GOSSRA

Generic Open Soldier System Reference Architecture

Collaborative Project

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GOSSRA Architecture for Standardisation - Vol. 2

Capability (View NCV)

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1 Overview and Summary Information

The Generic Open Soldier System Reference Architecture (GOSSRA) is described in this set of documents and represents the proposal of the GOSSRA Consortium for subsequent standardisation.

The standardisation itself lies outside the scope of this project. However, the consortium plans to propose the architecture to the "C4I and System Architecture" Working Group of the NATO "Land Capability Group Dismounted Soldier System" (LCG DSS) which has been following the work through GOSSRA Presentations and discussions during the course of the project.

The architecture consists of a set of documents with seven volumes /1/, /2/, /3/, /4/, /5/, /6/, and /7/ which contain the different architectural views according to the NATO Architecture Framework v3.1, with the addition of a Security View (see Figure 1-1). It is accompanied by a formal architecture represented by a set of computer files, compiled by using the SparxSystems Enterprise Architect (version 13) /8/.

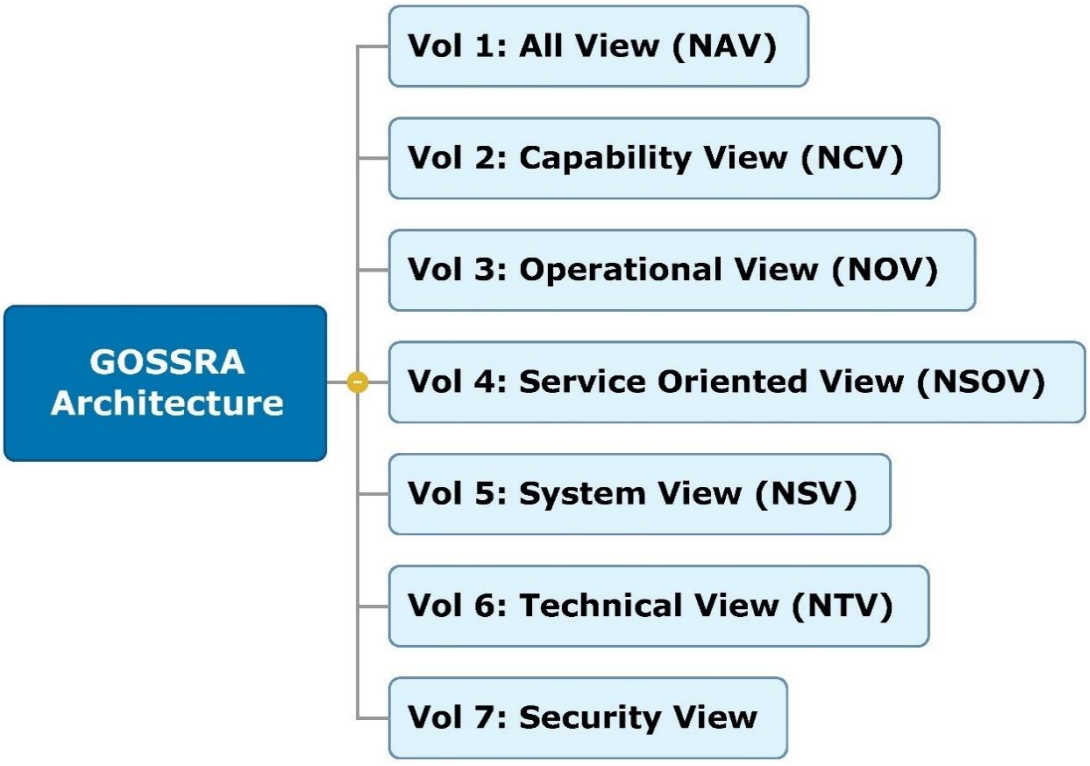

Figure 1-1 – GOSSRA Document Structure

This for Soldier Systems was developed based on following assumptions:

- **This is a reference architecture**. It consists of common best practices and does not depict any one nation's solution. When nations define, specify or develop their specific dismounted soldier system, they may elect to use this architecture as a reference.
- As a reference architecture, it is **not intended to dictate acquisition or procurement decisions**. Rather, it is meant to be used as a template for developing solutions.
- Nations are responsible for **using this reference to create target architectures (solutions)** depicting their implementation including specific equipment for specific roles.
- The reference architecture **standardizes specific aspects where innovation is expected to be slow**, but **leave options open where innovation is fast and competition is desired**.
- **Nations are also responsible for using this reference** when creating system-of-system architectures that include soldier systems.
- This architecture models **a squad as well as a single soldier**. We recognize soldiers do not operate on their own, are networked, and share equipment (especially vehicle platforms). A squad also consists of soldiers performing different roles, e.g. as commander, machine gunner, sniper, scout, medic, or other mission specific role and thus, needing different equipment.
- This architecture focuses on the **electrical and electronic equipment** a soldier wears, carries, and consumes as well as on **software and data communication**.
- This architecture embraces concepts of **interoperability, interchangeability, and commonality**.
- This reference architecture does not strictly and blindly comply with the process and views in the NATO Architectural Framework but rather takes the underlying concepts and uses them to efficiently develop **views which** are thought to be **useful for the purpose and the community**.

1.1 Architecture Scope

The purpose of the Generic Open Soldier System Reference Architecture (GOSSRA) is to serve as a common reference architecture on EU-/NATO-Level for deriving a Target Architecture at country-level.

This Reference Architecture comprehensively focuses on:

- software
- electronics
- voice and data communication
- sensors
- effectors
- human interface devices
- C4I

This Reference Architecture for Soldier Systems is ready for standardization to become openly available and not implying any protected intellectual property. The architecture, to be applied during at least the next 10 years, shall consider trends and potentials with respect to capabilities, operations and technologies.

The architecture represents “best practice”, “future trends and developments” and suggests standard interfaces. It shall be used as a reference to derive the “Target Architecture” which is the architecture for a specific Soldier System to be procured.

By referring to this reference architecture, the “Target Architecture” then:

- is easier to develop,
- includes all major aspects, and
- uses specific common standards enabling interoperability.

1.2 Identification

This set of documents represent the “GOSSRA Architecture for Standardisation” which is the deliverable D8.5 of the GOSSRA project.

The architecture had been developed between the 6th May 2019 and the 30st April 2020 by the GOSSRA Consortium. Led by Rheinmetall Electronics GmbH (Germany), GOSSRA’s consortium encompasses 9 participants from 7 countries: GMV (Spain), iTTi (Poland), Tekever-ASDS (Portugal), Larimart (Italy), Leonardo (Italy), SAAB (Sweden), Indra (Spain) and TNO (the Netherlands) and received an EU grant of roughly €1.5 million over 23 months (1st July 2018 to 30st April 2020).

The companies include major European Soldier System companies which developed and already delivered Soldier Systems in large numbers. Further, participants are smaller companies which provided subsystems or components and contributed their specific and valuable expertise to the project. Finally, a research institute provided knowledge about newest developments and technologies.

Following are the GOSSRA project team members:

- Rheinmetall Electronics GmbH (DEU, prime contractor)
  - Dr. Norbert Härle (Contract Manager)
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  - Daniel Riggers (Technical Coordinator)
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- GMV Aerospace and Defence (ESP)
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- Larimart SpA (ITA),
  - Marco Stella (Technical Expert),
  - Fabrizio Parmeggiani (Project Manager and Technical Expert)
  - Luigi Esposito (Technical Expert)
- Leonardo SpA (ITA)
  - Francesco Fedi, LDO (Principal Editor)
  - Rosa Ana Lopez Mazuelas (Technical Expert)
  - Fabio Casalino (Technical Expert)
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  - Marcel van der Lee (Technical Expert)
  - Angela Kwaijtaal (Project Manager)
  - RonaldRonald in 't Velt (Technical Expert)
  - Eelco Cramer (Technical Expert)

Additional to the consortium, the GOSSRA project established a Stake Holder Advisory Board with representatives from following European Governments:

- NLD
  - Luc de Beer (Mindef, DMO, DP&V, Ressort Projecten, Soldier System Procurement)
  - Major Koen van Veen (Defence Centre of Expertise for Soldier and Equipment)
  - Jasper Groenewegen (DNV GL)
- DEU
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- PRT
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  - LTCol Simão Sousa (Portugese Army)

Special thanks for their feedback and contributions.

2 Capability View

2.1 NCV-1 Capability Vision

The NATO Capability View (NCV) provides a strategic context for the capabilities described in the architecture. It also provides a high-level scope for the architecture which is more general than the scenario-based scope defined in NOV-1. Capability in the context of a Multi-National Force or National Force would entail having the ability to meet most, if not all, of the envisaged operational scenarios and challenges optimally. This would imply that the Dismounted Soldier System (DSS) envisaged through this reference architecture should provide a competitive edge over its adversaries in terms of every desired combat and combat support capability to the soldier.

Capability development of a force is a complex activity and the DSS, therefore, needs to look at all aspects of combat capability from observation, detection, target acquisition, target dissemination, decision support, effective engagement, reporting mission status, logistics and preparation for ensuing battle space contingencies to training and interoperability.

Envisioning such a capability spectrum would require a peep into the future threats to the dismounted soldier, as well as a constant check of the capability acquired by our adversaries as well as technology trends to keep the soldier system state of the art.

It is therefore important to spell out what such a vision encapsulates in terms of a *vision statement* and the *vision goals* which will help realise such a capability vision.

2.1.1 Vision Statement

The *Capability Vision* for a state-of-the-art soldier system is to enhance multinational soldiers' fighting capabilities by empowering them with information superiority, enhanced mobility, effective engagement, interoperability, resilience and agility to operate in diverse, complex and contested current and future environments.

2.1.2 Vision Goals

In order to be able to envision all the capability needs in the correct perspective, it is important to identify the v*ision goals* encapsulated within the capability vision. These *vision goals* are as under:

- Information Superiority through efficient and robust information sharing both among national land forces and with joint multinational forces and other actors (like media, NGOs, other humanitarian agencies, etc.);
- Effective and rapid decision making at all levels, supported by enhanced situational awareness in complex, congested battlefields;
- Enhanced mobility to allow forces to engage in joint manoeuvre, more flexible, agile deployments and operations in complex, contested and hazardous environments;
- Effective engagement to include countering remotely piloted and autonomous unmanned aerial systems including UAV swarms and a flexible range of non-lethal and non-kinetic effects, such as microwave and sonic-based weapons, to allow forces to minimise collateral damage while disrupting the adversary's capabilities.
- More independent and self-sustainable deployments through the provision of integral electronic manned / unmanned surveillance and reconnaissance means at the Small Tactical Unit (STU) level.

- Enhanced CIMIC (Civil Military Cooperation) to ensure the fulfilment of mission mandates and leverage deeper and common understanding between the armed forces and civilian actors;
- Enable integrated and reduced logistics through lightweight modular and easily transportable materials and equipment;
- Conduct defensive and offensive cyber operations at the strategic, operational and tactical level, including the ability to disrupt and take control of the adversary's manned and unmanned systems;
- Interoperability between EU/NATO Forces and their allies.

However, in order to be able to look at all the capability needs from the basic, through the current and to the future, it is important to envision the complete spectrum of soldier needs in a holistic manner. This entails examining capability from the different view-points of operations, services, technical, training, maintenance and logistics, business and sustainability.

The ensuing paragraphs explain the methodology of evolving this holistic capability vision for a soldier system.

2.1.3 Identifying Combat Capability Needs

The DSS supports soldiers in a mission with respect to the core questions to which a soldier seeks answers to during any operation:

- "What is my environment?"
- "Where am I?"
- "Where is the enemy?"
- "Where are my comrades?"
- "What is my task?"
- "What is the best way to engage/neutralise the enemy?"
- "What are my communicating and reporting instructions?"
- "What is my next likely task?" (In keeping with the Commander's Intent).

Figure 2-1 below, depicts the manner in which a soldier's basic capability needs should be interpreted to identify capability requirements for a soldier system.

In the first column, a soldier's or small tactical unit's basic combat questions are listed e.g. "What is my environment like?", "Where am I?", "Where is the enemy?" etc. In brackets below each question is the scope of the question e.g. the question 'What is my environment?' encompasses the physical environment – terrain, altitude, air, oxygen level, temperature, etc. Similarly, the question 'Where am I?' encompasses the scope of location (enemy/own), identifiable landmark, distance (from enemy/own troops / RV / Hide / Firm Base, etc.).

The third column depicts how these questions should be interpreted to evolve the requirement of combat capabilities e.g. terrain analysis, navigation, day-night visibility, location and communication, operational orders, target designation, effective engagement, communication, reporting instructions, situational and future task awareness, etc.

