One Step Back, Two Steps Forward: Towards a Sound Foundation for IT Support of Civil-Military Interaction

Dick Ooms MSc, Capt (Navy) ret.
Netherlands Defence Academy
Het Nieuwe Diep 8, 1781AC Den Helder
THE NETHERLANDS

dm.ooms.02@nlda.nl

ABSTRACT

This paper addresses Civil-Military Interaction (CMI) in the Comprehensive Approach (CA). The CA has gained broad international support as a successful concept to conduct international peace and stability operations, by increasing coherence. The CA requires effective CMI, however CMI still suffers from a range of persistent hurdles, dubbed "CMI inhibitors", which keep recurring. To complement existing CMI research, we propose a design-science approach to develop Information Systems (IS) solutions to support CMI actors. This requires a thorough understanding of the CMI domain. To this end we are designing a meta-model of the CMI domain, which should describe CMI concepts, their attributes and capabilities, interactions and the information exchange required. This should allow us to identify and model recurring patterns which are hampered by CMI inhibitors, and subsequently design solution blueprints. The paper analyses the CMI inhibitors, argues why distributed enterprise computing technology could be applied to design solutions, and shows how an enterprise architecture approach can be applied. Subsequently the development of a CMI Domain View and a CMI Interaction View is described as part of the CMI meta-model,, consisting of various models developed with different modelling techniques.

1.0 INTRODUCTION

During the past decade, the Comprehensive Approach (CA) has gained broad international support among both governmental, military and civilian parties involved, as a successful concept to conduct international peace and stability operations, by increasing coherence among participants. In this paper we adopt the following definition of CA: " *a process aimed at facilitating system-wide coherence across the security, governance, development and political dimensions of international peace and stability operations*" (De Coning & Friis, 2011). The concept was already announced in 2001 in a statement by the UN Security Council, and has subsequently been institutionalized within the UN organization, since 2008 known as the "integrated approach". This approach should ensure that all components of the UN system operate in a coherent and mutually supportive manner, and in close collaboration with other partners (UNSG, 2008).

With the Comprehensive Operations Planning Directive, NATO anchored the CA in its formal planning process in 2010. For NATO, the CA represents the recognition that the military alone cannot resolve a crisis or conflict, and should rather contribute to the overall international community aims, which requires a culture of active collaboration and transparency (Simon & Duzenli,2009). This translates into the requirement for effective Civil-Military Interaction (CMI).

The CA has also been embraced at the national level. The Netherlands adopted the concept, and more specifically the "3D approach" (Defence, Diplomacy and Development) for its operations in Uruzgan (southern Afghanistan). These operations were conducted as part of the International Security Assistance Force (ISAF) between 2006 and 2010 and were aimed at security, stability and reconstruction. In 2011 an analysis was conducted among participants of the perceived strengths, weaknesses, opportunities and threats (SWOT) of the 3D approach (Van der Lijn, 2011). This analysis showed that its strength *"The whole is more than the sum of its parts"* was perceived to outweigh all weaknesses and threats.

Probably the most challenging context of peace and stability operations and CMI are Complex Emergencies, defined as "*a combination of international conflicts with large-scale displacements of people and fragile or failing economic, political and social institutions. Other symptoms include non-combatant death, starvation or malnutrition; disease and mental illness; random and systematic violence against non-combatants; infrastructure collapse; widespread lawlessness; and interrupted food production and trade*" (Weiss & Collins, 2000).

1.1 Recurring hurdles

In spite of its broad support and perceived strength, the CA still suffers from a range of weaknesses and threats, which were acknowledged as well by participants in the aforementioned analysis of the Netherlands' Uruzgan operations. Civil and military practitioners on the ground appear still to be struggling to exchange information, build a common synchronized picture and align their efforts to improve collaboration, especially in Complex Emergencies. A CMI research literature survey which we conducted in 2012 (Ooms & Van den Heuvel, 2012) revealed a range of persistent hurdles to effective CMI, which we dubbed "CMI Inhibitors", defined as: "*factors obstructing collaboration and the required exchange of information between civil and military actors*".[1] These CMI inhibitors seem to be recurring and were confirmed again in the analysis of the Netherlands' Uruzgan operations. Just adopting and practicing the CA concept in the past years apparently has not been enough to overcome these recurring hurdles.

1.2 A new research approach

Research into the CMI process could reveal the underlying causes of CMI inhibitors and could investigate new approaches aimed at improvement of collaboration and the required exchange of information, by removing or mitigating inhibitors. CMI literature research indicates that most CMI research takes a behavioral science-approach (Eriksson, 2000; Mockaitis, 2004; Rietjens, 2006; Rietjens & Bollen, 2008; Hagar, 2012). To complement these efforts, we propose a design-science approach, which is an Information Systems (IS) problem-solving paradigm with its roots in engineering (Hevner, March, Park & Ram, 2004). Developing IS solutions to support CMI actors, especially in Complex Emergencies, requires a sound foundation: a thorough understanding of the problem space, being the CMI domain.

We define the CMI domain provisionally as: *the collection of all concepts (actors, resources, needs etc.) involved in international peace and stability operations*. In this definition we take deliberately a wide scope, which we will refine in the course of our research. To acquire a thorough understanding of the CMI domain, design-science takes full account of the results of behavioral science research. In our design-science approach, the first design artifact we are designing is a CMI meta-model, providing the vocabulary to formally describe the CMI domain, including CMI concepts, their attributes and capabilities, interactions between these concepts and with the domain environment, and the information exchange required for these

[1] In (Ooms & Van den Heuvel, 2012) the definition of CMI Inhibitor was limited to "factors obstructing the required exchange of information". Since the purpose of CMI is to improve collaboration between civil and military actors, from which the requirement for exchange of information is derived, it seems appropriate to expand the definition.

interactions. This should allow us to identify and model recurring patterns of processes and information exchange which are hampered by CMI inhibitors, and subsequently target our IS design efforts on these patterns, with the aim of developing solution blueprints.

