



Tracking Political Fragmentation

New Approaches for Measuring Political Fragility and other HSCB Events

Unclassified Brief on CAMP and the LPA for the Patuxent Defense Forum
Saint Mary's College of Maryland, April 21-22, 2009

Human, Social, Cultural and Behavioral (HSBC) Modeling for Military Needs

Defining the Problem



- Since the end of the Cold War, U.S. and global policy makers have been increasingly drawn into internal, regional and international conflicts.
 - The Global War on Terror escalated the pace, triggering a new drive to gather and analyze disparate data, rapidly provide “ground-truth” insight, and produce options for engagement grounded in cultural, political and financial realities.
- Social and behavioral scientists have been increasingly working together to explore how to combine vast history of human event driven knowledge together with advanced computational techniques
 - Behavioral Modeling and Simulations: From Individuals to Societies – (Nov. 2008) - <http://www.nap.edu/catalog/12169.html>
- **Increasingly recognized as AAI field, but the science is embryonic**



The Fragile States Challenge



- Difficult to model accurately:
 - There are so many different players and actors involved – hard to discriminate the cause and effect
 - Government failure frequently endemic
 - Hard to determine what the structure of the society is anymore
 - Uncertainty creates potentially adverse partnerships to stability goal
 - Chaotic interactions emerge when state no longer functioning
- Human, social, cultural or behavioral (HSCB) models are limited
 - Data is always an issue
 - Most models depend on real world simulated data
 - Data sources frequently obscure
 - Based on some sort of government functioning in some capacity
 - Either too generalized looking primarily at macro-level data or too specific to one type of micro event
 - Model lens frequently not defined (boots-on-the-ground focus vs. top-down strategic)
 - Heavily biased – based on subjective SME interpretation



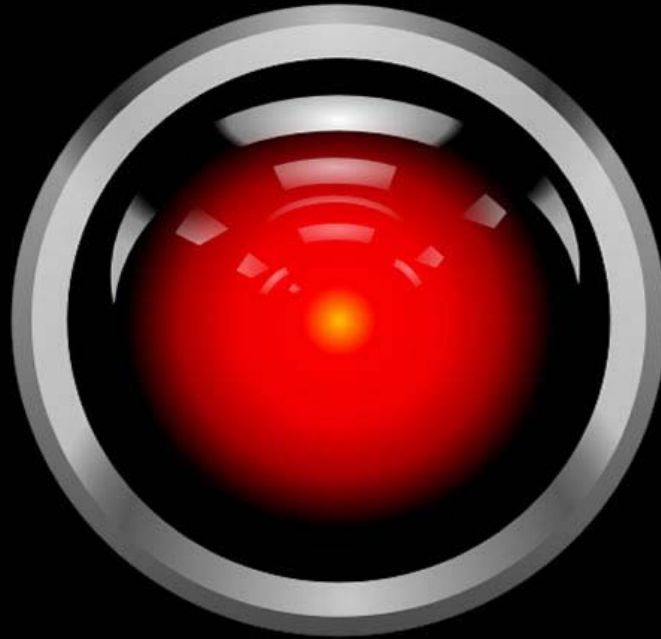
HSBC Modeling Challenges



- We are all trying to come to terms with:
 - How can we build systems that allow us to efficiently and reliably transfer domain expert knowledge on human-driven events to decision makers?
 - How do we bring largely academic and human-intensive M&S exercises into operational environments?
 - How can we build models that foster analysis across different levels of granularity, capturing the relevant conditions of human driven events in an AOR?
 - How do we match results from models against each other?
 - How much and what types of data is enough when measuring real world events?
 - How do you determine ground truth and/or data reliability?
- Bottom Line for decision making:
 - How do we capture all of the possible decisions that influence a particular event?
 - How can we assure the decision we make is the right one?
 - How do measure whether or not that's true?



Maybe we should ask someone else?



HELLO DAVE 

(Hmmm... maybe not...)

The LPA – Where We Are Now

Linguistic Pattern Analyzer



- An Analytic Modeling Platform that allows users to implement and scientifically test conceptual Human, Social, Cultural, and Behavioral (HSCB) models based on theoretical world views through the analysis of text
- A Flexible Semantic Parsing Engine that uses the analyst's model to collect, parse, and process large data sets to assess HSCB concepts
- A Reasoning Algorithm that assigns intensity values and relevancy to provide context and meaning to emerging real-world global events
- An Automated Pattern Identification Engine that notifies analysts of real-time changes in the dynamics of HSCB events on the ground

LPA - Automating Analytical Concepts for Assessment, Forecasting, and Measurement of Effects

