Linkage Between Pre- and Post- Conflict: Exploiting Information Integration & System Dynamics

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Abstract—In its Preface, *The 9/11 Commission Report* states: "We learned that the institutions charted with protecting …national security did not understand how grave this threat can be, and did not adjust their policies, plans, and practices to deter or defeat it" (2004: xvi). Given current realities and uncertainties "better preparedness" can be achieved by identifying, controlling and managing the elusive linkages & situational factors that fuel hostilities. This paper focuses on new opportunities and capabilities provided by anticipatory technologies that help understand, measure and model the complex dynamics shaping and precipitating conflict in specific settings worldwide. We introduce a research initiative focusing on linking pre- and post- conflict by drawing upon the power of system dynamics, augmented by new technologies for integrated information analysis, in conjunction with the development of conceptual and computational ontologies capturing the diversity, intensity, and dynamics of the conflict domain.

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1. INTRODUCTION

In its Preface, *The 9/11 Commission Report* states: "*We learned that the institutions charted with protecting …national security did not understand how grave this threat can be, and did not adjust their policies, plans, and practices to deter or defeat it*" [1: xvi]. Given current realities and uncertainties "better preparedness" can be achieved by identifying, controlling and managing the elusive linkages & situational factors that fuel hostilities. This paper focuses on new opportunities and capabilities provided by anticipatory technologies that help us to better understand, measure and model the complex dynamics shaping and precipitating conflict in specific settings worldwide. We put forth broad contours of a research initiative focusing on linking pre- and post- conflict. The importance of this type of understand was highlighted in the Wall Street Journal[1] when they noted "*Early US decisions in Iraq* (during pre-conflict) *is haunting current efforts* (during post-conflict).[2]" We propose to accomplish this by drawing upon the power of system dynamics augmented by new technologies for integrated information analysis in conjunction with the development of conceptual and computational ontologies capturing the diversity, intensity, and dynamics of the conflict domain.

More specifically, this paper presents early steps in the development of new technologies for (a) understanding and modeling the complexities of conflict, by leveraging the simulation power of system dynamics, (b) contextualizing integrated information in ways that enable rapid recognition of emergent patterns and enhance modeling capabilities, and (c) integrating diverse data sources and devising alternative modes of representing conflict in terms of scale, scope, and intensity.

System Dynamics [13] is a computer based approach for modeling and simulating complex physical and social systems and experimenting with the models to design policies for management and change. Feedback loops are the building blocks of these models and their interactions can represent and explain system behavior. Our strategy is to develop a suite of system dynamics models of conflict, augmented by context mediation technologies utilizing the foundations of the Context Interchange (COIN) information integration and mediation capabilities [5, 14, 15, 17], in conjunction with the Global System for Sustainable Development (GSSD) [9], an Internet-based platform for extracting contents transmitted through different forms of information access, provision and integration across

[1] April 19, 2004
[2] Notations regard pre- and post-conflict added.

multiple information sources, languages, cultural contexts and ontologies.

2. PRE- AND POST- CONFLICT SITUATIONS

2.1 Complexities of Conflict

Conflict is not like chicken pox - it does not just 'break out'. Most conflicts are not isolated events. Every action engenders a reaction. Context matters and matters a lot. And surprises are more of a rule than an exception. Post conflict situations are often shaped by the nature of the conflict and the dynamics of pre-conflict conditions. The situational realities of pre- and post- conflict is highly complex, and often interconnected. To focus on each phase separately is to impose artificial linearity in complex situations, distorts the causal interconnections and obscures that which is 'real'. Unlike the Cold War era, conflicts today are more localized and often associated with failed states and factors such as ethnic violence, social cleavages, cross-border affinities, and the like. The events of September 11, 2001 have signaled – unambiguously – the imperative of being inclusive rather than exclusive in our attention to issues of concern pertaining to data, information, knowledge, and interpretation.

Concurrently, we are caught in a paradoxical situation. On one hand, our analytical and computational tools have never been as powerful as they are today, and their future promise is virtually unlimited. On the other hand, the complexities of reality require commensurate specialization and concentration of knowledge and skills, which generate information, insights, data, and 'predictions' far more extensive than we have the ability to integrate, synthesize, and prioritize when confronted with unexpected changes in the global landscape or with new configurations of tension and threat. For example, information needs and policy imperatives differ in each of the following contexts:

(1) **Pre-conflict Conditions.** Information needs are characteristically immediate, usually highly customized, and generally require complex analysis, integration, and manipulation of information. The immediacy of conflict is usually signaled by the consolidation of a crisis. International crises are now impinging more directly on national security, thus rendering information needs and requirements even more pressing.