1.3 Paper aim and structure

Consequently, the aim of this paper is to outline the design of a CMI meta-model, in the context of a design-science approach, to support the development of IS solutions to support CMI actors. This paper is organized as follows. This introduction is followed by a description of the chosen research approach. In section 3 the problem space is examined. Section 4 and 5 describe the approach and initial results of our meta-modeling efforts, being domain modeling and interaction modeling, respectively. Finally, section 6 provides our initial conclusions and intentions with respect to further research.

2.0 RESEARCH APPROACH: DESIGN SCIENCE

According to (Hevner *et al*., 2004), Information Systems (IS) research should engage the complementary research cycle between behavioral science and design-science. These are complementary but distinct paradigms, which are aiming to produce justified theory (truth) and artifacts that are effective (utility), respectively. As, philosophically, truth and utility are two sides of the same coin, technology and behavior is not dichotomous in an information system; they are inseparable. Both sciences should perform IS research by alternatively investigating the environment, which ensures relevance, and applying the existing knowledge base, which ensures rigor. They provide theories and artifacts, respectively, which should be applied in the environment under study, and serve as well as additions to the knowledge base. This is illustrated with the Information Systems Research Framework (figure 21-1).

2.1 Applying the IS framework

Our research approach aligns well with this framework. We are ensuring relevance by extracting business needs from behavioral science literature about the environment (the CMI domain), augmented with interviews and field observations. We are ensuring rigor by applying the knowledge base for the selection of modeling techniques to construct the required (meta) model, which serves to formalize the knowledge obtained about the environment. Next we will assess the validity of these models and refine them by applying them in an appropriate environment, i.e. by conducting case studies of exercises and operations in which the CA is applied, preferably in a Complex Emergency context.

Of course modeling is not a goal in itself. In the modeling process we identify and focus on recurring patterns of processes and information exchange which are hampered by CMI inhibitors and which could benefit from IS support, with the intent to identify functional requirements for such support. In the next phase of research we intend to implement these models using selected Information Technology.

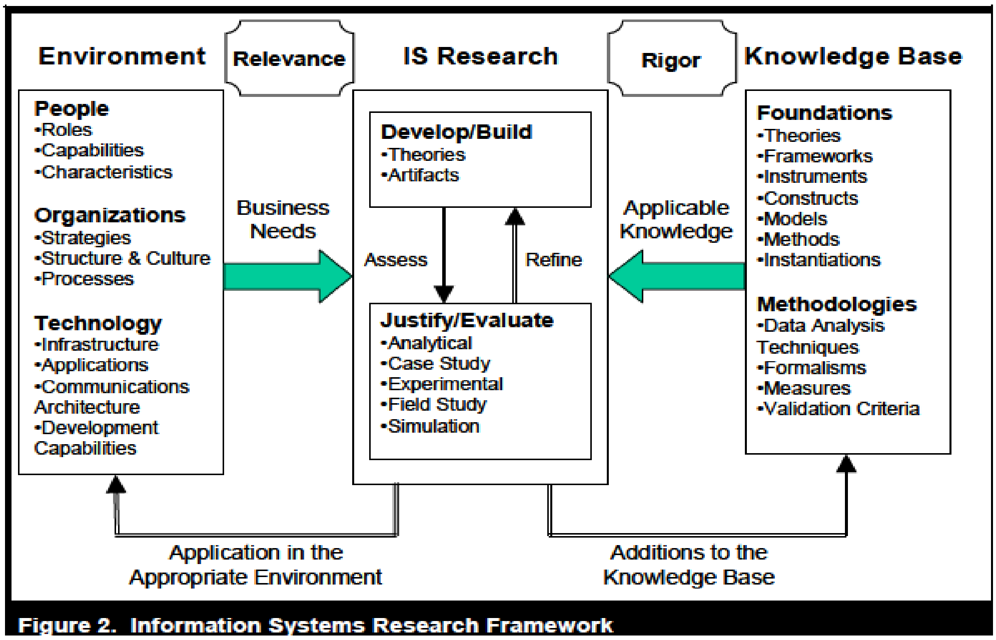

Figure 21-1: IS research framework, after (Hevner *et al.*, 2004)

2.2 CMI and e-Business

Our research approach is based upon our observation of similarities between CMI and the way commercial enterprises conduct business with each other, referred to as e-Business (Papazoglou & Ribbers, 2006), as shown in table 21-1. Some arguments against these similarities have been identified as well, shown in the column "differences" in table 21-1. These differences can be resolved or mitigated in various ways, as shown in the third column of table 21-1. Based on these similarities, it should be investigated to what extent distributed enterprise computing technologies, as being developed and used to support e-Business, could be used to develop IS solutions to support CMI actors.

In our previous research (Ooms & Van den Heuvel 2012, 2014) we conducted an initial assessment of the feasibility of various distributed enterprise computing technologies for this purpose, *inter alia* web services and Services Oriented Architecture, Complex Event Processing and Task Oriented Programming. A discussion on these technologies is outside the scope of this paper.

2.3 Modeling scepticism

In choosing this research approach we are aware of existing skepticism among practitioners and researchers about the feasibility of modeling the related domains of emergency management planning and humanitarian operations, and we will take reported research in this area into account.

In the related domain of emergency management planning, Peinel, Rose & Wollert (2012) show that business process modeling cannot be applied for emergency management planning. Instead, they suggest to use checklists for emergency management, for which they developed a meta-model.

In (Charles, Lauras & Tomasini, 2009) is explained that the usual enterprise modeling techniques cannot be applied in the related domain of humanitarian operations, since many commonly accepted definitions do not hold. They propose a range of adaptations of the enterprise modeling framework and the associated process improvement strategy, to fit humanitarian specificities.

Table 21-1: Comparison between CMI and e-Business.

