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Combined Knowledge Management and Workflow Management in C2 Systems – a user centered approach

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Abstract

Changing characteristics of military missions, collaboration needs in complex endeavors, and the impact of new innovative technologies have resulted in the need for enhanced effects in military operations and in specific requirements for military Command and Control (C2). Within this ever-changing framework providing comprehensive information to decision makers is essential for successful operations. Socio-technical networks have to be established which require optimized process models reflecting the various roles and rights of a heterogeneous community.

Collaboration systems are needed as support tools for improving knowledge production, creating shared situation awareness and understanding, generating courses of action, and supporting decision-making, planning, and execution.

Significant terms and their interrelationships within the scope of net-centric operations have been defined in the conceptual documents of the German Armed Forces (Bundeswehr). Information Management and Knowledge Management are two important examples (BMVg, 2004). How can such universally recognized requirements be adequately implemented in future-oriented C2 systems?

This paper shows by means of several recently developed contributions to a new messaging concept of the German Armed Forces that the gap between theory and practice doesn't actually have to be all that large. A major step in the right direction can be made by a consistent coupling of Knowledge Management and Workflow Management.

Introduction

In the information age global networks are connecting people and machines worldwide, the amount of data to process is massively increasing, algorithms and procedures are becoming more and more complex. The critical nature of military affairs requires specific treatment. To achieve the primary objective *information superiority* systematic cooperation of all users in C2 systems is imperative. Beyond this, added requirements will be laid on operators and systems – integration with outside systems and organizations, operation in an environment where rules change daily and severely limited resources exist.

Systems that can master these requirements have to be intelligent systems which can derive new knowledge from basic data. In many cases this intelligence can be achieved only by a symbiotic co-operation of human and machine. Therefore, the quality of human-machine-interaction design has significant influence on the efficiency of the overall C2 system.

Knowledge management and workflow management should be seen as inseparably interwoven issues. For more than 20 years the German Fraunhofer Institute for Communication, Information Processing and Ergonomics (FKIE) has developed model solutions optimized for military information and knowledge management. They consequently follow the above-mentioned concentration of optimized human-machine-interaction. Our concepts and applications take into consideration complex system architectures, challenging and ever-changing tasks, diversity of users with varying background knowledge, as well as uniquely military-specific requirements.

The current example, the new "Mission Reporting System" (MRS) of the German Armed Forces (Kaster, 2009), illustrates how systems designed for the future can be created incrementally - in concrete modules, manageable in development, easy to learn, goal-oriented

in operation and based upon the principles of net-centric warfare. Individual collaborative processes in the MRS run independent from each other following a clear, consistent procedure, while results are documented within a consolidated common information space.

In PART I we start with a discussion of the scientific challenges, military requirements, goals and constraints in the ongoing transformation process of the German Armed Forces. The focus is on the basic requirements and the motivation to consider the resulting ideas in new C2 systems. PART II and III focus on the significance of improved knowledge management combined with active workflow management. PART IV then presents several generic process solutions used in the German Armed Forces which aim to overcome traditional deficiencies.

PART I Transformation Challenges in the Armed Forces

Transformation and Network Centric Warfare

This chapter has the focus on the importance of a conclusive concept for network centric warfare. It will stress the need for changes in organizational culture, business processes and discuss strategies to overcome existing capability gaps.

The German Armed Forces are involved in an ambitious *Process of Transformation*. The term transformation has become a synonym for the visions of how the armed forces, as one of the manifold instruments of political action, might contribute to meeting the security challenges of the 21st century (Alberts, 2002). This military transformation process aims at a maximum use of technological superiority, in particular in the field of Command, Control, Communications, Computers, Information, Intelligence, Target Acquisition and Reconnaissance (C4I2STAR).

The transformation process of the German Armed Forces is related to the clear understanding that network-enabled capabilities are the most promising answer to enhance efficiency and effectiveness of future military operations. Therefore the German Minister of Defense points out in his “Armed Forces Transformation Directive” that the concept of *Network Centric Warfare* (NCW) is a key area of that transformation (BMVg, 2004). Identifiable, modern technology is required as a basis for joint and multinational interoperable networks connecting the different elements of the C2 system. NCW is a visionary joint concept that utilizes the possibilities of the information age for the deployment of military means. It translates own information advantages into superior combat power in the mission theater – by systematic connection of technological and cognitive capabilities.

Transformation and NCW represent continuous processes and efforts, i.e. not a destination, but a journey. New technological concepts play an important role in this development. Besides some very painful experiences stemming from former military operations, advances in information technology as well as in business processes and organizations have already contributed to the evolution of transformation and NCW (Cebrowski and Garstka, 1998; NATO ACT 2005b). In this sense modern technology has proved to be an *enabler* for the creation of a combined, joint, interoperable network of sensors, effectors and decision-makers. But still we have to explore requirements and consequences for the service branches in a common effort including users, researchers and developers of C2 systems.

Challenges in Transformation and NCW

Shifted paradigms for Bundeswehr missions as well as social changes and technological developments induce new challenges for NCW. Examples of related observations:

- Amount of data, observations, documents, etc. is rapidly growing;

- Decisions are time-critical;
- Increased networking and complexity of organizations;
- Changes in business processes (decisions are made decentralized rather than in concrete hierarchical network structures);
- Organizational changes are accompanied by loss of information and knowledge (e.g. during contingent rotation);
- Improved information and knowledge management becomes the key capability to overcome current deficiencies.

With respect to this variety of influence factors the improvement of system profiles has to reflect a capability-comprehensive approach. Conceptual guidelines and the consideration of mission reality bring joint and combined aspects into the centre of consideration (NATO ACT 2005b). E.g., the cycle of reconnaissance, command, and effect has to be considered in a holistic analysis. Functional dependencies have to be captured as exhaustive as possible and with an adequate level of detail. The optimal coincidence of resources (sensors, effectors, and information systems) is the linchpin to creating a powerful networked system. In such problem domains effective and extensive messaging is the fundamental basis for subsequent information aggregation and the production of context-related assessments.