(2) **Conflict & War**: During the course of conflict information needs often are not as time-critical, however, they are customized to a certain relevant extent, and involve a multifaceted examination of information. Increasingly, to track the dynamics of a conflict situation, the coordination of information access and analysis across a diverse set of players (or institutions) with differing needs and requirements (perhaps even mandates) is more the rule rather than the exception.

(3) **Post-Conflict Situation:** Information needs tend to be gradual, involve reutilized searches, and require a relatively straightforward extraction of information from sources that may evolve and change over time. In today's global context, 'preventative actions' take on new urgency, and create new demands for information services in order to anticipate new threats grounded in old situations.

In strategic terms, of course, a critical priority is to prevent the post-conflict situation itself to engender conditions for created new pre-conflict conditions. The nature of linkages among these phases of conflict must be better understood, measured and modeled if we are to break the vicious cycle. This requires the use of advanced modeling techniques – most notably system dynamics – for representing and simulating the pre- and post- conflict conditions, mediated by the nature of the dynamics during the course of the conflict itself.

2.2 The 3-D's Dilemma

Against this background, we highlight three fundamental features of current realities, namely the distributedness of data, the diversity of threat, and the density of conflict – jointly labeled the 3-D's. It presents some broad directives for the pursuit of a coherent web-based, information-robust knowledge strategy for understanding and anticipating the linkages between pre- during-, and post- conflict. Each of the individual D's is significant in its own right, but together they signal the generic nature of the embedded challenges, and the irrefutable relevance, if not centrality, to the overall calculus of linkages among phases within a 'singular' conflict and across a variety of conflict situations.

Distributedness of Data. Addressing problems central to complex domains as that pre- and post- conflict dynamics requires tools that easily combine observations from *disparate sources, compiled initially for different purposes, using different methods, and subject to different interpretations.* Clearly, more so now than ever, the Department of Homeland Security relies on intelligence information from all over the world to develop strategic responses to security threats. However, relevant information often is stored in various regions throughout the world and by diverse agencies in different media, formats, and contexts. Intelligent integration of information is fundamental to developing policies to anticipate and strengthen protection against terrorist threats and attacks on the United States.

Critical advances in information and analytical capabilities must span multiple domains shaping propensities for conflict (e.g., economic, political, geographic, commercial, and demographic), diverse contexts (i.e., meanings,

languages, assumptions), and numerous contending agents (i.e., states, governments, corporations, international institutions). Technology and knowledge tools are needed to focus on acquiring and enhancing information for user requirements both over individual domains (i.e., a single shared ontology) and across multiple domains, which are necessary for addressing complex challenges.

Diversity of Threats. Diversity in the global landscape – and all that this entails – is one of the most important legacies of the 20th century. In many ways, the powerful new parameters for global politics are reflected in critical new challenges to current modes of information, access, and understanding in the security domain broadly defined. We all recognize that the fall of the Berlin Wall, the end of Communism, the demise of the Soviet Union, and the creation of new states with new configurations and strategic dilemmas are among the more significant and observable of these changes. While there is a near-consensus that globalization is an increasingly salient phenomenon, there is less agreement as to its nature, scale, and scope and, more importantly, the extent to which it alters prevailing patterns of 'politics as usual'.

The unit of the 'state' is no longer the only source of, or agent for, conflict. A range of non-state actors and/or 'free agent' pressures create new instability and uncertainty, the nature of which may not be fully understood. Too much is changing, too quickly; creating too many challenges for effective information access and knowledge provision. While every threat is unique in its own right, diverse threats and counter threats all share common features characterized by dynamics of actions and reaction and escalating hostilities, rendering actions and interactions increasingly vulnerable to the proverbial 'tipping point' – into overt organized violence.

Density of Conflict. In many regions of the world, the increased mutually reinforcing, interlocking, and dynamic interactions among systems of conflict generate multipliers effects of their own. This means that a disturbance in one conflict domain could result in 'spillover' effects in others. Such conditions, generally known as loosely or tightly coupled system (as the case may be) invariably call for 'advanced concepts'. Few regions of the world illustrate the density of conflict than does the region of the Middle East and fewer still appear to harbor as much conflict potential as in former Soviet Republics of Central Asia. Seemingly 'local' conflicts can often be interconnected. Further complicating the critical task of protection against 'known' threats (as those from weapons of mass destruction) are multipliers generated by the complexity of new challenges generated by a wide range of actors (state-based and non state-based), operating not only in that region but in other parts of the world.

