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CHI Systems developed the CultureMap system to provide four key enabling capabilities designed to assist intelligence officers and the individual warfighter including (1) Automated analyses of news and social media sources to provide area atmospherics of local population sentiment (2) flexible tools and interfaces allowing ad hoc creation and communication of intermediate intelligence products for collaborative evolution (3) multiple, combinable visualizations: temporal, geospatial, and social network-based; and (4) cultural analysis and alerting tools that allow an intelligence officer to identify trends, understand the cultural influence on tactical operations, and share this information with operational units he/she services.

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Final Technical Report

CHI Systems, Inc. Participation in ONR's FORCEnet Science and Technology Large Tactical Sensor Networks II Program:

The CultureMap Project

CLIN 0001 - 0005, CDRL A009 Final Report

Contract: N00014-08-C-0323

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Abstract

Military personnel in a tactical environment can benefit from the dissemination of cultural intelligence information within the context of existing battlefield information systems. Cultural intelligence provides valuable context that can support the understanding of the behavior of a general population and enemy combatant groups, recognizing changes in behavior over time, and the ability to predict future behavior. To address this operational need, CHI Systems developed the CultureMap system that leverages our work on advanced net-centric information systems currently being fielded in Iraq. Because CultureMap was developed according to a Service-Oriented Architecture design, it has been engineered for easy integration with common parent information systems, such as the Distributed Common Ground Systems. CultureMap contains four key enabling capabilities designed to assist intelligence officers and the individual warfighter. CultureMap provides the following high-level functionality:

- Automated analyses of data intensive social media sources whose functionality has proceeded through establishment of face and construct validity with domain experts.
- Flexible tools and interfaces allowing ad hoc creation and communication of intermediate products for rapid, collaborative evolution;
- Multiple, combinable visualizations: temporal, geospatial, and social network-based; and
- Cultural analysis and alerting tools that allow an intelligence officer to identify trends, understand the cultural influence on tactical operations, and share this information with operational units he/she services.

This report describes the results of the CultureMap effort, centered on the goal to design and develop a visualization framework to support intelligence analysts with operational and intelligence insights through the process of collaborative sensemaking. As the military continues to evolve to more net-centric operations and incorporates systems to support collaborative sensemaking for a distributed command, there will be an increasing need for tools to help users across all echelons to aggregate, interpret, and share resulting data and analytics.

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Introduction

New classes of military information systems have the ability to collect, store, share, and analyze a vast array of operational, open-source, and intelligence data. These systems by virtue of their distributed nature and relative ease of persistent structured and unstructured data creation can, however, create a situation where more data are collected than can be efficiently and effectively used in support of operational and/or intelligence tasks. In parallel, online open sources and emerging social media (e.g., blogs, open commentary on newspaper sites, tweets, Facebook posts) offer a near real-time window into situations as they occur on the ground as well as the public sentiment evolving around those situations. These types of sources, however, yield an even more massive quantity of content that is almost exclusively textual and unstructured in nature. In all cases, the common problem, and corresponding opportunity, lies in the fact that within the enormous amount of data there exist behavioral and operational patterns that can be used to help our warfighters better understand our enemies. Finding these patterns and determining the relationships between events of interest can help to shape future operational actions and increase the survivability of the warfighters in the field, particularly during Intelligence Preparation of the Battlespace (IPB).

CultureMap is built as a framework using the Ozone Widget Framework (OWF) since the need for Human Social Culture Behavior (HSCB) model visualizations in the diverse Programs of Record (PORs) is best served through a common, standards-based, openly-available, and HSCB-tailored set of visualization tools or ‘widgets’, rather than having each application POR or system create its own ‘one-off’ capability. These visualization tools can be bound to program relevant and/or mission specific HSCB models (as determined by the program/end-user) and local operational variables by the operational end-user from within the local POR user interface. This concept allows the visualizations to be focused on the unique needs and nature of HSCB models and HSCB data, but also to be made available to a broad range of PORs and operational systems through the CultureMap underlying Service-Oriented Architecture (SOA).

Methods, Assumptions, and Procedures

The central goal of the CultureMap effort was to goal to design and develop a visualization framework to support intelligence analysts with operational and intelligence insights that are useful to the warfighter in both kinetic and non-kinetic warfare. The U.S. Military's recent experiences in Iraq and Afghanistan have pointed to the critical importance of bringing Cultural Intelligence (CI) information directly to the warfighter. CI information and CI tools are necessary to understand the attitudes and behavioral predispositions of the populace, to identify the leadership and tribal structure, and to understand the cultural behavioral influences based on group affiliation. Second order effects can also be modeled by coupling CI information with ground truth (i.e., demographics and narratives) to synthesize intelligence guidance and project cause and effect responses onto blue force intent. The overarching goal of the proposed expansion effort is to rapidly mature and deploy the CultureMap system to meet this important operational requirement. The high-level goals established to complete the CultureMap effort were focused in six specific areas, including:

- Develop a comprehensive Area Atmospherics data model, ingestion, and classifier pipeline that can iterate over open-source data for:
    - situational data sources (e.g., World Bank, CIA Factbook)
    - sentiment data sources (e.g., Twitter, Facebook); and
    - event/news story data sources (e.g., Factiva).
- Design a CultureMap user interface that facilitates the use of relevant visual analytics based on drill-down from the CultureMap high-level dashboard;
- Create an architecture and implementation that will allow for ingestion from multiple data sources that can be ingested by CultureMap and translated to a data form that is compatible with common Naval Tactical Cloud (NTC) stacks;
- Ensure compatibility with prevalent PORs through a SOA using the OWF;
- Develop a CultureMap concept of operations and design for a mobile CultureMap data collection tool; and
- Conduct iterative demonstrations and evaluations of the CultureMap application to garner feedback to guide the development and refinement of the CultureMap application.

These six goals were accomplished via the nineteen tasks discussed in the next section.

Results and Discussion

To aid the warfighter (with an emphasis on intelligence analysis) in exploring vast amounts of data and extracting useful information from the data, CultureMap was built upon CHI Systems' 4D-Viz framework for creating Command and Control (C2) applications, and benefited from the preexisting 4D-Viz framework to accelerate CultureMap development. CultureMap design, development, and evaluation were accomplished through an interrelated set of tasks mapped to the established project goals enumerated above. The results of these tasks are described in more detail below, with additional information provided in the Appendices that follow.

Task 1 - Functionality Definition

At the beginning of the CultureMap project, a functionality working group was established to initiate the production of CultureMap functional requirements. We focused initially on the production of tractable functionality goals that are consistent with the Office of Naval Research (ONR) directive of producing a Year 1 prototype in September of 2008. We participated in the formation of three Large Tactical Sensor Networks (LTSN) II Demonstration Working Groups – Cultural Intelligence, Determining Intent, and Cognitive Operation. Based on discussion with Lieutenant Commander Gooby, we were directed to focus on Cultural Intelligence as our primary working group.

Initial implementation work began to assess the feasibility of the proposed functionality in a rapid prototyping manner. We established an internal functionality working group and have continued to define the system concept of operation, data types, data requirements, data views, and functionality requirements. The results of our meetings were the beginnings of the formalized functional requirements specification and were key in directly guiding software prototyping efforts.

In August 2008, we received the Marine Corps Combat Standing Operating Procedure (SOP) manual from Major McHaty of Marine Corps Intelligence Activity (MCIA). We used Chapter 2 (Intelligence Operations) of the SOP to derive functional requirements for the CultureMap system. We followed the overall design theme that was articulated by MCIA: "We need tools to capture and maintain a running history of the cultural factors and forces within a particular area of operation" (McHaty, 2008, personal communication). We also focused on the design of functionality that supports the operations of the Company Level Intelligence Cell (CLIC) and Battalion-level Intelligence (S2) section. We combined our use of the Marine Corps Combat SOP manual, the Culture – Generic Intelligence Requirements Handbook (C-GIRH) with data collected at Space and Naval Warfare Systems Command (SPAWAR) Charleston to define the near, mid, and long term functionality of the CultureMap system.

The initial functional requirements specification was finalized and submitted to ONR on 6 Sep 08 in fulfillment of Data Item A003.

Task 2- Architecture Development

At the beginning of the CultureMap project, CHI Systems established an architecture working group to initiate the development of the CultureMap architecture. We developed CultureMap as a SOA with the ultimate intent of targeting Distributed Common Ground Systems (DCGS) as a transition target. Because of programmatic and schedule considerations, we asked ONR to consider the use of the OpenLayers Geographical Information System (GIS) as the surrogate platform for implementation and demonstration. We are confident that SOA will allow for early demonstration of CultureMap constructs in the accessible GIS platform (OpenLayers) and allow for an easy transition to DCGS once the Software Development Toolkit is available.

Further work refined the initial architecture by using Google Web Toolkit (GWT). GWT is a development environment for Web 2.0 applications and allows for the software to be initially written in Java and then automatically converted to Asynchronous Java Script and XML (AJAX) applications.

In August 2008, we began preliminary discussions with SPAWAR Charleston and other contractors within the Cultural Intelligence Working Group to establish architectural compatibility. The initial prototype architecture was completed and demonstrated in September 2008 as a standalone system. The initial software architecture specification and architectural designs were submitted to ONR on 6 Sep 08 in fulfillment of Data Item A005. Later implementations of CultureMap used the OWF platform, GeoMesa, Rya (for triple-store representation), and Accumulo for cloud compatibility with the NTC.

Task 3 – Cultural Information Representation and Fusion Algorithms

The earliest attempts at a cultural ontology design for CultureMap were based on requirements for cultural understanding derived from various sources, including the Marine Corps' draft C-GIRH of 2008. As the work proceeded and came to target MarineLink and its data repository as the ultimate home for CultureMap, the ontology developed in line with MarineLink's data models. In conjunction with Marine Corps personnel, these data models were extended to add ontology elements of a cultural nature not previously included. Before these efforts were completed in the implementation of MarineLink Web, an Ontology Working Group was constituted from multiple performers on the Large Tactical Sensor Networks (LTSN) Program. CHI's role in the working group focused primarily on ontology issues regarding the relationships between persons and groups, as well as the relationships between cultural factors and other entities such as persons, groups, and regions.

Of particular concern was the need to clearly separate and yet relate two different usages of the term "group." In everyday English usage, the term may refer to a population which has no internal organization but does have common patterns of behavior and belief. But the term may also refer to a number of individuals who are associated through personal contact and may act in concert, but only minimally share patterns of behavior and belief. There is in fact a spectrum of such "communities" of persons which can be termed groups and their relation to cultural factors may be complex. The ontology fragment below shows one attempt to organize some of this complexity:

- Group
  A simple class that represents a collection of people. A group is permitted to contain multiple subgroups. A group is also permitted to be a subgroup of multiple supergroups.
  - Name
  - Supergroups (list-of Group)
  - Subgroups (list-of Group)
  - Demographics (list-of Demographic)
- ExplicitGroup *isa* Group
  A particular type of group which is defined by an explicit enumeration of members.
  - Members (list-of Person)

- ReligiousGroup *isa* Group
  A particular type of group which shares a religious orientation.
  - TypeOfHouseOfWorship
  - SacredWritings
- GeoboundedGroup *isa* Group
  A particular type of group which occupies a bounded geographical region.
  - Area
- NetworkOfPersons *isa* ExplicitGroup
  A particular type of group defined by an explicit list of members and an explicit list of relationships that link those members to each other.
  - Relationships (list-of Relationship)

The relationships between individuals and groups is potentially highly complex. Individuals can be affiliated with many groups, play one or more roles within each of the groups, and so on. These relationships vary by cultural affiliation (e.g., a husband's role will differ from culture to culture), which further complicates the picture. The diagram below provides a graphical representation of some of the relationships between persons, groups, roles, and cultural factors which needed to be incorporated in a comprehensive ontology of cultural intelligence:

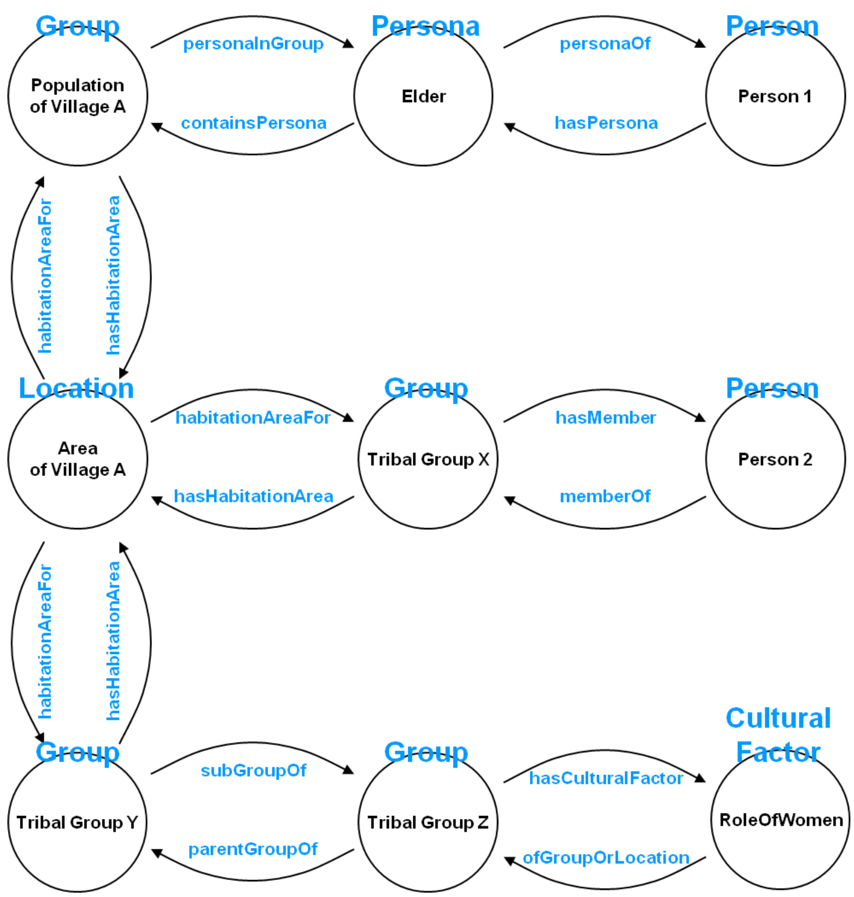

Figure 1. CultureMap Relationships Among Culture Factors-Persons-Groups

Based on working group results, ontology requirements were developed for CultureMap. These were of necessity consistent with the existing data models, but in large part aligned with the working group ontology. The figure below shows a part of the ontology requirement (focused on the Group entity) developed for the MarineLink Web version of CultureMap:

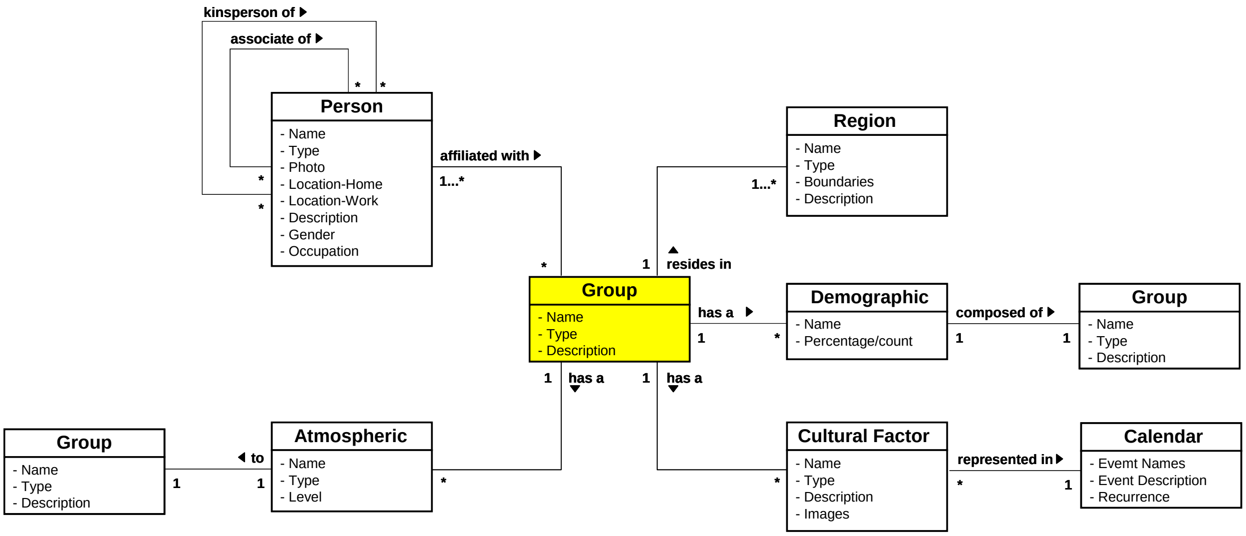

Figure 2. CultureMap Ontology Example - Groups

The last development iterations of the MarineLink Web version of CultureMap (before the MarineLink Web effort was terminated) provided interface features which allowed the user to construct relationships between entities which would mirror the relationships seen in the LTSN Working Group ontology. The entity creation window below is an example of the link selection capability implemented in those development iterations:

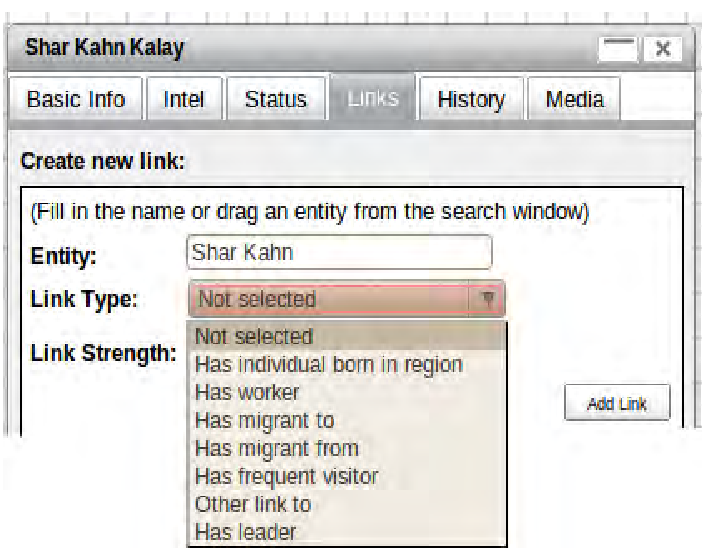

Figure 3. CultureMap Entity Creation Example

Following the end of the MarineLink Web efforts, the target capability of development for CultureMap changed from that of a small unit tool (in some ways similar to Tactical Ground Reporting System (TIGR)) for the manual entry and analysis of local cultural information in support of IPB, to a focus on leveraging available large scale data sets (e.g., news media, social media, and web-based sources of already aggregated data such as World Bank statistics) to provide cultural information in a more automated fashion for IPB at various echelons. The recent Global Knowledge Environment (GKE) demonstrations have been a culmination of that effort and are based on different, somewhat simplified ontology solutions, particularly in support of casting various data in the context of cultural "atmospherics." Group entities are still a critical part of the ontology but are focused primarily on government groups, both domestic and foreign, at various levels of organization, as well as opposition groups, similarly varied in scope. These entities are principally related to each other in the ontology based on the level of hostility which characterizes their interactions, a key piece of information when assessing the potential for stability within an area of interest. . Appendix A provides a complete listing of the current CultureMap ontology, as implemented for the GKE demonstrations.

Task 4 – User Interface Design

The CultureMap user interface design evolved over multiple iterations throughout the life of the project. Initial work on the software design began with the conversion of the software assets developed under the TIGR program to an SOA form. The major assets included track analysis, event clustering, temporal analysis, and extensible information containers. This initial phase included the creation of a demonstration platform that used OpenLayers as the GIS framework.

Post MarineLink versions of the CultureMap visual design requirements evolved based on further interviews with Intelligence Analysis subject matter experts against the requirement above. This resulted in an enhanced set of visual analytic metaphors for both *view* and *control* constructs within the CultureMap design. We implemented a set of user interface analytics based on the visual design requirements, the view and control constructs, and the accompanying techniques posited by Woods and Watts (1997). These constructs included:

- Geospatial Views: A predominant portion of information relevant to the CultureMap users is often highly geospatial in nature. Where data of any type has such information associated with it (e.g., latitude and longitude), the user must be able to view that information in the context of a 2D display.
- Network Views: An interactive view of the information is presented in graph form displaying the data attributes and their relationships. Advanced versions could include graph layout algorithms that impart meaning to the layout based on relationship data specified by the user.
- Temporal Views: The information of interest to the end user commonly has a temporal aspect associated with it as well (e.g., the observed time of an event or the time span of a religious holiday). When this is the case, the user must have a temporal perspective, or a selection of temporal perspectives, available for visualizing the information in this context. CultureMap include displays such as timelines and time series charts.
- Temporal Controls: An equally common starting point for navigating through the available information is time. A traditional calendar, with the ability for the user to select individual points as well as distinct ranges of time, is a familiar mechanism for achieving this functionality. However, as with the geospatial control mechanism described above,

wherever possible temporal views should 'double' as temporal controls, such as with CultureMap's TimeLine control visualization. CultureMap provides, for example, the ability to highlight a particular period of time on a timeline, consequently causing the data displayed in other views to be updated appropriately.

- Filtering Controls: The CultureMap design includes a filter control on top of the search function whereby the user may construct criteria for exactly which data, from the full set available, are presented. This functionality becomes essential once the initial query has been performed and the user then wants to drill-down or drill-up alternatively. Examples of this are data type (e.g. events, groups, places) and data subtype (e.g. IEDs, religious sects, mosques).
- Classic Search: While the above methods for querying and filtering the available data are visually intuitive, often a user needs to search for particular words or phrases in the data. To this end, the CultureMap application includes a more traditional search mechanism.
- Mashup: Individual visual analytics can be stored in private workspaces and can be annotated, saved, modified, and maintained over time, thus enabling the user to build and maintain an understanding of a region or culture of interest.
- Summary Dashboard: The CultureMap dashboard contains both situational and sentiment data. The Dashboard provides high-level, visually-coded trend information to the users, thus enabling them to drill-down into lower-level indicators.
- Charts: Analysts often need to examine high quantities of structured text (e.g., Significant Activities), so the need to examine trend information across time periods is supported by a trend chart, thus enabling users to examine temporal trends, such as looking for frequent events during times of the day and days of the week. Additionally, users often need to compare categorical frequencies, so a pie chart enables them to look at different clusters of event categories and compare them across time.
- Collaboration: All annotations and other changes to the workspace are pedigreed and tracked. In this way, a full history of which users have contributed to changes, and when, may be reproduced and shared with other CultureMap users. This is important as it promotes a more efficient Request for Information (RFI) workflow capability, thus enabling users to draw upon knowledge of cultural or tactical information that is often spread across geospatially distributed users (i.e., reach-back context).

CultureMap Visual Analytics

Specific CultureMap visual analytics to support the requirements above included a range of inter-related widgets, developed using OWF. These analytics are accessed by a user either through drill-down via the CultureMap dashboard or through direct search and analysis of individual analytics against search results. The set of functioning visual analytics are listed below and can be accessed through the CultureMap menu (seen in Figure 4 below).

The CultureMap Menu bar is organized into clickable icons, each invoking a visual analytic function. These visual analytics are largely tied to Search results/filters and interconnected (e.g., Pie Chart is dynamically updated as the time-selection on a Timeline presenting events from a Search is modified):

- Search – can be used to search/filter for data from the data-repository
- Map – provides a geo-map visualization of events, social media, Open-Source Intelligence (OSINT) data
- Network – provides a network-view of events, social media, OSINT data

- Timeline – provides a timeline view/control of events, social media, OSINT data
- Charts – provides Trend/Pie charts events, social media, OSINT data
- Rhetoric – provides a world cloud of events, social media, OSINT data
- Dashboard – provides a summary-level aggregation of atmospherics
- Create – enables user to create/maintain “mashups” of analytics and restore later
- Map-Network – hybrid network-over-a-map (not implemented)

Figure 4. CultureMap User Interface Example

In order to execute CultureMap visual analytics, a user can utilize the *Search* function to search across all ingested data, or filter against types of data based on the underlying ontology types (e.g., people, Tweets, groups). Figure 5 shows an example of the CultureMap Search.