NCW demands the development and availability of an up-to-date common operational picture to improve situational awareness. Particular critical requirements for an optimized communication and processing of data, information, and knowledge exist in the *military intelligence* (MI) area. E.g., the prospective dynamic intelligence network of the German Armed Forces will be of high complexity (EADS, 2010). This network and its utilization will be characterized by a complex system architecture, challenging and ever-changing tasks, diversity of users with various background knowledge, as well as by uniquely military-specific requirements. It will be dominated by uncertain and incomplete knowledge about non-cooperative elements, their activities and intentions. For instance, capabilities to collect and analyze threat indications through Improvised Explosive Devices (IEDs) are of major concern in current missions. In such an area support systems for (automatic) threat recognition require the collection of a broad range of information (Kruger et al., 2008). This is mandatory in order to provide the all-embracing database for the analysis and the extraction of relevant indicators of enemy activities. Threat recognition is just one example which illustrates that military decision-makers are confronted with a dramatically growing information load. On one hand, each item of this information must be available in the C2 system, on the other hand, decision-makers must be provided solely with the currently relevant extract.

As long as these observations and messages are not adequately aggregated, evaluated and distributed, users are facing information overload and get insufficient support, especially in time-critical situations. „We don’t know what we know!“ - that was recently the lamentation of a high-ranking officer in a central command post. He referred to deficiencies in the information management of his organization, where the complete database was distributed through different applications, systems, data storages, etc. (Kaster et al., 2003).

Another critical requirement is *interoperability*. A high level of interoperability (Clark & Jones, 1999) based on a variety of interface definitions is a must in future-oriented systems. However, this demand was widely underestimated (or even disregarded) in the history of C2 system planning and development. As a result, most systems achieve a maximum interoperability level of 1 (connected – electronic connection, separate data and applications) or 2 (functional – minimal common functions, separate data and applications), but are far away from level 3 (domain – shared data, separate applications) or even 4 (enterprise – interactive manipulation, shared data and applications).

Analyzing the basic deficiencies of suboptimal C2 systems from a user's point-of-view, two core problems become obvious: limited access to the existing information assets on one side, information overflow and lack of orientation within the information space on the other. Users are confronted with huge data storages, which are not adequately organized. To improve this situation, NCW clearly favors distributed organizational structures, including self-synchronization of participants (Dekker, 2006).

Generally a cultural change toward sharing of information and knowledge can be observed. Usage of new personal or social networks is neither a technical challenge nor something unusual for the younger generation. It is an integral part of daily life. It can also be stated that the young generation has a new willingness to self-disclosure. These concepts can be made beneficial also in military processes. As an ultimate consequence for reasons of effectiveness this may even lead to the liquidation of inherited military hierarchy levels – and thus to totally new strategies in NCW solutions.

Concept Development & Experimentation

Although network-centric capabilities are accepted as central element of the transformation program, the necessary overarching concepts for NCW still have to be developed and concretized. In this process possibilities and limitations have to be carefully analyzed. New harmonization requirements for symbiotic operation of man and machine have to be tested and proved.

Concept Development & Experimentation (CD&E) comprises a useful approach for the analysis and decision finding within the planning process as well as for the improvement of command and control capabilities during operations (USJFCOM, 2010). CD&E makes use of experts who take up developments emerging "outside the box" – in the strategic, political, economic and technical domain – and turn them into ideas for application in the armed forces. These ideas may be verified in an expert talk, a seminar, a technical conference, a simulation, a war game or even in a field trial involving active troops. The goal is to make a practical proposition for the rapid implementation of the idea and its conceptual translation as well as to obtain findings for further improvement of the command and control structures of the forces and their interoperability with partners.

Conclusions

Daily experience leads to the conclusion that the adequate consideration of the holistic system is the primary challenge in further NCW development. New general principles of internal command processes postulate a conducive organizational culture in the armed forces. E.g., concepts like decentralization, delegation of responsibility, mission tactics, etc., gained central significance with the transformation of the German Bundeswehr. The appropriate realization of requirements is an ongoing process which has to be continuously adjusted to current needs. In the long run a standardized solution is one of the most important goals.

This implies a need for comprehensively harmonized conceptual foundations. Basically the current goal in IT-systems design is to adequately consolidate user requirements and the resulting semantic and technical systems opportunities. This means that we have to agree: challenges are primarily on the organizational and functional levels, and secondarily in the development of technical solutions. Regarding the potential of an optimized cooperation of man and machine a well-tuned allocation of responsibilities to each other opens manifold opportunities. The impact of ongoing technological improvements on organizational structures and even cultural changes has to be considered.

Part II and III of this paper deal with these aspects in more detail. Part IV will present several prototypical solutions in different application domains.

PART II Challenges for improved Knowledge Management

In PART I it was stated that transformation requires strategies for analyzing, designing, and implementing new concepts of command & control. NCW was introduced as comprehensive task which has interdependencies with *information management* and *knowledge management* in every planning category of transformation. However, NCW is more than just technology. This chapter outlines the prominent role of the human factor and its impact on information and knowledge processing and even cultural aspects of NCW.

NCW and Information Management

Rapid situation assessment leads to the development of resilient activity options. The decision-maker and leader gains decision superiority, while subordinate forces can act more flexibly and maneuver-dominantly through self-synchronization. Information is the fourth decisive variable (in addition to the conventional military dimensions: means, space and time) that determines between success and failure of a mission. Distribution of timely and proper information must be achieved by an efficient information management system.

Information Management (IM) is strongly anchored within the DoD's conceptual documents. E.g., the conception of the DoD "TK NetOpFü" (German term for NCW, BMVg 2004) emphasizes the triad "Information Superiority – Command Superiority – Effect Superiority". This aims for higher speed in command and control and higher speed in operations, better effectiveness and improved survivability. An increased level of battlespace awareness should improve the operational capabilities of a joint force. The "shared mental model" provided by a capacious *common and relevant operational picture* (CROP) is seen as the central aim for the ongoing renewing of the high level Armed Forces C2 system.

A pre-condition for NCW is widely automatized role-oriented information management which is capable of supporting military personnel in their decision-making processes. Role-oriented information allocation has to provide the users with filtered relevant information and to avoid information overflow. Decision support systems and components must provide valid and prioritized activity options. Decisions have to be distributed – in the sense of mission tactics – via automated tasking to the best capable command level to achieve the intended effects. This all presupposes flexible access to a well-structured virtual information space. Continuous quality management is necessary to guarantee the required level of actuality, integrity, reliability, and authenticity.

