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KNOWLEDGE FLOW IN MULTINATIONAL LOGISTICS

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Abstract:
Multinational logistics encompass various elements of logistic support provided to a combined joint force by multinational means, such as lead nation logistic support, multinational integrated logistic unit or local contracting.
Defined as the movement of knowledge from a person, group or storage medium to another person, group or storage medium, knowledge flow sustain the ability of individuals to create, transfer and apply knowledge on identification and execution of new tasks, providing logistic support in real-time and creation of new logistic concepts and capabilities.
Using knowledge management tools, the purpose of this paper is to identify, describe and analyse knowledge flow in multinational logistics, emphasising its role in improving the individual and organisational performance of multinational logistics organisations.

Key words: Knowledge, flow, management, multinational, logistics, support.

1. Introduction

Logistics, defined by NATO as "The science of planning and carrying out the movement and maintenance of forces" [1], is a key contributor to ensure that NATO has the full range of capabilities necessary to deter and defend against any threat to the safety and security of populations and to:

- "Maintain the ability to sustain concurrent major joint operations and several smaller operations for collective defence and crisis response, including at strategic distance;
- Develop and maintaining robust, mobile and deployable conventional forces to carry out both our Article 5 responsibilities and the Alliance's expeditionary operations, including with the NATO Response Force[2];

Multinational Logistics represents the "provision of logistic support to operations through multinational means, such as lead nation, role specialisation and multinational integrated logistic support" [3].

Increasing domain complexity of multinational logistics, rapid advancement of technology, accelerating changes of security and operational environment, intensified demand for speed of responsiveness, increasing requirements of individual experience, strong connections with industrial base and commercial logistics are main driving forces for the need to identify and maintain a continuous knowledge flow among individuals, groups, organisations and artefacts.

2. Aspects of multinational logistics

Military logistics covers "the aspects of military operations which deal with: design and development, acquisition, storage, transport, distribution; maintenance, evacuation and disposal of materiel; transport of personnel; acquisition or construction, maintenance, operation and disposition of facilities; acquisition or furnishing of services; and medical and health service support." [1]

According to NATO logistics doctrine, there are three types of multinational logistics:

- Pre-planned mutual support, HNS, and contractor support to operations that are arranged bi- or multilaterally by NATO and/or nations;
- A nation formally undertakes to provide support or services to all or part of the multinational force, but under national command;
- One or more nations formally undertake to serve all or part of the multinational force, under control of the multinational Commander (e.g. MILU) [4].

Usually multinational logistic support provided to a combined joint force is a combination of the following modes of multinational logistic support:

- Lead nation logistic support;
- Role specialist nation logistic support;
- Mutual support arrangements;
- Commonly funded logistic resources;
- Multinational integrated logistic support;
- Aircraft cross servicing;
- Contracting support.

3. Types of knowledge in multinational logistics

Knowledge derives from information and combines various pieces of information with an interpretation and meaning.

Karl Wiig, defines different forms of knowledge as factual (that found in books and data), conceptual (found in perspectives and concepts), expectational (knowledge to make judgments and hypothesis), and methodological (knowledge from reasoning and strategies) [6] [1].

According to the hierarchical model for knowledge management defined by Prat, 2008, there are four criteria for knowledge classification:

- Explicitness: tacit knowledge, explicit knowledge;
- Reach: individual knowledge, collective knowledge (group knowledge, organisational knowledge, inter-organisational knowledge);
- Abstraction level: specific knowledge, general knowledge;
- Propositionality: declarative knowledge ("know-what"), procedural knowledge ("know-how").

Figure 1 depicts various types of knowledge which are briefly described below.