Today the post-conflict situation in Iraq is increasingly dominated by new insurgency groups and religious fundamentalists, consolidating new conditions that, if unchecked, may generate a set of new pre- conflict conditions which then shapes whole new conflict that takes on dynamics of its own. In retrospect, we now understand that the resolution of Gulf War I, and the many resulting indeterminacies provided fertile grounds for what eventually became Gulf War II, namely the war with Iraq. Moreover, conflicts in the Middle East and elsewhere (both latent and overt) are multiple and overlapping, and the potential solution of one conflict (such as, for example, the Palestine-Israeli conflict) does not guarantee the solution of another conflict (such as Iraq's threat to oil producing countries or the world's security through the deployment of weapons of mass destruction). The emergent threats from 'Islamic fundamentalism' and associated terrorist groups constitute yet an additional layer to an already complex landscape. Many similar factors appear in Central Asia, where increasing potentials for overt conflict appear imminent.

2.3 Essential Information Needs

These broad contours of the 3D's for pre- and post- conflict situations point to some information needs that must be met (i.e. data problems) and some conceptual challenges that must be resolved in order to make any progress at all. At a minimum these include:

(1) Capturing the ***'meaning(s)'*** of conflict in different contexts, diverse time frames, and various levels of social aggregation. (Note the view that "one man's terrorist is another's 'freedom fighter'").

(2) Understanding and tracking the ***dimensionality*** of conflict , in terms of *who*.

(3) does *what*, *when* and *how* - and with what potential *impacts* - in order to formulate viable dynamic perspectives.

(4) Improving the ***contextual basis*** for drawing inferences from different databases about propensities for threat from *diverse sources*. This is important given the range of countries that are already believed to support conflict. Is it reasonable to expect Chad - for example - to be more (or less) likely to harbor terrorism than any of its neighbors? If so, why? If not, why not?

(5) Using the above probes to frame 'rules of thumb' to help *anticipate* (or assess) potential severity of ***alternative forms*** of conflict and of violence under various conditions.

(6) Developing ***differentiation criteria*** or metrics to provide more nuanced inferences in a timely way (for example, understanding and differentiating the damage potential of state-based conflict, vs. private-motivated violence, vs. organized conflict, etc.)

(7) Representing dynamics of linkage in conflict situations – before they are consolidated—and capturing the changing the ***role of critical drivers***, as well as their manifestations and measures

(8) ***Customizing responses*** to knowledge needs that are shaped by different strategic conditions and imperatives.

(9) ***Tracking changing configurations*** and capabilities of actors and agents in terms of special location, jurisdictions, alignments, capabilities, and other key features.

Clearly, some order in the domain and dimensionality of conflict must be achieved so as to help model pre- and post-conflict linkages from the root causes or critical drivers into the *emergent process*es that must be controlled if military interventions are to be mitigated. We believe that problems of this sort are fundamentally complex and can be addressed if, and only if, a research strategy is designed to address the 3-Ds head on by (1) harnessing the power of anticipatory technologies and (2) applying system dynamics principles of modeling and simulation to conflict domain, focusing on the linkages among pre- and post- conflict conditions.

3. HARNESSING THE POWER OF ANTICIPATORY TECHNOLOGIES

While provision of information through the Internet has become standard operating procedure in both scholarly and policy domains, there are significant opportunity costs associated with barriers to the effective use of dispersed, diverse, and disconnected data sources. There is a large number of databases on 'conflict' but little consistency in content, coverage, or measures, creating, immense barriers to access and use of these data in coherent ways. At a minimum, new enhanced web-based capabilities and/or approaches are needed to (a) differentiate among types of *conflicts under varying degrees of risk and uncertainty*, (b) *identify barriers to access and analysis of critical information* for improving the value of empirical and theoretical analysis in this domain, (c) provide tools to facilitate access to and *correct interpretation* of essential information that is critical to anticipating dynamics of conflict (as well as to other similarly complex domains), and (d) facilitate venues for organizing, integrating and assessing information bearing on *linking pre and post conflict analysis*, directly or indirectly, in order to (e) explore operational ways of managing information on variability in time, space, and identities of actors or agents – in any particular facet of the global landscape. The strategic power in the deployment of anticipatory technologies can be demonstrated by drawing upon the potentials of background work in two related, but distinct, analytical and computational capabilities, namely the *Global System for Sustainable Development* (GSSD) and the *COntext INterchange* Project (COIN).