Theoretically, IM consists of the continuous analysis and definition of information requirements, information exchange and regulation and monitoring of information flow. However, in current C2 systems we envision multiple constrictions in the messaging processes, which, for instance, distribute just isolated observations instead of context-related information. Deficiencies exist with respect to the construction of a universal information space, optimized information exchange with partners, transparent access methods and task-oriented user support. Examples: (a) the biggest part of information exchange is still conducted via point-to-point communication between users using emails; (b) many existing systems omit context-oriented relations, which would be necessary to support an appropriate investigation of data storages; and (c) another limitation is the use of inflexible and poorly structured intranet portals. The intranet of the Bundeswehr ("IntraNetBw") today is used primarily as a platform for factual information, and databases. The problem remains that the recently developed intranet presences have grown independently in different departments, without adequate conceptualization or common guidelines. This led to many isolated, decentralized and largely unstructured offers. They are characterized by redundancies, quality deficiencies, and problems in search and navigations capabilities.

To integrate the services in a C2 system, semantic consolidation and the development of a joint, interoperable and level-independent IT-system with standardized applications on the basis of a secure network are mandatory. The Bundeswehr has started a continuous migration to harmonize heterogeneous approaches and to introduce the "Joint Command and Control Information System" (JCCIS) which is constituted on the base of a consistent and comprehensive architecture. The goal is to meet the requirements of NCW in a broader range than existing systems can do. This comprises the realization of common, cross-level and interoperable communication network which connects the relevant persons and systems in all units and departments.

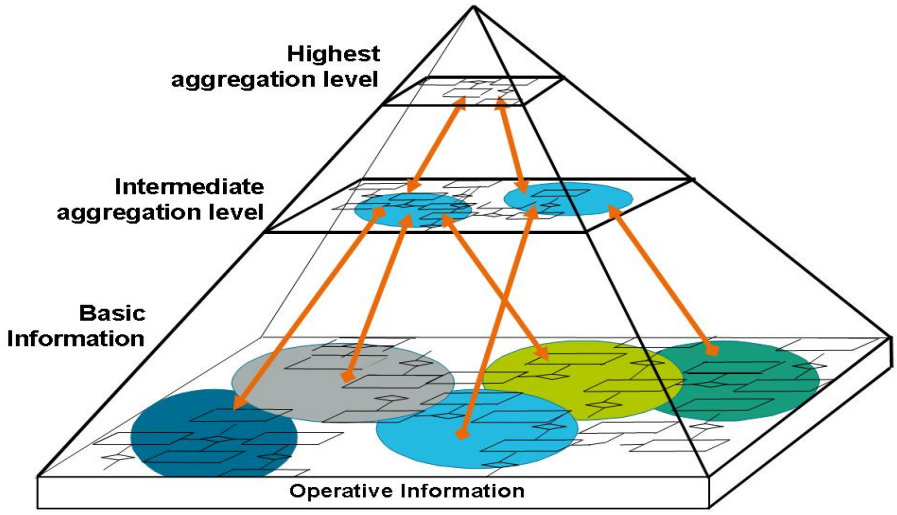

Fig. 1 The past service- and platform oriented way of thinking, planning and procuring has to be given up for the sake of new joint capabilities. A comprehensive architecture is required as a basis for joint interoperable network connecting the different elements and levels within the command and control process. Multiple, synchronized process solutions transport messages through the command levels.

The introduction of such an overarching IT infrastructure, incorporating all organizational levels, marks an important step in providing access to high-quality information services for all participants. Three kinds of networks have to be utilized in combination:

- Information network – information for joint and combined armed forces is received, processed, communicated, saved and protected.
- Sensor network provides the sensors required for the respective task.
- Effect-producing network likewise connects weapon systems, planners, decision makers and the deployed troops.

All three networks are to be closely interconnected with often overlapping components. The JCCIS will enable a virtual information space with access to the totality of available information, including the content of external sources which are accessible via system adapters.

NCW and Knowledge Management

However, NCW is more than technology. Transforming the military toward NCW requires that every aspect contributing to the functioning of military forces i.e. doctrine, organization, training, materiel, leadership, personnel, and facilities has to be adjusted and adopted. An additional challenge is the transformation of situation awareness into actionable knowledge.

Knowledge has become the critical resource for improved security, sustainability, and prosperity. Therefore, the ongoing transformation process toward successful knowledge management gains increasing dynamics. The conception of the German Bundeswehr emphasizes its impact on the operational readiness of forces und requests the integration and usage of explicit and implicit knowledge for successful missions.

Beyond technical capabilities individual and the organization's knowledge have to be made available to the respective users. While designing and creating C2 systems the following definitions may be used as basic guidelines:

- *Knowledge* is always bound to the perception of persons and determined by the experience they gained during context related interpretation and assessment. Knowledge develops individually during examination and processing of qualified information. Generation of knowledge as well as (re-)converting knowledge to information (to make knowledge transferable) are individual and decentralized activities that have to be supported in order to optimize the operative handling of knowledge within the C2 process.
- *Knowledge cycle* comprises the individual process of dealing with knowledge, it bundles and structures all appropriate elements und incorporates methods and procedures of knowledge generation, representation, communication, and application.
- In contrast to Information Management, *Knowledge Management* (KM) is the overarching expression for all command and management functions which increase the efficiency and effectiveness of the knowledge cycle of military personnel. KM ties the creative and innovative capabilities of individuals to the goals and processes of an organization.

Knowledge Management as an Executive Function

Knowledge management needs motivated people who understand its necessity and who want to play an active role within the processes. The human factor plays the central role. All relations between individuals and organizations have to be taken into account. This concept has to be strengthened by the C2 system: knowledge management has to be seen as an executive function that can be fostered by role models. Ideally conviction starts at the level of leaders and decision-makers. Leaders, superiors and decision makers should encourage subordinates and staff members to increase their expert knowledge and prove to be more fault-tolerant. Unfortunately, today's organizational culture is characterized by error avoidance and safeguarding.

One critical example, for instance, arises at times when contingent personnel are to be changed. Normally during personnel changes there is too little time to conduct all necessary steps of knowledge transfer which in turn results dramatically in loss of knowledge (Allen, 1983). The critical question is: how can the knowledge available be preserved for the successors!? New persons and staff members have to be introduced into their area of responsibility as well as their concrete tasks.

Knowledge transfer in such a case is subdivided into different stages:

- Identify individuals with high-level expertise (knowledge holders);
- Identify qualified knowledge recipients;
- Organize the knowledge transfer process (content, time, method);
- Execute knowledge transfer;
- Control the success with respect to resulting expertise and capability.

