

## Modeling the Great Game in Asia

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### Abstract

*The Great Game provided an analytical framework that organized successful efforts by imperial Britain to build a stable and secure Asian rimland long before automated machines allowed the rapid accumulation and processing of information. The Great Game framework provided structured forms of argumentation for the production of intelligence that resulted in improved monitoring and analytical capability. However, these insights do not translate readily into current analytical frameworks and cannot work with automated reasoning tools. The authors combine historical knowledge with UML, model-based transformations, and computational analysis to configure the Great Game framework to a more formal and modern assessment. The models will generate structured information about the system as input to computational tools, using in this instance ORA from CMU. The resulting information analysis offers the opportunity for a feedback loop that can improve the model and structure useful discussion about the framework.*

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models with Bayesian analysis to allow for probabilistic reasoning. Figure 4 shows what the model of the Great Game scenario looks like in a spreadsheet, with the property values used for sorting. In this case, agents with high autonomy scores found their way into the network analysis tool. Additional attributes can be added as needed depending on the target for the model. Note the most UML 2 tools save direct to XML, so one can have the subject matter experts modify the values in a spreadsheet and not bother with a complicated modeling tool.

	CV	CY	CZ	DB	DC	DD
1	<b>name74</b>	<b>source76</b>	<b>ns2:type77</b>	<b>Autonomy</b>	<b>AgentType</b>	<b>Certainty</b>
657	British India	appliedStereotypes	IR_8:IR_Agent	10	institution	9
661	Soviet Union	appliedStereotypes	IR_8:IR_Agent	10	institution	5
665	China	appliedStereotypes	IR_8:IR_Agent	10	institution	3
690	Pakistan	appliedStereotypes	IR_8:IR_Agent	10	institution	4
708	India	appliedStereotypes	IR_8:IR_Agent	10	institution	4
712	Great Britain	appliedStereotypes	IR_8:IR_Agent	10	institution	9

**Figure 4: XML version of the model viewed in a spreadsheet to prepare for analysis in another tool.**

### Agent

The agent represents the player in the game. As with most elements in this model, the agent has a property that describes the type of agent. Here, the types include “individual:”, “institution”, “occupational group” “social network”, “ethnic group”, “caste” with additional types easy to add. In most cases, models will deal with agents as institutions and groups, recognizing the capability exists to analyze them as individuals, if needed.

Each <<agent>> also has an integer (by convention a value from a low of one to a high of ten) that shows the autonomy of that agent. In modeling out a scenario from an individual perspective, the agents will typically reside in an elaborate inheritance hierarchy, with lower elements showing allegiance to higher elements. For Britain’s Indian empire, such a relationship hierarchy organized the hundreds of groups that held allegiance to the Crown. For the analysis of the Great Game, the primary concern resides with actors that have high autonomy scores, reside toward the top of the hierarchy, and hold ambitions relevant to the effective control over territory. The agent’s relationships also provide a filtering mechanism to focus on the agents important for a particular scenario. Each of the lines radiating from the agent indicates a relationship, with the line label providing a description: agents hold values, seek goals, acquire skills, monitor developments, control resources, and can move in a location. Note that all the navigation arrows point away from the agent, indicating that it is the agent that knows about the relationship and not the target entity. The only bidirectional relationship in the model is the relationship between two agents, as each agent will know the nature of the relationship with the other agent. The resulting models from this profile will emphasize decoupled entities with many contradictory and fissiparous forces. Territorial goals provide the constraints to focus the analyst to make the model manageable.

### Goals and Location

An agent seeks to achieve goals. A goal in the Great Game always includes a target location. The focus on the unchanging reality of geography provides structure to the debates about the Indian system. A goal will target at least one location, as described by geospatial coordinates or some other type of coordinates. Locations refer to fix points that are unique, although one can nest locations inside of each other.

A <<location>> entity will have an importance derived from the territorial ambitions of all the different actors in the system. The location will also have attributes indicating the population density and the degree of organization over the population. Highly organized locations have effective methods of social control. An agent has a relationship with a location independent of their territorial goals showing the degree of agent maneuverability. In some scenarios, an agent will require the capability to deploy troops, in others the ability to simply monitor the activities of another agent. An agent can have a gap between the desired capability for maneuver and the actual, a situation that indicates potential for conflict. Geographic features will constrain the types of activities that can take place in any location. For example, geospatial coordinates that lack land (such as the ocean), constrain the capability to place fixed buildings at the location. Finally, locations also provide access to resources that translate into money and material that an agent can use, provided they have the skills to take advantage of these.

