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Tribal and Locality Dynamics in Afghanistan: A view from the National Military Academy of Afghanistan [1]

By

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14. ABSTRACT

This report describes Afghan cadet projects, cadet, faculty and interpreter discussions, faculty and interpreter classes, prototype models and prototype tools developed during five months (February to July, 2009) at the National Military Academy of Afghanistan (NMAA). The report also describes subsequent efforts to expand the lessons learned and develop additional approaches and tools to collect and analyze data useful in understanding tribal and locality dynamics as they affect counterinsurgency (COIN) operations in Afghanistan. The thread of commentary and analysis linking these activities summarize initial results of efforts to understand tribal and locality dynamics of Afghanistan. The recent thread of development efforts for modeling and sharing tactical information are extended to discuss the implications for modeling and simulation of tribal and locality dynamics as they affect tactical level operational outcomes. Finally, the lessons learned while at NMAA in Afghanistan are related to earlier experiences accumulated from 1969 to 1970 in the Republic of Vietnam (RVN) as a District Senior Advisor in Phu Thu District, Thua Thien Province. The conclusions in the report are 1. Tribal dynamics matter at the tactical level and may determine mission success or failure 2. Locality dynamics matter at the tactical level and may determine mission success or failure 3. The utility of understanding tribal and locality dynamical analysis lies in understanding their affects on tactical outcomes and thus, tactical operational decisions 4. Models of tribal and locality dynamics will be wrong but may be useful 5. Estimating the utility (relative value) of tribal and locality dynamics should be a component of a more general approach for valuing tactical information among nodes in a tactical network 6. Value of information at the tactical level should be directly related to achieving command intent for the operation since command intent is the only battlespace invariant 7. Since the relative value of information is a subjective (human) estimate, the models of tribal and locality dynamics need to be simple to be useful at the tactical level 8. Models of tribal and locality dynamics should result in ratio-scale estimates (i.e. not just that one attribute is more important but ?how much? more important one attribute is than another) 9. NMAA faculty and staff are a national treasure of tactical, cultural, and locality understanding 10. NMAA cadets are future Afghan leaders and their presence at NMAA for four years constitute a unique experiment in cultural diversity at the national level 11. NMAA interpreters provide a window into Afghanistan tribal and locality dynamics, and 12. US and Turkish officers, civilians, and non-commissioned officers are regularly exposed to cultural dynamics in daily mentor

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ABSTRACT

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The conclusions in the report are:

1. Tribal dynamics matter at the tactical level and may determine mission success or failure,
2. Locality dynamics matter at the tactical level and may determine mission success or failure,
3. The utility of understanding tribal and locality dynamical analysis lies in understanding their affects on tactical outcomes and thus, tactical operational decisions,
4. Models of tribal and locality dynamics will be wrong but may be useful,
5. Estimating the utility (relative value) of tribal and locality dynamics should be a component of a more general approach for valuing tactical information among nodes in a tactical network,
6. Value of information at the tactical level should be directly related to achieving command intent for the operation since command intent is the only battlespace invariant,
7. Since the relative value of information is a subjective (human) estimate, the models of tribal and locality dynamics need to be simple to be useful at the tactical level,
8. Models of tribal and locality dynamics should result in ratio-scale estimates (i.e. not just that one attribute is more important but “how much” more important one attribute is than another),
9. NMAA faculty and staff are a national treasure of tactical, cultural, and locality understanding,
10. NMAA cadets are future Afghan leaders and their presence at NMAA for four years constitute a unique experiment in cultural diversity at the national level,
11. NMAA interpreters provide a window into Afghanistan tribal and locality dynamics, and
12. US and Turkish officers, civilians, and non-commissioned officers are regularly exposed to cultural dynamics in daily mentor roles with their NMAA counterparts in academic, athletic, and military programs.

In the appendix we extend a platoon-level scenario developed to reason about command intent and value tactical information. The extensions provide an example of tribal and locality dynamics affecting tactical outcomes. A model for estimating tribal and locality dynamics is provided in the appendix.

PREFACE

This report draws upon over forty years of experience as a commander of company-level tactical operations in peace and war, as a manager of computer systems development in government and commercial sectors, and as an educator in graduate and undergraduate engineering programs. Thus, the report would never have been written without the contributions of many individuals over many years. Thank you all.

The challenge to which the report seeks to make a contribution is that of “understanding” tribal and locality dynamics in Afghanistan. Seeking to write such a report after spending only a few months in a restricted area is very presumptuous. However, as will be seen in the body of the report, the items discussed have all been experienced on a daily basis for several months, the events described occurred in a multicultural setting, and the conclusions drawn are modest. The hope is that the results will prove useful in constructing models and tools which might contribute to success of future tactical counter insurgency (COIN) operations. The basic premise of the report will be very familiar to civilian and military service members who have had the privilege of serving with the soldiers, sailors, airmen and marines who have chosen to “…protect and defend the Constitution of the United States against all enemies…” The premise is that for soldiers to “understand” an operation, commanders must “keep it simple”. However, the plain fact is that commanders at every echelon are confronted with interacting and interdependent networks of systems which currently defy the capabilities of science and technology to “understand” in the sense of building predictive models of system behaviors. Thus, the project starts at the simplest level of operations yet retains the complexities present at each echelon. Indeed, operations at the lowest tactical level are described today in terms of “the strategic corporal” both because of the instant and worldwide attention possible using communication and information network capabilities and also because of the asymmetric effects possible due to the interdependencies of networked systems. Likewise, the basic approach chosen for constructing models, general systems theory, has been studied for many years and will be familiar to many control engineers involved in aerospace, energy, transportation, and chemical industries as well as economists and applied mathematicians. However, while many individuals involved in dynamic systems modeling assume that discrete models of system dynamics are sufficient to predict future behaviors, the position taken here is that modeling the complexities of tactical operations requires both continuous and discrete components to adequately capture the dynamics of interest. This argument is not new in general system science. Indeed, for several years every student majoring in either electrical engineering or computer science at the University of California at Berkeley has taken a course which requires considering systems as compositions of continuous and discrete components (Lee & Varaiya, 2000).

Our ongoing efforts seek to develop science and technology to move information management from a focus on securing information to a focus on sharing information. The hypothesis is that mission success for humanitarian assistance/disaster recovery (HADR) operations requires flowing information among individuals and groups who are not normally "on the net" with other coalition partners. We believe that the science and technology we are investigating offers a path to make tactical operations more effective by enabling commanders to declare policies for sharing required information and receive automated assistance in flowing information among such groups.

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SECTION I: INTRODUCTION

As indicated in the abstract, this report provides an interpretation of tribal and locality dynamics from the perspective of a series of activities conducted while at the National Military Academy of Afghanistan between February and July of 2009. This interpretation is not given from a psychological or sociological point of view of but from the point of view of what is needed to "understand" the tribal and locality dynamics from an operational perspective. That is, from the point of view of what might affect decision-making by platoon leaders and squad leaders while conducting counterinsurgency operations.

In that regard, the report is written from the perspective of what is required in order to flow valued information among network nodes in order to assist squad and platoon leaders in making more informed decisions. The United States Military Academy has a multi-year project funded by the Army Research Office to investigate science and technology associated with flowing valued information among network nodes in tactical communication systems. Tactical commanders are faced today with complex networks of interconnected and interdependent systems which affect, and possibly determine, mission success. The initial report (James, et al., 2009) in the Flowing Valued Information (FVI) project describes an extension to the long-standing Bell-LaPadula formal result for achieving computer systems security based upon implementing a "need-to-know" constraint for access to data. The report provides a definition of a "need-to-share" and provides a formal proof that the Bell-LaPadula "need-to-know" constraint can be maintained for data which needs to be protected while also allowing implementation of a "need-to-share" for data which a commander has declared a policy requiring the sharing of the information.

The initial report also provided a scenario of a Humanitarian Assistance/Disaster Recovery (HADR) operation whose mission success depends upon sharing information. While the initial FVI report discussed the need to share specific data on disaster information such as the number of people dead, number of people missing, and status of essential services, this report discusses the mission impact of understanding tribal and locality dynamics of the area in which a HADR operation might take place. The initial models developed are motivated by the same goal of the information security result: begin to consider what is required to eventually be capable of building predictive models of complex systems. We believe that initial results may also be useful in analyzing competing theories of current behaviors of parameters of interest and choosing reactive responses to alter the current state of those parameters.

We argue that the formal result from the first report concerning establishing a mechanism for automatically sharing data based on a declaration of a "need to share" also applies to data collected concerning tribal and locality dynamics. That is, the utility of knowledge of tribal and locality dynamics in achieving mission success for HADR missions is directly dependent upon sharing that information with individuals whose actions might exacerbate existing tense relations due to tribal and/or locality dynamics or whose actions might negate existing peaceful relations due to tribal and/or locality dynamics. The challenge then is to consider what is required to achieve the goal of enabling squad and platoon leaders to consider tribal and locality dynamics as a portion of the essential elements of information needed for mission success.

A premise for building models of system dynamics

Counter-insurgency (COIN) operations today require that squad and platoon leaders consider a broad range of battlespace outcomes sometimes described using the acronym PMESII (political, military, economic, social, infrastructure, and information). Altering the current state of the range of battlespace outcomes is expected to occur by commanders selecting from a domain of actions often described using the acronym DIME (diplomatic, information, military, and economic). Unfortunately, science and technology do not currently enable building predictive models of system dynamics to guide selection of DIME actions in order to move the state of PMESII outcomes from the current state to some desired future state.

The premise followed in this report for model development is that a condition for soldiers to "understand" an operation is that commanders must "keep it simple". However, commanders at every echelon are confronted with interacting and interdependent networks of systems which currently defy the capabilities of science and technology to "understand" in the sense of building predictive models of system behaviors. Thus, the central goal of the report is to propose an approach for overcoming these scientific and technical shortfalls by starting at the simplest level of operations yet retain the complexities present at each echelon. Indeed, operations at the lowest tactical level are described today in terms of "the strategic corporal" both because of the instant and worldwide attention possible using communication and information network capabilities and also because of the asymmetric effects possible due to the interdependencies of networked systems.

A choice of a framework for modeling system dynamics

The framework chosen for constructing models, general systems theory, has been studied for many years and will be familiar to many control engineers involved in aerospace, energy, transportation, and chemical industries as well as economists and applied mathematicians. However, while many individuals involved in dynamic systems modeling assume that discrete models of system dynamics are sufficient to predict future behaviors, the position taken here is that the modeling the complexities of tactical operations require both continuous and discrete components to adequately capture the dynamics of interest. This argument is not new in general system science. Indeed, for several years every student majoring in either electrical engineering or computer science at the University of California at Berkeley has taken a course which requires considering systems as compositions of continuous and discrete components (Lee & Varaiya, 2000). Consistent with that approach, we consider the expression $S \subseteq X \times Y$ where the system S may be a relation on the abstract sets X and Y (i.e. discrete system models). However, in addition to the discrete-valued elements which are members of abstract sets, we observe that the general system S may have continuous-valued elements which are members of general functional spaces (Lee & Varaiya, 2002).

Systems Modeling

General systems theory has been a very valuable tool for advancing our understanding of complex systems. Unfortunately however, the science of systems modeling still lags the complexity of large-scale networks of systems of interest (e.g. power generation and distribution networks, telecommunications networks, and economic networks) in the sense of being unable to predict future behaviors of networks of complex systems (BAST, Board on Army Science and Technology, 2005). The report by the National Academy also applies to the inability of predicting future states of the social networks category of complex systems which are the area of interest of this paper. The interest in social networks lies in the fact that tribal and locality dynamics are those exhibited by social networks of interest and are known to affect outcomes of tactical operations through assisting or opposing the mission outcomes. In this paper specific models predicting specific outcomes are not attempted. What is attempted is the description of tribal and locality dynamics observed and reported during a period of time in Afghanistan and the abstraction of those observations and assertions into models which, given the identification of system parameters, could provide estimates of future system state. Since the models will be wrong, the goal of the effort is that the predictions of future system state available from the models will be "close enough" to the actual future states of the systems of interest to be valuable to commanders in selecting alternative courses of action to meet the intent of the commander for a given operation.