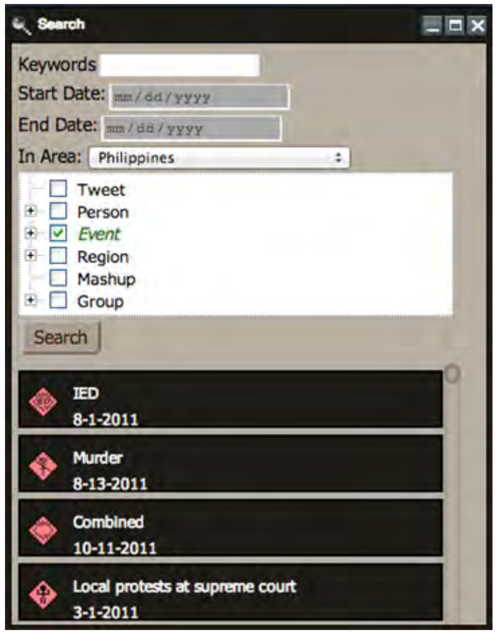

Figure 5. CultureMap Search Example

The Timeline analytic can be used to visualize temporally-oriented data – such as events – to depict the data through temporal ordering of this data as well as frequency display. The timeline acts as both a display element – to display temporal information for Search results as a time-based frequency chart – and as a Control element, to enable the user to perform a Time-based filter that affects the open existing visualizations, as seen in Figure 6.

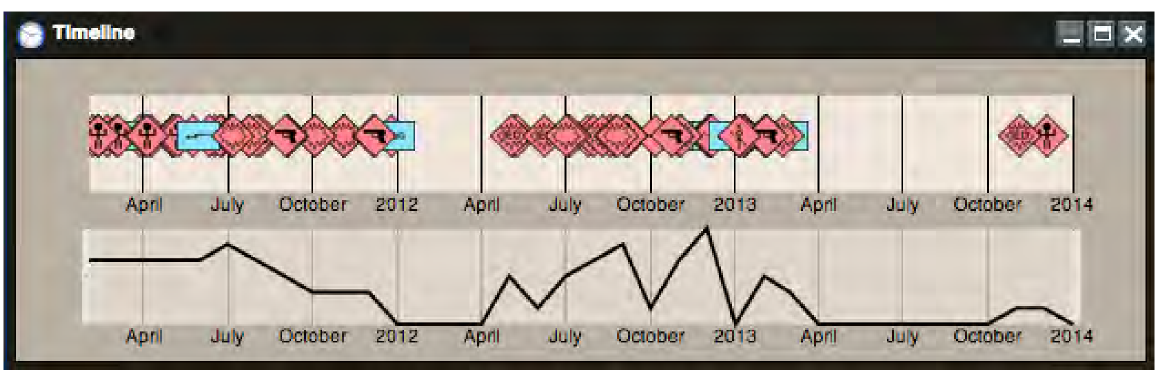

Figure 6. CultureMap Timeline Control Example

The *Timeline* is a temporal control tied to visualizations (e.g., Map, Trend Chart, or Pie Chart) allowing the user to use the time-control sliders to change the beginning and end times. The open linked visualizations will update accordingly. Additionally, the time-control slider can be moved left or right to move backward or forward in time. Figure 7 below shows an example of an analyst using the *Timeline* control to view alternate time periods of data.

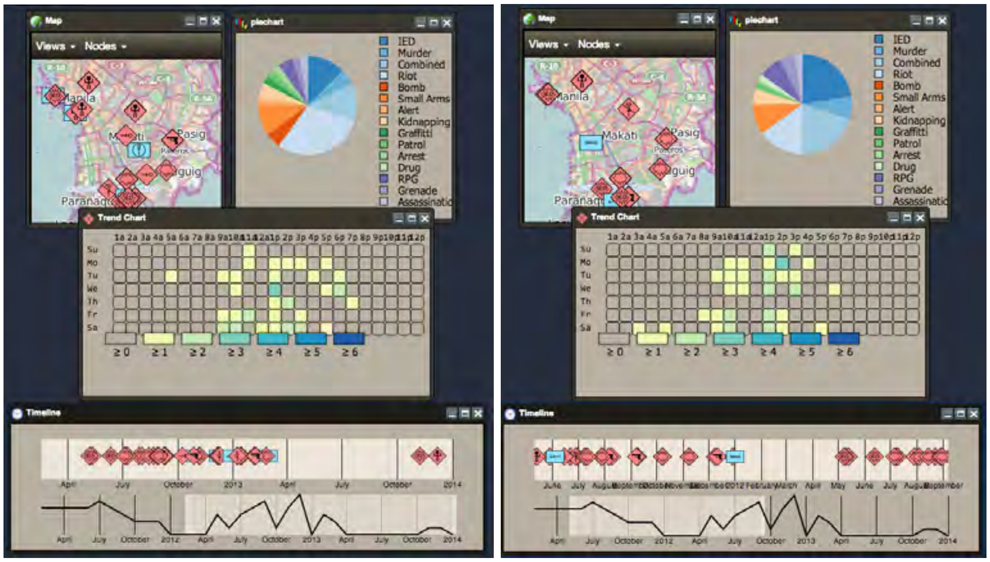

Figure 7. CultureMap Timeline Control Example – Linked Visualizations

The CultureMap *Network* analytic displays ingested data as a network, with links connecting events and entities in the network to show relationships among those items. In the Network View (Figure 8 below), entities are represented as icons but the user can also change to thumbnail pictures or Ball-and-Stick diagrams, selectable through the 'View' Network menu, as seen in Figure 9.

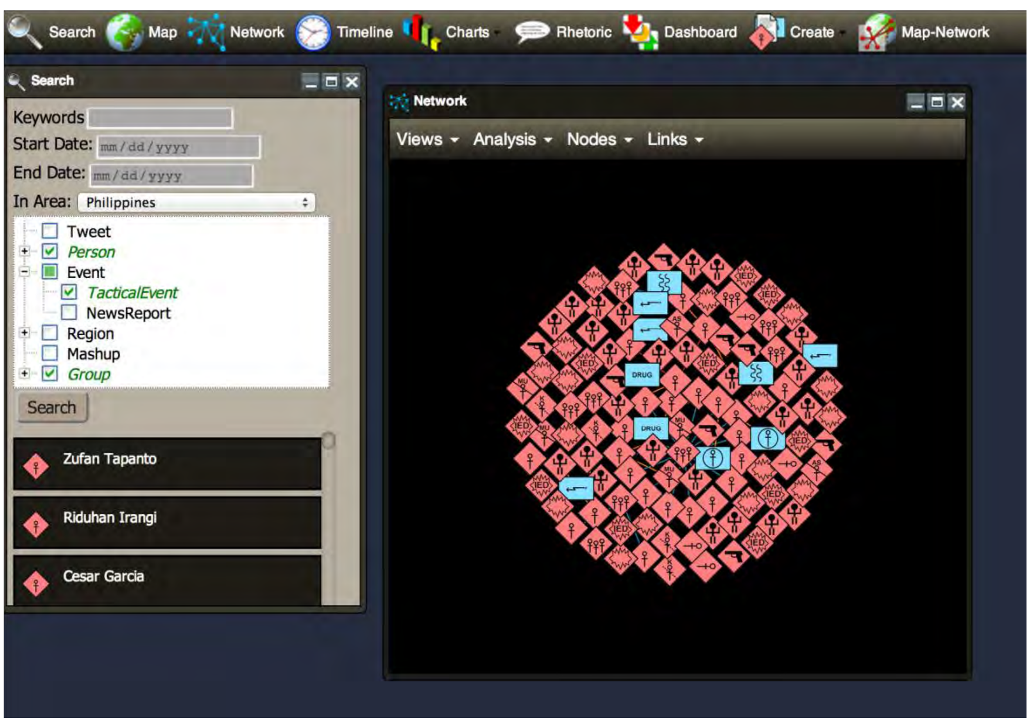

Figure 8. CultureMap Network Example

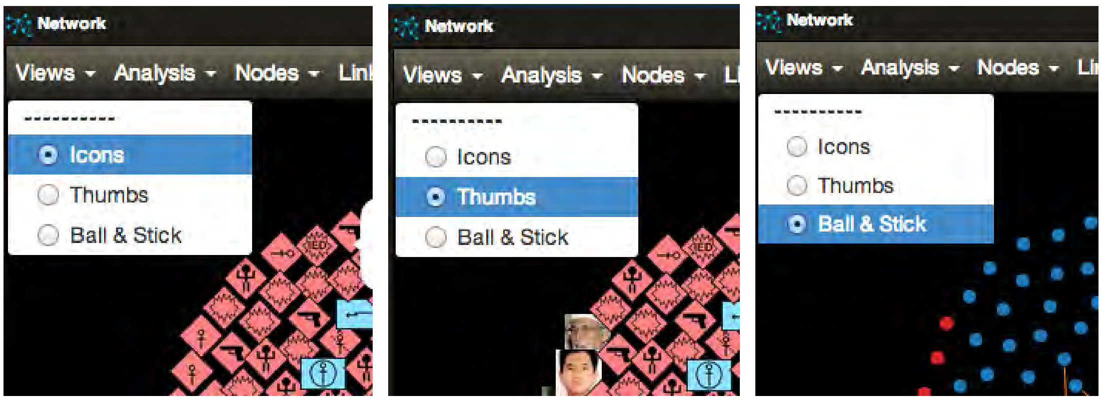

Figure 9. CultureMap Network Display Options

Relations are represented as color-coded lines between entities. The display slowly reorganizes its layout, bringing relation-linked groups of entities closer together. Nodes can be filtered by type under the ‘Nodes’ Network menu.

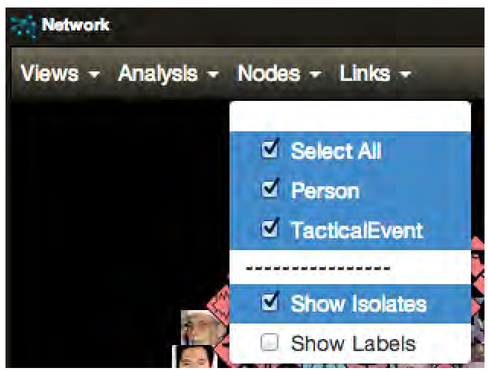

Figure 10. CultureMap Network Node Filtering

Links between Nodes can be filtered by type under the ‘Links’ Network menu.

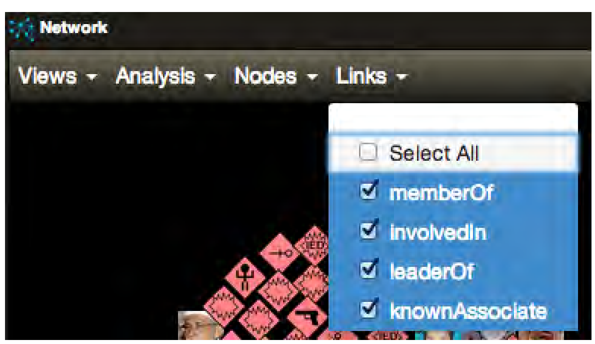

Figure 11. CultureMap Network Link Filtering

Both entities and relations are labeled in the display by hovering over the link or entity; the link or entity then displays a pop-up information box.

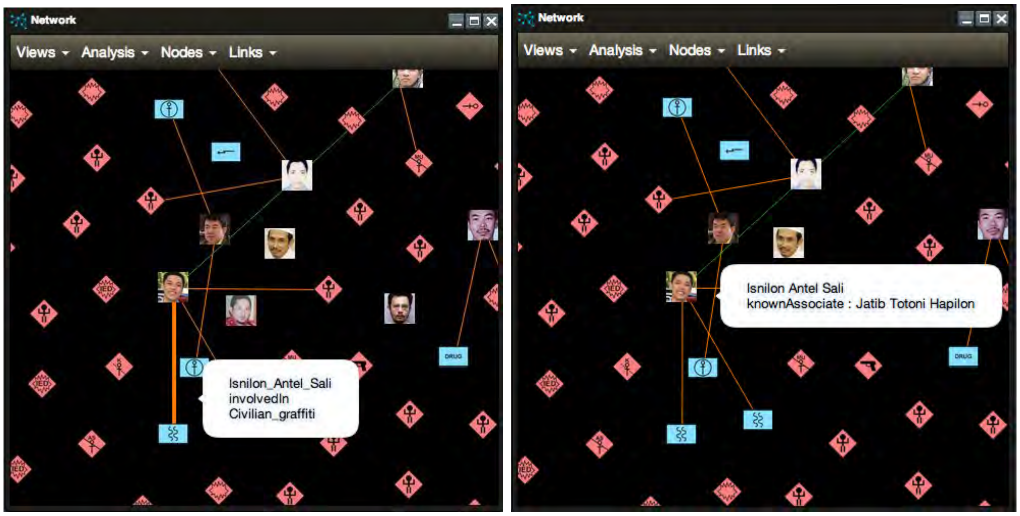

Figure 12. CultureMap Network Link Hovers

Individual Nodes in a Network can be moved around for custom-defined network diagram layouts by clicking-and-dragging a given node. Additionally, isolates (i.e., nodes without links) can be filtered under the 'Nodes' Network menu to further de-clutter a busy network view.

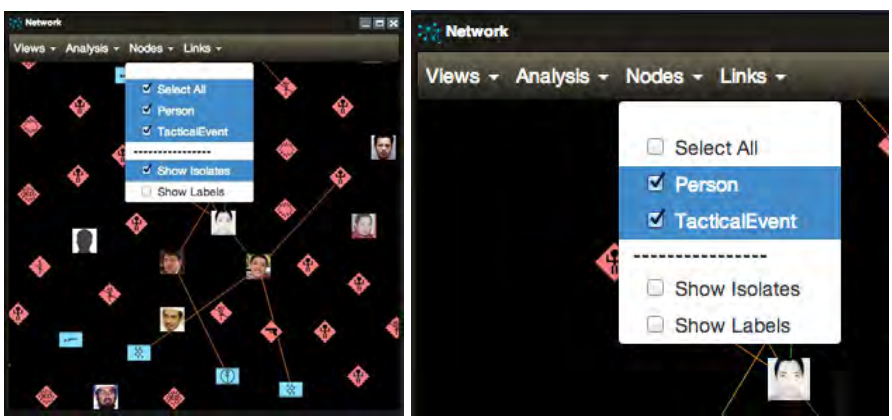

Figure 13. CultureMap Network Isolate Filtering

The *Map* view is intended for use as a geo-based view that can display a sub-set of Search results (primarily for geo-located Search result data). This includes search types:

Event:TacticalEvent
Event:NewsReports
Tweet [for those Tweets that have geo-location data]

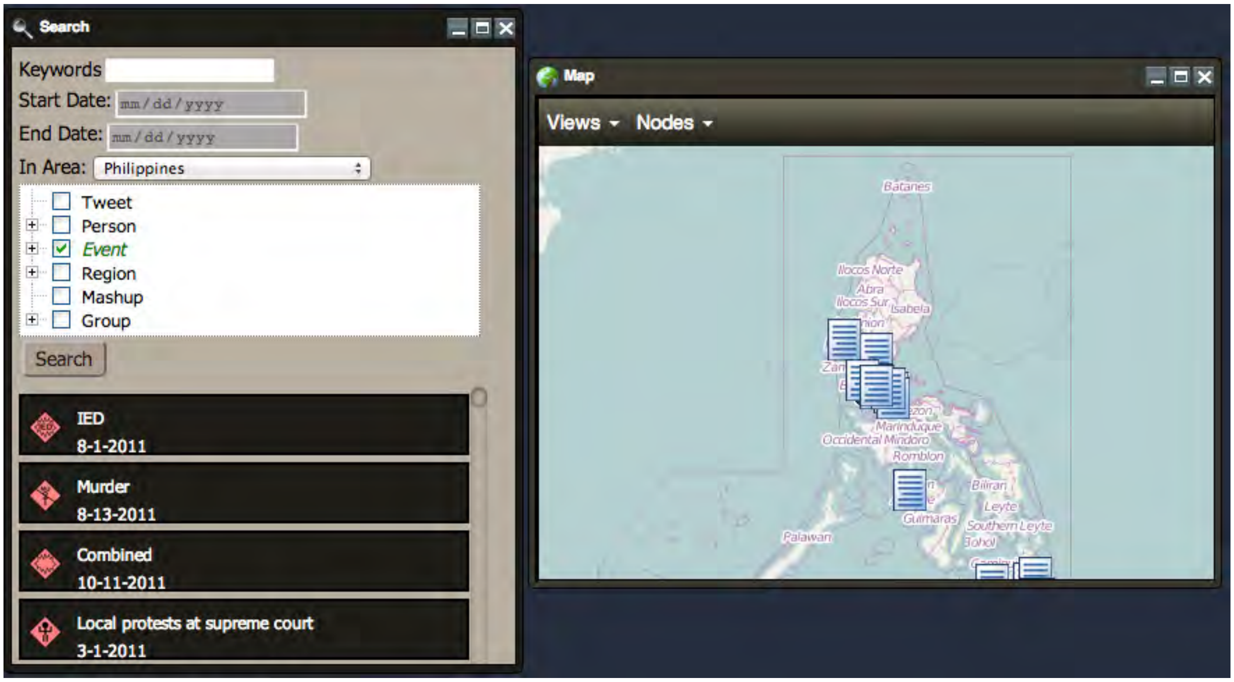

Figure 14. CultureMap Map View Example

Icons within a map, changeable under the Map 'Views' menu, can be displayed as either: Icons or Ball-and-Stick.

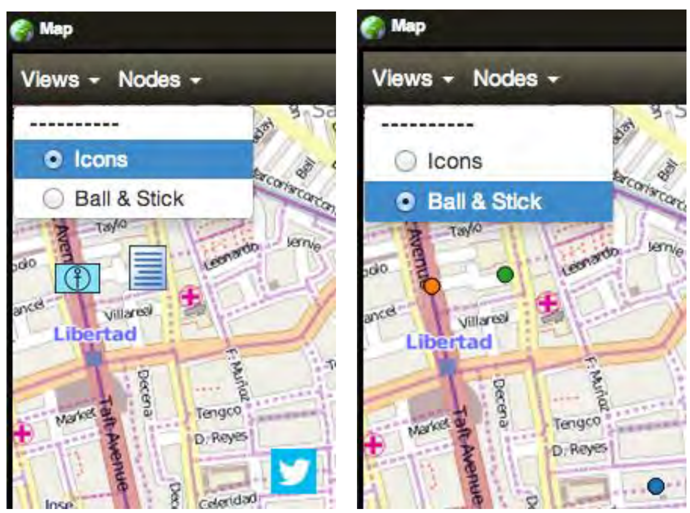

Figure 15. CultureMap Map Icon Control

Icons on a map can be individually filtered using the 'Nodes' menu for types: Tweet, Event, TacticalEvent, and NewsReport. Additionally, all events can be selected by using 'Select All'. 'Show Labels' toggles the icon names on/off.

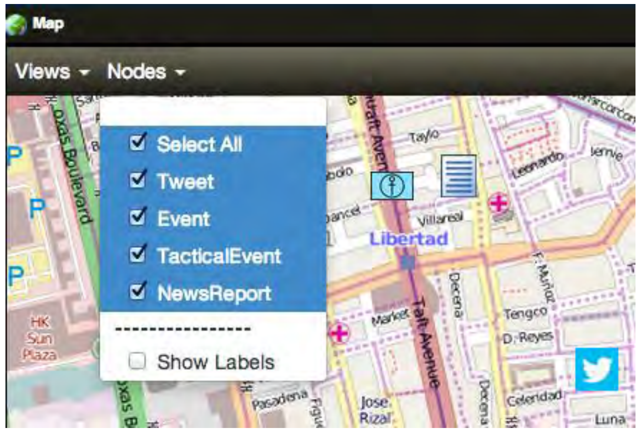

Figure 16. CultureMap Type Filtering

Meta-data available for a given icon on a map can be viewed as a pop-up by hovering over an icon, as shown in the example Tweet below.

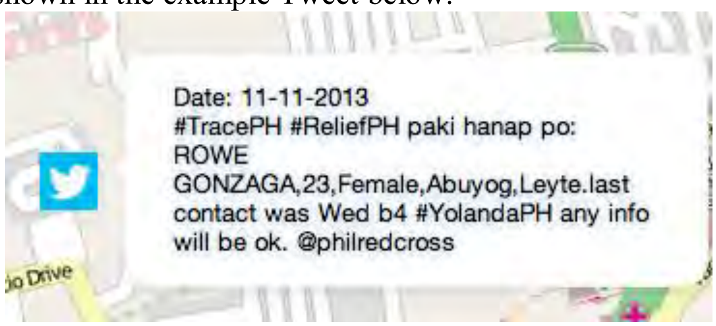

Figure 17. CultureMap Map Hovers

The CultureMap *Trend Chart* analytic can be useful for examining temporal trends within data. It shows a 'heat map' of the relative frequencies of any information contained in the Search results that has time-stamped data associated with it. The Trend Chart below shows an example view of the Event search results below.

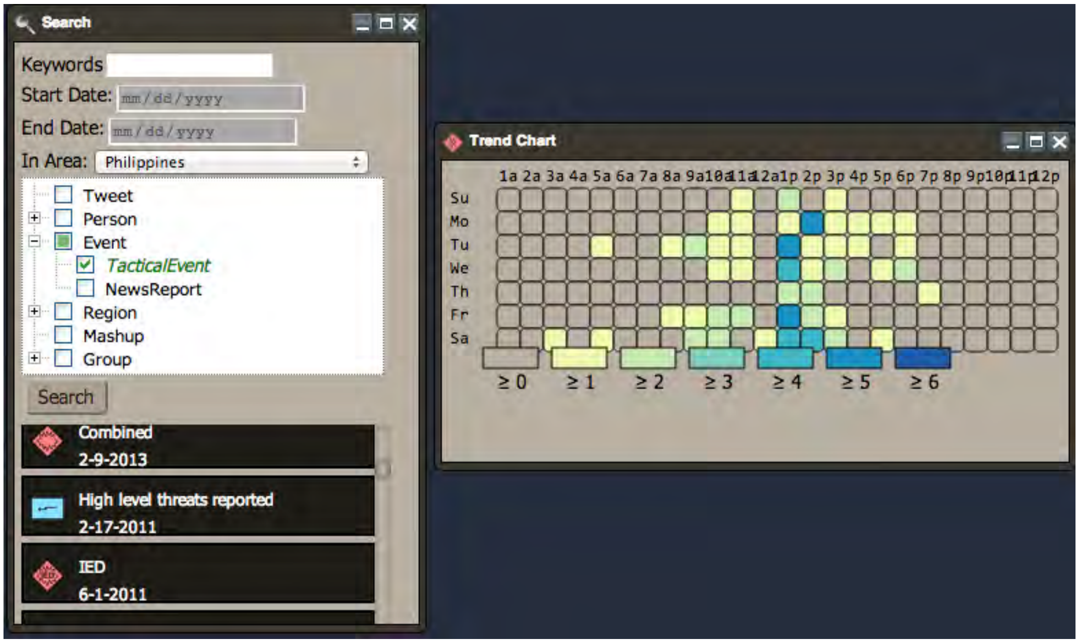

Figure 18. CultureMap Trend Chart

The CultureMap *Pie Chart* analytic can be useful for examining relative proportions within data. It shows the proportions of categories of any information contained in the Search results. The Pie Chart below shows an example view of the Event search results below.