We recognize the strategic relevance of the results from an existing Internet-based 'platform' for exploring forms of information generation, provision, and integration. This needs to operate across multiple domains, regions, languages, and epistemologies designed for complex but domain-specific applications. This platform has been applied to international development problems. To our knowledge, *GSSD* remains the only existing multilingual (non-Western), hierarchical, tested knowledge platform for distributed information worldwide, operating in the public domain. We believe there is an important need for a special application of this system to the complex domain of conflict analysis (in, for example, the deployment of a 'Global System for Conflict Analysis'), as a critical capability for threat analysis in the international relations and the national security domain.

Advances in computing and networking technologies now allow extensive volumes of data to be gathered, organized, and shared on an unprecedented scale and scope. Unfortunately, these newfound capabilities by themselves are only marginally useful if the information cannot be easily extracted and gathered from disparate sources, if the information is represented with different interpretations, and if it must satisfy differing user needs [6, 17, 18]. The data requirements (e.g., scope, timing) and the sources of the data (e.g., government, industry, global organizations) are extremely diverse. The need for intelligent harmonization of heterogeneous information is important to all information-intensive endeavors – which encompasses many disciplines including governments, education, science and engineering.

3.1 GSSD - Integrative Knowledge-Based Web-Platform

The *Global System for Sustainable Development* serves as an Internet-based platform for exploring forms of information access, provision, and integration across multiple information sources, languages, cultural contexts, and ontologies. The conceptual framework for GSSD serves to provide linkages across multiple domains and levels of activity that are relevant to the broader notion of sustainability. GSSD databases cover issues related to dynamics of conflict, as well as other domains relevant to conflict and violence – such as migration, refugees, unmet human needs, evolving efforts at coordinated international actions, etc. While GSSD provides a rich testing ground for new information technologies, new functionalities are called for in its information streamlining and analysis capabilities. These include, for example, automated methods for information aggregation from various sources, sustained context mediation capabilities, customized information retrieval capabilities, and updated, concurrent development of ontology representations of rapidly changing threats to national security.

GSSD has an extensive, quality-controlled set of ontologies related to system sustainability and threats to sustainability, which is an essential dimension of conflict and conflict

dynamics. By definition, conflict is a manifest threat to security and stability, and unresolved conflicts can often result in system 'collapse'. Designed and implemented by social scientists, GSSD is seen as demonstrating 'opportunities for collaboration and new technologies,' according to the National Academy of Engineering [19, p. viii]. Applications to the domain of pre- and post- conflict represents an extension of current capabilities – in theory, domain applications, and strategic relevance. The capabilities of GSSD can readily be applied to mapping the domain of conflict dynamics, since 'conflict' is one of the substantive domains in the knowledge base (including the 'unbundling' of the concept into its constituent elements, identifying critical information sources, determining the political and strategic agendas underlying each source, and highlighting the essential barriers to information aggregation and integration).

3.2 COIN Information Integration

Identifying barriers per se does not automatically translate into transcending them. For this and other reasons, it is analytically and strategically empowering to draw upon the utilities of new harmonization technologies (such as COIN). Such capabilities enhance, and may well be essential, for mobilizing integrative capabilities of distributed knowledge-based systems (such as GSSD).The *COntext INterchange* (COIN) Project has developed a basic theory, architecture, and software prototype for supporting intelligent information integration, employing context mediation technology [5, 14, 15, 17]. It is important to explore the utility of the COIN framework to develop theories, methodologies, and a web-based strategy for information harmonization and integration – driven by user needs and specifications. The fundamental concept underlying such a system is the representation of knowledge as Collaborative Domain Spaces (CDSs). A CDS is a grouping of knowledge including source schemas, data context, conversion functions, and source capabilities as related to a single domain ontology.

The software components needed to provide harmonized information processing (i.e. through the use of a CDS or collections of CDSs) include a context mediation engine, one or more ontology library systems, a context domain and conversion function management system, and a query execution and planner [2]. In addition, support tools are required to allow for applications' (i.e. receivers') context definitions and source definitions to be added and removed (i.e., schemas, contexts, capabilities).