Following the development provided in the first Flowing Valued Information (FVI) project report (James, et al., 2009), we assume a system, S, to be adequately approximated as an input-output relation. That is, we consider the behaviors of S to be represented as:

$$S \subseteq V \times X$$

where S is a function from V to X (S: V →X), and it is natural to consider S to be a functional system. In this case, it is convenient to consider the elements of V to be inputs and the elements of X to be outputs (the state of the system) so that S expresses a functional input-output relationship. However, while many system modeling efforts assume that V and X are members of abstract sets, capturing the complexity of networked systems of interest requires that the domain and range of the functions of interest be expanded to include real-valued variables as well as discrete-valued variables. Following the development of hybrid control theory as discussed by Lygeros, Pappas, and Sastry (Lygeros, Pappas, & Sastry, 1999), we consider the functional behavior (input output mapping) of a complex system, S, to be closely approximated by a *hybrid automaton*, *S*, which captures the logical and physical constraints on system evolution: $S = (X, V, Init, f, Inv, R)$ where

X is a finite collection of state variables. We assume

$X = (X_D \cup X_C)$ with X_D countable and

$X_C \in \Re^n$;

V is a finite collection of input variables. We assume

$V = (V_D \cup V_C)$ with V_D countable and $V_C \in \Re^n$;

$Init \subseteq X$ is a set of initial states;

$f: X \times V \to X_C$ is a vector field, assumed to be globally Lipschitz in X_C and continuous in X_C ;

$Inv \subseteq X \times V$ is an invariant set;

$R : X \times V \rightarrow 2^X$ is a reset relation.

We refer to $x \in X$ as the state of S and to $v \in V$ as the input of S.

Associated with this model are rigorous definitions of continuous and discrete states and associated models of continuous behaviors and discrete behaviors and hybrid (combination of continuous and discrete) behaviors. These behaviors consist of continuous, discrete and hybrid trajectories from a set of initial states to a set of final states. The complete power of the hybrid modeling approach is not needed for each component (and may not be desirable!). For some (maybe most) of the system components, a discrete model is sufficient. Likewise, for some components, a continuous-system model is sufficient. The hybrid model is used when the future states of the composed system includes parameters of interest which exhibit both discrete and continuous behaviors (evolutions). We are convinced that for our particular problem space, the hybrid model is generally required for capturing the range of parameter values of interest for complex system evolution. Our problem space of interest in this paper is that which can adequately represent tactical-level military operations where success in humanitarian assistance/disaster recovery (HADR) operations requires reasoning about trustworthiness of information elements to be flowed between distributed information nodes in a manner which (1) increases the value of information available for goal-oriented decisions in accordance with the intent of the commander taking into account that some of the information elements vary continuously with time and space, and (2) which complies with a command decision to share information. Decision support tools available to commanders today continue to rely on security models which restrict analysis to parameters whose values are members of sets. Restriction of the variability of parameters to discrete values (i.e. to values which are members of sets) does not enable reasoning about parameters of interest whose values change continuously. An example of situations in which reasoning about continuous-valued and discrete-valued parameters of interest for mission success will affect operational outcomes is provided in the appendix.

The focus of this report is on modeling and sharing of information pertaining to understanding (predicting) the effects of tribal and locality dynamics on desired tactical outcomes (i.e. PMESII state of the local battlespace).

Flowing Information

As indicated by a key individual in implementing the current security features available in Java, Li Gong, "Fred Schneider, a key member of the Java Security Advisory Council, together with his PhD student at Cornell, Ulfar Erlingsson, proposed Inline Reference Monitors, which promised not only a mechanism to completely separate security policy from enforcement (via bytecode rewriting) but also a theoretical proof that the solution was extremely expressive – it is able to encode all enforceable policies (Gong, 2009)." The idea of incrementally adding security features as information flows through a system has also been investigated by Tse and Zdancewic: "In addition to allowing more expressive security policies, run-time principals enable the integration of language-based security mechanisms with other existing approaches such as Java stack inspection and public key infrastructures. We sketch an implementation of run-time principals via public keys such that principal delegation is verified by certificate chains (Tse & Zdancewic, 2007)." Incremental manipulation of signals over time is also an attribute of causal systems which are the category of systems considered by the controls community. The hybrid automaton modeling approach has been developed within the control community for analysis, design and implementation of distributed (networked) control systems for moving the state of causal systems from a current state to some future state. The technology enables a more rigorous analysis of the Service Oriented Architecture (SOA) or middleware approach for distributed system development whereby applications use well-defined interfaces to access services from other local and distributed applications (the service or middleware) in order to enable achieving desired functionality.

We observe that the interacting networks which determine battlespace state for tactical operations are causal systems. Within the limits of control science and the range of actions available to alter the battlespace state, models of systems which are "close enough" to the actual system behaviors enable movement of system outcomes to desired future states. By appropriate choice of the domain and range of the functional system (hybrid automaton) (and a set Z to represent outputs when necessary), one can closely represent some situation of particular interest and reach significant conclusions about that situation.

Secure Computer Systems

Also, while we shall investigate a bounded subset of the general problem of computer security for networked devices, the problem is chosen to be representative of the more general problem of improving our understanding (prediction) of the future states of sets of interdependent complex networks of infrastructures (James, Dodge, Graham, & St. Leger, 2009) and the populations which use them (Thompson, 2006). Indeed, the more general problem for operationally-significant information elements is to value the information relative to its trustworthiness and temporal and spatial relevance (James J. R., Thoughts on Information Operation Detection as a Nonlinear, Mixed-Signal Identification Problem: A Control Systems View, 2000; James & Mabry, Building Trustworthy Systems: Guided State Estimation as a Feasible Approach for Interpretation, Decision and Action Based on Sensor Data, 2004) (James & McClain, Tools and Techniques for Evaluating Control Architecture, 1999). That is, the issue of valuation and sharing of battlespace data is directly tied to estimating trust among the participants in providing information artifacts concerning battlespace state as well as in estimating the temporal and spatial degradation of the relevance of the information between different points among the battlespace dimensions.

Our interest in this paper is in a bounded subset of the general certification problem studied by the National Institute of Standards and Technology (Ross, Katzke, Johnson, Swanson, & Stoneburner, 2008) which is to provide an approach to certify security status within a single computer (i.e. a single component of an information system comprised of a network of devices). We specifically seek to enable certification of an implementation of an approach for flowing valued information among network nodes in a tactical communication system. In the initial report (James, et al., 2009) we sought to enable certification that a security compromise would not occur within a given computer. In addition, the first report also sought to enable certification that a sharing compromise (failure to share elements of information which have been marked as "need to share") would not occur within a given computer. The entities of interest in analyzing the possible security or sharing compromise were: applications, data, algorithms which control access to data, classifications of data elements and applications, the "need-to-know" status of computer entities, and the "need-to-share" status of computer entities.

For this report we are interested in maintaining the absence of ***security compromises*** or ***sharing compromises*** but we are focused on ***developing and sharing*** *estimates of tribal and locality dynamics* which could affect tactical operation outcomes.

Securing Information

Absolute security is not known to be achievable with available science and technology. The approach taken by the National Institute of Standards and Technology (NIST) under the authority of the Federal Information Systems Management Act (FISMA) is to make explicit decisions regarding balancing functionality with risk and to certify systems for operation after putting acceptable controls in place to achieve the selected level of risk (Ross, Swanson, Stoneburner, Katzke, & Johnson, 2004). For military operations, there are situations, such as Humanitarian Assistance/Disaster Recovery (HADR) operations, where ***mission success*** requires that relevant operational information ***be shared with individuals and groups not normally among those with whom we share operational information***. A widely-recognized operational shortfall is an inability to provide automated support to operational decisions to share information. One need is to provide automation support to small unit commanders to exercise military judgment and choose what information to share with whom and when to share the information. At the same time, provision of that support to automatically share relevant information and ***avoid sharing compromises***, must be implemented in such a fashion as to ***avoid security compromises*** of information which remains in a "need to know" status.

Valuing Information

For purposes of the Flowing Valued Information (FVI) project, the FVI team has distinguished between a parameter of interest converging over time to a particular quantity (value in one sense) and the relative contribution of a parameter of interest to accomplishing a given mission (value in another sense). That is, for elements of information deemed critical to the accomplishment of a given mission, all elements of information are not equal in value to the accomplishment of the mission. While the current report is authored by a single member of the FVI team of researchers, the first report (James, et al., 2009) also discusses the problem of valuing information.

We assume (1) that the only invariant in the battlespace over the time and space (temporal and spatial variance) associated with a given operation is the intent of the commander and (2) that the relative value of an element of information for a given operation is determined by the *relative contribution* of the information to meeting the ***intent of the commander***, and (3) that an *objective estimation* of the *relative value* of the various essential elements of information which can contribute to mission success is not possible since ***valuation is fundamentally a subjective process***. Thus, implementation of automation support for flowing valued information necessarily must include input from commanders in determining the relative contribution of elements of information to meeting the intent of the commander. We note that while Quality of Information (QoI) estimates are subject to objective metrics and estimation for use in sensor networks, the Value of Information (VoI) as we have used it is independent of the QoI. That is, any given element of information might be of extremely high quality (high QoI) but be essentially useless (low VoI) to determining the outcome of a tactical operation (or achieving any goal oriented behavior). Likewise, while a given element of information (parameter) might be extremely valuable (high VoI) to determining the outcome of a tactical operation, the actual quality of a given assignment (numerical quantity or string of symbols) to a variable representing that element of information might be very low (low QoI). Also, while some combination of QoI and VoI are needed to determine the relative utility of information to a decision-making process, the relative trustworthiness of the initial source of the data and the subsequent provenance of a given data element available for analysis also affect the utility of the data.

In addition, some estimate of risk lies at the heart of the problem of valuing information. For instance, implementation of the formal result reported in the first report (James, et al., 2009), for *maintaining an absence of security compromises* while *achieving an absence of sharing compromises* will require each commander to make trade-off decisions regarding maintaining security of information that needs to be protected while sharing information needed for mission success. That is, implementation of a “need-to-share” creates the risk that some material which should not be disclosed might be inadvertently released while sharing other information (e.g. a commander might deliberately choose to release particular information relative to a given operation to ensure local governance or NGO involvement but might inadvertently release data pertinent to oppnents inferring recurring tactics, techniques, and procedures (TTP) which were not intended to be disclosed). This is not a new situation since the tradeoff between maintaining security or achieving functionality is always present and simply placing information in an automated system approved for any level of security creates a risk that a security compromise might occur. The first report provides a framework for protecting information which must be protected while sharing information which needs to be shared in order to increase the likelihood of accomplishing the intent of the commander. The framework is a formal result for treating the sharing of information with coalition partners based on a "need-to-share" with the same degree of support as protecting information based on a "need-to-know".

Thus, we seek an easily understood approach for assigning metrics to elements of information which can subsequently be used for flowing information among network nodes in such a manner to increase the value of information available for making decisions. More formally, we seek a set of metrics and an associated set of processes for assigning numerical quantities and strings of symbols to parameters of interest in such a manner to facilitate determining the utility of the set of parameters to meeting the intent of the commander. That is, for the *hybrid automaton*, *S*, which captures the logical and physical constraints on system evolution: $S = (X, V, Init, f, Inv, R)$, we seek to facilitate analysis of a subset , X', of the finite collection of state variables (parameters) X , where

$X' = (X'_D \cup X'_C)$ with X'_D countable and

$X'_C \in \Re^n$.

The analysis of the subset of parameters will estimate the utility of the information to meeting the intent of the commander. To determine the relative utility, *U*, of the subset of parameters to meeting the intent of the commander we must discover the functional relationship between the quality of information (QoI), value of information (VoI) , trust, and risk associated with parameters, X'. That is, the utility, U, associated with the extent to which a set of parameters can estimate the likelihood of success in achieving the intent of the commander can be closely approximated by a *hybrid automaton*, $U = \left(X', V, Init, f, Inv, R\right)$ where

X' is a subset of the finite collection of state variables (parameters), X , where

$X' = \left(X'_D \cup X'_C\right)$ with X'_D countable and

$X'_C \in \Re^n$;

V is a finite collection of input variables. We assume

$V = \left(V_D \cup V_C\right)$ with V_D countable and $V_C \in \Re^n$;

$Init \subseteq X$ is a set of initial states;

$f: X \times V \to X_C$ is a vector field, assumed to be

globally Lipschitz in X_C and continuous in X_C ;

$Inv \subseteq X \times V$ is an invariant set;

$R : X \times V \to 2^X$ is a reset relation.

We refer to $x' \in X'$ as the state of the utility automaton, U and to $v \in V$ as the input of U .

The following assumptions and characteristics of modeling command intent and relative value of information are provided:

1. The intent of the commander is the only battlespace invariant during the course of execution of an operations order (OPORD).
2. If a commander sets relative importance of categories of information and policies for sharing information prior to commencement of execution of an operation, then automation assistance in flowing information during the operation is feasible.
3. The temporal constraints on unit activities to meet command intent are captured by the synchronization matrix.