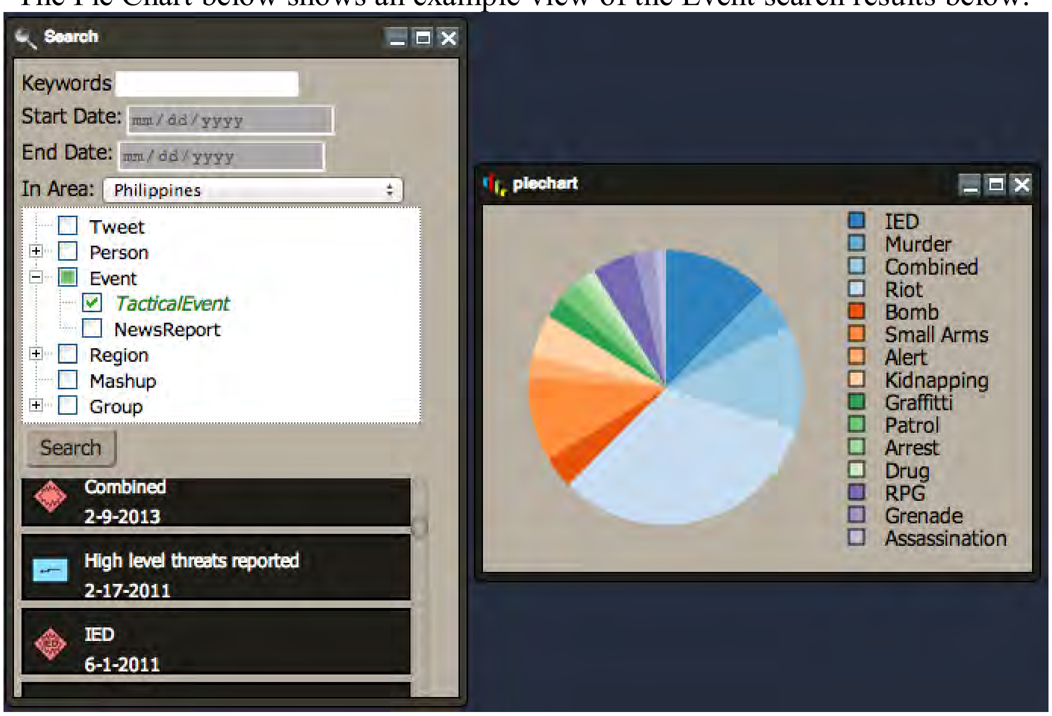

Figure 19. CultureMap Pie Chart

The CultureMap *Rhetoric* word cloud analytic can be is useful for examining key topics frequently mentioned in a set of Search results. It shows the most frequently occurring terms in the Search results (e.g., Tweets + Events) and displays their relative proportional frequency as the size of the most salient terms. The Rhetoric Word Cloud below shows an example view of the Event search results below.

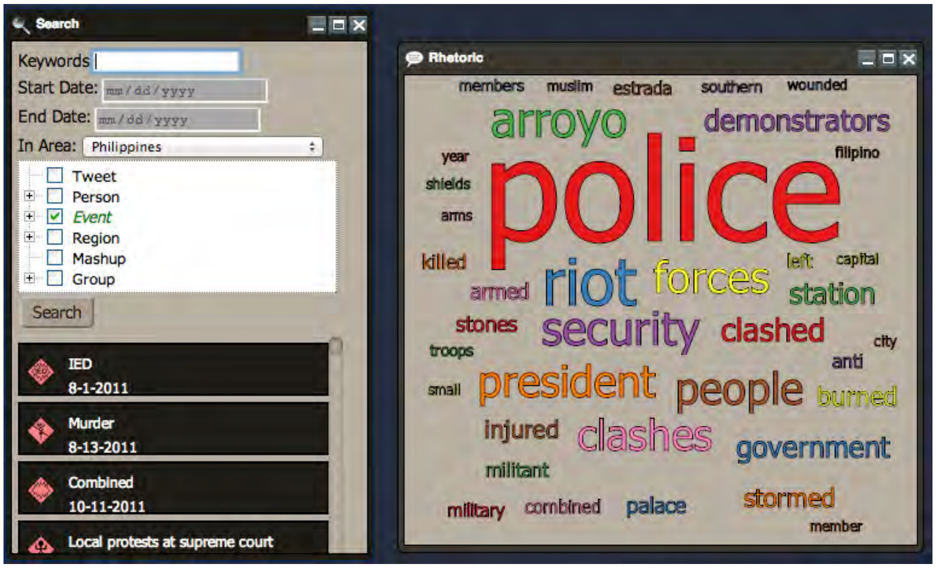

Figure 20. CultureMap Rhetoric Word Cloud

The CultureMap mashup can be used as a means to save, store, and manage collections of visual analytics. These stored analytics can be 'restored' from the mashup, thus enabling a user to resume analysis on saved intermediate analyses. The CultureMap analytics that can be stored in the mashup include: Map, Network, Timeline, Trend Chart, Pie Chart, Rhetoric (Word Cloud). Figure 21 below shows an example mashup.

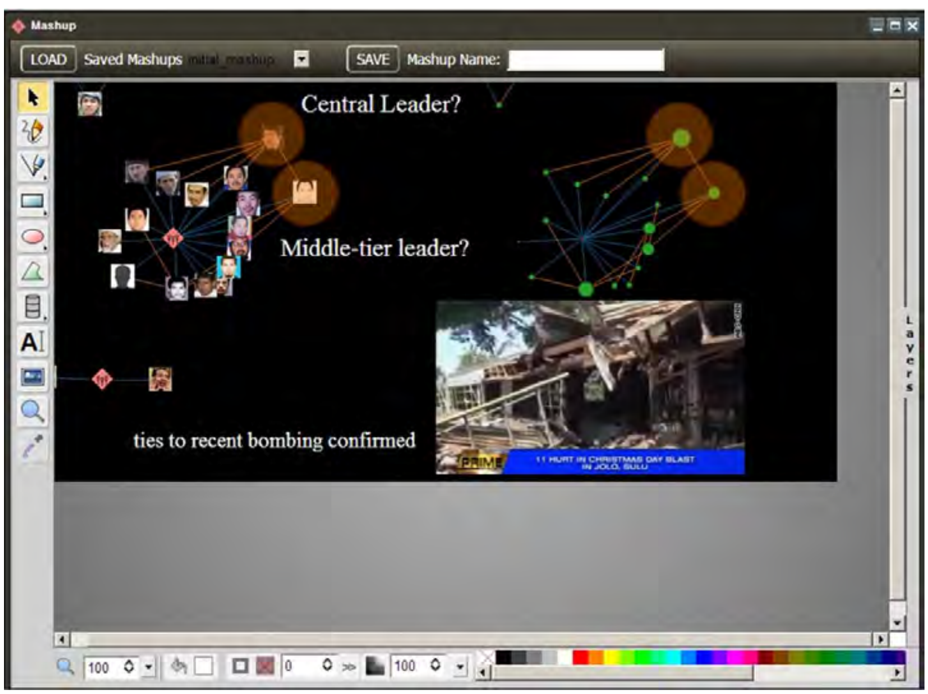

Figure 21. CultureMap Mashup Example

Task 5 – Software Design and Implementation

The Initial prototype was constructed using the GWT framework to provide the overall application level functionality within a Web 2.0 context. The map component was implemented in the OpenLayers GIS framework. The CultureMap wiki component was developed using the XWIKI platform to provide a mechanism for the display and maintenance of cultural backdrop information. The implementation of the individual views as well as the map, search, Wiki, and data entry components were demonstrated on 26 Sep 08 at the Integrated Team Solutions Facility, which supports Marine Corps Systems Command.

Early program guidance from ONR to redirect our short-term design and development efforts to focus on CI to ensure alignment with the Intelligence Surveillance and Reconnaissance (ISR) goals of the LTSN II program. The earlier design was heavily focused on IPB context. IPB, as defined by Marine Corp Warfighting Publication (MCWP) 2-1 Intelligence Operations, is the "systematic, continuous process of analyzing the threat and environment in a specific geographic area. IPB helps to provide an appreciation for the characteristics of the area of operations and the enemy capabilities, weaknesses, and Course of Actions (COAs)". Other doctrinal documentation such as the Multi-Service Tactics, Techniques, and Procedures for Cultural Impact on Tactical Operations have formulated a definition of CIPB as the process of "providing mid-range COAs that take into consideration the beliefs, perceptions, behavioral patterns, and likely actions and reactions of nearly every group and significant individual in the battlespace." The software infrastructure within CultureMap presently exists to support common IPB processes.

In the process of determining how CultureMap can support CIPB, we considered candidate functionality within the general IPB framework provided in MCWP 2-1 that enumerates the following IPB stages: defining the battlespace environment, describing the battlespace effects, evaluating the threat, and determining threat COAs. The set of driving requirements derived to drive the design and development of CulureMap are provided below within this general IPB context.

<u>Tools for Defining the Battlespace</u>

This is the process of defining all Military Cultural Factors (MCFs) and MCF data attributes that need to be collected, stored, geo-referenced, disseminated, and maintained over time for all significant individuals, groups, regions, and infrastructure within a Command's Area of Responsibility (AOR). This process develops a frame of reference for the AOR in cultural intelligence terms and allows for all levels of command to have situational awareness of the relevant MCFs with respect to red and blue force activity. Efforts focused on the implementation of data and user interface structures to support the collection and representation of person, place, group, and region entities according to an extensible set of MCFs that have been derived from both the MCIA Generic Information Requirements for Culture (GIR-C) and other U.S. military publications. Areas of functionality development within the cultural battlespace included:

- Continued development and refinement of the process for creating, geo-referencing, displaying, and managing information on people, group, place, and region entities such as:
    - Importing of entity data from other LTSN sources;
    - Adding additional sophistication for the editing and updating of MFC attribute data associated with each of the major entities;
    - Providing the ability to attach multi-media data to entities as amplifying information;

    - Providing the ability to view all entity data in both a database and wiki form;
    - Developing a seamless mechanism for bidirectional editing between the database and wiki forms of data;
    - Generating and storing of map overlay graphics that are associated with people, group, place, and region entities;
    - Developing local atmospheric scales that can be used to describe/display behavioral state information of all entities that includes factors for the following dimensions – economic status, food availability, medical availability, media sources/saturation, security/stability, relationship to opposing forces, public works status (e.g., water, sewer, electric, trash, fuel, traffic), feelings about the local government, and feelings about U.S. forces.
- Providing the ability to visually link people, group, place, and region entities and define the relationship type;
- Providing the ability to display tactical event data from sources such as the Combined Information Data Network Exchange (CIDNE);
- Providing the ability to display blue force data such as Blue Force Tracker;
- Providing the ability to display and manage visual layers of generic Keyhole Markup Language (KML) overlays on the map representing human terrain atlas-type data;
- Producing generic wiki export containers for people, places, groups, and regions;
- Providing tools to modify the entity data attributes used in people, group, place, and region data collection user interface containers (e.g., a capability for dynamic creation of intelligence requirements for entities);
- Providing tools to enumerate intelligence gaps with respect to the data saved for people, places, groups, and regions that have been stored in the system with respect to required entity MCF attributes.

<u>Tools to Capture and Display the Battlespace Effects</u>

In traditional IPB, this area is generally concerned with processes such as terrain, mobility, and climate analysis. In the case of CultureMap and CIPB, we can extend this definition to include the human terrain and the cultural climate analysis. Development items in this area could include:

- Defining, displaying, and updating culturally significant temporal factors (i.e., maintaining a cultural calendar of significant events);
- Defining, displaying, and updating the dynamics characteristics of the human terrain (e.g., tribal, political, and economic overlays) and cultural climate (e.g., local atmospherics data for specific regions);
- Visualizing the relationships among people, groups, places, and regions, over both space and time as an association matrix or network diagram; and
- Producing a battlespace effects summary wiki.

<u>Tools to Evaluate the Threat</u>

In this area, CultureMap can provide visualizations of the relationship between cultural entities and red force event frequency data. This would provide greater situational awareness of the relationship between cultural infrastructure and significant individual and battlespace activity. Areas of continued functionality development could include:

- Providing heat map visualizations of event density;
- Providing heat map visualizations of local atmospherics;

- Providing drill-down and summary statistics and charts for heat maps;
- Providing temporal visualizations to examine patterns of red/blue force activity with respect to cultural temporal factors;
- Providing visual correlation of people, places, groups, and regions with heat map visualizations for red and blue activity; and
- Providing a threat evaluation summary wiki.

Tools to Evaluate Threat COA

The goal in this stage of IPB is to use cultural information to assist in the process of developing potential threat COAs. Cultural intelligence knowledge can be used to provide insight into potential behaviors and provide the ability to speculate on red force as well as non-combatant reactions to blue force intent. The development of an understanding of behavioral patterns and perceptions can help planners determine the best ways to influence people and groups in the battlespace. Functionality development options in this area include:

- Providing tools to develop situational templates (e.g., anticipated impact of blue force actions within specific regions or with respect to specific individuals or cultural infrastructure);
- Providing tools to develop perception assessment matrices to predict the likely attitudes and reactions of people, groups, and regions to potential changes in cultural atmospheric conditions;
- Predicting friction points between regions, groups, and individuals;
- Developing association matrices showing the relationship of people and groups to one another and to cultural infrastructure; and
- Developing a COA evaluation summary wiki.

Task 6 – CultureMap System Integration

CHI Systems participated in a working meeting at SPAWAR Charleston on 22 July 08. During this meeting, we had the opportunity to identify and examine data sources for CultureMap, to continue to discuss system integration issues with both SPAWAR and other Cultural Intelligence Working Group members, and to initiate a working relationship with SPAWAR Charleston. The SPAWAR meeting was extremely useful from the perspective of identifying useful data sets for CultureMap development. The following is a prioritized list of the data available from SPAWAR Charleston that aided in the evolving design and demonstrations of CultureMap:

- CIDNE,
- Census Bureau,
- MCIA Tribal Data,
- Mosque Reporting, and
- Tactical Reports.

Later versions of CultureMap were augmented to ingest data from the Lockheed Martin Integrated Crisis Early-Warning System (ICEWS), including both ICEWS Sentiment (iSENT) analysis data and ICEWS Trend Analytics (iTRACE) from news reports.

Task 7 – CultureMap Test/Evaluation/Demonstration

In order to garner feedback from sponsorship as well as the operational community, CultureMap was iteratively demonstrated at a number venues.

An initial prototype of the CultureMap system was demonstrated on September 2008. The prototype provided the following functionality and architectural structures:

- A stable Web 2.0 client application implementation and web service bindings based on the Google Web Toolkit (GWT);
- GIS visualization and functionality based on GeoServer and OpenLayers;
- An initial Structured Query Language (SQL) database implementation and database persistence, transaction management, and data indexing/searching via the Grails library;
- Web service interoperability via Simple Object Access Protocol (SOAP), Open Geospatial Consortium (OGC) Standards (Web Map Service (WMS), Web Feature Service (WFS)), and SPARQL Protocol And RDF [Resource Description Framework] Query Language (SPARQL);
- Data model interoperability with XML and OWL ontological representations; and
- The initial demonstration of tactical/cultural representation within the GIS and mission planning functionality;

CHI also participated in a variety of Technical Exchange Meetings (TEMs) and demonstration venues, which focused on later iterations of CultureMap, as well as made plans for future demonstrations including:

- February, 2014, participated in multi-day TEM with DCGS-N PMO and aligned CultureMap with DCGS-INC2 requirements based on TEM results;
- March 2014, demonstrated CultureMap to invited members of the US Marine Corps;
- March 2014, participated in multi-day TEM with US Central Command and demonstrated CultureMap capabilities;
- June 2014, demonstrated CultureMap to SPAWARPAC and DCGS-N PMO representatives;
- July 2014, briefed representatives from INSCOM on CultureMap capabilities;
- Participated in preparation meetings and final demonstration for Global Knowledge Environment (GKE) demonstration to fleet representatives:
    - GKE Dry Run Demonstrations (Telecon and DCO), 25 September 2014
    - Demonstration Dry Run #1 (NRL), 3 October
    - Demonstration Dry Run #2 (NRL), 9 October
    - GKE Demonstration (NRL), 15 October
    - October 2014, DCGS-N GKE Demonstration at SPAWAR (22 October)
- November, 2014 OtK GKE Demonstration at MCIOC (20 November)
- January, 2015 MARCIMS GKE Demonstration (14 January)

Task 8 - Project & Transition Management

The official project kick-off meeting is scheduled at ONR on 17 April 2008. All coordination was accomplished through LCDR Gooby. We formally constituted and briefed the project's Board of Expert Advisors in an initial BOA meeting that was held in conjunction with internal planning efforts. The project management plan (i.e., CRDL A003) was submitted on 6 May 08. The project transition plan (i.e., CRDL A008) was be submitted on 6 June 2008. We formally constituted the CultureMap BoA on 29 May 2008. In attendance at the initial meeting were: CHI Systems – Dr. Wayne Zachary, Charles Barba, Jim Stokes, and Vassil Iordanov, Raytheon – Mr. Bob Stroud, JFCOM J9 – Mr. Tim Beacon, and Consultants – COL Ray Liddy and CAPT Rolf Yngve. Dr. Doug Porch of NPS was unable to attend this initial meeting. During this initial meeting, a programmatic and technical briefing was provided by CHI System. Discussion items with the BoA focused on the following general topics:

- Transition plan and issues,
- Content and data,
- Functionality, end-user tools, a concept of operation, and requirements,
- Integration with DCGS-M,
- Metrics and the BoA's help in defining, and Schedule and plans.

A number of potential transition and partnership opportunities were pursued during the Phase CultureMap project. A number of potential end-user organizations, each with a need for some form of intelligence analysis capability as developed within CultureMap, as well as the larger 4D-Viz framework, were identified as potential transition organizations. These included:

- The Distributed Common Ground System Program Offices for both Navy and Marine Corps (DCGS-N/MC),
- Marine Corps Intelligence Activity (MCIA),
- US Central Command (CENTCOM),
- US Army Armaments Research, Development, and Engineering Center (ARDEC), U.S. Army Intelligence & Security Command (INSCOM), and
- SPAWAR Systems Center Pacific (SPAWARPAC).

We participated in multiple TEMS with stakeholders from these organizations and integrated feedback within the CultureMap application as it evolved. We are currently pursuing transition support of the CultureMap and larger 4D-Viz framework with the DCGS-N INC2 Risk Reduction prototype program as well as with an intelligence analysis program for CENTCOM as there is an acute fit between those operational requirements expressed by these organizations/programs and CultureMap functionality. Ongoing transition efforts forward will focus on transition of CultureMap to the Navy Tactical Cloud (NTC) as well as operational formative assessment of CultureMap.

Task 9 – DCGS Integration and Demonstration

In April 2010 CHI Systems began consultations with IAS on transitioning CultureMap into future versions of MarineLink. Over the course of the following year we identified developed a transition plan and converted CultureMap to fully integrate with the MarineLink software infrastructure. The initial version of CultureMap for MarineLink was prepared for end user evaluation by the 1st Marine Expeditionary Force in April of 2011. Subsequent work on the MarineLink integration was carried out under the CultureMap contract expansion as task 12.

Later iterations of CultureMap were built upon the Ozone Widget Framework (OWF) and Synapse data interoperability libraries (http://www.ozoneplatform.org). An OWF foundation provides CultureMap with maximal compatibility with variants of the Distributed Common Ground System (DCGS), allowing other DCGS OWF components to use and embed one or more CultureMap widgets within larger applications via the Ozone market place. Data interoperability via Synapse permits tight coupling and communication between widgets within the larger CultureMap application. The OWF portion of CultureMap is composed of two Apache web servers. The first server consists of the base OWF version 7 software customized with CultureMap-specific configurations containing specialized functionality to provide easy access to important analysis and visualization capabilities. The second server, the OWF Widget Server, hosts the collection of OWF widgets that have been designed and developed for the CultureMap system. All widgets developed for CultureMap were designed to allow for easy integration into any system utilizing OWF.

Task 10 – Real-time Cultural Intelligence Alerts

As various atmospheric indicators were developed (sentiments from social media, hostile and cooperative actions from news media, aggregate statistics from the World Bank and similar web sources) it became clear that the combination of information into single atmospherics would not be feasible. Although the approach taken to sentiment analysis would make it possible to readily align categories of sentiment derived from different sources, the scales (e.g., frequency rates) of those results cannot easily be combined (e.g. are a thousand tweets the equivalent of two newspaper reports?). Although it is possible to provide aggregations based on weighting the various component sources (news reports, tweets, Facebook entries, etc.), there is little justification for any single approach to doing so and a strong likelihood that transparency will be lost no matter what aggregation solution is chosen. A similar problem is posed by the need to combine both sentiment-based and situation-based atmospheric components. In this case it is clear that directly fusing results into single atmospheric values will often be misleading. For example, food production/importation may be declining while optimism about food availability is growing. In another situation, the reverse might be true. It is hard to imagine a fused value which would not roughly equate these two instances regardless of their very different implications for the future. Fusing situation and attitude about situation into a single atmospheric state value could be highly misleading and users need to be aware of the difference in order to understand the human terrain. At the same time, Area Atmospherics are conceptual units of interest and a useful way of organizing an unwieldy mass of information.

Users need to be made aware of negative changes in the atmospheric whether the changes are rooted in situation or sentiment (the former often assumed to be a precursor of the latter). Any solution to atmospheric alerting needs to be readily readable as unitary atmospheric state indicators, yet transparent as combinations of frequently diverse underlying indicators which may simultaneously trend in different directions. To address the complexity of the issue of alerting, a dashboard metaphor was developed to provide a common representation for summary, drill down, and alerting related to atmospherics

In the initial dashboard design, each atmospheric was represented by a button visually coded for a specific atmospheric and the state of that atmospheric (see below). Icons from left to right are to be read as Stability, Local Government Support, Opposing Forces Support, Blue Force Support, Food Availability, Economic Condition, Public Works Status, Medical Availability, and Media Saturation, seen in Figure 22 below. The buttons are color coded red/amber/green for the threat level indicated by the current state of each atmospheric. The recent threat trend is indicated by the presence of an embedded red or green arrow in the icon. A surrounding glow effect is used to highlight buttons, indicating a highly significant recent change or the fact that the user has not yet examined the underlying information.

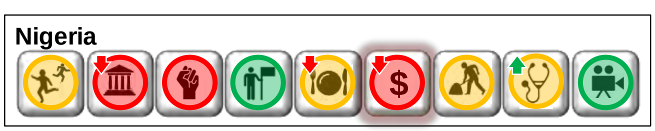

Figure 22. Dashboard Example

Since each atmospheric includes multiple underlying indicators, which may or may not agree in threat level or trend direction, the state of the highest threat level indicator is propagated up to the atmospheric itself. When the user clicks an atmospheric button in the dashboard, a separate panel is added to the bottom of the dashboard showing the threat level for each of the indicators associated with that atmospheric, as seen in Figure 23 below. An example of this drawer metaphor is shown below. The indicators for Food Availability and Economic Conditions are displayed and color coded with the same conventions used for the atmospherics themselves. The Inflation and Employment indicators are shown as selected (buttons depressed) and their associated graphics (timeline charts, heat maps, etc.) would therefore be displayed in dedicated atmospheric visualizations or within shared visualizations of the required type (i.e., a common map view).

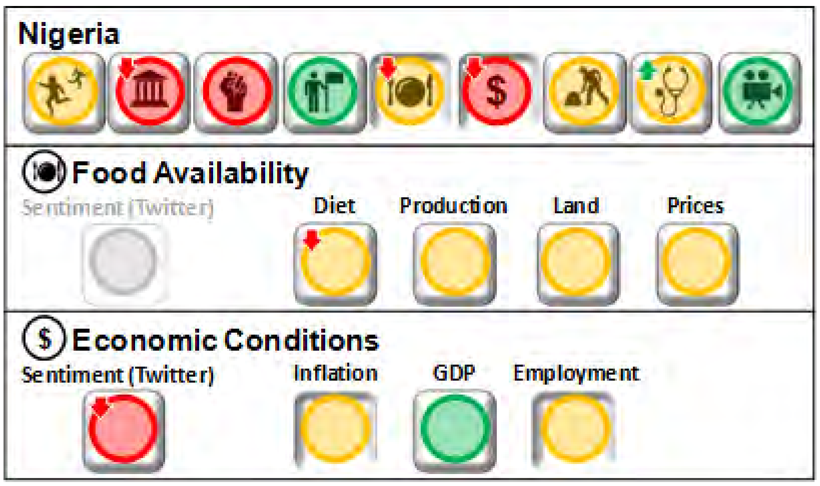

Figure 23. Dashboard Expanded – Comparing Atmospherics

A threat-oriented dashboard approach allows the user to quickly assess the state and trend of local atmospherics and drill down to underlying details. At the same time, this approach avoids relying on opaque aggregation approaches which may conceal specific low-level sources of concern or suggest stability when underlying indicators are moving in opposing directions. Color coding atmospheric results based on a notion of "threat" also decouples the summary view from the details of specific values which may be confusing if displayed directly (e.g., an increase in Local Government Support is good, but an increase in Opposing Forces Support is bad). Color coding within visualizations will clearly indicate the source of the indicator button colors (e.g., the presence of a red zone at the bottom of a Local Government Support chart and the presence of a red zone at the top of the Opposing Forces Support chart).