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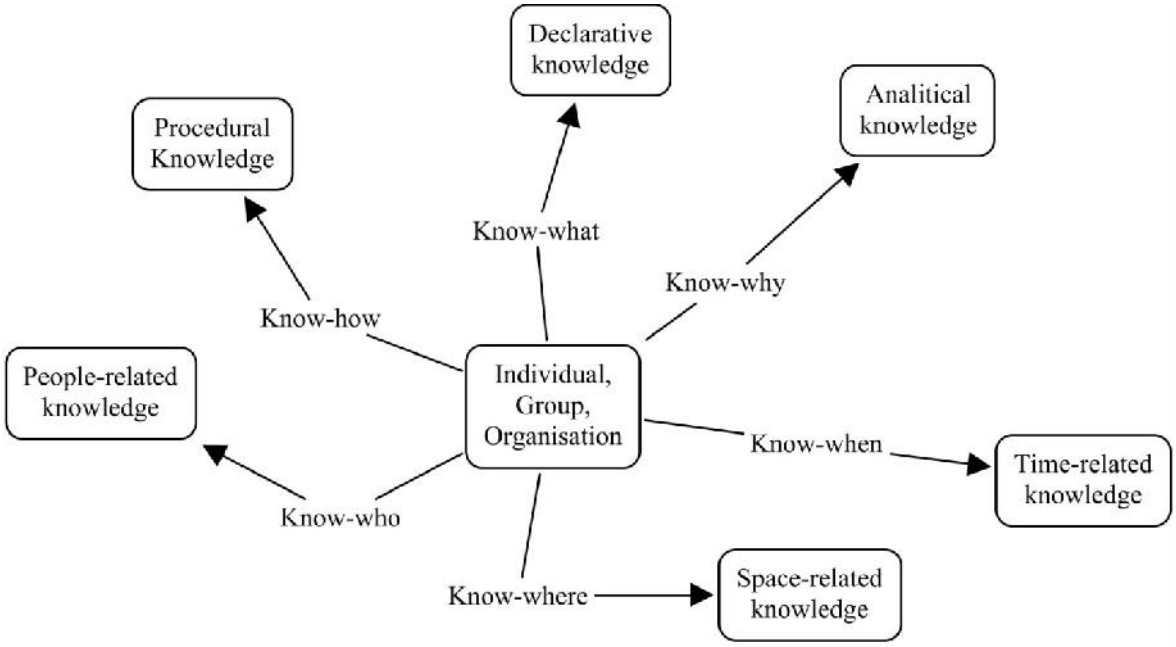

Fig. 1

Tacit knowledge is possessed only by individuals, resides in culture, expertise, skills, habits and effective transfer by words or symbols requires extensive communication and trust. Tacit knowledge is rooted in actions, procedures, routines, commitment, ideals, values, and emotions (Nonaka, 1996).

Explicit knowledge is easy and readily to be transmitted, can be articulated, codified, and stored in manuals, documents, procedures or in dedicated media.

People-related knowledge (know-who) denotes the ability to find and to evaluate people and documents.

Individual knowledge is seen as the final result of personal understanding, residing in skills, expertise of the members of an organisation.

Collective knowledge is the result of all communication processes among the members of an organisation and is applied and included in organisational processes, products, services etc.

Declarative knowledge (know-what) is similar to explicit knowledge, consists of descriptions of what tasks, methods and procedures are used by members of an organisations and includes principles, facts, figures, diagrams etc.

Examples: NATO logistic vision and objectives; NATO principles and policies for logistics; NATO stockpile planning guidance, Readiness and sustainability policy; Principles of NATO standardisation; Concept of operations (CONOPS); Logistic support guidelines; NATO concept for co-operation in logistics; Modes of multinational logistics.

Procedural knowledge (know-how) is associated with tacit knowledge, refers to means for achieving goals and describes how to act under specific circumstances (accomplish a task, perform a duty).

Examples: NATO standards (operational, administrative and materiel standards); Operation plan (OPLAN); Contingency plan (COP); Logistics tactics, techniques and procedures (TTPs); Deployment plan, Standard operating procedures.

Another types of knowledge in multinational logistics are *analytical knowledge (know-why)*, *time-related knowledge (know-when)*, *space-related knowledge (know-where)*.

4. Knowledge flows

A knowledge flow is a process of knowledge passing between people or knowledge processing mechanisms [5].

Movement of knowledge from a person, group or storage medium to another person, group or storage medium, sustain the ability of individuals to create, transfer and apply knowledge on identification and execution of new tasks, providing logistic support in real-time and creation of new logistic concepts and capabilities.

Direction, content and carrier are essential attributes that characterise a knowledge flow and determine the sender and the receiver, the sharable knowledge content and the media that can pass the content.