While the goals of an agent unambiguously indicates the locations they target and what they need in that location, one cannot determine from the goals the values that will drive territorial ambition. The value realm remains distinct and requires a modeling effort decoupled from the review of location.

## Values

A number of reasons animate an agent to seek a location, from control over water for crops to a desire to promote a religion to a desire to ameliorate suffering or stop a perceived evil, such as slavery or genocide. Important from the vantage point of Great Game goals is the value and territorial ambition remain decoupled, with the nature of the control required over that territory also left as a variable. This decoupling in the models indicates a dynamic and constantly changing system of alliances. Note that the decoupling does not leave a system without values nor does it indicate Great Game agents lacked values. The framework, however, only analyzed those values in the fashion that they *resulted in territorial ambitions* or provided instruction on *how to organize society* in a territory. The focus of the Great Game on effective organization of territory on the globe did not derive from hostility to values in social organizations but from a decoupling that this model strives to replicate. Surprisingly, the decoupling of the value realm which some could see as denigrating values in foreign policy actually provided a space for consideration of moral questions to flourish. The debate about values could continue over time in this model in a way that the debate about geographic features, which for practical purposes don't change, could not.

In this context, consider the attributes of the <<value>> classifier. An agent can hold values with no constraint on their coherence. All values have a priority used by each agent to prioritize conflicting claims in the practical translation of values into goals. The types of values available include religious beliefs, perceptual truths, cultural norms, ideological positions, and aesthetic preferences. These values not only navigate towards a territorial goal, as mentioned, but they also navigate toward a preference for a type of social control. For example, agents in the Great Game could seek to implement their version of Islamic law. Other agents, such as Pathans on the Northwestern frontier sought to maintain their distinct local authority structures in the face of the expansion of civil service and legal bureaucracies. The system can tolerate a proliferation of values and social control aims leading to a constantly changing constellation of polities, ideologies, cultural practices, and religions.

## Social Control

Agents holding values will promote particular mechanisms of social control consistent with those values. The types of authority for this social control available in the model include legal (statutory), constitutional (common law precedent), religious, or familial.

An instance of <<social control>> will indicate one to many locations where this control is exercised. The British more than any other Empire emphasized multiple, overlapping, and even contradictory methods of social control over a location.<sup>2</sup> The federal idea in constitution making provides the expression of this in practice, with the many federal polities organizing continental spaces a testimony to this approach. Government can allow agents to express their desire for a particular method of social control at a local level while higher level organizations would focus on items of common concern, such as defense. That the Great Game players on the British side did not demand a single form of social control guaranteed the proliferation of competing forces and jurisdictions.

This tolerance for different forms of local rule had limitations: it did not function as a universal rule applied to all circumstances, but only in those that did not contradict the ability of the British to maneuver in a location that they required. These various entities are all illustrated in the Afghanistan model described above. How can one change this model into something for computational analysis?

## Model Transformation

Finding entities to populate the model for portraying the Great Game scenario in Afghanistan proved easy. On the agent side, one could easily load in all 100+ princely states in India, as well as any number of political, religious, occupational, caste, and religious groups. Such a massive model would do little to improve the core model. Ultimately, a model could scope to include that scale of detail, but prior to analysis in a computation tool, the relevant entities would emerge based on the situation. For this model, only the most important entities were placed in the model. The model produced stereotypes as follows: 34 <<agent>>, 22 <<skill>>, 25 <<values>>, 23 <<resources>>, 50 <<locations>>, with 23 <<goals>>.

The UML model on its own does not provide the computational rigor to improve the analysis. From UML, one can transform to any number of targets. This paper argues that the VSG's emphasis on argumentation that analysts could falsify represents a strength. Without exposing the constructed model to some feedback system, knowledge will advance slowly, if at all. The initial target transformation was DynetML, with long term aspirations to move the model to an Agent-Based simulation. DynetML feeds into a tool called ORA. ORA has been supported by a program from the Air Force Research Lab called Topsail that looks to provide cognitive aids to support intelligence

analysis.<sup>3</sup> This model provides an opportunity to demonstrate the type of analysis that such computational tools can perform in the context of more traditional diplomatic history.