4. The spatial constraints on unit activities to meet command intent are captured by the operations overlay.
5. The verbal approximation of command intent is captured in the mission and execution paragraphs of the operations order.
6. For HADR operations, the most critical information needed to determine mission success in meeting command intent will normally not be available on the tactical Internet. Examples of these elements of information include:
    a. Number of civilian dead,
    b. Number of civilian missing,
    c. Amount of food, water, shelter, and medical supplies needed,
    d. Tribal dynamics, and
    e. Locality dynamics.
7. Features of a reasonable dynamical model for valuing information elements include:
    a. Piecewise linear approximations of non-linear relationships,
    b. Exponential decay of effects over space and time,
    c. Bilateral and trilateral dynamical relationships among tribes, and
    d. Bilateral and trilateral dynamical relationships among locations.
8. Reasonable constraints for estimating relative utility (some function of quality, value, trust and risk) of information elements in meeting the intent of the commander include:
    a. Rules which identify changes in the phases of an operation called out in a synchronization matrix and associated data elements which determine satisfaction of those rules are more valuable than rules which determine values within a phase.
    b. If a "main effort" has been declared by the commander, then rules which determine status of the main effort are more important than rules which determine status of secondary efforts.
    c. Rules which identify crossing a coordination boundary of the operations overlay are more important than rules which determine location within a given coordination boundary.
9. The Analytical Hierarchy Process (AHP) is a reasonable approach for obtaining human estimates of the relative value (ratio scale estimates) of system parameters to meeting the intent of the commander.

A set of conclusions to be discussed in the report

The conclusions discussed in the following sections of the report regarding developing and sharing estimates of tribal and locality dynamics are:

1. Tribal dynamics matter at the tactical level and may determine mission success or failure,
2. Locality dynamics matter at the tactical level and may determine mission success or failure,
3. The utility of understanding tribal and locality dynamical analysis lies in understanding their affects on tactical outcomes and thus, tactical operational decisions,
4. Models of tribal and locality dynamics will be wrong but may be useful,

5. Estimating the utility (relative value) of tribal and locality dynamics should be a component of a more general approach for valuing tactical information among nodes in a tactical network,
6. Value of information at the tactical level should be directly related to achieving command intent for the operation since command intent is the only battlespace invariant,
7. Since the relative value of information is a subjective (human) estimate, the models of tribal and locality dynamics need to be simple to be useful at the tactical level,
8. Models of tribal and locality dynamics should result in ratio-scale estimates (i.e. not just that one attribute is more important but "how much" more important one attribute is than another),
9. NMAA faculty and staff are a national treasure of tactical, cultural, and locality understanding,
10. NMAA cadets are future Afghan leaders and their presence at NMAA for four years constitute a unique experiment in cultural diversity at the national level,
11. NMAA interpreters provide a window into Afghanistan tribal and locality dynamics, and
12. US and Turkish officers, civilians, and non-commissioned officers are regularly exposed to cultural dynamics in daily mentor roles with their NMAA counterparts in academic, athletic, and military programs.

Summary

It is increasingly the case that tactical commanders are inundated with a tidal wave of information that may or may not be critical to determining the outcome of the mission at hand (information/cognitive overload). With the increasing availability of unmanned ground and air vehicles, the information (sensory) overload will continue to grow. The Flowing Valued Information project seeks to develop underlying science and technology to move useful information to those nodes in a tactical network for which the value of the information available for decision making by tactical commanders is increased.

In section I we have provided a brief overview of general systems theory. We also discussed the need to protect (prevent security compromise) of information which needs to be protected and share (prevent sharing compromise) of information which needs to be shared and referenced a formal result from the first FVI report which established the technical feasibility of meeting this need.

The key portions of this section provide a discussion of estimating relative value of information and using that estimate together with estimates of information quality, trust, and risk, to estimate utility of information. The goal of the project is to use estimates of information utility to flow valued information among network nodes to increase the value of information available for decision making.

Section II: The National Military Academy of Afghanistan

NMAA as a national treasure of Afghanistan operational experience

The National Military Academy of Afghanistan (NMAA) was established in 2005 and is patterned after the United States Military Academy. NMAA provides a balanced four-year liberal arts education while also requiring completion of extensive military and athletic experiences. Athletic classes occur during the academic year. While most of the military classes occur during the breaks between semesters, military science classes are also taught during the academic year. The first class graduated from NMAA in January of 2009 (1388 in the Afghan calendar). The first female cadets were admitted in March of 2009. While approximately 350 cadets have been admitted in the past few years, the class being admitted in March of 2010 (class of 1393) will number approximately 640 since NMAA is ramping up from a total of approximately 1200 cadets to a population of approximately 2400 cadets.

NMAA Parade honoring departure of Sandhurst competition team to West Point NY, April 2009

NMAA is a National treasure of operational experience in Afghanistan. The cadets, officers, non-commissioned officers, and interpreters have lived the decades of conflict which have afflicted Afghanistan from the latter half of the twentieth century and are representative of the ethnic distribution of the population at large (i.e. Pashtun, Tajik, and Hazara dominant with other important ethnic minorities). The NMAA Commander is MG Mohammed Sharif, a Tajik. The Commandant is BG Hassamudin, a Tajik. The Chief of Staff is COL Mohammed Kazem, a Hazara. The Deputy Commander for Education (Dean) is COL Abdul Baqi Hamedullah, a Pashtun. COL Hamedullah's son is the first Afghan to graduate from the United States Military Academy (Class of 2009).

Lunch with NMAA Commander, MG Sharif

Officers with decades of operational experience

Many of the officers have decades of operational experience with a number of the senior officers having received training with the Soviets. This operational experience spans the time frame of the five different governments which have run Afghanistan over the past forty years (a kingdom, then an Afghan communist government, then the Soviets, then the Taliban, and now the Government of the Islamic Republic of Afghanistan (GIROA)).

Intimate knowledge of social and cultural aspects of the country

The officers, non-commissioned officers, interpreters and civilians at NMAA have intimate knowledge of the social and cultural aspects of the country. Since the ethnic distribution of the staff, faculty and cadets reflects that of the nation as a whole, the broad cultural diversity of the nation is present at one location.

Knowledge of TTP by location and cultural group

The officers, non-commissioned officers, interpreters and civilians at NMAA have knowledge of tactics, techniques and procedures (TTP) of the mujahedeen, Taliban, local militias, Afghanistan National Army (ANA), and Afghanistan National Police (ANP). The TTP of the ANA is taught during the academic year during military science courses and experienced during the Summer as pert of the Summer military training.

Rotation of graduates and staff and faculty back to operational assignments

The officers, non-commissioned officers, interpreters and civilians at NMAA maintain contact with their local villages, districts and provinces and are rotated to different assignments in the ANA. The cadets return to their home provinces during semester breaks and are assigned into leadership positions in the ANA upon graduation.

Summary

In Section II information has been provided regarding the some attributes of the National Military Academy of Afghanistan. While the near-term result of the NMAA effort is to provide a source for Afghanistan National Army (ANA) officers with a liberal education, NMAA also is a treasure of operational experience and a source of mid-grade ANA officers who will rotate back to operational assignments.

Section III: Dynamics of interactions of NMAA Staff and Faculty

The NMAA curriculum shown below is patterned after the curriculum of the United States Military Academy in terms of offering a liberal arts education with a substantial number of required courses in a variety of disciplines.

General Curriculum

	1st Year							
1st Semester	Foreign Language I 4.0	Composition (Dari) 4.0	Information Technology 3.0	Chemistry I 4.0	Pre-Calculus & Modeling 4.0	Physical Education 1.5	Intro to the Military Profession 2.5	
2nd Semester	Foreign Language II 4.0	Composition (Pashto) 4.0	Psychology 3.0	Ethics, Moral Theory & Islam 4.0	Calculus I 4.0	Physical Education 1.5	Introduction to Warfighting 2.5	
	2nd Year							
3rd Semester	Foreign Language III 4.0	Law 3.0	Information Systems 3.0	Physics I 3.0	Calculus II 4.0	Physical Education 1.5	Small-Unit Tactics I 2.5	
4th Semester	Foreign Language IV 4.0	Economics 3.0	Intro to Engineering I 3.0	Physics II 3.0	Statistics 4.0	Physical Education 1.5	Small-Unit Tactics II 2.5	
	3rd Year (Select Major)							
5th Semester	Foreign Language V 4.0	Afghan Regional & Islamic History 2.0	Intro to Engineering II 3.0	Military Geography 3.0	Elective	Elective	Combined Arms Operations I 2.5	
6th Semester	Foreign Language VI 4.0	World History 3.0	Biology 4.0	International Relations 3.0	Elective	Elective	Combined Arms Operations II 2.5	
	4th Year (Select Branches)							
7th Semester	Military History I 3.0	Military Leadership 3.0	Elective	Elective	Elective	Elective	Military Science I 2.5	
8th Semester	Military History II 3.0	Government 2.5	Elective	Elective	Elective	Elective	Military Science II 2.5	
	COMMISSION							

General Curriculum

The general curriculum for a NMAA cadet is shown above. This graphic, as well as the graphics for the department programs given below are taken from the 2009 command briefing for the US mentor team.

Many trained in USSR

The military faculty in general do not have technical training. Many of the senior officers and all of the senior aviators were trained in the Soviet Union. Some recent graduates are being retained to work with the academic departments. The goal is to eventually have all of the military faculty educated to conduct the academic class material. However, currently Afghan civilians are contracted by the US mentor team for the majority of the Civil Engineering, Computer Science, and Legal faculty as well as in other academic departments.

All cadet classes taught by Afghans

All of the academic, athletic, and military science classes are taught by Afghans. Class sizes are small (19 cadets or less) and have frequent cadet recitations of course material during the instructional periods.

Computer Science Department

The Computer Science Department provides an undergraduate education in Computer Science. The Curriculum for the Computer Science Program is comparable to that of computer science curricula in the United States.

N M A A

Computer Science

	1st Year						
1st Semester	Foreign Language I 4.0	Composition (Dari) 4.0	Information Technology 3.0	Chemistry I 4.0	Pre-Calculus & Modeling 4.0	Physical Education 1.5	Intro to the Military Profession 2.5
2nd Semester	Foreign Language II 4.0	Composition (Pashto) 4.0	Psychology 3.0	Ethics, Moral Theory & Islam 4.0	Calculus I 4.0	Physical Education 1.5	Introduction to Warfighting 2.5
	2nd Year						
3rd Semester	Foreign Language III 4.0	Law 3.0	Information Systems 3.0	Physics I 3.0	Calculus II 4.0	Physical Education 1.5	Small-Unit Tactics I 2.5
4th Semester	Foreign Language IV 4.0	Economics 3.0	Intro to Engineering I 3.0	Physics II 3.0	Statistics 4.0	Physical Education 1.5	Small-Unit Tactics II 2.5
	3rd Year (Select Major)						
5th Semester	Foreign Language V 4.0	Afghan Regional & Islamic History 2.0	Intro to Engineering II 3.0	Military Geography 3.0	Fundamentals of Programming 4.0	Wed Design & Graphics 4.0	Combined Arms Operations I 2.5
6th Semester	Foreign Language VI 4.0	World History 3.0	Biology 4.0	International Relations 3.0	Adv Programming 4.0	Computer Networks 3.0	Combined Arms Operations II 2.5
	4th Year (Select Branches)						
7th Semester	Military History I 3.0	Military Leadership 3.0	Data Structures & Algorithms 4.0	Network Admin 3.0	Computer Architecture 3.0	Database I 4.0	Military Science I 2.5
8th Semester	Military History II 3.0	Government 2.5	Web Development & Application 4.0	Network Security 3.0	Software Engineering Capstone Project 8.0	Database II 4.0	Military Science II 2.5
	COMMISSION						

Four Year Program for Computer Science Majors

Elective Computer Science class at NMAA

The Computer Science courses are taught in six computer laboratories. A fiber optic Campus Area Network (CAN) operating at 1 gigabit per second between the headquarters building and all academic buildings was completed in July of 2009.

Civil Engineering Department

The Civil Engineering Department provides an undergraduate education in Civil Engineering. The Curriculum for the Civil Engineering Program is comparable to that of civil engineering curricula in the United States.