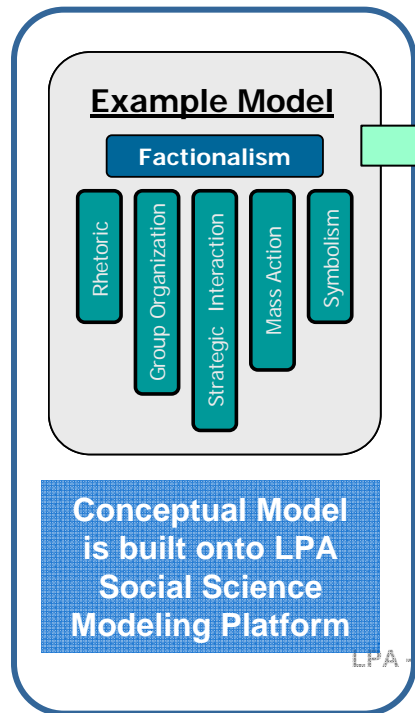
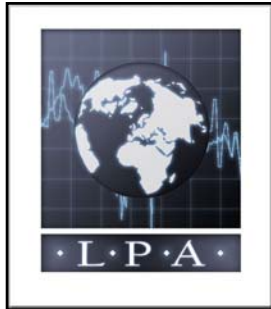
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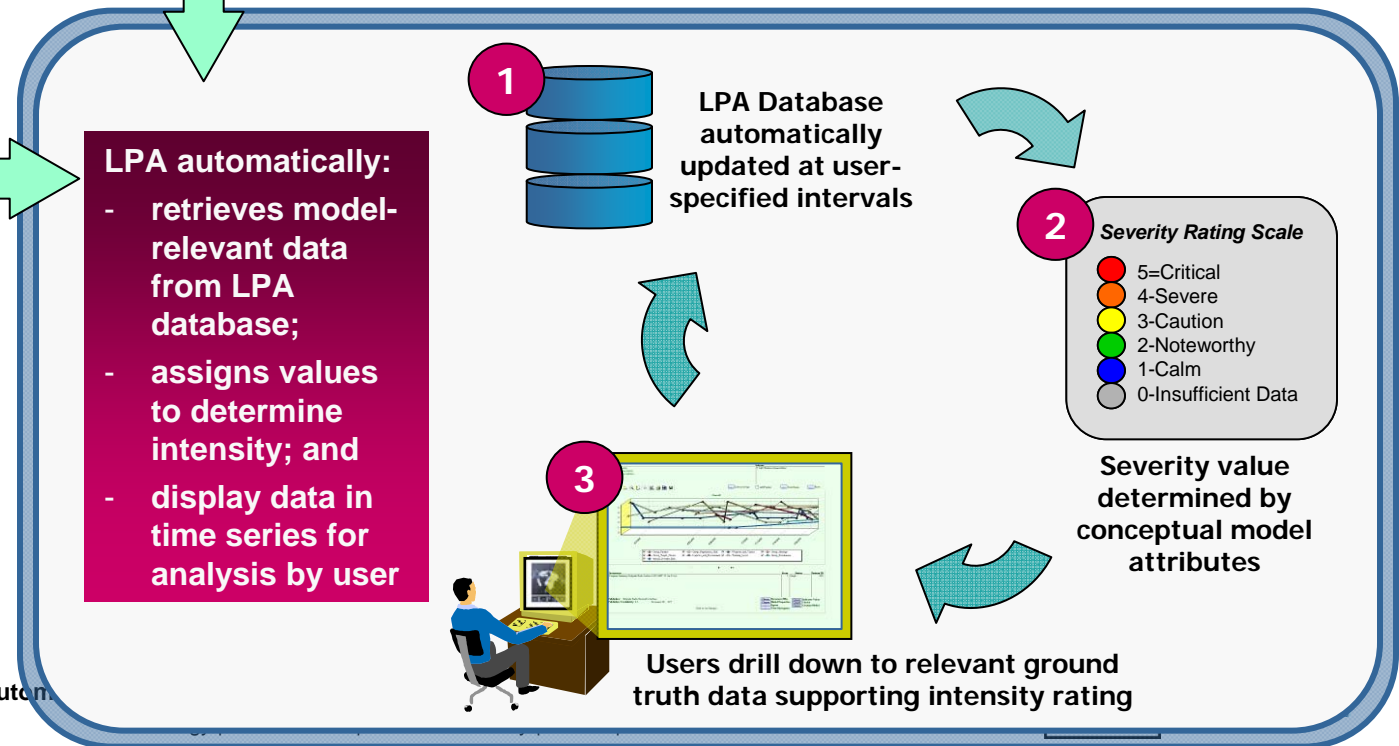
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LPA Overview – How it Works

Assessing Current Events for Operational Use



LPA - Autom.

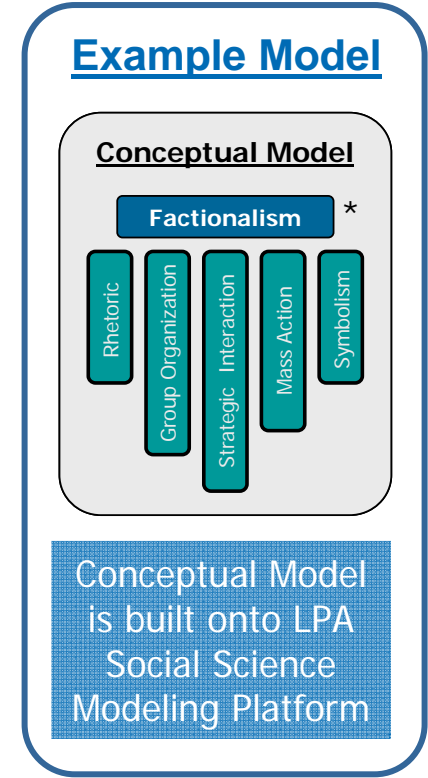


Modeling Concepts for Automation



- Custom-built conceptual HSCB models:
 - Taken from any field of social and/or behavioral sciences and applied to country, region, or locale
 - Rapidly monitor, analyze, and assess the political and social impacts of and changes in key local, regional, and national events and actions
 - Can be applied at policy, strategic, or tactical levels
- Once built, models run automatically with minimal human involvement
- Other example models:

- Governing body capacity
- State legitimacy
- Economic viability
- Insurgent activity
- DIME/PMESII
- Socio-political mobilization
- Public infrastructures
- Capacity of security apparatus
- Anti-state activity
- Foreign perceptions