Although the threat levels described for the dashboard approach could be thought of in terms of ad hoc or analysis/experimentation derived thresholds for indicator values, the approach would work equally well with thresholds applied to changes in indicator values (e.g., trends, spikes). In this case the users' attention would be focused on significant deviations from previous metric baselines (e.g., deviations outside the high/low of the previous month(s)).

Further development of the dashboard design included the decision to provide shape redundancy for the color coding (to address the color blindness issue), the color is constrained as a background shape to the atmospheric icon: an up- or down-arrow or a direction-neutral disk shape. This modification to the dashboard appearance appears as seen in Figure 24 below:

Figure 24. Dashboard Trend and Recency Coding

Presentation of the dashboard approach at a project review meeting elicited a number of comments. Although these comments were generally positive, it was noted that in the summary dashboard representation, the user is given no indication of the reliability or recency of the data/analysis underlying the threat level indicated. The reliability component of atmospheric status (with recency being a key element in any reliability assessment) is clearly a critical issue for focusing user attention and must be addressed as a key component of the dashboard design. A number of modifications for analog display of percent reliability were devised. These generally required the addition of an icon element to each button, as shown in the examples as in Figures 25:

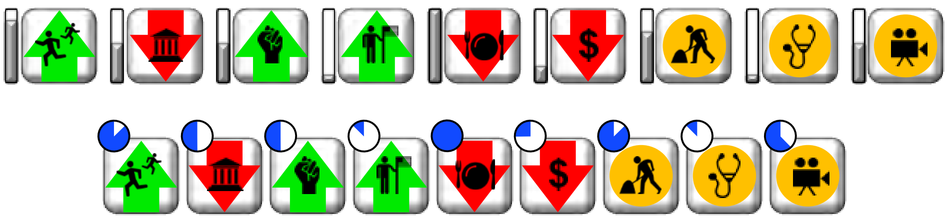

Figure 25. Dashboard Coding Candidates Explored

These formulations were deemed unsuitable for the summary dashboard as they require the user to “read” the graphic elements separately and attend to two different simultaneous codings (e.g., “look for the most reliable” vs. “look for the most threatening”). A simpler approach representing discrete reliability levels was also explored, as seen in Figure 26 below:

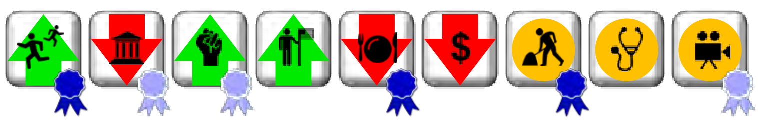

Figure 26. Dashboard Coding – Simplified Candidates

Although somewhat better, these approaches seemed to pose problems similar to the addition of the analog icons, in that there is no intuitive fusion of the indicators on the part of the user. As a result of these analysis results, the possibility of loading an additional indicator onto the color variation was explored. As shown below, variation in saturation does not provide an obvious mapping to reliability and may in fact confound the color blind issue, as seen in Figure 27 below:

Figure 27. Dashboard Coding – Manipulation of Saturation

A combination of a variation in value (brightness) and tint (paleness), however, does seem to provide just such an intuitive link, with a reduction in reliability mapping to a fading out of the color-coded symbol, as seen in Figure 28 below:

Figure 28. Dashboard Coding – Manipulation of Brightness/Tint

The revised dashboard design below utilizes three discrete levels of value/tint to indicate levels of reliability. Stability, Food Availability, and Public Works Status are shown at the highest level of reliability. Blue Force Support, Economic Condition, and Medical Availability are shown at the lowest level of reliability. This approach appears to be relatively intuitive as it seems to constitute a natural fusion of notions of polarity and substantiality in the color coding alone, as seen in Figure 29 below.

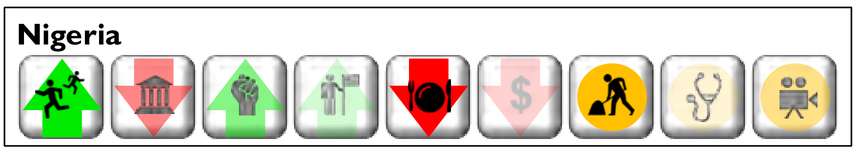

Figure 29. Dashboard Coding – Three Discrete Levels of Brightness/Tint

This convention is carried over into the design of each "opened" atmospheric in the dashboard – a pane used to represent the collection of indicators which underlie a single atmospheric (shown below). Here the levels of reliability are shown for each indicator via the same value/tint coding and it is clear that recent changes in sentiment are the source of the highly negative coding of the top level atmospheric button for Food Availability, as seen in Figure 30 below.

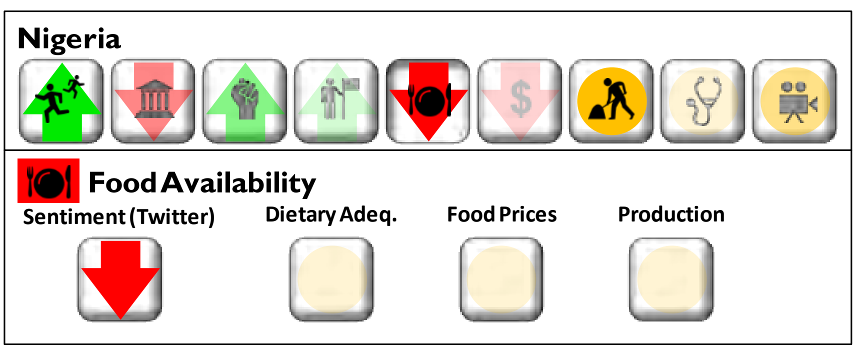

Figure 30. Dashboard Coding – Expanded Example

The overriding purpose of the atmospherics dashboard is to provide users with both quick access to a wide range of atmospheric indicators and an indication of the urgency and reliability of those indicators with reference to any threat they may pose for local operations. Although the top level dashboard atmospherics buttons are coded to bring the most recent negatively trending underlying indicator to the attention of the user, the underlying indicators may present a complex mosaic. In general this is accessible by opening each atmospheric separately, but ultimately a summary view was added to the design to allow a single quick overview of all underlying indicators without the need to drill down on individual atmospherics.

The dashboard design allows users to open individual indicators as well as individual atmospherics. An early demonstration implementation of this feature is shown below in Figure

31. In this example a history of the inflation indicator is shown as a timeline chart, with colored bands indicating good, adequate and poor value levels.

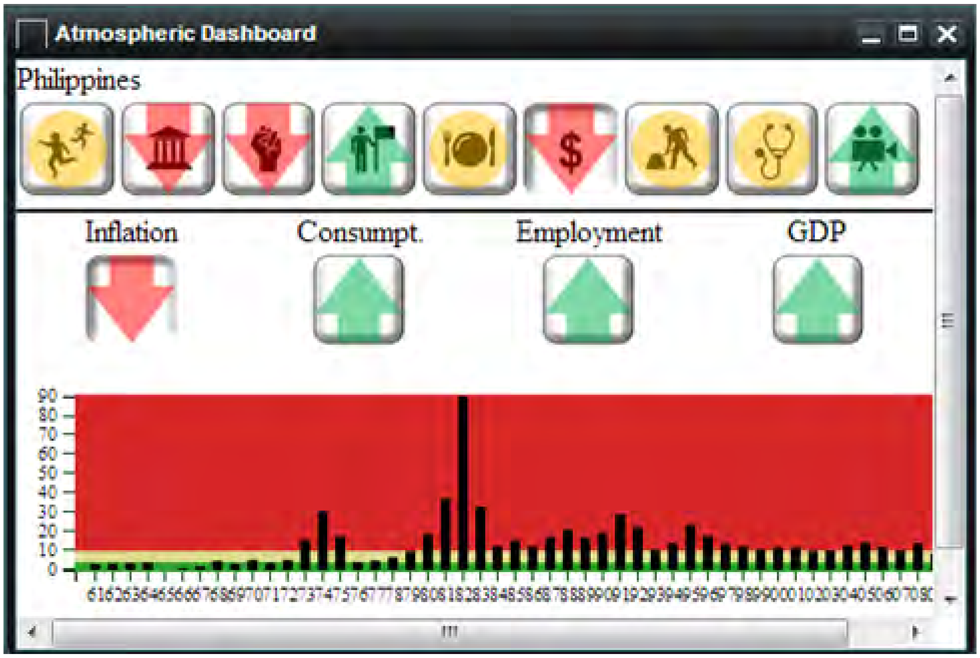

Figure 31. Dashboard Coding – Fully Expanded Example

The most recent implementation of indicator charts allows the user to click a single bar in the chart and load the associated data into CultureMap search results. This, in turn, allows the user to immediately examine the full range of visualizations for that data. For example, clicking on a spike in a sentiment chart allows the user to immediately open a word cloud visualization to examine the content of the sentiment spike. This means that an analyst user can go directly from a color coded alert regarding a recent negative change in an atmospheric of interest, to the various semantic, geographic, or temporal details of the indicator data which was responsible for the alert.

Task 11 – Transition Support – End User Documentation

To support ongoing and future transition efforts for CultureMap, we developed a range of end-user support for CultureMap, via creation of formal training materials, system operations documentation, and integrated on-line help functionality. See *Appendix B CultureMap System User Documentation* for a detailed overview of the user documentation that is included with the CultureMap software deliverable.

Task 12 - Maturing CultureMap to meet deployment requirements defined by IAS

Work on transitioning CultureMap to MarineLink began in May 2011 following the expansion of the CultureMap project. Work transitioning CultureMap to MarineLink's database, internal infrastructure, and adding MarlineLink specific administration functions proceeded on schedule with monthly builds delivered to IAS for evaluation. Bug, issues and feature requests arising from these evaluations were resolved in the following month. In October 2011 CHI Systems worked with IAS to prepare an ROM for MARCORSYSCOM to address the feasibility of adding CultureMap to MarineLink 2.3 the deployed version at that time. Funding for the transition was supplied in January 2012. In April and May 2012 CHI systems demonstrated CultureMap as part of MarineLink 3.0. No further work was done on this task after May 2012.

Task 13 - Development of area atmospherics estimation/prediction model

Work began on Calculating Area Atmospherics task with the premise that both people's expectations regarding human needs fulfillment and their assessment of whether their expectations are being met are central to our understanding and forecasting of area atmospherics. Therefore, we undertook and are presenting an analysis of how the Area Atmospherics currently included in CultureMap and MarineLink Web relate to the 9 atmospheric categories below:

1. (**Food availability**) Personal Physiological Needs – food, water, clothing, shelter, and possibly job/money (i.e. first category of human needs).
2. (**Medical availability**) Local Institutions Supporting Health and Safety – drug stores (or supplies for alternative medicine healers), hospitals (clinics, midwives) (i.e. second category of human needs). Police and schools are not currently atmospherics, but also fit in category 2.
3. (**Public Works**) Regional Infrastructure – roads, railways, navigable waterways, reservoirs, power grid, telephone lines or towers, media coverage (as opposed to saturation). (This third atmospheric supplies the regional support for the first two atmospherics. How elaborate the regional infrastructure needs to be depends on the social structure of the region. Self-sustaining nomads or farmers need relatively little infrastructure.) This atmospheric will impact mobility and communication, and thus the groups in which you can effectively participate. Thus, it can also have an impact on category 3 of human needs.
4. 5. and 6. (Support for national or international organizations, including **blue force**, **opposing force**, or **local government**) Factors contributing to support:
    a. To Which Group Do You and Your Family and Friends Want to Belong – which of these groups have the most appealing traits and goals that align with yours. Research has demonstrated that people make trait inferences spontaneously (quickly and with no conscious intentions) in response to a wide array of social events. Inferences about an actor's goals typically play a central role in making trait ascriptions about them, and trait ascriptions about an actor typically involve making claims about the goals and beliefs of the actor (Read, et.al. 2005). A person seen helping a blind person cross a street will be ascribed a helpfulness trait. Statements about hidden ulterior motives can often reverse the good or bad impression that would normally be made by the act. A complicated interaction is involved and trust is critical. (This aspect of support directly addresses category 3 human needs, and a person's role in supporting an organization could also be source of esteem, a category 4 need.). Note that insurgents and government workers are merged into the rest of the population, while Blue force actors are foreign and not merged. This could impact people sense of belonging.
    b. Buying Support – By being a reliable source of income, a force or government can be seen as helping with category 1 and category 2 needs. Being paid well can even add to a person's sense of esteem (i.e. category 4 human needs). This would make a force or government worthy of support even if people feel

little affinity for them and don't feel that their interests are aligned.

   c. Coercing support – Threatening the safety of a person, and/or their family and friends can gain short term support, at the cost of engendering hostility and anger. Here concern about category 2 needs is the source of support. Coerced support tends to disappear very quickly.

7. (**Media**) Region to international information dissemination and acceptance – The underlying question is how do people hear about events and what are their trusted sources of information? Very different versions of an event appear in different newspapers, radio stations, and TV channels. It would be important to know which version of an event people are telling, if any.
8. (**Economy**) Economic Variability for the Individual or Business in Regions from Local to National Size. There are two major dimensions along which an individual's economic condition can be varying. The first dimension is fundamental lifestyle. If it is changing a lot, then it is hard to relate goodness in the old lifestyle to goodness in the new lifestyle. If the basic lifestyle has a sufficient baseline, then economic condition can be tied to whether you are able to obtain the necessities and luxuries associated with that lifestyle. Business conditions are easier to rate. Important factors include the availability of raw material, skilled workers, credit, transportation, and a market. Business success can be measured in terms of profits, anticipated profits, and market share.
9. (**Stability**) Military/protest Actions Being Directed Against Groups in the Region. This atmospheric has answers at many levels. At the region level, this can be related to whether one government is remaining in power. Although, a bloodless coup may have little impact on the population. At the level of cities and villages, it could focus on whether there are riots and protests in the street. Is it possible to do normal business and transport necessities safely? Is there fighting between forces, or is the local population being targeted? Is the government taking repressive measures? So, lack of stability, which could be expanded to include natural disasters, can potentially affect all of the other atmospherics in a negative way.

Using the 9 organizing categories above, we determined that there exist two different but equally important perspectives to understanding atmospherics relevant to cultural intelligence: *situational* and *sentiment*. Situational data describes what is happening in absolute quantifiable terms, for example are people receiving enough food aid to prevent malnutrition? Yes, *X* tons of wheat and maize products are being distributed in affected areas, thus ensuring that each person receives 1500 calories of food per day. Sentiment data describes how the population within the area of interest perceives the situation through their own cultural perspective. For example, is there an adequate food supply? No, people are not receiving enough rice. For the analyst to apply atmospherics to the IPB process, he must understand the nature and sources of each indicator type.

<u>Situational Atmospherics (Facts on the ground)</u>

These indicators can be gleaned from national and international referential sources such as the World Bank Data, United Nations Agencies, Central Intelligence Agency Factbook, military personnel in the area, and even news reports. These indicators include items such as:

- annual rice production/imports nationwide
- average price of rice on a national level
- current price of rice in a specific village market

- amount of rice available (known imported quantities)

Sentiment Atmospherics (Perceptions)

These indicators are not as clear-cut as facts on the ground and must be accumulated, analyzed, and interpreted from sources such as social media (Twitter, Facebook, web logs ("blogs"), on-line news comments, and even military personnel in the area. These indicators include items such as:

- the population's belief that the price of rice is too high (by comparison to neighboring countries it might actually be low)
- the population's belief that there is a shortage of rice (whether true or not, it might cause hoarding)
- the population's belief that the government is to blame for a real or perceived shortage (may tie into other unrelated anti-government sentiments)
- the population's believe that rice availability is being controlled by corrupt officials

These atmospherics are then combined into aggregate situational and sentiment indicators describing the most recent trends in the data and if they represent a positive impact on the operational environment and presented through the CultureMap dashboard (see *Task 10* above).

CultureMap Atmospherics Classifier Development/Refinement

A preliminary training set of 249 documents was collected via internet search results. The training set was subsequently analyzed using the Weka machine learning toolkit (http://www.cs.waikato.ac.nz/~ml/weka/) to assess the feasibility and efficacy of learning a model to recognize atmospheric-related themes and sentiments within unseen documents (i.e., via semantic analysis and classification algorithms). Each document, or report, in the training set was manually evaluated and annotated as to whether the document provides evidence of negative or positive sentiment toward the government. This partitioned the training set into three classes: those containing evidence of negative sentiment toward the government (the "Sentiment.Government.Negative" class), those containing evidence of positive sentiment toward the government (the "Sentiment.Government.Positive" class), and control documents (i.e., documents regarding the geographic region in question, but containing no discussion of atmospheric-related topics) (N = 133, 16, 100 respectively).

To prepare the data for model learning and evaluation, each document was transformed into a feature vector of terms, where the terms were taken from the set of all documents processed, and a document's vector values corresponded to the occurrence of each of those terms within that particular document. Most methods (e.g., latent semantic analysis) make the assumption that words which often occur physically close to one another are more often semantically close to one another, and that key concepts often may be expressed not with single words, but rather with several co-occurring words. Therefore, *n*-grams (i.e., single words, word pairs, and word triples) were used as terms within the feature vector, with *n* ranging from 1 to 3. Stemming and stopword removal were also performed to respectively reduce words to their simplest form and remove common, unremarkable words. Finally, the term list was algorithmically pruned to retain only those terms with sufficient discriminatory value across classes.

Obviously, an optimal model to be used on unseen data should be trained on all available data (and ideally iteratively refined when new training instances become available). For the current evaluation purposes, however, a cross-validation technique was employed. The training set was randomized and divided into 10 equal sized subsets, or folds. All model learning and evaluation was subsequently performed iteratively. In each iteration, 9 folds were used for training and a different 10th fold was left out as test cases to assess the models performance after training. The results from all iterations were combined to produce metrics describing the model's accuracy (i.e., precision, recall, and confusion matrix).

We trained, evaluated, and compared four different types of models: a decision-tree algorithm (an implementation of C4.5), classification via clustering using an expectation-maximization (EM) algorithm, and two types of Bayesian models. The entire process discussed here has been developed and stored as a data mining pipeline in Weka which may be reused and refined in the future, as seen in Figure 32 below.

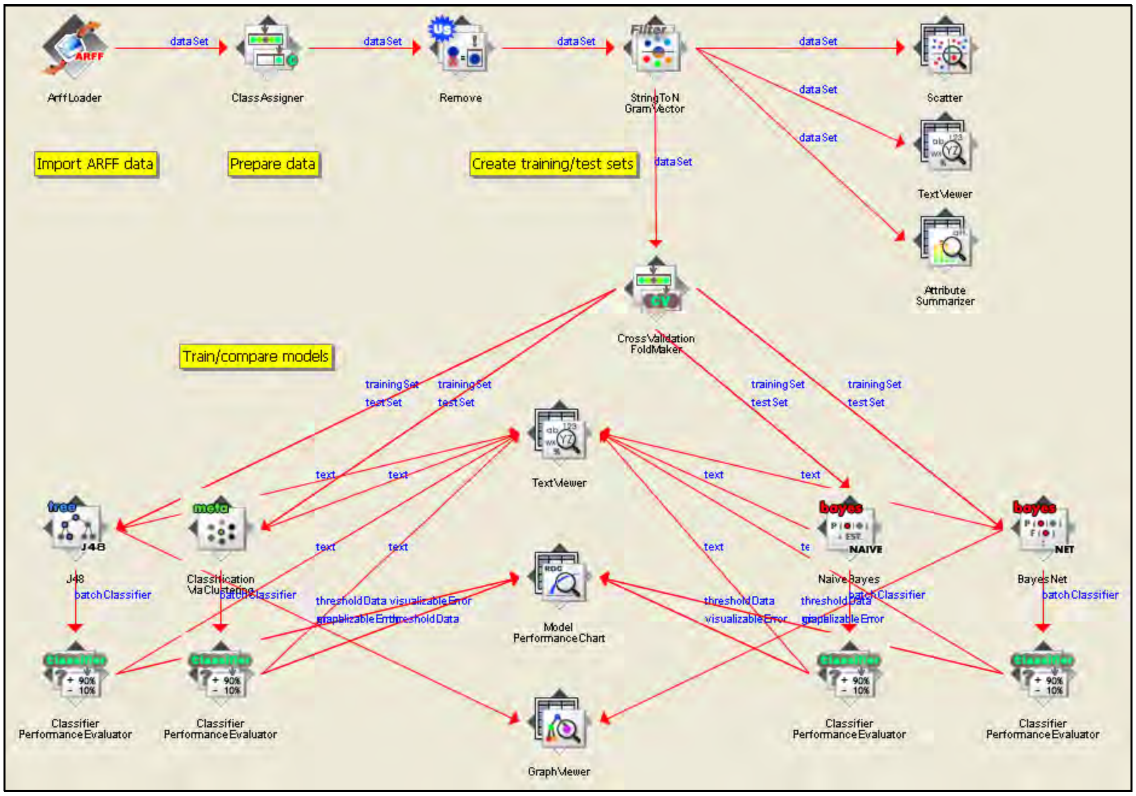

Figure 32. CultureMap Classifier Processing

Before control documents were added into the training set, all models falsely reported high accuracy. This was due to the large class unbalance in the data set (i.e., the scarcity of examples expressing positive sentiment toward the government). Without a cost attached to misclassification, many models learned quickly that naively guessing the "Sentiment.Government.Negative" class yielded the correct result in most cases. Once the control documents (i.e., the "NONE" class) were included in the training set, the accuracy claimed by several models declined. The initial results for all four models are provided in the appendix below, but overall the Bayesian methods have shown the best results so far. The most accurate model evaluated had the following accuracy and error rates, as seen in Figure 33 below.

```
Correctly Classified Instances        220
                                    88.3534 %
Incorrectly Classified Instances      29
                                    11.6466 %
True Positive Rate:     0.884
False Positive Rate:    0.11
Overall Precision:      88.4%
Overall Recall:         88.4%
=== Confusion Matrix ===
 a    b    c    classified as
88   11    1    a = NONE
 8  125    0    b =
Sentiment.Government.Negative
 2    7    7    c =
Sentiment.Government.Positive
```

Figure 33. CultureMap Classifier Performance Example

While other models trained and tested thus far can correctly classify a marginally higher percentage of cases, at the expense of much increased complexity (in both time and space), as of now Bayesian models such as that shown above yield equally promising results and produce a more desirable confusion matrix (i.e., in terms of which misclassifications would be considered more problematic in a final system and should therefore be avoided). In later stages, the accuracy of these models was reassessed and tracked as training sets were enlarged considerably and augmented to include other atmospheric-related themes and sentiments. A variety of normalizations were experimentally applied to the feature vector of term frequencies to determine if accuracy may be boosted in the case of each different model type (e.g., document length normalization, TD-IDF weighting). The minimum and maximum *n*-gram size was also varied to determine its effect on accuracy. Later, numerous alternative algorithms, variations, and parameterizations were swapped into the existing pipeline and evaluated as to whether they yielded better results. Lastly, meta-models were explored to see if they could also increase accuracy (e.g., models which combine the results from several models, and models trained with an overlying cost-matrix defining the different costs associated with making different types of classification errors).

Having established a feasible methodology for classifying tweets on a single topic from a single area, we needed to establish the most efficient and effective methods for categorizing tweets across different cultural and stability contexts. In order to determine the degree to which classification can be based on training from a single cultural/stability context, it was necessary to collect substantial numbers of tweets in order to compare the various solutions (e.g. training on country A versus training on countries A and B, and then applying to country C). Expanding the process to a larger set of countries was also required in order to account for the additional classes of atmospheric-related sentiments remaining to be covered. Collection, tagging, and analysis has therefore been ongoing for the following six countries (selected in coordination with ONR): Philippines, Nigeria, Zimbabwe, Myanmar, Venezuela, and Ecuador.

We accumulated a sufficiently large sample to incorporate the new data, along with additional classes of atmospheric-related sentiments, into the automatic classification process. We have constructed automatic classifiers capable of discriminating between sentiments expressed toward the six atmospheric classes for which sufficiently large samples were collected. These include sentiments toward Opposing Forces, Blue Forces, Government, Stability, Economy, and Food Availability. While present in the data, the sets of exemplars found for the classes of sentiment toward Media, Medical Availability, and Public Works Status were too small to be significant, and therefore were temporarily excluded. While more data for these classes may be found during ongoing analysis, it is likely that calculation of these atmospherics will rely more heavily on situational data sources. *Appendix C. CultureMap Preliminary Classifier Analysis Results* contains a log of classifier testing results.