Civil Engineering

	1st Year							
1st Semester	Foreign Language I 4.0	Composition (Dari) 4.0	Information Technology 3.0	Chemistry I 4.0	Pre-Calculus & Modeling 4.0	Physical Education 1.5	Intro to the Military Profession 2.5	
2nd Semester	Foreign Language II 4.0	Composition (Pashto) 4.0	Psychology 3.0	Ethics, Moral Theory & Islam 4.0	Calculus I 4.0	Physical Education 1.5	Introduction to Warfighting 2.5	
	2nd Year							
3rd Semester	Foreign Language III 4.0	Law 3.0	Information Systems 3.0	Physics I 3.0	Calculus II 4.0	Physical Education 1.5	Small-Unit Tactics I 2.5	
4th Semester	Foreign Language IV 4.0	Economics 3.0	Intro to Engineering I 3.0	Physics II 3.0	Statistics 4.0	Physical Education 1.5	Small-Unit Tactics II 2.5	
	3rd Year (Select Major)							
5th Semester	Foreign Language V 4.0	Afghan Regional & Islamic History 2.0	Military Geography 3.0	Engineering Mathematics 4.0	Construction Management 3.0	CE Fundamentals Surveying, CADD, & Site Eng 4.0	Combined Arms Operations I 2.5	
6th Semester	Foreign Langauge VI 4.0	World History 3.0	International Relations 3.0	Biology 4.0	Thermodynamics & Fluid Mechanics 4.0	Mechanics of Materials 4.0	Combined Arms Operations II 2.5	
	4th Year (Select Branches)							
7th Semester	Military History I 3.0	Military Leadership 3.0	Geotechnical Engineering 4.0	Environmental Engineering 4.0	Design of Reinforced Concrete Structures 4.0	Structural Analysis 3.0	Technical Communication 3.0	Military Science I 2.5
8th Semester	Military History II 3.0	Government 2.5	Transportation Engineering 4.0	Hydrology & Hydraulic Design 4.0	Design of Steel & Masonry Structures 4.0	Earth Quake Dynamics 3.0	CE Design Project 4.0	Military Science II 2.5
	COMMISSION							

Four Year Program for Civil Engineering Majors

Legal Studies

The Legal Studies Department provides an undergraduate education in law. The Curriculum for the Legal Studies Program is comparable to that of law curricula in the United States with the exception of the course in Islamic law.

Legal Studies

	1st Year						
1st Semester	Foreign Language I 4.0	Composition (Dari) 4.0	Information Technology 3.0	Chemistry I 4.0	Pre-Calculus & Modeling 4.0	Physical Education 1.5	Intro to the Military Profession 2.5
2nd Semester	Foreign Language II 4.0	Composition (Pashto) 4.0	Psychology 3.0	Ethics, Moral Theory & Islam 4.0	Calculus I 4.0	Physical Education 1.5	Introduction to Warfighting 2.5
	2nd Year						
3rd Semester	Foreign Language III 4.0	Law 3.0	Information Systems 3.0	Physics I 3.0	Calculus II 4.0	Physical Education 1.5	Small-Unit Tactics I 2.5
4th Semester	Foreign Language IV 4.0	Economics 3.0	Intro to Engineering I 3.0	Physics II 3.0	Statistics 4.0	Physical Education 1.5	Small-Unit Tactics II 2.5
	3rd Year (Select Major)						
5th Semester	Foreign Language V 4.0	Afghan Regional & Islamic History 2.0	Intro to Engineering II 3.0	Military Geography 3.0	Introduction to Law 3.0	Comparative Law 3.0	Combined Arms Operations I 2.5
6th Semester	Foreign Language VI 4.0	World History 3.0	Biology 4.0	International Relations 3.0	Islamic Law 3.0	Public International Law 3.0	Combined Arms Operations II 2.5
	4th Year (Select Branches)						
7th Semester	Military History I 3.0	Military Leadership 3.0	Human Rights Law 3.0	Constitutional Law 3.0	General Criminal Law 3.0	Law of Armed Conflict 3.0	Military Science I 2.5
8th Semester	Military History II 3.0	Government 2.5	General and Military Criminal Procedures 3.0	International Criminal Law 3.0	Course Thesis 4.0	Commercial Law 3.0	Military Science II 2.5
	COMMISSION						

Four Year Program for Legal Studies

Major in General Science and Engineering

The intent is to begin a major in General Science and Engineering which will allow cadets to choose to study a range of science and engineering subjects without concentrating on either civil engineering or computer science.

Major in Language and Culture

The intent is also to offer an opportunity to focus more on liberal arts courses by offering a major in language and culture which will allow cadets to choose to study a range of liberal arts courses without concentrating on legal studies.

Major in Leadership and Management

Subsequent to offering majors in General Science and Engineering and Language and Culture, the intent is to create a major in leadership and management.

Department of Military Instruction

The Department of Military Instruction offers military science courses during the academic year and coordinates the military training activities during the Summer break between semesters.

Unfailingly courteous and considerate of guests

The NMAA staff and faculty are unfailingly courteous and considerate of guests. The responsibilities of a host are taken very seriously and the proper treatment of guests is a matter of honor to those involved.

Pay, status, and working relationships

A recurring theme among the staff and faculty was the dynamic of the different individuals and tribal groupings "looking over their shoulder" at other groups to ensure that their perceived status and pay were similar. Differences in pay were a recurring reason for complaints among the Computer Science faculty. Since the pay for the civilian faculty was being paid through the US mentor team, the officer in charge of the contracts experienced recurring complaints by faculty members that the pay of one individual or another was higher than theirs while the work performed and faculty experience was the same.

Discussions with several of the interpreters indicated that this issue of constant comparison of status and relative reward is a feature of Afghanistan culture. That is, individuals within a given family, tribe, and location are constantly "looking over their shoulders" to see if their status or level of reward is comparable to those whom they see as competitors.

Classroom observations and technical seminars

The Afghan cadets are very attentive in class and the instructors are well-prepared. While the technical curricula for the different majors are comparable to those of liberal arts colleges in the US, the content remains constrained by the fact that none of the faculty has a doctorate in their disciplines and most do not have a master's degree in their discipline. However, NMAA is the "crown jewel" of the Afghan education system in both the quality of the facilities available and the quality of the education offered. It was inspiring to see the faculty and the cadets work to deliver and understand the computer science material that I observed presented in the classes I attended.

Summary

NMAA Staff and faculty provide a challenging yet supportive environment for the Afghan cadets to learn a variety of disciplines. The tribal dynamics exhibited among the staff and faculty offer a view of that of the country at large. However, the fact that the ethnic and locality distribution of staff, faculty, and cadets reflects that of the nation as a whole means that NMAA provides a testbed for resolving tribal and locality conflicts and achieving national unity.

Section IV: Dynamics of interactions of NMAA Cadets

Now number approximately 1200

The first class from the National Military Academy of Afghanistan graduated in January of 2009 (Afghanistan year 1388). The number of cadets now numbers approximately 1200 but approximately 640 will be admitted in March of 2010 as the number is ramped up to approximately 2400.

First female cadets admitted in March of 2009

The first female cadets were admitted in March of 2009. Ten female medical students were admitted with 30 male medical students and will follow the first year of the NMAA curriculum before transferring to the medical school at Kabul University.

Major Letsy Perez with first NMAA female cadets

Bright, hard working, and want to do good things for their country

The NMAA cadets are much like Service Academy cadets and midshipmen in the United States. They are bright, hard working, and want to do good things for their country.

Family first, then tribe, but also a sense of national identity

Each Sunday, the US mentors conduct a voluntary "conversations in English" activity with the NMAA cadets in which small groups of NMAA cadets meet with mentors and practice their English while asking whatever questions they choose of the mentors.

Dr. James during "Conversations in English" with two fourth year cadets

The two cadets in the photo above, one a member of the Pashtun tribe and one a member of the Uzbek tribe, are friends and are both to be commissioned into the Army Air Corps upon graduation in 2010. They asked similar questions concerning opportunities for study in the United States and relations between the US and the GIRoA.

Database project

The NMAA administrative information has been largely stored in paper records reflecting data stored in spreadsheets on local computers. With the creation of the NMAA campus area network, it has become feasible to create a NMAA database stored on one of the servers attached to the network. While this is very normal throughout the United States and much of the rest of the world, this is quite innovative in Afghanistan where the majority of the population cannot read and electric power, where it is available, is intermittent at best.

The NMAA commander approved construction of the NMAA database with the initial application of the database to be facilitation of the computation of the "Order of Merit" for the Class of 1389 (Class of

2010). While the Order of Merit is principally determined by weighted average of the grade in each academic course and the number of semester hours for each course, military and athletic results are also considered. Calculation of the Order of Merit for the initial class which graduated in January of 2009 was problematic since information from many different paper sources and spreadsheets had to be manually combined to determine the cadet with the highest overall average. COL Ed Naessens from USMA and LTC Hal Taylor of USAFA prepared a spreadsheet application in the Spring of 2009 which was approved by the Dean and the Commander for calculation of the Order of Merit so the database project was initiated to create a repository for the necessary data to be provided to the spreadsheet and the resulting sequence of merit for graduation entered back into the database. The project was given to the Head of the Computer Science Department, COL Rahman, to supervise and he assigned a recent graduate who is a junior faculty member of his department, LT Jumaladen Kamazada, as the project lead.

LTC Scott Lathrop, Computer Science Mentor, and LT Jamaladen Kamazada reviewing database design

The database will provide the NMAA Commander with the opportunity to improve management of NMAA installation and support functions as well as the military, academic, and athletic activities of the cadets, staff and faculty. The database can also be the basis of longitudinal studies of social and cultural trends across Afghanistan since NMAA is unique in being the one place where tribal and locality dynamics are available for review and reflection.

Section V: Dynamics of interactions of NMAA Interpreters

The NMAA interpreters are another source of observing the cultural diversity of Afghanistan. There are ten interpreters who work with the US mentors, one of which is female, and one interpreter who works with the Turkish mentors.

Capabilities, experiences, and work products

The interpreters enable the US mentors to interface with their NMAA counterparts. They interpret the daily discussions held among the mentors and the Afghan staff and faculty. They translate documents related to administration and curriculum development. They provide insights into cultural differences which facilitate interactions (such as it is OK to ask about whether a person's family is doing well but not specifically about a person's wife). The interpreters conducted a weekly session of common phrases in Dari to assist mentors in interacting with their counterparts.

Pay, status, and working relationships

A consistent attribute of working with the staff, faculty, cadets, and interpreters is that there is an ever present awareness among a given group of the relative status (whether the metric of measuring the status is pay or recognition or access) of different members of the group. Discussions with the interpreters indicate this is an attribute in communities across Afghanistan and a constant source of conflict among tribal and locality affiliations. That is, everyone (by social grouping whether it is family, tribe, or community) is "looking over their shoulders" to make sure that some other group is not getting a larger piece of a particular pie than they are. Thus, it behooves mentors at NMAA and advisors across the International Security Assistance Force (ISAF) to seek "common ground" for advancement among whatever groups are involved in a given effort.

Lessons learned from a series of classes given to interpreters

Interpreters, similar to the cadets, staff and faculty are eager to learn more about the United States and seek to develop long-term relationships. They deeply appreciate any effort to improve their own understanding of a given area of expertise. I conducted a series of voluntary seminars on use of the Excel spreadsheet and each lecture was well attended.

Section VI: NMAA Status and Future Developments

NMAA remains the "crown jewel" of Afghanistan educational opportunities and will graduate the future leaders of the country. NMAA has ISAF and GIRoA support for expansion of staff and faculty capabilities.

Move to Qargha and the National Defense University

NMAA is in the process of moving to a new facility to be constructed North West of Kabul. NMAA will be the largest institution to be housed at the National Defense University to be built at Qargha.

Increase in size of the cadet corps

The size of cadet corps is being increased to match the recent increase in the size of the Afghanistan National Army (ANA). The class to be admitted in March of 2010 will be 640 and the size of the corps is increasing from around 1200 to around 2400.

Increase in the number of female cadets

The goal is to have ten percent of the NMAA Corps of Cadets to be female. The new facility will have female barracks as well as male barracks.

Difficulty of planning for the future

One attribute of the Afghanistan management infrastructure is a consistent difficulty in planning for the future. This was evident in several actions undertaken while I was at NMAA but especially in assisting in planning the move to Qargha and also in updating the five-year plan for the information infrastructure.

Section VII: NMAA Mentors

Navy, Air force, Army Reserve, USMA, and USAFA team members

The US Mentor team has Navy, Air Force, Army Reserve, and representatives from both the United States Military Academy (USMA) as well as the United States Air Force Academy (USAFA).