According to Wiing (1995), a flow of knowledge has four basic functions:

- *Building of knowledge* by knowledge transfer from external sources and creating new knowledge by research and development;
- *Storage of knowledge* by preserving current knowledge in artefacts;
- *Distribution of knowledge* by sharing and transfer;
- *Application of knowledge* by integration in organisational processes, products and services.

2.1 Types of knowledge flow

Different types of knowledge flow derive from a combination of possible connections between sources of knowledge, respectively human and artefacts.

Knowledge artefacts are seen as artefacts (objects made by a human being) which represent an encoding of knowledge.

a) *Human – human knowledge flow*: transfer of tacit and explicit knowledge between individuals, groups and organizations.

Transfer mechanisms include socializations, general or tailored training, formal and informal learning, mentorship.

This type of knowledge flow is specific to a strategy of knowledge management, namely personalization strategy, focused on knowledge as an object of exchange through person-to-person contacts. Chat, instant messaging, online meetings, and shared application technologies are core instruments in support of human – human knowledge flow initiation and maintenance.

An excellent example of human - human knowledge flow is offered by *Operational Mentor and Liaison Team (OMLT)* program, which is a NATO-ISAF initiative aimed at improving the capacity of the Afghan National Army (ANA) through deploying small OMLT teams to work with ANA forces [6].

The main task of OMLTs is to provide training and mentoring to the ANA. Individuals in OMLT organization are considered experts within a particular domain (e.g. infrastructure engineering for logistics, advanced mechanics, maintenance, supply, medical support). Expertise is high in tacit knowledge and transfer of expertise occurs via consultation, collaboration, mentoring, and observation.

The relevance of knowledge transferred to Afghan military personnel depends on the currency of the knowledge in the context of its application, and it can be extended by renewal and learning. Improvement of mentoring performance relies on the availability of experts to form OMLTs and the ability of a specific military organization to quickly locate the required expertise for a given operational situation.

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NATO offers a productive environment for communication and knowledge exchange consisting of dedicated bodies [7]:

- *Logistics Committee (LC)*: the overall mandate of the SC is to address consumer logistics matters with a view to enhancing the performance, efficiency, sustainability and combat effectiveness of the Alliance's forces and to exercise, on behalf of the Council, an overarching co-ordinating authority across the whole spectrum of logistics vis-à-vis the other logistic committees and bodies of NATO;
- *Logistic Staff Meeting (LSM)* - monitors and co-ordinates the implementation of logistic policies, programmes and initiatives through consultation and co-operation among nations, the SCs, and with other NATO logistic and logistic-related bodies; it provides a forum for addressing logistic concerns;
- *Movement and Transportation Group (M&TG)* - monitors and co-ordinates the implementation of M&T policies, programmes and initiatives through consultation and co-operation among nations, the SCs and other NATO transportation and transportation-related groups and agencies.

b) *Human – artefacts knowledge flow*: transfer and storage of explicit knowledge in physical media.

Prior to be stored, knowledge is refined and preserved. Refinement of knowledge includes activities such testing, labelling, restructuring, indexing and updating of existing explicit knowledge. Preservation of knowledge encloses activities like formatting, codification, organising and storing in different media formats.

Human-artefacts knowledge flows are part of a strategy of knowledge management named codification strategy that is based on the idea that maximising the use of technology the knowledge can be extracted from individuals, codified, stored and reused.

c) *Artefact – human knowledge flow*: distribution of preserved explicit knowledge from physical media to users by sharing and direct transfer with the aim to be applied in organisational processes.

Literature offers two primary mechanisms of knowledge utilisation - direction and routine. Direction involves codifying tacit knowledge into explicit rules and instructions that can be communicated throughout the organization. Routine assumes the development of predetermined response alternatives to environmental and operational changes.

In logistics, direction mechanism is materialised in policies, visions, doctrines, strategies, concept, terms of references etc. On the other side, logistic plans and standard operating procedures implement routine and form the framework for execution of standard activities in response to operational requirements.

Presentation of knowledge as an enabler of knowledge distribution is important and military portals are key elements in knowledge dissemination. Portals offer a rich knowledge-sharing environment by collecting content and offering access, often on a need-to-know basis, to information and knowledge repositories consisting of aggregating Web services, information sites, collaboration tools, and decision-support applications.