The second column depicts, how these capabilities apply commonly or differently to the three categories of

- Basic Soldier,
- Specialist Soldier (Gunner/Grenadier/ Bombardier) or
- STU Leader.

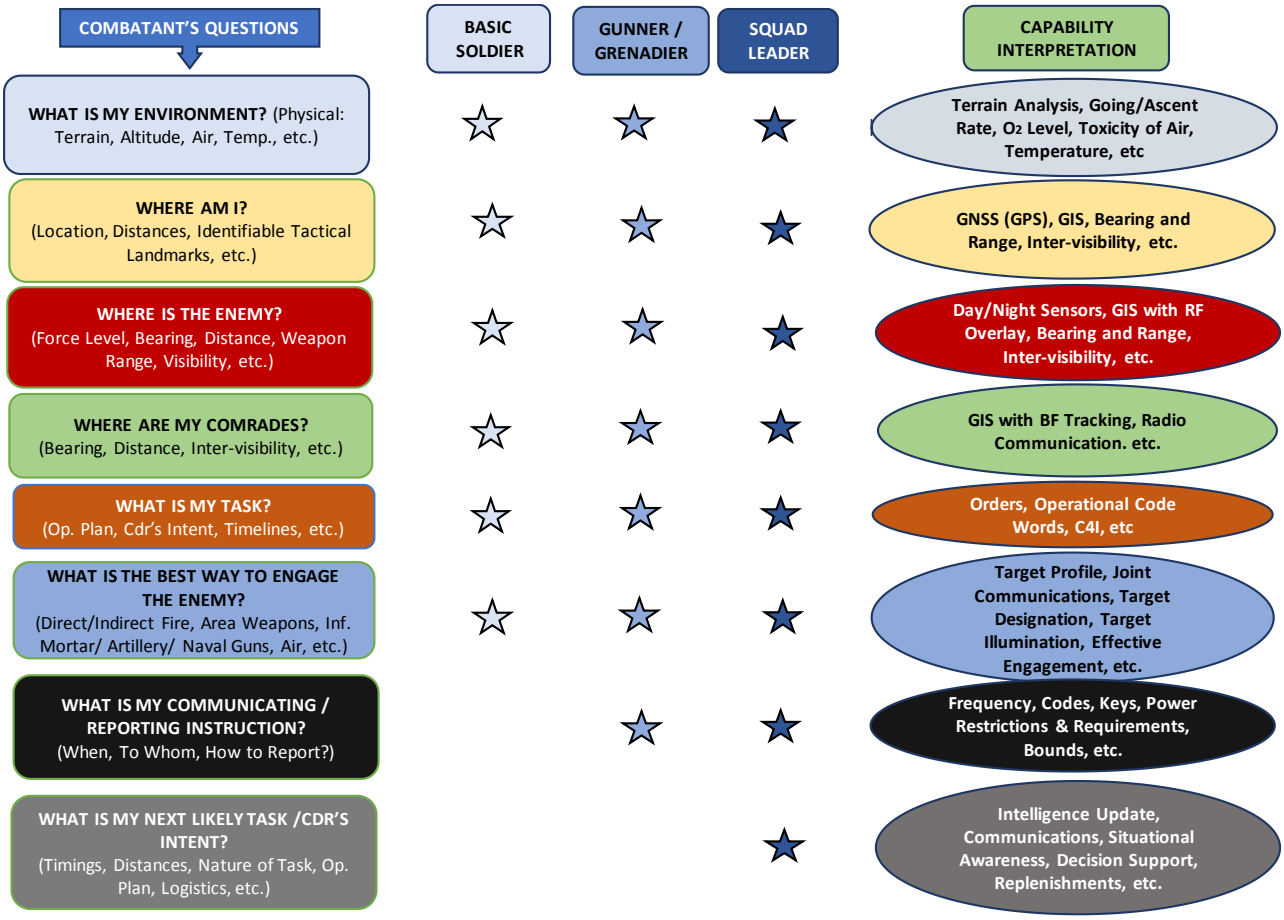

Figure 2-1 – Identifying Combat Capability Requirements

There would of course be a number of related questions that a soldier would need answers to, depending upon the combat situation or nature of mission. These would lead to the interpretation of further capability needs.

Analysis of the capability interpretation column specifically for different combatant categories of the individual soldier, gunner/bomber/grenadier or the STU leader would also help in arriving at the basic and add-on capability configuration of the DSS.

2.1.4 Capability Requirement Areas and Goals

In order to design a holistic soldier system, it is important to be able to classify the capability requirements in broad categories, which would encompass most operational needs. The *Capability Vision Goals* defined in section 2.1.2 above, can be achieved through the synergistic development of a number of capability requirements. Figure 2-2 depicts the broad capability requirement areas and the ensuing paragraphs describe the trends and goals to be achieved within each in detail.

Figure 2-2 – Capability Categories

2.1.4.1 Capability Category 1: Command, Control, Communications, Computing (C4)

The soldier system should enable self-coordination and self-monitoring inside the STU as well as coordination and monitoring by higher echelons allowing only very small delays for information processing or data transmission. Orders, reports and tactical information should be provided appropriate to the situation and echelon level. Through the use of information processing devices and technical information exchange capabilities, the soldier system should relieve the soldier of all tasks which can be semi-automated or automated.

Other command and control aspects like CIMIC, warrants the forces to be able to carry out the following actions:

- Establish effective civil-military cooperation by setting up a CIMIC Group in support of a Joint Forces Command (JFC) or Land Component Command (LCC) or equivalent HQ.
- Set up a system of civil – military information exchange.
- Assess how military operations are viewed from the civilian side to prepare holistic and balanced operational plans.

Capability Goals in the Capability Area of C4 are

- **Multisensory Approach:** Utilisation must be made of the full spectrum of user interfaces for all types of human senses (visual, audio, haptic). Increasingly tactile user interfaces,

utilising augmented reality, tactical vests, (3D) - audio instead of the more traditional voice and computer screen interfaces are being used today.

- **Automated Functions:** The soldier should not be hindered in his actions and all possible operational functions / interactions should be automated, including predictive activity sequences using AI based decision support.
- **Enhanced Radio-Based Combat Identification (RBCI):** In order to prevent fratricide situations, where soldiers unintentionally shoot at each other, perceiving they are shooting the enemy, a complete real-time picture is necessary, where all friendly soldiers (and vehicles) are depicted of all neighbouring units.
- **Quick and Rich Information Sharing:** Information should be distributed in the best format/type for an operation. If streaming live video is better suited for the military operation than text messages or map overlays, then video should be chosen.
- **Tactical versus Personal Choices:** It is tempting to offer soldiers a freedom in configuring the settings of their system or in giving the soldier a large choice of applications on their smartphones/devices from which she/he may choose from. This freedom of choice needs to be carefully considered with respect to their influence on the tactical success in battle.
- **Hemisphere Awareness:** Currently user interfaces of goggles and scopes offer a limited field of view. For example, with stereo night vision goggles it is hard to walk because you cannot see your own feet due to the restricted field of view. Ideally, all user interfaces should operate with a full 360 degrees, hemisphere field of view. This may also be applied to smartphone screens and 3D Stereo radio voice communication.

2.1.4.2 Capability Category 2: Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR)

In general, the soldier system should help to acquire, identify and engage targets even in adverse visibility and weather conditions in a fast and reliable manner. The combined importance of C4ISTAR Capability is to enable the conduct of NCO (Network Centric Operations) resulting in better synchronised effects in the battle space; achieve greater speed of command and control; increased lethality, survivability and responsiveness; and diminish adversaries' courses of action. C4ISTAR Capability enables high quality of shared situational awareness and develops a shared understanding, including the commander's intent, to promote self-synchronised operations at the STU or small tactical unit (STU) level.

Capability Goals in the Capability Area of ISTAR are:

- **Info-fusion.** Integration /fusion of information from visual/audio/haptic/other tactile manned / unmanned sensors;
- **STU as a Sensor.** Automated data distribution in platoon from single devices for the "STU to act as a sensor";
- **Data Capture and Analysis**. Big Data storage, access and quick retrieval of enemy tactics, weapons, serviceability state, etc.;
- **CROP (Common Relevant Operational Picture)**. Ability to select situational awareness pictures of varying ranges and detail, based on applicable areas of interest / influence;
- **Tactical Augmented Reality (TAR):** Auto georeferenced TAR can allow targets to be displayed both during day and night adaptable to IR/II devices as well as sighting systems. Augmented reality looks promising, but care should be taken to ensure that it promotes simplicity and improves clarity and does not overload the soldier with information.
- **EW Resilient Network.** ISTAR with UAV should be explored even though is more likely to be target of EW because it reduces the dependency to BMS/Tactical data.
- **Info Security & Access Control.** Cyber security for communication and systems and access control based on biometrics must be given priority.

- **Non-human Intelligence Cooperation.** Improve mission planning through non-human intelligence cooperation (using IT/AI tools) to assess mission parameters (configuration, duration, decision support, etc.).
- **Smart Power Management & Systems**. Wireless power transfer, magnetic power connectors (especially head and torso), smart system zoning and independent processor for each zone can minimize cabling to helmet and weapon to make the information sharing hardware more robust, modular and simpler.

2.1.4.3 Capability Category 3: Effective Engagement

The soldier system should optimally coordinate and support the soldier with respect to the engagement of an effector suitable for the specific task. This would include handing over of targets from one soldier to another unambiguously and with high precision e.g. enable soldiers with better shooting positions to improve the initial hit probability may be required. Algorithms in the FCS (Fire Control System) of the soldier system should enable the STU Leader to choose and automatically designate the target to the soldier who is in the best position (line of sight to target through 3D map inter-visibility analysis) to engage the enemy target. Handing over targets via advanced communication links to own and friendly forces also enables effective joint fire with reliable and precise target data. An infantry STU, supported by a soldier system, is hence, highly effective against an enemy who is not equipped with a similar support system.

Another key feature impacting effective engagement is the integration of sensor-shooter in terms of target data designation and engagement speed with the most optimal lethality of munition and its quantity to neutralise/destroy a target. Automation of factors impacting effector engagement and munition ballistics like target location, direction and speed, wind speed, humidity, temperature, known protection level, etc. in the fire control system greatly enhance effective engagement.

In a peace-keeping or riot control scenario ability of the personal weapon of the soldier system to fire non-lethal/less than lethal ammunition as well, will greatly improve its adaptability to mission types.

The ultimate goal is to achieve complete interoperability of the sensor-shooter network amongst all alliance multinational forces in terms of communications, fire support procedures, commonality of weapon category, ammunition and what defines effective engagement.

Capability Goals in the Capability Area of Effective Engagement are:

- **Shooting Around Corners.** Shooting around corners especially in built up areas / MOUT
- **Auto-Fire Control.** Automated coordination of direct and indirect fire support including air-to-ground support
- **Body Worn Sensor Integration.** Coordination of body worn sensors and IT Systems
- **TAR (Tactical Augmented Reality)**. Enhanced vision, positioning and RBCI using TAR
- **Electronic Warfare (EW).** GPS jamming/spoofing, Anti-spoofing module in GPS at STU Level.
- **Small Arms-Sensor-Networking**
    - Target acquisition systems for (in)direct shooting STU weapons
    - Automated and standardized RBCI system for weapon systems to prevent fratricide
    - Integration of UxVs with DSS through small arms-sensor-networking

2.1.4.4 Capability Category 4: Mobility

An infantry STU, supported by a DSS, shall be enabled to always move and navigate either mounted or dismounted in all environments. The soldier system should support the flexible use of various mobility platforms of own, joint, and combined forces, including commercial vehicles and boats.

While operating in mountains or snow-bound heights, it is imperative that the dismounted soldier system, instead of being a burden, allows enhanced mobility. This could be achieved by reducing the Size Weight and Power (SWaP) requirements of the DSS basic configuration to the minimum and improving its ergonomics as well as making add-on functionalities modular in design. This will enable the scouts or lead elements to use only the extra light weight basic configuration of the DSS in difficult terrain to establish a fix or foothold for faster follow up of the rest of the STU.

In certain difficult terrain an add-on module providing additional strength to the soldier through exoskeletons or other innovative means will help enhance the Mobility Capability Category. The system should be made modular and configurable in accordance with the planned mission, such that volume, weight, energy consumption and operating effort are optimally low for the desired level of mobility.

