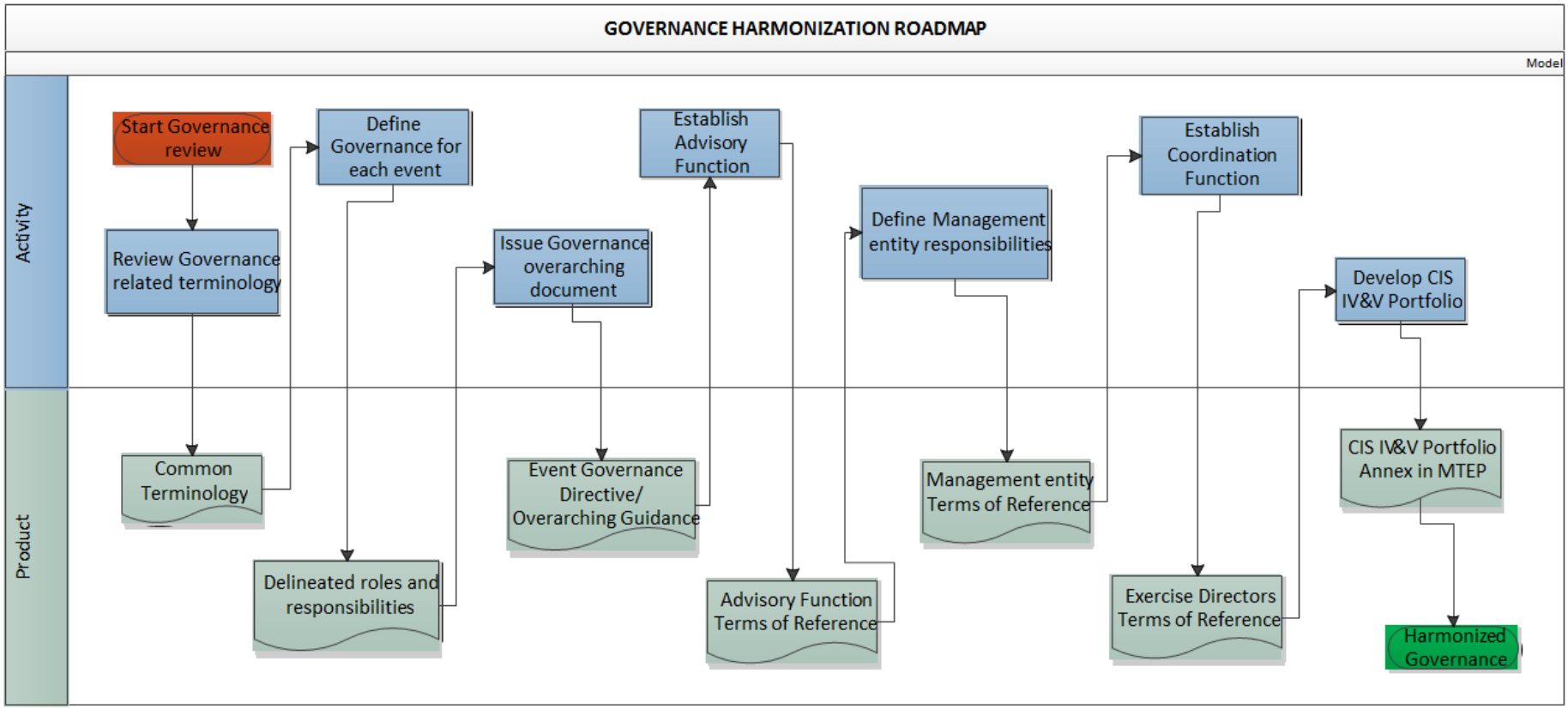

Figure 7: Model for Governance Harmonization Roadmap

5 ELEMENTS SUPPORTING THE ACHIEVEMENT OF THE OBJECTIVES

INTRODUCTION

88. As already described in chapter 3, general objectives are achieved particular to each of the reviewed CIS IV&V-related events. However, the project team identified that there are several elements that are common to all reviewed events and support the achievement of the objectives. These elements are reflected in how: the events are planned; their performance is assessed; testing is conducted; information is captured and shared; and human resources and technology are employed in support of achieving the objectives.

89. For the purposes of this report (and as requested by the customer), the project team analysed the following elements supporting the achievement of the objectives: Processes; Information; People; and Technology. The findings related to these elements are presented in the following sections. Additional supporting findings and recommendations are presented in Annex F and Annex G.

PROCESSES

90. The project team focused its analysis on four processes conducted during a full cycle of each event: planning, testing, performance review, and lessons learned.

Planning

91. Each of the eight reviewed events has its own planning process, developed in accordance with its specific regulatory framework, and each requires a considerable number of meetings, conferences, etc. As stated by several interviewees, the activities and milestones for each reviewed event appear to be planned and conducted in relative isolation from other events. Figure 8 illustrates the schedule for the principal activities and milestones of each CIS IV&V-related event in 2016.

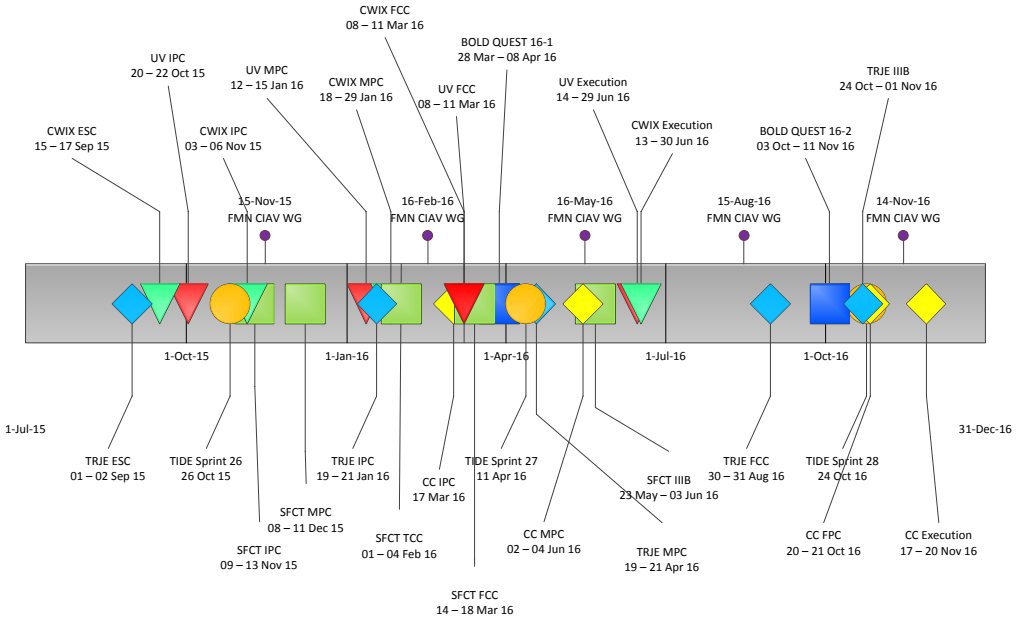

Figure 8: Main Event Activities and Milestones for 2016

92. Figure 8 shows that a tight timeline exists—even concurrent for some activities—that is the result of an uncoordinated planning process among the CIS IV&V-related events. Such a tight timeline has two undesirable consequences that directly impact participating nations and HQs:

a. a lack of exploitation of the outputs from one event to another; and

b. the inefficient employment of human and financial resources for nations and HQs involved in multiple events.

Further details on the planning process are presented in Annex F.

Testing

93. According to Alliance C3 Interoperability Policy (Reference B), *"...verification and validation of interoperability solutions through testing,"*[25] is a fundamental principle to ensure the effective development and use of C3 Capabilities.

94. A review of the testing process conducted in the CIS IV&V-related events shows that, generally, a three-step approach is followed: planning, performing, and results.

a. During the planning step, the test objectives and related testing requirements are established, and the capabilities and/or procedures to be tested are also identified. These activities are followed by defining the testing environment and the test baselines (e.g. NATO Interoperability Standards and Profiles (NISP)).

b. The performing step includes the generation of test cases/tests and the execution of tests.

c. The results step consists of all the activities related to the analysis of test results; the identification of issues, shortfalls, or best practices; and, finally, the sharing of the results in relevant reports.

FMN Testing Environment

95. Some of the events are qualified as FMN instantiations where FMN confirmation is conducted, whereby the interoperability of the systems is reliable. However, several SMEs pointed out that FMN confirmation is conducted in different testing environments and testing results are assessed equally. This assessment could lead to the perception that reliability of interoperability of the systems confirmed may be affected.

96. Concerning FMN confirmation in different testing environments the project team, observed the following:

a. during SFCT16, the tests for confirmation of the capability requirements specific to Spiral 1.0 were conducted in a deployed network with all the specific security settings;

b. in CWIX16, the FMN confirmation tests were conducted in a simulated environment; and

c. FMN CIAV tests are conducted in a simulated environment.

97. Although some SMEs stated that testing for FMN confirmation in different environments has no impact on the test results, other SMEs expressed the view that FMN confirmation should be conducted for all affiliates in the same type of environment. To elicit national positions on this view, the following statement was included in the survey, *In order to obtain the desired optimized level of interoperability, testing for FMN Confirmation should be conducted in the same technical and operational testing environment for affiliates*. Figure 9 presents the responses.

[25] Alliance C3 Interoperability Policy; Page 5-2 (Reference B).

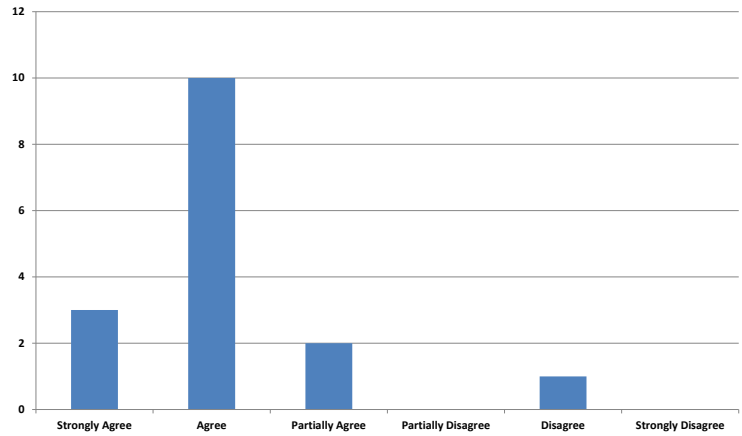

Figure 9: FMN Similar Testing Environments

98. Figure 9 shows that 15 out of 16 respondents recognized that, in order to obtain an optimized level of interoperability, testing for FMN confirmation should be conducted in the same technical and operational testing environment for all affiliates. However, most of the comments provided noted that *same testing environment does not mean same and/or only event*.

Performance Review

99. The analysis of the performance review shows that each CIS IV&V-related event has its own defined process. This process includes the review of activities, organizations, and/or capabilities and may be an assessment, evaluation, or certification. An overview of the performance review process is presented in Annex F.

100. It is clear that any performance review should be accurate in order to allow an understanding of the potential limitations of the capabilities and to be able to adjust the level of ambition accordingly. The accuracy of the performance review is based on the quality of the analysis being conducted by the analysts supporting the event: having analysts with the right operational and technical expertise and experience is an essential enabler.

Lessons Learned

101. All the reviewed events present learning opportunities for participants and for sending HQs. Following review of relevant documentation and interview responses, the project team identified that there is a lessons learned process in place for all the events, which, in general, follows the NATO Lessons Learned Process as established in Bi-SC Directive 080-006 (Reference AC).

a. The event lessons learned process starts with Data Collection, usually observations collected in the NATO *ODCR* format (Observation, Discussion, Conclusion and Recommendation). The submitted ODCRs address either administrative or operational-related issues, as further described in Annex F.

b. The Analysis Phase is identifiable in all events and concludes with various Lessons Identified containing remedial actions, issues, or shortfalls to be taken forward in the Remedial Action phase.[26]

c. Sharing and dissemination of lessons is an important aspect of the effective exploitation of Lessons Learned. However, as stated by most of the interviewed SMEs and identified by the project team, most Lessons Learned-related information is *stove-piped* and the various IT tools used are not able to communicate with each other, resulting in information not being readily shared between participants in different events.