	Similarities	Differences	How to resolve differences
1	Different organizations need to work together and exchange information efficiently	Organizations are sometimes reluctant to work together, want to keep their distance for various reasons e.g. culture	e-Business technology allows various degrees of integration. Cultural differences might be engaged using socially enhanced services
2	Use of open standards, with Internet serving as common infrastructure	Connectivity might be interrupted, bandwidth might be limited	e-Business technology is often asynchronous, which allows interruptions better than traditional synchronous communications (e.g. telephone calls)
3	Information exchange between heterogeneous actors benefits from standard message exchange using XML[1]	XML[2] message formats have not yet been used in the CMI domain	Using XML[2] Schema Definition Language, standard formats are being developed
4	Collaborative processes can be supported with orchestration technology e.g. BPEL[1]	In CMI, processes are very ad-hoc, unpredictable and with varying participants, environment is volatile, for which BPEL[3] is not suitable	BPEL[3] appears to be too rigid for e-Business as well, e-Business environment becomes more volatile, new technology is being developed which could support both CMI and e-Business
5	Trust and personal relations are important	Short rotations in military hampers building and maintaining relations	Building and maintaining relations and trust could be supported by socially enhanced services

3.0 PROBLEM SPACE: EXAMINING INHIBITORS

Since it is our intention to develop IS solutions to support CMI actors, an examination of the problem space, being the CMI domain, is the starting point for our research. Our IS solutions should be targeted at the "factors obstructing collaboration and the required exchange of information between civil and military actors", which we dubbed CMI inhibitors. Table 21-2 provides a summary of the CMI inhibitors which we identified in our earlier literature research (Ooms & Van den Heuvel, 2012). The results of the strengths, weaknesses, opportunities and threats (SWOT) analysis of the CA in Dutch operations in Uruzgan mentioned earlier (Van der Lijn, 2011) were not included in our research but they confirm our findings.

3.1 Inhibitors analysis

An examination of the characteristics of these inhibitors yields two observations. First, they range from technical to cultural related, second they relate to both the CMI processes, the information flow related to these processes, and the supporting Information and Communications Technology (ICT).

The first observation raises the question whether all CMI inhibitors will be amenable to our proposed technical approach to remove or mitigate them. The answer is: probably not all of them, however, it could well be possible to solve some non-technical problems with technical solutions. A recent example of this possibility is the advent of a new area of research into software services: *socially enhanced services computing*, which aims to support services that are not realized by programs but by human beings (Dustdar, Schall, Skopik, Juszczyk & Psaier, 2011). More traditional examples of technical support to non-technical problems are decision-support systems.

Table 21-2: CMI inhibitors, after (Ooms & Van den Heuvel, 2012).

reference	area	description of related CMI inhibitor
X1	ICT infrastructure	Local ICT infrastructure is often unreliable and with limited capacity. Mobile users have intermittent access and limited bandwidth
X2	Technical interoperability	Hidden problems become apparent when civil and military information systems are connected to exchange information
X3	Unstructured databases	Due to diverse and unstructured databases in use, information becomes difficult to retrieve and working methods are inefficient
X4	Short rotations, insufficient handovers	Military rotations of 6 months are too short to build relations and trust. Much information and expertise gets lost in short handovers
X5	Manual information collection	Much information is gathered by meetings, telephone calls and e-mails, which is inefficient and hampered by unreliable ICT infrastructure
X6	Overlap in information gathering	Information is insufficiently shared, which leads to inefficiency, same information is being gathered by different organizations
X7	Security issues	The military tends to over-classify information; what is made available is often outdated; civil sensitive information is not made available to the military
X8	Semantic interoperability	Semantic interoperability problems due to cultural differences and unfamiliarity with each other, due to the temporary nature of coalitions
X9	Cultural differences	Civil organizations have different organization and coordination mechanisms, different goals, and related timeframes than the military
X10	Lack of trust	Distrust among civil actors about military intentions regarding non-military tasks, being not impartial, and in support of military mission

The second observation points at an enterprise architectural approach to modeling the CMI domain. Ever since John Zachman coined the term Enterprise Architecture (EA) in 1982, enterprise architecture frameworks have been based on a layered structure, in which the upper layer contains business processes, supported by lower layers containing data and information services (which can be combined), which in turn are supported by a lower layer containing the required hardware (networks, computing platforms) (see figure 21-2 below). This approach could help to disentangle the disordered jumble of CMI inhibitors into clearly defined categories (layers) with specified relations to each other. We will elaborate on this approach when discussing domain modeling in the next section.

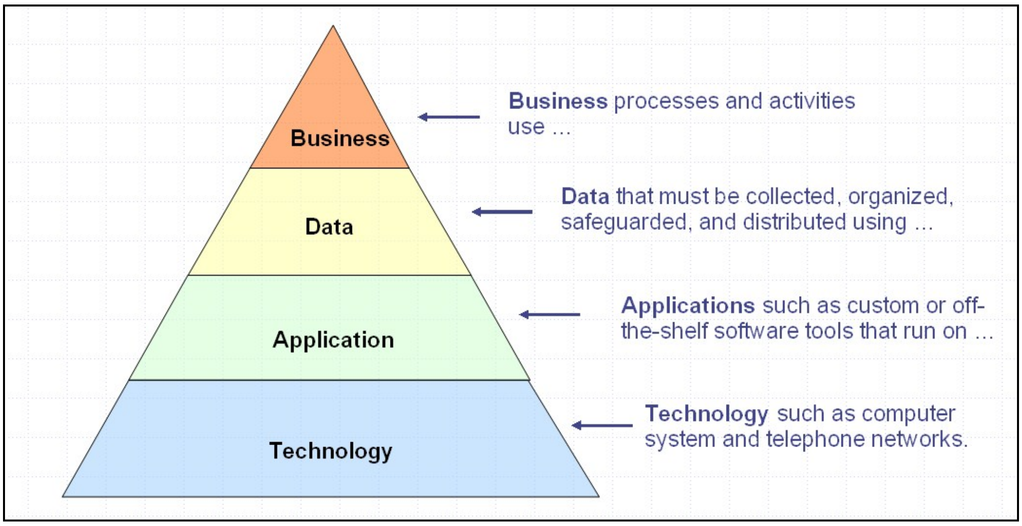

Figure 21-2: Enterprise Architecture layers.

4.0 CMI DOMAIN MODELING: AN ARCHITECTURAL APPROACH

Our object of study, being civil-military interaction within the context of international peace and stability operations, might seem unrelated to the concept of EA, which has its origins in the business domain. To find out whether EA theory and methodology are applicable for our research we need to examine how the concepts of "enterprise" and EA are defined.