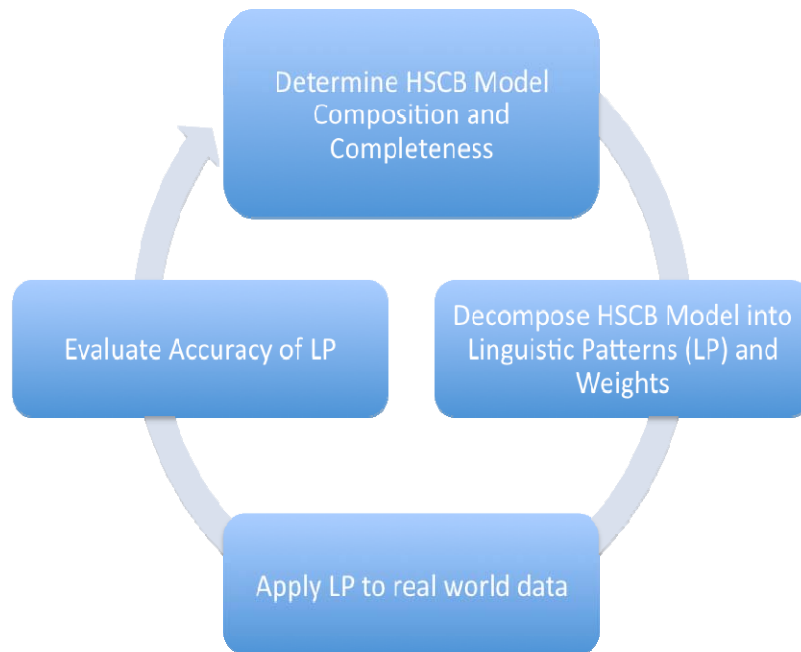


Automating Concepts

Distilling Social Science Theories into Replicable Models



The Instantiation Life Cycle of an HSCB Model in the LPA



- Model building starts with the analysts view:
 - Analyst determines causal indicators that will best express concepts and assertions of human, social, cultural or behavioral (HSCB) models
 - Analysts work with SAIC social science engineers to build linguistic phrases that best capture the expression of each indicator at each intensity level
 - Analysts assign weights and determine higher-level patterns of importance to situation analysis based on model
- Model presents results in form natural to human analyst's process:
 - Assess meaning and context of global events
 - Displays model trends over time, highlighting indicator patterns of interest
 - Make sense of complex and frequently contradictory reports, prioritizing those needing immediate attention
 - Identify causal factors that help anticipate the likely course of emerging events



Automated Data Population

Processing and Analyzing Real-Time, Streaming Data for Rapid Use



The LPA

- Processes millions of documents a day, to find information of operational relevance to customers
- Automates collection, parsing and analysis process, allowing analysts to focus resources on analyzing actual event trends
- Quantifies results for use in analysis, operations, and policy and/or planning support
- Supports multi-lingual searches based on fuzzy logic, natural language processing, variable term weighting, and proximity Boolean searches



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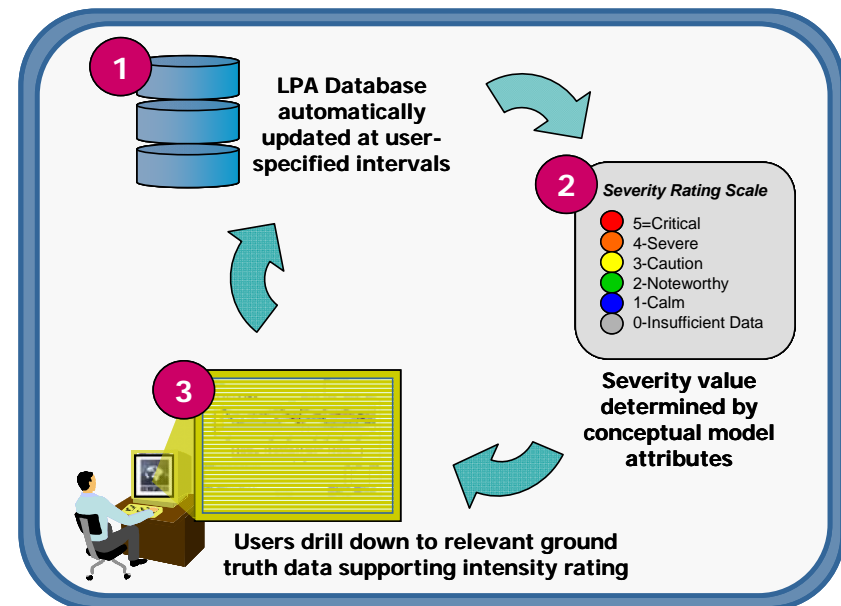
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Automated LPA Models

Instantiate Once and Run against Real Data



- Aggregate and project results in cultural context and over time, displaying key indicator patterns at local, regional, national or international levels
- Allow users to:
 - Identify new timing, sequence, frequency, slope and/or other patterns emerging from course of events
 - Test social science assumptions about how the world works in computational environment
 - Validate data, patterns, and theoretical assumptions against ground truth





The State Stability Modeling Pilot

- Examples from a Real World Application of the LPA

State Stability Pilot Goals



- Major Goals:
 - Implement social science model within the LPA to automatically assess current (retrospective) conditions in 200 countries
 - Evaluate automated results against human-derived “ground truth”
 - Determine whether the LPA can assist analysts use social science models to produce reports more frequently than on a yearly or quarterly basis
- Step 1: Instantiating the Factionalism model on the LPA
 - LOE: 160 man-hours for instantiation, calibration and performance testing
 - Worked directly with Monty Marshal to determine “correct” modeling parameters (indicators, elements, weights, etc.)
- Step 2: Document Collection
 - Collected 7.5 million documents on 200 countries (120 man-hours)
 - Collected first 20 Lexis-Nexis document per day for 2-year period using only name of country as search criteria
- Step 3: Initial testing and calibration on seven countries (France, Kenya, Belgium, Czech Republic, Pakistan, Russia, Thailand) to determine:
 - Whether LPA phrases are correctly collecting data automatically
 - Whether indicators are correctly weighted as determined by original modeler (Monty Marshal)
- Step 4: Run model on 200 countries
 - Validate results against manual results produced by analysts using model during same period