Mounted mobility would warrant the need of soldier system to be configurable to standard NATO/EU transportation systems in terms of being operational, ability of the soldier system to plug n play (plug in to be charged, as well as being able to communicate with other systems). Mounted operations may require both mounted and dismounted soldier systems to be able to operate together like in built up areas, lightly held defences or when infantry is in support of mechanised forces in tactical groups (infantry-tank cooperation). Mobility Capability Category of the DSS also warrants that soldiers can quickly transition from mounted and dismounted fighting methods; or be inducted through air (air assault/parachute jumping). The DSS equipment should never hinder the soldier's mobility.

Another aspect of mobility is tactical and operational mobility in battle. Tactical Mobility is dependent on the tactical movement of the complete STU or tactical unit and not just the individual mobility of a soldier. Soldiers need to know where their buddy, neighbouring STU or tactical unit is, in relation to the enemy, in real time. This is especially true in basic tactics like fire and move, placement of stops or look outs, cordon and search operations, ambush, raids, etc. Similarly, Operational Mobility is dependent on the ability to move humans (operational plan) and material (operational logistics) at the point of decision.

Capability Goals in the Capability Area of Mobility are:

- **Reduction in Size, Weight and Power (SWaP)**:
    - Reduction in size, weight and power of DSS components, have been identified as the main drivers for enhancing mobility.
    - An alternative approach is to reduce what soldiers need to transport.
    - Combine functions:
        - Utilise equipment for additional functions (e.g. same equipment that can have more applications – e.g. battery providing protection and energy)
        - Use of a central (common) battery that provides power to multiple modules
        - Use common use devices and connectors without redundancy e.g. USB
        - With respect to weight reduction, further solutions can be:
            - introduce a load distribution system
            - increase of the frequency of re-supply (to carry less weight) as also re-supply platforms can transport back empty batteries from battlefield
    - Invest in exoskeletons (passive or active – powered)

  - Invest in soldier borne cooling systems in order to reduce fatigue and hence increase mobility
- **Autonomous vehicles and its applications:**
  - Distribute soldier's cargo weight by using an UGV/UAV as an independent cargo carrier
  - Equip the UGVs with other equipment in order to enhance its capabilities, e.g. equip UGV with radio so that UGV can work as an additional communication node (hop) to provide radio link and/or with sensors in order to provide some relevant data while transporting cargo
  - UGVs to be used as autonomous weapon platforms for improved tactical mobility
  - Investment on new fuel/engine types (e.g. electric engines) in order to improve overall performance of vehicles and reduce acoustic and heat signatures
- **Digitization:**
  - Modularity can reduce the weight to be carried by each soldier:
    - Complementary functions could be integrated into a single digital device (e.g. maps, GPS, compass, LRF, etc.);
    - C4I components can be "fractionated" into a set of small, networked elements each providing a specific function in order to reduce the weight per soldier, i.e. each soldier only carries those devices required as per specific assigned mission tasks.

2.1.4.5 Capability Category 5: Protection and Survivability

Survivability is the ability to remain mission capable during and after an operational engagement. It requires provision of protection against all possible means that can inflict damage to the soldiers or their soldier systems.

The adoption of (autonomous) unmanned vehicles, eventually miniaturised, to carry out dangerous tasks can avoid to expose soldiers, and contemporary improve (near) real time situational awareness for a faster decision-making so increasing the chances of survivability.

Capability Goals in the Capability Area of Protection and Survivability are:

- **Protection.** Apart from conventional damage inflicting ballistics, protection implies safeguarding of own troops against effects of non-lethal high-power weapons, electronic warfare, CBRNE and similar effects. This may warrant the provision of CBRNE early warning, individual protection equipment (capable of being integrated with the soldier system with minimum requirements), and low power C-IED jammer against EW at the STU level.
- **Zero Emission:** To make DSS invisible to sensors we have to consider the different emissions that could be detected by these sensors:
  - Thermal emissions. With warm textile or painters, it is possible to change the solider temperature and to dim with the temperature around him.
  - EM Emissions. Reducing communications range and maintaining radio silence.
  - Electromagnetic (EMI EMC protection, cables and connectors screens, etc.)
  - Visual (Mimetic Textile) Harry Potter cloak
- **Emergency Functions:** Clothing with biometric sensors should monitor vital body functions of soldiers for emergency evacuation / telemedicine functions.
- **Temperature Management/ Climate Control:** Use special fabrics, devices for automatic climate control of soldier to help reduce the stress due to heat/cold/humidity.
- **Load Carriage:** Integrate protection vest with carriage functions:
  - Load carriage balance is quite important to ensure the correct mobility of the DSS.
  - Locate load close to the human body centre of gravity to reduce fatigue.

2.1.4.6 Capability Category 6: Sustainability and Logistics

Sustainability implies that the soldier is able to operate the DSS for the desired period of time. During this time, he may be supported by logistics, e.g. with a supply of fully recharged batteries or spare parts.

Enhancement of operational sustainability in the soldier system can be achieved by a variety of measures like having communication and processing infrastructure which is suitable for maximum information capacity with minimum cognitive burden on the operator; effective weapon, fire control system and ammunition capable of engaging all types of targets envisaged in a mission; and; sub-systems for power management and conservation that enable automatic, as well as operator controlled, cutting off power supply to components of lesser importance in a hierarchical manner (much like the auto/manual setting of energy saving mode of modern smart phones, wherein the user can select which functions can be de-powered or which function should continue to work till the battery dies).

Logistics can be improved by enabling easy configurability; robust weapon and efficient ammunition (load to effect ratio); modular design; automatic ammunition expenditure/remaining battery life report generation; component/module error detection by the system to help in speedy replacement/repair; reducing spare parts inventory; replacement of modules in the field and carrying out component level repair at forward/base workshops; adopting additive manufacturing from a network of superfast 3D printers for supply on demand; and; incorporating modern supply chain strategies in the maintenance philosophy of the soldier system.

Sustainability in the strategic context also implies, being able to sustain the system in service for a reasonable period of time and being able to carry out periodic upgrades to keep it state of the art for a prolonged period of time.

This can be achieved by ensuring that future upgraded components or new sub-systems have a standardised modular and easily replaceable design that allow automatic update of software and when necessary, component/device upgrades in the field, ideally even during a mission. This should be possible across the multinational forces i.e. the field workshop of one nation's force should be able to repair/upgrade components and update the common software of the DSS of another nation's force.

Another aspect of sustenance and integrated logistics would be to secure the growing reliance for certain supporting logistics functions from civilian networks. This area of CIMIC would warrant the sustenance and logistics of DSS to be able to be supported by the civilian sector during military operations. HQs Component Command or Joint Forces Command may have to conclude specific agreements for providing goods and services to one another in such instances.

Capability Goals in the Capability Area of Sustainability and Logistics are:

- **Integrated Logistics.** Reduction in configuration complexity and use of common interface to reduce logistic requirements, allowing sharing and improved interoperability
- **Sustainable Power**. Management of energy request vs energy availability
- **Commonality & Interchangeability of Connectors**. Common Battery and connectors to reduce inventory and improve interoperability
- **Potential Alternative Power Sources**:
  - Knee generator
  - Backpack special battery charging
  - Solar cell rain cover for backpack
- **Enhanced Modularity**: Individual Soldier; Gunner/Specialist Soldier; STU Leader.
- **Software Update and Device Upgrades.** Automatic software updates and in-situ device upgrades

- **Production and Manufacturing Models.** Lifetime storage / Just in Time Production / Lease Model
- **Additive Manufacturing**. Adopting additive manufacturing from a network of superfast 3D printers for supply on demand;
- **Aerial Resupply**. Quick forward area resupply (using drones/UGVs) returning with empty batteries

2.1.4.7 Capability Category 7: Education and Training

Training is the most important capability desired by military commanders, as it prepares soldiers for combat and in the use of new equipment, methods and validates tactics and strategies. Training is carried out at the individual, STU or combined forces level to validate joint and combined operational concepts or formulate new doctrines. It's a cross cutting Capability Category which applies to all other Capability Categories.

In order to support individual skill level training, the DSS should be incorporated with a self – training facility to support training with minimum time and cost.

However, additional training equipment, where necessary should be provided, e.g. for measurement purposes, effect generation, etc. in a combat training centre, which could be done through the preparation of a collective training package using modelling and simulation.

The DSS should therefore be provided with both individual and collective training packages, which can validate the improvement in an individual or tactical unit's effectiveness in terms of the following:

- **Conformity to the NATO MMOE** (Mission Measure of Effectiveness), with some 20 parameters like
  - number of enemy casualties;
  - own casualty;
  - detection avoidance;
  - reduction in need of radio communication;
  - information assessment rate, etc.
- **Conformity to an EU Measure of Effectiveness Parameters Package** developed specifically for operations for the EU multinational forces (Euro Corps or EU Battle Groups or the under- development EU Crisis Response Operation Corps).

In short, training needs should be identifiable, configurable and quantifiable in a realistic battle space environment.

Capability Goals in the Capability Area of Training are:

- **Multifarious Approaches to Training**:
  - E-Learning
  - Virtual Reality (VR)
  - Re-using gaming software
  - Re-use C4I system as training harness
  - Training facilities as a compound / during the mission
  - "Hardware in the loop": Soldier System couples to Simulator to be used in a virtual battlefield
  - Artificial Intelligence (AI) support (Computer Generated Forces, CGF's)
- **Enable Multiple Training Domains:**
  - Individual Skill Development
  - "C4I" Training

- Platform Training
- Safety and Medical Training
- User Level Maintenance
- Collective Training / Tactical Training
- Joint / Combined Training

2.1.4.8 Capability Category 8: Multi-National Interoperability

In order to have interoperable forces it is imperative that a soldier system should have the inherent ability to achieve the minimum level of *compatibility* and endeavour to achieve the ultimate level of ambition of *complete interoperability* in a multi-national environment. This entails achieving commonality of doctrine and procedures, of communications and information systems (CIS), of relevant multi-national equipment, and interchangeability of combat supplies.

The highest level of standardisation defined by NATO in terms of technical, operational and logistical Capability Categories, is to achieve interoperability. The level of ambition in each capability requirement area should, therefore, intend to achieve complete interoperability and adaptability to the NIP (NATO Interoperability Policy).

2.2 NCV-2 Capability Taxonomy

The Capability Taxonomy sub-view provides a structured view of capabilities and sub-capabilities that are required within a broad capability area during a certain timeframe.

In order to design a holistic soldier system, it is important to be able to classify the capability requirements in broad categories, which would encompass most operational needs.

2.2.1 Capability Category 1: Command, Control, Communications, Computing (C4)

Command and Control (C2) is the exercise of authority and direction by a properly designated individual over assigned resources in the accomplishment of a common goal. “C4” in military operations implies the command or clear directions a military commander provides to its personnel for the execution of a chosen operational plan and the control of its execution using communications. Computers help in computing data for analysis, decision making and the graphic representation of the battle picture, showing own and enemy ORBAT (Order of Battle – force levels of soldiers and equipment), current locations, outline phases of the operational plan /commander’s intent, and dissemination of a common relevant operational picture (CROP) using relevant communication media.

The soldier system should provide tools to plan the mission in advance and support modifying the plan during the mission as well as and communicating it to all relevant nodes.

The soldier system should provide secure communication infrastructure for voice and data with minimum risk of electronic jamming or interference caused by hostile forces and requires minimum attention. The soldier system should support communication - with high reliability, confidentiality and integrity - to own and joint/combined forces.

Data communication may also include transmission of images, video, sketches, signs, symbols and markers. The soldier system should enable information superiority and never hinder soldiers’ ability to carry out their basic combat tasks.

The taxonomy description of C3 is standardised within NATO in the ‘’C3 Taxonomy’’ /9/ developed by ACT which consists of an ‘’Operational Context’’ and ‘’Communication and Information Systems (CIS) Capabilities’’. When we look at the C2 process in the sense of the exercise of authority and direction to a military unit this process is not further subdivided in the C3-taxonomy. However, a model of C2 has been defined in the ‘’ACT Command and Control Focus Area Functional Analysis’’ document where four main phases within Command and Control are distinguished as depicted at Figure 2-3.