The Superintendents of USMA have sent over 100 staff and faculty members to NMAA since assisting is founding NMAA in 2005. The NMAA Support Team is a part of the Combined Security Transition Command – Afghanistan (CSTC-A) which is a subordinate command of the International Security Assistance Force (ISAF) which is assisting the Government of the Islamic Republic of Afghanistan (GIROA) under the auspices of the United Nations Assistance Mission of Afghanistan (UNAMA).

Dr. John James with ISAF Flags at NMAA and Kabul airport runway in the background

NMAA US Mentors in the Spring of 2009

US Mentors in June 2009: Left to right – MAJ Perez USA, SFC Wiser USA, LTC Cross USA, COL Cook USAF, SFC Herbert USA, LT Moch, USN, COL Crawford USA, CPT Mather USA, Capt Carpenter USAF, LTC Lathrop USA, Dr. Tully Army Civilian, LTC Veneri USAF, LTC Yedinak USA, MAJ Mikits USA, Dr. Bristow Army Civilian, COL Korycinski USA, LTC Modinger USAF, LTC Jones USAF, SFC Waggoner USA, Dr. James Army Civilian, LTC Phillips USA, LTC Jones USA

Turkish mentors

The Turkish mentors have a similar role to play as the US mentors. That is, they mentor their counterparts in academic, athletic, and military classes but do not conduct classes themselves. Like the US mentor team, the Turkish mentor team has both officer and enlisted personnel assigned to work with the NMAA staff and faculty.

Roles, missions, and projects

The US and Turkish mentors seek to assist the NMAA staff and faculty in planning and executing their academic, athletic, and military science classes. Mentors also assist in cadet and faculty projects.

Role of mentors in sending cadets to the PRTs

Mentors assisted in preparing a letter from the NMAA Commander, MG Sharif, through the ANA headquarters to the ISAF Commander requesting assistance in placing cadets in their home provinces during semester breaks to work with the Provincial Reconstruction Teams (PRTs).

Section VIII: Importance of Provincial Reconstruction Team capabilities

The Provincial Reconstruction Teams (PRTs) are the chosen vehicle to assist GIRoA in building (or rebuilding) the various infrastructures of Afghanistan.

A Princeton University Report from the Woodrow Wilson School in early 2008 , http://wws.princeton.edu/research/pwreports_f07/wws591b.pdf , reviewed three models of organizing PRTs in Afghanistan. The report has a fairly extensive analysis of PRT efforts to achieve improvements in civil-military operations and achieve interagency cooperation. However, the report does not compare the Afghanistan PRT organizational varieties and alternative project execution processes to those used by the US Army in Vietnam during the period 1968-1972 even though that effort achieved singular success in aligning civil-military operations and achieving interagency cooperation. Significant differences between efforts in Vietnam and those in Afghanistan was the decision to (1) have the civil portion of the civil-military operation subordinate to the military operational chain of command and (2) Have a significant civil-military structure and presence at the District level in Vietnam to assist in implementing the change in strategy from a “search and destroy” to a “seize and hold” strategy. The seize and hold strategy is sometimes referred to as an “ink blot” counterinsurgency (COIN) strategy in that the intent is to remain in selected areas squeeze out the insurgents by making them irrelevant to success in a given area and incrementally increase the size of the area that is fully controlled by the government (that is, “grow the ink blot”).

Need to involve district and tribal leaders

Similar to what was done in Vietnam at the Provincial and District level, improvements are needed in Afghanistan to increase the coalition presence at the District level which is where the various projects are actually accomplished. There is recurring evidence that the culture of Afghanistan is one which has retained its inclination to organize governance activities around tribal leaders. The Taliban consistently seek to replace the tribal leaders and this is a mistake which coalition partners should seek to exploit by coordinating activities through the tribal leaders and encouraging them to align their activities with the government and occupy positions of authority in the district and village governance elements. However, the majority of the ISAF structure is allocated at provincial level which is too far removed from the district and village level.

Need to improve awareness of project status

Recurring evidence has been received that there is little or no awareness at national level of many of the projects undertaken at district and village level. This needs to be improved.

Need to understand dynamics at squad and platoon level

There is a need for commanders at platoon and squad level to understand tribal and locality dynamics in their area of operations. Conflicts of long standing due to competitions among tribal groups or among different families in a given tribe of resources available at a given location (water, land, timber, minerals, jobs,…) should be understood by tactical commanders in order to improve chances of achieving assigned missions, especially HADR missions.

Relation of HADR operations and security operations

Depending on the level of hostile capabilities in a given area of operations, the success or failure of humanitarian assistance/disaster recovery (HADR) operations may depend upon the effectiveness of associated security operations.

During the year I spent as a District Senior Advisor (DSA) in Phu Thu District, Thua Thien Province in South Vietnam, about 7,000 refugees from the Tet 1968 operations were resettled back into their home village areas in the five villages and thirty hamlets of the District. We also increased the arable land in the district by about a third by rebuilding a dam that had been destroyed and USAID providing small diesel tractors to each village chief so that land which had lain fallow could be re-cultivated. New strains of high-yield rice were introduced by USAID as were Yorkshire hogs which grow to be much larger than the Vietnamese pigs. Cement was issued to hamlet chiefs to dig wells to provide potable water since the principle health issue was dysentery. These efforts were made possible by the fact that the Viet Cong insurgents had largely turned the populace in the district against them by atrocities committed during the Tet 1968 offensive. This meant that efforts to form local militia units were successful and the government issued arms to platoons of militia in 30 of the hamlets as well as six company-sized militia units at the district level.

The strategy for military operations in Vietnam had switched from a “search and destroy” approach to a “seize and hold” approach. The “seize and hold” operations were characterized by a large number of small patrols throughout selected areas. The Phu Thu District forces participated in a two-month combined arms operation, Operation Saturate , in which the US Marine Combined Action Company (CACO) assigned to the district participated in patrols with six of the People Self Defense Forces (PSDF) platoons, while an infantry battalion from the 101st Airborne Division (the 1st of the 327th Infantry) teamed with a battalion from the First ARVN Division. The combined efforts resulted in conducting more than fifty patrols at squad level throughout the district for two months. The district forces continued to conduct nightly patrols throughout the district after the completion of Operation Saturate. The security operations enabled village elections and reconstruction efforts at the district level in addition to the resettlement, health, and agriculture efforts mentioned above. The reconstruction efforts at district level included a class 60 bridge across a canal to offer easier access to the district as well as a six kilometer road across the middle of district and smaller farm-to-market roads linking to the central road.

Similar to what was done with great success in Vietnam in support of the “seize and hold” strategy, support of the “ink blot” strategy in Afghanistan de expanded efforts at District and Village level. That is, to be successful in enabling the GIRoA to lead security and reconstruction efforts, future coalition activities should focus at district and village level while management of the flow of resources is coordinated at provincial level. Discussions with other advisors in theater, especially the engineers supporting the Provincial Reconstruction Teams (PRTs) indicated a need for transparency for resource allocations between provincial and district levels. Such a strategy will decrease corruption and enable more results for the people of Afghanistan. This is consistent with recent announcements by General McChrystal concerning reducing civilian casualties and also with the paper from MG Flynn, the senior intelligence officer in ISAF, MG Michael Flynn, http://www.cnas.org/files/documents/publications/AfghanIntel_Flynn_Jan2010_code507_voices.pdf which asserts an intention to move from a focus on the enemy to a focus on the people.

Need to synchronize national and coalition partner efforts

While the number of troops are not available in Afghanistan to conduct the same level of operations at district level, I believe the fact that so little is known at national level concerning the status of PRT operations is partly due to the fact that we have no effort at the district level which is where the direct connection to the people in the villages is made. There is a need to synchronize national and coalition partner efforts in selecting and executing PRT projects.

Section IX: Role of the DARPA TIGR system as a means of collecting tactically relevant data

The DARPA Tactical Ground Reporting (TIGR) system has performed admirably as an effective tool for replacement in place/transfer of authority (RIP/TOA) activities as well as in incrementally improving the understanding of the area of operations for tactical units.

People and events, reports, and collections of reports

The TIGR system for collecting multimedia (movies, pictures, audio, and text) data provides a browser interface to a map display system similar to Google Maps. However, TIGR provides a relational database for multimedia storage and a search capability which returns icons displayed on the map of data of interest to tactical commanders.

Data is arranged at the lowest level as people and events. The information on people and events can be collected into reports about the people and events and the reports can be arranged as collections of reports about particular items of interest.

TIGR capabilities in collecting HADR operational data

The DARPA PM is arranging for a HADR interface to be created for TIGR which will enable TIOGR to collect and display data useful for HADR operations.

Section X: Synchronizing USMA and NMAA information

The Flowing Valued Information project will demonstrate bi-directional flow of information across a security boundary in accordance with a command declaration of a need to share. The data will be sensitive but unclassified data collected in support of HADR operations conducted with the PRTs.

Need to understand operations at the tactical level

There is a need to understand operations at the tactical level in order to flow information among network nodes to increase the value of information available at the tactical for making decisions to meet the intent of the commander.

DIME on PMESII technical shortfalls

We are currently unable to predict the PMESII outcomes which will occur in response to DIME decisions. The FVI project aims to understand complex systems well enough at the lowest tactical level to begin to build “close enough” predictive models to assist in meeting the intent of the commander.

Need to share information with ANA, ANP, and NGOs

There is a pressing need to share HADR information with the ANA, ANP, and the NGOs.

NMAA Server Rack July 2009

Technical goals

The Flowing Valued Information (FVI) project seeks to develop underlying science and technology and to prototype information management systems which will flow information among tactical network nodes in accordance with the relative value of the information to the success of the mission at hand. The current intent is to use the initial prototype devices to involve NMAA cadets returning to their home provinces during semester breaks to assist in coordination of reconstruction projects.

Database project

The NMAA Commander, MG Sharif, approved creation of a NMAA database in the Spring of 2009. The project is underway and will initially be used to calculate the order of merit for the second class to graduate from NMAA .

Cadet vacation project with the PRTs

The NMAA Commander, MG Sharif, has sent a letter to the ISAF commander and also to the CSTC-A commander requesting assistance in placing NMAA cadets with the Provincial Reconstruction Teams in their home provinces during semester breaks. The intent is to have the first cadets visit the PRT teams in August of 2010.

Using HADR missions as a means of understanding DIME on PMESII complexities

Analyzing the PRT activities in support of HADR missions should provide a rich source of data to begin to understand complexities of predicting the effects of DIME actions on PMESII outcomes.

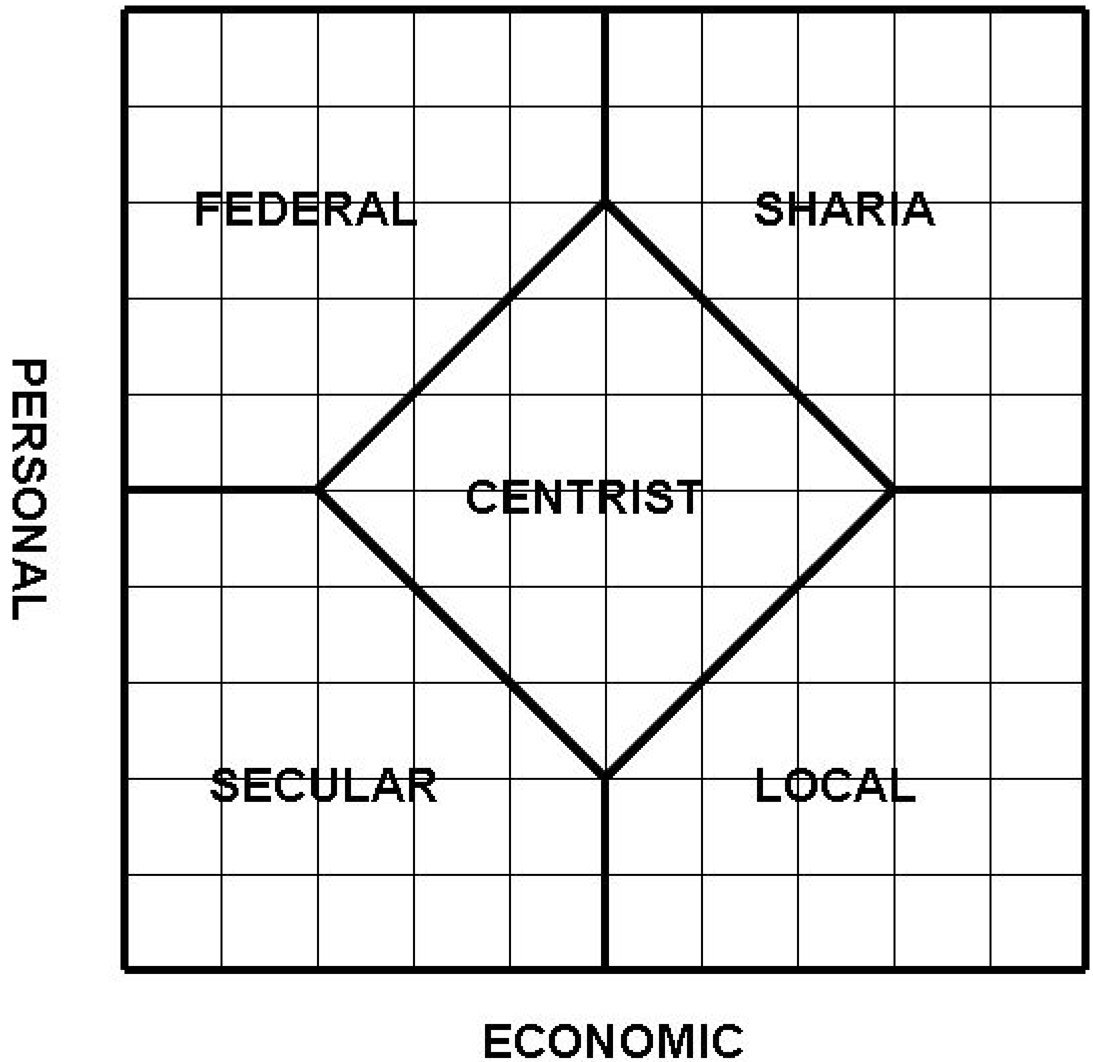
Estimating Tribal and Locality Dynamics for Reconstruction Activities