In this regard, NATO Standardization Agency (NSA) Public and protected Web Sites are valuable portals that offer access to NATO publications and standards stored in NATO Standardization Document Database (NSDD). Standardization is defined within NATO as the process of developing concepts, doctrines, procedures and designs to achieve and maintain the most effective levels of "compatibility, interchangeability and commonality" in the operational, procedural, materiel, technical and administrative fields.

The primary products of this process and NATO's tools for the enhancement of interoperability are Standardization Agreements (STANAGs) between member nations [8]
.

d) *Artefact – artefact knowledge flow*: automatic transfer of knowledge between physical media based on dedicated software.

Knowledge flow among artefacts is fully enabled by NATO Network Enabled Capability (NNEC) that offers advanced techniques and architectures for more effective sharing of information and knowledge across the enterprise's distributed and heterogeneous information systems (high-performance information grid, integrated sensor grids (satellite imagery, manned and unmanned reconnaissance aircraft, ground sensors), high-speed automated assignment of resources, access to all appropriate information sources, weapons, interactive network, data-sharing technologies) [9].

5. Identification of knowledge flow in multinational logistics

Knowledge flow identification in multinational logistics is a phased adaptive process encompassing three stages:

a) Identification of main sources of knowledge;
b) Classification of knowledge content of identified sources;
c) Identification of senders and receivers, interactions and transfer mechanisms that finally define the knowledge flow.

5.1. Knowledge sources

Sources of knowledge include individuals, groups and organisations and documents in specific physical formats (paper, video, audio, multimedia, virtual resources such portals, web-pages etc.).

Individual knowledge resides in members of various logistics organisations providing logistic support to a multinational force.

In logistics organisations knowledge is structured and managed by specific groups of Subject Matter Experts (SMEs). Knowledge based organisations allow SMEs to structure their body of knowledge more efficiently, manage explicit relationships between knowledge objects, share knowledge with one or many groups and gather, receive and capture observations, lessons identified, comments and feedback from key participants in logistic processes and activities on specific subjects or topics.

Important sources of knowledge may be identified in *logistic organisations* specific to different modes of multinational logistic support, such National Logistics, National Support Elements (NSE), Host Nation Support (HNS), Resources in the JOA, Mutual Support Agreements (MSA), Lead Nation (LN), Role Specialist Nation (RSN), Multinational Integrated Logistic Units and Multinational (MILUs) and Multinational Integrated Medical Units (MIMUs), Third Party Logistic Support Services (TPLSS).

In NATO community the main sources of domain specific knowledge are enclosed in NATO *publications* referring to logistic policies and concepts [10], briefly described below.

NATO Logistic Policy documents are developed at the highest NATO levels and include: Policy for Cooperation in Logistics, Logistic Readiness and Sustainability Policy, Principles and Policies for Logistics, Medical Support Precepts and Guidance for NATO, Principles and Policies for Host Nation Support (HNS), Principles and Policies for Movement and Transportation, Military Assistance to International Disaster Relief

Operations, Logistics Support concept for NATO Response Force Operations, Principles and Policies for the Maintenance of Equipment.

Allied Joint Logistic Doctrine documents are distributed as Allied Joint Publications (AJPs). The AJPs provide foundational logistic doctrine, under which more detailed logistic techniques and procedures are established. The following AJPs are presently developed and promulgated: AJP-4(A) Allied Joint Logistics Doctrine, AJP-4.4 Allied Joint Movement & Transportation Doctrine, AJP-4.5 Allied Joint Host Nation Support Doctrine & Procedures, AJP-4.6 Multinational Joint Logistic Centre, AJP-4.7 POL Doctrine, AJP-4.9 Modes of Multinational Logistic Support, and AJP-4.10 Allied Joint Medical Support Doctrine.

Allied Logistic Publications describe supporting component/service contribution to Multinational Logistics Doctrine: ALP-4.1 Multinational Maritime Logistic Doctrine, ALP-4.2 Land Forces Logistic Doctrine, ALP-4.3 Air Forces Doctrine & Procedures, and Air Logistics.

Logistic Tactics, Techniques and Procedures constitute detailed procedural documents that are published primarily as Strategic Command Directives and NATO Standardisation Agreements (STANAGs).