This example gives a first indication of the kind of activities in conjunction with knowledge processing. To classify the various aspects it is useful to consider the four distinctive dimensions of net-centric warfare as defined in the Bundeswehr conception “TK NetOpFü”. This means while designing and creating C2 systems the focus should be on the: (a) physical dimension, (b) information dimension, (c) cognitive dimension and (d) social dimension:

- The physical dimension of net-centric command and control systems deals with the necessary operational means and environment.
- The information dimension, that is, a functioning virtual information space as well as goal-oriented information management, comprises the fundamental basis for the creation of comprehensive situation awareness.
- The social dimension deals with group-dynamic processes which arise from networking and from the differing responsibilities of the participants.
- The cognitive dimension is comprised of the connection between the content of the information space and the expertise and experience of the user.

A closer look at the components and dimensions of knowledge management provides further hints as to which aspects have to be concretely considered in the C2 system development. The following list of significant aspects underlines the variety of elaboration:

- Search, acquisition, and classification,
- Representation and visualization,
- Structuring, storage, and publication,
- Communication and cooperation,
- Integration, expansion, and interoperability,
- User administration and security aspects,
- Computer-based teaching and training,
- Technical platform and compatibility to IT-infrastructure.

The application examples presented in Chapter IV reflect this bundle of requirements, dimensions, and components of KM.

Conclusions

“Knowledge” summarizes the cognitive capabilities of individuals, groups and organizations. While only the conscious part of knowledge (*explicit knowledge*) can be transmitted verbally, in written form or in other ways, *implicit knowledge* cannot be formalized. This duality – and resultant focus points of a knowledge management strategy – is of great significance in command and control systems. Only the combination of both perspectives gives the chance to create a common shared mental model. Explicit knowledge can be stored in documents and databases (“people-to-document”) and transferred through technical networks. The transmission of implicit knowledge needs additional communication methods (“people-to-people” strategies). Therefore the next chapter gives specific attention to the need of user-centered workflow management within C2 systems.

PART III Challenges for Workflow Management

The example discussed in chapter II accentuates one of the many situations where problems in knowledge transfer are typical. This transfer can neither be accomplished by technical means only nor solely by human conversation. Without technical functions and features knowledge transfer would be clearly delimited; however, technology has only a subordinate and serving role in the sphere of transformation.

Cultural Changes in Command and Control

Knowledge management has crucial cultural and organizational aspects. Creation of an accepted knowledge-oriented *organizational culture* is essential. Conception papers like the previously mentioned "TK NetOpFü", elaborated strategies of inner command, and the principles of mission tactics provide a reasonable breeding ground for a new self-image. IT-planners will have to perceive the Armed Forces as a socio-technical system with strong interrelations between social and technical components. This brings experiences and capabilities of individuals into the center of development processes. Two important aspects should be mentioned here:

Network-centric warfare calls for an *active use of information connections* in totally and robustly networked armed forces. Most promising are approaches which cultivate a "self-learning organization" with a flat hierarchy and a netted structure. Such an organization is best suited for acquiring, generating, and transmitting knowledge based on broad collaboration processes. It can adapt its behavior to new findings and situations. One of the main objectives in C2 development is to create the precondition for self-synchronizing of forces. In such a collaborative environment, all participants can share their data in a joint information space and process the findings according to their respective level and duty. Through decision-makers, common joint battlespace knowledge can be generated. The ability to self-synchronize enables the staff members for autonomous operations according to the superior command principles and avoids redundant micro-management.

Staff training is another essential challenge that delivers an important contribution to the success of a NCW system. It is also a sort of synchronizing, in this case, synchronizing the perception of human operators. Computer-based training (CBT) – along with other activities – is one of the methods which can be professionally implemented as a network-centric method. Excellence and motivation can be enhanced by interactive CBT products. As a cultural competence it may increase the mutual confidence between individuals and groups within an organization. Confidence allows that persons do not consider their individual knowledge as an instrument of power, but as common property that can be shared within the community. Confidence is not only a prerequisite of knowledge transfer; it is also a product of it.

Integrated Workflow Management

Transformation as a cultural challenge is subdivided in many areas. It has to incorporate the interdependencies between static IT application and the dynamic aspects of cooperation. *Workflow Management* (WM) is an important component which adds these dynamic dimensions of business processes (Wang & Petrounias, 2008). We are convinced that the direct integration of WM methods and tools within the handling of business objects is useful and easy to accomplish, especially if the specific application domain is not too complex (Wirth et al., 1997). This means the developer should orientate himself applying a user-oriented *outside view* onto the logical information flow instead of an *inner system view* with focus on technical functionality. The aim should be to improve the quality of work results, to

optimize work schedule, to reduce the operator's workload, especially in time-critical situations, and to reduce training expenditures (Van der Aalst, 2002).

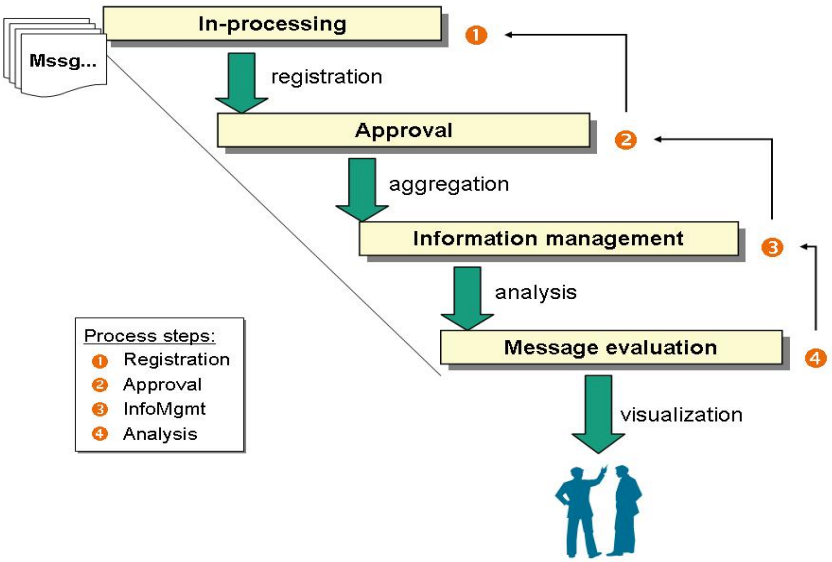

Fig. 2 Social dimension of NCW: In most cases collaboration processes can be restricted to just a few work levels. The example illustrates the process model of the Message Reporting System (MRS) as detailed in chapter 4.