Data Analysis: Mapping Social Media Data to Atmospherics

In order to move forward in the development of our sentiment analysis approach, we decided to focus exclusively on the analysis of twitter data. To do this we needed to establish the most efficient and effective methods for categorizing "tweets" (individual messages or status updates posted on Twitter) across different cultural contexts. In order to determine the degree to which classification can be based on training from a single cultural context, it was necessary to collect substantial numbers of tweets in order to compare the various solutions (e.g., training on country A versus training on countries A and B, and then applying to country C). Expanding the process to a larger set of countries was also required in order to account for the additional classes of atmospheric-related sentiments remaining to be covered. Collection, tagging, and analysis are, therefore, ongoing for our six target countries.

While our set of analyzed and tagged data is still expanding, we have accumulated a large sample (over 105,000,000 tweets as of June 2014) which allows us to incorporate the new data, along with additional classes of atmospheric-related sentiments, into the automatic classification process. We successfully constructed automatic classifiers capable of discriminating between sentiments expressed toward the six atmospheric classes for which sufficiently large samples were collected. These include sentiments toward (1) Opposing Forces, (2) Blue Forces, (3) Government, (4) Stability, (5) Economy, and (6) Food Availability. While present in the data, the sets of exemplars found for the classes of sentiment toward Media Saturation, Medical Availability, and Public Works Status are currently still too small to be significant, and therefore were temporarily excluded. While more data for these classes may be found during ongoing analysis, it is likely that calculation of these atmospherics will rely more heavily on situational data sources.

Automatic classification across six classes is an inherently difficult problem. Inspecting individual elements of content reveals that instances of misclassification are often caused by a natural, true overlap existing between one class (e.g., such as Stability) and a small number of related classes. For example, the following excerpted tweet each contains an indication of negative sentiment toward both the Government and Stability:

a) *"RT @#####: The poor in the Philippines are not only income poor but also suffer from deprivations in health and education.*

Given the ultimate goal of the current effort, the exact classification of any individual piece of content (e.g., tweet) is much less significant than the larger, summative results aggregated over different granularities of time and space. Therefore, accuracy in the overall, aggregated results can be best improved by allowing each content element to partially contribute simultaneously to multiple atmospheric categories in order to characterize mixed content such as that seen in the examples provided above. The most accurate classification methods we have used, however, do not lend themselves easily to this as they involve employing a series of multiple, pairwise classifiers, each trained to discriminate between a single pair of atmospheric categories. We therefore implemented an additional post-classification algorithm which, for each content element, transforms the set of confidence values produced by the many pairwise classifiers into a single continuous probability distribution across all six atmospherics (Hastie & Tibsirani 1998, Wu, Lin, & Weng 2004).

With this post-classification algorithm implemented, we then began a process of manually inspecting the final results, focusing on individual cases that either clearly fell into one distinct category or that clearly straddled multiple categories simultaneously. Below is an example case found during inspection that fit within multiple categories of food and stability:

> b) *"RT @Oxfam: We're now providing emergency water, sanitation & shelter in worst hit parts of the Philippineshttp://t.co/q7cZS3HiAF #Haiyan…"*

Example (a) above was manually determined to be exclusively an expression of negative sentiment toward the government. The probability distribution produced by the algorithm is congruent with what we would expect to see in such an example, assigning a 99.08% probability that the content indicates negative sentiment toward the government and extremely low probabilities to all other categories. Example (b), on the other hand, was manually determined to be an exemplar case of content expressing a mix of sentiments simultaneously (i.e., it expresses anti-government sentiment in talking about corruption, but also implies the corruption has led to a degree of instability as roads are being blocked). Again, as expected, the distribution has the two highest probabilities assigned to negative sentiment toward the government and stability (at 60.20% and 37.51% respectively). For the time being, until we have a better understanding of the probability distributions, we combine the probability distributions over all categories to form an indexed value for each atmospheric. These summary metrics are used to drive the atmospheric dashboard (i.e., the first example would mainly contribute to the dashboard's summary metric for government sentiment, while the second would contribute partially to both government and stability sentiment).

The large bulk of ingested social media content, however, will often be irrelevant to the current effort, and therefore should not be allowed to contribute to any metric illustrated in the dashboard. This is true even when location and keyword constraints are applied, such as in example (c) provided below:

> c) *"RT @#####: @##### Number 3 in the Philippines :) http://t.co/OkbRLZ3ZSj"*

Tweets such as above are not relevant to atmospherics, but nevertheless will still be assigned some probability distribution across the atmospheric classes. Some like example (c) are easily filter out after the classification processing because they are not assigned to any category with high-levels of confidence. But others like example (d), which was assigned to the government atmospheric with an extremely high-level of confidence, are harder to pick out using our current processing methods.

d) RT @####: Good Morning Philippines! Good Morning World!Good morning to all out there on the road to success.

With the initial classification and post-classification algorithms implemented, we undertook the task of validating our methodology with real-world data. By this point, we had already collected nine continuous months of Twitter data for our target countries, including the Philippines. The timing of our validation phase coincided with the aftermath of Typhoon Haiyan; using the twitter data preceding, during, and following the typhoon landfall represented a timely and useful case study. Samples from the data set were therefore processed through the entire analysis pipeline and the results inspected.

A closer look (Figure 34 below) at the classification of the tweets collected for the Philippines over a period of two months shows that the perturbations in the data coincide with events in the Philippines: the climax to a weeks-long standoff with Muslim rebels in the southern city of Zamboanga, the recent earthquake in the province of Bohol, and the landfall of Typhoon Haiyan. As seen in the chart, events surrounding Haiyan generated an enormous

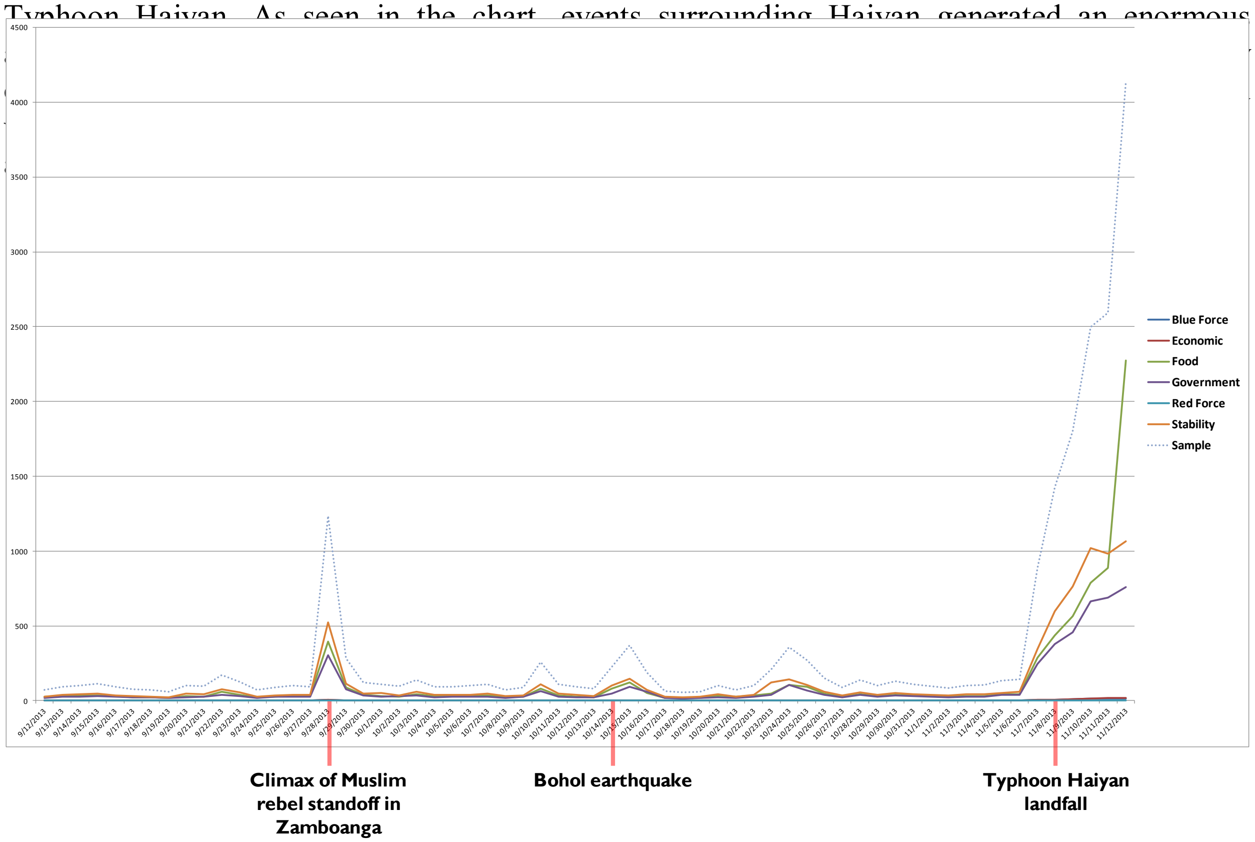

Figure 34. Atmospherics for landfall of Typhoon Haiyan Analysis

Task 14 - Advanced research in supervisory control mechanisms for intelligence systems

A problem faced by intelligence analysts in the field is the need to utilize the ever-growing amount of data collected by various means within the battlespace. Without any level of automation, *particularly for data ingest and data conditioning*, it requires many person-hours to research, collate, and draw correlations between entities defined in these disparate data sources. The purpose of this task was to identify methods for providing human assisted, semi-automated processes to capture pertinent data contained in structured and unstructured data sets, and to provide features that allow users to selectively tune data mining algorithms for the collation and reification of pre-existing cultural entities within CultureMap. This functionality was aimed at lessening the burden on the analyst to perform searches through libraries of information, and focus their efforts on the validation and corroboration of narrative collected in the field.

Given the CultureMap user interface design and user requirements, we implemented the best candidate approaches to provide useful and pertinent tools to the intelligence analyst to ingest, analyze, fuse, and incorporate data from multiple data sources within CultureMap. The main focus of automation for a CultureMap user is to ability to mine and extract information from various ingest data types. Additional work was performed to implement a supervisory control user interface that 1) connects with available data portals for live feeds of data, 2) presents the user with findings from automated processing, and 3) allows the explore the lower-level data through drill-down, to the point of examining each individual data element where relevant.

The subsequent research efforts on this task were three-fold. First, from the technical domain, we needed to consider the efficacy of algorithms for data extraction and select candidate techniques for implementation. Second, we needed to consider the sources from which data is coming, and provide tools that assist the analyst in analyzing this data in ways that are consistent with the data model and user interface elements. Third we needed to ensure supervisory control design was also capable of ingesting future data sources that continue to become more pervasive throughout the computing community (such as social networking, blogging, and media sharing tools). Additionally, we needed a human-centered design approach for the supervisory control, assuring our implemented tools provide an adequate coverage of the intelligence analyst's workflow within the knowledge management domain.

One of the challenges with automated data extraction methods is in handling inconsistencies between old and new data when existing data is perceived to be "ground truth". There is also the question of determining the level of credibility a source has in relation to other sources (Clark 2009). Extracted data can lack the supporting data required for it to be deemed usable (Weiss and Indurkhya, 2000), and it can also conflict with existing data, raising issues of data integrity. Much of the data collected in this fashion tends to be redundant and act as clutter to the analyst (Gallo, De Bie, and Cristianini). We needed to be cognizant of these challenges as we provided implementations of algorithms for extraction of geotemporal information, entities, associations between existing entities, and data on local atmospherics within known regions.

The presentation of qualitative data formats (such as pictures or animated sequences) for evaluation in this discussion must be analyzed separately, due to their complexity and challenges as compared with textual data. As the literature suggests, qualitative data may lack certain structure and classification, potentially making the job of filtering and aggregation quite complex. More importantly, users of data collection systems often collect qualitative data that possesses pertinent metadata that is ill defined or incomplete, lacking imbuing information such as data definitions, collection methodologies, and collection policies (Schuurman, 2009). Although qualitative data may have some classifiers (such as a named location, a geographic boundary, a typed qualifier of the location) and are stored in a database queryable form, they typically require visual inspection in lieu of statistical analysis to prove a data point’s worth (Pavlovskaya, 2009). Although techniques have been applied to quantify factors in qualitative data (Gellman, 2005), quantification of this data can dilute its desired effect. Research within this area will focus on combining several techniques for a salient solution – capturing available media metadata for inclusion in data mining processes, adding tagging and entity identification facilities to media imports, and utilizing content based image retrieval (CBIR) techniques that allow the system to auto-detect and categorize artifacts within an uploaded image.

Any efficiency gained by semi-automatic extraction and identification of concrete data points could be lost if the analyst is incapable of utilizing the harvested data in a way that will fulfill their intelligence requirements. Often, an intelligence analyst uses analytic tools to draw relations and correlate data between known entities. The tools required to perform this development (document analysis, geospatial mapping, etc) are typically disparate and limited, adding cognitive workload to the user (Patterson, Woods, Tinapple, Roth, Finley, and Kuperman, 2001). Also, although these processes typically share key aspects, they must be rebuilt each time an analysis is required. Drawing from knowledge gained in researching various methods for data classification and extraction, we will identify techniques to create reusable scenarios that will serve a dual purpose: flagging additional requirements for data extraction, and reifying the process in which the automated processes use to extract data from the available sources in a form suitable with the supplied visual analytics.

A key aspect of CultureMap is providing the appropriate data visualizations to the user in a form that optimizes the capabilities, and overcomes the limitations, of humans. The goal of these visualizations is to highlight the data's "features in order of importance, reveal patterns, and simultaneously show features that exist across multiple dimensions" (Fry, 2008). The visualizations we selected will allow the user to see their data in many different lights to expose different patterns within the data. They may necessarily be multidimensional and interactive, providing the user with the ability to shift, slice, hide, rotate and drill into data once it is visualized to aid their investigation. Additionally, the visualizations need to handle data over time. One of the key aspects of determining causality is time. In most definitions, causality is assessed by an event A preceding (or in some cases occurring simultaneously with) another event B where the occurrence of B depends on the occurrence of A. Visual assessment of causality must therefore also take into account data over time.

The types of supervisory controls supplied through CultureMap visual analytics were designed based on Woods and Watts (1997) description of a number of design techniques to maximize visual momentum, of which a subset was included within our design. The design therefore includes specific capabilities to support interactions with the user interface based on these design techniques, namely: (1) “longshot” displays; (2) related/parallel views; (3) center surround; (4) cues to status; and (5) conceptual spaces, all briefly explained in Task 17 section *Principles Leveraged in the CultureMap Design*. These concepts were used to derive the specific CultureMap user interface (see Task 4 above) based on the underlying concepts associated with these supervisory control design techniques.

Task 15 - System integration and interoperability support

We utilized a systems engineering approach to design the CultureMap software architecture based on the need to be able to rapidly reconfigure variations of the application to accommodate differences in deployed users' needs based on mission differences. Further, given the need for future iterations of the toolset to support rapid integration with various PORs, likely drawing upon a wide range of data formats and ingest requirements, we developed CultureMap based on three key systems design considerations, including the need to:

- Create an Ozone Widget Framework (OWF)-based/web-based implementation available as analytics services, Ozone widgets, or a stand-alone, integrated application, so that CultureMap could act as a framework that can be tailored to user roles/needs, while at the same time supporting the ability to enable efficient sharing and dissemination of intelligence products derived via those widgets, and
- Design a computational Service Oriented Architecture (SOA) that is compatible with both the developmental testbed as it matures and to support ultimate integration with the Distributed Common Ground System (DCGS) so that CultureMap could be deployed to users based on their specific mission and usage needs.
- Model, ingest, and store information in a representation sufficiently flexible and expressive to capture a wide range of data types from multiple sources.

The architecture ultimately created for the CultureMap system supports interoperability with common PORs, such as the Distributed Common Ground System (DCGS), through the combination of a flexible data model developed using an extensible ontology, the Government Open Source Software (GOSS) OWF, and a modular Service Oriented Architecture (SOA).

<u>Enhancements to CultureMap to Support Robust Interoperability</u>

To support a level of interoperability sufficiently robust enough to operate across a range of data types and ingest sources (see below), we needed to leverage these concepts above to make three primary enhancements to CultureMap.

1. Develop a data ingest pipeline that was capability of automatically processing a range of data-sources without requiring human (i.e., analyst) intervention. This pipeline would be required to condition the data as part of the ingest process which would include aggregation (for use in displaying aggregated data within the CultureMap dashboard) as well as normalization/filtering (in cases of spurious data). Additionally, this pipeline process would need to include the ability to periodically update the data based on revisions/updates to the original data sources (such as periodic updates to situational data sources that typically are only updated on a 6 month to 1 year cycle).
2. Develop a data enrichment pipeline that was able to classify ingested data against CultureMap's atmospherics categories. This would enable CultureMap to include other complementary analytics to augment natively available analytics (e.g., CultureMap's sentiment analysis). In particular, in coordination with ONR sponsorship, we focued on ingest data from the Lockheed Martin Integrated Crisis Early-Warning System (ICEWS) as the use-case for this enrichment pipeline.
3. Migrate CultureMap to be compatible with the Naval Tactical Cloud (NTC) to ensure compatibility with major relevant Programs of Record (POR).

The concept overview of the CultureMap enhancements to support these three areas is depicted in Figure 35 below, followed by short write-ups to describe each in detail.

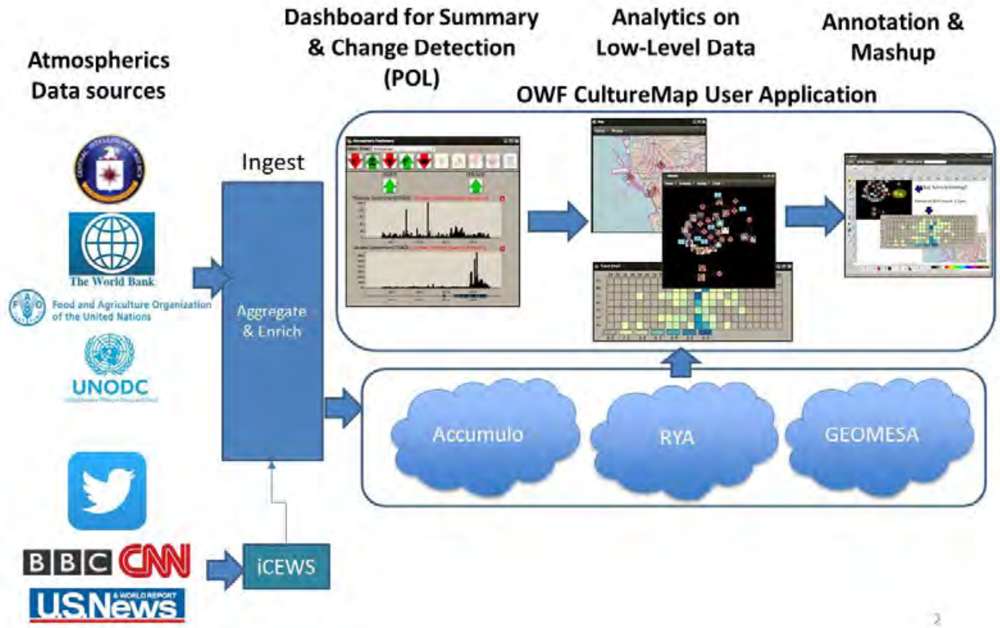

Figure 35. CultureMap Data Integration and Conditioning Pipeline

<u>Enhanced Data Ingest Pipeline</u>

The CultureMap Atmospherics pipeline starts with collection of Twitter posts using the standard Twitter Streaming APIs. Posts are collected using the Twitter API keyword filters that stream all Twitter posts containing keywords provided by an end-user. Each post and its descriptive data along with data describing the poster's Twitter account are saved as it is collected. The Twitter post collector is written in Java using the open source Twitter4j classes (twitter4j.org) to control interaction with the Twitter streaming services. All data is stored within a MySQL database. A web based GUI (see Figure below 36) provides control functions for the collection process and allows CHI Systems's analysts to review data and to assign posts to natural language training datasets. Currently there are two implementations of the Twitter post collector. The current production collector is based on the Play Framework (www.playframework.com) that provides a runtime environment and web server that hosts the GUI. An enhanced version simplifies maintenance of ingest and is written as a Linux system service and uses the standard Apache2 web server to host the GUI. The capability to automatically run natural language processing on Tweets as they come in was added as well.

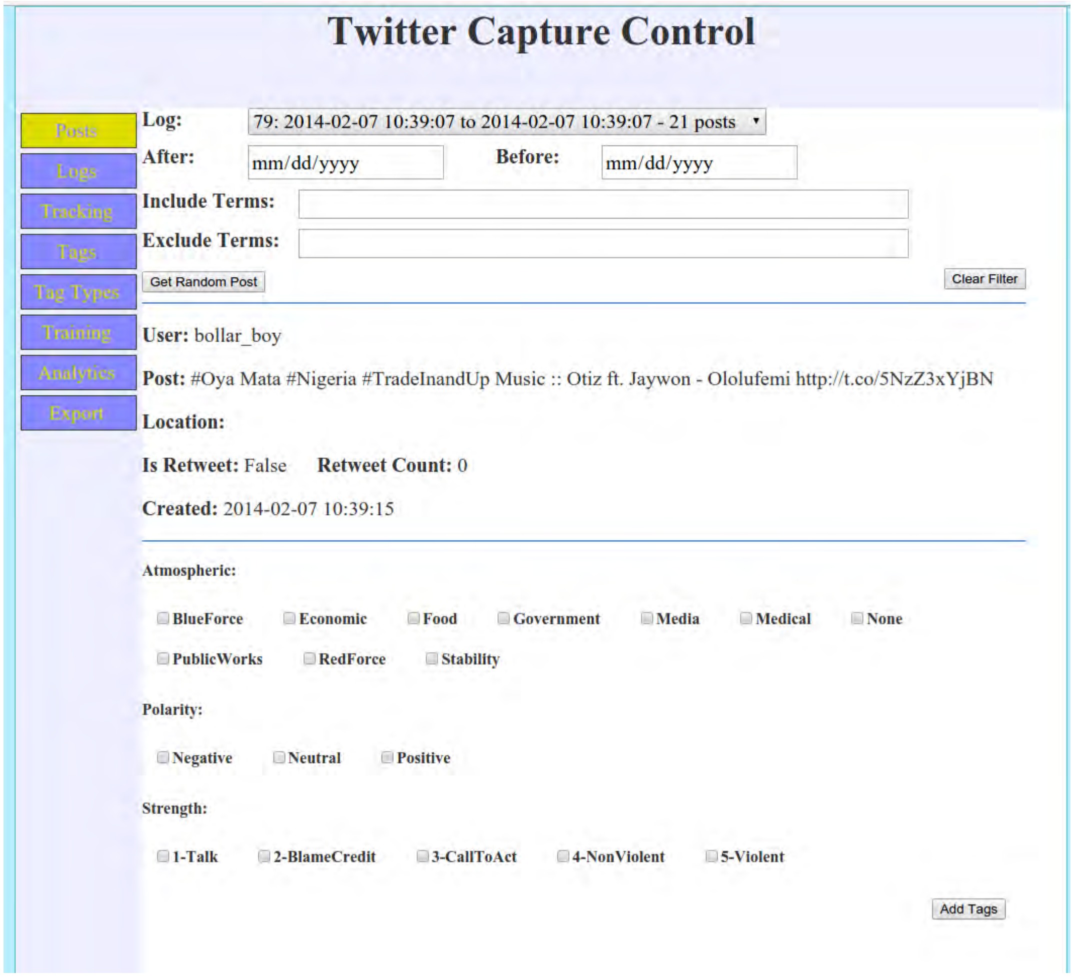

Figure 36. CultureMap Pipeline Tool for Twitter Capture

Training sets for sentiment analysis and topic recognition (see Task 13 section *CultureMap Atmospherics Classifier Development/Refinement*) can quickly be assembled using the Twitter Collector's web based GUI. Each post can be assigned to an atmospheric category, labeled with a polarity (positive, negative, neutral) and a strength of sentiment (1 through 5). Once a sufficiently large sample was tagged, the posts and their tags can be exported from the database through a Linux shelf script, thus automating the complex procedure. Once the topics and sources for the situation atmospheric data are determined, a standalone data collection application is applied (see Figure 37). The application was written in Python and uses the wxPython GUI extension to ensure that it can be easily updated. Because many of the sources on our datasets change their file formats on a regular basis, Python's rapid development cycle allows us to react quickly to these changes. This utility allows for the entire Situational Atmospherics dataset to be downloaded and preprocessed in under ten minutes. Although the tool requires some human interaction to download some of the datasets through web pages, it contains filters that allow the user to collect only the countries and years that they are interested in. The utility also has the ability to upload the data directly to development versions of the CultureMap database.

