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Hall, Steven
Blais, Curtis

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Understanding Sector Dependencies in the Stabilization and Reconstruction of Nation-States

Steven Halla, Curtis Blaisa*

aNaval Postgraduate School, 700 Dyer Rd, Monterey, CA 93943

Abstract

The United States Army is undergoing a re-definition of its Civil Affairs officer positions. A recent project to define the educational requirements for an Army Civil Affairs Officer (38G) identified an educational requirement to help officers understand the complex ways in which the operations that advance the achievement of one stabilization objective often hinder the achievement of other objectives. The system level thinking was seen to be frequently insufficiently ingrained amongst Civil Affairs Officers (and the leaders they advised), who were both often perceived to be inclined, in the face of the complexities of the situation on the ground, to become too narrowly focused on achieving their specific assigned responsibilities, limiting their ability to see how the mission effectiveness of what they were recommending would be influenced by the state and trajectory of other Sectors and how, in turn, their recommendations would influence the mission effectiveness of other Sector stewards. While system dynamics modeling has proven itself to be effective in capturing and effectively communicating feedback loops that define such non-linear (and non-intuitive) systems they do not, in themselves, provide sufficient modeling richness to comprehensively capture the critical spatial (geographical) determinants of a successful state reconstruction process. For these purposes, a multi-agent cellular automata model is recommended both as a vehicle for introducing students to the complex nature of the state reconstruction process and, eventually, for use in the field by deployed Civilian Affairs Officers at all levels. This paper describes the problem and the modeling approach to address it.

Keywords: Multi-agent; system dynamics; modeling and simulation; panarchy; resiliency; stability; reconstruction and humanitarian operations.
1. Introduction

This paper reports on work that is focused on providing analytical support to planners attempting to stabilize and/or reconstruct a failed or failing host nation-state. As such, the work attempts to provide, to strategic planners, the possible and sometimes-probable outcomes of the operations being proposed by the various donor agents: nations, international organizations, non-governmental organization, trans-national and corporate entities; on the host nation’s hoped for trajectory towards resilient self-determination.

We begin by defining what a resilient and self-determining nation-state does and what is assumed to underlie its capacity to do so. Fundamentally, as depicted in Figure 1, a ‘state’ provides three essential services to the nation with which it is associated: 1) it defines and maintains a national ‘identity’ composed of a core set of value-based narratives, situated relative to the narratives of external entities, that support a shared understanding of common interests and mutual obligations amongst its citizens [1]; 2) it determines the needs of the constituents of the nation-state and effectively ensures their individual well-being [2]; 3) it engages with external entities and effectively ‘negotiates’ with them to minimize potential threats to nation-state survival and international stature while maximizing potential collaborative opportunities [3].

![Fig. 1. The Three Essential Functions of a Resilient State.](image)

An important consequence of this understanding of the optimal role of the state lies in the implication implicit in the distinction between what the state defines as part of ‘us’ versus part of ‘them’. The optimal state’s resource expenditures external to the state are modelled as being allocated in the (bounded) rational (potentially ‘enlightened’) self-interest of the nation. Conversely the optimal state’s internal resource expenditure strategy is modelled as being allocated to sustain the most vulnerable of the state’s constituents. Thus, understanding (and managing) the boundaries of the state becomes a key aspect of establishing what ‘legitimate’ decision making looks like for a state.

This characterization suggests that the essential reconstructive/stabilization analytical support question for us is: what are the necessary conditions for the emergence of such ‘state’ capabilities and how do we characterize them in quantifiable metrics that can be measured and tracked? Fortunately the United States Institute of Peace (USIP) has characterized, within its Guiding Principles for Stabilization and Reconstruction [4], the essence of much of the current critical scholarship on this question. USIP defines five key ‘end-states’ as being characteristic of national-level social identity groups (SIGs) that maintain highly functional states. These include: A Safe and Secure Environment; A Sustainable Economy, Social Well-being; Stable Governance and the Rule of Law as outlined in Figure 2.
This paper, in particular, characterizes some of the fundamental challenges that must be confronted in providing reliable analytical support for planning such operations in a host nation that will bring about such end-states and it provides some suggestions as to what a modelling and simulation architecture might look like that could adequately provide the needed support while retaining enough flexibility to incorporate future insights garnered from operational experience and theoretical developments.