[26] The project team had limited visibility on how this phase is further conducted.

INFORMATION

102. The project team identified the following factors that impact the way information is used to achieve the objectives of the reviewed events: the use of common terminology; information sharing; and information availability.

Common Terminology

103. The review of relevant documentation and interview responses showed that the development of CIS-related terminology NATO-wide was conducted in isolation, without full coordination by an overarching authority. The resulting ambiguity of terminology through contextualization and sometimes different understanding and use, results in an impact on a commonly shared situational awareness. More details are presented in Annex F.

104. Additionally, with respect to FMN, a senior level SME indicated the need to align FMN-specific terminology with NCIA terminology, based on the same C3 Taxonomy Baseline.

105. The ambiguous use of key terms such as *verification* and *validation* are often understood quite differently among the communities participating in the events (the operational community, technicians, and the FMN community), as detailed in Table 3 below:

Table 3: Verification and Validation Definitions[27]

Source / Specific	Verification	Validation
NFIP, vol 1, Annex B *FMN specific*	**The evaluation** of whether or not a product, service, or system complies with a regulation, requirement, specification, or imposed condition.	**The assurance** that a product, service, or system meets the needs of the customer and other identified stakeholders.
AAP-33[28] / ANSI / IEEE[29] *Technical specific*	**The process** of determining whether or not the products of a given phase of the software development cycle fulfil the requirements established during the previous phase.	**The process** of evaluating software at the end of the software development process to ensure compliance with software requirements.
AAP-33 / ANSI / ASQC[30] A3 *Technical specific*	**The act of** reviewing, inspecting, testing, checking, auditing, or otherwise establishing and documenting whether or not items, processes, services, or documents conform to specified requirements.	-
AAP-06[31] *NATO specific*	-	**The confirmation** of the capabilities and performance of organizations, individuals, materiel, or systems to meet defined standards or criteria, through the provision of objective evidence.

[27] Acronyms first used in this table can be found in the Glossary of Acronyms in Annex A to this report.

[28] AAP-33 NATO Glossary of Avionics Terms and Definitions (Reference AD).

[29] Software and Systems Engineering Committee; Standard for System and Software Verification and Validation; The Institute of Electrical and Electronics Engineers (Reference AE).

[30] American National Standard Quality Systems Terminology; American Society for Quality Control; 1987 (Reference AF).

[31] AAP-06 NATO Glossary of Terms and Definitions (2016) (Reference AG).

Information Sharing

106. Information sharing is essential for learning both from one's own and others' experiences and for coordination of efforts. In each of the reviewed events, information sharing is supported by various sharing mechanisms. However, as stated by many interviewed SMEs, several sharing limitations were identified, such as: security regulations; limited national willingness to share; and sharing caveats imposed by the companies from the national defence industry participating in the events. Additionally, sharing is sometimes limited because of a lack of clear sharing mechanisms, enforced through authoritative documents.

Information Availability

107. The project team identified three potential issues related to information availability: information that is available but difficult to locate; FMN procedural guidance; and NISP accuracy. More detail on these potential issues is provided in Annex F.

108. Additionally, several SMEs indicated that the regulatory framework providing information in support of the development of Interoperability Testing Requirements is in place but, in some cases, is out of date. As a result, for one specific event, the Interoperability Testing Requirements were not developed based on actual authoritative documents but on ad hoc solutions. However, these ad hoc solutions do not necessarily reflect the agreed position of Allies. Having up to date authoritative documents agreed upon by nations will ensure Interoperability Testing Requirements are developed in line with operational needs.

PEOPLE

109. The analysis of the reviewed events shows that the human factor contributes to ways of achieving the objectives through the interaction, knowledge, and availability of the people involved. This section presents the main aspects related to people, while additional supporting details are provided in Annex F.

Interaction

110. Face-to-face interaction is a key element in the overall success of the events by facilitating the sharing of information, lessons, and best practices, leading to improved commonly shared situational awareness. Most of the interviewees indicated that there is a significant level of satisfaction with the interaction opportunities offered by the reviewed events. However, some SMEs considered that a closer interaction during some events between ACT and ACO representatives would contribute to a greater harmonization of objectives and increased coordination.

Knowledge

111. Building participant corporate knowledge is a critical factor supporting each of the reviewed events. Additionally, it was generally acknowledged that the sharing of knowledge between national and NATO participants was a benefit realized during all events. However, some SMEs indicated that, in certain events, building cyber corporate knowledge was difficult because cyber IV&V-related issues remained closely held by a few individuals; a contributing factor cited was the lack of a published cyber IV&V testing framework and appropriate supporting documentation. Therefore, there exists the risk that cyber IV&V-related issues may not be properly captured at the organizational level.

Availability of Personnel

112. Ensuring there are sufficient personnel available during an event poses a challenge because of (often) competing national events and the number of available and knowledgeable NATO and national CIS personnel, which requires the employment of human

resources to be prioritized. As previously discussed, greater coordination of all the CIS IV&V-related events would permit more efficient employment of the available resources.

TECHNOLOGY

113. The project team approached the technology element as being the sum of tools, devices, software, implementation mechanisms, and associated knowledge that are or could be employed during events. In the scope of this project, two types of technology and tools have been identified that support the events: those related to community interaction; and those supporting the testing process.

Community Interaction Tools

114. The tools related to community interaction are hosted on various platforms (Tidepedia, HQ SACT workspace, SHAPE workspace, NATO Exercises, Training, Reporting, and Analysis (EXTRA) Portal, CoI Portal, etc.) that are accessible on different networks—the internet, Combined Federated Battle Laboratories Network (CFBLNet), Reach, NATO Unclassified, NATO Secret, etc.—as further described in Table 7 of Annex G. Most of the events use tools developed on platforms that are accessible via the internet, a fact that led to an increased level of sharing and easy access to information, especially for Partners. However, although some of these tools are interconnected, some are not easily found. Improving the interconnectivity of these tools in a *one-stop-shop* approach would enhance the sharing of event-related information and collaboration among members of the community.

Event Testing Tools

115. The tools related to event testing are tailored to an individual event and are deployed in a permanent network enclave or in the Mission Secret network set up for the event as described in Table 7 of Annex G. However, these tools are independent and disconnected from other similar tools. By having suitable IT solutions supporting NATO Interoperability Testing that can easily and readily exchange information, the tests and test results could be directly exploited from one event to another.

CONCLUSIONS

116. For FMN confirmation testing, there is a need to establish which capabilities are to be tested in a simulated environment and which are to be tested in a deployed network, so that the testing process for FMN confirmation is conducted in a similar environment for all affiliates.

117. The pool of analysts involved in the events should have the necessary operational and technical expertise, so that the quality of the analysis is assured.

118. There is a need to review CIS IV&V terminology under the lead of a single authority so that the use of a common terminology baseline and commonly shared situational awareness are ensured.

119. Clear information sharing mechanisms are needed to delineate between *need to know* and *responsibility to share*, so that there will be improved sharing among iterations/events leading to increased harmonization of events' objectives.

120. There is a need to review the testing regulatory framework to ensure relevant documents are up to date, so that Interoperability Testing Requirements are baselined.

121. A formalized cyber IV&V testing framework for all events would lead to enhanced cyber IV&V awareness and corporate knowledge.

122. Suitable IT solutions supporting NATO Interoperability Testing would increase sharing among CIS communities and contribute to the exploitation and re-use of the tests/test results among reviewed events.

RECOMMENDATIONS

123. In light of the above conclusions, the project team makes the following recommendations for the consideration of HQ SACT as the appropriate tasking authority.

a. Request the FMN Management Group to update the applicable FMN confirmation documentation with requirements related to the testing environment.

b. Encourage NATO entities and national contributors to CIS IV&V-related events to provide analysts with the right operational and technical expertise and experience.

c. Engage with appropriate authorities in order to initiate a review of CIS IV&V terminology.

d. Request event management entities to establish who, what, when, how, and with whom the IV&V information is shared.

e. Engage with relevant authorities in order to initiate a review of current documents governing the development of Interoperability Testing Requirements.

f. Request event directors to review the cyber IV&V testing framework to ensure that appropriate documentation is in place to support the building of corporate cyber awareness and knowledge.

g. Engage with appropriate authorities in order to identify solutions for the federation of existing databases specific to the CIS IV&V related events.

h. Engage with appropriate authorities in defining the requirements for suitable IT solutions to support NATO Interoperability Testing. This recommendation supports the requirement captured in Project Data Sheet III in Annex F to Enclosure 1 to Bi-SC Submission of CP 9C0102, *Provide Service Management and Control Services*[32] (Reference AH), and is included in the Service Management and Control Services Capability Packages (CP) Roadmap (Annex G to Enclosure 1 to Reference AH), as *Service Validation & Testing Capability*.

[32] The document states: "…*represents the required program for implementation of the first three projects in implementing the Information Technology Infrastructure Library framework to provide for the Service Management and Control of NATO networks. It reflects the minimum requirement to support NATO's ability to operate Command and Control (C2) across the Enterprise NATO Communications and Information Systems (CIS).*" CP 9C0102; Page 1 (Reference AH)

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Annex A
GLOSSARY OF ACRONYMS

ACO	Allied Command Operations
ACOS	Assistant Chief of Staff
ACT	Allied Command Transformation
AdatP	Allied Data Processing Publication
ANSI	American National Standards Institute
APAN	All Partners Access Network
ASQC	American Society for Quality Control
Bi-SC	of the two Strategic Commands
BQ	BOLD QUEST
C2	Command and Control
C2DS	C2 Deployability and Sustainability
C2DS FWD	C2DS Forward Branch
C2IS	C2 Information System
C3	Consultation, Command, and Control
C3B	C3 Board
C4	Command, Control, Communications, and Computers
C5	Command, Control, Communications, Computers, and Cyber
C5I	C5 Interoperability
CC	CYBER COALITION
CERT	Computer Emergency Response Team
CFBLNet	Combined Federated Battle Laboratories Network
CIAV	Coalition Interoperability Assurance and Validation
CIICS	Cyber Information and Incident Coordination System
CIS	Communication and Information Systems
CISR	Coalition Intelligence Surveillance and Reconnaissance
CMX	Crisis Management Exercise
CNAD	Conference of National Armaments Directors
CoI	Community of Interest
CONOPS	Concept of Operation
COORD	Coordinator
COP	Common Operational Picture
CP	Capability Package
CPT	Core Planning Team
CPX	Command Post Exercise

CSD	Coalition Shared Dataserver
CV2E	Coalition Verification and Validation Environment
CWIX	Coalition Warrior Interoperability eXploration, eXperimentation, eXamination, eXercise
DB	Demonstration Branch
DIR	Director
DMP	Decision Making Process
DNBL	Distributed Network Battle Labs
EAG	Executive Advisory Group
EPG	Exercise Planning Group
ETEE	Education, Training, Exercise and Evaluation
EVAL	Evaluation
EXCON	Exercise Control
EXDIR	Exercise Director
EXPLAN	Exercise Plan
EXSPEC	Exercise Specification
EXTRA	Exercises, Training, Reporting, and Analysis
FER	Final Exercise Report
FFT	Friendly Force Tracking
FMN	Federated Mission Networking
G2A SA	Ground to Air Situational Awareness
IDLL	Innovation, Doctrine and Lessons Learned
IEEE	Institute of Electrical and Electronics Engineers
IFFG	Initial Follow-on Forces Group
IMS	International Military Staff
Interop EXPERT	Interoperability Exercise Planning Execution and Reporting Tool
IOTA	Interoperability Test and Assessment
IP	Internet Protocol
IP CaT	Interoperability Profiles Capability Team
ISR	Intelligence, Surveillance, and Reconnaissance
IT	Information Technology
IV&V	Interoperability Verification and Validation
JALLC	Joint Analysis and Lessons Learned
JC2C	Joint C2 Capability
JCGISR	Joint Capability Group on ISR
JEMM	Joint Exercise Management Module
JFC	Joint Force Command