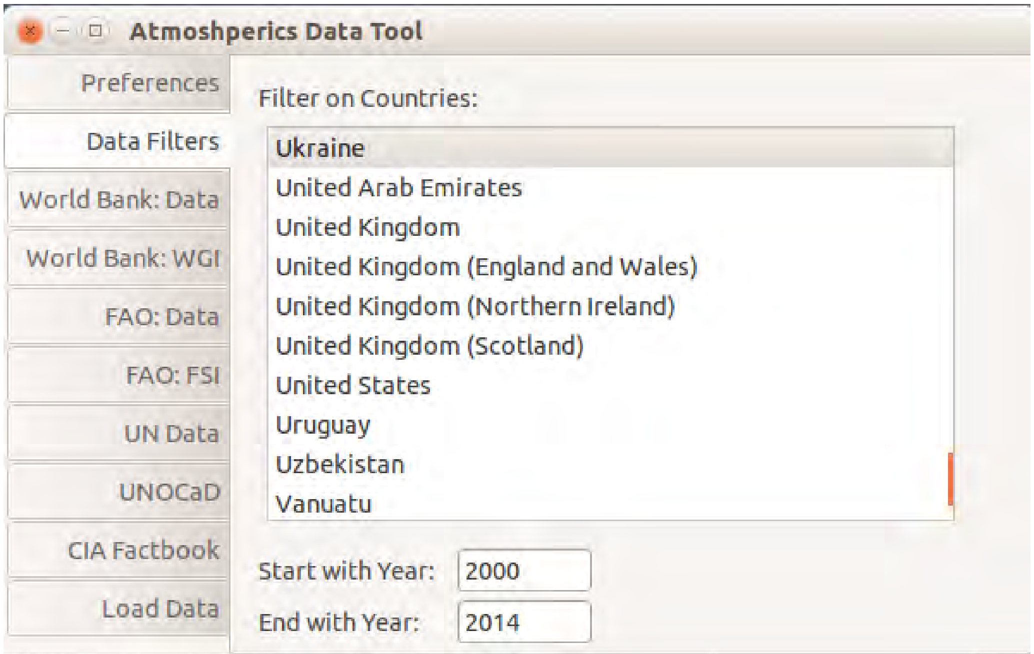

Figure 37. CultureMap Pipeline Tool for Situational Data Ingest

Data Enrichment Pipeline

As a complement to the native CultureMap sentiment analysis described above (Task 13), we evaluated the utility of ingesting and enriching Lockheed Martin's (LM's) Integrated Crisis Early-Warning System (ICEWS) data, as a means to augment our sentiment analytics capabilities. We developed a data conditioning pipeline that was able to ingest data from ICEWS, including both sentiment data (iSENT) and news reports (iTRACE), and enrich this data by automatically mapping it to the CultureMap atmospheric categories. ICEWS mappings ultimately included the category-driven assignment of LM news event types to atmospheric categories, the table-driven assignment of actors in the news to actor categories (e.g., high-level groups such as "Islamists"), and the use of an automatic classifier to assign LM sentiment-processed social media instances to atmospheric categories.

Early evaluation results showed that with reference to domain-independent utility and utility in IPB context, W-ICEWS was a good candidates for integration with the CultureMap application. All available information also indicated that these ICEWS constituted the most mature HSCB modeling software yet developed, a necessary condition for inclusion within CultureMap. In discussions with the ONR client it was decided to focus on incorporating W-ICEWS in the CultureMap application. Major factors in this decision were the relative scarcity of datasets with the kind of entity-link information required for network analyses and a more immediate interest in leveraging the kind of massive open source datasets that are basic to the W-ICEWS approach. Although later CultureMap development discussed throughout this report focuses on integrating W-ICEWS capabilities within the larger CultureMap system, CultureMap necessarily must support user access to the wide range of data types and visual analytic tools needed to leverage HSCB results in the performance of the larger IPB task context.

The inclusion of the ICEWS data streams enabled us to both (a) enhance CultureMap architecture by generalizing the types of data that could be ingested in order to accommodate integrating future data feeds and (b) provide of proof-of-concept of this widened data feed pipeline through ingest of iSENT sentiment analytics against social media (Facebook/Twitter) as well as iTRACE news events sourced through Factiva (which includes dozens of open-source news outlet feeds such as The Wall Street Journal, Dow Jones Newswire etc).

Migration to Support Naval Tactical Cloud (NTC)

In addition to the inclusion of these data sources, we migrated CultureMap to support integration within the Naval Tactical Cloud (NTC) in order to provide a robust big-data analytic processing capability. As shown in Figure 38 above, the CultureMap system currently includes support for the Naval Tactical Cloud (NTC). On the presentation side of its architecture, CultureMap already utilized the Ozone Widget Framework (OWF) platform for extensibility and compatibility with major PORs. To accomplish the NTC migration on the data side of CultureMap's architecture, the CultureMap software was modified to connect and draw data from an Apache Accumulo cloud store instead of the original OpenAnzo store (http://accumulo.apache.org/). Accumulo, in combination with Hadoop and Zookeeper, provides CultureMap with the ability to process, analyze, and visualize extremely large data sets in parallel. Over top of Accumulo, two additional indexing technologies were employed to leverage the nature of the available data. First, the GeoMesa indexing package (http://www.geomesa.org/) was used to permit the indexing and rapid searching of the data's spatiotemporal aspects. Second, the Rya indexing package was used to provide an RDF-like view to the underlying Accumulo data, thus mimicking the semantic structure previously provided by the OpenAnzo triple store. To achieve the highest performance with the given quantity of data, GeoMesa indexing was used for the ingestion and storage of raw instance information (e.g., iTrace, iSent) as well as for the automatic mapping processes that enrich this data with the corresponding atmospheric(s). The Rya RDF indexes, on the other hand, were used for the storage and retrieval of aggregated results of analyses, such as the atmospheric states and trends calculated for different portions of time and space.

Task 16 -Development of a plug-in architecture to extend CultureMap

The CultureMap plug-in architecture, developed to promote modularity and interoperability, can be largely divided into two parts, as shown in Figure 38 below: the Data Layer responsible for modeling, storing, and providing information, and the Presentation Layer responsible for providing the user with the means to discover, analyze, visualize, and communicate relevant portions of this information.

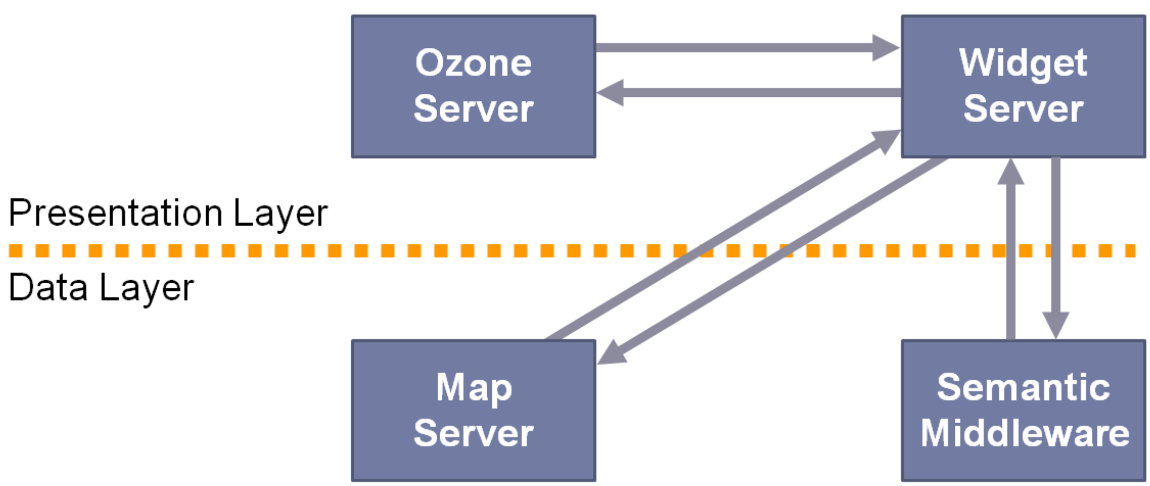

Figure 38. CultureMap Architecture Conceptual Overview

Data Layer

The data-facing side of CultureMap's architecture was built specifically with heterogeneous data sources in mind. A requirement for the CultureMap system was the ability to potentially connect to various HSCB sources, as well as other available data sources of complementary information. As each potential source utilizes its own distinct format or schema, a method for modeling information was required that was flexible, extensible, and descriptive. For this reason, we employed the Resource Description Framework (RDF) for describing information with the CultureMap system. RDF was designed by the World Wide Web Consortium (W3C) to serve as an abstract model for describing data of any type (i.e., a "metadata model"), and it is capable of capturing the nature of information and concepts across a variety of domains. The RDF specification expresses all information in the form of statements, each statement asserting a relationship that exists among "resources". Each statement (or "triple") is comprised of a subject, a predicate, and an object, where the subject denotes the resource in question (i.e., the source of the relationship), the predicate is a resource denoting the type of the relationship, and the object is a resource denoting the target of the relationship. As all resources (subjects, predicates, and objects) are represented by unique identifiers, each may be the subject of other RDF statements describing different aspects of the information, and the aspects of information may relate to one another. The inherent abstractness and interconnectedness of these statements makes RDF the ideal formulism for modeling heterogeneous HSCB and related data.

To store and transport RDF triples, we have integrated CultureMap with the OpenAnzo semantic middleware platform (http://www.openanzo.org). OpenAnzo was originally developed under IBM's Semantic Layered Research Platform (SLRP) and provides for distributed clients, offline processing, versioning, access controls, transactions, and real-time notification via a publish-subscribe mechanism. By leveraging OpenAnzo and the RDF formalism, we were able to externalize and thereby decouple the data model driving the CultureMap system from the CultureMap software itself. RDF ontologies were developed using Stanford's Protégé tool (http://protege.stanford.edu) to describe HSCB and sample tactical data. These ontologies were then able to be imported into OpenAnzo and subsequently automatically reflected in elements of the CultureMap user interface (e.g., data type options for search criteria). Additionally, the types of HSCB information, as well as their particular details (i.e., attributes), were able to be iteratively refined during the course of development without necessitating constant software changes. More recent versions of CultureMap were migrated from the OpenAnzo store to the Accumulo cloud store to ensure compatibility with the Navy Tactical Cloud (NTC).

Presentation Layer

The user-facing side of CultureMap's architecture was built upon the Ozone Widget Framework (OWF) and Synapse data interoperability libraries (http://www.ozoneplatform.org). An OWF foundation provides CultureMap with maximal compatibility with variants of the Distributed Common Ground System (DCGS), allowing other DCGS OWF components to use and embed one or more CultureMap widgets within larger applications via the Ozone market place. Data interoperability via Synapse permits tight coupling and communication between widgets within the larger CultureMap application. The OWF portion of CultureMap is composed of two Apache web servers. The first server consists of the base OWF version 7 software customized with CultureMap-specific configurations containing specialized functionality to provide easy access to important analysis and visualization capabilities. The second server, the OWF Widget Server, hosts the collection of OWF widgets that have been designed and developed for the CultureMap system. All widgets developed for CultureMap were designed to allow for easy integration into any system utilizing OWF. To this end, CultureMap widgets are written in JavaScript and leverage the d3.js library to create data-driven visualizations (http://d3js.org). They adhere to the principle of responsive web design, aimed at providing an optimal viewing experience across different devices. Their presentation logic is decoupled from the data layer allowing widgets to hook into a variety of data sources including Synapse. Widgets from the original, Grails-based CultureMap system have been recreated as Ozone widgets, and new, HSCB-tailored widgets have been designed and implemented. See *Appendix B CultureMap System User Documentation* for a detailed overview of the widget-based analytics. The CultureMap plug-in architecture described above enables developers to create OWF-based widgets that can be readily embedded within the CultureMap application, thus promoting a more open, extensible architecture.

Task 17 – Visual analytics research in Human Social Cultural and Behavioral (HSCB) Science

Visual Analytics is "the science of analytical reasoning facilitated by interactive visual interfaces." (Thomas and Cook 2005) Put another way, visual analytics entail methods to determine how to put the atmospherics data together so that an analyst can use it in an efficient manner.

- Must merge access to cultural intelligence, HSCB modeling results, and tactical events into single suite of visualizations providing geographical and temporal context
- Must be possible to view a single data set through the lenses of various visualizations and readily move between them in order to allow analysts to integrate these multiple perspectives
- Rapid navigation along threads of interest through the data, moving between different visualizations and related data subsets of interest
- Drill down to understand and evaluate summary visualizations
- Need multiple views of data sets, with cross-view interaction (e.g., highlighting of same elements in multiple views), and the ability to move from aggregated data to individual data elements (e.g., tweets).

In the development of a visually oriented analysis system requiring user activities that involve moving across many displays, advanced human-computer interaction techniques are needed in order to support the user to reduce cognitive load and complexity. To meet this complex user-interface challenge, we leveraged a concept developed by Woods (1984) termed visual momentum. Woods describes visual momentum as the "…observer's ability to extract task-relevant information." (Woods & Watts 1997). More specifically, "…the amount of visual momentum supported by a display system is inversely proportional to the mental effort required to place a new display into the context of the total data base and the user's information needs. When visual momentum is high, there is an impetus or continuity across successive views that support the rapid comprehension of data following the transition to a new display" (Woods 1984). We have leveraged a number of techniques developed by Woods and colleagues to maximize visual momentum in order to reduce cognitive complexity of the user interface and workload of the user. Taken in aggregate, Figure 2 below depicts our user interface based on a hypothetical visual analysis.

The user interface requirements derived to meet the needs of Intelligence Analyst end-users, as well the design principles used to guide the design of the user interface constructs developed around these techniques, are both briefly described below.

Principles Leveraged in the CultureMap Design

Woods and Watts (1997) describe a number of design techniques to maximize visual momentum, of which a sub-set was included within our design. The design therefore includes specific capabilities to support interactions with the user interface based on these design techniques, namely: (1) "longshot" displays; (2) related/parallel views; (3) center surround; (4) cues to status; and (5) conceptual spaces, all briefly explained below.

(1) Longshot displays allow a user to see "the big picture" or overall status of the work-context (e.g., battlespace) without having to view every detail shown at one time. Where possible, information will be put in context in a meaningful manner given the informational needs of the observer, and in a form that helps guide the user's attention to that which deserves a more immediate response. From such a display the user is able to pursue more detail in a natural manner from the overview, and it is possible, where appropriate, to reorganize the information to efficiently provide alternate views that reveal further facts or relationships about the data shown. We integrated four longshot characteristics described by Woods and Watts (1997) into our design, including ensuring that data is distilled and abstracted, conveys change/sequence information, and conveys information relevant to the user's context.

(2) Related views enable users to view information with intrinsic relationships and to do so in parallel. While a simple concept, the idea of presenting related information in parallel is an important one in user interface design. It may be important, for instance, to show overview (i.e., longshot) information with the related detailed information to help put the detail in perspective. Other relationships captured by showing statistical charts in parallel (e.g., number of events over time in parallel with geographic display of event locations) or a table of significant events in parallel with data that represents effects they may have caused are also important.

(3) Center surround draws upon concepts related to how human focal attention and vision supports the process of knowing where to look when. Within this set of concepts, design questions arise as to how to encapsulate, aggregate, and disaggregate information to highlight relationships within data relative to how that information is salient for the user depending on context. When designers effectively use center surround, it helps the user see overall relationships and where to focus further attention. One way to focus and obtain more information is to 'zoom', where more information is obtained about a subset of the data by changing the range of interest on a scalar metric. For instance, a user can change the date/time range or grid coordinates range within a search/filter component. Looking at the map display of events for a selected date range the user could notice a large concentration within that narrow time-frame within a close proximity of a specific landmark (e.g., mosque). The user could therefore zoom in on that part of the city and examine specific clusters of IED events near the mosque.

(4) Cues to status enable users to quickly 'size up' status or activities within the task space or to quickly understand what has changed, and the recency of that change, within a data-space. In particular, longshot displays benefit from well-designed cues to status as they should include a distillation of the most salient aspects of interest to the user, include

abstracts of the data beyond simple drill-down, and enable users to maintain their workflow with limited interruptions.

Task 18 – AOR Book and work product development

To support our ultimate vision for a flexible application environment that can provide intelligence analysts with tools that support the analysis, visualization, reification, and dissemination of cultural and social information, we used a widget-based, services-oriented development approach as described above. The toolset supports shared battlespace understanding, as it is architected and designed around the recognition that sensemaking in a distributed environment relies upon a mix of individuals, each possessing unique knowledge and incremental insights in an area of responsibility based on cultural and social information requirements. The CultureMap application provides a frame of reference for understanding the Area of Responsibility (AOR) in cultural intelligence terms and allows for all levels of command to have situational awareness of the relevant Military Cultural Factors (MFCs) with respect to red and blue force activity. But, to make maximal use of CultureMap's capabilities requires both the ability to store intermediate and end-state intelligence products generated using CultureMap analytics as well as the ability to share/collaborate on those intelligence products.

To that end, the system was engineered to support collaboration – based on the concept of accommodating RFI workflows, whereby an RFI may start with a single user and require multiple additional consumers and producers to add to that RFI before it satisfies the intent of the originator of the initial RFI, as notionally depicted in Figure 39 below.

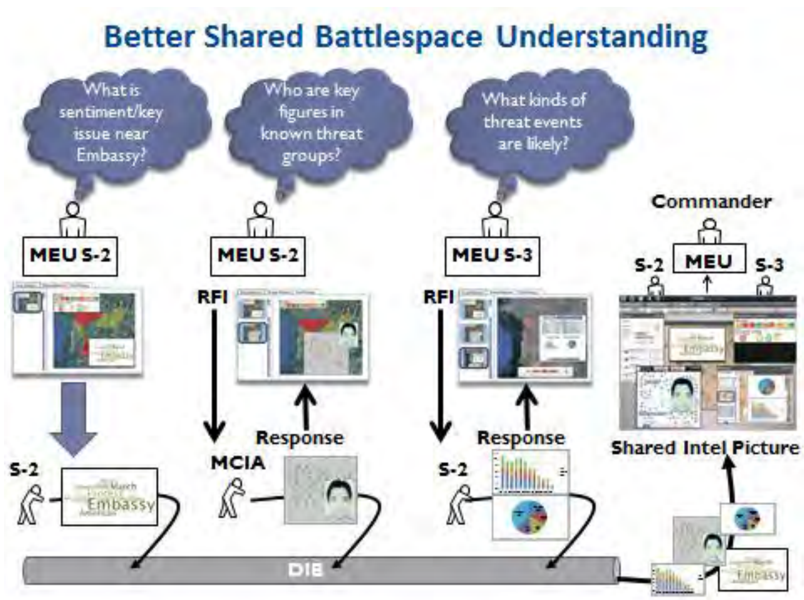

Figure 39. Example Producer-Consumer Workflows

The core conceptual and functional capability that collaboration within the system is premised upon is that of the "mashup." Mashups are collections of individual visual analytics that individual users can create within their own workspace that can be annotated, saved, modified, and curated over time, thus enabling the user to build and maintain an understanding of a region/culture of interest. More importantly, they are the basis upon which visual analytics can be shared between system users as they include the entire context used to generate each intermediate product as well as all enhancements by each user as it is shared and distributed over time. Thus, as RFI workflow products iteratively progress across team-members, users can leverage these saved mashups to restore underlying data sets for live processing, allowing resumption of ongoing analyses, and exploration of multiple hypotheses of their own. Mashups are based on four key design considerations:

- Support the analysis capture, collaboration, and dissemination of individual user analytics,
- Composed as collection of annotatable visualization snapshots,
- Restorable for live manipulation as original visualizations & underlying data set/criteria, and
- Support emergent RFI workflows.

The ability for any user to designate exactly which pieces of information are of interest, based on combining visualizations and information of interest, and creating reified versions of information directly provided by the system, is a powerful capability and is consistent with the Woods and Watts (1997) Conceptual Spaces concept. Since mashups can be annotated, saved, modified, and maintained over time, users can build and maintain an understanding of events, entities, and information of interest, as seen in the example in Figure 40.

Figure 40. CultureMap Mashup Concept

Task 19 – Development of a handheld CultureMap concept to accelerate data collection

The purpose of this task was to design a concept for a Cultural Intelligence (CI) mobile application variant of CultureMap to aid warfighters in counterinsurgency operations. CI and Human Terrain Mapping (HTM) have been identified as key factors in the ongoing battle to suppress and eliminate counterinsurgency (COIN) in the current military areas of operation (Marr, 2008). Understanding and identifying the enemy within an indigenous population requires that the warfighters have a variety of information at hand about the population. They need to know the people, customs, ethnicities, and leadership structures within the community. Additionally, information about the local economics, working conditions, utilities, and location of key community buildings such as mosques, schools, and markets all help the warfighters paint a better picture of the environment in which they are operating. All of this CI information aids warfighters in identifying anomalies and understanding the immediate context of COIN operations.

Lieutenant Colonel Marr, US Army, through his experiences in Operation Iraqi Freedom, has concluded that while CI and HTM greatly help the warfighters to foster a deeper understanding of their AOR and enable them to leverage the complex human relationships required in COIN operations, it is the *creation* and *gathering* of this information that is most important (Marr, 2008). The act of having a tangible presence in an AOR while observing and talking to the people and leaders of the villages/tribes enables the warfighters to experience the daily lives of the population and formulate their own assessments. While having a CI database in place for units entering an AOR is extremely important, it is of the utmost importance for the units to witness the population and establish their own relationships. CultureMap is an ideal tool for the gathering and storing of CI information, but it relies on data gathered from different sources. To better support Lt. Col. Marr's assertion that the "doing" offers great dividends, CHI Systems designed an Android-based mobile CI concept that would allow warfighters to use existing CI information and gather pertinent information, all while in the field. This solution, called CMAP Mobile represents an extension of the CultureMap concept to a small device form-factor to offer a number of unique features to directly aid the warfighter in COIN operations.

The CMAP Mobile application would focus on providing the warfighter with pertinent information about the areas in which he is currently operating. This would include an AOR Summary Rollup and an Augmented Reality view. The AOR Summary Rollup would display CI information about the current AOR including structured summaries of significant AOR characteristics, local ethnic and cultural background, and social network diagrams. This view would take advantage of the hardware GPS contained in the mobile device and automatically alert the user when he moves from one AOR to another, switching to the new AOR Summary Rollup. Some concept designs of this functionality are displayed below in Figure 41.