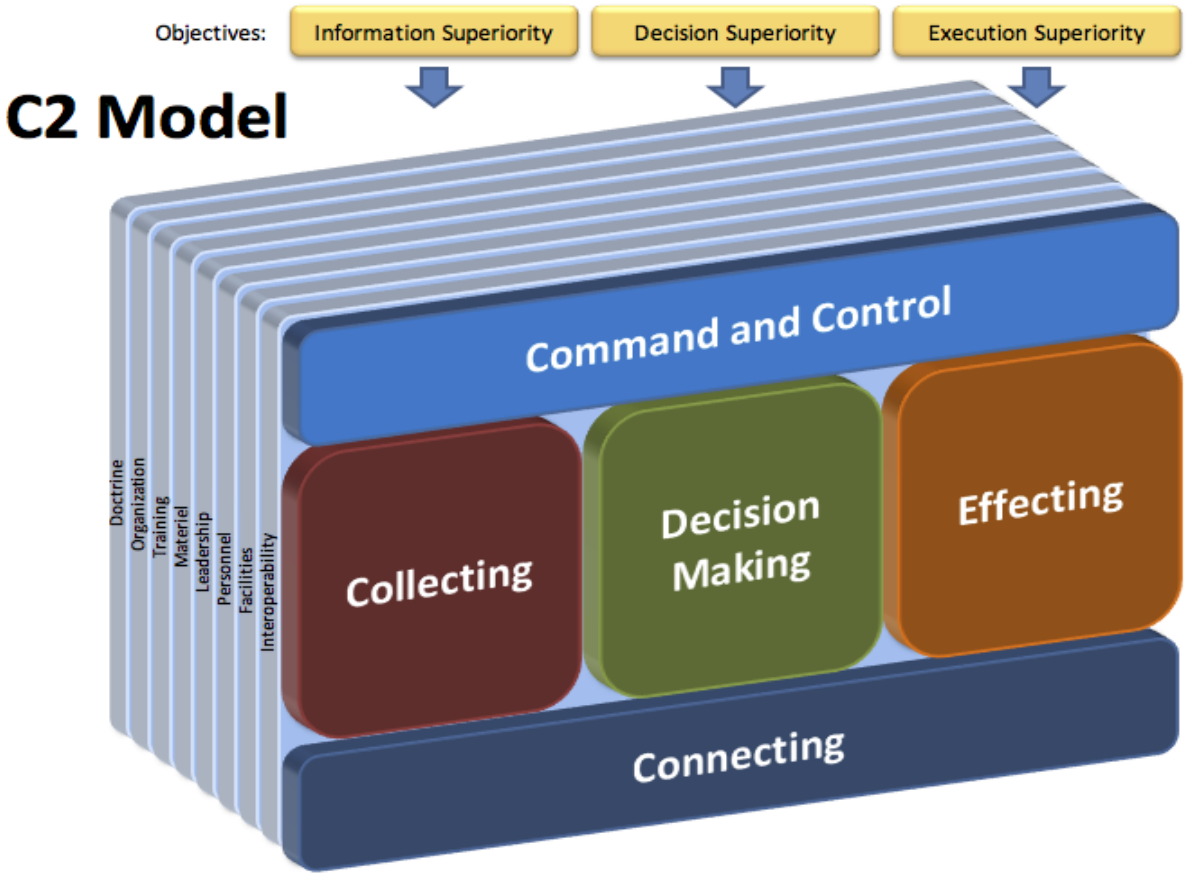

Figure 2-3 – NATO-ACT Conceptual C2 Framework (see /9/)

According to ACT, Command and Control is the overarching concept and functions that connect and direct the three other components Collecting, Decision Making and Effecting. As the main outcome of collecting is to transform raw data into recognized information, which is then input to Decision Making. In the case of the small tactical unit, this will merely consist of situation awareness information for decision support and effective engagement to achieve the desired result.

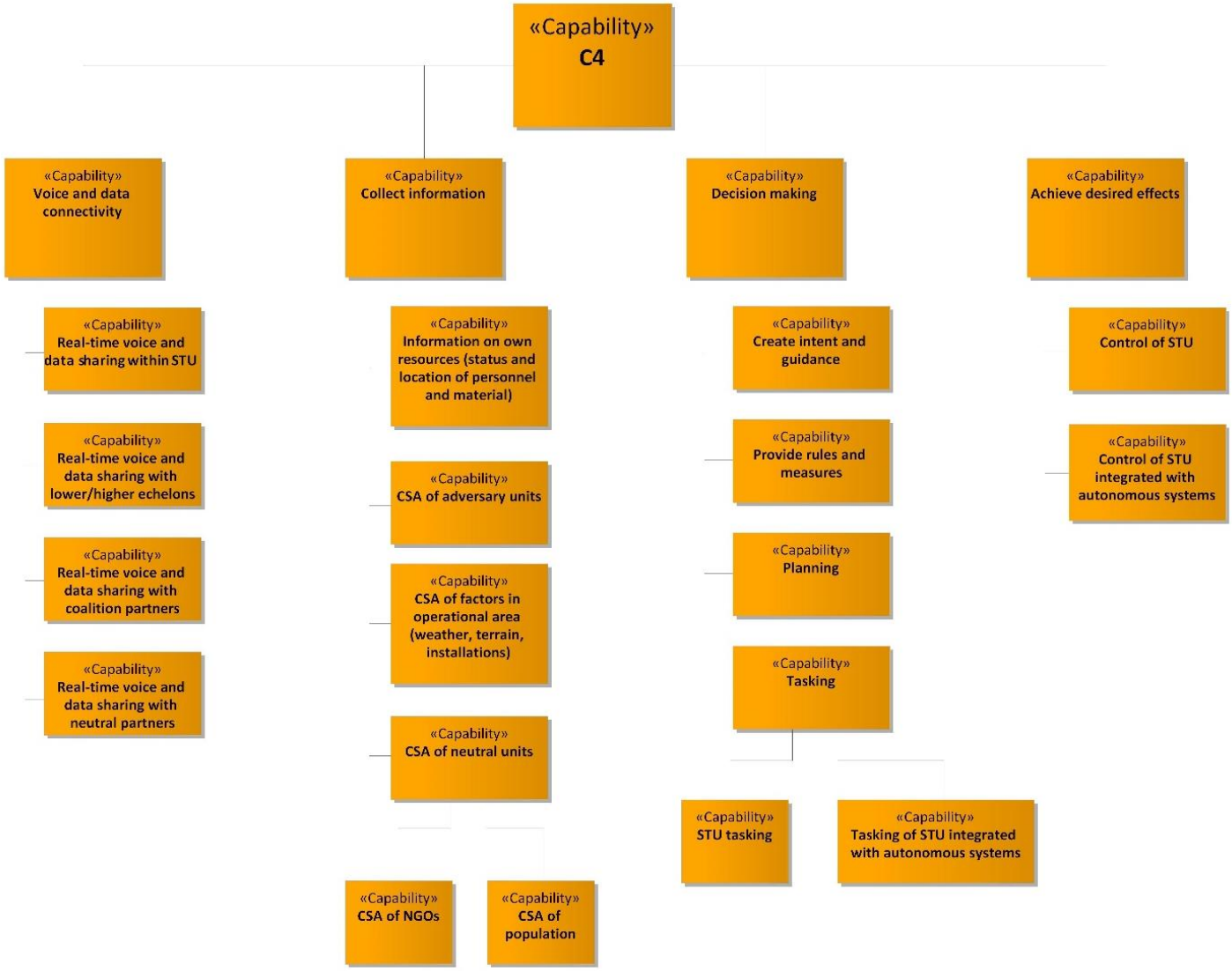

Figure 2-4 – Taxonomy of Command, Control, Communications and Computing Capability Category

In the third layer of the taxonomy, a further sub-division into functions and information products is made. Most of the information products listed in NATO C3 taxonomy also appear in this layer.

- **Command, Control, Communication and Computing:** See definition of C4 above.
- **Voice and Data Connectivity:** The set of automated, semi-automated and manual communication and information capabilities/processes required to connect all actors and platforms. (Definition based on ACT-C2 Focus Area). The main actors in the context of a small tactical unit are the unit itself (STU), the lower/higher echelons, coalition partners and neutral partners.
- **Collect Information**: The set of automated, semi-automated and manual sensing, collecting, mining, analysing, parsing, processing, translating, aggregating, fusing and correlating capabilities/processes required to achieve required information. Collecting activities transform raw data into recognized information. (Definition based on ACT-C2 Focus Area). For small tactical units the main categories of information are information of

own resources, of adversary units, of neutral units and environmental information (weather, terrain, installations).

- **Decision Making:** The set of automated, semi-automated and manual awareness, assessment, prediction, simulation, planning and decision-making capabilities/processes. (Definition based on ACT-C2 Focus Area). This includes creation of intent and guidance, the provision of rules and measures, planning and tasking. According to NATO C3 taxonomy, rules are authoritative statements of what to do or not to do in a specific situation, issued by an appropriate person or body. Measures indicate the degree or grade of excellence expressed in terms of performance or effectiveness.
- **Achieve Desired Effects:** The processes needed to achieve and measure the intended effect. For small tactical units, the process of control of the unit will be most prominent in this category.

2.2.2 Capability Category 2: Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR)

ISTAR is the comprehensive information gathering practice for the military and includes a variety of battlefield functions which assist a combat force in employing its sensors and managing the information they gather. Information is collected through systematic observation by deployed soldiers as well as a variety of electronic sensors.

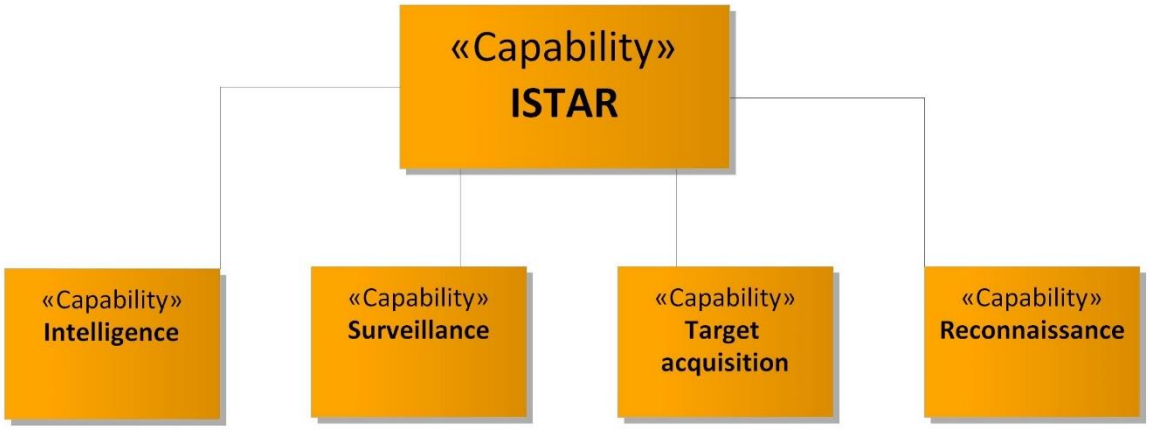

Figure 2-5 – Taxonomy of the ISTAR capability category

The functional meanings of each of the words in the acronym ISTAR in military parlance are:

- **Intelligence** denotes the inferences drawn from analysis of raw data from an operational point of view – to enable/plan military actions;
- **Surveillance** implies continuous observation of the selected battle space to track the enemy's location, actions and thereby gauge its likely intentions;
- **Target Acquisition** comprises two parts – acquisition and designation. Acquisition of the target implies capturing its parameters like distance, bearing, elevation, speed, direction of movement, quantity, nature of target, etc. Designation implies earmarking the target to an engagement entity like a gun, missile, artillery, soldier STU, individual soldier, etc.
- **Reconnaissance** implies observing new areas either for possible enemy presence/activity, terrain analysis or deployment of own forces for an operational activity.

The ISTAR process integrates and evaluates information from multiple sources and generates processed information that is relevant and contributes to an understanding of the ground, enemy dispositions and intentions. The main purpose of ISTAR is to improve the situational awareness and assist the military commander(s) in the process of decision making and evolving an operational plan.

An infantry STU, supported by a Soldier System which includes suitable sensor and computing devices, is required to carry out surveillance, target acquisition and reconnaissance, which is processed in near real time to obtain operational or actionable intelligence. ISTAR is shared within the STU and integrated in the C4. The intelligence is displayed in a suitable manner (e.g. as Common Relevant Operational Picture) such that the soldier easily focuses on the important issues and receives a high level of situation awareness.

2.2.3 Capability Category 3: Effective Engagement

One of the decision dilemmas a soldier faces during operations is when and with what effector to open fire, for how long and with what munition, in order to engage the enemy optimally and effectively. Effective Engagement is not a generic term, but one that is defined in different operational scenarios and target profiles with specifics e.g. an anti-tank weapon should be fired and take effect before the enemy tank reaches the tactical engagement range of its main weapon system. The SSKP (Single Shot Kill Probability) of the anti-tank weapon system and its ammunition type (HE, HEAT, APFSDS, Fire and Forget, Top-Attack, etc.) will dictate the number of rounds /munitions required to be fired (to effectively damage or neutralise the tank).