JFD	Joint Fires Division
JFT	Joint Force Trainer
JFTC	Joint Force Training Centre
JISR	Joint ISR
JISR CAM	JISR Capability Area Manager
JWC	Joint Warfare Centre
LANDCOM	Allied Land Command
LIAL	Lessons Identified Action List
LIVEX	Live Exercise
MC	Military Committee
MISP	Malware Information Sharing Platform
MEL / MIL	Main Event List / Main Incident List
MG	Management Group
MoD	Ministry of Defence
MT	Management Team
MTEP	Military Training and Exercise Programme
NAC	North Atlantic Council
NC3B	NATO C3B
NCIA	NATO Communication and Information Agency
NAFAG	NATO Air Force Armaments Group
NCIRC	NATO Computer Incident Response Centre
NCIRC TC	NCIRC Technical Centre
NCISG	NATO CIS Group
NFIP	NATO FMN Implementation Plan
NHQC3S	NATO HQ C3 Staff
NIAG	NATO Industrial Advisory Group
NIAT	NATO Interoperability Assessment Team
NISP	NATO Interoperability Standards and Profiles
NNEs	Non-NATO Entities
NNN	Non-NATO Nations
NRF	NATO Response Force
NSO	NATO Standardization Office
O&M	Operation & Maintenance
OCE	Officer Conducting Exercise
ODCR	Observation, Discussion, Conclusion and Recommendation
ODE	Officer Directing Exercise
OEPLAN	Operational Experimentation Plan

OPR	Officer with Primary Responsibility
OSE	Officer Scheduling the Exercise
PED	Processing, Exploitation, and Dissemination
R&D	Research and Development
RSOM	Reception, Staging, and Onward Movement
RQ	Research Question
SACEUR	Supreme Allied Commander Europe
SACT	Supreme Allied Commander Transformation
SACTREPEUR	SACT Representative in Europe
SEE	Staff Element Europe
SFCT	STEADFAST COBALT
SME	Subject Matter Expert
SMG	Senior Management Group
STANAG	NATO Standardization Agreement
STRATCOM	Strategic Communication
TACT	Transformational Activity
TE	Trial Executive
TIDE	Technology for Information, Decision, and Execution superiority
TMT	Trial Management Team
ToR	Terms of Reference
TRJE	TRIDENT JUNCTURE
USEUCOM	US European Command
UV	UNIFIED VISION
VJTF	Very High Readiness Joint Task Force
WG	Working Group

Annex B
RECOMMENDATIONS MATRIX

Para.(s)	Recommendation	Tasking Authority
60(a)	Initiate the development of a CIS IV&V Portfolio. This CIS IV&V Portfolio should be an Annex to the MTEP, utilizing a similar construct to the *Concept Development and Experimentation* Annex. Additionally, include the development of the CIS IV&V Portfolio in the *task & deliverable* for Item number 12 - Future Exercise Study, from the ACT Key Deliverables Plan / ACT Capacity Post Warsaw Summit.	HQ SACT
60(b)	Conduct a study on cyber IV&V opportunities in order to identify ways for increased exploitation of the outputs from the events.	HQ SACT
60(c)	Investigate with appropriate authorities the need for a defined list of critical services to be mandatorily tested during CWIX.	HQ SACT
86(a)	Engage with appropriate authorities for development of a *Governance Directive / Overarching Guidance* for each CIS IV&V- related event, detailing the structures and delineated roles and responsibilities between Governance and management entities. The documents should consider long- term provisions, developed in a similar construct (e.g. who approves, who endorses, who leads, who schedules, who conducts, etc.) and should be complemented by *Terms of Reference* for the management entities.	HQ SACT
86(b)	Engage with appropriate authorities to formalize a CIS IV&V advisory function.	HQ SACT
86(c)	Engage with NHQC3S to review the Exercise Directors Board status and Terms of Reference as well as to continue the staffing process in order to formalize the Exercise Directors Board as a CIS IV&V coordination function.	HQ SACT
123(a)	Update the applicable FMN confirmation documentation with requirements related to the testing environment.	FMN MG
123(b)	Encourage NATO entities and national contributors to CIS IV&V – related events to provide analysts with the right operational and technical expertise and experience.	HQ SACT
123(c)	Engage with appropriate authorities to initiate a review of CIS IV&V terminology.	HQ SACT

Para.(s)	Recommendation	Tasking Authority
123(d)	Liaise with Event management entities to establish who, what, when, how, and with whom the IV&V information is shared.	HQ SACT
123(e)	Engage with relevant authorities to initiate a review of current documents governing the development of Interoperability Testing Requirements.	HQ SACT
123(f)	Liaise with Event Directors to review the cyber IV&V testing framework to ensure that appropriate documentation is in place to support the building of corporate cyber awareness and knowledge.	HQ SACT
123(g)	Engage with appropriate authorities to identify solutions for the federation of existing databases specific to the CIS IV&V related events.	HQ SACT
123(h)	Engage with appropriate authorities to define requirements for suitable IT solutions to support NATO Interoperability Testing. This recommendation supports the requirement captured in Project Data Sheet III in Annex F to Enclosure 1 to Bi-SC Submission of CP 9C0102, *Provide Service Management and Control Services* and is included in the Service Management and Control Services Capability Packages Roadmap as Service Validation & Testing Capability.	HQ SACT
Annex E (3)	Review the relevant part of MTEP and provide consistent details related to CYBER COALITION.	HQ SACT
Annex E (14)	Engage with appropriate authorities to include detailed decision making mechanisms in the events' specific overarching documents.	HQ SACT
Annex F (16a)	Initiate in the appropriate forums the development of an overarching guidance and the formalization of a coordination function so that events' activities and milestones are deconflicted	HQ SACT
Annex F (16b)	Engage with appropriate authorities to establish the activities and milestones/events that could be conducted at the same time and location, in order to ensure improved information sharing of the outputs.	HQ SACT
Annex F (16c)	Investigate with CWIX Director, Allied Land Command (LANDCOM), SHAPE J6 and NCIA the possibility of including the testing for experimentation of new systems supporting CIS interoperability at the tactical level (land), in the CWIX programme.	HQ SACT

Para.(s)	Recommendation	Tasking Authority
Annex F (16d)	Engage with Exercise Directors to determine the necessary operational and technical expertise and experience requirements for the analysts supporting their events and provide them to NATO entities and national contributors.	HQ SACT
Annex F (16e)	Liaise with NATO EXTRA Portal managers (for NATO Secret) and NCIA CoI Portal managers (for Reach/internet) to create a CIS IV&V Community of Interest.	HQ SACT
Annex F (25a)	Engage with appropriate authorities to review the CIS IV&V related terminology and Glossaries and to update the content in the NATO Term Database[33] to be used as a unique source for terms and definitions.	HQ SACT
Annex F (25b)	Engage with appropriate authorities to provide Exercise Directors with a document containing Terms and Definitions common to all exercises.	HQ SACT
Annex F (25c)	Establish a C3 Taxonomy release timeline and to define a version management and implementation process, so that a common C3 Taxonomy version is used as a baseline.	C3B
Annex F (25d)	Engage with appropriate NCIA and FMN authorities to develop a detailed FMN procedural guidance for the events qualified as FMN instantiation. Additionally, for an improved applicability of the guidance, FMN authorities to ensure a tailored FMN training package (e.g. booklet, online course, etc.) is delivered to participants prior to execution/Phase III of the FMN instantiations.	HQ SACT
Annex F (25e)	Engage with appropriate authorities to review the authoritative regulatory framework for the development of Interoperability Testing Requirements for each event.	HQ SACT
Annex F (25f)	Engage with Interoperability Profiles Capability Team (IP CaT) to review the NISP v.9 and develop a process for the management of the standards included therein during its life cycle.	HQ SACT
Annex F (30a)	Coordinate with relevant decision-makers and stakeholders to set up a coordination function to facilitate improved interaction and coordination between ACT and ACO representatives.	HQ SACT

[33] NATOTerm Database is the new official reference for the NATO Terminology. The terminology migration process from other sources (e.g. glossaries) is ongoing. The NATOTerm is available on NS at http://natoterm.hq.nato.int/MultiTransWeb/content/nato/pages/home.html?lg=en and on the internet at https://nso.nato.int/natoterm.

Para.(s)	Recommendation	Tasking Authority
Annex F (30b)	Engage with relevant authorities to review the documentation (Terms of Reference; handbook and Standing Operating Procedures) supporting the activities of existing Cyber Defence entities in the events.	HQ SACT
Annex G (4)	HQ SACT C2DS to populate and advertise the CWIX Portal available on the HQ SACT workspace on NS network or develop another IT solution (e.g. CWIX Wiki).	HQ SACT
Annex G (5)	SHAPE / NCISG to provide a link to the SFCT portal on the home page of NCISG workspace on NATO Secret network.	SHAPE
Annex G (12a)	Engage with relevant authorities to review the requirements for a suitable Interoperability Testing solution and further support the approval of Capability Package (CP) 9C0102 as requested by the Strategic Commanders.	HQ SACT
Annex G (12b)	Review the Interoperability Test and Assessment (IOTA) requirements as a NATO CIS Interoperability Assessment Tool and to address the possibility of its further development as a capability through a NATO CP.	HQ SACT

Annex C

OVERVIEW OF CIS IV&V OPPORTUNITIES

1. CIS are a key element of a capability so that CIS interoperability is an essential part of capability interoperability. CIS interoperability is verified and validated in various events, open to the Nations and Partners, providing a number of different CIS IV&V opportunities.

2. As described in chapter 3, each of the reviewed events allows specific CIS IV&V opportunities. These opportunities result from a combination of the frequency; their relevance to the maturity of the capability lifecycle (R&D, Experimental, Near Fielded, and Fielded) and the reason for testing the capability (Exploration, Experimentation, Verification, Validation, Confirmation, and Certification); as well as the events' benefits and the ways they are delivered. All of these possible combinations are presented in detail in the table below:

Table 4: CIS IV&V Opportunities

Event	Frequency	Capability		Main Benefits	Venues for Achieving Benefits
		Maturity	Tested for		
TIDE Sprint	2 / year	R&D	Exploration	New ideas Develop C2 concepts	Conferences Meetings TIDE Tracks
CWIX	1 / year	R&D Experimental Near Fielded Fielded	Experimentation Verification Validation Confirmation	Interoperability Shortfall List Focus Area Achievements and recommendations FMN Readiness Confirmation	Conference Exercise Focus Areas Testing in simulated environment
FMN CIAV	Persistent (based on the needs and the agreed calendar)	Experimental Near Fielded Fielded	Verification Validation Confirmation	Prove capability / limitations Operational impact assessment Risk Reduction FMN Readiness Confirmation	Meetings Teleconference Testing in simulated environment
BQ	2 / year (only one iteration is in multi - national environ-ment)	Experimental Near Fielded	Demonstration Verification Validation	Demonstrated capabilities Focus Area achievements and recommendations Risk reduction FMN Readiness Confirmation	Conferences Meetings Focus Areas Testing in deployed network environment and simulated environment
UV	Every 2 years	Experimental Near Fielded Fielded	Experimentation Verification Validation	Proof of concept for federated JISR PED Solutions for optimized interaction of Ops, Intel and C4ISR functions for JISR activities	Conferences Meetings Trial Testing in simulated environment

Event	Frequency	Capability		Main Benefits	Venues for Achieving Benefits
		Maturity	Tested for		
CC	1 / year	Near Fielded Fielded	Verification Validation	Improved collaboration on cyber defense Solutions for cyber defense technical challenges Solutions for optimized interaction and sharing.	Conferences Exercise Testing in simulated environment
SFCT	1 / year	Near Fielded Fielded	Verification Validation Confirmation	Build, verify and validate for NRF C4ISR Architecture Train CIS units FMN Readiness Confirmation Media and STRATCOM engagement	Conferences Force Activation, Deployment and RSOM[34] Exercise Testing from/in deployed network environment Testing in simulated environment
TRJE	1 / year	Fielded	Certification Experimentation	Certified mission network for NRF Use of deployed network Trained JFC and NRF components Media and STRATCOM engagement Experiments according Transformational Activity (TACT)[35]	Conferences Exercise

3. Review of the frequency of events, or rather how often the reviewed events take place, shows that TIDE Sprint takes place twice a year and UNIFIED VISION takes place every other year. Except for FMN CIAV activities, which can be coordinated throughout the year, all the other events take place once a year. For NRF certification, TRJE will be used as a venue only in 2018 and other venues (which do not fall within the scope of this project) will be used in 2017 and 2019.