Version 9 of The Open Group Architecture Framework (TOGAF) (The Open Group, 2009) appears currently the world' s most widespread civil EA framework. TOGAF defines "enterprise" as "*any collection of organizations that has a set of common goals*". Its scope could be further widened to "extended enterprise", which includes partners, suppliers and customers. According to this definition, the CMI domain could be regarded as an (extended) enterprise, depending on the scope we choose. The Enterprise Architecture Research Forum defines EA as "*the continuous practice of describing the essential elements of a socio-technical organization, their relationships to each other and to the environment, in order to understand complexity and manage change*". Civil and military actors collaborating in an international peace and stability operation could be viewed as "a socio-technical organization" since, as shown in the previous section, the CMI inhibitors hampering this collaboration bear technical as well as non-technical (social, cultural) characteristics.

4.1 Military architectures and modelling scope

The United States Department of Defence (US DoD) has been developing and applying architecture frameworks since the years '80. The US DoD Architecture Framework (DoDAF), being developed since 2003, is related to TOGAF since they share a common ancestor: the US DoD C4ISR[2] AF (1994 – 2003). The NATO Architecture Framework (NAF) (NATO, 2007) is related to DoDAF and has been developed in parallel. It seems only natural to relate our architecture modeling work to NAF, since we are modeling specific military activity in a civilian context. As such, the output of our research could in our view contribute to the development of NATO architecture.

---

[2] C4ISR: Command & Control, Communications, Computers and Information/Intelligence, Surveillance and Reconnaissance.

When deciding on the scope of our modeling efforts, we are facing a dilemma. As stated before, to avoid modeling becoming a goal in itself, we intend to restrict our modeling efforts to the areas of the CMI domain (processes, information flows) that are amenable to technical support. However, to ensure that we do not overlook potential target areas for technical support, we need to look initially to the entire domain. Once we have established an overall picture of the domain, its actors and processes, this will allow us to select specific areas for further investigation. Applying this approach to EA modeling, we need to translate it into EA concepts and terminology. Appendix 1 provides an overview of the internationally standardized terminology for architecture descriptions in systems and software engineering, how these terms are being used in DoDAF and NAF, and how we apply them in our research.

4.2 Developing the CMI Domain View

For the design of a CMI meta-model we have decided to initially design two views as part of the operational viewpoint: a CMI Domain View and a CMI Interaction View. The CMI Interaction View is discussed in section 5. The CMI Domain View specifies the main concepts in the CMI domain and their relations. For this view we are developing two Architecture Models: a CMI Domain Class model (see figure 21-3) and a CMI Actor model (see figure 21-4). Both models are using the UML Class Diagram as Model Kind. These models are currently being discussed with subject matter experts to verify and refine them.

4.3 The CMI Domain Class model

The CMI Domain Class model provides a description at the highest level of abstraction of the concepts in the CMI domain and their relations. The CMI Actor model complements the CMI Domain Class model by providing further details of one of the concepts of the CMI domain, being the CMI Actor. Other models, detailing other concepts of the CMI domain, could be added later to further amplify the CMI Domain View. The CMI Domain Class model is explained below in detail. In accordance with UML modeling convention, words indicating UML Classes are capitalized (e.g. Recipient).

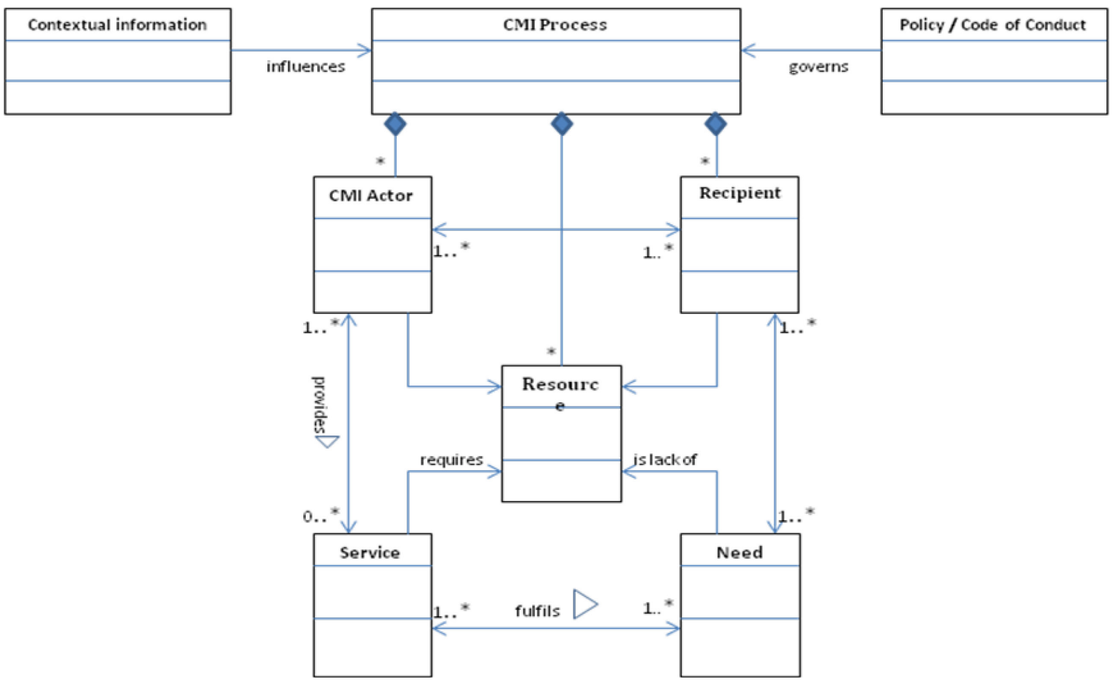

Figure 21-3: CMI Domain Class Model.

CMI Domain Class model explanation:

CMI Process: the basic purpose of the CMI Process is to deliver Services provided by CMI Actors to Recipients to fulfill their Needs, following the principle that humanitarian aid and development support should always be needs-driven. The Class CMI Process is composed of multiple CMI Actors, Recipients and Resources.