User support tools utilized within a business process need to be closely coupled with an ergonomically optimized user interface, allowing the operator to: task and constrain the process; view and understand what the automated part of the process can do; and override, correct, and retask the processed documents and information flow if necessary. Proper consideration of these aspects meets the requirement that decision-relevant situational awareness is gained only through an assessment from the human perspective. In a similar manner cooperation is not perceived by designing the communication of machine-to-machine, but comprises the communication of humans through the use of networks and machines. Added values are generated by the cooperation of persons and their expertise.

In both aspects information and communication technology has the role of an enabling factor: by supporting the processes (especially where mass data have to be processed); by efficient filter, search, and analysis functions; and by overtaking the routine functions.

The coordination of factors like corporate identity and culture, organizational structure and procedures, human resources management, and IT networks and functions is decisive for the potential and capability of C2 systems. Adequate balancing and common orientation are to be in the scope of development. Organizations like the armed forces should bundle the accessible knowledge and expertise of all involved persons, distinguishing between three levels of workflow management: organizational-social, individual, and media-technical level.

Conclusions

As a result of the considerations presented in this chapter we can state that classic information and knowledge management which is fixated on the linkage of information and the optimization of search algorithms etc. has its limitation, where multiple organizations and knowledge holders are engaged in a joint creation of cognitive values. Knowledge management and workflow management are inseparably interwoven. This is the starting point for the business process solutions our institute created for military C2. Chapter IV introduces typical applications referring back to these assertive statements.

PART IV Examples of Process Control in C2 Systems

In the last decade the German Fraunhofer Institute for Communication, Information Processing and Ergonomics (FKIE) has developed model solutions optimized for military information and knowledge management, with particular focus on the field of military intelligence. These prototypes consequently follow the abovementioned principles of combined application of knowledge management and workflow management. The examples demonstrate step by step (i.e., one system is based on the other) how the principles discussed have been successfully incorporated during C2 system evolution.

Example 1: Global Message Database (GMD)

The first system was developed several years ago to overcome serious problems in the messaging processes of the German Armed Forces. The Army Operations Command was unable to deal adequately with the huge amount and variation of daily messages from operations in actual conflict areas (Balkan Crisis). Messages were transmitted and widely distributed via Email and stored in hierarchical file systems.

An enormous improvement was achieved by the introduction of the "Global Mission Database" (GMD). The GMD is based on a rather simple concept which aimed on the renunciation of distributing emails and attachments to large distribution lists and storing those documents in strongly hierarchical structures. The GMD is based on a powerful client-server concept that accumulates the information in a central, non-redundant database (Pedersen and Jensen, 2001). Within this system messages are managed (created, replicated, analyzed, visualized) in a multi-level working process.


DocID:
Mission*: KFOR
Sender*: G2 MNB S
Recipient*: J2 DJTF
DocCreated*: 031830Bjun00
SerNo.:
Status:
ValidThru: 16
Source: unbekannt
Assessment:

Messagetype*: **HUMINT**

MainTopic*: **Sicherheitslage**
SubTopic*: **Sonstige**

Lemma:* **Information about the Environmental and Chemical Group in SUVA REKA (DM 8690) (D3)**

Date of Incident: from: 031830Bjun00 to:
Place of Incident: REKA
Coordinate UTM: 34TDM8690 LAT / LON: /

Keywords: -

Message text:

The KPC got some radio sets from the Republic of MALAYSIA. Every day the commander of the Environmental and Chemical Group must perform two times a radio check with the HQ of the KPC. Also he must do the radio check with all RTG´s. (NFDK)
The Mercedes Benz company has concluded a preliminary agreement with the HQ of the KPC to supply some off-road vehicles. (NFDK)
The Environmental and Chemical Group has get 300,000,- DM to build up a new place and house where the Group will be dislocated. (NFDK)

Assessment:

Fig. 3 Global Message Database: The main business object is a generic document container for messages and reports that contain mostly unformatted data and observations. The structuring of the metadata, i.e. the orientation on user needs, has great impact on the quality of retrieval processes

The main business object of this system is a *generic document container* as illustrated in Figure 3. This template has a structure that reflects all needs of information management in this specific messaging process:

- The *message part* comprises facts, event descriptions, assessments, and activities.
- The *metadata* contain all ordering parameters for the thematic classification of a message as well as further details needed for the database administration.

- The *semantic profile* is organized by a three-level keyword allocation. On base of this three-level structure a message can be sufficiently categorized within a thematic classification tree, on the other hand the limited depth avoids user confusion in searching and combining documents logically.

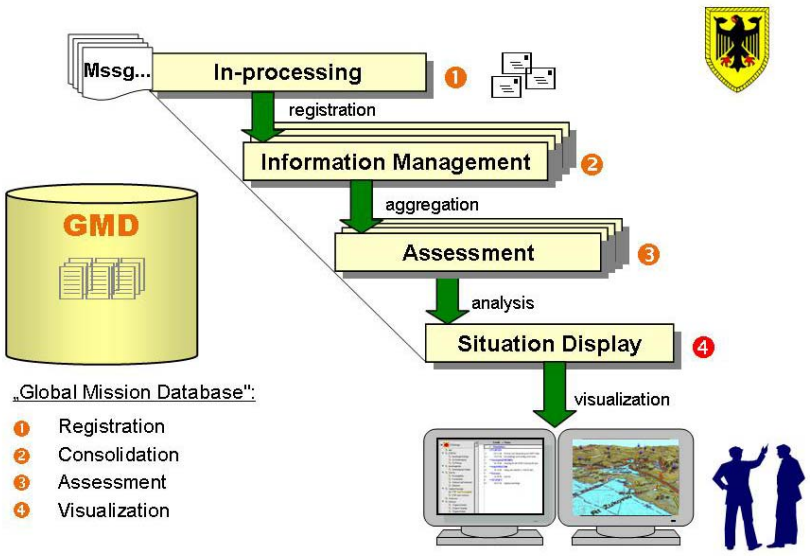

Fig. 4 Global Message Database: Mainly free formulated observations, e.g. from field humint units, are enhanced during in-processing with concrete metadata which allow the thematically consolidated archiving and context-oriented filtering, searching, and retrieval of relevant information.

The work process is subdivided into four main steps (Figure 4):

1. During *input processing* new documents are created in the defined format (use of templates) or existing external documents may be imported and qualitatively enhanced (import of messages with – if needed – additional indexing).
2. An efficient, stable, and well-organized *document management* is guaranteed by the utilization of a powerful database platform and application. Specific military functions (as dealing with date-time-groups, DTG, or specific coordinate standards like UTM) are added. Information research and fusion functions are also made available.
3. Transparent *selection ad processing methods* allow the user to sift the material according to actual needs.
4. Geo-referenced data can be visualized directly in the *military situation display* system.