There are numerous sources for identifying general knowledge applicable to multinational logistics. These include but are not limited to [11]:

- Literature review – an extensive review of published literature (theory, case studies, tools, etc);
- Dedicated best practice resources published by various sources;
- Access to best practice information via resources on the internet;
- Networking in conferences, training courses and so on;
- Personal networks;
- Organised benchmarking site visits;
- Co-operation with specialised research centres and educational establishments.

5.2. Knowledge content classification

Classification of knowledge aims to group applicable knowledge in categories related to domain, organisation, processes, and activities.

We consider the *knowledge domains* of logistics associated with work domains as following [3]:

- *"Production/Acquisition Logistics" Knowledge Domain* – domain of knowledge related to research, design, development, manufacture and acceptance of materiel, that includes standardisation and interoperability, contracting, quality assurance, procurement of spares, reliability and defence analysis, safety standards for equipment, specifications and production processes, trials and testing (including provision of necessary facilities), codification, equipment documentation, configuration control and modifications;
- *"In-Service Logistics" Knowledge Domain* – domain of knowledge associated with procuring, receiving, storing, distributing and disposing of materiel that is required to maintain the equipment and supply the force;
- *"Consumer/Operational Logistics" Knowledge Domain* – domain of knowledge concerning reception of the initial product, storage, transport, maintenance (including repair and serviceability), operation and disposal of materiel, that includes stock control, provision or construction of facilities,

movement control, reliability and defect reporting, safety standards for storage, transport and handling and related training.

Subsequently, we also consider that *knowledge areas* are included in knowledge domains and associated with logistic functions. Accordingly, knowledge areas incorporate Supply, Materiel, Services, Logistic Information Management, Equipment Maintenance and Repair, Movement and Transportation (M&T), Reception, Staging and Onward Movement (RSOM), Petroleum Logistics, Explosive Ordnance Disposal (EOD), Infrastructure Engineering for Logistics (IEL), Medical Support, Contracting, Host Nation Support (HNS).

A knowledge area belongs to a single or several knowledge domains (e.g. "Materiel" Knowledge Area includes knowledge related to specification, design and production that belong to "Production/Acquisition Logistics" Knowledge Domain and knowledge connected to reception of the equipment into service, its distribution and storage, repair, maintenance and disposal that belong to "Consumer/Operational Logistics" Knowledge Domain).

5.3. Knowledge transfer

Transfer of knowledge implies the involvement of both the sender (source) and the receiver (recipient) of knowledge by [12]:

- C*ommunication* – knowledge is acquired by talking to somebody; by *transaction,* it is acquired by purchasing a document, transferring of a certain form of property rights, such as patents or copyrights;
- *Cooperation* – knowledge is acquired by working together on a project.

Opportunities for knowledge transfer is offered by co-operative logistics that include bilateral and multilateral consumer and production logistics arrangements allowing best practices with the aim to achieve cost-savings through economies of scale, harmonised life cycle processes and increased efficiency in peacetime, crisis and wartime logistics support, using modern techniques in the field of materiel management and procurement.

An enabling organisation for knowledge flow is Multinational Joint Logistic Centre (MJLC).

Established in NATO-led operations, MJLC acts as a focal point for identification, de-confliction, and co-ordination of major logistics requirements for both NATO Joint Force Headquarters (HQs) and participating nations, as a tool to enhance efficiency and effectiveness of logistic support by providing external logistic knowledge and direction.

NATO Multinational Integrated Logistics Units (MILUs) are other excellent examples of knowledge exchange by working together on a project:

- *Joint Theatre Movement Staff (JTMS) MILU* - performs theatre movement co-ordination duties in support of a NATO operation or exercise;
- *Infrastructure Engineering for Logistics (IEL) MILU* - facilitates the logistic mission of opening lines of communication and constructing support facilities.

Knowledge transfer is sustained by various information technologies, techniques and methods such groupware and workflow, document management, databases, data warehouses and business intelligence, multimedia, Web (Architectures – Internet, Intranet, Extranet, portals; search engines; languages – HTML, XML), artificial intelligence (expert systems - machine learning, intelligent agents, multi-agent systems, ontology, knowledge engineering and capitalization methods and models);

6. Knowledge flow in theatre level logistic support

Allied Joint Doctrine for the Conduct of Operations (AJP-3B), 2011, states that „the complexity of operations is increased since a significant presence of non-military participants is more common than in the past".