The following thoughts concerning the characteristics of predictive models of tribal and locality dynamics are provided:

- Piecewise linear “small signal” models around equilibrium points
- Assume exponential decay of dynamical behaviors with time and distance from local area where equilibrium conditions hold
- Assume threshold switching surface for supporting or opposing a collective action (by another tribe or locality or by members of the same tribe from another locality

Making a survey of tribal and locality preferences

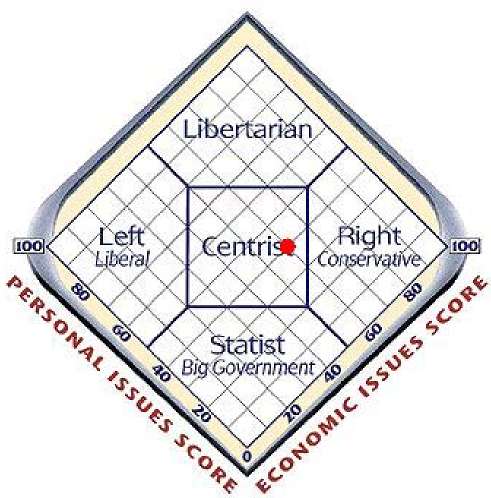
Upon returning from Afghanistan one discussion with other individuals at USMA and at the California State University in San Bernardino (CSUSB) has focused on the problem of estimating cultural and locality dynamics and their impact on governance. The figure below is an initial thought on obtaining a rough estimate of personal and economic positions by creating a set of ten questions to be answered. The approach is based on modifying an existing survey instrument represented by the next two figures.


FEDERAL
SHARIA
PERSONAL
CENTRIST
SECULAR
LOCAL
ECONOMIC

Personal Issues			
(Choose **A** if you agree, **M** for Maybe, **D** if you disagree.)	**A**	**M**	**D**
Government should not censor speech, press, media or Internet.	(•)	( )	( )
Military service should be voluntary. There should be no draft.	( )	( )	(•)
There should be no laws regarding sex for consenting adults.	( )	( )	(•)
Repeal laws prohibiting adult possession and use of drugs.	(•)	( )	( )
There should be no National ID card.	( )	( )	(•)

Economic Issues			
(Choose **A** if you agree, **M** for Maybe, **D** if you disagree.)	**A**	**M**	**D**
End "corporate welfare." No government handouts to business.	(•)	( )	( )
End government barriers to international free trade.	(•)	( )	( )
Let people control their own retirement; privatize Social Security.	(•)	( )	( )
Replace government welfare with private charity.	( )	( )	(•)
Cut taxes and government spending by 50% or more.	( )	( )	(•)

The RED DOT on the Chart shows where you fit on the political map.



Your **PERSONAL** issues Score is **40%**.
Your **ECONOMIC** issues Score is **60%**.

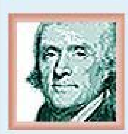
According to your answers, the political group that agrees with you most is...


Okay, what exactly is a centrist, anyway?


How you can help support this project


Help us spread the word about this Quiz!


Learn more about the Quiz and the Advocates


Want to learn a bit more about libertarianism?

SECTION XI: CONCLUSION

Introduction

In Section I we discussed the motivation and basis for this paper. We pointed out advancement of general system theory since the time of the original Bell-La Padula model and mentioned the need to support access to information based upon a commander's decision to share the information.

Subsequently, we pointed out that the decades of access control work since the Bell-La Padula mathematical model for achieving secure computer systems based upon a "need to know" constraint for defining a security compromise does not support current operational needs to share certain information for certain missions in accordance with DoD policy enabling commanders to declare a "need to share". We also pointed out that the same logical framework for access control implemented to avoid a **security compromise** is consistent with the logical framework need to avoid a **sharing compromise**. The mathematical model supporting both approaches includes considerations of compositions of logical and continuous system components as well as considerations of meeting requirements for protecting information in accordance with the notion of a ***security*** compromise while supporting an approach for sharing information in accordance with the notion of a ***sharing compromise***.

We then provided initial ideas concerning conclusions which can be drawn for analyzing tribal and locality dynamics. We also provided initial ideas on the relations among concepts of Quality of Information (QoI), Value of Information (VoI) and Utility of Information (UoI). We differentiated QoI from VoI based upon QoI being more related to *objective measures* of information attributes such as those whose quantities can be automatically determined through known models of sensor behaviors while VoI is more related to *subjective measures* of information attributes such as those whose behaviors are best estimated by humans (e.g. a quantity assigned as the relative contribution of each category of information to achieving an assigned goal). UoI in achieving goal-oriented behaviors is then the result of estimating the relative contribution of valued information to meeting an assigned goal.

Access Control

For purposes of the project goals of Flowing Valued Information we note that the general problem of controlling the movement of information across a distributed set of communication nodes in support of tactical operations can be partitioned into three stages:

1. Select a model framework for the problem of understanding battlespace state to include the local infrastructures, economic and social constraints as well as the soldiers and units involved and the roles that the units will play in a given operation and the information requirements and information infrastructure available to execute those roles,
2. For the model, identify parameters associated with predicting future values of parameters of interest (future behaviors) including information available at different nodes in the network, and
3. Apply the model to move information among the nodes in the network to make more valued information available at commander nodes to assess the current state and make decisions related to moving from the current state to a desired future state. We desire to support commanders in choosing DIME actions to achieve desired PMESII states.

Unfortunately, as noted by the National Academy (BAST, Board on Army Science and Technology, 2005), science does not exist to build predictive models of the parameters of interest for the level of complexity envisioned in "Net-Centric Warfare" literature. Our focus is then on modeling the lowest level of military operations and the smallest region of civilian infrastructure. We also focus in a category of military operation whose success depends upon direct sharing of information (i.e. avoiding a **sharing compromise**) with individuals and groups who are not normally "on the net". Today being "on the net" means that access is to information of the net is controlled on a "need to know" basis of avoiding a **security compromise**. Thus, in terms of achieving these three analytical steps, access control of information must be strictly manual (the only method available to commanders today) or the process of automation support for access control must be widened to include the notion of a "need to share" and support provided for enabling a commander to declare sharing policies with users and groups needed for mission success.

For the issue of ***access control*** of information representing the *state of a complex system*, we revisit the hybrid system model and discuss issues associated with maintaining estimates of continuously-varying parameters associated with physical systems while making logical approximations at appropriate instants of time. We note that in the model of information utility presented below, some of the model constraints will be declarations by commanders of a "need to share" information with individuals who have required information needed for mission success, such as tribal elders, local mayors, local police, local security forces, and Red Cross, Red Crescent, or Doctors Without Borders. The first report provides a framework for protecting information which must be protected while sharing information which needs to be shared in order to increase the likelihood of accomplishing the intent of the commander. The framework is a formal result for treating the sharing of information with coalition partners based on a "need-to-share" with the same degree of support as protecting information based on a "need-to-know".

Thus, we seek an easily understood approach for assigning metrics to elements of information which can subsequently be used for flowing information among network nodes in such a manner to increase the value of information available for making decisions. More formally, we seek a set of metrics and an associated set of processes for assigning numerical quantities and strings of symbols to parameters of interest in such a manner to facilitate determining the utility of the set of parameters to meeting the intent of the commander. That is, for the *hybrid automaton*, *S*, which captures the logical and physical constraints on system evolution: $S = \left(X, V, Init, f, Inv, R\right)$, we seek to facilitate analysis of a subset , $X^{'}$, of the finite collection of state variables (parameters) X , where

$X^{'} = \left(X^{'}_{D} \cup X^{'}_{C}\right)$ with $X^{'}_{D}$ countable and

$X^{'}_{C} \in \Re^{n}$.

The analysis of the subset of parameters will estimate the utility of the information to meeting the intent of the commander. To determine the relative utility, *U*, of the subset of parameters to meeting the intent of the commander we must discover the functional relationship between the quality of information (QoI), value of information (VoI) , trust, and risk associated with parameters, $X^{'}$. That is, the utility, U, associated with the extent to which a set of parameters can estimate the likelihood of success in achieving the intent of the commander can be closely approximated by a *hybrid automaton*, $U = \left(X^{'}, V, Init, f, Inv, R\right)$ where

$X^{'}$ is a subset of the finite collection of state variables (parameters), X, where

$X^{'} = \left(X^{'}_{D} \cup X^{'}_{C}\right)$ with $X^{'}_{D}$ countable and

$X^{'}_{C} \in \Re^{n}$;

V is a finite collection of input variables. We assume

$V = \left(V_{D} \cup V_{C}\right)$ with V_{D} countable and $V_{C} \in \Re^{n}$;

$Init \subseteq X$ is a set of initial states;

$f: X \times V \rightarrow X_{C}$ is a vector field, assumed to be

globally Lipschitz in X_{C} and continuous in X_{C};

$Inv \subseteq X \times V$ is an invariant set;

$R : X \times V \rightarrow 2^{X}$ is a reset relation.

We refer to $x^{'} \in X^{'}$ as the state of the utility automaton, U and to $v \in V$ as the input of U.

Viability constraints are associated with ensuring that the composition of system logical components and physical components represents a physically-realizable system (many models are not physically realizable) (Aubin, 1991) (Deshpande & Varaiya, 1995). The issue of viability of existence of a solution to the composed problem is dealt with in the controls community by ensuring that "sufficiently close" approximations are available from the composed components used to generate the feedback control laws (digital and/or analog signal filters) used to move the current system state to some desired future state. Models used for this purpose must be grounded in viable solutions to approximating (predicting) future state from current state and current input (the system identification problem). Validity of such models is only assured for time-invariant (stationary) systems or, for slowly time-varying systems, for the time frame in which the system parameters have not changed "significantly". Future reports will deal with issues of trust and viability for scenarios of interest. The current scenario being studied for information sharing is contained in the appendix for a platoon-level Humanitarian Assistance-Disaster Recovery (HADR) operation.

Understanding the HADR problem (in the sense of building models which predict future values/states of parameters of interest) at the platoon level, exhibits the full range of complex systems analysis issues we are interested in addressing. This scenario of an earthquake in Afghanistan, requires a unit to move to a new location, coordinate with local leaders and non-government agencies to provide disaster relief, and provide local security in the area of operations. Given that the local government and economy has been affected and the disaster has occurred in an area being contested between the Government of the Islamic Republic of Afghanistan (GIRoA) and the Taliban, then the scenario places the leader in the position of considering political, military, economic, social, infrastructure, and information (PMESII) outcomes related to whatever decisions are taken in attempting to assist in providing disaster relief. Furthermore, available analytical techniques for determining the human terrain (social and cultural aspects of social network analysis studies) are just now being investigated. While predictive models of human terrain are not expected to be available for some time, the modeling approach described above supports the broad range of hybrid system modeling techniques that have been used in the past for automatic control system identification (i.e. data analysis to determine the correct model type and assign model parameters to predict future system state), system control law design (i.e. feedback filter design to cause the closed-loop current system state to move to a desired future system state in response to inputs over time), and control law implementation and update (for adaptive control systems). These modeling techniques include state-space model (linear or nonlinear, statistical or deterministic, stationary or non-stationary, frequency/spectral-domain or time-domain) models as well as wavelet models. The basic issues in each model effort includes matching model parameters to actual system data and determining the range of parameter values for which the model behavior is "close enough" to actual system behavior. For the range of PMESII problems being addressed by junior leaders on a daily basis, we are as yet unable to achieve acceptable ("close-enough") model performance.