4. Potential benefits gained from the events are aligned with the established objectives and may be delivered in various venues such as conferences, meetings, simulated environment testing, etc.

5. Some of the events are also qualified as FMN instantiations and provide affiliates with the opportunities to confirm their capabilities in accordance with the respective FMN Spiral specification.

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[34] RSOM stands for Reception, Staging and Onward Movement.

[35] According to the TRJE16 EXSPEC: "*TACTs provide a comprehensive ability to support the Commander's intent while providing a structured approach to achieving programmatic objectives. TACTs comprise a variety of activities that support problem analysis, the introduction and observation of reasonably mature elements into an exercise, or relatively immature elements into a stand-alone event*." TRJE16 EXSPEC; Page 5 (Reference O).

Annex D
OBJECTIVES HARMONIZATION

INTRODUCTION

1. In support of the analysis provided in chapter 3, this annex presents additional information relating to the objectives of the reviewed events and the factors contributing to their harmonization, as well as a model for the CIS IV&V Portfolio.

GENERAL OBJECTIVES

2. To further support the details presented in chapter 3 regarding the identified general objectives, the project team further analysed how the events' general objectives are distributed in the CIS IV&V landscape and represented them in a diagram covering: capability maturity; reasons for testing; and interoperability dimensions. This diagram is presented in Figure 10 below.

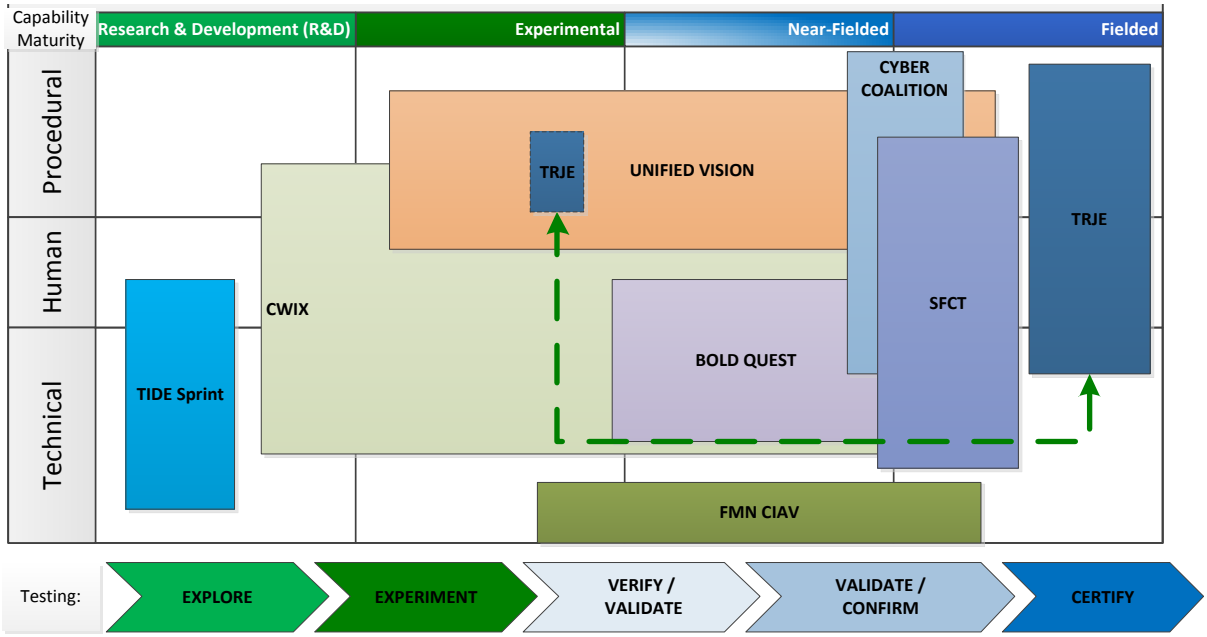

Figure 10: Distribution of CIS IV&V General Objectives

3. Figure 10 shows an overlap of some events in terms of the maturity of the capability tested and its interoperability dimension. However, the project team identifies that these overlaps are normal taking into account the different systems employed / services tested and training audiences. Additionally, in the diagram, the human interoperability dimension is over-emphasized, because there are significant benefits derived from each event for the people involved, as recognized by most of the interviewed SMEs.

SPECIFIC OBJECTIVES

4. Several of the interviewed SMEs indicated that there are some specific objectives related to testing in the same interoperability dimension that are similar across multiple events, as summarized in Table 5.

Table 5: Similar Testing Activities[36]

Testing	Areas	Event
CISR / JISR	Integrated CISR operations ISR Capabilities (Identification & Assessment)	CWIX; SFCT; BQ; UV
FFT	STANAG 5527[37] / ADatP-36 STANAG 5528[38] / ADatP-37	CWIX; SFCT; BQ
Cyber / Cyber Defence	Cyber Defence procedures	CWIX; SFCT; BQ; CC

5. Referring to Table 5:

a. For the CISR/JISR area, the project team identified that similar testing activities were conducted in CWIX, SFCT, BOLD QUEST and UNIFIED VISION. For example, although on different scales, CWIX has a JISR Focus Area where tests (across different security domains) are conducted for capabilities, while JISR related testing (exclusively in one security domain) in UNIFIED VISION involves Mission Threads. Also, in SFCT16 one of the goals was to build C4ISR Architecture (including JISR) for NRF 2017, while in BOLD QUEST, CISR capabilities are also tested (e.g. Integrated CISR operations from Combined Joint Task Force to Brigade level).

b. For FFT, the project team identified similar testing activities in CWIX and BOLD QUEST; both events have FFT Focus Areas where parts of NATO STANAGs 5527 and 5528 were tested. In CWIX, the FFT related tests were focused on, inter-alia: the use of an updated version of ADatP-36 and a draft version of an ongoing revision of ADatP-37; the exchange of FFT data; and, contributions to the Common Operational Picture (COP). In BOLD QUEST, similar FFT tests were aimed at demonstrating Ground to Air Situational Awareness (G2A SA). Additionally, in SFCT16 tests related to FFT were also conducted.

c. For Cyber, similar testing activities were identified in CWIX, SFCT, BOLD QUEST and CYBER COALITION. For CWIX, there were tests performed to support IV&V of cyber defence tools and solutions in the Cyber Focus Area, with system penetration tests on static and deployable networks. For SFCT, testing was conducted to assess cyber defence measures covering secure set-up, configuration, deployment, and interconnection of systems. Other tests were conducted to assess and evaluate NATO's ability to establish and operate a real time awareness and cyber-defence response capability on the Mission Secret and NATO Secret Networks. For BOLD QUEST, cyber aspects covered improving methodology, planning practices and products, to include cyber security in a coalition federated environment. For CYBER COALITION, test penetrations were conducted throughout the event for exercising NATO cyber capabilities and procedures, as well as information sharing and real time cyber awareness

FACTORS CONTRIBUTING TO OBJECTIVES HARMONIZATION

6. Following the analysis of the general and specific objectives, the project team identified that there are several factors which may contribute to the greater harmonization of these objectives.

a. **Governance**: Through effective Direction and Guidance, the entities involved in the Governance of an event could establish harmonized objectives. However, this harmonization could be obtained based only on adequate awareness of the conduct of the

[36] Acronyms first used in this table can be found in the Glossary of Acronyms in Annex A to this report.

[37] STANAG 5527 Friendly Force Tracking Systems (FFTS) Interoperability (Reference AI).

[38] STANAG 5528 Services to Forward Friendly Force Information to Weapon Delivery Assets (Reference AJ).

event. This advice should come from an advisory function, as detailed in para 74 - para 75 (Governance / Advisory Function).

b. **Planning**: A better exchange of information related to each event would lead to more coherent planning, resulting in the avoidance of potential overlapping of objectives and to a more effective and coordinated activities and milestones distribution in event timelines. However, such coherent planning could be best realized by a coordination function that would have an overall view of the events, working with Event Managers to de-conflict event scheduling and associated objectives. More details are presented in para 79 – para 81 (Governance / Coordination Function).

c. **Resources**: The right use of resources is always a challenge for the conduct of most of the events. This challenge comes primarily from the ability to maintain an appropriate balance between the level of ambition and the resources available, as well as from understanding and accepting limitations. A realistic definition of event objectives is necessary, which could be addressed by an advisory function that could provide Governance with the best advice on the use of resources. More details are presented in para 74 – para 75 (Governance / Advisory Function).

MODEL FOR CIS IV&V PORTFOLIO

7. In order to support the development of a CIS IV&V Portfolio as described in chapter 3, the project team proposes a model that could be used as an initial concept. This model is presented in Figure 11 and further detail is provided in the following paragraphs, but further analysis is needed prior to implementation.

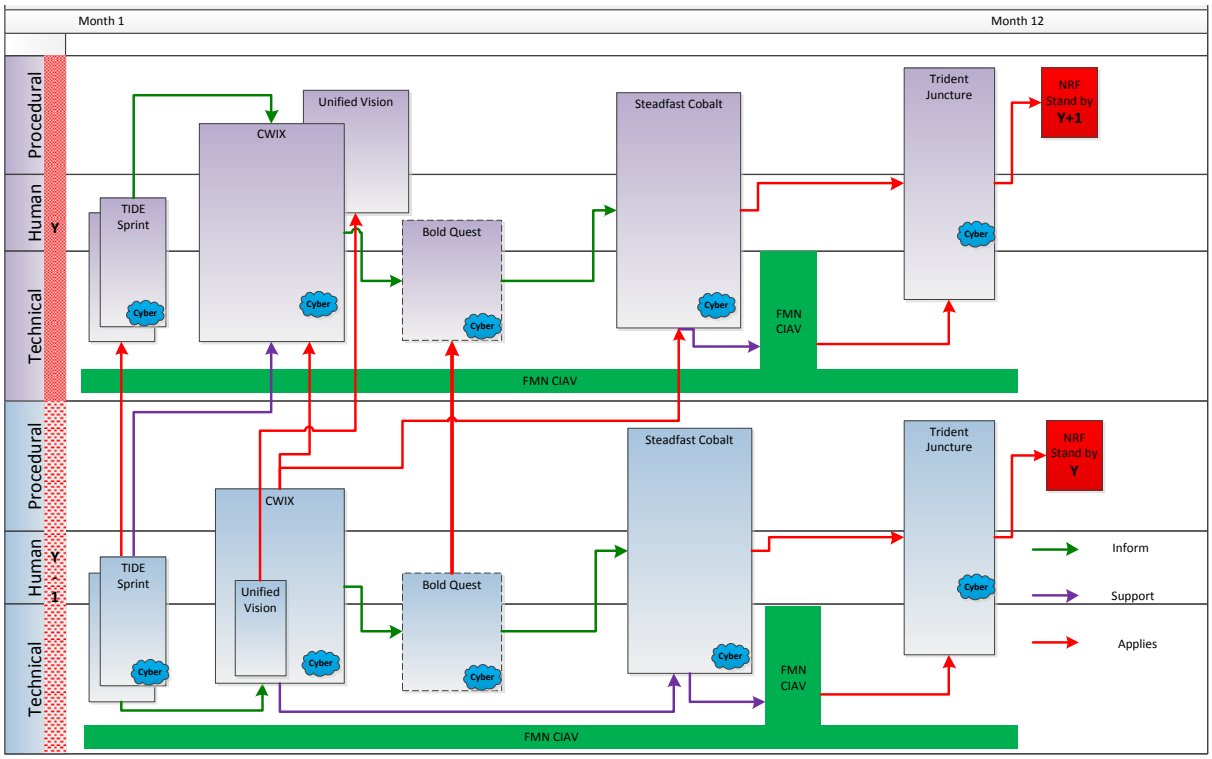

Figure 11: Model for CIS IV&V Portfolio

8. This model of the CIS IV&V Portfolio is NRF-centric and aims to improve the exploitation of the outputs from one event to another, in line with the smart defence concept. The model covers a three year cycle and shows three types of outcomes (among the events): outcomes that inform other events; outcomes that support other events; and outcomes that should be mandatorily applied in other events. Parts of two different cycles may occur in the same event iteration.