Beyond that the GMD fulfills specific requirements reflecting precisely the needs of each military level and user group. Dedicated processing functions are realized as a result of intensive analysis of user requirements. Configuration methods reflect domain specific characteristics with respect to user participation, database organization, comprehensive security, and common conceptualization.

The above conceptualization has been evaluated in multinational exercises and successfully used in the German Armed Forces.

Characteristics of the GMD:

- Consolidated database incorporating multiple message formats;
- Multiple research and fusion functions;
- Immediate utilization of user experience and intelligence;
- Role-oriented control functions reflecting military needs.

Example 2: Mission Diary System (MDS)

The “Mission Diary System” (MDS), constructed for the use within the Armed Forces Command Center, is the next application based on the same basic concept. It demonstrates the methodological approach to combined knowledge management and workflow management within one system. The core object is a document template similar as that known from the GMD system. However, this template also has portions that meet the requirements for communication, documentation, and assessment:

- The workflow is role-based and implemented in a straightforward manner allowing the persons in charge to cooperate symbiotically within their sphere of responsibility.
- The application concept is optimized with respect to ergonomic criteria. According to the three main processing phases as defined in conceptual documents, the solution reflects the basic activities: initial database for generating, evaluating, and approval of drafts; the actual operational diary used by the leadership; and an archiving concept.

Structure of the document and process rules decide whether a relevant diary entry can be found in context related research situations. The MDS is used within a client-server environment simultaneously by all responsible staff members. The challenges for users at each workstation are minor. This allows for a high individual competence of each operator without need for extensive training. The added value of this kind of diary system results mainly from the rather simple but straightforward process model.

Characteristics of the MDS:

- Convenient structure of documents (analogous to GMD);
- Role-oriented process and access control features;
- Efficient selection methods and multiple evaluation functions,
- Classification criteria in various dimensions;
- Prototypic generic solution.

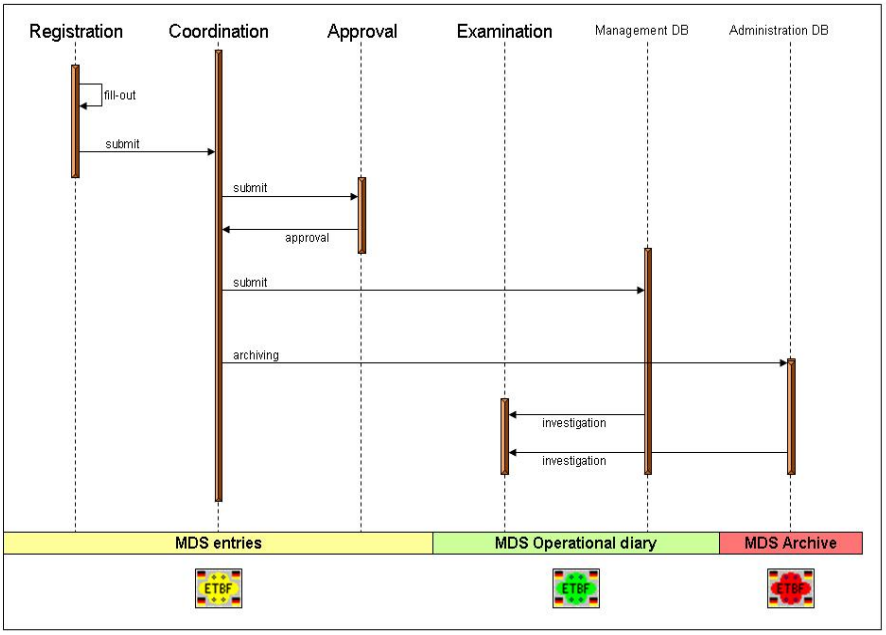

Fig. 5 Mission Diary System: Linear process model with high usability

Example 3: Collaboration in Command & Control (CliCC)

Political changes that are characterized by terms like “asymmetric warfare”, “terroristic threat”, or “irregular forces” induce the necessity to implement new concepts of intelligence and reconnaissance cells or centers in the military command posts. Based on the support tools introduced above, we developed a prototype that combined the existing process models in a common architecture, complemented by new specialized modules. The technical goal of the new concept was to provide integrated services and workflow solutions to support the collection, evaluation, and dissemination of all relevant message formats. The system should support collaborative work that aims on consolidation of formatted as well as unformatted or poorly structured messages, information fusion processes and shared situation assessment. At high military echelons, a common operational picture should be continuously updated for each area of interest.

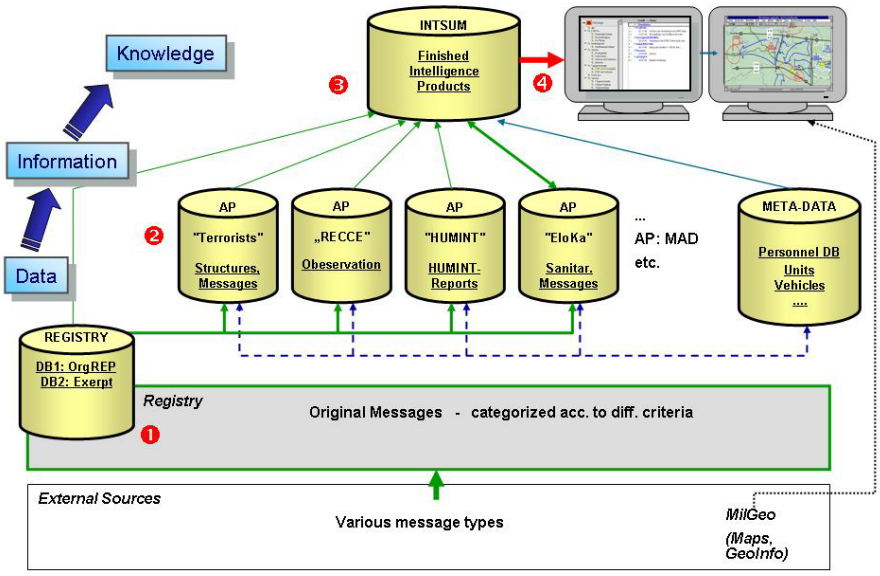

Fig. 6 Collaboration in Command and Control (CliCC): Modular system to provide integrated services and workflow solutions to improve situation awareness.