CMI Actor: may provide one or more Services to one or more Recipients to fulfill a Recipient's Need. Vice versa, a Service may be provided by one or more CMI Actors. CMI Actors may also not provide Services, e.g. when only acting in a coordinating role.

Resource: providing a Service usually requires Resources (e.g. transport). CMI Actors may provide Resources, may need Resources and may have a lack or surplus of Resources. These conditions are CMI Process drivers. Recipients may provide Resources as well (e.g. local transport or storage facilities). Needs could be expressed as a lack of Resources. For this reason, Resources occupy a central position in the model. Resources may be software (data, information) or hardware (transport, food etc.).

Need: a Service fulfills a Need of a Recipient. Needs can be explicitly stated by Recipients or can be discovered by CMI Actors, as part of an assessment. Needs are one of the drivers of the CMI Process and are usually investigated upfront. A Service may fulfill more Needs, and vice versa one Need may be fulfilled by more than one Service.

Recipients: can be anything from an individual to a group of individuals, an organization, a region or a country. They all have in common that they have one or more Needs and may receive Services to fulfill those Needs. Every Recipient has at least one Need, and vice versa, every Need is expressed by one or more Recipients. Strictly speaking, Recipients could also be regarded as actors in the CMI Process, but the model has been designed differently in order not to blur the essential distinction between Service providers (CMI Actors) and Service receivers (Recipients).

Policy/Code of Conduct: governs the CMI Process and may influence all participants, but is not part of the CMI Process. A Policy/Code of Conduct or part of it might turn out to be a CMI inhibitor.

Contextual Information: any type of information other than Policy/Code of Conduct that influences the CMI Process but cannot be regarded as an attribute of one of the Classes of the model, e.g. climate, geography.

CMI Inhibitors: Any attribute of a Class could manifest itself as a CMI inhibitor, depending on the context. For this reason, CMI inhibitors are not modeled as a Class. Example: the specific culture of a group of NGOs could reinforce the collaboration among them, but might turn into an inhibitor once the NGOs need to cooperate with the military, and vice versa.

Quality of service: can be attached as attribute to a variety of Classes: Services, Resources, CMI Actors. For this reason, Quality of Service is not modeled as a Class.

4.4 The CMI Actor model

The CMI Actor model is considered self-explanatory, see figure 21-4. Tables 21- 3 and 21-4 provide an initial listing of attributes and operations of CMI Actors. These are currently being completed and verified with subject matter experts.

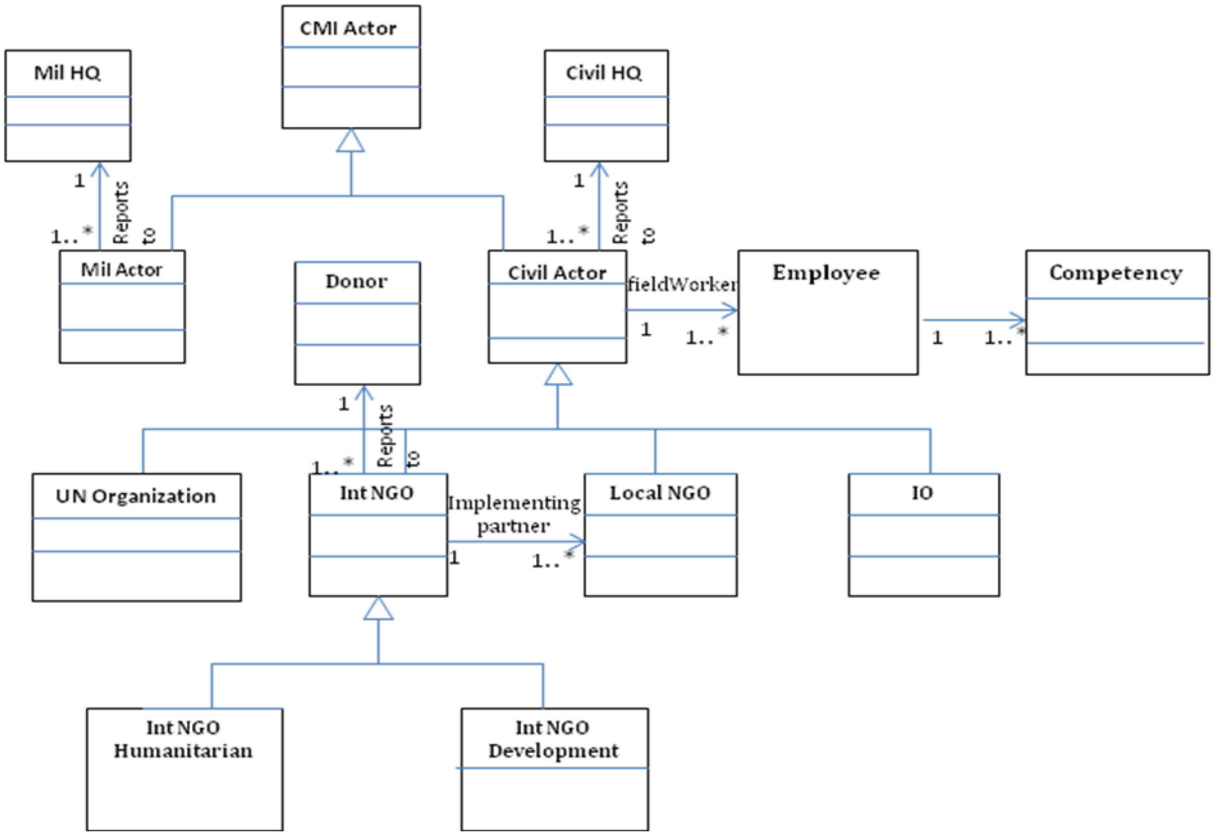

Figure 21-4: CMI Actor model.

Table 21-3: Attributes of CMI Actor.