9. For most of the events, this model promotes a modular approach which may require mandatory focus areas common to several events. The objectives for these focus areas should be defined in a coordinated manner among the events, in order to ensure that the NRF required capability is delivered at the end of the cycle.

Additionally, this model proposes: an integration of UNIFIED VISION with CWIX (joint with CWIX when UNIFIED VISION is conducted and as a new Focus Area in CWIX during UNIFIED VISION off years); coordinated cyber training and CIS IV&V opportunities; and wider FMN implementation through a relevant Focus Area. In this regard, Partners' participation will be ensured and the framework for testing both in a simulated and deployed network environment will be provided.

Annex E
GOVERNANCE

INTRODUCTION

1. The overview of Governance as presented in chapter 4 shows that it is dissimilar from one event to the other, with a variety of decisions and actions made by various entities. The following sections first provide an additional finding related to the event Governance structures and a review of the events' Decision Making Process (DMP).

STRUCTURES

2. Related to the Governance structures of the events, particularly for CYBER COALITION, the project team has identified an inconsistency in the way that the Governance is presented in the MTEP (Reference H). For example, for CYBER COALITION 17 the OCE and the OSE roles are assigned to *COM NATO HQ* (!) while the Officer with Primary Responsibility (OPR) is assigned to SHAPE. However, the details for CYBER COALITION 18, CYBER COALITION 19, and CYBER COALITION 20 are more in line with the provisions of MC Implementation of the IMSM-0594-2014 Cyber Defence Action Plan (Reference AK).

Recommendation

3. HQ SACT as the tasking authority to consider the review the relevant part of MTEP and provide consistent details related to CYBER COALITION.

DECISION MAKING

4. The project team reviewed the DMP of each event and identified that it is conducted by various structures (as described in Table 2 of chapter 4). The following sections summarize the DMP for each event.

TIDE Sprint

5. According to the TIDE Sprints portal on Tidepedia, the TIDE DMP is collaborative, based on consensus and involves contributions from the TIDE Sprint Coordinator, Track Lead, and Participants. These contributions are reflections of their responsibilities and support a bottom-up approach.

CWIX

6. According to the CWIX Overarching Guidance (Reference G), the CWIX SMG, chaired by the CWIX Director, is the CWIX detailed decision-making body. It meets during the planning conferences to provide further guidance concerning management issues of the upcoming exercise, recommendations for future exercises and approves the Interoperability Test Requirements. SMG members are representatives from ACT, ACO, the CWIX nations and the NHQC3S on behalf of the C3B. Advisors to the SMG include the Host Nation, Working Group Leads, Focus Area Leads (Joint, Land, Air and Maritime), representatives from NATO Commands, NCIA, advisors from nations, and other invitees by the SMG.

FMN CIAV

7. According to FMN CIAV WG Terms of Reference (Reference J), FMN CIAV WG meetings are guided by agenda items that are developed from discussions among FMN CIAV WG National Leads and tasking from the FMN Management Group. Meeting decisions are reached by consensus; (i.e. an agreement reached by common consent). A decision is arrived at when it is accepted by each voting FMN Affiliate. Decisions are subsequently recorded and distributed to FMN CIAV WG members for review and approval.

BOLD QUEST

8. According to BOLD QUEST Final Reports, BOLD QUEST is fundamentally a collaborative endeavour where decision making within most areas of planning and execution is by consensus. Participants define their objectives and requirements, resource their own efforts, and the related decision making remains with the sending nation/HQ. The BOLD QUEST Operational Manager facilitates the planning and execution processes and primarily seeks to set the conditions for nations' programs, in order to successfully accomplish their objectives.

UNIFIED VISION

9. According to Trial Management Plans, the JCGISR has designated the JISR CAM as the UNIFIED VISION 16 Trial Executive (TE). The primary responsibility of the TE is to provide oversight and direction of all aspects of trial planning, execution, and reporting; and has ultimate authority in all matters relating to the trial. To assist the TE in their decision making, an EAG was established to provide expertise, in order to review the overall approach of the trial and to coordinate the objectives across the Alliance to ensure coherence, consensus and participation. The EAG improves the flow of information and assists trial management in prioritizing available resources. The EAG consists of senior representatives from ACT, SHAPE, NCIA, NHQC3S, IMS Intelligence, and the JCGISR Chairman, as well as the former Chairman as an adviser. Membership is tailored to the specific needs of the trial as planning matures.

CYBER COALITION

10. According to the CYBER COALITION Exercise Plans, decision making is delineated through three levels that reflect the management level of the exercise: the EXDIR; the CPT; and the EPG. Nations decide their level of participation and propose objectives for the exercise. After revision, EXDIR / CPT submit the draft objectives for MC approval, which is the overall decision making body.

SFCT

11. According to the SFCT CPT ToR (Reference AL), a CPT is established by the OCE and is led by the OCE OPR, supported by SMEs from SHAPE (OSE EPG), NCISG (as Coordinating Authority), NCIA (as Technical Authority) and Training Audience. The CPT is responsible for conducting detailed planning, coordination and preparation. Direct communication and liaison takes place between applicable NATO Strategic Commands, the JWC, the JFCs, as well as other HQs and agencies as required. For the exercise related aspects, primary decision making duties reside within Exercise Control (EXCON) that is under the control of EXDIR. From the verification and validation perspective, the Evaluation Group is the entity making decisions on the way that the tests are conducted and evaluated.

TRJE

12. According to the EXSPEC, SACT assumes the duties of the OSE for TRJE and will initiate and monitor the Exercise Process within the framework of the OSE EPG, and in close coordination with ACO, the OCE, and the Officer Directing Exercise (ODE), through the CPT. Each of these entities has defined decision making ability in accordance with Bi-SC Directive 075-003 (Reference F). The decision making related to NATO Partner and NNEs participation belongs to the NAC. Generally, the Initial Planning Conference is the forum where decisions are made concerning the various locations where the Primary Training Audience participates.

Conclusion

13. A review of the events' DMP illustrates the proliferation of different decision making entities for each event. In some cases, the DMP implies direct national decisions and is

based on consensus by applying voting and de-confliction mechanisms, which contributes to a more complex CIS IV&V landscape.

Recommendation

14. HQ SACT, as the tasking authority should consider that an improved DMP could be facilitated by having the decision making mechanisms clearly articulated in an overarching document for each event, and to engage with appropriate authorities to include detailed decision making mechanisms in the events' specific overarching documents. Details are also provided in para 71 – para 73 (Governance / Overarching Guidance).

Annex F
SUPPORTING ELEMENTS PROCESSES, INFORMATION, AND PEOPLE

INTRODUCTION

1. As explained in chapter 5, the project team identified that there are several elements that are common to all reviewed events and support the achievement of the objectives. These elements are reflected in how: the events are planned; their performance is assessed; testing is conducted; information is captured and shared; and human resources and technology are employed in support of achieving the objectives.

2. In this annex, additional findings and more detail is presented with regard to three of the four elements that the project team focusses on in chapter 5: Processes; Information; People. Additional findings relating to the fourth element: Technology, are presented in Annex G which takes a closer look at the relevant tools supporting CIS IV&V events.

PROCESSES

3. As stated in chapter 5, the project team focused its analysis on four processes: planning, testing, performance review, and lessons learned. In this section, findings for planning, performance review and lessons learned are presented in addition to those already presented in chapter 5.

Planning

4. The analysis of the planning process and the activities and milestones distribution in time, as presented in chapter 5, clearly shows a tight timeline (even concurrent in some situations), and is the result of an uncoordinated planning process among the events. This lack of coordination has two consequences for the participants in the events: a lack of exploitation of the outputs from one event to another (Unavailability of Outputs); and challenges to the employment of human and financial resources (Resource Constraints).

Unavailability of Outputs

5. For the reviewed events, every activity (such as conferences, meetings, and deployments) has an output that is made available in various formats (reports, post meeting minutes, action lists, etc.) after a certain time frame. However, because of the tight timelines, it is difficult to exploit these outputs in other events. Some interviewed SMEs suggested the possibility of having meetings and conferences of events at the same time and at the same location, so that meeting/conference participants are more readily able to coordinate, interact and remain updated on the outputs of the parallel activities and milestones from other events. A formal update report could be included as an agenda item to such a meeting.

Resource Constraints

6. Although different events have different planning teams, there are core staff members (especially technicians) that are involved in different roles in many of the reviewed events. For example, some participants involved in SFCT and CWIX had to potentially attend a total of nine (multi-day) Planning Conferences for SFCT and CWIX within a short time frame, in locations dispersed throughout Europe. In order to overcome this challenge, a coordinated timeline of events should be developed that allows adequate time between the various activities and milestones and, if necessary, suitable external resourcing.

7. Additionally, for effective use of CIS resources (both human and technical), national participation in the reviewed events should ideally be de-conflicted with other national and

multinational commitments that employ CIS fielded capability not for testing purposes. Apparently this de-confliction is not easy and coordination among the similar events in terms of timeline and sequence has become increasingly difficult, as a result of the complex multinational exercise planning. For example, the SFCT execution phase was conducted during the same period as a multinational exercise. This situation generated a serious resource challenge for one nation that had to test CIS Land Capability in SFCT, such that—because of a lack of operators—some of these capabilities were operated by Air Force operators. Although their professionalism is acknowledged, with appropriate planning this ad-hoc solution could be avoided, and an overall coordination of the events with the national exercise programmes' needs could be achieved.

Testing

8. Many interviewees indicated that after Exercise Combined Endeavour[39] was cancelled, the CIS Interoperability testing at tactical level was put on hold. The recent VJTF and Initial Follow-on Forces Group (IFFG) concepts triggered the need to continue the testing at tactical level (land), SFCT being identified as a venue for testing Near-Fielded and Fielded systems. The project team identified that there are two main elements supporting the testing at tactical level (land): updated regulatory framework and experimentation programmes.

a. Regarding the updated regulatory framework, it is currently in the process of being addressed by ACO through drafting of MC 640 that aims to replace the STANAG 5048 - *Minimum Scale of Communications for the NATO Land Forces* (Reference AM).

b. Regarding the experimentation programmes for new tactical level (land) systems (i.e. Internet Protocol (IP) over radio; Tactical Voice Bridge for secure communication; FFT for VJTF formations), before having them tested in SFCT, they should be experimented in the appropriate venues and included in the appropriate projects. Currently, this testing is uncertain and the lack of relevant projects and funding was identified by several SMEs as a cause. According to NATO ETEE Policy (Reference N), para 3.134 / A-24, the OEPLAN (Operational Experimentation Plan) describes ACT/JWC/Joint Force Training Centre (JFTC) experimentation execution during an exercise. With HQ SACT in the lead, CWIX appears to be the most suitable venue to perform testing for experimentation of new systems at the tactical level (land). The new Communication Focus Area developed for CWIX could provide an opportunity for NATO and nations to conduct testing for experimentation of new communication systems.

Performance Review

9. The project team has identified that the performance review process covers the performance of activities, organizations, or capabilities, and occurs under different terminology specific to each event: assessment, evaluation or certification. The table below shows the definitions of these terms, as described in AAP-06 (Reference AG).

Table 6: Comparison of Terms

Assessment	Evaluation	Certification
The process of estimating the capabilities and performance of organizations, individuals, materiel or systems.	The structured process of examining activities, capabilities and performance against defined standards or criteria.	The process of officially recognizing that organizations, individuals, materiel or systems meet defined standards or criteria.