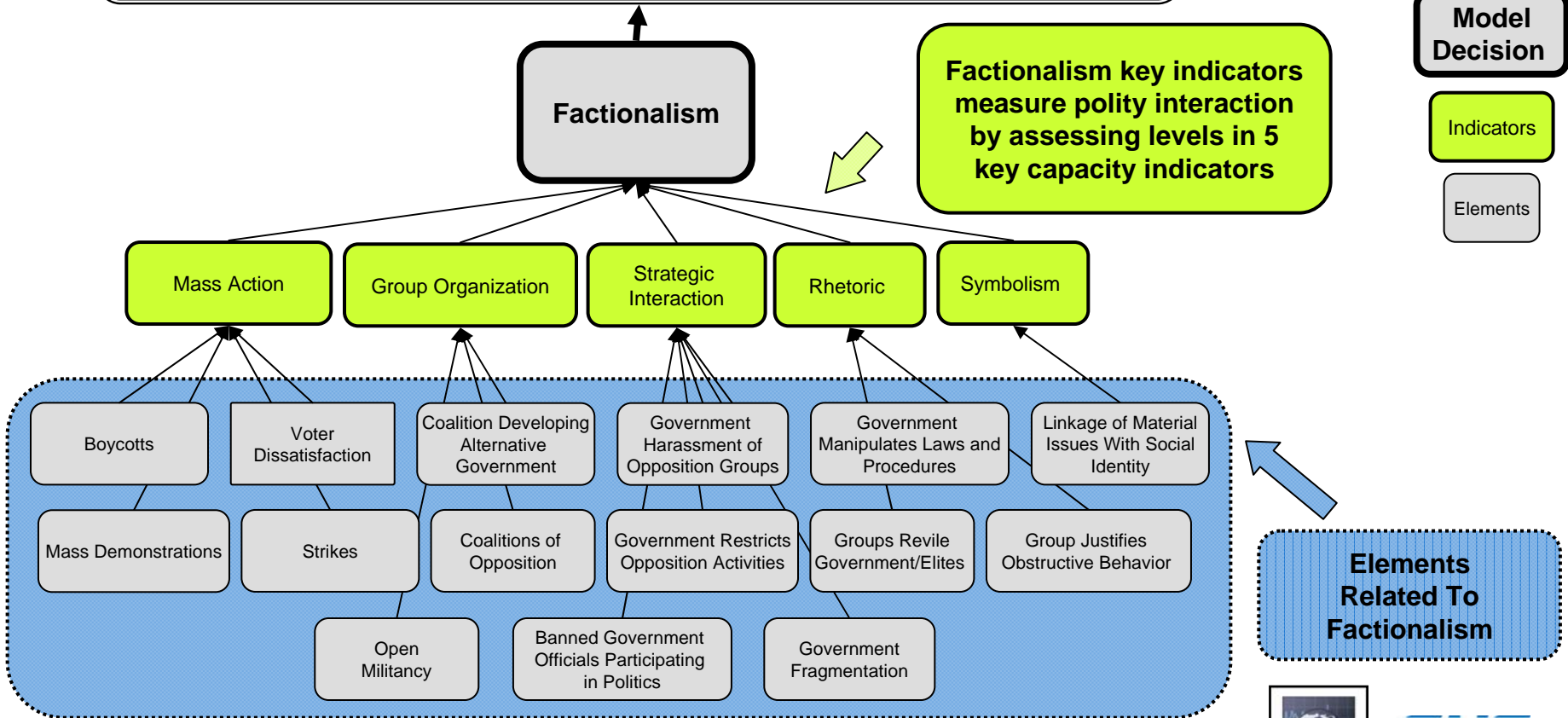


Example: The State Stability Model

Measuring Levels of Factionalism at the Nation-State Level



Initial State Stability Model
 whether the country's polity is unstable and is of "concern" to U.S.



State Stability Model Pilot Results: Pakistan

Running the Model and Producing Results



- **Summary of Events**

- The Musharraf regime suffered a series of political setbacks in 2007, beginning with the attempted dismissal of the Chief Justice of the Supreme Court, who was removed on March 9 and reinstated by court ruling on July 20. The dismissal triggered widespread demonstrations by lawyers and quickly escalated to general public protest and dissent.