Data Base Sharing

The original Bell-La Padula paper (Bell & LaPadula, 1973) discussed some of the issues associated with implementing the security results on a shared database since, at the time the paper was published, this was the method of implementation of sharing information. We observe here that implementations for sharing data over networks of sensing, communicating, and computing devices have grown exponentially over the intervening 36 years and will probably continue to grow for at least the next 15 years as Moore's Law continues to fuel Information Age expansions. Also, Bell subsequently observed that the multi-level security result obtained from the original paper applies to networks of devices (Bell D. E., 2005). Thus, our efforts to apply the extensions developed in the first FVI report will focus on the trust and viability issues mentioned above. In that regard, we expect to extend the capabilities of the Android smart phone to prototype information sharing technology implementations.

We intend to initially prototype automation support which implements the logical constraints imposed on information transfer by the results of this paper. The information transfer will be appropriate for that authorized by a commander in executing a HADR operation and will simulate a commander creating a text string and authorizing the string to be shared with designated individuals over a designated area for a designated time. We will move the string (and subsequent responses to the string) across security boundaries among network nodes in accordance with a declaration of a "need-to-share" while maintaining constraints on other information whose movement is constrained by a "need-to-know".

Summary

The first FVI report provided extensions to the Bell and La Padula model which lay the groundwork for: (1) building more accurate models of the complex operational environments of today and tomorrow, and (2) providing automation support for a commander's decision to share information while simultaneously maintaining the security of information which must not be compromised.

This report has built on the results of the first report to discuss an approach for considering tribal and locality dynamics in the conduct of HADR operations. Specific assumptions and model characteristics have been provided which will constrain construction of models of tribal and locality dynamics as well as how these variables may determine the success or failure of HADR operations.

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Appendix A: Earthquake Scenario

Humanitarian Assistance/Disaster Recovery (HADR) Operation

Earthquake Scenario (With Information Sharing)

Operations Order

1. **Situation** Two earthquakes occurred early this morning in Nangahar Province North East of Kabul, Afghanistan. Approximately 200 families are homeless and 20 people have been killed. There is a need for food, temporary shelter, water, medical aid, and search teams. Our platoon will depart in four hours to provide HADR support to the Provincial Reconstruction Team (PRT) of Nangahar Province. We have been assigned to ?? Village, ?? District, Nangarhar Province, Afghanistan.

2. **Mission** Provide HADR support to the people of ?? Village, ?? District, Nangarhar Province from H Hour on D Day until relieved (relief in place expected in 72 hours).

3. **Execution** Phase 1 is movement to the village area. Phase 2 is securing the village and searching for additional victims. Phase 3 is providing recovery assistance.

   During Phase I the Platoon Leader will lead an advance party to the village while the Platoon Sergeant moves the platoon into the village area. Phase 1 ends when the Platoon Leader briefs the platoon on the advance party results and assigns security and search areas.

   During Phase 2 first and second squads will provide security of the village area while third and fourth squads assist villagers in searching for survivors and victims. As the search is underway the Platoon Sergeant will lead security activities and the Platoon Leader will lead search activities and coordinate with local leaders, government and non-government agencies concerning feasible recovery assistance activities. Phase 2 ends when the village leaders indicate all inhabitants are accounted for or that the search for survivors is completed. The Platoon Leader will then assign recovery activities to each squad based upon the results of coordination with local leaders, government and non-government agencies.

   During Phase 3 third and fourth squads will provide security of the village area while first and second squads execute assigned recovery activities. Phase 3 will continue until relieved.

4. **Command and Signal** Current command relations are unchanged. Current CEOI will remain in effect. There will be United Nations (UN) relief organization personnel in the area as well as other national and international relief organization personnel who may or may not be members of the UN Assistance Mission of Afghanistan (UNAMA).

5. **Administration and Logistics** Carry basic combat load, extra water and three days of rations. Battalion will be setting up a temporary combat outpost in the vicinity within 24 hours.

Discussion

Currently there is ***no underlying science*** for automatically moving valued information from one network node to another in accordance with a commander's ***intent for conduct of an operation***. Furthermore, there is ***no underlying science*** for automatically moving information across a security boundary in accordance with a commander's declaration of ***intent to share the information***. Thus networks of forces in Afghanistan and elsewhere are inundated with information which may not be valuable to the current operation and commanders are constrained to manually share information face-to-face with coalition partners who are unable or unwilling to obtain security clearances to work on available networks.

The Flowing Valued Information project will result in ***flowing valued information among network nodes to increase the value of shared information***. Consider what might be possible with information sharing technologies which will automatically flow valued information and will also execute movement of information across network nodes in accordance with a commander's declaration of intent to share information with an individual or with a group. The discussion in the sections below considers modeling and analysis of HADR operations such as the one summarized in the above Operations Order (OPORD) and movement of information across network nodes needed to facilitate HADR operations.

The flowing Valued Information project seeks to enable dynamic alteration of the movement of information across network nodes in response to both (1) the relative utility of the information to meeting commander's intent and also (2) the expressed intent (perhaps recently expressed) of sharing information with a particular group and/or individual. In order to achieve these goals, a mechanism must be created to dynamically change the information being flowed across network nodes and to do so at multiple time scales and multiple distance scales.

Command Intent:

The Military Decision Making Process (MDMP) is a structured approach for generating alternative courses of action, selecting a course of action, generating written operation orders for the selected course of action, and executing the selected course of action. ***Command Intent*** for the selected course of action is not explicitly captured in the written documents associated with an OPORD but is expected to be understood and achieved in executing the selected course of action. Command intent is summarized in the *mission* and *execution* sections of the OPORD but may also include elements not included in these sections. Subordinate commanders are expected to understand ***command intent*** from development of the selected course of action during the planning process and to exercise ***military judgment*** in dynamically altering the details of the plan during execution in order to meet ***command intent***.

The OPORD sketched out above would normally not be written since the echelons below battalion level normally do not follow the MDMP and normally do not issue written OPORDs. Instead ***Troop Leading Procedures*** are followed in which the same basic decision flow of considering alternative courses is considered, a course of action is selected, and a verbal OPORD is created and delivered to subordinate commanders. However at both the higher echelons of tactical-level operations (Brigade and Battalion) and the lower echelons of tactical operations (Company, Platoon and Squad) ***command intent*** is developed and conveyed to other leaders during the decision-making process and subordinate commanders are expected to dynamically change the plan during the execution process to meet the intent of the commander.

Thus, in the mathematical sense, command intent is the ***system invariant*** around which other parameters vary during the execution process and information flow should be optimized to make information available at different communication and computing nodes in the unit network according to the role to be played by the unit associated with that node in meeting the ***intent of the commander***.

Discrete and Continuous Variables

Moreover, the kinds of parameters which may dynamically vary during the conduct of the operation consist of both discrete and continuous variables. For instance, soldiers are trained to make and continuously update a visualization of the battlespace (i.e. the ***state*** of the operational environment) which considers Mission, Enemy, Terrain and weather, Troops and support available, Time available, and Civil considerations (METT-TC). Variables which define the weather and vary continuously include air density, wind velocity, temperature, humidity, rainfall, and illumination. Terrain and time available vary continuously. The physical parameters which affect the accuracy of every engagement process vary continuously (weapon and target position (latitude, longitude, and altitude), three dimensions of velocity, three dimensions of acceleration, projectile flight characteristics, atmospheric dynamics, projectile charge explosive characteristics,…). Commanders at higher levels may identify and specifically task intelligence personnel to identify values for the commander's critical information requirements (CCIR). CCIR are usually discrete-valued variables such as enemy strength, enemy location, and enemy intent. However, The Army's Field Manual for Operations also indicates that "METT-TC emphasizes the operational environment's human aspects. This emphasis is most obvious in civil considerations, but it affects the other METT-TC variables as well. Incorporating human factors into mission analysis requires critical thinking, collaboration, continuous learning, and adaptation. It also requires analyzing local and regional perceptions. Many factors influence perceptions of the enemy, adversaries, supporters, and neutrals. These include—

- Language.
- Culture.
- Geography.
- History.
- Education.
- Beliefs.
- Perceived objectives and motivation.
- Communications media.
- Personal experience. "

Need-to-Know and Need-to-Share

While some of the data on the tactical intranet (such as a written estimate of METT-TC for an upcoming operations) might be considered for sharing by a commander, the scenario in question provides an example of the case facing many commanders in which mission success requires asking questions of local leaders and non-government organizations (NGOs) and receiving answers. Consider the fact that mission success for the Platoon Leader, Platoon Sergeant, and four Squad Leaders of the platoon responding to the earthquake requires that they understand the tactical situation (e.g. the METT-TC estimate which is in the "need-to-know" information category) and prepare as best they can to help the village deal with the disaster. Questions which need to be answered immediately (and are in a "need-to-share" category) include:

- How many people are dead?
- How many people are missing?
- Is shelter available for those whose homes are destroyed?
- How much bedding and clothing are needed?
- Is the road network functional?
- Are the waterworks functional?
- Is electricity available?
- How many people need to be fed?

In addition, consider that the Platoon Leader, Platoon Sergeant and Squad Leaders might have the following information sharing needs for the different phases mentioned in the OPORD:

Phase 1 (movement into the operational area) – need to share location and activity data with

- Doctors Without Borders

- Local leaders
- UNAMA
- PRT (may not have TiGR)
- Brigade HTT (automatic)

Commander's critical information requirements include:

- Any new earthquake activity
- Any government and/or non-government agency providing HADR support in the platoon AO
- Any hostile activity in the area
- Any changes in the estimates for assistance in water, food, shelter, or medical support

Phase 2 (search for survivors) – need to share data with

- Doctors Without Borders
- Local leaders
- UNAMA
- PRT (may not have TiGR)
- Brigade HTT (automatic)
- Red Cross
- Red Crescent
- Another coalition partner

Phase 3 (recovery operations) – need to share data with

- Doctors Without Borders
- UNAMA
- Local leaders
- PRT (may not have TiGR)
- Brigade HTT (automatic)
- Red Cross
- Red Crescent
- Another coalition partner
- Government reconstruction agencies
- Local and international construction companies

Valuing Information

As indicated in the body of the report, we must discover scientific principles and create technologies based on those principles to enable a simple approach for commanders to declare an intent to share valued information with coalition partners and non-government organizations (NGOs) whose support will determine mission success for HADR operations. Thus, we seek an easily understood approach for assigning metrics to elements of information which can subsequently be used for flowing information among network nodes in such a manner to increase the value of information available for making decisions. More formally, we seek a set of metrics and an associated set of processes for assigning numerical quantities and strings of symbols to parameters of interest in such a manner to facilitate determining the utility of the set of parameters to meeting the intent of the commander. That is, for the *hybrid automaton*, *S*, which captures the logical and physical constraints on system evolution: $S = (X, V, Init, f, Inv, R)$, we seek to facilitate analysis of a subset , X', of the finite collection of state variables (parameters) X , where

$X' = (X'_D \cup X'_C)$ with X'_D countable and

$X'_C \in \Re^n$.

The analysis of the subset of parameters will estimate the utility of the selected elements of information (normally declared by the commander to be critical to mission success) to meeting the intent of the commander. To determine the relative utility, *U*, of the subset of parameters to meeting the intent of the commander we must discover the functional relationship between the quality of information (QoI), value of information (VoI) , trust, and risk associated with the selected parameters, X'. That is, the utility, U, associated with the extent to which a set of parameters can estimate the likelihood of success in achieving the intent of the commander can be closely approximated by a *hybrid automaton*, $U = (X', V, Init, f, Inv, R)$ where

X' is a subset of the finite collection of state variables (parameters), X , where

$X' = (X'_D \cup X'_C)$ with X'_D countable and

$X'_C \in \Re^n$;

V is a finite collection of input variables. We assume

$V = (V_D \cup V_C)$ with V_D countable and $V_C \in \Re^n$;

$Init \subseteq X$ is a set of initial states;

$f: X \times V \to X_C$ is a vector field, assumed to be globally Lipschitz in X_C and continuous in X_C ;

$Inv \subseteq X \times V$ is an invariant set;

$R : X \times V \rightarrow 2^X$ is a reset relation.