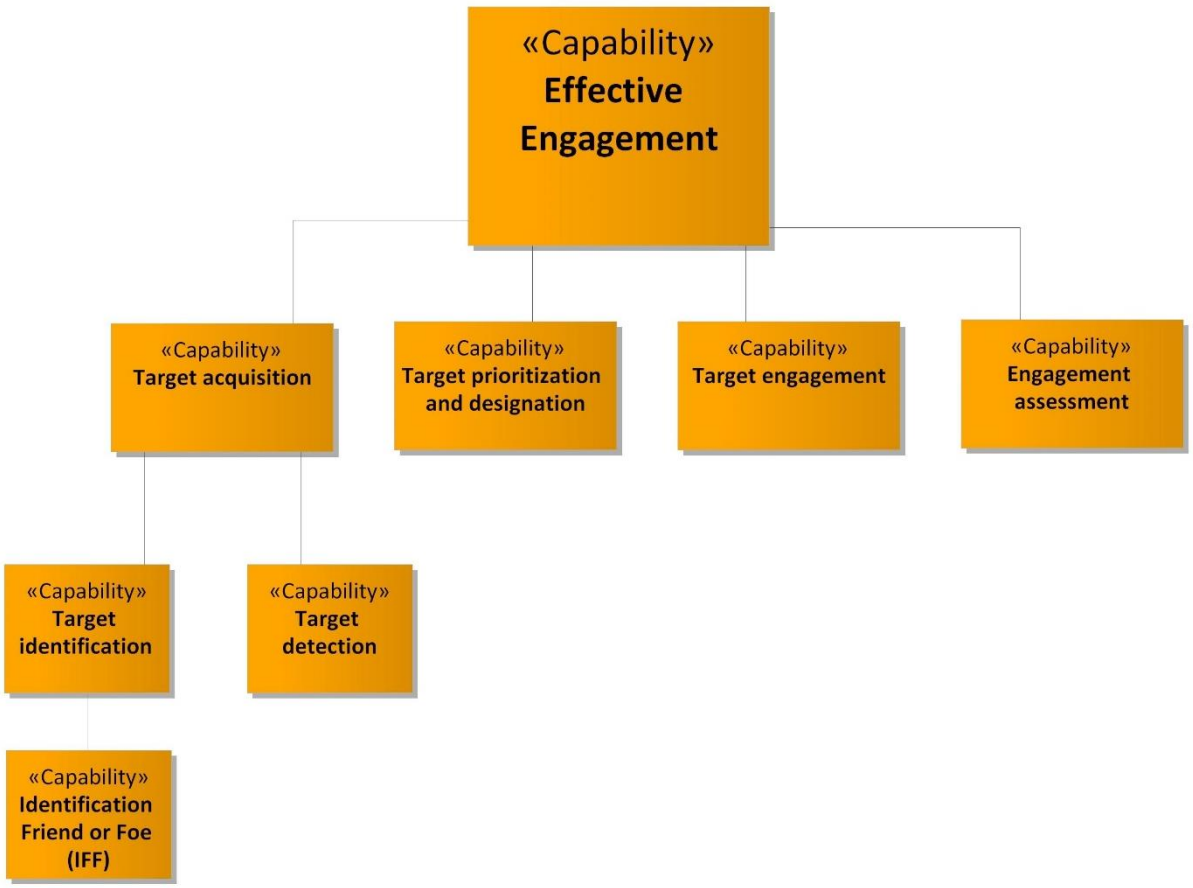

Figure 2-6 – Taxonomy of Effective Engagement Capability

- **Target Acquisition**: The detection, identification, and location of a target in sufficient detail to permit the effective employment of weapons. (AAP-6)
- **Target Prioritization and Designation**: The act of prioritizing the order of engagement of targets and the assignment of weapons to targets. This can result in a decoupling of sensor and shooter which requires target hand-over.
- **Target Engagement**: Use of weapons against a hostile force.
- **Engagement Assessment**: The determination of the effect of attacks on targets. (AAP-6)

2.2.4 Capability Category 4: Mobility

Mobility consists of three main sub-capabilities: Orientation/Navigation, Moving and Load Carriage. (Figure 2-7)

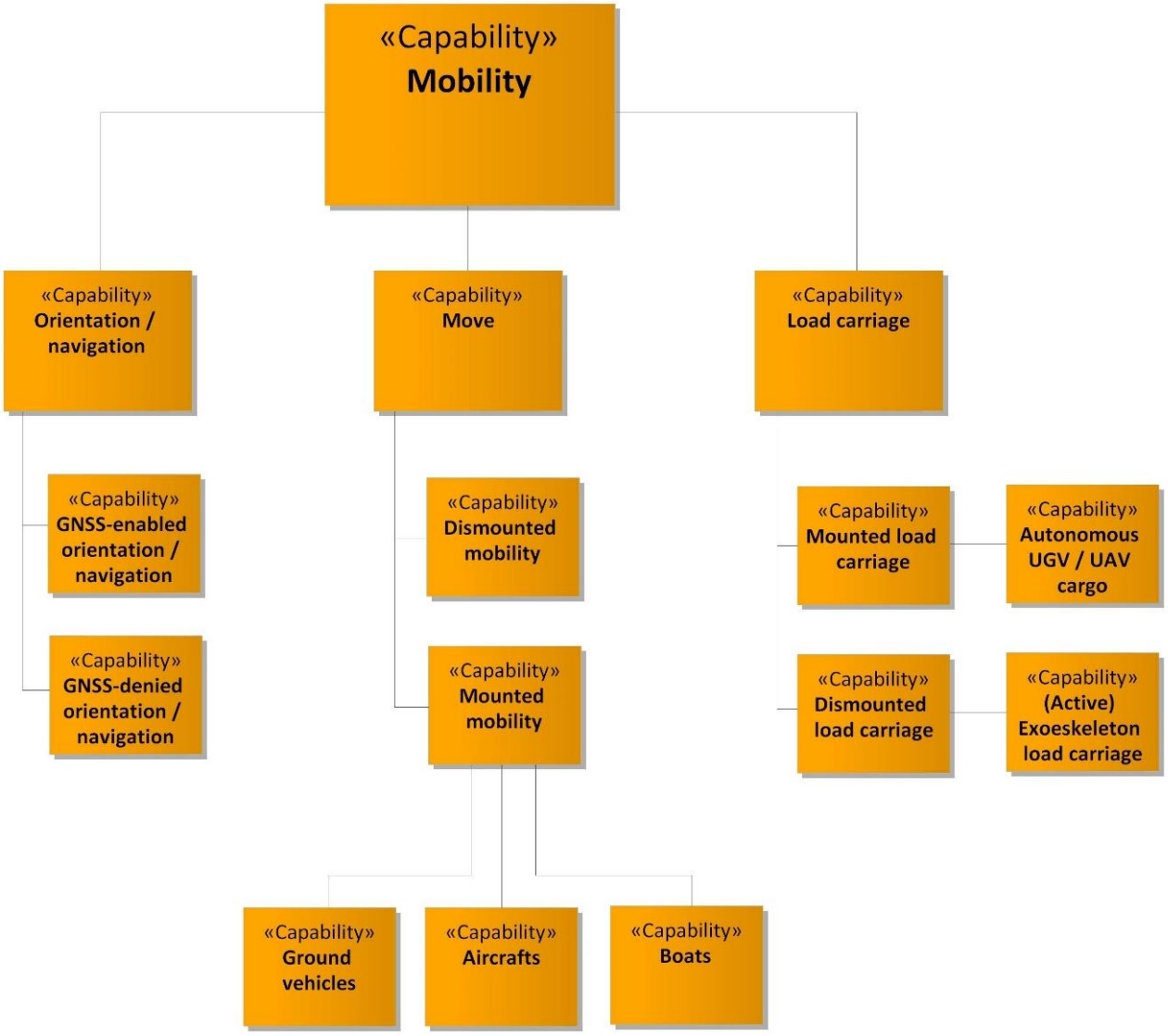

Figure 2-7 – Taxonomy of Mobility Capability Category

2.2.5 Capability Category 5: Protection and Survivability

The DSS should provide the individual protection against:

- projectiles like bullets,
- splinters and shrapnel of ground or air burst munitions,
- shock,
- heat/ extreme temperatures,
- LASER,
- loud noise,
- CBRN munitions,
- IR detection, and
- all other means of battle field /environmental damage.

Such protective DSS equipment help soldiers of the infantry STU/support arms to endure physical battle stresses, while being exposed to:

- hostile fire,
- splinters,
- stabbing weapons and
- the psychological stresses due to uncertainties and insecurities in the fog of war.

Camouflage and concealment are the basic tactics used by a soldier to gain passive protection against enemy detection. Adaptive camouflage material, with abilities for IR screening (to reduce or minimise IR signature and detection by night) will enhance protection. Temperature controlled clothing with biometric sensors can help reduce the stress against cold, heat and keep tabs on the essential body functions (of perhaps a sick or injured soldier till evacuated). Figure 2-8 shows the taxonomy of the capability category Protection and Survivability.