Pragmatically the first step in the pursuit of this task is to compellingly characterize and communicate the non-linear and complex nature of the state (re)building process such that stakeholders unfamiliar with the inherent challenges of the state reconstruction process, and/or the tools required to manage such processes, can readily see the need for a theoretically anchored multi-agent modelling and simulation approach if we are to adequately provide support to the current missions and better educate such planners to support their real-world operational planning.

The second step of this task is to explore how adequately the Guiding Principles has already qualitatively captured the subject matter expertise (SME) of existing state stability and reconstruction subject matter experts and to suggest the nature of the formulization process through which this expertise can be captured and integrated into a computational model.

Progress on both of these objectives is summarized in the following sections.

1.1 Why a Multi-agent Modeling and Simulation Approach is Required

The first insight, in understanding the challenge of providing the required analytically support, is found in a realization that the various donor parties, while sharing a disdain for a failed state, do not necessarily share a vision of what the end-state of the reconstruction process should look like. Some interests are more economically focused on retaining an uninterrupted supply of host-nation goods and services; others are concerned about the potential spread of instability to their own ‘shores’; yet others are motivated by the perception of human suffering; while yet others are concerned about the loss of cultural diversity and its impact on global resiliency. It’s reasonable to assume that all of these concerns/motivations can, to one degree or another, be identified within each of the donor entities, and that the relative strength of these motivations is itself subject to modification as the stabilization/reconstruction process evolves. Pragmatically this variability, in end-state vision, can lead to differences within the collaborating team with regard to: how much autonomy the host-nation should emerge with; how enduring the engagement should be and what kind of privileges donor entities should retain vis-à-vis non-donor entities. These
differences in end-state vision, if not managed well, can result in a loss of ‘unity of effort’ or, worse, loss of coalition partner participation altogether. Thus, not only do we need to capture and predict the potential consequences of any selected reconstruction/stabilization operation on the host nation but on the donor team as well.

Figure 3 provides a taxonomic framework for situating these various ‘philosophical’ and ‘international relations’ visions of what should guide reconstruction/stability operations and what ‘success’ would look like.

![Fig. 3. Two Dimensions that Distinguish the Range of Stakeholder IR Approaches](image)

The implications of this variability, in stakeholder approaches/objectives, is that depending on the stakeholder’s beliefs in the possibilities inherent in sustaining an ‘other’ (competition, cooperation, co-dependence) [along with what they conceive of as the various strengths of the other’s corresponding beliefs] in conjunction with their own [and the other’s] perception of change (threatening, inevitable, promising) will determine their notion of what constitutes the desired mission success. Overall mission success from the operational perspective will often only be quantitatively characterizable as a multi-objective optimization problem.

The second insight is that knowing the critical functions that must be performed by the state in order for it to be resilient [5] does not in itself define the process by which these functions come to exist and persist at the national level. Certainly there is a bootstrapping interdependence amongst the development of these Sectors as well as between many of the sub-functions within each Sector. Figure 4 provides an illustrative characterization of these inter-Sector influences. The figure provides a high-level characterization of the natural evolution of a resilient state. As security increases perceived investment risk goes down which in turn supports a revitalization of the economy which in turn increases the supply of goods and services consequently increasing social well being and the population’s consent to pursue more encompassing collective interests by the ‘state’ which underwrites the influence of rule-of-law which finally cycles back to further supporting the development of a safe and secure environment. However the key observation here is that not only can the reconstruction process spiral itself up into mutual resiliency via a nudge to any one of the sectors … but it can equally easily spiral down if the nudge is in the wrong direction.
More relevantly, many of the operations/interventions that are pragmatically available to the reconstruction team entail simultaneously generating a positive influence in one sector while generating a detrimental influence in another sector. Thus the critical question in regard to the overall constructiveness of any given operation often boils down to understanding the relative strengths of these influences in the current context … and the temporal trajectories of those influences.