From the 200 entities and roughly 500 relationships in the core model, the relevant subset was transformed into DynetML using the profile entities and their attributes to drive the process. Agent mapped to agent while location and resource mapped to resource, knowledge and values to skill, and goal to task. The mapping was not always clear, but any mapping for the first thread provides a baseline: we can refine the transformation based on the results. Future versions of the profile can more clearly highlight values needed for producing edge weights in this target and for filtering out entities not needed for the scenario analyzed. ORA produced a rich set of measures to review and to compare networks. Figure 5 below shows the UML 2 model as viewed in the XML browser. The ability to manipulate the model and model properties in XML proved essential for carrying out this transformation in a timely manner.

name		eAnnotations		ownedAttribute	
British India					
	xmi:id	_1Hp34KuLEdm9KY-o0E1Pgg			
	source	appliedStereotypes			
	contents				
	xmi:type	IR_8_IR__Agent			
	xmi:id	_j85rWkV-EdmXp_OvklpTwrVA			
	Autonomy	10			
	AgentTy...	institution			
	Certainty	9			
Soviet Union	eAnnotations	xmi:id=_MzCSokUeEdm9KY-o0E1Pgg	source=applied...	ownedAttribute	(3)
China	eAnnotations	xmi:id=_LzndAKuLEdm9KY-o0E1Pgg	source=appliedS...	ownedAttribute	(2)
Iran	eAnnotations	xmi:id=_KVc14KuLEdm9KY-o0E1Pgg	source=applied...	ownedAttribute	(1)
Disrupt Economic Flow	eAnnotations	xmi:id=_Te5IAKuLEdm9KY-o0E1Pgg	source=appliedSt...	ownedAttribute	(1)

Figure 5: XML version of the Great Game model viewed using an XML browser

### Findings

The table below shows the ORA results at a high level for the afterPartition and beforePartition models. Note that ORA analyzed the entire relevant subset of the model and the model properties, not just the entities in the model diagram shown above. The ORA analysis even at such a coarse-grained understanding shows a system after partition that handles resources differently with a different cluster of players, resource allocation, and task focus. The before and after partition scores demonstrate the network differences. Note the system after partition has far more cliques as well as nodes with more demand placed on them, illustrating the VSG’s argument that partition diverted attention inward, inviting Soviet expansion in Afghanistan as well as the formation of hostile fringe forces attacking regional stability, such as the Taliban.

The debate in official circles regarding the impact of air power on Indian defense provides another interesting element of these findings. Our initial scenario focused on the air power debate as this reflected actual discussion in the VSG. The results of this analysis, however, illustrate why Caroe regarded air power as ultimately a minor issue in the larger question of defense. The result of analyzing the Indian system as a network in the context of the great game illustrates the point that compared to partition there is no event related to technology that comes even close in terms of the impact on the region.

One puzzling result was the centrality of Gandhi to the network. That Mohandas Gandhi emerged here as a more central figure in 1947 compared to 1935 prove more startling. Reviewing the model and the network export indicated that to the system Gandhi had a particular focus on Indian unity over other goals, which made him a more central figure. In a more fractured system, Gandhi was even more central as measured by “Betweenness”. What this means, in terms of the tool, is that Gandhi represented a node more capable of acting as a mediator between the different groups. Gandhi certainly straddled a number of goals and issues in the political evolution of India, and this interpretation of Gandhi’s increased importance post-partition fits with the fact that his assassination came after independence at the hands of one of the groups focused on more regional goals and values. Other nationalist leaders such as Nehru focused on the modernization of a truncated India over controlling the frontiers while the Muslim League leaders such as Jinnah wanted to have a central government with a Muslim majority. Explained in this way, the network analysis produced a result that made sense given the input model. Where a result might not make sense, we suggest the best way forward is to review the model inputs, change the model properties, and then repeat the network analysis. Even where the result does not on the first iteration make sense, it could provoke discussion and clarify the role of key actors in the scenario.