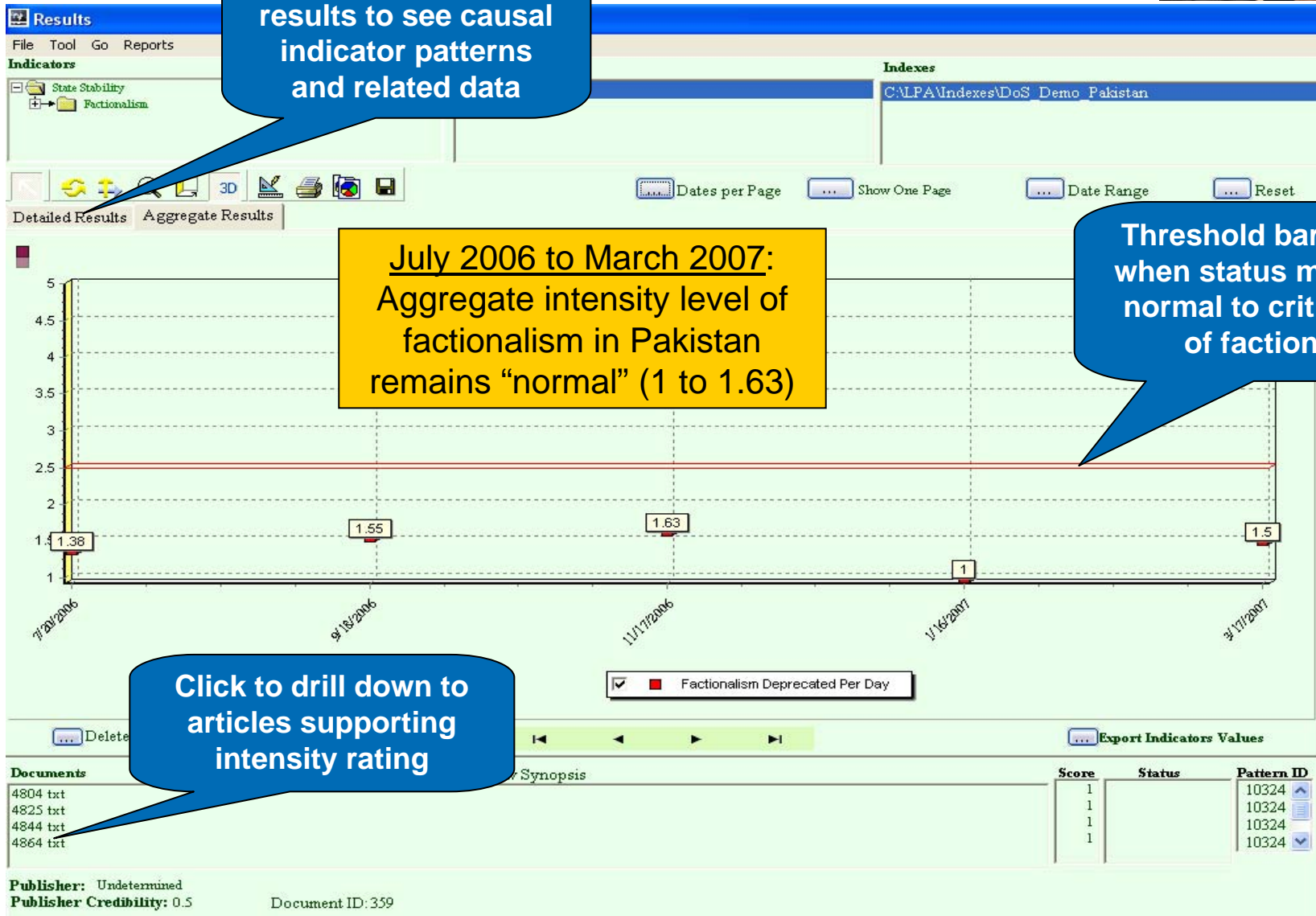


Model Results: Pakistan

Pre- Factionalism Period: July 2006 to March 2007

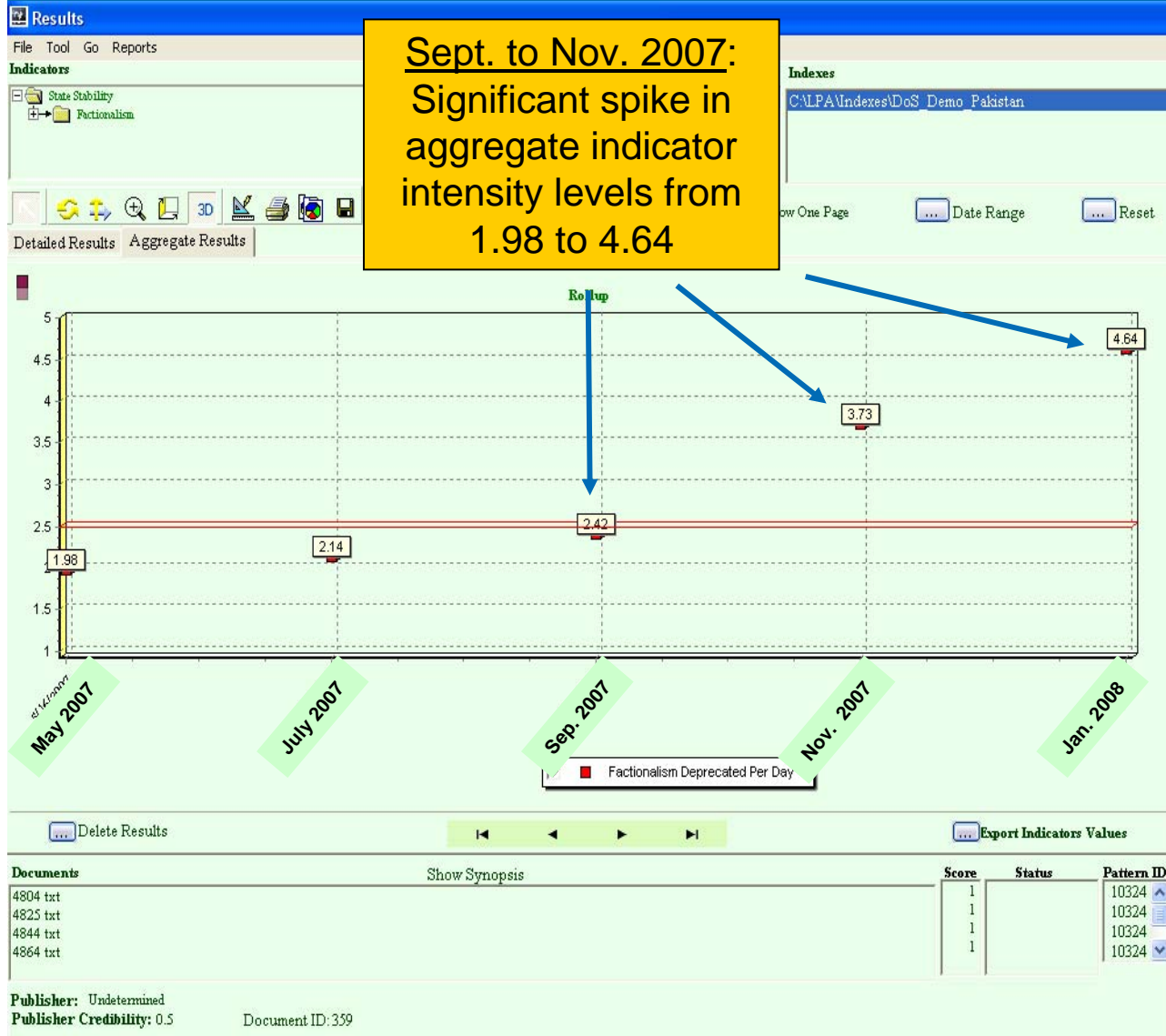


Click on detailed results to see causal indicator patterns and related data



Model Results: Pakistan

Factionalism Increasing: May 2007 to January 2008



Key Chronology

July 3 – Government moves forcibly against public defiance of radical Islamic clerics in Islamabad's Red Mosque

July 10 – Government troops storm the Red Mosque as July 3 confrontation quickly escalates to armed violence