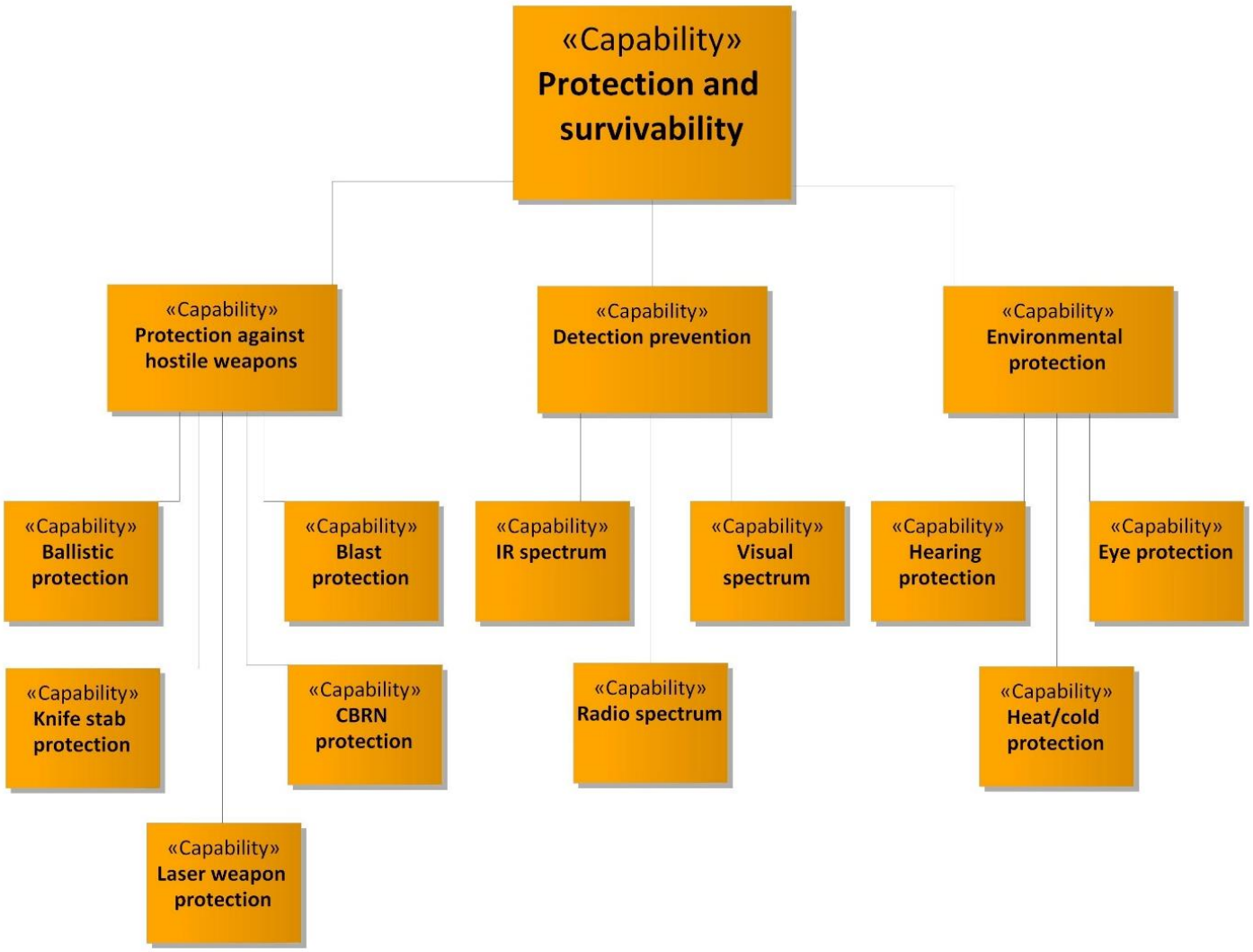

Figure 2-8 – Taxonomy of Protection and Survivability Capability Category

2.2.6 Capability Category 6: Sustainability and Logistics

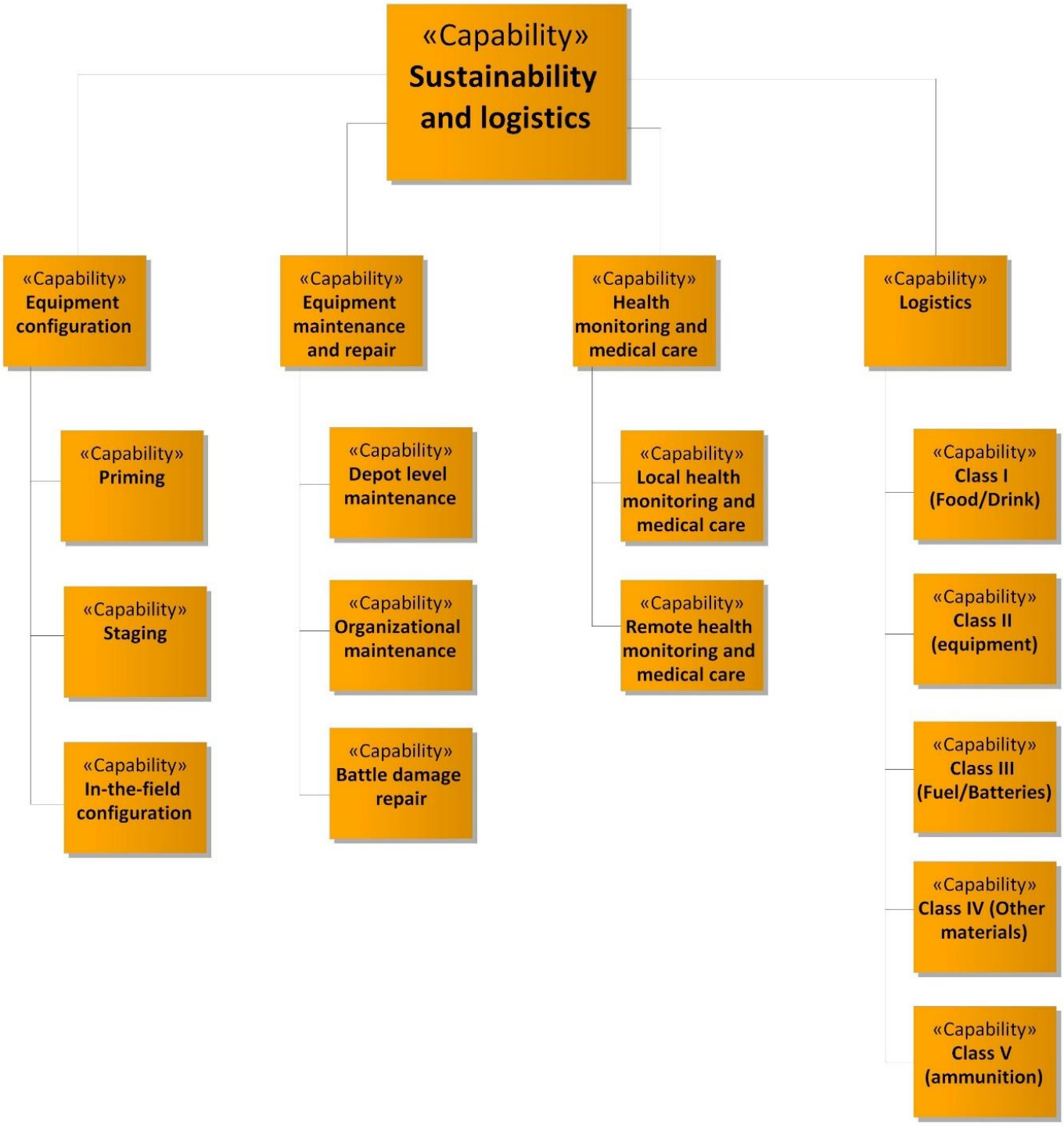

Figure 2-9 – Taxonomy of Sustainability and Logistics Capability Category

2.2.7 Capability Category 7: Education and Training

Within NATO, the Bi-Strategic Commands (Bi-SCs) have produced unified directives for education and training. (Bi-SCD 75-7 Education & Individual Training Directive, Bi-SCD 75-3 Collective Training & Exercise Directive). Education and Training is categorised into two areas; Individual and Collective, which is then further described by four discrete areas: Education, Individual Training, Collective Training and Exercises.

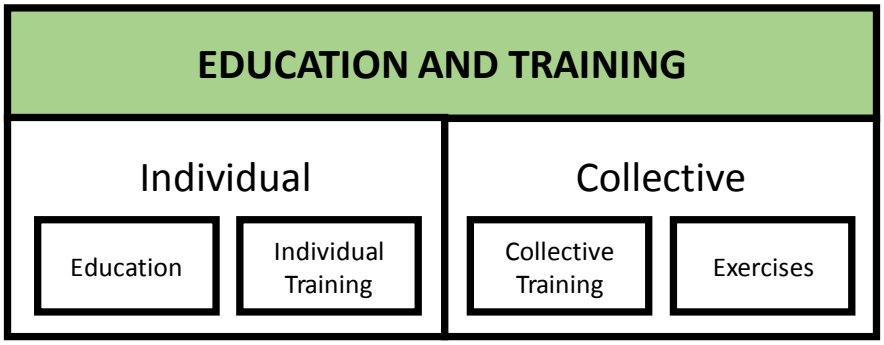

Figure 2-10 – Categorisation of Education and Training (Bi-SC 75-2/75-3)

- **Education**. Education in the context of the users of soldier system implies the laid down levels of academic education required to be attained at different hierarchical levels of the military/police or user organisation. This would in general be broken down into entry-level and continuing education as per policies of different organisations. Knowledge of STEM (Science Technology, Engineering and Mathematic) subjects should be encouraged by user organisations at both the entry-level and continuing education.
- **Individual Training**. Individual training of users of soldier systems implies the laid down proficiency or individual skill level required to be imparted/attained in the use of the soldier system and its support systems, as well as in generic military disciplines like map reading, weapon and ammunition handling, camouflage and concealment, physical and psychological endurance training, radio telephony, swimming, climbing, skiing, basic tactics, etc.
- **Collective Training.** Includes procedural drills and the practical application of doctrines, plans and procedures to acquire and maintain tactical, operational and strategic capabilities.
- **Exercises.** Ensure that HQ and formations are efficiently and effectively trained to fulfil their missions within the given readiness criteria.

The Bi-SCD directives describe the basic structure for the preparation, conduct and reporting of training and exercises and details the processes and products supporting the development, implementation, maintenance and overall management of NATO education and individual training. The taxonomy depicted below shows the sub-capabilities for the execution part of education and training.

Figure 2-11 – Taxonomy of Training Capability

2.2.7.1 Individual Education and Training

Individual Education and Training is accomplished through the process courses of instruction and assessment / evaluation exercises at academies or centres of excellence/military schools of instruction. Both instructions and assessments are a mix of theoretical and practical lessons and evaluation tests and exercises, based on knowledge and performance. Most individual courses of instructions are graded although some intensive ones may have a criterion of successful completion and candidates termed as simply qualified. The highest grade is often termed as qualified as instructor. Laying down the standards required to be achieved in terms of in-depth knowledge of the soldier system and its training modules would give such instructors the ability to configure and impart training to STUs on modern soldier systems.

2.2.7.2 Collective Training and Exercises

Collective training and exercises are conducted to familiarise and train troops in the concept of joint command and control in a possible EU/NATO joint operation. The NATO Exercise Process (EP) consists of four stages:

- Stage 1: Concept and Specification Development;
- Stage 2: Planning and Product Development;

- Stage 3: Operational Conduct;
- Stage 4: Analysis and Reporting.

These stages which are rehearsed and refined during collective training or joint collective training exercises are conducted in areas such as:

- Force Activation
- Deployment
- Reception, Staging, Onward Movement and Integration (RSOM&I) Process
- Operations – Actual exercises may be Computer Assisted Exercise (CAX); Field Training Exercise (FTX); Map Exercise (MAPEX) or an exercise involving physical movement of troops (MOVEX).
- Assessment is usually a part of the After-Action Report (AAR) and includes problems faced and resolutions to them for the future (Lessons Learnt).

In the context of building training modules for soldier systems use of M&S tools should be made in all types and forms of exercise. NATO has a wide range of M&S tools (refer Annex N to NATO BI-SCD 075-003 dated 2 Oct 13) that should be considered for the development of scenario modules and to deliver exercise data in the proper formats and granularity to provide the best training for the training audience.

2.2.8 Capability Category 8: Multi-National Interoperability

2.2.8.1 Interoperability Terms and Definitions

NATO defines Interoperability as “the ability to act together coherently effectively and efficiently to achieve Allied tactical, operational and strategic objectives”. It also differentiates the terms Standardisation; Compatibility; Interchangeability; and Commonality as mentioned below.

- **Standardisation:** The development and implementation of concepts, doctrines, procedures and designs in order to achieve and maintain the compatibility, interchangeability or commonality which are necessary to attain the required level of interoperability.
- **Compatibility:** The suitability of products, processes or services for use together under specific conditions to fulfil relevant requirements without causing unacceptable interactions.
- **Interchangeability:** The ability of one product, process or service to be used in place of another to fulfil the same requirements.
- **Commonality:** The state achieved when the same doctrine, procedures or equipment are used.

2.2.8.2 Levels of Standardisation

Within NATO, standardisation is the process of developing concepts, doctrines, procedures and designs to achieve and maintain the most effective level of standardization in the fields of operations, administration and material. The levels of standardisation are in ascending order of compatibility, interchangeability and commonality. The aim of NATO standardisation is to enhance the Alliance's operational effectiveness and to improve the efficiency in the use of available resources. Multi-nationality is a key factor in NATO's force structure. Compatibility is the minimum level of standardisation required for Alliance forces. However, nations should strive for the standardisation level of interoperability, as this will better enhance the Alliance's operational effectiveness.

2.2.8.3 Interoperability Taxonomy

Land Capability Group Dismounted Soldier System (LCG DSS) has assessed that interoperability can be either Technical, Operational or Logistical. Interoperability taxonomy is depicted at low.