## Modeling the Great Game in Asia

There are a number of areas for analysis and discussion based on the terms of the concepts set in the model: this effort was designed to make those conversations possible in a structured manner with some objectivity and model complexity. Knowledge advances with a feedback loop where the discussions of how different groups handle the continuous factors in international relations can progress. The goal for this exercise was to get from diplomatic history, to model, to export, to analytical tool. With that done, one can see a number of additional scenarios one can run that will prove interesting. Conversations about the model and the network analysis will only improve the vision; the point of the exercise is to support a virtual study group where discussion improves knowledge.

KEY ACTORS COMPARISON		[afterPartition]		[beforePartition]	
Measure	Rank	value	Name	value	Name
Cognitive Demand	1	0.4142	India	0.3004	British India
	2	0.3179	west Pakistan	0.1362	Soviet Union
	3	0.1909	Soviet Union	0.0538	China
	4	0.1373	United States	0.0509	Indian National Cong
	5	0.1050	China	0.0371	Iran
Centrality [Total Degree] AA	1	0.4459	India	0.4306	British India
	2	0.3784	west Pakistan	0.2083	Indian National Cong
	3	0.2297	Pakistan	0.1806	Princely States
	4	0.2027	East Pakistan	0.1389	Great Britain
	5	0.1757	Princely States	0.0972	Gandhi
Centrality [Betweenness] AA	1	0.0255	India	0.0254	British India
	2	0.0113	Gandhi	0.0111	Princely States
	3	0.0060	Indian National Cong	0.0071	Gandhi
	4	0.0045	Princely States	0.0056	Indian National Cong
	5	0.0038	west Pakistan	0.0048	Muslim League
Centrality [Eigenvector] AA	1	1.0000	west Pakistan	1.0000	British India
	2	0.9250	Pakistan	0.6070	Princely States
	3	0.8451	East Pakistan	0.5580	Great Britain
	4	0.3057	Sikhs	0.3807	Madras
	5	0.2418	India	0.3046	Rajasthan
Exclusivity [Task]	1	0.0628	Soviet Union	0.0902	British India
	2	0.0421	India	0.0670	Great Britain
	3	0.0185	Iran	0.0563	Soviet Union
	4	0.0185	China	0.0193	Iran
	5	0.0185	RSS	0.0193	China
Exclusivity [Knowledge]	1	0.0256	Iran	0.0263	Iran
	2	0.0208	India	0.0183	British India
	3	0.0112	west Pakistan	0.0107	China
	4	0.0105	China	0.0000	Soviet Union
	5	0.0010	United States	0.0000	India
Clique Count AA	1	1.0000	India	0.0000	India
	2	1.0000	Pakistan	0.0000	Pakistan
	3	1.0000	Hyderabad	0.0000	British India
	4	1.0000	Princely States	0.0000	Soviet Union
	5	1.0000	East Pakistan	0.0000	Iran

**Figure 6: Results from ORA**

### Conclusion and Next Steps

The models of the VSG Great Game scenario demonstrated how the framework provides continuity in international assessment, showing an ability to provide insight on both the Cold War and the War on Terror. The transfer of model information from UML into a common tool for analytical analysis proved successful, providing an additional method for assessing international systems. The value added for a rich model of the region would bring substantial payoff using this approach primarily because arguments can link into an overarching framework. This scenario has demonstrated the feasibility of a thread all the way from an instance model of a Great Game scenario based on the VSG through a UML profile through a model transformation into a network format for analysis. Those who might disagree with the assessment of aspirations of the key Great Game players can participate in the debate within the model and run their scenarios through analytical tools.

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<sup>1</sup> For detail on UML, see Erikson, Penker, Lyons and Fado, *UML 2 Toolkit*, (New York: Wiley Press, 2004).

<sup>2</sup> See the multi-volume set on British constitutional history that starts with Madden, Frederick with David Fieldhouse. 'The Empire of the Bretaignes', 1175-1688: The Foundations of a Colonial System of Government. Vol. 1, Select Documents on the Constitutional History of the British Empire and Commonwealth. Westport: Greenwood Press, 1985.

<sup>3</sup> For an overview of ORA, see Kathleen M. Carley and Jeff Reminga, "ORA: Organization Risk Analyzer CASOS Technical Report", July 2004 CMU-ISRI-04-106. While this model can demonstrate the utility of tools supported by Topsail, the modeling effort and Great Game model were not produced under the Topsail program.