Clearly the 3-D's are driving a research environment that places high value on capturing the information needs and demands of the receivers' context definition. Far from a 'one size fits all', the imperatives of the conflict domain are such that the reverse is true: customization of information is essential for any effective analysis of pre- and post- conflict conditions. All of this is fundamental to the core of our research strategy namely the development of viable and robust system dynamics models of pre- and power- conflict situations and the linkages among them.

4. SYSTEM DYNAMICS MODELING (SDM)

4.1 Value of System Dynamics

System dynamics modeling (SDM) has been used as a modeling and simulation method for more than 30 years. System dynamics focuses on understanding and representing the dynamics of a system, including interactions among actors, actions, structures and processes in complex situations, with a special focus on feedback dynamics and delays to highlight the unanticipated consequences. System Dynamics modeling is designed to eliminate the limitations of linear logic. It is based on understanding system structure, identifying core variables, specifying interconnections among positive and negative feedback loops, and tracking intended as well as unintended consequences of action. Based on iterative process of difference equations, this approach requires an a priori identification of system boundary, clarification of core elements and 'causal linkages', and exploratory propositions about the sources and consequences of alternative system behaviors.

SDM is a valuable resource for understanding possible and often unexpected undesirable outcomes, creating 'insurance' against unintended consequences, and enabling a better fit between conflict conditions and strategic operations. SDM has been applied to numerous domains, for example, crisis and threat in the world oil market, stability and instability in developing countries, conflict among competing countries, dynamics of arms races, etc. SDM enables analysts to uncover 'hidden' dynamics in conflict situation, and helps anticipate new modes of threat and violence. For strategic purposes, it is essential to exploit the potential power of phase-linkages, i.e. how and to what extent do pre-conflict dynamics influence the course the conflict and, more important, shape the post-conflict phase.

4.2 SDM of Pre- and Post Conflict Situations

Over the years, a large number of individual factors have been studied as causes of conflict, but how do they interact with each other? SDM is well-suited for analysis of complex systems and evolving or emergent dynamics under great uncertainty. The literature on system dynamics models of conflict explores new terrain in both the modeling and the conflict analysis domains. It has been used for better understanding of interconnections among causes and consequence of conflict, and has successfully captured the linkages between domestic and international factors [10, 4, 16, 21, 22] and generated robust representation and modeling of conflict by differentiating between internal

sources and external influences, and articulating the linkages between and among them. The initial representation of a system dynamics model (highlighting the core logic) is through the causal loop diagram (a step prior to computational rendering).

Most SDM models of conflict draw upon the theory of lateral pressure in international relations [11, 12]. The theory argues that internal sources of conflict lead to potentials for external conflict, and then posit dynamics of lateral pressure rooted in the relative capabilities of adversary countries in terms of their population features (P), level of technology (T) and resource access and availability (R) – with the implication that different 'base lines' of P, T, R generate different propensities for conflict behaviors.

The following figures illustrate the progression of SDM logic and modeling. This model is designed to explore the connections between internal and external conflict. The goal is to simulate potentials for violence in select developing and industrial countries, anchored in 1990 data, and simulated n-years into the future. In other words, this is an example SDM model that relates the conditions *within* a country to *external* impacts and, by extension, the feedback dynamics between internal and international factors.

A highly simplified view of the overall logic is in Figure 1, which shows the entire system and defines the components or 'sectors' of the model that must be rendered more explicit in order to formulate the key equations. It is the most skeletal form of the functional relations (note, at this stage, the absence of positive or negative in the directionality of the arrows). Figure 1 is clearly too general to be used operationally. The point however is that even at this most abstract level, an SDM model is rendered in terms of critical feedback dynamics. For example, we can see in Figure 1 that "resources" (and other factors) influences "military force." In turn, the amount of "military force" (and other factors) influences the amount of "violent conflict." The amount of "violent conflict" influences the amount of "resources" – leading us around the circle back to "resources". This type of feedback loop is fundamental to System Dynamics and, when all the factors are considered simultaneously, easily exceed the cognitive skills of most "mere mortals." That is why the computer-based SDM modeling and simulation are so important.