A disaggregated and representative example of such a ‘system dynamic’ of the internal dynamics of a particular Sector model is presented in Figure 5 below. Here the effectiveness of operations intended to reduce the number of insurgents (with the goal of increasing security) is seen to be influenced by: how much collateral damage is produced by those operations; the legitimacy vulnerability of the state to collateral damage caused by the operations of ‘external’ agents; as well as the baseline growth rate of recruitment candidates (which is, in turn, influenced by current economic conditions which may also, in turn, be influenced by any uptick in military operations). Thus the ‘system’ effectiveness of such operations is ultimately determined by the relative influence of the negative consequences relative to the positive consequences, in the current context, on the overall system.
A third insight in modelling any situated state reconstruction process is the need for a well-articulated characterization of how these national scale social-environmental ‘ecosystems’ along with their multi-scale constituent ‘ecosystems’ all simultaneously naturally evolve towards fragility and are consequently maintained in their most efficient but fragile states only in virtue of the presence of higher level ‘eco-systems’. Figure 6 graphically depicts these multi-scale interdependencies.

One of the more promising characterizations of this resiliency process is the Panarchy model [6]. Panarchy provides a conceptual framework for understanding and representing the resiliency influences that emerge from living systems, such as nation-states, that are composed of constituent ‘living systems’ at a variety of temporal and spatial scales.

These three insights highlight the complexity of the nation-state reconstruction process and clearly underline why current reconstruction teams, operating without the benefit of computational models of possible and probably unintended consequences, have all too often, in recent engagements, made decisions that were clearly regrettable only in hindsight. The solution to this cognitive dilemma is to utilize the computational modelling tools offered by system dynamics and complex adaptive systems models to help manage and explore the behavior of such a system in its current state. Even simple conclusions derived from exploring such models can provide important insights into what operations the nation-state system will likely be relatively insensitive to and which will likely trigger a ‘tipping point’ and, of course, which of these most influential operations will likely lead to a desirable outcome and which will likely not.

Fig. 3 State Resiliency and Fragility is a function of Interactions at Multiple Scales

2. Assessing and Formalizing Stability and Reconstruction Expertise

Our second objective was to identify the completeness of the current subject matter expertise extraction process and to begin defining a process by which this information could be formalized. The objective was pursued in the context of a set of working group sessions held with nationally recognized nation-state reconstruction subject matter experts (SMEs).

To illustrate; the SMEs were asked to help define and expand upon the key tradeoffs that a 38G-SSE (Safe and Secure Environment) Specialist should understand and consider when providing such objective recommendations. Five such keys tradeoffs had already been provided within the ‘Guiding Principles’. The group focused on both expanding our understanding of the provided tradeoffs as well as searching for tradeoffs that had either been overlooked or were of lesser saliency. The result revealed that the assembled SMEs collectively had a more nuanced understanding of the potential pitfalls than had been clearly delineated in the Guiding Principles.

The inquiry was structured around the seven defined UN objectives of SSE operations. SMEs were asked to identify the conditions under which the pursuit of these objectives might undercut the overall rebuilding goal. The following list summarizes the kind of negative consequences that can result from such operations in a variety of implicitly and explicitly defined conditions reconfirming the complex feedback oriented nature of such operations.

1. **Warring Faction Separated and Fighting Stopped** can: separate families, tribes, clans; provide the opportunity to rearm, regroup, and prepare for follow-on operations; backfire if economic conditions are weak; allow existing problems to fester (e.g., Israel/Palestine); create issues with flow of goods for local economics; sever beneficial cultural interactions; appear preferential to one group over another; and have a net negative influence on social well-being.
2. **Civilians Protected** can: enable looting of archaeological sites with an impact on well-being; be perceived as engendering inequities in group protection; be implemented so as to generate a perceived loss of personal liberty; and sometimes lead to reduced SSE (e.g., by pushing too much money too fast).

3. **Freedom of Movement** can: enable illicit business; create a welfare mentality leading to loss of governability and economic resilience; facilitate insurgent operations; disrupt state security; result in the loss of disease containment control; contribute to environmental damage; add additional stress on existing infrastructure (e.g., urban areas); and detrimentally impact villages/towns.

4. **Public Order Re-Established** can limit: social and technical innovation; the ability to redress political grievances and injustice; freedom of movement with its impact on SWB and Economics; nation-state resiliency; critical ‘social defined time-outs’ that act as ‘safety valves’; the development of a ‘national identity’; and a sense of independency.

5. **Disarmament, Demobilization and Reintegration (DDR)** can: negatively impact the economy, state legitimacy, and eventually a SSE if not combined with Reintegration; negatively impact perceived injustice if Reintegration occurs without Restitution; and can deny needed security personnel to host nation SSE forces.