The resulting system architecture “Collaboration in Command and Control” (CliCC) (Kaster, 2008) is realized as a three-level support model with comprehensive aggregation, fusion, and analysis methods. It aims at the support of situation assessment, CROP visualization, and ISR dissemination. The concept of operations (CONOPS) can be characterized by a multi-level collaboration process:

- Incoming formatted messages (e.g. ADatP3 enemy situation reports, ENSITREP) are processed automatically and integrated into military database modules (NATO, 1994; MIP, 2008). Unformatted or slightly formatted messages (e.g. ADatP3 intelligence reports, INTREP) are enhanced by the registrar and then processed to the respective DB modules.
- Information fusion techniques are applied to produce intelligence products.
- The operational military display is produced automatically for each area of interest by software agents and, if necessary, manually enhancement by the operator.
- Intelligence products are produced as formal messages and/or as a combination of formal messages and graphical attachments derived from the military display system.
- Finally, intelligence products are disseminated to the adjacent staff, component commands and other involved recipients.

The system is scalable with respect to actual needs. At least three role-players, complementing one another in their functional areas, cooperate closely and independently to process the variety of messages and documents. If appropriate the number of operators can be massively increased to spread the workload to specific experts.

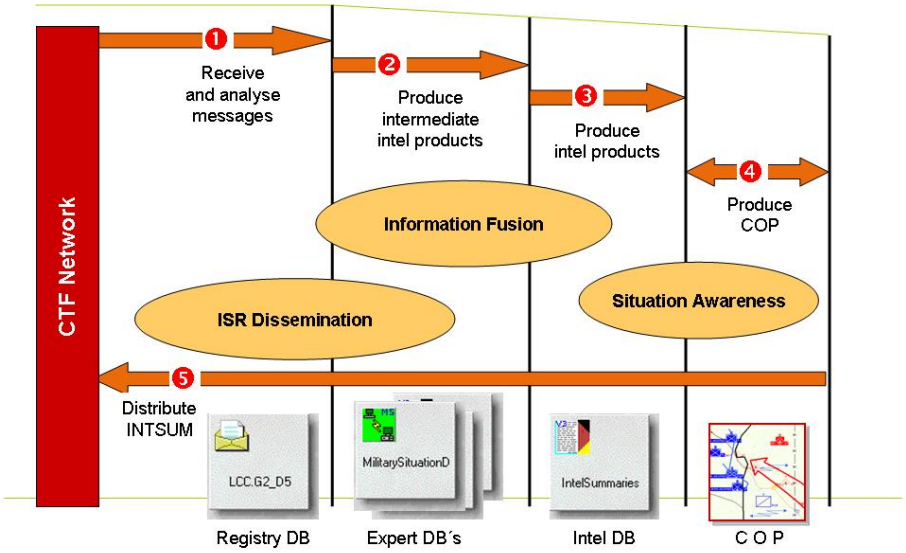

Fig 7 Collaboration in Command and Control (CliCC): The primary goal is to support the generation of "Finished Intelligence Products".

Again the core component of the modular CliCC system is the GMD which allows processing of multiple reconnaissance messages (which may be poorly formatted or even unstructured) in combination with specific sensor data. The upgrade with knowledge-based procedures can further enhance the capability profile of the intelligence cell, e.g. via computer linguistic methods, automated threat recognition.

CliCC proved that its integration concept to simultaneously process formatted and unformatted messages in a consistent manner is well suited to support complex military operations in the intelligence perspective (DSO, 2001; USNORTHCOM 2004; NATO, 2005a). Routine messages can be processed automatically by "machine intelligence", while weekly formatted textual information (which is predominant in all military missions) has to be consolidated and enriched semi-automatically by "human intelligence". The utilization of ergonomically optimized human computer interaction techniques is a major reason for the successful application of the CliCC concept. It is easy to understand and to learn and eliminates irritating side effects.

Characteristics of the CliCC system:

- Modular, scalable structure; based on the same concepts as GMD, MDS, and RFIMS.
- Complex role-play to incorporate and process a huge amount of incoming messages in near-real time;
- Incorporation of human intelligence;
- Support of routine work by semi-automated processes;
- Production of finished intelligence products;
- Automatic production and updating of multiple operational display;
- Control mechanisms to supervise the timely processing of RFIs (DGIWG, 2006).

Example 4: Mission Reporting System (MRS)

In conformance with the four dimensions of NCW as introduced in chapter II, the "Mission Reporting System" (MRS) of the German Armed Forces was modernized in 2009 (Kaster, 2009). The main concepts are summarized below. The MRS includes several collaboration work aids coupled with semi-automated information processing. Prototypes have been designed using a cognitive approach, which concisely presents critical process information that allows the operator to rapidly understand and assess the relevant information. All mission support concepts are based on clearly structured generic process models, which have been designed from a user-centered perspective. The MRS serves four application domains: daily routine reports and assessments, originating from the mission contingents; daily routine reports and assessments of the Bundeswehr Operations Command; event-driven messages; directives and orders issued from the leadership.

The applications are technically developed on base of the Lotus Domino groupware technology which comprises highly efficient document management as well as highly sophisticated groupware functionality (IBM, 2010). The database can be treated as a tool box which can be configured according to actual operational needs. During system setup the needed database instances are installed on distributed servers which are connected and synchronized through powerful replication mechanisms. All activities are embedded in a systematic processing chain. Users and user groups are managed through the Access Control List (ACL) which is based on the central user directory.

These symbiotic prototypes incorporate the specific capabilities of man and machine and enable the operator and technical components tools to collaborate at a cognitive level and to arrive at a better solution than either alone could find. The operator can control the information flow, setting constraints and bounds using parameters according to actual needs.

Characteristics of the MRS:

The common characteristics are summarized recapitulating the dimensions of NCW:

- The *physical dimension* (necessary operational means and environment) of the MRS is realized by the existing Joint Command and Control Information System (JCCIS). The groupware platform Lotus Domino is used as software basis for combining document management with efficient communication processes.
- The *information dimension* (functioning virtual information space as well as goal-oriented information management) within the MRS system is realized by multiple role-based process applications which conform to operational requirements, and which are partially automated where feasible. These applications are based upon clearly defined metadata that support need-based structure and filtering of the multitude of available documents, providing the leadership with relevant information while at the same time preventing information overflow.
- The *social dimension* deals with group-dynamic processes which arise from networking and from the differing responsibilities of the participants. In the MRS system the various requirements of this dimension are systematically implemented in process models, in which information flow – from creation to representation and communication to utilization of information – is mapped.
- The *cognitive dimension* is comprised of the connection between the content of the information space and the expertise and experience of the user. Additionally, there is a pressing need for action in the area of training in order to ensure that the ever-present demands for a better leadership culture are being dealt with. As a result, MRS has taken new steps along the path to the development of expertise to increase the process understanding of participants and to raise the quality of their products (ILT, 2009).