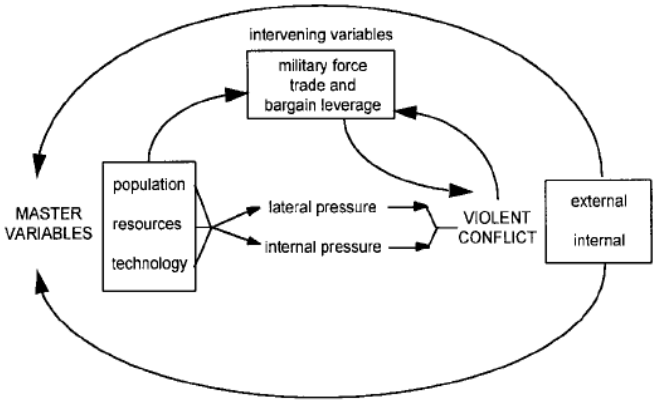

Figure 1. Overview of Conflict Model

More specification of the logic is required in order to formulate the key equations. Figures 2 and 3 proceed then to unbundle the dynamics into more detailed key feedback relationships.

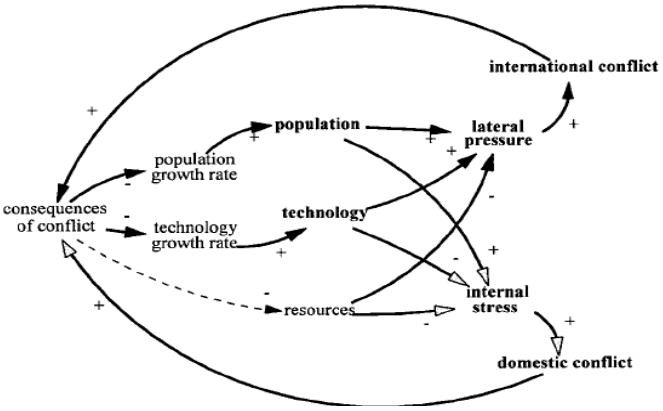

Figure 2. Six core loops for impacts of master variables

In Figure 2 the connections among the core drivers (or master variables) namely population, resources, and technology represent the hypothesis that when increases in population and in technology (or overall capability) are accompanied by declining resources, then the greater the resource needs, the more will be the level of internal stress. Sustained internal stress leads to domestic conflict, and the greater the conflict the more severe will be the impacts on the country's core capabilities (the master variables).

The plus and minus signs in Figure 2 represent the nature of the expected causal relationship. A plus (+) indicates that we expect an increase to occur, whereas a minus (-) indicates that we expect a decrease to occur. For example, we expect that an increase in "population" will likely lead to an increase in "internal pressure." There is nothing predetermined about (+) or (-), it simply is a way of rendering the feedback dynamics explicit and to connect to the rest of the model.

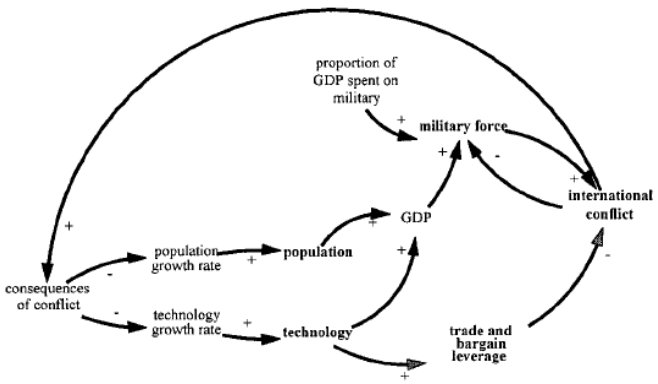

Figure 3. Military force loop and trade and bargain leverage loop

Some of the more detailed connectivity logic is shown in Figure 3, indicating how the impacts of conflict – mediated through the master variables as intervening processes – influence the country's overall economic performance, indicated by its GNP will be affected accordingly. The greater the domestic conflict, the more will be the detrimental effects on economic performance. When this happens, then there is an increase in the propensity to use military force and to engage in external conflict.

Figure 3 also includes is an alternative to the military option, namely trade and bargaining. These are essentially two different 'pathways.' The propensity for conflict management and/or the de-escalation of hostilities increases with less reliance on the military and greater use of trade and bargaining options. The eventual outcomes, then, are shaped by the relative strength of the alternative pathways.

It is important to stress again that in this model the feedback dynamics is from the external to the internal environments. The nature of the feedback dynamics is a specific (and practical) mechanism through which to explore the linkages between pre and post conflict situations.