6. **Defense Sector Professionalized** can: train insurgents to fight more effectively; upset the host nation civilian military balance; insult the dignity/pride/confidence of host nation defence forces; instil values that are in conflict with host nation cultural values; exacerbate state legitimacy if the political leadership has questionable legitimacy; be perceived as creating a proxy (for US) military domination; unbalance the recovery if not coordinated with professionalization of other sectors; lead to excessive and unmitigated force application if not implemented with a concordant educational reform in the role of civilian leadership.

7. **Territorial Integrity Recovered** can: result in artificial boundaries that are difficult and expensive to maintain; impede trade with the international community; cut communities apart leading to a loss of human level sustenance; drain critical resources required for other sector recovery efforts; threaten neighbours and trigger aggressive responses; reify multi-ethnic fault-lines and exacerbate brewing resentments; and impact refugee movement both into and out of the country.

Through a formal process, beyond the scope of this paper, this qualitative data was formalized into a quantitative characterization of the inter-sector tradeoffs involved in executing any stabilization/reconstruction operation.

### 3. A Glimpse at the SHROOM Model

A prototype multi-agent system dynamics model called SHROOM (Stability, Humanitarian, Reconstruction Operations Optimization Model) was created in NetLogo to capture and integrate the multi-resolution resiliency effects described by the Panarchy model as well as the context dependent operational influences described in the Guiding Principles and refined by our Subject Matter Experts. A screen image of SHROOM is found in Figure 7.

![Fig. 4 Prototype SHROOM Model](image)
This prototype version of the SHROOM model provides a one-player game context in which the player attempts to (re)stabilize a nation-state from its initial and sometimes increasing state of instability. The model incorporates: 91 village-level, 9 provincial-level and 1 state-level agents each of whom is running a simplified system dynamics model of the interactions described in the Guiding Principles and depicted in the upper right of the figure. A set of input controls is available to specify the top-level influences of a destabilizing ‘Red’ force while the ‘Blue’ player is provided with a set of operational alternatives supporting recovery of each of the 5 sectors but which invariably involves generating some degree of negative consequence on at least one of the other 5 sectors. The Blue player can conduct any of the available operations at any administrative level (village, provincial or state) currently available in the game. The cost of conducting an operation is directly proportional to the area of operations. By default Blue is given a limited budget to spend on each turn so that selecting which operations to conduct at which locations and scales must be made judiciously in order to ‘win the game’. In general, the model incorporates diminishing returns at both the upper end and lower ends of the effects spectrum so that, for example, operations conducted to increase security have increasingly less influence as security approaches the maximum value while similarly the detrimental influences of operations are muted as the affected sector approaches its minimum value. The critical panarchic influences are captured in the system dynamics model in the lower right of the figure. As with the Operational influences, each of the 91 agents runs its own version of the Panarchy model. The panarchy model captures two important characteristics of such multi-scale resilient systems. First, it captures the inevitable rise in system potential/wealth as connectedness increases with the dominance of the ‘fittest’ along with the invariable loss of adaptive resilience and flexibility that eventually leads to fractionation and decline and consequently a return to innovative adaptation to the environment. Second it captures the cross scale influences that are generated from the subordinate (constituent) and superordinate systems to which the system is connected. The most important of these cross-sea influences are such that a collapse of a lower level system tends to expedite the collapse of a high potential superordinate while a high potential superordinate can both minimize the loss of potential in a reorganizing subordinate and expedite its growth/exploitation phase. As a consequence of developing an understanding of the nature of panarchic resilience, players come to understand that the goal of resilient nation-state reconstruction is to, metaphorically, allow groves of the forest to burn while judiciously working to avoid letting the whole forest burn at once with the full knowledge that everything they do will have a negative influence but that understanding the nature of diminishing returns can significant facilitate generating the desired effect.

One final note: It is interesting to note that in a large number of circumstances a consequence of the linking of these two models together results in a near synchronization of the panarchic states of the villages within a given province. The colored ‘map’ in the upper left quadrant of Figure 7 displays such a state. The emergence of these resonant oscillations within a sub-network within a larger social network is a pattern we’ve seen in real world data (still in press) that often serves as a harbinger of both emergent new social identities and, under conditions that preliminary data suggest are predictable, and can predict the outbreak of rebellious secessionist and/or revolutionary movements.

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