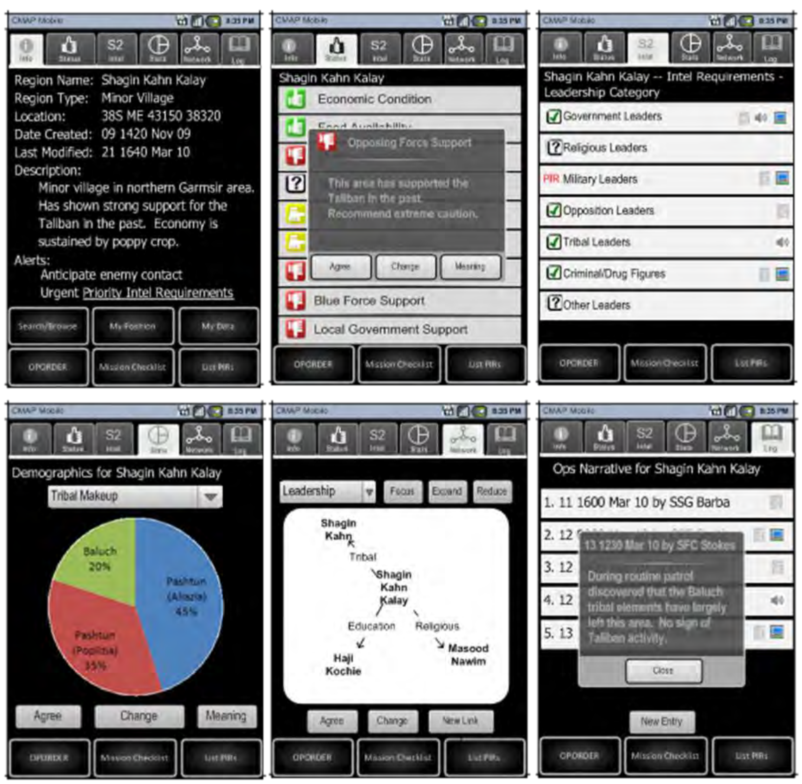

Figure 41: User Interface Concept for a CMAP Mobile application

Augmented Reality (AR) has been a much-researched topic over the last decade. AR seeks to present additional information to a user related to his current location or environment. Due to recent advances in mobile hardware, AR can finally be realized in a handheld device. For CMAP Mobile, an AR view of the warfighter's current location that overlays significant CI information and activities would be presented to the user. Figure 42 below displays a mockup of this design concept. For this view, we would utilize the mobile device touchscreen, camera, GPS and accelerometer. We would present the view from the camera and overlay icons representing the CI information related to event, people sightings, and other pertinent information. Clicking an icon would provide a short summary of the CI information in a pop-up window. The icons should be positioned on the screen based upon distance from the user's current location using the GPS unit. Additionally, a small, radar like screen would be presented in the upper left corner of the display to show the position of other CI events in the vicinity of the user based upon their current bearing from the user. The device's accelerometer would be used to determine when the user is changing direction (turning left or right). As the user turns, all of the icons should update their positions on the screen. This view would greatly enhance the warfighter's understanding of the actual area in which the CI events occurred.

Figure 42: Augmented Reality Concepts for CMAP Mobile

CMAP Mobile would also allow the warfighter on patrol to gather additional CI information. General information input would use the device's three main input techniques: on-screen keypad, microphone, and camera (both still and video). Any place within the application requiring a data input would allow the user to choose the input method that makes the most sense to them. The main types of information gathering in which CMAP Mobile would engage in are the gathering of Priority Information Requirements (PIRs) and data corroboration. PIRs are specific cultural or economic questions that need to be answered for a particular region, and in many cases are the factors that drive and influence atmospheric values. CMAP Mobile would allow warfighters to have these PIRs on hand when interacting with the local population and quickly store answers in a variety of formats.

CMAP Mobile would also provide opportunities for data corroboration. One of the most important and difficult jobs in intelligence is keeping data accurate and up-to-date. CMAP Mobile would help in this area by allowing warfighters to corroborate existing information with the information they gather and witness while on patrol. The warfighters would be able to agree with or modify existing information while they are in the field so that the CI information is as current as possible.

In order for CMAP Mobile to be realized, it must contain and be able to update the information stored in CultureMap. This would require that a Synchronization Service API be built into both CMAP Mobile and CultureMap. This API should include a set of interfaces to support data synchronization between CMAP Mobile and CultureMap. The API would be divided into two sections covering data export and import. For exporting, a geospatial search would provide a set of data to be pushed to the CMAP Mobile application and a data transform engine would transform the data from CultureMap into CMAP Mobile's optimized mobile data model. For importing, an algorithm would be developed to intelligently create / update information in CultureMap based on the data residing on the CMAP Mobile device.

CONCLUSIONS AND FUTURE WORK

As the military continues to transform to more net-centric operations and incorporates systems to support collaborative sensemaking for a distributed command, there will be an increasing need for tools to help users across all echelons to aggregate, interpret, and share resulting data and analytics. The framework and sample application that we have developed provide a flexible architecture that provides for the rapid development of visualization capabilities and graphical user interfaces that afford battlespace understanding using proven information visualization principles and techniques. Beyond the direct utility that the framework provides to prospective end-users, a number of lessons-learned have been garnered from a more general perspective regarding the development of sensemaking applications. These lessons learned can be applied to broader applications beyond our system, known as CultureMap, that involve complex visual analytic frameworks, including the need to:

- design towards a flexible infrastructure to facilitate the evaluation of new visual analytics technologies and approaches based on principled human factors guidelines;
- create and use a common standards-based widget framework that includes security and privacy infrastructure;
- use a component-based software development approach for visual analytics software to facilitate evaluation of research results in integrated prototypes and deployment of promising components in diverse operational environments; and
- create a community of practice and develop guidelines for best-practices to guide the use of the visual analytic framework so that they can be effectively integrated within operational systems.

We believe that providing cultural data analysis tools, as developed within the CultureMap framework, coupled with visualizations that afford easy interpretation of the key features of complex multifaceted data is a powerful approach. Future evolutions of CultureMap will focus on the expansion of the underlying RFI workflows, collaboration and sensemaking tools, and integration with other sentiment analysis tools and frameworks.

References

Chapman, R. J., Graham, J. M., Carley K. M., Rosoff A. & Paterson, R. (2005). Providing Insight into Command Post Operations through Shareable Contextualized Net-Centric Visualizations & Analysis. Human Interaction with Complex Systems 2005: Collaborative Sensemaking in Dynamic Organizations. Nov 17-18, 2005. Greenbelt, VA.

Clark, Robert M.. *Intelligence Analysis: A Target-Centric Approach*. 3rd ed. Washington, D.C: CQ Press, 2009. Print.

Eilbert, J., Carmody, D., Santarelli, T., Wischusen, D., & Donmoyer, J. (2002). Reasoning About Adversarial Intent in Asymmetric Situations. In Proceedings of American Association of Artificial Intelligence Fall Symposium Series: Intent Inference for Users, Teams, and Adversaries, North Falmouth, Massachusetts:AAAI.

Eilbert, J., Santarelli, T., Carmody, D. (2004) A New Framework for Cognitive and Perceptual Problems. In Proceedings of the ICCM 2004. Pittsburgh, PA 7/30-8/1/04

Endsley, M. R. (1995). Toward a theory of situation awareness in dynamic systems. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *37*(1), 32-64.

Endsley, M. R. (1997). The role of situation awareness in naturalistic decision making. *Naturalistic decision making (A 97-39376 10-53), Mahwah, NJ, Lawrence Erlbaum Associates, Inc., Publishers, 1997,*, 269-283.

Gallo, A., T. De Bie, and N. Cristianini. "MINI: Mining Informative Non-redundant Itemsets." *Proceedings of the 11th conference on Principles and Practice of Knowledge Discovery in Databases* 1 (2007). Print.

Geertz, C. (2003). Thick Description: Toward an Interpretive Theory of Culture, in Turning Points in Qualitative Research. Yvonna S. Lincoln and Norman K. Denzin eds., Altamira, New York.

Greenberg, T.L. (1993). The Handbook for Focus Group Research. Lexington, MA: Lexington Books.

Hastie, T. & Tibshirani, R. (1998). Classification by Pairwise Coupling. The Annals of Statistics 26 (1998), no. 2, 451--471. doi:10.1214/aos/1028144844. http://projecteuclid.org/euclid.aos/1028144844.

Heer, Jeffrey, Michael Bostock, and Vadim Ogievetsky. "A Tour through the Visualization Zoo - ACM Queue." ACMQ Site - ACM Queue. N.p., n.d. Web. 6 June 2010. <http://queue.acm.org/detail.cfm?id=1805128>.

Kahneman, D., Slovic, P., & Tversky, A. (Eds.). (1982). *Judgment under uncertainty: Heuristics and biases*. Cambridge University Press.

Kulak, D. & Guiney, E., Eds. (2000). Use Cases: Requirements in Context. ACM Press, New York.

Marine Corps Intelligence Activity (2008). C-GIRH Cultural generic information requirements handbook. Quantico, VA

Marr, Jack, John Cushing, Brandon Garner, and Richard Thompson. "Human terrain mapping: a critical first step to winning the COIN fight." Military Review 1 Mar. 2008: 18-24. Print.

Matzen, . McNamara, . Cole, . Bandlow, . Dornburg, and Bauer. Proposed working memory measures for evaluating information visualization tools. Position paper presented orally at the BELIV conference, 2010.

Murdock, G.P. (1938). *Outline of Cultural Materials*. New Haven, CT: Institute of Human Relations.

Nickerson, R. S. (1998). Confirmation bias: a ubiquitous phenomenon in many guises. *Review of General Psychology*, *2*(2), 175.
Nielsen, J. (1993). Usability engineering. Chestnut Hill, MA: AP Professional.
Norman, D.A. (1981). Steps Toward A Cognitive Engineering. Technical Report, Program in Cognitive Science, University of California at San Diego.
Punnoose, R., Crainiceanu, A., & Rapp, D. (2012). Rya: a scalable RDF triple store for the clouds In *Proceedings of the 1st International Workshop on Cloud Intelligence*.
Rand, W. (1971). Objective criteria for the evaluation of clustering methods. *Journal of the American Statistical Association* (American Statistical Association) 66 (336): 846–850. doi:10.2307/2284239. JSTOR 2284239.
Rasmussen, J. & Vicente, K. (1989). Coping with human errors through system design: Implications for ecological interface design. International Journal of Man-Machine Studies, 31, 517-534.
Read, S. J., Miller, L. C., Kostygina, A., Chopra, G., Christensen, J. L., Corsbie-Massay, C.,
Romesburg, H. (1984). *Cluster Analysis for Researchers*, Lifetime Learning Publications, Belmont, CA.
Thearling, Kurt. "An Introduction to Data Mining." Data Mining and Analytic Technologies (Kurt Thearling). N.p., n.d. Web. 11 June 2010. <http://www.thearling.com/text/dmwhite/dmwhite.htm>.
Thearling, Kurt. "Understanding Data Mining: It's All in the Interaction." Data Mining and Analytic Technologies (Kurt Thearling). Web. 11 June 2010. <http://www.thearling.com/text/dsstar/interaction.htm>.
Thomas, J.J. & Cook, K.A., eds. (2005) Illuminating the Path—the Research and Development Agenda for Visual Analytics, IEEE CS, 2005.
Tufte, Edward R.. Envisioning Information. New York: Graphics Press, 1990. Print.
Tukey, J.W. & Tukey, P.A. (1985). Computer graphics and exploratory data analysis: an introduction. In
Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, *185*(4157), 1124-1131.
Vicente, Kim. (1999). Cognitive work analysis. Mahwah, NJ: Lawrence Erlbaum.
W.S. Cleveland (Ed.), The Collected Works of John W. Tukey: Graphics 1965-1985, Volume V (pp. 419-431). Chapman and Hall/CRC.
Waldron, S.M., Duggan, G.B., Patrick, J., Banbury, S., & Howes, A. (2005). Adaptive information fusion for situation awareness in the cockpit. Proceedings of the Human Factors and Ergonomics 49th Annual Meeting. Santa Monica, CA: HFES.
Weiss, S., and N. Indurkhya. "Decision-Rule Solutions for Data Mining with Missing Values." *Proceedings of SBIA/IBERAMIA* 1 (2000). Print.
Wong, P.C. & Thomas, J. (2004). Visual Analytics, *IEEE Computer Graphics and Applications*, Volume 24, Issue 5, Sept.-Oct. 2004 pgs. 20–21.
Woods, D. D. & Watts, J. C. (1997). How not to have to navigate through too many displays. In M. Helander, T. K. Landauer, & P. Prabhu (Eds.), *Handbook of human–computer cooperation* (2nd rev. ed., pp. 617–650). New York: Elsevier.
Woods, D. D. (1984). Visual momentum: A concept to improve the cognitive coupling of person and computer. *International Journal of Man–Machine Studies, 21,* 229–244.

Appendix A: CultureMap Ontology Definition


```xml
<?xml version="1.0"?>
<!DOCTYPE rdf:RDF [
	<!ENTITY time "http://www.w3.org/2006/time#" >
	<!ENTITY owl "http://www.w3.org/2002/07/owl#" >
	<!ENTITY xsd "http://www.w3.org/2001/XMLSchema#" >
	<!ENTITY rdfs "http://www.w3.org/2000/01/rdf-schema#" >
	<!ENTITY rdf "http://www.w3.org/1999/02/22-rdf-syntax-ns#" >
]>
<rdf:RDF xmlns="http://www.chisystems.com/culturemap#"
	 xml:base="http://www.chisystems.com/culturemap"
	 xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
	 xmlns:time="http://www.w3.org/2006/time#"
	 xmlns:owl="http://www.w3.org/2002/07/owl#"
	 xmlns:xsd="http://www.w3.org/2001/XMLSchema#"
	 xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
	<owl:Ontology rdf:about="http://www.chisystems.com/culturemap">
		<owl:imports rdf:resource="http://www.opengis.net/gml/"/>
		<owl:imports rdf:resource="http://www.w3.org/2006/time"/>
	</owl:Ontology>
	<!--
	///////////////////////////////////////////////////////////////////////////////////////
	//
	// Object Properties
	//
	///////////////////////////////////////////////////////////////////////////////////////
	 -->
	<!-- http://www.chisystems.com/culturemap#atmospheric -->
	<owl:ObjectProperty rdf:about="http://www.chisystems.com/culturemap#atmospheric">
		<rdfs:range rdf:resource="http://www.chisystems.com/culturemap#AtmosphericType"/>
		<rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
		<rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapObjectProperty"/>
		<owl:inverseOf rdf:resource="http://www.chisystems.com/culturemap#indicator"/>
	</owl:ObjectProperty>
	<!-- http://www.chisystems.com/culturemap#atmosphericType -->
	<owl:ObjectProperty rdf:about="http://www.chisystems.com/culturemap#atmosphericType">
		<rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#Atmospheric"/>
		<rdfs:range rdf:resource="http://www.chisystems.com/culturemap#AtmosphericType"/>
		<rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapObjectProperty"/>
	</owl:ObjectProperty>
	<!-- http://www.chisystems.com/culturemap#cultureMapObjectProperty -->
	<owl:ObjectProperty rdf:about="http://www.chisystems.com/culturemap#cultureMapObjectProperty"/>
	<!-- http://www.chisystems.com/culturemap#dataSource -->
	<owl:ObjectProperty rdf:about="http://www.chisystems.com/culturemap#dataSource">
		<rdfs:range rdf:resource="http://www.chisystems.com/culturemap#DataSource"/>
		<rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
		<rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapObjectProperty"/>
	</owl:ObjectProperty>
	<!-- http://www.chisystems.com/culturemap#group -->
	<owl:ObjectProperty rdf:about="http://www.chisystems.com/culturemap#group">
		<rdfs:range rdf:resource="http://www.chisystems.com/culturemap#Group"/>
		<rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#GroupProvider"/>
		<rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapObjectProperty"/>
	</owl:ObjectProperty>
	<!-- http://www.chisystems.com/culturemap#indicator -->
	<owl:ObjectProperty rdf:about="http://www.chisystems.com/culturemap#indicator">
		<rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#AtmosphericType"/>
		<rdfs:range rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
		<rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapObjectProperty"/>
	</owl:ObjectProperty>
	<!-- http://www.chisystems.com/culturemap#indicatorType -->
	<owl:ObjectProperty rdf:about="http://www.chisystems.com/culturemap#indicatorType">
		<rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#Indicator"/>
		<rdfs:range rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
		<rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapObjectProperty"/>
	</owl:ObjectProperty>
	<!-- http://www.chisystems.com/culturemap#recency -->
	<owl:ObjectProperty rdf:about="http://www.chisystems.com/culturemap#recency">
		<rdfs:range rdf:resource="http://www.chisystems.com/culturemap#Recency"/>
```

```
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#TrendProvider"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapObjectProperty"/>
</owl:ObjectProperty>
<!-- http://www.chisystems.com/culturemap#region -->
<owl:ObjectProperty rdf:about="http://www.chisystems.com/culturemap#region">
        <rdfs:range rdf:resource="http://www.chisystems.com/culturemap#Region"/>
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#RegionProvider"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapObjectProperty"/>
</owl:ObjectProperty>
<!-- http://www.chisystems.com/culturemap#relation -->
<owl:ObjectProperty rdf:about="http://www.chisystems.com/culturemap#relation">
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#CultureMapEntity"/>
        <rdfs:range rdf:resource="http://www.chisystems.com/culturemap#Relation"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapObjectProperty"/>
</owl:ObjectProperty>
<!-- http://www.chisystems.com/culturemap#salientConcern -->
<owl:ObjectProperty rdf:about="http://www.chisystems.com/culturemap#salientConcern">
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#Atmospheric"/>
        <rdfs:range rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapObjectProperty"/>
</owl:ObjectProperty>
<!-- http://www.chisystems.com/culturemap#source -->
<owl:ObjectProperty rdf:about="http://www.chisystems.com/culturemap#source">
        <rdfs:range rdf:resource="http://www.chisystems.com/culturemap#CultureMapEntity"/>
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#Relation"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapObjectProperty"/>
</owl:ObjectProperty>
<!-- http://www.chisystems.com/culturemap#sourceGroup -->
<owl:ObjectProperty rdf:about="http://www.chisystems.com/culturemap#sourceGroup">
        <rdfs:range rdf:resource="http://www.chisystems.com/culturemap#Group"/>
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#NewsReport"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapObjectProperty"/>
</owl:ObjectProperty>
<!-- http://www.chisystems.com/culturemap#target -->
<owl:ObjectProperty rdf:about="http://www.chisystems.com/culturemap#target">
        <rdfs:range rdf:resource="http://www.chisystems.com/culturemap#CultureMapEntity"/>
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#Relation"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapObjectProperty"/>
</owl:ObjectProperty>
<!-- http://www.chisystems.com/culturemap#targetGroup -->
<owl:ObjectProperty rdf:about="http://www.chisystems.com/culturemap#targetGroup">
        <rdfs:range rdf:resource="http://www.chisystems.com/culturemap#Group"/>
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#NewsReport"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapObjectProperty"/>
</owl:ObjectProperty>
<!-- http://www.chisystems.com/culturemap#temporalGranularity -->
<owl:ObjectProperty rdf:about="http://www.chisystems.com/culturemap#temporalGranularity">
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#Aggregate"/>
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
        <rdfs:range rdf:resource="http://www.chisystems.com/culturemap#TemporalGranularity"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapObjectProperty"/>
</owl:ObjectProperty>
<!-- http://www.chisystems.com/culturemap#trend -->
<owl:ObjectProperty rdf:about="http://www.chisystems.com/culturemap#trend">
        <rdfs:range rdf:resource="http://www.chisystems.com/culturemap#Trend"/>
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#TrendProvider"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapObjectProperty"/>
</owl:ObjectProperty>
<!-- http://www.chisystems.com/culturemap#utility -->
<owl:ObjectProperty rdf:about="http://www.chisystems.com/culturemap#utility">
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
        <rdfs:range rdf:resource="http://www.chisystems.com/culturemap#Utility"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapObjectProperty"/>
</owl:ObjectProperty>
<!--
///////////////////////////////////////////////////////////////////////////////////////
//
// Data properties
//
///////////////////////////////////////////////////////////////////////////////////////
```

```
-->
<!-- http://www.chisystems.com/culturemap#adequateThreshold -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#adequateThreshold">
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
        <rdfs:range rdf:resource="&xsd;double"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#confidence -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#confidence">
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#Estimate"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
        <rdfs:range rdf:resource="&xsd;double"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#confidenceList -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#confidenceList">
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#Estimate"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
        <rdfs:range rdf:resource="&xsd;string"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#countryCode -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#countryCode">
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#Region"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
        <rdfs:range rdf:resource="&xsd;string"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#cultureMapDataProperty -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
<!-- http://www.chisystems.com/culturemap#date -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#date">
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
        <rdfs:range rdf:resource="&xsd;dateTime"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#description -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#description">
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#NamedEntity"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
        <rdfs:range rdf:resource="&xsd;string"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#eventID -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#eventID">
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#NewsReport"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
        <rdfs:range rdf:resource="&xsd;string"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#eventType -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#eventType">
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#NewsReport"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
        <rdfs:range rdf:resource="&xsd;string"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#goodThreshold -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#goodThreshold">
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
        <rdfs:range rdf:resource="&xsd;double"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#headline -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#headline">
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#NewsReport"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
        <rdfs:range rdf:resource="&xsd;string"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#icon -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#icon">
        <rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#IconProvider"/>
        <rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
        <rdfs:range rdf:resource="&xsd;string"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#intesity -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#intesity">
```

```
		<rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
		<rdfs:range rdf:resource="&xsd;double"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#metricValue -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#metricValue">
		<rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#Metric"/>
		<rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
		<rdfs:range rdf:resource="&xsd;double"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#name -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#name">
		<rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#NamedEntity"/>
		<rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
		<rdfs:range rdf:resource="&xsd;string"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#score -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#score">
		<rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#NewsReport"/>
		<rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
		<rdfs:range rdf:resource="&xsd;double"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#status -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#status">
		<rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
		<rdfs:range rdf:resource="&xsd;string"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#text -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#text">
		<rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#NamedEntity"/>
		<rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
		<rdfs:range rdf:resource="&xsd;string"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#thresholdSource -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#thresholdSource">
		<rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
		<rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
		<rdfs:range rdf:resource="&xsd;string"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#totalInstances -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#totalInstances">
		<rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#Aggregate"/>
		<rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
		<rdfs:range rdf:resource="&xsd;int"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#units -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#units">
		<rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
		<rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
		<rdfs:range rdf:resource="&xsd;string"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#uri -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#uri">
		<rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#UriProvider"/>
		<rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
		<rdfs:range rdf:resource="&xsd;anyURI"/>
</owl:DatatypeProperty>
<!-- http://www.chisystems.com/culturemap#weight -->
<owl:DatatypeProperty rdf:about="http://www.chisystems.com/culturemap#weight">
		<rdfs:domain rdf:resource="http://www.chisystems.com/culturemap#Relation"/>
		<rdfs:subPropertyOf rdf:resource="http://www.chisystems.com/culturemap#cultureMapDataProperty"/>
		<rdfs:range rdf:resource="&xsd;double"/>
</owl:DatatypeProperty>
<!--
///////////////////////////////////////////////////////////////////////////////////////
//
// Classes
//
///////////////////////////////////////////////////////////////////////////////////////
 -->
<!-- http://www.chisystems.com/culturemap#Aggregate -->
```

```xml
<owl:Class rdf:about="http://www.chisystems.com/culturemap#Aggregate">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#MetricEstimate"/>
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#TrendProvider"/>
	<rdfs:subClassOf rdf:resource="&time;TemporalEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#Atmospheric -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#Atmospheric">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#Aggregate"/>
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#MetricEstimate"/>
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#RegionProvider"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#AtmosphericType -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#AtmosphericType">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#NamedEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#BlueForceIndicatorType -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#BlueForceIndicatorType">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#CultureMapEntity -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#CultureMapEntity"/>
<!-- http://www.chisystems.com/culturemap#DataSource -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#DataSource">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#NamedEntity"/>
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#UriProvider"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#EconomyIndicatorType -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#EconomyIndicatorType">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#Estimate -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#Estimate">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#CultureMapEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#FoodIndicatorType -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#FoodIndicatorType">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#ForeignGroup -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#ForeignGroup">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#Group"/>
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#GovernmentGroup -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#GovernmentGroup">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#Group"/>
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#GovernmentIndicatorType -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#GovernmentIndicatorType">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#Group -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#Group">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#NamedEntity"/>
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#RegionProvider"/>
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
	<rdfs:subClassOf rdf:resource="&time;TemporalEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#GroupProvider -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#GroupProvider">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#CultureMapEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#IconProvider -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#IconProvider">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#CultureMapEntity"/>
```

```
</owl:Class>
<!-- http://www.chisystems.com/culturemap#Indicator -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#Indicator">
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#MetricEstimate"/>
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#RegionProvider"/>
		<rdfs:subClassOf rdf:resource="http://www.opengis.net/gml/Point"/>
		<rdfs:subClassOf rdf:resource="&time;TemporalEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#IndicatorAggregate -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#IndicatorAggregate">
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#Aggregate"/>
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#Indicator"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#IndicatorSource -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#IndicatorSource">
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#DataSource"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#IndicatorTrend -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#IndicatorTrend">
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#Aggregate"/>
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#Indicator"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#IndicatorType -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#IndicatorType">
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#NamedEntity"/>
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#MediaIndicatorType -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#MediaIndicatorType">
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#MedicalIndicatorType -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#MedicalIndicatorType">
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#Metric -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#Metric">
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#CultureMapEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#MetricEstimate -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#MetricEstimate">
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#Estimate"/>
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#Metric"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#NamedEntity -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#NamedEntity">
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#CultureMapEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#NewsReport -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#NewsReport">
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#GroupProvider"/>
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#Indicator"/>
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#NamedEntity"/>
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#OppositionGroup -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#OppositionGroup">
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#Group"/>
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#Pedigree -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#Pedigree">
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#CultureMapEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#PedigreedEntity -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#PedigreedEntity">
		<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#CultureMapEntity"/>
</owl:Class>
```