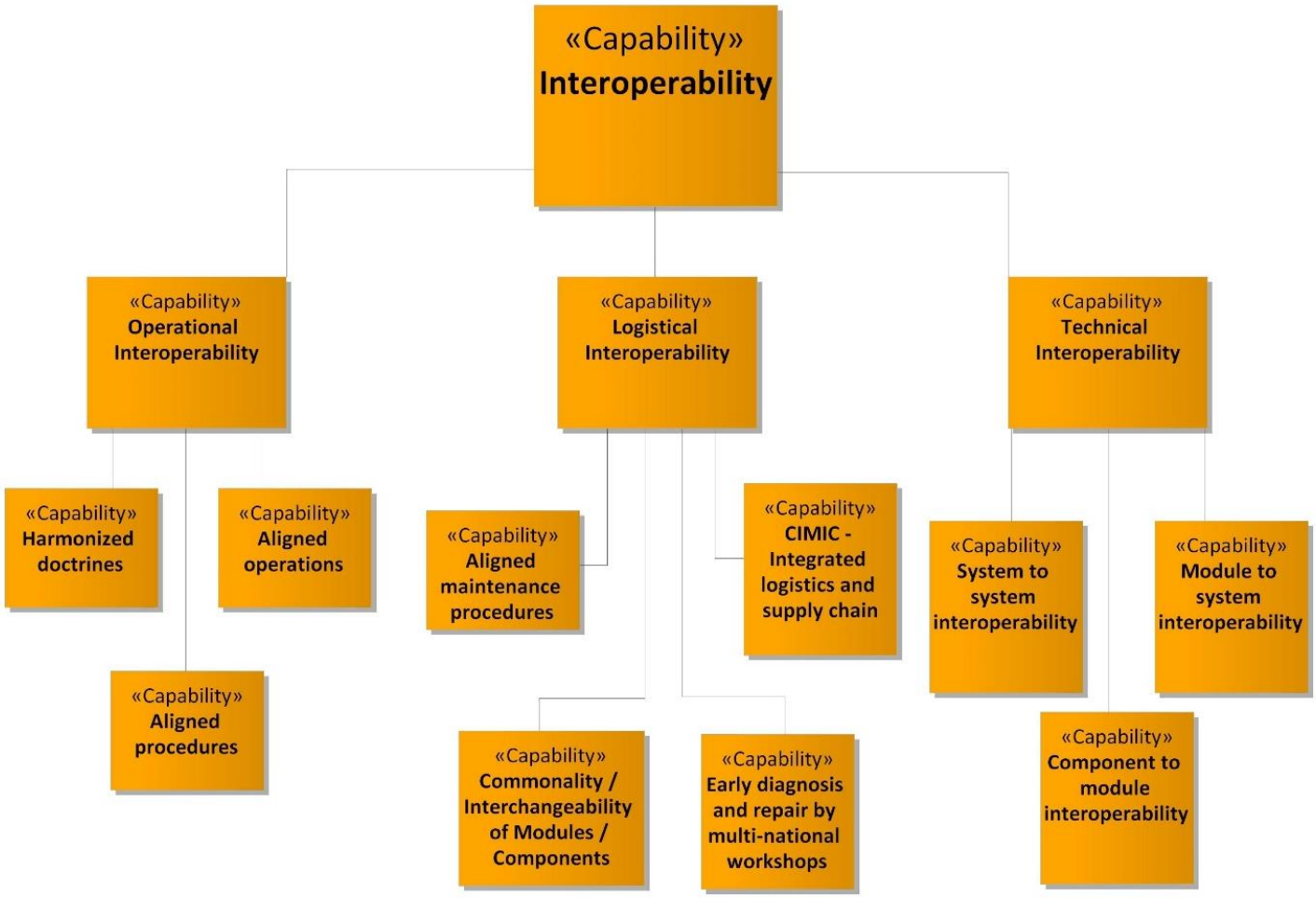

Figure 2-12 – Taxonomy of Interoperability

2.2.8.3.1 Operational Interoperability

- **Harmonized Doctrines.** NATO doctrines plans and procedures to acquire and maintain tactical, operational and strategic capabilities needs to be harmonized between EU/NATO Forces i.e. there should be a common and shared understanding of the strategic, operational and tactical objectives of the Alliance force (which can be built during peace time exercises).
- **Aligned Operations.** This implies that NATO /EU forces operational concept, plans and procedures for the conduct of operations in a particular operational thread or situation should be commonly understood and have a common operational objective.
- **Aligned Procedures.** These may include generic operational procedures like *force activation*, *deployment drills, RSOM&I (Reception, Staging, Onward Movement and Integration)* and other TTPs (Techniques, Tactics & Procedures).

2.2.8.3.2 Technical Interoperability Levels

The technical interoperability levels are:

- **Level 1: System to System Interoperability:** That is one nation's Dismounted Soldier System or Dismounted Soldier Battle Management System to a NATO transportation system, NATO garrison system or another nation's Dismounted Soldier System or Dismounted Soldier Battle Management System.
- **Level 2: Module to System Interoperability:** That is one nation's Dismounted Soldier System Module to another nation's Dismounted Soldier System or Dismounted Soldier Battle Management System.
- **Level 3: Component to Module Interoperability:** That is one nation's component to another nation's Dismounted Soldier System Module. Level 3 interoperability gives the possibility of one nation to use another nation's components as parts of a soldier system module.

2.2.8.3.3 Logistical Interoperability

- **Aligned Maintenance and Logistic Procedures.** This may include procedures like forward delivery of expendables, pooled return logistics, etc.
- **Commonality / Interchangeability of Modules/Components.** These may include interchangeable modules, charging devices, adaptable or common connectors, etc.
- **Easy Diagnosis and Repair by Multi-National Workshops.** This implies that the field workshop of Nation A should be able to repair the soldier system of Nation B and vice versa.
- **CIMIC - Integrated Logistics and Supply Chain**. This entails on-demand production (in case feasible - through smart additive manufacturing in the field) and supply of components and sub-assemblies through shared logistic supply chains, which may include even civil establishments.

2.3 NCV-4 Capability Dependencies

Figure 2-13 below illustrates the capability and sub-capability dependencies, which enable the force using a networked and modern soldier system to attain an operational or mission capability.

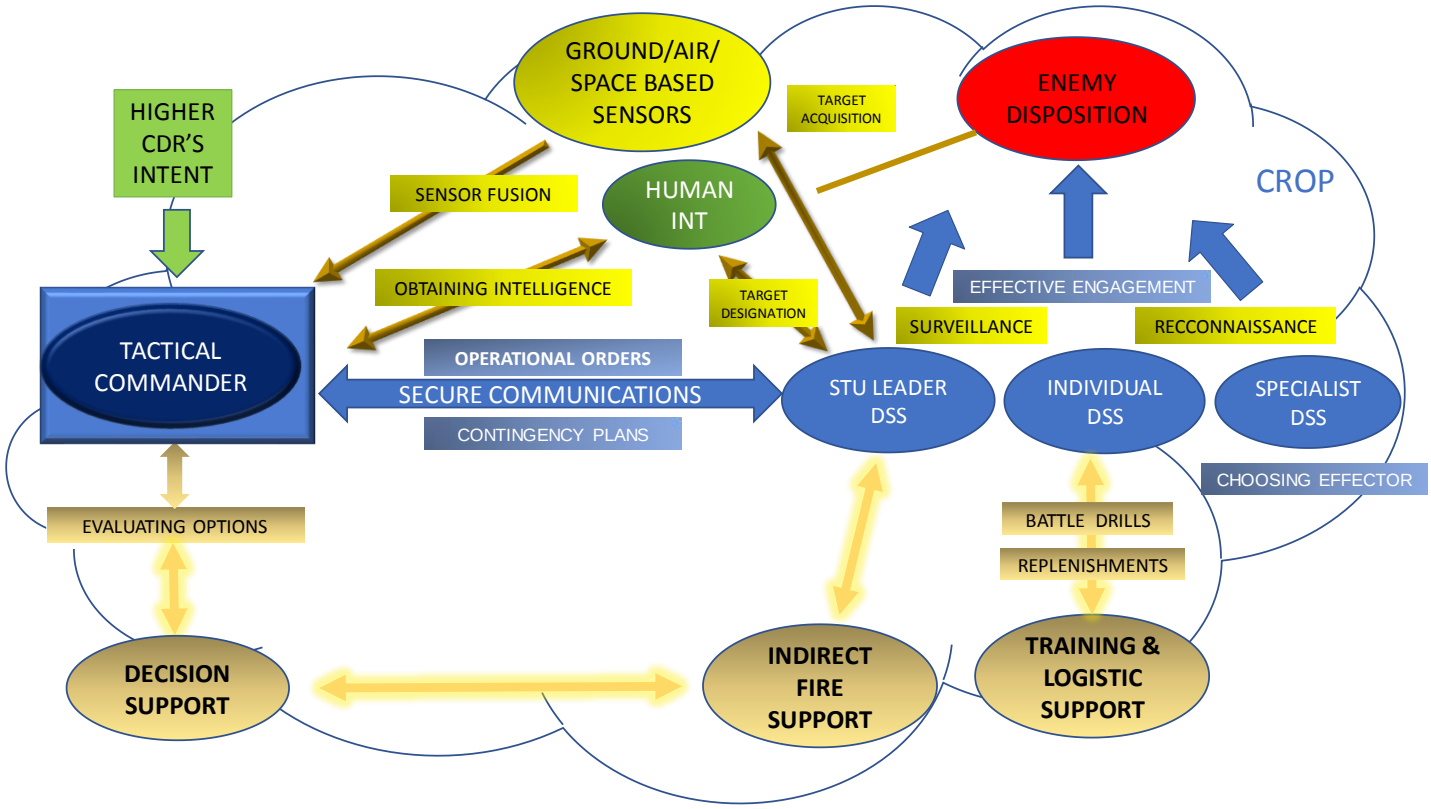

Figure 2-13 – Capability Taxonomy Dependencies Relationship

In this example, in blue is the Tactical Unit in combat, with the Tactical Commander receiving the higher commander's intent and decision support in order to evaluate options and arrive at an operational plan (including contingency plans) which he/she disseminates as operational orders / instructions via secure communications of the soldier system to other team members.

In yellow are the ground / air /space-based sensors, which together with human intelligence (human intelligence agents or other soldier systems in the combat zone) provide real time intelligence about the enemy ORBAT (Order of Battle – meaning number and type of enemy units and their grouping), their disposition and likely intentions.

Sensors also provide this information for the purpose of target acquisition and designation to own forces. In addition, own forces with their integral resources of surveillance and reconnaissance provide real time intelligence to the STU leader to help him / her to enable effective engagement using direct and indirect fire and if required, alter the operational plans.

This situational awareness picture, which includes own and enemy dispositions, enables fire support, battle space replenishments and logistic support is termed as the Common Relevant Operational Picture or CROP. This empowers the soldier system to partake simultaneously in both planning and conduct of network enabled operations as an entity in a dynamic manner.

Automating sub-systems like monitoring of ammunition / fuel / charge levels helps in a push model of operational logistic support. Similarly, vital signs monitoring health system in the soldier system can help monitor battle causalities for speedy medical evacuation/advance notice for treatment; and; reporting of material damage for speedy replacement of components/systems. Feedback from operational engagements helps plan ensuing operations and refine future combat simulation and training.

Hence, it can be seen that operational capabilities have an inherent interdependency – for example C4 is not possible without effective planning, which is dependent on intelligence gathering; and; effecting the operational plan is not possible without tactical and operational mobility; both forms of mobility are impacted by the DSS being provided enemy and ground information very quickly and their ability to act on it effectively – namely the Capability Categories of C4ISTAR and Effective Engagement. These capabilities in turn provide Protection and Survivability to the soldier. This highlights the interdependence and synergy needed from several capability requirement areas.

2.4 NCV-6 Capabilities to Operational Activity Mapping

Each capability requirement area fulfils several operational activities in different operational contexts.

The following tables map the correlation of Capability Areas to Operational Activities. This is an indicative and not a comprehensive list of all operational activities, which can vary based on the type and intensity of an operational mission.

CAPABILITIES		OPERATIONAL ACTIVITIES	
Capability Category	**Capability**	**Operational Activities**	**Operational Activity Group**
C4	**Voice and Data Connectivity**	Exchange information	**Command, Control, Communications and Computing**
		Receive and Acknowledge Critical data, e.g. Orders from higher echelons	
		Perform Voice Call Sessions	
	Collect Information	**Observation and Acquisition of Situation**	
		Acquire Orders from Higher Echelons	
		Acquire Observation from own resources	
		Acquire Observation from other Units (Peer, higher echelons, subordinate units)	
		Acquire Information from Neutral Sources	
		Validate / Consolidate a Common Relevant Operational Picture	
	Decision Making	**Assessment and Decision Making**	
		Operation Planning	
		Coordinate with Peers and Subordinate Leaders	
		Convert order into tactical operational plan.	
		Order Production and Dissemination	
		Briefing	
		Order Issuing	
		Move to a location.	
		Deployment and coordination.	
		Execute tasks using planned and rehearsed tactics, techniques and procedures (TTP).	
		Modify plan during mission.	
	Achieve Desired Effects	**Execution Control**	
		Evaluate progress of operational plan	
		Report progress of operational plan	
		Request casualty evacuation	
		Evaluate mission completion	
		Assess damage after mission (enemy/ own)	
		Evaluate logistic supply status	
		Report to Higher Echelons	

Table 2-1 – Capability to Operational Activity Mapping (Capability Category 1: C4)

CAPABILITIES		OPERATIONAL ACTIVITIES	
Capability Category	**Capability**	**Operational Activities**	**Operational Activity Group**
ISTAR	**Surveillance**	**Surveillance**	**Intelligence, Surveillance, Targeting, Acquisition and Reconnaissance**
		Continuous systematic observation of the surrounding environment to detect possible threats in a given battlespace area.	
		Report observations and/or integrate surveillance information into CROP.	
	Reconnaissance	**Reconnaissance**	
		Receive and collate information from multiple sources.	
		Analyse information from observations and raw data.	
		Communicate resulting information about terrain, enemies and their activities and resources.	
	Target Acquisition and Designation	**Target detection**	
		Acquire target in terms of distance, bearing, elevation, speed, direction of movement, quantity and type of target.	
		Track target manually or electronically (manually or automatic target tracking).	
		Select appropriate weapon.	
		Assign target(s) to means / weapons.	
	Intelligence	**Intelligence Gathering**	
		Visual / electronic assessment.	
		Guard own forces from surprises and it provides the foundation for a targeted approach.	
		Reconnaissance patrols	
		Report observations and / or integrate BDA Information into CROP.	
		Carry out observation of the area around while moving.	