July 27 – In an attempt to broaden his support beyond the military, Musharraf begins talks with exiled former-Prime Minister Benazir Bhutto

August 23 – Supreme Court rules that former-Prime Minister Nawaz Sharif, who had been deposed by Musharraf in 1999, also had a right to return from exile. Sharif arrested and re-deported by authorities upon his arrival.

October 6 – Musharraf is re-elected in controlled presidential elections amid increased outcry from opposition to his continuing rule and his dual role as military chief and president.

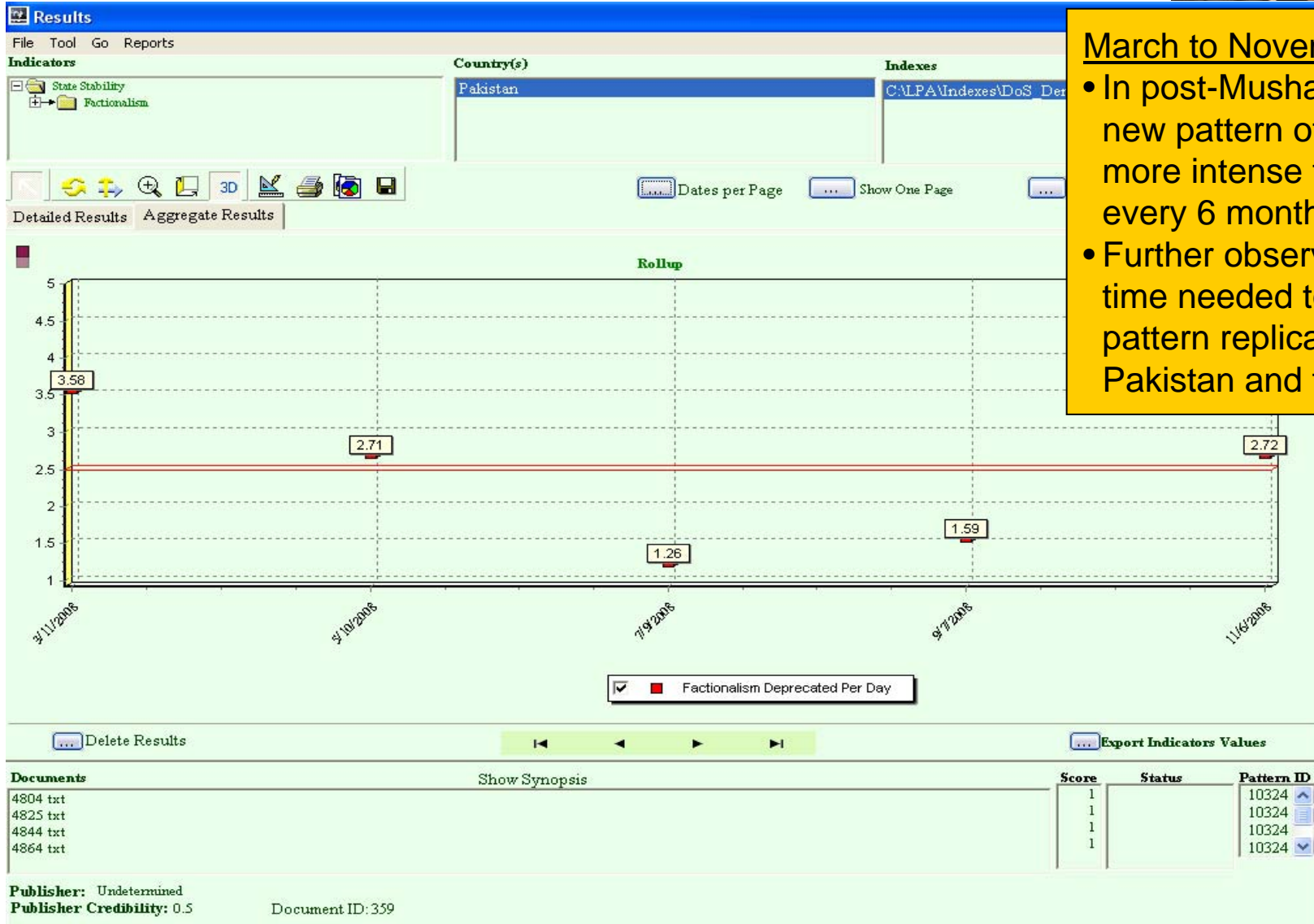
Mid-October – Benazir Bhutto returns to Pakistan from exile.