We refer to $x^{'} \in X^{'}$ as the state of the utility automaton, U and to $v \in V$ as the input of U .

The following assumptions and characteristics of modeling command intent and relative value of information are provided:

1. The intent of the commander is the only battlespace invariant during the course of execution of an operations order (OPORD).
2. If a commander sets relative importance of categories of information and policies for sharing information prior to commencement of execution of an operation, then automation assistance in flowing information during the operation is feasible.
3. The temporal constraints on unit activities to meet command intent are captured by the synchronization matrix(NOTE: for platoon operations a written synchronization matrix is normally not prepared but the same temporal control measures contained in the synchronization matrix are provided verbally during the Troop Leading Procedures decision process which creates provides the verbal operations order).
4. The spatial constraints on unit activities to meet command intent are captured by the operations overlay (NOTE: for platoon operations an operations overlay is normally not prepared but the same spatial control measures contained in the operations overlay are provided verbally during the Troop Leading Procedures decision process which creates and provides the verbal operations order).
5. The verbal approximation of command intent is captured in the mission and execution paragraphs of the operations order (NOTE: for platoon operations a written operations order (OPORD) is normally not prepared but the same categories of information contained in a written operations order are provided verbally during the Troop Leading Procedures decision process which creates and provides the verbal operations order).
6. For HADR operations, the most critical information needed to determine mission success in meeting command intent will normally not be available on the tactical Internet although some of the information may be available through national technical means. Examples of these elements of information include:
    a. Number of civilian dead,
    b. Number of civilian missing,
    c. Amount of food, water, shelter, and medical supplies needed,
    d. Dynamics updates on essential elements of information a through d above,
    e. Tribal dynamics, and
    f. Locality dynamics.

7. Features of a reasonable dynamical model for valuing information elements include:
    a. Piecewise linear approximations of non-linear input-output relationships (functions) of DIME actions affecting PMESII outcomes,
    b. Exponential decay of effects over space and time,
    c. Bilateral and trilateral dynamical relationships among tribes, and
    d. Bilateral and trilateral dynamical relationships among locations.
8. Reasonable constraints for estimating relative utility (some function of quality, value, trust and risk) of essential elements of information in meeting the intent of the commander include:
    a. Rules which identify changes in the phases of an operation called out in a synchronization matrix (i.e. temporal significant events) and associated data elements which determine satisfaction of those rules are more valuable than rules (and parameter values) which determine values within a phase.
    b. If a “main effort” has been declared by the commander, then rules which determine status of the main effort are more important than rules which determine status of secondary efforts.
    c. Rules which identify crossing a coordination boundary (i.e. spatial significant events) of the operations overlay are more important than rules which determine location within a given coordination boundary.
9. The Analytical Hierarchy Process (AHP) is a reasonable approach for obtaining human estimates of the relative value (ratio scale estimates) of system parameters to meeting the intent of the commander.

Discussion of Valuing Information

The above assumptions and characteristics might be more than required to capture the complexity of a particular operation or less than required to capture the complexity of a given operation. However, the paragraphs below consider how the nine assumptions and characteristics mentioned above might be applied for the given HADR scenario.

Command Intent

The mission and execution paragraphs provide a verbal statement of command intent. However, building a computable model of command intent remains a research issue.

Relative Importance of Information Categories

There are structures in place to capture lists of information which are deemed important. The commander’s critical information requirements (CCIR) is one popular list. However, there is normally no priority assigned among different members of the list. Everything is equally important.

Temporal Constraints on Unit Operations

Temporal constraints on unit operation are normally provided in the synchronization matrix but this is usually not prepared at platoon level. Moreover, there is normally some degree of uncertainty surrounding the precision associated with the different temporal phases of operation declared in the synchronization matrix. While assignment of unit or individual responsibilities by phase of an operation is usually done verbally by the Platoon Leader or Squad Leader during Troop Leading Procedures, completion of a given phase and movement to the subsequent phase may be accomplished “on order”.

Spatial Constraints on Unit Operations

Spatial constraints on unit activities to meet command intent are captured by the operations overlay for higher echelon units. As indicated above, for platoon operations, an operations overlay is normally not prepared but the same spatial control measures contained in the operations overlay are provided verbally during the Troop Leading Procedures decision process which creates and provides the verbal operations order. As is the case for temporal constraints, the spatial constraints for tactical level operations may not be well-defined from the viewpoint of creating a computable model of spatial constraints. For some decisions the center of mass of a unit may be sufficient for estimating whether an operation is “on track” with command intent from the viewpoint of being in the correct location at the correct time. However, for other decision the precise location and orientation of each crew-served weapons system or individual soldier may be desired.

Verbal Approximation of Command Intent

As noted above the verbal approximation of command intent is captured in the mission and execution paragraphs of the operations order (OPORD) and for platoon operations a written OPORD is normally not prepared although the same categories of information contained in a written operations order are provided verbally during the Troop Leading Procedures decision process which creates and provides the verbal operations order. However, once again, science lags application in the sense of not being available to create a computable model of command intent. While the discipline of semiotics seeks to assign meaning to symbols, the fact remains that natural language understanding is still a nascent science in terms of assigning meaning to the strings of symbols in written statements of mission and execution contained in an OPORD.

Critical Information

For HADR operations the list of commander’s critical information requirements provided on the previous page are a good place to start for the operation under consideration. However, what is needed from the commander is some estimate of the relative importance of the different categories of information. For the automation support to be developed, what is needed is an approach for enabling the commander to easily declare the information of interest and the relative importance of the categories of information.

Dynamical Model

A dynamical model sufficient to capture the complexities of the systems of interest is that provided for constructing a ***utility automaton***.

Model Constraints

The constraints provided above are reasonable ones to start with. The science and technology remains to be developed to provide appropriate tools to enable commanders to declare temporally-constrained and spatially-constrained rules appropriate for learning and updating rules for estimating quantities to be assigned to parameters of interest.

Use of the Analytic Hierarchy Process

The basic information management problem facing tactical commanders today and for the foreseeable future is the torrent of information available for analysis. The expected deployment of ever-increasing numbers of unmanned aerial and ground vehicles with multiple sensors and additional sensor networks will only accelerate the growth in the amount of information available to be analyzed. Furthermore, the trend over the past three decades has been that the amount of information available to be moved over network connections exceeds by orders of magnitude the capacity of the available networks to move the information. Thus, a necessary step in moving valued information is valuing the information to be moved. *Shannon's information theory* provides underlying science for estimating *how much data* can be moved over a given information channel. However, it provides ***no insight*** on ***which information*** to move.

What is needed is science and technology for automatically valuing information in a given context according to the relative importance of that information in assisting or resisting the completion of goal-oriented behaviors, given that the context changes over time and the behaviors of the complex systems involved resist efforts to build predictive models valid for even short periods of time. In the absence of science and technology to construct predictive models for reliably developing relative importance of parameters of interest, what is currently available is a tool which has been widely used to obtain human estimates of these parameters, the Analytic Hierarchy Process (AHP) (Saaty, Decision Making for Leaders Vol. II of the AHP Series, 2001).

For the operation under consideration the levels in the hierarchy might be:

I. Earthquake assistance categories (food, water, shelter, clothing, health)
II. For each category, context elements which affect providing the assistance (security, governance, electricity, transportation, communications, economy, tribal dynamics, locality dynamics)
III. For each category and context element a capability or context parameter whose value affects provision of the required assistance in a given context (e.g. for locality dynamics possible existing local conflicts concerning timber rights, grazing rights, mineral rights, water rights, land distribution, and/or access to local jobs)

Available Technologies:

US Forces (interacting with the existing military network (MILNET) – DISA has made great strides in implementing the service oriented architecture approach to enabling automation support for enterprise processes. Specific results which affect the future utility of project results include the Joint Cross Domain eXchange (JCDX) system to share data across the multilevel level secure system (MLS) and the classification Policy Decision Service (cPDS) system to enable discovery of labeled data for and subsequent automated identification of trust relations.

These MILNET services enable automated building of the XML signature chains necessary for using the NetSMART project results to automatically implement policy decisions by commanders to share information across the Global Information Grid (GIG).

New tools available for the Development Process

Hardware development tool research has been working for some to move the automated tools available for electronic systems development from the resisistor-transistor-logic (RTL) level to the electronic systems level (ESL). As indicated in an article on system-level design by Rami Rachamim,:

> …the development process can be divided into three phases: Concept, ESL design, and RTL implementation. Each phase is derived from the previous one and feeds the next one.
>
> Concept (Vision): At the concept phase a system designer creates a conceptual description of the system without explicit software/hardware definitions or boundaries concept. The phase starts with a spec and a set of requirements that are mapped into algorithms and functions that can be validated. There are several languages that can serve this domain including UML and C/C++.
>
> ESL Design (Strategy): At the ESL design phase the designer needs to drive its strategies and map the conceptual description into hardware (RTL) and software (C/C++) representations. This is where the ability to impact (variability) is the greatest, and iteration cycles are shorter. The design phase should define the hardware and software domains (partitioning) that can carry the concept and drive parallel hardware and software implementation flows. It should allow exploration and optimization when allocating and configuring hardware and software resources while making sure they interface appropriately.
>
> The ESL design phase is where the designer creates and finds the best possible hardware and software system configuration that is functionally correct and can support the original system concept. The output of the design process should be a well-defined hardware structure at the RTL level (most likely VHDL or Verilog description) and some of the software layers. It is important to optimize systems against real software since the application greatly impacts the performance and power behavior of the system, and is reflected at the user experience level.
>
> RTL Implementation (Tactics): At the implementation phase the designer actually executes upon the ESL guidelines and maps the hardware (RTL) into silicon. Automating the ESL design phase would not only make the RTL implementation task more efficient, it would also result in shorter verification cycles, since the integration of the main hardware and software blocks is already validated. RTL Verification would then focus solely on implementation related aspects, rather then system-level aspects (e.g. hardware/software interaction, protocol mismatches and data integrity) that are much harder to detect at RTL.

Software system-level design: The Flowing Valued Information project aims to flow information between the military network (MILNET) and other networks in accordance with Department of Defense (DoD) policy for sharing information. The DoD intent is to use SOA as the architecture-level approach for enabling sharing information among the US Armed Services as well as with our coalition partners. However, there is currently no underlying science available for flowing valued information among network nodes or for sharing information dynamically with coalition partners and non-government agencies. Thus, we specifically will investigate system-level design approaches for flowing valued information and sharing the information across security boundaries.

Software design and implementation: Also at the software level, new tools are available for implementing service-oriented architecture systems. Specifically, a promising set of open-source tools are being built under the Eclipse Swordfish project. As indicated on the project web site,"The goal of the Swordfish project is to provide an **extensible SOA framework** based on the proven Eclipse Equinox runtime technology. The framework is designed to be complemented by additional open source components such as a service registry, a messaging system, a process engine etc. to form a comprehensive open source SOA runtime environment based on both established and emerging open standards." The SOA project provides an open-source solution for using the Common Object Request Broker Architecture (CORBA) as the messaging component of an SOA and an extension of the NetSMART inference engine as the process engine to implement sharing policies.

Challenges: While new hardware and software technologies are available to perform system-level design and implementation , there are many unknowns and challenges in achieving the two primary goals of the project. Specifically:

1. Flowing valued information among network nodes in accordance with the **commander's intent**:
    a. How do we model **Complex Event Systems** (CES) with enough precision to predict future states of the system? A mathematical result over a century old establishes the existence of solutions to systems of equations which describe the complex event systems of interest (i.e. systems described by compositions of discrete-event components and continuous-time components). However, to date no method of discovering the solutions to such composed system models has been found. Thus, we will follow an approach of constructing components with known dynamics, composing those components, and experimenting with predicting future states of the composed systems.
    b. Which metrics are sufficient for capturing commander's intent and how do we measure system parameters to **estimate values** of those metrics?
    c. How do we accommodate the need of the commander to dynamically **change intent** of an operation while the operation is underway?
2. Moving information among network nodes in accordance with an expressed **intent to share**:
    a. How do we discover trust relations between entities distributed in time and space which normally are not connected as nodes in a communication network?
    b. How do we dynamically chain together trust relations to establish a "chain of trust" among components which are normally not connected?

c. How do we prove that the trust policies of DoD for sharing information are satisfied by the system we implement for sharing information across security boundaries? For example, in the scenario above, **how do we prove** that we comply with DoD policy in our implementation of a solution for enabling the network to respond to a commander's declaration of an intent to share information X with user Y and group Z for period of time T?