Table 2-2 – Capability to Operational Activity Mapping (Capability Category 2: ISTAR)

CAPABILITIES		OPERATIONAL ACTIVITIES	
Capability Category	**Capability**	**Operational Activities**	**Operational Activity Group**
Effective Engagement	**Target Prioritization and Designation**	Choose Desired Effect	**During Battle/Engagement: Withdrawal operations, Delaying operation,·Anti-Aircraft,·Holding an area, Deter or Deterrence**
		Based on effect-based operational objective like destruction, neutralisation, suppression, etc.	
		Based on nature and profile of target – soft/hard, open/covered, individual, group or swarm, etc.	
		Handing Over of Targets	
		From one sensor to another.	
		From one platform / weapon system to another.	
	Target Engagement	Select most Appropriate Position to Engage Target from.	
		Direct – line of sight & range of deployed weapons	
		Indirect – Obstacle clearance / range / minimum dead range of weapons.	
		Select Weapon and Munition	
		Direct / Indirect / Cyber weapon.	
		Type of Munition - Air burst, proximity fuze incendiary, penetrating, etc.	
	Target Acquisition Target Engagement	Weapon Designation, Orientation, Alignment, Ballistic Corrections, etc.	
		Designate desired number of weapons.	
		Provide target data for weapon orientation, target alignment and tracking.	
		Provide weather data for ballistic corrections.	
	Target Acquisition	Manage Duration and Coordination of Fire	
		Start and stop fire based on movement of target and own troops and effect desired.	
		Coordinate fire when both air and land forces are engaging the enemy as per the joint fire plan.	
		Obtain target parameters on the move.	
	Target Engagement	Engage Targets while Moving	
		Carry out target engagement while moving both mounted and dismounted.	

	Engagement Assessment	Carry out observation of the area around while moving.	
		Surveillance	
		Systematic observation of aerospace, surface or subsurface areas, places, persons, or things, by visual, aural, electronic, photographic, or other means	

Table 2-3 – Capability to Operational Activity Mapping (Capability Category 3: Effective Engagement)

CAPABILITIES		OPERATIONAL ACTIVITIES	
Capability Category	**Capability**	**Operational Activities**	**Operational Activity Group**
Mobility	**Mounted Mobility**	**(Land, Air, Maritime)**	**Individual and STU Mobility**
		Joint	
		Combined	
		Civil	
	Move	**Transition from Mounted to Dismounted**	
		Dismounting on objective area.	
		Dismounting short of objective area.	
		Communicate while Moving	
		Operate radio set on the move.	
		Communicate using hands free communication equipment.	
		Engage Targets while Moving	
		Obtain target parameters on the move.	
		Carry out target engagement while moving both mounted and dismounted	
		Observe and Report while moving	
		Carry out observation of the area around while moving.	
		Report about any cognizable activity or untoward observation to higher echelon.	
	Dismounted Mobility	**Dismounted Move Across Various Terrain**	
		Mountains / high altitude areas	
		Riverine / marshy areas	
		Deserts / semi- deserts	
		Plain / open country	
		Jungle / Forested	
		Move to Desired Position using different mobility platforms	
	Orientation/Navigation	**Navigate While Moving**	
		Point to point map reading / navigation.	
		Satellite data fed real time automatic navigation using GPS / other GNSS device.	
	Load Carriage	**Achieve Desired Tactical / Operational Mobility**	
		Through the correct positioning of fire and move elements.	
		Through the correct and timely deployment of personnel, equipment and operational logistic elements.	

Table 2-4 – Capability to Operational Activity Mapping (Capability Category 4: Mobility)

CAPABILITIES		OPERATIONAL ACTIVITIES	
Capability Category	**Capability**	**Operational Activities**	**Operational Activity Group**
Protection and Survivability	**Protection against hostile weapons**	Remain Mission Capable	**Protection and Survivability**
		Protect self from enemy actions to injure /destroy.	
		Maintain mission weapons, equipment and ammunition to keep it serviceable at all times.	
		Endure Enemy Fire	
		Protection from small arms fire	
		Protection from CBRNE	
		Protection from shrapnel and splinters	
		Air Defence	
		Minefield marking	
	Detection Prevention	Camouflage and Deception	
		Camouflage as per terrain.	
		Use broken ground and cover to conceal from enemy line of sight sensors and weapons.	
		Avoiding noise	
		Electronic Protective Measures	
		Silence for radio, RADAR and LASER.	
		Encryption and Disguise	
		Deter or Deterrence	
		Safe Guarding	
		Peacekeeping	
		Peace Enforcement	
		Humanitarian operations	
	Environmental Protection	Endure Hostile Environment	

		Extreme temperatures cold or heat	
		Rain / snow /sleet	
		High winds	
		Low oxygen levels in HA areas	
		Breathe under-water	
		Endure Physical and Psychological Stresses	
		Relief in place	

Table 2-5 – Capability to Operational Activity Mapping (Capability Category 5: Protection and Survivability)

CAPABILITIES		OPERATIONAL ACTIVITIES	
Capability Category	**Capability**	**Operational Activities**	**Operational Activity Group**
Sustainability & Logistics	**Logistics**	Logistic sustainment	**Sustainability & Logistics**
		Provides services to mainly maintain the personnel, medical and logistic capabilities of a company.	
		Provides resources & services for operating for mission whose duration is at least 48 hours.	
		Provides resources & services for operating during day/night and under adverse weather conditions.	
		Remain self -contained and if required live off the land till evacuated / return to own/friendly logistic area.	
		Plan the resource & services for the whole estimated mission duration.	
		Adopt ICT systems for automated monitoring & communication of expenditure / remaining supplies and spares.	
	Equipment Configuration	Enable DSS equipment to be configured on a per mission base.	
		Enable DSS to adapt to new mission configuration within the mission task timing constraints.	
	Equipment maintenance and repair	Design DSS critical components to be repaired in the field.	
		Design DSS critical components as modular replaceable units to be substituted within the mission task timing constraints by non-technical personnel.	
		Recover / destroy (zeroizing) damaged / compromised equipment remotely.	
		Design DSS Applications to be updated, even by secure remote sites, and automatically.	
		Design DSS Component to be upgraded with minimal impact on the other DSS system components.	

		Obsolescence Management	
	Health monitoring and medical care	Monitor critical human body parameters of self / others.	
		Administer first aid in the field.	
		Provide advance information and give SOS call for casevac / medevac.	
		Plan for first aid site in the field.	
		Inform own and allies troops about the availability of first aid sites in the operational area.	

Table 2-6 – Capability to Operational Activity Mapping (Capability Category 6: Sustainability & Logistics)

CAPABILITIES		OPERATIONAL ACTIVITIES	
Capability Category	**Capability**	**Operational Activities**	**Operational Activity Group**
Training	**Individual Education & Training**	Handle Weapons & Equipment Proficiently	**Training**
		Individual weapon-skill training.	
		Carry out technical training	
		Adapt to CTC / Simulation Training	
		Incorporate simulation training at individual, weapon/system and collective training stages.	
		Improve technical knowledge and skills of individual soldiers, military leaders and planners.	
		Update simulation training packages with feedback from operational / live training exercises.	
	Collective Training & Exercise Execution	Become Proficient in Tactical Operations	
		Battle physical proficiency training.	
		Carry out STU level tactical training.	
		Carry out joint and combined force collective training based on likely operational thematic areas.	
		Train troops in remaining self-contained / living off the land.	
	Individual Education & Training	Become Proficient in all Capability Areas	
	Collective Training & Exercise Execution	Balance out individual, collective and simulated versus live training.	
		Balance out training in all capability areas like physical, weapon, tactics, mission planning, etc	
	Collective Training & Exercise Execution:	Validate Operational Concepts and Doctrines	
	Operations	Evolve a common doctrine for affiliation / coalition forces.	
		Field new concepts of operations during integrated training.	
		Increase Affiliation, Coordination and Confidence	

		Evolve and share multi-national planning & training norms.	
		Identify training needs through gap analysis.	
		Carry out integrated collective training.	
		Prepare annual schedules for joint training at all levels	
		Correlate training budgetary requirements, allocations and programmes.	
	Collective Training & Exercise Execution:	Measure Operational Readiness	
	Assessment	Lay and achieve training standards for operational readiness levels.	
		Lay and achieve standards for equipment and system readiness levels	

Table 2-7 – Capability to Operational Activity Mapping (Capability Category 7: Education & Training)

CAPABILITIES		OPERATIONAL ACTIVITIES	
Capability Category	**Capability**	**Operational Activities**	**Operational Activity Group**
Interoperability	**Operational Interoperability**	Evolve common multi-national operational planning norms and TTPs.	**NATO/EU Joint Forces and allied multi-national interoperability**
		Share a Common Relevant Operational Picture for multinational operational threads.	
		Perform coordinate tasks via the exchange of tactical information and voice communications.	
	Technical Interoperability	Adopt standard symbols for Human Machine Interface for a common understanding of the CROP.	
		Adopt standard secure communication protocols for both seamless data exchange and voice communication.	
		Adopt an integrated tactical information network to minimize data exchange delays and maximize the robustness of the coalition information system.	
		Adopt standard data model for seamless information exchange and processing.	
		Adopt integrated multinational IT security systems to minimize any IT security gap at Coalition level.	
	Logistical Interoperability	Use integrated logistics and common supply chain concepts and protocols for seamless and shared repair and recovery tasks.	
		Adopt an integrated network of first-aid sites to provide for multinational medical recovery and common evacuation operations.	
		Adopt standard critical component which can act as logical replaceable unit for DSS of different nations.	
		Adopt compatible execution platforms to allow the deployment and usage of Soldier Applications as support of common operational threads.	

Table 2-8 – Capability to Operational Activity Mapping (Capability Category 8: Multi-National Interoperability)

3 Integrated Dictionary

3.1 Abbreviations and Acronyms

ASD	AeroSpace and Defence Industries Association of Europe
AAR	After Action Report
ACT	Allied Command Transformation
APFSDS	Armor-Piercing Fin-Stabilized Discarding Sabot
AI	Artificial Intelligence
BMS	Battery Management System
BDA	Bomb Damage Assessment
CBRN	Chemical, Biological, Radiological, and Nuclear
CBRNE	Chemical, Biological, Radiological, Nuclear and Explosive
CIMIC	Civil Military Cooperation
CTC	Combat Training Centre
CROP	Common Reference Operational Picture
CIS	Communication and Information System
CAX	Computer Assisted Exercise
DNV GL	Det Norske Veritas Germanischer Lloyd (NLD)
DEU	Deutschland (Germany)
DSS	Dismounted Soldier System
ET	Ejercito de Tierra
EM	Electro Magnetic
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EW	Electronic Warfare
EDA	European Defence Agency
EU	European Union
MOVEX	Exercise involving physical movement of troops
EP	Exercise Process
FTX	Field Training Exercise
FCS	Fire-Control System
GOSSRA	Generic Open Soldier System Reference Architecture
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HQ	Headquarters
HA	High Altitude
HE	High Explosive
HEAT	High Explosive Anti Tank
IED	Improvised Explosive Device
ICT	Information and Communication Technologies
IT	Information Technology
IR	Infrared
ISTAR	Intelligence, Surveillance, Target Acquisition and Reconaissance
ITA	Italy

JFC	Joint Forces Command
LCG-DSS	Land Capability Group – Dismounted Soldier Systems
LCC	Land Component Command
LRF	Laser Range Finder
MAPEX	Map Exercise
MOUT	Military Operation in Urban Terrain
MDE	Ministerio de Defensa de España
MMOE	Mission Measure of Effectiveness
NAV	NATO All View
NCV	NATO Capability View
NIP	NATO Interoperability Policy
NOV	NATO Operational View
NSOV	NATO Service Oriented View
NSV	NATO System View
NTV	NATO Technical View
NLD	Netherlands
NCO	Network Centric Operations
NEC	Network Enabled Capability
NATO	North Atlantic Treaty Organization
ORBAT	Order of Battle
POL	Poland
PRT	Portugal
PADR	Preparatory Action on Defence Research
PU	Public
RBCI	Radio-Based Combat Identification
RSOM	Reception, Staging, Onward Movement and Integration
SOS	Save Our Souls
STEM	Science Technology, Engineering and Mathematic
SC	Secure Communications
SSKP	Single Shot Kill Probability
STU	Small Tactical Unit
ESP	Spain
SCD	Strategic Commands Directives
SWE	Sweden
TAR	Tactical Augmented Reality
TTP	Techniques, Tactics & Procedures
USB	Universal Serial Bus
UAV	Unmanned Aerial Vehicle
UGV	Unmanned Ground Vehicle
VR	Virtual Reality

3.2 Referenced Documents

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/10/ C3 Taxonomy Baseline 3.1, Consultation, Command and Control Board (C3B), NATO document AC/322-D(2019)0034 (INV), July 2019