In this context, „the Alliance seeks to achieve its objectives through a comprehensive approach that requires effective coordination and cooperation among national governmental departments and agencies, non-governmental organizations (NGOs), international organizations (IOs), and the private sector in any alliance or coalition throughout an entire operation".

At theatre level, joint logistics encompasses the planning and execution of the movement and sustainment of forces and includes the disciplines of movement and transportation, contracting, supply/maintenance/services management and host nation support (HNS) coordination.

The successful planning and execution of military operations requires advanced individual and organisational knowledge embedded in doctrines, concepts, procedures, techniques, standards.

At theatre level, sources of military knowledge consist of:

- *Logistic organisations*: Multinational Joint Logistic Centre (MJLC), Logistic Lead Nation (LLN), Logistic Role Specialist Nation (LRSN), National Support Elements (NSEs), Multinational Integrated Logistic Units (MILUs), Multinational Integrated Medical Unit (MIMU), Forward Logistic Sites (FLSs), Advanced Logistic Support Sites (ALSSs), Land Component Command Theatre Level Logistics (LCC Theatre Level Log), Air Component Command Level Logistics (ACC Theatre Level Log);
- *Operational planning documents*: concept of operation (CONOPS), combined joint statement of requirements (CJSOR), operation orders (OPLAN), support plans (SUPLANs), cooperation plans (COPLANs), standardisation agreements (STANAGs), logistic publications etc.

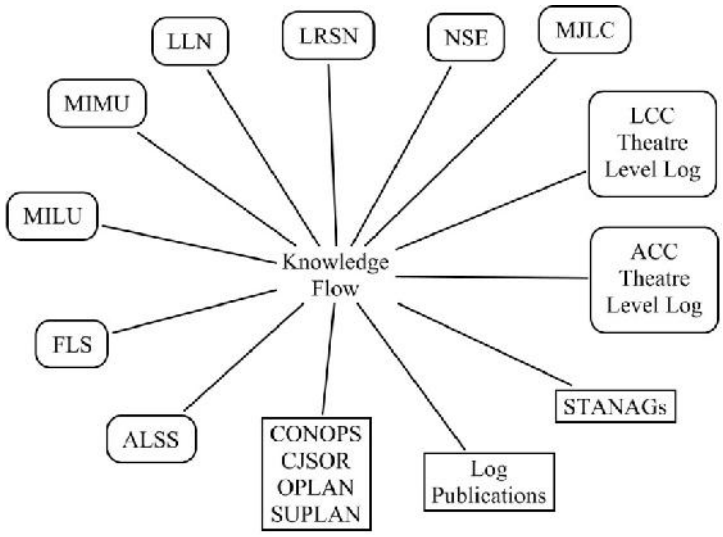

Fig. 2

Transfer of knowledge among various military organisations and media is fully supported by NATO Network Enabled Capability (NNEC) that is a key enabler for knowledge management at theatre level.

Although, the general purpose of the NNEC is to facilitate a dynamic, distributed decision making process at all levels of military command by involving multiple diverse sensors in the process of generation and maintenance of a common perception of the situation, allowing shared awareness across the battlefield [13], NNEC provides support for knowledge discovery and creation, integration and sharing by three components:

- *Technical network* (*Physical infrastructure*) - acquisition, generation, distribution, manipulation and utilisation of knowledge;
- *Social network* (*Group of interacting people*) - transfer, manipulation, integration and sharing of knowledge;
- *Knowledge network* (*Minds of the people*) - perception, awareness, understanding, expertise, beliefs and values, decisions.

7.Conclusion

Knowledge flow plays a key role in multinational logistics contributing to improvement of organisational capabilities to response to environmental and operational changes.

Military staffs integrate and use collaborative tools in developing strategies and plans and assist execution with knowledge-based communications.

Knowledge flow contributes to improvement of individual and organisational performances, enhancement of organisational innovative capabilities, and development of relationship among national and multinational logistic units, structures of Lead nations or Role Specialist Nations.

The success of initiation and maintenance of knowledge flow in military organisations is measured through contribution to capacity of forces to sustain operations, coherence in operational planning, development and use of new capabilities, improvement of working and operating methods.

Furthermore, knowledge flow contributes to increase effectiveness of decision-making processes, responsiveness of logistics to change through effective assessment and understanding of operational environment.

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