4.3 The Problem of Data Deficits in SDM

Comparing leading modeling technologies in the social sciences along specific criteria, Axelrod [3] ranks SDM high on flexibility, transparency, and range of application domains; and low on construction time, user prerequisites, and learning time. This ranking however, does not take into account construction or expansion of the database or meeting key information needs. In this connection, a chronic limitation of SDM applications, so far, has been its relatively limited empirical bases, i.e. it does not take into account the construction of expansion of the data base or of meeting key information needs that must be addressed prior to actual modeling. Therefore, capturing the full value of understanding and representation of a conflict system requires the prior resolution of select information needs (as noted in section 2.3 above). Deploying the technologies highlighted in Sections 3.1 and 3.2 above, namely GSSD and COIN as an inherent part of an overall system dynamics modeling strategy and creates multiplier effects in anticipatory and explanatory capabilities.

5. CONCLUSION – NEXT STEPS

5.1 Full Circle – Information Integration & Context Mediation

For modeling purposes, it is essential to reduce serious information barriers, enhance understanding and meaning across substance, topics, and ontologies, and provide new tools for conflict analysis. For example, data on incidences of conflict and war are available on the web sites of a wide range of institutions with different capabilities and objectives, such as the US Department of State, SIPRI in Sweden, the UN HCR, the Correlates of War Project [http://www.pcr.uu.se/research/UCDP/conflict_dataset_catalog/data_list.htm]. Despite all this information, we cannot compute the 'actual' number of deaths and casualties in a conflict – at one point in time, over time, and as the contenders change and reconfigure their own jurisdictions – largely due to differences in definitions of key variables. These are typical questions that have plagued researchers, as far back as 1942, with classics in the field such as Quincy Wright's *A Study of War,* [23] and even earlier, with Lewis Fry Richardson's *Statistics of Deadly Quarrels* (1917) [19]. This is one of the major challenges in the new domain of inquiry, termed CyberPolitics, as noted in the *International Political Science Review* (2000) issue "CyberPolitics in International Relations" [7, 8] which identifies new directions of research, research priorities, and critical next steps.

5.2 Leveraging the Power of SDM's

In the domain of conflict analysis, there are some particular 'leverage tasks', essential for enhancing the power of SDM's. These include reducing barriers to information access and use when the *properties of the problem* themselves are changing as a function of *unfolding* conflicts and contentions, and when the *demands* for information change in the course of the contentions. The research design includes three sets of test applications selected because of their known and powerful impediment to pre and post conflict situations.

(1) **Disconnects in Definitions of 'Conflict'** – e.g. the wars and casualties problem. Of the leading 10 data sets on international conflict and violence over time, no two data sets are synchronized or reconciled (see below for two examples).,

(2) **Shifts in Spacial Configuration** – e.g. the territorial boundaries problem. As any student of international relations knows, the dissolution of the Soviet Union is a major, but far from unique reconfiguration of

territorial boundaries. Several data bases seek to capture these changes, and below we refer to one such example with cases spanning well over one century (1816-1996).

(3) **Distortions due to Data Temporality** – e.g. economic and political 'currency' problems. Achieving integration of diverse data sets on attributes and activities of states over time requires the ability reconcile different coding schemes representing states as well as the ability to track and integrate the impacts of changes in territorial and jurisdictional boundaries (using, for example, the Uppsala Territorial Change data set). With the power of anticipatory technologies (Section III) it should be possible to connect many of these factors to available data sources and thereby enable fact patterns to be readily filled in so that the method can be more readily applied to supporting the policy analytic process.

5.3 Next Steps in Research Project

To deploy the anticipatory technologies (in Section III) in conjunction with the modeling capabilities of SDM's (Section IV) toward solving specific problems in the Pre- and Post- Conflict domain, we propose to proceed in the following steps: (1) identify the referent situations in terms of a spacially defined conflicts (i.e. the Middle East or Central Asia), (2) create the case-catalogue of such cases, identify all conflict-related or overlapping spacial reconfigurations over the past 20 years, and verify the degree of congruence among alternative sources for representing the shifts, (3) identify the similarities and differences between the variable definitions of the problem in various information systems or relevant data bases and compare these to the topic and/or domain specific ontology in GSSD, (4) Use the results to design context features for computational purposes of new context mediation tools, and then (5) construct the pilot pre- and post- conflict SDM model for the case in point.

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BIOGRAPHY

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