November 3 - Musharraf declares State of Emergency, suspending the constitution, blacking out all independent media, packing the courts with loyalists, and detaining thousands of opposition figures.

December 27 – Benazir Bhutto is assassinated. Legislative elections scheduled for January 8 were postponed until February 18.

Model Results: Pakistan

Factionalism Increasing: March to November 2008



March to November 2008:

- In post-Musharraf world, new pattern of periods of more intense factionalism every 6 months
- Further observation over time needed to see if pattern replicable in Pakistan and for how long

State Stability Model Pilot Results: Pakistan

Running the Model and Producing Results



- In case of Pakistan, increased levels led to regime change
 - February 18 elections resulted in a heavy defeat for Musharraf's ruling Pakistan Muslim League-Qaid-i-Azam (PML-Q).
 - A new government formed by a coalition of the main opposition parties: the Pakistan People's Party (now led by Bhutto's widower Asif Ali Zardari) and the Pakistan Muslim League-Nawaz (led by Nawaz Sharif who had been deposed by Musharraf's 1999 coup).
 - Anti-Musharraf alliance of the rival PPP and PML-N quickly disintegrated with the PML-N leaving the coalition government on 12 May 2008.



State Stability Modeling Pilot Metrics

What we are Measuring when we Evaluate Models



	Calibration Testing					Performance Testing		
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8
Precision	65%	64%	58%	53%	54%	64%	63%	61%
Recall	14%	18%	39%	95%	96%	86%	89%	87%

- Numbers obtained by human comparison of automatically produced LPA results to real event data (ground truth)
 - Precision: shows the probability that a (randomly selected) retrieved document is relevant
 - (e.g., of all the events that the LPA picked, how many of them actually apply)
 - Recall: the probability that a (randomly selected) relevant document is retrieved in a search
 - (e.g., if there were 20 events in the corpus, did we capture them all)
- Calibration Testing: Are we picking up indicators at a high enough frequency?
 - Experimentation team modifies indicators, phrases to increase ability of indicators to distinguish relevant data by indicator
- Performance Testing: Are we picking up the correct indicators at the right intensity levels?
 - Experimentation team tweaks phrases to assure that correct 1-5 intensity levels are being classified within the model as expected
- Once instantiation cycle and validation completed, produces results automatically with little human intervention



State Stability Model Results



- Application of model across 200 countries running on real data allowing customer to simultaneously track all countries on real-time basis
 - Before pilot: customer received status report once yearly with quarterly updates for select number of countries (less than 10)
 - The manual analysis takes a year to complete and reviews about less than 15 thousand documents on an annual basis
 - LOE for human analysts for 200 countries (1600 hours)
 - LOE for LPA for 200 countries (Total 308 hours)
 - » Model Instantiation (160 hours)
 - » Data collection (140 hours)
 - » Running model (8 hours)
 - Pilot showed customer how they can use LPA to track and analyze incoming events in all 200 countries in area of operation as they occur
 - Processed 7.3 million documents automatically in 8 hours vs. 15,000 documents processed manually over course of a year
- LPA shows when measurable increase in factionalism model levels lead to critical change event
 - Combination of classified and unclassified data increased precision by 5%.
 - Highest level of precision and recall achieved when model run solely against classified data.
 - High level of inflammatory language within open source data produced more false positives.

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Integrating the LPA with other Models

Exploring the Future Space



- Potential LPA and HSBC Modeling Intersects
 - Integration with other modeling platforms (agent-based, neural networks, latent semantic, analysis, etc.) Mapping between events on the ground and simulation models
 - Automated model population and instantiation (No More Hand-Coding!!)
 - Developing scenario simulations of COA outcomes based on real data inputs
- Future Applications
 - Preparing for the Future
 - Inputting different “what if” scenario options to see potential alternative courses of events based on real on-the-ground conditions
 - Assessing Courses of Action
 - Measuring the effectiveness of actions implemented in the field based on ground truth impact
 - Determining what we know and what we don’t
 - Using advanced machine learning techniques to determine what’s new and emerging from the ground truth data as it is received within system