Attribute	Description
Quality of Service	The quality of (support) work performed by a CMI actor, based on observations, partner experiences, information from support recipients, operational analysis etc.
Capacity	A quantitative measure of the amount of support that can be provided by a CMI actor within a given timeframe.
Readiness	The amount of warning time required for a CMI actor before support can be delivered.
Sustainability	The period during which provision of support can be sustained by a specific CMI actor.
Operational experience	The experience gained by a CMI actor by providing support in a Complex Emergency.

Table 21-4: Operations of CMI Actor.

Operation	Description
Support	To provide support in a Complex Emergency of a specific type, *e.g.* food, education, medical, security, infrastructure, ICT, …
Advise	To provide advice to actors concerning the provision of specific support
Coordinate	To coordinate the provision of the same type of support by different actors
Assist	To assist another actor in the provision of support by providing *e.g.* transport, ICT support, personnel or infrastructure support
Protect	Provide physical protection with military means against an opponent or threat

5.0 INTERACTION MODELING: IN SEARCH FOR PATTERNS

Every domain modeling should describe both the static (structural) and the dynamic (behavioral) aspects of the domain (Dietz, 2006; Fowler, 2004).3 For our modeling effort this is even more important, since the inhibitors we intend to focus on will manifest themselves in the interaction processes. Modeling the static (structural) aspects of the CMI domain has been discussed in section 4 (CMI Domain View). For modeling CMI processes for the CMI Interaction View, we can make use of Business Process Management (BPM) modeling languages and standards, which have proliferated in the past 20 years, as shown by the BPM standards survey study by (Ko, Lee & Lee, 2009). Our previous research into the selection of modeling methods and languages for CMI domain modeling (Ooms & Van den Heuvel, 2014) showed that the Business Process Modeling Notation (BPMN) is suitable for our purpose, inter alia since it is intuitive and thus readily understandable for non-technical CMI practitioners.

5.1 Academic alternatives to business products

However, like the development of EA frameworks such as TOGAF, development of BPM standards has been largely business-driven and hence lacks academic rigor, as shown by (Ko et al., 2009) for BPM and by (Dietz & Hoogervorst, 2011) for TOGAF. This shortfall has spurred an academic response, taking the form of academic research in the area of BPM and EA since the years ’90. Two developments in this area of research have gained substantial acceptance: the Design and Engineering Methodology for Organizations (DEMO) developed by Dietz (Dietz, 2006) and the work on workflow patterns by (Van der Aalst, Ter Hofstede, Kiepuszewski and Barros, 2003). Both developments appear to be of interest for our CMI domain modeling which is discussed below.

5.2 Applying DEMO

DEMO offers a comprehensive theory and method to develop an enterprise ontology, which for the purpose of this paper equals a meta-model. With its basic transaction pattern, based on the Language-Action Perspective (Habermas, 1981), DEMO offers insight into the detailed working of interactions between individuals, formalized in its universal transaction model. In DEMO, business processes are constructed as

[3] The term “behavioral” in this respect is not to be confused with “behavioral science” discussed in section 2.

chains of such transactions. As argued by Dietz (2006), this approach offers a white box model of interactions, contrary to other business process modeling methods such as BPMN, which are restricted to black box modeling, i.e. specifying only the input and output of a process step (transaction). Apparently DEMO has been successfully applied in various business environments since its inception. Since we intend to concentrate our research on CMI processes on the ground, i.e. between field workers and military personnel, DEMO could offer a valuable method to unravel interactions and investigate where and why problems arise in the interaction process.

The use of DEMO could be complementary to the use of BPMN for development of the CMI Interaction View. Initially we develop a BPMN model, which lends itself well for discussion with subject matter experts. Once we have validated the BPMN model, we translate the model into a DEMO model. This will generate more detailed questions about the interaction process, which will provide deeper insight into the process and its possible inhibitors. The way in which the DEMO method will be applied requires more research, since DEMO provides a comprehensive family of models, which cover the behavioral (dynamic) as well as the structural (static) aspects of the domain.

5.3 Using workflow patterns

The results of research on workflow patterns by Van der Aalst *et al.* (2003) have been used by various researchers to test and evaluate modeling methods, e.g. by White (2004) to compare and analyze BPMN and the UML Activity Diagram. The results of workflow pattern research are relevant for our research as well, since we aim to identify and model recurring patterns of processes and information exchange which are hampered by CMI inhibitors. For this reason we intend to use the comprehensive collection of workflow patterns developed by Van der Aalst *et al.* (2003) to assist us in identifying interaction patterns.

5.4 Developing the CMI Interaction View

Currently we have developed a comprehensive BPMN process model of the CMI process which we are discussing with subject matter experts to refine and validate it. Since a detailed presentation and discussion of the model is beyond the scope of this paper, we provide an overview of the outline of the model.

Although we intend to concentrate on CMI processes on the ground, we have extended this process model to cover all CMI-related activities including early stages of preparation, starting when there is not yet an indication of a Complex Emergency. This is because information gathered and exchange in this phase could become important in later stages, so it should be stored, shared and managed properly. CMI Actors with own “swimlanes” in the BPMN model are: the military, other ministries (including in the donor-role), Non Governmental Organizations (NGOs) divided into development support-oriented (NGO-D) and humanitarian support-oriented (NGO-H), and local NGOs (implementing partners).

We have provisionally defined the following five phases of the CMI process:

<u>Phase 1: peacetime preparation:</u> no indication of a developing Complex Emergency; NGO-D activities, with local NGOs involved as implementing partners; other actors prepare in general by collecting information and maintaining liaison.

<u>Phase 2: assessment & decision to participate</u>: Complex Emergency is developing; a (comprehensive) needs assessment is conducted, NGOs assess individually whether or not to participate; UN agencies get involved; political decision making on military involvement; increasing exchange of information between all actors involved.

Phase 3: military intervention: most NGOs suspend operations due to insecurity; military intervention proceeds along phases shape-clear-hold-build; during hold phase small relief projects including "winning hearts and minds" initiated by military with local NGOs involved; in build phase handover of projects to NGOs-H.

Phase 4: humanitarian relief: operations by NGOs-H together with local NGOs; military actors revert to ensuring a secure environment, providing specialized support when required.