10. The following is a summary of how performance review is conducted for each event:

[39] According to the C3B Guidance and Advice on NATO CIS Exercise Harmonization; Page 1-2 (Reference AN), *Combined Endeavour* was a USEUCOM led exercise that involved a wide spectrum of partners enabling them to test coalition interoperability by utilizing tactical CIS capabilities.

a. **TIDE Sprint** – According to the TIDE Sprints portal on Tidepedia, as an exploration event, there is no formal assessment or evaluation process. However, in order to synchronize the exploration efforts, information discussed in various group sessions is evaluated daily and further utilized to determine themes for subsequent discussions.

b. **CWIX** – According to the CWIX Management Plans, there is an assessment process based on the analysis conducted by the Analysis Team (AT) as part of the Analysis Working Group. During CWIX execution, the members of AT are assigned to the different Focus Areas, in order to analyse the test cases and the test results. Following their analysis, a final recommendation is provided for the capability – Success, Limited Success, Interoperability Issue, or Not Tested. The information is ultimately provided to Focus Area Leads for inclusion in the event Final Report.

c. **FMN CIAV** – According to FMN CIAV WG ToR (Reference J) and CV2E CONOPS (Reference I), the FMN CIAV WG conducts a tailored suite of pre-joining interoperability assessments regarding aspirant FMN Affiliates' ability to federate and contribute to collective FMN capabilities. These assessments look at several aspects, including the tests performed in CV2E, following which SMEs define the capability limitations and assess the operational impact.

d. **BOLD QUEST** – According to BOLD QUEST Final Reports, there is an assessment process in place conducted by analysis and assessment teams, specific to each demonstrated capability. The process starts with the collection of observations through documentation of key event activities and continues with identification of network and procedural gaps. The data is further analysed by members of the specific teams and the associated recommendations and ways forward are included in Assessment Reports, as part of the Final Report for each event iteration.

e. **UNIFIED VISION** – According to Trial Management Plans, the Assessment Team (identified as T8) functions as a component of the Trial Management Team. The team provides a comprehensive and unbiased assessment of tests conducted during the Trial, supported by data and observations, in accordance with their Trial Assessment Plan. Objectives of each Trial are assessed and the results are provided for inclusion in the First Impression Report and Final Trial Reports.

f. **CYBER COALITION** – Each nation conducts a self-assessment of the objectives' achievement and provides the results to the CPT, which further compiles all data provided and conducts the final assessment, related to the level of achievement of the exercises and training objectives.

g. **SFCT** – According to the Evaluation Plans and Specific Evaluation Directive (Reference AO), an evaluation process is in place. The evaluation process is conducted to support the achievement of the exercise and training objectives, against technical, procedural, and operational standards and requirements. The evaluation process refers to Interoperability Test Evaluation, Training Objectives Evaluation, and FMN Evaluation (from 2015 on). The process starts with the definition of mission essential tasks and operational requirements; continues with the training objectives and evaluation criteria definition; and ends with release of the Final Evaluation report that includes reports for each of the three areas evaluated. The evaluation is conducted by the Evaluation Group and triggers various remedial actions. The urgent remedial actions are applied before TRJE (or other NRF certification venues). Mid- and long-term remedial actions are addressed within the SFCT C4ISR Interoperability Evaluation Report and transferred to SHAPE J7 Lessons Learned Database through Lessons Identified Action List (LIAL).

h. **TRJE** – According to the relevant EXSPECs and Bi-SC Directive 075-003 (Reference F), for TRJE, there are assessment, evaluation, and certification processes in place.

- The assessment process is conducted by each participating organization, in their respective area of expertise. This process is more elaborated in Phase IV / Stage 3

where an After-Action report is produced, in order to assess the Phase IIIB/ Stage 3 of the exercise.

- The evaluation process is conducted by the Evaluation Group provided by SHAPE J7, who directs the process and leads the planning and preparation of the joint evaluation. The evaluation process is conducted against volumes V (Reference AP) and IX (Reference AQ) of Allied Force Standards and concludes with an Evaluation Report.
- The certification process is based on the requirements coordinated in the Rolling Certification Programme WG and promulgated in the JFC Specific Certification Programme for NRF, prior to the preparation phase. Other entities are also involved in the coordination and synchronization of tactical and joint levels certification.

11. The veracity of the performance review for each event is dependent on the quality of the supporting analysis.

a. Several interviewees and senior SMEs indicated that sometimes the analysts did not always have the required background for a solid analysis of the test results, in order to properly validate tests or to identify the proper corrective action. For example, in some cases, tests were validated by the analysts just because information passed from originator to the target and the information was displayed on a virtual map. However, the analysts did not initially identify that the conventional icons were not displayed properly and/or at the correct coordinates, so that the test should not have been fully validated.

b. In a different context, the analysis was properly performed, but it was identified that there was a need for technical analysts who, for specific situations, could give a better overall assessment. For example an initial test on tactical satellite communication was validated, but when repeated, it was not fully successful (because of factors such as satellite path, meteorological conditions, etc.). An analyst with sufficient technical background could have identified more effectively how to mitigate the impact of the specific circumstances.

12. Another observation is that in CWIX, including the *interoperability issue*[40] as part of the results scale leads to ambiguity concerning the test results, way of reporting; and the relevant statistics, for some capabilities. For example, there may be a nation that has a successful test for a capability, but it reports that the capability is part of a test case[41] with an interoperability issue (vice individual tests), which may lead to ambiguities when reporting test results and misleading statistics. A clear and detailed statistical analysis of the test will support the general understanding of the event dimension, in addition to an improved feedback and balance between the resources and level of ambition.

Lessons Learned

13. In all reviewed events, the learning process results in improvements with both administrative and operational value. Significant operational value learning results from following the testing process and exploiting the test results. Each test result could be seen either as a good practice, if the test is a success or as a potential Lesson Identified if the test shows a shortfall or gap. However, without an appropriate tagging of the tens of thousands of tests conducted during several event iterations, it is difficult to exploit the test results for learning purposes.

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[40] According to the CWIX16 FER: "… *an interoperability issue occurs when a test case between two or more capability configurations does not meet (or only partially meets) its success criteria*." CWIX16 FER; Page 9 (Reference AR).

[41] Although not formally defined in the *Terms and Definitions* part of the CWIX16 FER, a CWIX test case may contain several individual tests.

14. Sharing and dissemination of lessons is an important aspect of the Lessons Learned capability, allowing an effective exploitation of the outputs of the Lessons Learned Process. However, as stated by most of the interviewees and observed by the project team, most Lessons Learned related information is *stove-piped* and the various supporting IT tools are not able to communicate with each other, such that information cannot be readily shared between participants in the different events. Additionally, some interviewed SMEs with extensive participation in CWIX and SFCT stated that although at least in these two events true learning occurs, there is significant rotation of personnel involved which means it is mainly the NCIA civilian staff who benefit most from learning as they (generally) remain in their posts for a long(er) period of time. As such, there appears to be a risk that corporate knowledge and institutional learning will remain sub-optimal without an appropriate exploitation of lessons learned outputs based on effective sharing and dissemination.

15. Annex S of Bi-SC Directive 075-003 (Reference F) and the Exercise Reporting and Handling Lessons of Exercises (Reference AS) describe the Lesson Learned Process and Information Sharing in NATO Collective Training and Exercises and establish the NATO EXTRA Portal as a tool to support information sharing. However, not all events allowing CIS IV&V opportunities have been made available in the NATO EXTRA Portal, so that it cannot facilitate access to a potentially wider CIS IV&V community. Moreover, since the NATO EXTRA Portal is available only on NS network, a sharing solution allowing easy access for involved Partners could be supported by use of the NCIA CoI Portal, available on the internet.

Recommendations

16. In light of the above, the project team makes the following recommendations for the consideration of HQ SACT as the appropriate tasking authority.

a. Initiate in the appropriate forums the development of an overarching guidance and the formalization of a coordination function so that events' activities and milestones are de-conflicted.

b. Engage with appropriate authorities to establish the activities and milestones/events that could be conducted at the same time and location, in order to ensure improved information sharing of the outputs.

c. Investigate with CWIX Director, LANDCOM, SHAPE J6 and NCIA the possibility of including the testing for experimentation of new systems supporting CIS interoperability at the tactical level (land), in the CWIX programme.

d. Engage with Exercise Directors to determine the necessary operational and technical expertise and experience requirements for the analysts supporting their events and provide them to NATO entities and national contributors.

e. Liaise with NATO EXTRA Portal managers (for NATO Secret) and NCIA CoI Portal managers (for Reach/internet) to create a CIS IV&V Community of Interest.

INFORMATION

17. The analysis of the information element, specific to the reviewed events, led to additional findings and recommendations that support the conclusions and recommendations given in chapter 5 of this report, related to a use of common terminology and information availability, as described below.

Common Terminology

18. As a result of the review of relevant documents and the responses from the SME interviews, it became clear that a common understanding of CIS IV&V terminology used does not exist. It would appear that the authors of documents—various policies and their subsequent implementing directives, various ToRs, or simple working papers—worked in

relative isolation concerning their use of CIS-related terminology. Additionally, review and use of the Annexes *Terms and Definitions* used in the majority of documents revealed an intricate language, where even simple words became ambiguous through their contextualization, leading to a different understanding and use, with direct impact on common understanding in the events. The use of an apposite and common CIS terminology would lead to greater harmonization in the definition of the objectives for the reviewed events and to a commonly shared Situational Awareness, avoiding duplication of efforts and reducing the quantity of data to be stored. This use of a common terminology as part of *semantic interoperability* is in line with the provisions of para 8.5 of Alliance C3 Interoperability Policy (Reference B).

19. As an example, for the purposes of this report, the project team used the definition of information as provided by C3 Policy Glossary (Reference R) which states that, *"Information is any communication and representation of knowledge such as facts, data or opinions in any medium or form, including textual, numerical, graphic, cartographic, narrative, or audio-visual forms."*[42] However, *information* is defined differently in other documents such as AAP-06 (Reference AG) and the NAC's document on Security within NATO (Reference AT). Other examples may be seen in the use of *Focus Areas* which may be SACT Focus Areas, CWIX Focus Areas or BOLD QUEST Focus Areas (which are all defined differently) or in the use of *Capability Package* (CP), which is specific, but different for both a NATO CP and FMN CP used for Spiral Specification.

20. Another issue observed and reported multiple times relating to terminology was the lack of compliance with the established naming convention associated with tests (i.e. performing, results, and shortfalls). As a result, in some situations, there was some confusion during manual and automatic data analysis that impacted the accuracy of the statistics.

21. However, several interviewed SMEs with extensive participation in CWIX and SFCT indicated that there has been an improvement in the level of common understanding and use of common terminology related to missions and operations, operational capabilities, and CIS Capabilities. Such improvement was identified as a result of the development and increased use of C3 Taxonomy, which is identified in the Political Guidance 2015 (Reference AU), as providing guidance to support overall coherence and comprehensiveness of C3 Capabilities through their life-cycle.[43] The document in force during the execution phase of the observed events was NATO C3 Taxonomy, Baseline 2.0 (Reference AV).

22. Another important document for CIS IV&V testing is the NISP. The NISP in force during the execution phase of the observed events was NISP Version 9 (Reference AW) released in May 2016 but that still used the NATO C3 Taxonomy, Baseline 1.0 from 15 June 2012. The complication, therefore, for participants in the events was that although the NATO C3 Taxonomy in force was Baseline 2.0, the NISP was still using NATO C3 Taxonomy Baseline 1.0. The NATO C3 Taxonomy should follow a clear development and implementation timeline, in order to both support the development of the NISP and provide Capability Area Managers, NCIA and other relevant entities the same baseline throughout an event's cycle.

[42] C3 Policy Glossary; Page 1-6 (Reference R).

[43] According to the C3 Taxonomy portal in Tidepedia, "*The purpose of the C3 Taxonomy is to capture concepts from various communities and map them for item classification, integration and harmonization purposes. The scope of this mapping exercise is to link Political and Military Ambitions, Mission-to-Task Decomposition, Capability Hierarchy, Statements and Codes, Operational Processes, Information Products, Applications, Services and Equipment to Reference Documents, Standards, Implementation Programs and Fielded Baselines.*" (Reference AX).