PART V Summary

Today, support for command and control is characterized by distributed and networked systems. The ability of these systems to provide appropriate process models and user support is an essential precondition for the participation in joint and combined missions, and it finally determines mission effectiveness.

The Defense Policy Guidelines (DPG) (BMVg, 2002) marked a paradigm shift for the German Bundeswehr. International conflict prevention, crisis management and anti-terrorism operations have replaced territorial defense as the focal point for the structure and organization of the Bundeswehr. Consequently, the DPG conclude that: “to a larger extent than before, armed forces must be oriented on harmonizing their capabilities, means and structures with those of their partners, … .” Against this background, Transformation, NCW and CD&E are of increasing relevance for the Bundeswehr

Consequently, the Bundeswehr is engaged in various multinational committees and experimentation, which deal with transformation issues:

- The Multinational Interoperability Council, a “parent organization” for the multinational cooperation dealing particularly with interoperability aspects in multinational operations (MIC, 2010);
- Participation as a partner in the Multinational CD&E program (US JFCOM, 2010; NATO 2010);
- Active participation in US and NATO CD&E programs, e.g. Coalition Warrior Interoperability Demonstration 2004-2010 (NATO, 2010; DISA, 2010).

Both information and knowledge management are essential components of the capability profile in net-centric operations. However, in the context of actual missions universal information and knowledge management are fairly unsolved challenges.

In principle, network centric operations are global, joint and multinational. Operational effectiveness requires complete interoperability – technical, procedural and operational. Unfortunately, an admission ticket to NCW only has a limited validity period. It requires continuous efforts to maintain networking capabilities. Activities within the scope of CD&E or CWID are used for evaluation and to keep pace with changing trends.

The ultimate objective of Network Centric Operations (NCO) is the transition from today’s “platform-centric” command and control capability into a seamless multi-service and multi-national networked command and control environment. The past service- and platform-oriented way of thinking, planning, and procuring has to be given up (partially) for the sake of new joint capabilities, in order to achieve increased efficiency and dramatically shortened reaction times (MacKenzie et al., 2006).

This NCW command and control capability requires reconsideration of operational concepts, system architectures and standardization efforts. Interoperability efforts in terms of design and implementation, as defined in the NATO Interoperability Management Plan (NIMP) (NATO, 2000), require additional considerations to achieve a “multi-service and multinational networked-centric command and control” capability.

The temptation to replace human knowledge and skills by automation is not the proper solution in the area of military intelligence. There is a risk that the proposed actions and assessments by the system are uncritically accepted as truth or even “the only possible” truth. The human being should always have total control and the right to make the ultimate decision. Therefore we prefer to make the man-machine-system intelligent, not the computer system. The combination of capable knowledge management and transparent workflow management is the way which provides the best options.

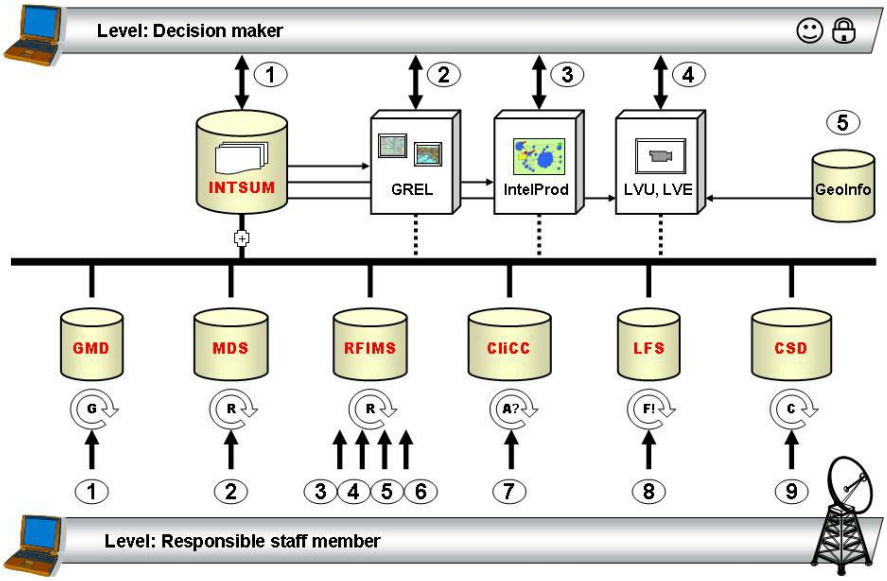

Fig 8: Toolbox of process modules that can be configured according to actual operational needs.

The process solutions developed continuously by FKIE during the last decade are intended to support the role-based processing of information and knowledge in a complex C2 network. The aim in each case is an inter-divisional and trans-sectoral interpretation and aggregation of a huge amount of critical data, messages, and reports. The problem space covers mainly unformatted or poorly formatted kind of data, because these are usual in current missions. The central aim is to improve situational awareness within dedicated application domains and to enable the common operational picture, defined as shared mental model. The generic examples are based on rather straightforward process solutions, which can be combined and synchronized to provide just a modular tool-set an operator needs. All examples are based on the same Bundeswehr-wide available groupware platform (Lotus Domino).

FKIE has introduced advanced network-centric solutions, which process real-time decision-making information from dispersed network participants in a networked operations environment, leading to a revolutionary change in command and control. The result is a "Coordinated Engagement Capability", which allows a self-organizing, coordinated, synchronized and fast command and control execution. Network enabled systems generate and distribute a COP in a netted environment, to provide situational awareness to all network participants. The traditional hierarchical military C2 process is enhanced by a much more challenging and demanding doctrine management process. An additional challenge is the transformation of situational awareness into actionable knowledge.

The current example, the new "Message Reporting System" (MRS) of the German Armed Forces, illustrates how systems designed for the future can be created incrementally. Individual collaboration processes were designed in a clear, consistent manner.

All approaches are based over years on each other thus representing an example of a continuous evolution of C2 systems.

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