Phase 5: stabilisation & reconstruction: often in parallel with phase 4; NGOs-D resume their projects or initiate new ones; military presence decreasing.

Along with the development of this process model we have postulated a range of interaction patterns which we are investigating, however discussing these in this paper would be premature.

6.0 CONCLUSIONS, FURTHER RESEARCH

In this paper we have outlined why and how we are designing a meta-model of the CMI domain: to identify and analyze interaction patterns which are hampered by recurring CMI inhibitors. We have shown why a design-science approach to CMI might be beneficial by designing Information Systems support for CMI actors, aimed at mitigating or removing the inhibitors identified. In view of the variety of CMI inhibitors, we have shown how our modeling efforts are aligned with Enterprise Architecture theory and methods and could contribute to the NATO Architecture Framework. Finally we have shown and discussed some initial modeling results.

We intend to further develop and refine our models in discussions with subject matter experts, and subsequently to validate these models by applying them in case studies of exercises or peace and stability operations. According to (Yin, 2003), the models should subsequently be used as "propositions" in the Case Study design. Large scale civil-military exercises in which the CA is being trained, such as exercise Common Effort (2011), organized by the first German-Netherlands Army Corps (Essens, De Vries, Everts & Rietjens, 2012) and its successor exercise Peregrine Sword (2012) seem well suited for case study research. These exercises are characterized by elaborate series of preplanned incidents involving civil-military interaction, each of which could be regarded as an "embedded unit of analysis" (Yin, 2003). In such a unit of analysis, the interaction between military personnel and NGO field workers could be analyzed in detail, if possible using the DEMO modeling method. As an alternative, and to complement studying an exercise environment, a real-world operation could be the subject of a case study, such as the Netherlands operations in Uruzgan, Afghanistan.

After validation of the CMI domain model, we intend to implement models of interaction patterns by developing and testing Information Systems prototypes, designed to support CMI actors by mitigating or removing CMI inhibitors.

APPENDIX 1 – APPLYING ARCHITECTURE CONCEPTS

EA terminology is at times confusing, and the fact that NAF and DoDAF appear to use different terms for the same concepts (e.g. view vs viewpoint) adds to the confusion. In 2011, all standardization agencies involved agreed on ISO/IEC/IEEE[4] 42010: 2011 – *Systems & Software Engineering – Architecture Description* , which we follow in our research[5]. Figure 21-3 below provides a meta-model of the concepts and relations defined in this standard. Translated to our research, "Stakeholders" refers to military and civil actors involved in international peace and stability operations; "Concerns" have been described in section 1 and 3, and the CMI domain could be regarded as a "System" and its "Environment".

"Architecture Viewpoint" is defined by ISO/IEC/IEEE as: "*establishes the conventions for the construction, interpretation and use of architecture views for specific concerns. A concern can be framed by more than one viewpoint".* The layers mentioned in the previous section have been defined in DoDAF as viewpoints: Business layer corresponds with Operational viewpoint, Data and Application layer with Services viewpoint, and Technology layer with Systems viewpoint[6]. Since we found that the CMI inhibitors reside in all layers mentioned, our research involves these three viewpoints.

From each viewpoint various "Views" can be developed, defined by ISO/IEC/IEEE as *"… expresses the architecture of a system from the perspective of specific system concerns in accordance to its Viewpoint*". Both DoDAF and NAF specify a range of possible views (in NAF called "subviews") for each viewpoint, which are not mandatory. The selection of what to model and how is driven by the purpose of the architecture and the stakeholder concerns.

"Model kinds" are defined by ISO/IEC/IEEE as: "conventions for a type of modeling, e.g. Class diagrams, data flow diagram etc." We have conducted previous research into the selection of modeling methods and langu ages for CMI domain modeling (Ooms & Van den Heuvel, 2014). Based on our research, we selected the Unified Modeling Language (UML) (Fowler, 2004), the Business Process Modeling Notation (BPMN) (OMG, 2007) and the Design and Engineering Methodology for Organizations (DEMO) (Dietz, 2006). According to ISO/IEC/IEEE terminology, the models and diagrams specified in these modeling methods and languages (e.g. the UML Class Diagram, the DEMO Process Structure Diagram) are the Model Kinds we are using for constructing the Architecture Models. The use of UML is discussed in section 4, the use of BPMN and DEMO in section 5.

---

[4] These acronyms refer to the following international organizations developing International Standards for the world:
ISO: International Organization for Standardization;
IEC: International Electrotechnical Commission;
IEEE: Institute of Electrical and Electronics Engineers

[5] With respect to the terms "view" and " viewpoint", DoDAF appears to follow the last version of the ISO/IEC/IEEE standard.

[6] NAF recognizes the same layers but uses the term View instead of Viewpoint.