Information availability

23. The proper planning and execution of the events allowing CIS IV&V opportunities depends, to a significant degree, on information availability. As described in chapter 5, the project team identified three potential shortfall areas.

a. The first area refers to information that is available and shared, but is not easy to find. For example, assuming that a participant is provided with access to all the platforms hosting the information, he/she may have to look for specific information by searching hundreds of documents such as EXPLANs, reports, lists and thousands of tests and test results. Additionally, for the reviewed events, there is a need for 5-15 credentials (username and password) for accessing resources on various platforms (depending on the networks and the user domain), with specific rules which, added to daily professional and personal business, lead to a challenging usernames and passwords management that potentially reduces the willingness of participants to search for information. Without an appropriate *tagging and flagging* of the information and easy access in a *one-stop-shop* format, the time required for research will significantly increase or may lead to ignoring the resources available, so that there is a risk of repeating the same mistakes made in different events.

b. The second area concerns a gap in the information available in the FMN procedural guidance. Several SMEs mentioned that, in some events, although technical guidance was in place (the *what*), there was a need for more detailed procedural guidance (the *how*), which led to some limitations in understanding the whole FMN concept. This fact was further exacerbated by a lack of training of some participating personnel on the FMN Readiness Confirmation. Understanding the FMN concept, through guidance and training, is essential for the proper implementation of the FMN concept in the events allowing CIS IV&V opportunities.

c. The third area refers to availability of accurate information in the NISP. Although identified as a fundamental authoritative document, the NISP was perceived by many SMEs as a file containing an amalgam of commercial, national, and NATO standards and profiles, some of them outdated, forgotten, or without appropriate ownership. It is recognized that significant progress was made by releasing NISP v.9, which is clearer and is less than half the size of the previous version. However, further work—such as the revision of commercial standards as detailed in the Bi-SC Tasking to Update the NISP Commercial Standards presented in Reference AY—is necessary, in order to have a useful document that provides accurate test resources. An accurate NISP, with a clearly defined standards' life cycle management, would allow better synchronization of the testing resources employed during testing events.

24. The development of Interoperability Testing Requirements was another related concern. Several SMEs, including at the senior level, indicated that for some events the Interoperability Testing Requirements are in place as a result of collaborative work between NCIA and NHQC3S, based on personal knowledge and previous experience. However, these developed requirements are not a formally agreed and approved document. It may be argued that the NATO C3 Interoperability Handbook for Expeditionary Operations (Reference AZ) and Technical Requirements for NATO-to-Nations Service Interoperability in Expeditionary Operations – Technical Note 1174 (Reference BA) could be the documents informing the development of the Interoperability Testing Requirements, but both are outdated from an operational perspective, as well as from a technical and C3 taxonomy perspective, as confirmed by several senior level SMEs. Several interviewed SMEs further stated the need for testing to be based on authoritative documents that reflect agreed national positions and not on ad-hoc solutions proposed and adopted by a limited group.

Recommendations

25. In light of the above, the project team makes the following recommendations for the consideration of HQ SACT as the appropriate tasking authority.

a. Engage with appropriate authorities to review the CIS IV&V related terminology and Glossaries and to update the content in the NATO Term Database to be used as a unique source for terms and definitions.

b. Engage with appropriate authorities to provide Exercise Directors with a document containing Terms and Definitions common to all exercises.

c. Request NATO C3B to establish a C3 Taxonomy release timeline and to define a version management and implementation process, so that a common C3 Taxonomy version is used as a baseline.

d. Engage with appropriate NCIA and FMN authorities to develop a detailed FMN procedural guidance for the events qualified as FMN instantiation. Additionally, for an improved applicability of the guidance, FMN authorities to ensure a tailored FMN training package (e.g. booklet, online course, etc.) is delivered to participants prior to execution/Phase III of the FMN instantiations.

e. Engage with appropriate authorities to review the authoritative regulatory framework for the development of Interoperability Testing Requirements for each event.

f. Engage with the Interoperability Profiles Capability Team (IP CaT) to review the NISP v.9 and develop a process for the management of the standards included therein during its life cycle.

PEOPLE

26. The human resources availability, face-to-face interaction and individual and corporate knowledge directly contribute to the achievement of the events' objectives. This section complements the discussion presented in chapter 4.

27. Besides increased commonly shared situational awareness, face-to-face interaction allows an improved coordination of administrative and testing aspects, networking and building knowledge that are always valuable returns for the sending nation or HQ. Many SMEs stated that working together contributes to the immediate identification of issues, their solutions, and consensus on the way ahead. One example was provided at CWIX: a national element needing details about some previous tests was able to find them—after receiving guidance from other participants—in the tool used by the FMN Team.

28. Following the interviews and a review of the lists of participants, the project team identified that during some events, there is room for improvement in the interaction and coordination between ACT and ACO representatives. For example, according to some interviewees, representatives from CWIX and UNIFIED VISION were not visibly active in the SFCT framework; and some CWIX representatives stated that a personal request had to be made to receive the calling letter for Phase IIIB of SFCT16.[44] A closer interaction of ACT and ACO representatives would lead to an increased commonly shared situational awareness within the NCS and more harmonized CIS IV&V related events. Such interaction could be realized during the events, as well as in the establishment of a coordination function as previously recommended.

29. From a cyber perspective, the project team identified that in a particular event, the Cyber Team was a group of individuals with a considerable level of knowledge, expertise and background. However, the project team was not able to identify a formal document

[44] Although it should be noted that SACT is always included as an Action addressee on the distribution list for SFCT.

delineating the composition of the team, its ToRs and/or specific procedures to be followed. This situation may trigger the risk of relying too much on individuals and when they are no longer available, corporate knowledge will be affected. Some interviewed SMEs noted that one Nation has a Cyber Defence Operational Testing and Evaluation Body, supported at the political level which conducts its activities according to a handbook, updated as deemed necessary. This example could be viewed as a best practice.

Recommendations

30. In light of the above, the project team makes the following recommendations for the consideration of HQ SACT as the appropriate tasking authority.

a. Engage with relevant decision-makers and stakeholders to set up a coordination function to facilitate improved interaction and coordination between ACT and ACO representatives.

b. Engage with relevant authorities to review the documentation (Terms of Reference; handbook and Standing Operating Procedures) supporting the activities of existing Cyber Defence entities in the events.

Annex G

OVERVIEW OF TOOLS USED IN SUPPORT OF CIS IV&V RELATED EVENTS

INTRODUCTION

1. The complexity of the CIS IV&V related events, the amount of data specific to each event, and the need for sharing and working in a collaborative environment, requires the use of various IT tools. Each event uses its own specific IT tools for, inter alia, planning and sharing purposes, interoperability testing, assessment, and analysis of the test results.

2. Based on their functionalities, the IT Tools used in support of the reviewed events may be classified in two categories: tools that are related to event **community interaction** and tools that are related to **IV&V testing**. The characteristics of the tools are summarized in Table 7.

TOOLS RELATED TO COMMUNITY INTERACTION

3. Most of the events use tools developed in platforms that are accessible via internet, a fact that has led to an increased level of sharing and easy access to information, especially for Partners. For example, all interviewed SMEs from the CWIX community stated that the CWIX Portal (providing access to legacy documents) and the CWIX Wiki available on Tidepedia (via internet) satisfy their needs in this respect. However, CWIX and UNIFIED VISION information is not available on the NATO Secret network, so that the operational community, who mainly use this network, do not have easy access and exploitation of the resources. The project team identified that there is a CWIX portal created on the NATO Secret network; however, it is not populated with information. In a similar vein, some interviewed SMEs from the transformational community (ACT) stated that the SFCT portal is difficult to locate, so that correspondence or email exchanges are needed to acquire appropriate information. For example, as of September 2016, SFCT has two portals developed (for 2015 and 2016 iterations) and they are located on the NCISG portal on the NATO Secret network, and accessible through a series of links provided in the Exercise Calling Messages or from other portals (e.g. the FMN portal on the SHAPE NATO Secret network workspace). An increased visibility of SFCT portals will enhance the ACT community's access to SFCT related information.

Recommendations

4. HQ SACT / C2DS to populate and advertise the CWIX Portal available on the HQ SACT workspace on the NATO Secret network or develop another IT solution (e.g. CWIX Wiki).

5. SHAPE / NCISG to provide a link to the SFCT portal on the home page of NCISG workspace on NATO Secret network.

TOOLS RELATED TO TESTING

6. The project team identified that ad-hoc solutions were adopted to satisfy the need for exploiting test results. For example, during SFCT16, a matrix was used to show the codes of similar tests performed in SFCT, CWIX and BOLD QUEST. However, it is a challenge to accurately maintain and update this matrix, due to the high number of tests performed during each event, so that using an IT solution would facilitate the easy re-use and exploitation of previous tests and tests results.

7. According to some interviewed SMEs extensively involved in the testing process for both CWIX and SFCT, about 80% of the tests conducted in those two events have common features. The need to harmonize the use of supporting tools during events is readily identified by the participating communities. A suitable common testing tool could potentially lead to the effective re-use of test results, thereby optimizing costs. It is noted that discussions have occurred between NHQC3S and NCIA / Independent Verification and Validation Line to find solutions for a suitable and common testing tool. The project team has identified that this requirement is captured in Project Data Sheet III / Annex F as well as Service Validation & Testing Capability / Annex G to Enclosure 1 to Reference AH.

8. The views of interviewees regarding a common CIS IV&V tool to support the testing in CIS IV&V events were divided into two approaches: to have a common tool incorporating the functionalities needed for each CIS IV&V event; or to create an interface that facilitates the access to the existing tools. Another option suggested by several IT specialists was to create a new Interoperability Testing Tool, with a set of core functionalities and to expand it with additions specific to each CIS IV&V event. In addition, any new tool should have the capability to track the functionality for systems during their full life cycle, what tests were applied by version, their results, and what were the corrections and updates implemented.

9. The large number of tests carried out during CIS IV&V events serves as an illustration of the difficulty of exploiting and re-using test results without a suitable IT tool. Considering only SFCT and CWIX: 7457 tests were conducted during SFCT16; and approximately 3500 test cases were performed in CWIX16.

10. Another need identified by several interviewed SMEs was to check compliance of various systems with NATO standards, as well as to monitor the timeliness and quality of the tested service (whether within the required parameters or degraded), in order to determine the need to troubleshoot that service. These are end-user needs for understanding data quality degradation, logical connectivity and timeliness of operational dataflow among the battlespace capabilities that will benefit commanders, decision-makers and managers of the Recognized Picture and Functional Areas Services. Currently, in some events, the *Interoperability Test and Assessment (IOTA) Tools Suite* is used, developed in line with the Connected Forces Initiative and Smart Defence through a suite of applications. IOTA currently supports an Enhanced Shared Situational Awareness, Service Manager and Control Domain Manager for C4ISR Data/Information Flows and Assess Data content, quality and standards Compliancy. However, according to several SMEs, the tool is not mature enough to answer all the needs for a common interoperability assessment tool to be employed during CIS IV&V related events.[45]

11. Based on interviews and the documentation review, the project team identifies that for a long term sustainment in a cost effective manner and to become an Operation & Maintenance (O&M) application, a review of the requirements and solutions for further development of IOTA is needed by associating it with a suitable NATO CP.

Recommendations

12. In light of the above, the project team makes the following recommendations for the consideration of HQ SACT as the appropriate tasking authority.

a. Engage with relevant authorities to review the requirements for a suitable Interoperability Testing solution and further support the approval of CP 9C0102 as requested by the Strategic Commanders in Reference AH.

[45] According to the *C4ISR Data Interoperability and Traffic Assessment Picture, CONOPS*, Version 1.1 (Reference BB), a CONOPS for an improved version of IOTA was created by NCIA as a result of combined efforts of ACT and ACO, aiming to provide scope, direction and guidance regarding the C4ISR Data Interoperability and Traffic Assessment Quality Picture.

b. Review the IOTA requirements as a NATO CIS Interoperability Assessment Tool and to address the possibility of its further development as a capability through a NATO CP.