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Back-up Slides



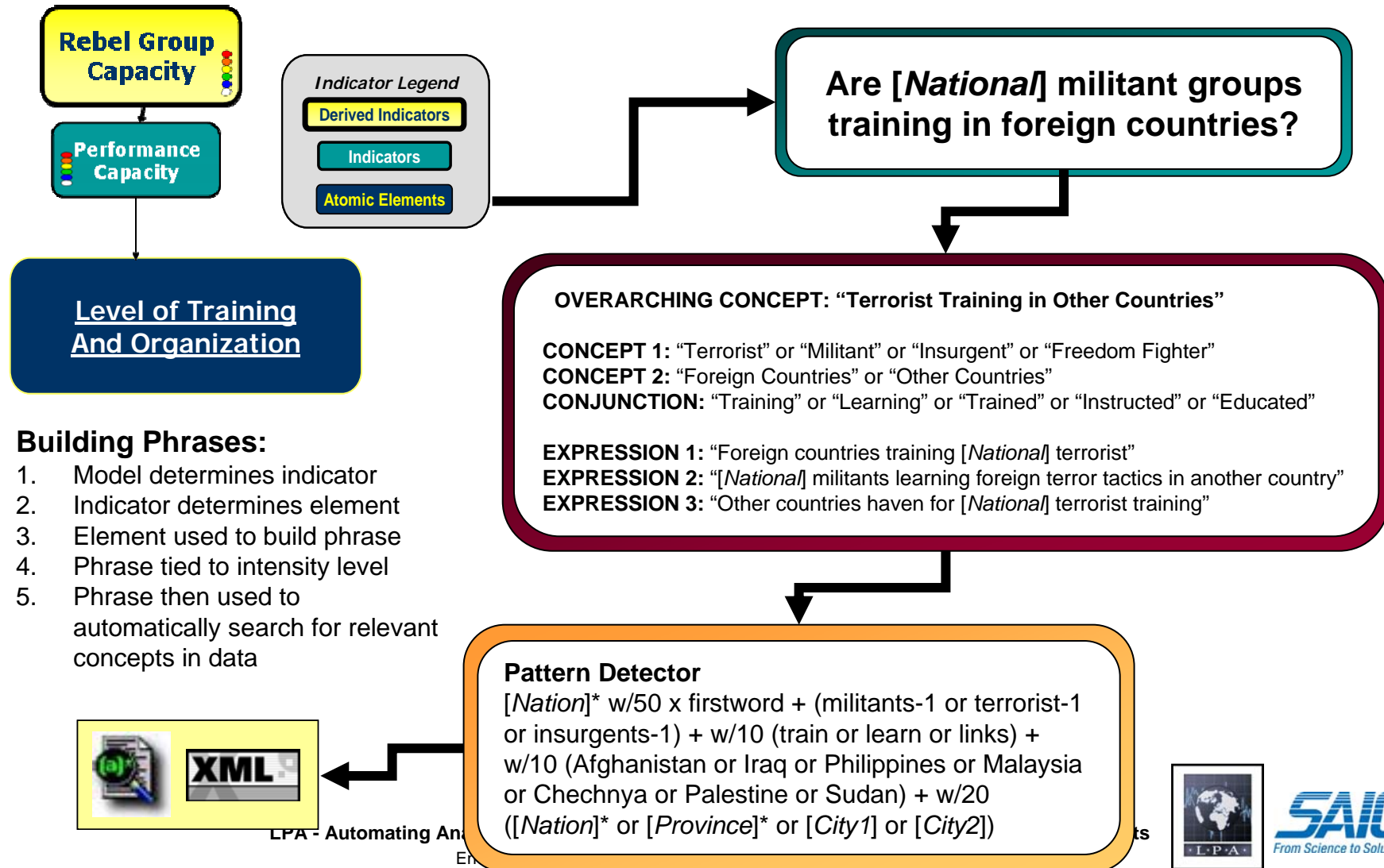
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Model Building in the LPA

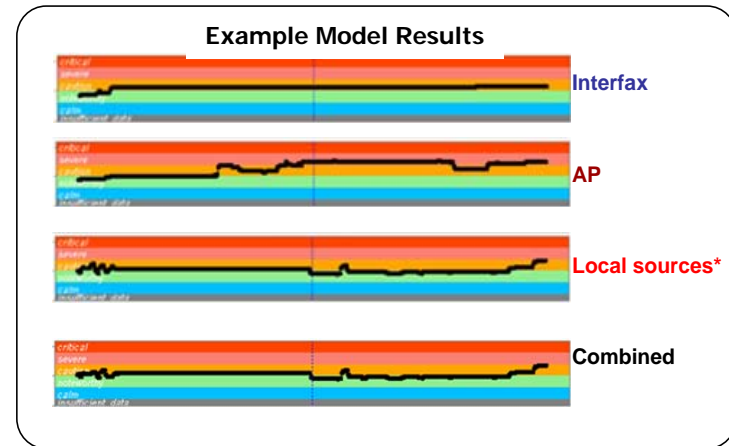
Example Linguistic Phrase from the Rebel Activity Model



Comparing Multi-Language Data Sources

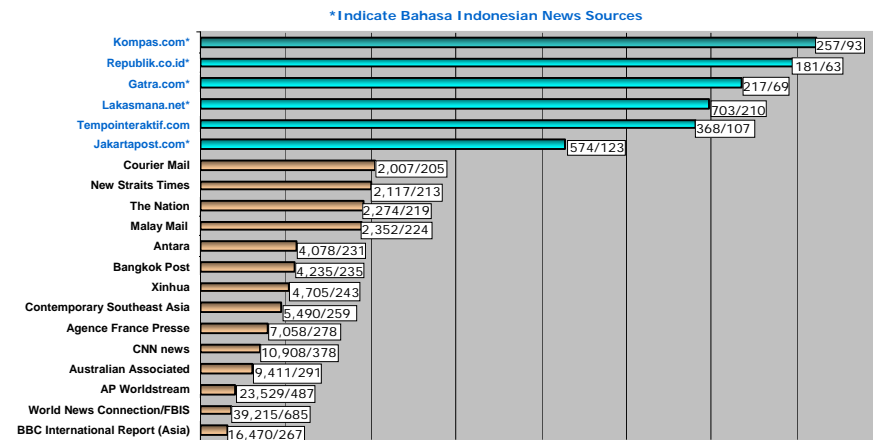


- Filtering data by source allows users to:
 - Identify reporting bias
 - Compare the accuracy of results of different sources types



Example of differentiation in intensity levels based on source

- LPA automatically identifies and analyzes key data in multiple languages
 - Foreign linguists focus translation time on key documents of interest



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Example of source data usage based on local language