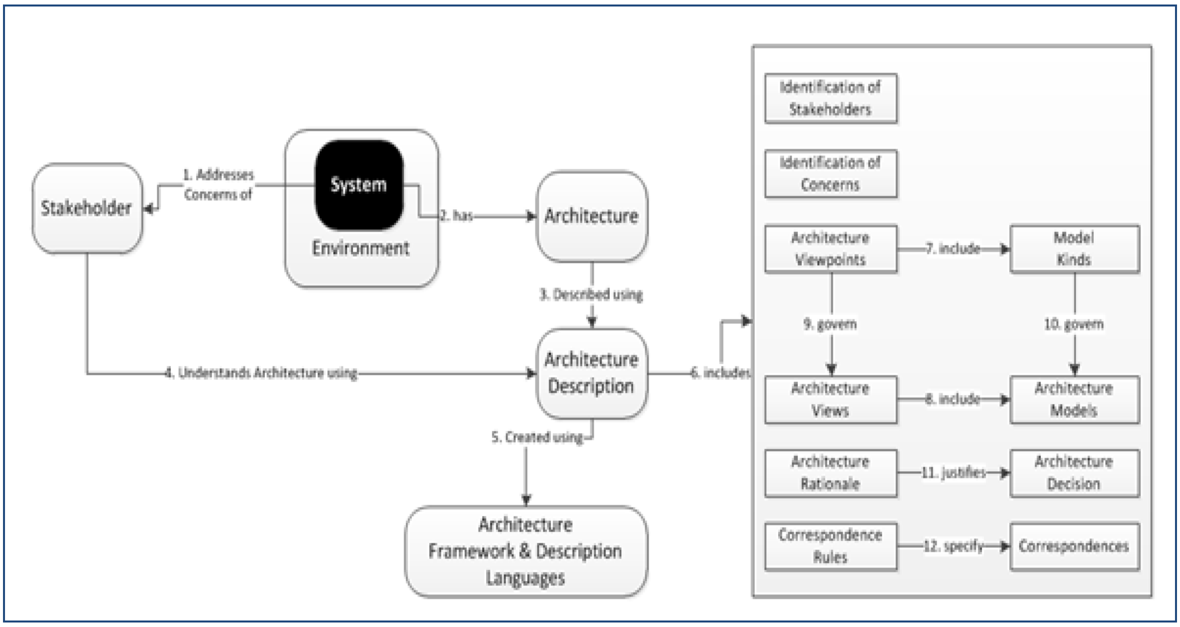

Figure 21-5: Meta-model of architecture description standard ISO/IEC/IEEE 42010: 2011.

REFERENCES

[1] Charles, A., Lauras, M., & Tomasini, R. (2009). Learning from previous humanitarian operations, a business process reengineering approach. Gothenburg, *Proceedings of the 6th International ISCRAM Conference.*

[2] De Coning, C. & Friis, K. (2011). Coherence and coordination - the limits of the comprehensive approach. *Journal of International Peacekeeping, (15),* 243-272

[3] Dietz, J. L. G. (2006). *Enterprise ontology – theory and methodology.* Berlin, Springer.

[4] Dietz, J. L. G. & Hoogervorst, J. A. P. (2011). An enterprise engineering based examination of TOGAF. *Lecture Notes on Business Information Processing (LNBIP) no.79.* Berlin, Springer

[5] Eriksson, P. (2000). Civil-Military Co-ordination in Peace Support Operations – An Impossible Necessity? *The Journal of Humanitarian Assistance*, posted 16 September 2000

[6] Essens, De Vries, Everts & Rietjens (2012). *'Common Effort': an experiment in collaboratively building a comprehensive approach.* TNO report, Soesterberg (to be published)

[7] Fowler, M. (2004). *UML distilled: a brief guide to the standard object modeling language* (3rd ed.). Boston (MA), Pearson Education

[8] Habermas, J. (1981). *Theorie des Kommunikatives Handelns, Erster Band*, Frankfurt am Main, Suhrkamp Verlag

[9] Hagar, C. (Ed). (2012). *Crisis Information Management – Communication and technologies.* Oxford, Chandos Publishing.

[10] Hevner, A. R., March, S. T., Park, J. & Ram, S. (2004). Design science in information systems research. *MIS Quarterly, 28*(1), 75-105

[11] Ko, R. K. L., Lee, S. S. G. & Lee, E.W. (2009). Business process management (BPM) standards: a survey. *Business Process Management Journal, 15*(5), 744-791

[12] Mockaitis, T. R. (2004). *Civil-Military cooperation in peace operations: the case of Kosovo.* Carlisle, PA, Strategic Studies Institute, U.S. Army War College.

[13] NATO (2007). *NATO Architecture Framework (NAF) version 3.* Brussels, North Atlantic Treaty Organization.

[14] OMG (2007). *Business Process Modeling Notation,* Needham, MA, Object Management Group (OMG)

[15] Ooms, D. M. & Van den Heuvel, W. J. (2012). Business *not* as usual: civil-military interaction from an e-Business perspective. Vancouver, *Proceedings of the 9th International ISCRAM Conference*

[16] Ooms, D. M. & Van den Heuvel, W. J. (2014). If every nail looks different, you need different hammers: modeling civil-military interaction. University Park, PA, *Proceedings of the 11th International ISCRAM conference,* to be published.

[17] Papazoglou, M. P. (2008). *Web services: principles and technology*. Harlow (Essex), Pearson Education.

[18] Papazoglou, M. P. & Ribbers, P. (2006). *E-Business: organizational and technical foundations.* Chichester (West Sussex), John Wiley.

[19] Peinel, G., Rose, T. & Wollert, A. (2012). The myth of business process modeling for emergency management planning. Vancouver, *Proceedings of the 9th International ISCRAM Conference.*

[20] Rietjens, S. J. (2006). *Civil-military cooperation in response to a complex emergency: just another drill?* Enschede, University of Twente, PhD thesis.

[21] Rietjens, S.J.H. & Bollen, M.T.I.B. (Eds.). (2008). *Managing Civil-Military Cooperation.* Aldershot, Ashgate Publishing.

[22] Simon, G. & Duzenli, M. (2009). The comprehensive operations planning directive. *NRDC-ITA Magazine issue 14 (2009).* NATO Rapid Deployable Corps (Italy)

[23] The Open Group (2009) *The Open Group Architecture Framework (TOGAF) version 9.* Zaltbommel, Van Haren Publishing.

[24] United Nations Secretary General (2008). *Decision Number 2008/24 – Integration.* Decisions of the Secretary General, 25 June 2008. Policy Committee, United Nations.

[25] Van der Aalst, W., Ter Hofstede, A., Kiepuszewski, B. and Barros, A. (2003) Workflow Patterns, *Distributed and Parallel Databases*, 14, 1, 5-51.

[26] Van der Lijn, J. (2011). *3D 'The next generation' – Lessons learned from Uruzgan for future operations.* The Hague, Netherlands Institute of International Relations 'Cingendael'.

[27] Weiss, T. G. and Collins, C. (2000). *Humanitarian Challenges and Intervention.* Boulder, CO, Westview Press.

[28] White, S. (2004). Process Modeling Notations and Workflow Patterns. *Workflow Handbook* (p.265-294), Lighthouse Point, FL, Future Strategies.

[29] Yin, R. K. (2003). *Case study research: design and method* (3rd ed.). London, Sage.