REVIEW OF MAIN IT TOOLS

13. Table 7 below presents the main IT tools employed in the reviewed events, as identified by the project team.

Table 7: Primary IT Tools Employed[46]

Event	Tool	Platform / Network	Owner	Content Manager	Main Functionalities
TIDE Sprint	TIDE Sprint Portal	TIDEPEDIA -via internet	HQ SACT	HQ SACT	- sharing - repository - collaboration
CWIX	CWIX Portal	TIDEPEDIA -via internet	HQ SACT	HQ SACT	- sharing - repository - collaboration * no longer used but contains useful data
		HQ SACT Workspace – via NATO Secret	HQ SACT	HQ SACT	Not populated
	CWIX Wiki	TIDEPEDIA -via internet	HQ SACT	HQ SACT	- sharing - repository - collaboration - manages the participants - generates, manages, distributes and monitor the execution of tests - stores the test results - facilitates descriptive statistics
FMN CIAV	FMN sites	SHAPE Workspace – via NATO Secret	SHAPE	FMN Secretariat	- sharing - repository - collaboration
		Communities of Interest Cooperation Portal (former DNBL) – via internet and NATO Secret	NCIA	FMN Secretariat	- sharing - repository - collaboration

[46] Acronyms first used in this table can be found in the Glossary of Acronyms in Annex A to this report.

Event	Tool	Platform / Network	Owner	Content Manager	Main Functionalities
	NATO Lab and National Labs (around 20)	Coalition Verification & Validation Environment (CV2E) Platform / Pink Enclave in CFBLNet – accessible via NATO Unclassified	NCIA and nations	NCIA and nations	- recreate environment for federated coalition mission network - record and analyse data - share data end test results - SMEs collaboration
	CWIX Wiki	TIDEPEDIA -via internet	HQ SACT	FMN CIAV WG	- similar to CWIX
BQ	BQ CoI	APAN – accessible via internet	US Joint Staff	US Joint Staff	- sharing - repository - collaboration - networking
UV	UV CoI	Communities of Interest Cooperation Portal (former DNBL) – via internet	NCIA	HQ SACT	- sharing - repository - collaboration
	CSD	CSD Topology (over 20 national CSDs)	NCIA and nations	NCIA and nations	- sharing - repository - testing
CYBER COALITION	CC Sites	CC Planning Portal / NCIA – via internet	HQ SACT	NCIA and ACT SEE / C2DS FWD	- sharing - repository - collaboration
		NATO EXTRA Portal – via NATO Secret	JALLC	HQ SACT	- sharing - repository - collaboration
	JEMM	Stand-alone – accessible via NATO Secret and internet	NCIA	NCIA	- sharing - repository - collaboration - management - MEL/MIL
	Insight	Stand-alone – accessible via NATO Secret	NCIRC	NCIRC TC	- sharing - dissemination - repository
	MISP	Stand-alone – accessible via internet	BEL	BEL	- sharing of technical data - repository - cross-specific domain analysis
	CIICS	Stand-alone – accessible via internet	Nations (CAN, NLD, ROU)	CERTs	- sharing / warning - incident handling - repository
SFCT	SFCT (annual) Portal	NCISG / SHAPE Workspace – via NATO Secret	SHAPE	NCISG	- sharing - repository - collaboration

Event	Tool	Platform / Network	Owner	Content Manager	Main Functionalities
	Interop EXPERT	Reach and Mission Secret / SFCT	DEU MoD	NCIA	- creates scenario and roles - manages the participants - allocates the roles to units - generates, manages, distributes and monitor the execution of tests - stores the test results - facilitates descriptive statistics
TRJE	TRJE Sites	HQ SACT Workspace – via NATO Secret	HQ SACT	HQ SACT	- sharing - repository - collaboration
		NATO EXTRA Portal – via NATO Secret	JALLC	HQ SACT	- sharing - tracking - repository - collaboration
	JEMM	Stand-alone – accessible via NS and internet	HQ SACT	HQ SACT	- sharing - repository - collaboration - management - MEL/MIL
Various Events	IOTA	Various C2 Information Systems	HQ SACT	HQ SACT	- COP quality data picture - Data flow as a service - Interoperability standardization

Annex H
SURVEY

NATO UNCLASSIFIED
Joint Analysis & Lessons Learned Centre
NATO's Lead Agent for Joint Analysis
16104 IVV

Survey

Introduction:

Background

HQ SACT has tasked the JALLC to *review key[1] NATO and multi-national events that provide opportunities for CIS Interoperability Verification and Validation (IV&V) and make recommendations for greater harmonization of these events relating to, inter alia, CIS IV&V objectives, ways of achieving these objectives, and supporting tools.*

JALLC has prepared this survey in order to validate data already collected from interviews and a literature review to get additional information relevant to this study.

Content

The first five questions are designed to understand the approaches and benefits to nations from participating in CIS IV&V events. The subsequent four questions are to understand the challenges and the potential solutions for improved harmonization of the CIS IV&V events.

It is estimated that this survey will take about 15 minutes to complete, but some of the information that is requested may require you to carry out some preparatory research.

This survey and your responses should be NATO UNCLASSIFIED; if you wish to include responses at a higher classification, please mark appropriately and return the completed form on the NATO SECRET (NS) Network.

The JALLC Project Team appreciates your time and effort to complete this survey. The information provided will be used anonymously in order to provide recommendations for the delivery of CIS IV&V events to improve interoperability.

Submission

Please submit your completed survey **no later than 02 September 2016**, by clicking on the **Submit by Email** button. If you have any questions, please contact the JALLC Project Team at:
Marcos.Sevilla@jallc.nato.int (cc: Stefan.Olaru@jallc.nato.int; Marcello.Fardelli@jallc.nato.int)
Be aware that Adobe Reader will not automatically save the data entered into this survey before or at submission by email. Therefore, if you wish to save the version of the file you are working on, for example to email the survey to another person prior to final submission, please use the "Save" or "Save As" commands in Adobe Reader, or please click on the "Save pdf File" button in the footer.
If you encounter any problems when using the **Submit by Email** button, it is possible to save a local copy of the completed survey as described above and then please send the saved file using your email client to the following two email addresses: ivv16104@jallc.nato.int; c3bsecretariat@hq.nato.int

-- Please note that you may have to click on "Enable all features" in Adobe Acrobat Reader to be able to complete the survey --

(1) Key CIS IV&V events to be reviewed are *inter alia* TIDE Sprint (Technology for Information, Decision and Execution Superiority), CWIX (Coalition Warrior Interoperability eXploration, eXperimentation, eXamination, eXercise), BOLD QUEST, UNIFIED VISION, FMN CIAV WG (Federated Mission Networking Coalition Interoperability Assurance and Validation Working Group), CYBER COALITION, STEADFAST COBALT and TRIDENT JUNCTURE.

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16104 IVV

Survey

Section 0:

Respondent contact details: The information requested below is only for the project team to be able to contact you in case your reponses need clarification; all responses will be used anonymously.

Nation	
Rank/NATO Grade (or equivalent):	
Name	
First Name	
Position / HQ	
Official email (lower case only)	
NS email (if applicable)	
Commercial Phone (including country code)	
NCN Phone (if applicable)	

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16104 IVV

Survey

Section 1: Interoperability is critical to every phase of capability development, from initial concept through operational use and withdrawal from service. There are several NATO and national events that provide an opportunity to undertake CIS IV&V activities. This Section of five questions is designed to understand the approaches and benefits to nations from participating in CIS IV&V events.

Question 1a: Which of the events listed below has your nation participated in during last three years? If there are any CIS IV&V events that are not listed which your nation has participated in, please enter them in the comments box.

Event	2014	2015	2016
TIDE Sprint	☐	☐	☐
FMN CIAV WG	☐	☐	☐
CWIX	☐	☐	☐
Unified Vision	☐	☐	☐
Steadfast Cobalt	☐	☐	☐
Trident Juncture	☐	☐	☐
Cyber Coalition	☐	☐	☐
Bold Quest	☐	☐	☐

Comments (use as much space as you need):

Please specify any additional CIS IV&V events that are not listed which your nation has participated in.

Question 1b: Based on your response to Question 1a, please provide an overall assessment of how beneficial to your nation was participation in these events?

Event	Very Beneficial	Beneficial	Partially Beneficial	Not Beneficial	Not Applicable
TIDE Sprint	○	○	○	○	○
FMN CIAV WG	○	○	○	○	○
CWIX	○	○	○	○	○
Unified Vision	○	○	○	○	○
Steadfast Cobalt	○	○	○	○	○
Trident Juncture	○	○	○	○	○
Cyber Coalition	○	○	○	○	○
Bold Quest	○	○	○	○	○

Comments (use as much space as you need):

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Question 1c: Now looking to the future, in which events is your nation most likely to take part in over the next three years? Please explain in the comments box below if there are specific reasons for participation such as NRF rotation, or if your nation has decided not to participate in particular events in the future.

Event	2017	2018	2019
TIDE Sprint	☐	☐	☐
FMN CIAV WG	☐	☐	☐
CWIX	☐	☐	☐
Unified Vision	☐	☐	☐
Steadfast Cobalt	☐	☐	☐
Trident Juncture	☐	☐	☐
Cyber Coalition	☐	☐	☐
Bold Quest	☐	☐	☐

Comments (use as much space as you need):

Reasons for partipation or non-participation in particular events.

Question 1d: Is there any aspect **not covered** by these CIS IV&V events that your nation would wish to have included?

◯ Yes ◯ No/Not Applicable

Please provide details:

Question 1e: Is there any aspect **currently covered** by these CIS IV&V events that your nation would like to have withdrawn or improved?

◯ Yes ◯ No/Not Applicable

Please provide details:

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Section 2: This section of four questions are to understand the challenges and potential solutions for improved harmonization of the CIS IV&V events.
If the question does not apply to your nation for any reason, please select `Not Applicable', and provide some explanation in the free text comments box.

Question 2a: As defined in the Alliance C3 Policy, *"Governance is the structures and processes for decision-making, accountability, control and behaviour within organisations."*

To what extent do you agree or disagree with the following statement:
Common governance for all NATO CIS IV&V related events may lead to an improved harmonization of such events.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Partially Agree
- ◯ Partially Disagree
- ◯ Disagree
- ◯ Strongly Disagree
- ◯ Not Applicable

Comments (use as much space as you need):

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Question 2b: Directly linked to Question 2a, NIAT[2] has been identified as a potential advisory body for common governance that may substantially contribute to a greater harmonization of CIS IV&V related events. However, since the approval of NIAT Terms of Reference was postponed, NIAT is not yet functional.

To what extent would your nation support a functional NIAT?

- ◯ Fully Support
- ◯ Partially Support
- ◯ Do Not Support
- ◯ Not Applicable

Comments (use as much space as you need):

(2) The NATO C3 Interoperability Assessment Team (NIAT) was an advisory group to provide support to implement C3 Interoperability between NATO and Nations' CIS.

Question 2c: An FMN Capability enables forces to connect in a federated mission environment at any time, immediately, and at an optimized level of interoperability. Some CIS IV&V events are identified as FMN Confirmation Events of the affiliates.

To what extent do you agree or disagree with the following statement:
In order to obtain the desired optimized level of interoperability, testing for FMN Confirmation should be conducted in the same technical and operational testing environment for all affiliates.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Partially Agree
- ◯ Partially Disagree
- ◯ Disagree
- ◯ Strongly Disagree
- ◯ Not Applicable

Comments (use as much space as you need):

Please give reasons for your response.

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Question 2d: NATO CWIX is an annual transformation activity, designed to support the continuous improvement of C4ISR systems interoperability within the Alliance. Currently, the Military Committee (MC) approves the overarching guidance from the NATO C3 Board (NC3B), and annual objectives and Focus Areas of CWIX are agreed by Nations at the CWIX Senior Management Group (SMG).

To what extent do you agree or disagree with the following statement:
*The guidance provided by NC3B in its "NATO CWIX Exercise - Overarching Guidance" should **specify** the list of critical services from the NATO C3 Taxonomy to be mandatorily tested during each CWIX.*

- ◯ Strongly Agree
- ◯ Agree
- ◯ Partially Agree
- ◯ Partially Disagree
- ◯ Disagree
- ◯ Strongly Disagree
- ◯ Not Applicable

Comments (use as much space as you need):

Please give reasons for your response.

Thank you for your time and effort to complete this survey. If necessary, please feel free to provide additional comment in the box below. Once finished, you can click on the **Submit by Email** button below to return your completed survey to the JALLC Project Team.

Additional Comments (use as much space as you need):

Please enter any additional information on national views on CIS IV&V events.

Submit by Email | Print Form

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