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<!-- http://www.chisystems.com/culturemap#PrimaryIndicatorType -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#PrimaryIndicatorType">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#PublicWorksIndicatorType -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#PublicWorksIndicatorType">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#Recency -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#Recency">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#CultureMapEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#RedForceIndicatorType -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#RedForceIndicatorType">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#Region -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#Region">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#GroupProvider"/>
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#NamedEntity"/>
	<rdfs:subClassOf rdf:resource="http://www.opengis.net/gml/Polygon"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#RegionProvider -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#RegionProvider">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#CultureMapEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#Relation -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#Relation">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#NamedEntity"/>
	<rdfs:subClassOf rdf:resource="&time;TemporalEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#SecondaryIndicatorType -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#SecondaryIndicatorType">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#SocialMedia -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#SocialMedia">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#GroupProvider"/>
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#Indicator"/>
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#NamedEntity"/>
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#StabilityIndicatorType -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#StabilityIndicatorType">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#IndicatorType"/>
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#TemporalGranularity -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#TemporalGranularity">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#CultureMapEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#Trend -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#Trend">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#CultureMapEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#TrendProvider -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#TrendProvider">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#CultureMapEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#UriProvider -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#UriProvider">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#CultureMapEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#User -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#User">
	<rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#NamedEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#Utility -->
```

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<owl:Class rdf:about="http://www.chisystems.com/culturemap#Utility">
    <rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#CultureMapEntity"/>
</owl:Class>
<!-- http://www.chisystems.com/culturemap#VisibleEntity -->
<owl:Class rdf:about="http://www.chisystems.com/culturemap#VisibleEntity">
    <rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#CultureMapEntity"/>
    <rdfs:subClassOf rdf:resource="http://www.chisystems.com/culturemap#IconProvider"/>
</owl:Class>
<!--
///////////////////////////////////////////////////////////////////////////////////////
//
// Individuals
//
///////////////////////////////////////////////////////////////////////////////////////
 -->
<!-- http://www.chisystems.com/culturemap#AverageDietaryEnergySupplyAdequacy -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#AverageDietaryEnergySupplyAdequacy">
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#FoodIndicatorType"/>
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#PrimaryIndicatorType"/>
    <adequateThreshold rdf:datatype="&xsd;double">100.0</adequateThreshold>
    <goodThreshold rdf:datatype="&xsd;double">130.0</goodThreshold>
    <name rdf:datatype="&xsd;string">Diet Energy</name>
    <thresholdSource rdf:datatype="&xsd;string">FAO</thresholdSource>
    <units rdf:datatype="&xsd;string">Percentage</units>
    <description rdf:datatype="&xsd;string">The food available for human consumption It reflects both food consumed and food wasted (United Nations FAO data)</description>
    <atmospheric rdf:resource="http://www.chisystems.com/culturemap#Food"/>
    <utility rdf:resource="http://www.chisystems.com/culturemap#Positive"/>
    <temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#BirthRateCrude -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#BirthRateCrude">
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#MedicalIndicatorType"/>
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#SecondaryIndicatorType"/>
    <name rdf:datatype="&xsd;string">Birth Rate</name>
    <description rdf:datatype="&xsd;string">The number of births per 1,000 people (World Bank data).</description>
    <units rdf:datatype="&xsd;string">per 1,000 people</units>
    <atmospheric rdf:resource="http://www.chisystems.com/culturemap#Medical"/>
    <region rdf:resource="http://www.chisystems.com/culturemap#Philippines"/>
    <utility rdf:resource="http://www.chisystems.com/culturemap#Positive"/>
    <temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#BlueForce -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#BlueForce">
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#AtmosphericType"/>
    <name rdf:datatype="&xsd;string">Blue Force Support</name>
    <indicator rdf:resource="http://www.chisystems.com/culturemap#BlueForceISENT"/>
    <indicator rdf:resource="http://www.chisystems.com/culturemap#BlueForceITRACE"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#BlueForceISENT -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#BlueForceISENT">
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#BlueForceIndicatorType"/>
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#PrimaryIndicatorType"/>
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
    <name rdf:datatype="&xsd;string">Sentiment</name>
    <description rdf:datatype="&xsd;string">Sentiments (positive and negative) expressed toward Blue Force elements</description>
    <atmospheric rdf:resource="http://www.chisystems.com/culturemap#BlueForce"/>
    <temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Day"/>
    <utility rdf:resource="http://www.chisystems.com/culturemap#Negative"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#BlueForceITRACE -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#BlueForceITRACE">
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#BlueForceIndicatorType"/>
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#PrimaryIndicatorType"/>
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
    <description rdf:datatype="&xsd;string">Description Here</description>
    <name rdf:datatype="&xsd;string">News</name>
    <atmospheric rdf:resource="http://www.chisystems.com/culturemap#BlueForce"/>
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			<utility rdf:resource="http://www.chisystems.com/culturemap#Positive"/>
			<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Week"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#Current -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#Current">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#Recency"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#Day -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#Day">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#TemporalGranularity"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#DeathRateCrude -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#DeathRateCrude">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#MedicalIndicatorType"/>
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#SecondaryIndicatorType"/>
			<name rdf:datatype="&xsd;string">Death Rate</name>
			<description rdf:datatype="&xsd;string">The number of deaths per 1,000 people (World Bank
data).</description>
			<units rdf:datatype="&xsd;string">per 1,000</units>
			<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Medical"/>
			<utility rdf:resource="http://www.chisystems.com/culturemap#Negative"/>
			<region rdf:resource="http://www.chisystems.com/culturemap#Philippines"/>
			<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#Degrading -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#Degrading">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#Trend"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#DepthFoodDeficit -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#DepthFoodDeficit">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#FoodIndicatorType"/>
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#SecondaryIndicatorType"/>
			<goodThreshold rdf:datatype="&xsd;double">0.0</goodThreshold>
			<adequateThreshold rdf:datatype="&xsd;double">100.0</adequateThreshold>
			<thresholdSource rdf:datatype="&xsd;string">FAO</thresholdSource>
			<name rdf:datatype="&xsd;string">Food Def.</name>
			<description rdf:datatype="&xsd;string">The number of calories needed to lift the undernourished from their
status (United Nations FAO data).</description>
			<units rdf:datatype="&xsd;string">kcal/caput/day</units>
			<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Food"/>
			<utility rdf:resource="http://www.chisystems.com/culturemap#Negative"/>
			<region rdf:resource="http://www.chisystems.com/culturemap#Philippines"/>
			<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#DomesticFoodPriceVolatility -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#DomesticFoodPriceVolatility">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#FoodIndicatorType"/>
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#SecondaryIndicatorType"/>
			<description rdf:datatype="&xsd;string">A reflection of the extent of variation in food prices (United Nations
FAO data).</description>
			<name rdf:datatype="&xsd;string">Food Price</name>
			<units rdf:datatype="&xsd;string">Index</units>
			<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Food"/>
			<utility rdf:resource="http://www.chisystems.com/culturemap#Negative"/>
			<region rdf:resource="http://www.chisystems.com/culturemap#Philippines"/>
			<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#Economy -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#Economy">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#AtmosphericType"/>
			<name rdf:datatype="&xsd;string">Economic Condition</name>
			<indicator rdf:resource="http://www.chisystems.com/culturemap#EconomyISENT"/>
			<indicator rdf:resource="http://www.chisystems.com/culturemap#EconomyITRACE"/>
			<indicator rdf:resource="http://www.chisystems.com/culturemap#FinalConsumptionExpenditure"/>
			<indicator rdf:resource="http://www.chisystems.com/culturemap#GDPGrowth"/>
			<indicator rdf:resource="http://www.chisystems.com/culturemap#InflationConsumerPrices"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#EconomyISENT -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#EconomyISENT">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#EconomyIndicatorType"/>
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			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#PrimaryIndicatorType"/>
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
			<description rdf:datatype="&xsd;string">Positive and negative sentiments expressed regarding the economy (W-ICEWS iSENT social media data).</description>
			<name rdf:datatype="&xsd;string">Sentiment</name>
			<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Day"/>
			<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Economy"/>
			<utility rdf:resource="http://www.chisystems.com/culturemap#Negative"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#EconomyITRACE -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#EconomyITRACE">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#EconomyIndicatorType"/>
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#PrimaryIndicatorType"/>
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
			<description rdf:datatype="&xsd;string">Description Here</description>
			<name rdf:datatype="&xsd;string">News</name>
			<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Economy"/>
			<utility rdf:resource="http://www.chisystems.com/culturemap#Negative"/>
			<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Week"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#ElectricPowerLosses -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#ElectricPowerLosses">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#PrimaryIndicatorType"/>
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#PublicWorksIndicatorType"/>
			<description rdf:datatype="&xsd;string">Electric power transmission and distribution losses include losses in transmission between sources of supply and points of distribution and in the distribution to consumers, including pilferage (World Bank data).</description>
			<name rdf:datatype="&xsd;string">Power Loss</name>
			<units rdf:datatype="&xsd;string">kWh</units>
			<utility rdf:resource="http://www.chisystems.com/culturemap#Negative"/>
			<atmospheric rdf:resource="http://www.chisystems.com/culturemap#PublicWorks"/>
			<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#EmploymentToPopulation -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#EmploymentToPopulation">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#EconomyIndicatorType"/>
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#SecondaryIndicatorType"/>
			<adequateThreshold rdf:datatype="&xsd;double">90.0</adequateThreshold>
			<goodThreshold rdf:datatype="&xsd;double">96.0</goodThreshold>
			<name rdf:datatype="&xsd;string">Employment</name>
			<units rdf:datatype="&xsd;string">Percentage</units>
			<description rdf:datatype="&xsd;string">The proportion of a country&apos;s working age population that is employed (World Bank data).</description>
			<thresholdSource rdf:datatype="&xsd;string">UNESCO</thresholdSource>
			<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Economy"/>
			<utility rdf:resource="http://www.chisystems.com/culturemap#Positive"/>
			<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#FinalConsumptionExpenditure -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#FinalConsumptionExpenditure">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#EconomyIndicatorType"/>
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#SecondaryIndicatorType"/>
			<name rdf:datatype="&xsd;string">Consumpt.</name>
			<description rdf:datatype="&xsd;string">The market value of all goods and services, including durable products (such as cars, washing machines, and home computers), purchased by households (World Bank data).</description>
			<units rdf:datatype="&xsd;string">US Dollars</units>
			<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Economy"/>
			<utility rdf:resource="http://www.chisystems.com/culturemap#Positive"/>
			<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#FixedTelephoneLines -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#FixedTelephoneLines">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#MediaIndicatorType"/>
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#SecondaryIndicatorType"/>
			<name rdf:datatype="&xsd;string">Phone</name>
			<units rdf:datatype="&xsd;string">Telephone Lines</units>
			<description rdf:datatype="&xsd;string">The number of fixed telephone lines (United Nations data).</description>
			<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Media"/>
			<utility rdf:resource="http://www.chisystems.com/culturemap#Positive"/>
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		<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
	</owl:NamedIndividual>
	<!-- http://www.chisystems.com/culturemap#Food -->
	<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#Food">
		<rdf:type rdf:resource="http://www.chisystems.com/culturemap#AtmosphericType"/>
		<name rdf:datatype="&xsd;string">Food Availability</name>
		<indicator rdf:resource="http://www.chisystems.com/culturemap#AverageDietaryEnergySupplyAdequacy"/>
		<indicator rdf:resource="http://www.chisystems.com/culturemap#DepthFoodDeficit"/>
		<indicator rdf:resource="http://www.chisystems.com/culturemap#DomesticFoodPriceVolatility"/>
		<indicator rdf:resource="http://www.chisystems.com/culturemap#FoodGrossProductionIndex"/>
		<indicator rdf:resource="http://www.chisystems.com/culturemap#FoodISENT"/>
		<indicator rdf:resource="http://www.chisystems.com/culturemap#FoodITRACE"/>
	</owl:NamedIndividual>
	<!-- http://www.chisystems.com/culturemap#FoodGrossProductionIndex -->
	<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#FoodGrossProductionIndex">
		<rdf:type rdf:resource="http://www.chisystems.com/culturemap#FoodIndicatorType"/>
		<rdf:type rdf:resource="http://www.chisystems.com/culturemap#SecondaryIndicatorType"/>
		<name rdf:datatype="&xsd;string">Food Prod.</name>
		<units rdf:datatype="&xsd;string">Index</units>
		<description rdf:datatype="&xsd;string">This reflects the aggregate volume of food produced (United Nations
FAO data).</description>
		<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Food"/>
		<utility rdf:resource="http://www.chisystems.com/culturemap#Positive"/>
		<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
	</owl:NamedIndividual>
	<!-- http://www.chisystems.com/culturemap#FoodISENT -->
	<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#FoodISENT">
		<rdf:type rdf:resource="http://www.chisystems.com/culturemap#FoodIndicatorType"/>
		<rdf:type rdf:resource="http://www.chisystems.com/culturemap#PrimaryIndicatorType"/>
		<rdf:type rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
		<description rdf:datatype="&xsd;string">Positive and negative sentiments expressed regarding food availability
(W-ICEWS iSENT social media data).</description>
		<name rdf:datatype="&xsd;string">Sentiment</name>
		<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Day"/>
		<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Food"/>
		<utility rdf:resource="http://www.chisystems.com/culturemap#Positive"/>
	</owl:NamedIndividual>
	<!-- http://www.chisystems.com/culturemap#FoodITRACE -->
	<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#FoodITRACE">
		<rdf:type rdf:resource="http://www.chisystems.com/culturemap#FoodIndicatorType"/>
		<rdf:type rdf:resource="http://www.chisystems.com/culturemap#PrimaryIndicatorType"/>
		<rdf:type rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
		<description rdf:datatype="&xsd;string">Description Here</description>
		<name rdf:datatype="&xsd;string">News</name>
		<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Food"/>
		<utility rdf:resource="http://www.chisystems.com/culturemap#Positive"/>
		<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Week"/>
	</owl:NamedIndividual>
	<!-- http://www.chisystems.com/culturemap#GDPGrowth -->
	<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#GDPGrowth">
		<rdf:type rdf:resource="http://www.chisystems.com/culturemap#EconomyIndicatorType"/>
		<rdf:type rdf:resource="http://www.chisystems.com/culturemap#SecondaryIndicatorType"/>
		<adequateThreshold rdf:datatype="&xsd;double">0.0</adequateThreshold>
		<goodThreshold rdf:datatype="&xsd;double">5.0</goodThreshold>
		<name rdf:datatype="&xsd;string">GDP</name>
		<thresholdSource rdf:datatype="&xsd;string">IMF</thresholdSource>
		<description rdf:datatype="&xsd;string">The sum of gross value added by all resident producers in the
economy plus any product taxes and minus any subsidies not included in the value of the products (World Bank data).</description>
		<units rdf:datatype="&xsd;string">annual percent change</units>
		<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Economy"/>
		<utility rdf:resource="http://www.chisystems.com/culturemap#Positive"/>
		<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
	</owl:NamedIndividual>
	<!-- http://www.chisystems.com/culturemap#Government -->
	<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#Government">
		<rdf:type rdf:resource="http://www.chisystems.com/culturemap#AtmosphericType"/>
		<name rdf:datatype="&xsd;string">Government Support</name>
		<indicator rdf:resource="http://www.chisystems.com/culturemap#GovernmentISENT"/>
		<indicator rdf:resource="http://www.chisystems.com/culturemap#GovernmentITRACE"/>
	</owl:NamedIndividual>
```

```xml
<!-- http://www.chisystems.com/culturemap#GovernmentISENT -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#GovernmentISENT">
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#GovernmentIndicatorType"/>
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#PrimaryIndicatorType"/>
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
    <description rdf:datatype="&xsd;string">Positive and negative sentiments expressed regarding the government (W-ICEWS iSENT social media data).</description>
    <name rdf:datatype="&xsd;string">Sentiment</name>
    <temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Day"/>
    <atmospheric rdf:resource="http://www.chisystems.com/culturemap#Government"/>
    <utility rdf:resource="http://www.chisystems.com/culturemap#Negative"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#GovernmentITRACE -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#GovernmentITRACE">
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#GovernmentIndicatorType"/>
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#PrimaryIndicatorType"/>
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
    <description rdf:datatype="&xsd;string">Hostile actions toward the government by entities of all types (W-ICEWS iTRACE news report data).</description>
    <name rdf:datatype="&xsd;string">News</name>
    <atmospheric rdf:resource="http://www.chisystems.com/culturemap#Government"/>
    <utility rdf:resource="http://www.chisystems.com/culturemap#Negative"/>
    <temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Week"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#HomicideRate -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#HomicideRate">
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#SecondaryIndicatorType"/>
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#StabilityIndicatorType"/>
    <name rdf:datatype="&xsd;string">Homicides</name>
    <description rdf:datatype="&xsd;string">The rate of intentional homicides per 100,000 people (data from United Nations Office on Crime and Drugs).</description>
    <units rdf:datatype="&xsd;string">per 100,000 people</units>
    <utility rdf:resource="http://www.chisystems.com/culturemap#Negative"/>
    <atmospheric rdf:resource="http://www.chisystems.com/culturemap#Stability"/>
    <temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#Hour -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#Hour">
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#TemporalGranularity"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#ImmunizationDPT -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#ImmunizationDPT">
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#MedicalIndicatorType"/>
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#SecondaryIndicatorType"/>
    <adequateThreshold rdf:datatype="&xsd;double">50.0</adequateThreshold>
    <goodThreshold rdf:datatype="&xsd;double">80.0</goodThreshold>
    <name rdf:datatype="&xsd;string">Immuniza.</name>
    <units rdf:datatype="&xsd;string">Percentage</units>
    <description rdf:datatype="&xsd;string">The percentage of children ages 12-23 months who received adequate vaccinations  against diphtheria, pertussis, and tetanus (World Bank data).</description>
    <thresholdSource rdf:datatype="&xsd;string">WHO</thresholdSource>
    <atmospheric rdf:resource="http://www.chisystems.com/culturemap#Medical"/>
    <utility rdf:resource="http://www.chisystems.com/culturemap#Positive"/>
    <temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#ImprovedRuralWater -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#ImprovedRuralWater">
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#PublicWorksIndicatorType"/>
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#SecondaryIndicatorType"/>
    <units rdf:datatype="&xsd;string">Percentage</units>
    <name rdf:datatype="&xsd;string">Rural H20</name>
    <description rdf:datatype="&xsd;string">The percentage of the rural population using an improved drinking water source (World Bank data).</description>
    <utility rdf:resource="http://www.chisystems.com/culturemap#Positive"/>
    <atmospheric rdf:resource="http://www.chisystems.com/culturemap#PublicWorks"/>
    <temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#ImprovedUrbanWater -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#ImprovedUrbanWater">
    <rdf:type rdf:resource="http://www.chisystems.com/culturemap#PublicWorksIndicatorType"/>
```

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<rdf:type rdf:resource="http://www.chisystems.com/culturemap#SecondaryIndicatorType"/>
<units rdf:datatype="&xsd;string">Percentage</units>
<description rdf:datatype="&xsd;string">The percentage of the urban population using an improved drinking water source (World Bank data).</description>
<name rdf:datatype="&xsd;string">Urban H20</name>
<utility rdf:resource="http://www.chisystems.com/culturemap#Positive"/>
<atmospheric rdf:resource="http://www.chisystems.com/culturemap#PublicWorks"/>
<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#Improving -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#Improving">
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#Trend"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#InflationConsumerPrices -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#InflationConsumerPrices">
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#EconomyIndicatorType"/>
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#PrimaryIndicatorType"/>
<adequateThreshold rdf:datatype="&xsd;double">10.0</adequateThreshold>
<goodThreshold rdf:datatype="&xsd;double">4.0</goodThreshold>
<thresholdSource rdf:datatype="&xsd;string">Federal Reserve</thresholdSource>
<name rdf:datatype="&xsd;string">Inflation</name>
<description rdf:datatype="&xsd;string">The annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly (World Bank data).</description>
<units rdf:datatype="&xsd;string">annual percent change</units>
<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Economy"/>
<utility rdf:resource="http://www.chisystems.com/culturemap#Negative"/>
<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#InternetUsers -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#InternetUsers">
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#MediaIndicatorType"/>
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#PrimaryIndicatorType"/>
<name rdf:datatype="&xsd;string">Inet Users</name>
<description rdf:datatype="&xsd;string">People with access to the worldwide network (World Bank data).</description>
<units rdf:datatype="&xsd;string">per 100 people</units>
<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Media"/>
<utility rdf:resource="http://www.chisystems.com/culturemap#Positive"/>
<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#LongTermUnemployment -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#LongTermUnemployment">
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#SecondaryIndicatorType"/>
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#StabilityIndicatorType"/>
<adequateThreshold rdf:datatype="&xsd;double">10.0</adequateThreshold>
<goodThreshold rdf:datatype="&xsd;double">4.0</goodThreshold>
<name rdf:datatype="&xsd;string">Employment</name>
<units rdf:datatype="&xsd;string">Percentage</units>
<description rdf:datatype="&xsd;string">The number of people with periods of unemployment of a year or longer, expressed as a percentage of the total unemployed (World Bank data).</description>
<thresholdSource rdf:datatype="&xsd;string">UNESCO</thresholdSource>
<utility rdf:resource="http://www.chisystems.com/culturemap#Positive"/>
<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Stability"/>
<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#Malaysia -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#Malaysia">
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#Region"/>
<countryCode rdf:datatype="&xsd;string">MYS</countryCode>
<name rdf:datatype="&xsd;string">Malaysia</name>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#Media -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#Media">
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#AtmosphericType"/>
<name rdf:datatype="&xsd;string">Media Saturation</name>
<indicator rdf:resource="http://www.chisystems.com/culturemap#FixedTelephoneLines"/>
<indicator rdf:resource="http://www.chisystems.com/culturemap#InternetUsers"/>
<indicator rdf:resource="http://www.chisystems.com/culturemap#MediaISENT"/>
<indicator rdf:resource="http://www.chisystems.com/culturemap#MediaITRACE"/>
<indicator rdf:resource="http://www.chisystems.com/culturemap#MobileCelluarSubscriptions"/>
```

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<indicator rdf:resource="http://www.chisystems.com/culturemap#TelevisionReceivers"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#MediaISENT -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#MediaISENT">
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#MediaIndicatorType"/>
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#PrimaryIndicatorType"/>
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
<description rdf:datatype="&xsd;string">Positive and negative sentiments expressed regarding media (W-ICEWS iSENT social media data).</description>
<name rdf:datatype="&xsd;string">Sentiment</name>
<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Day"/>
<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Media"/>
<utility rdf:resource="http://www.chisystems.com/culturemap#Neutral"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#MediaITRACE -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#MediaITRACE">
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#MediaIndicatorType"/>
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#PrimaryIndicatorType"/>
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
<description rdf:datatype="&xsd;string">Description Here</description>
<name rdf:datatype="&xsd;string">News</name>
<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Media"/>
<utility rdf:resource="http://www.chisystems.com/culturemap#Negative"/>
<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Week"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#Medical -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#Medical">
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#AtmosphericType"/>
<name rdf:datatype="&xsd;string">Medical Availability</name>
<indicator rdf:resource="http://www.chisystems.com/culturemap#BirthRateCrude"/>
<indicator rdf:resource="http://www.chisystems.com/culturemap#DeathRateCrude"/>
<indicator rdf:resource="http://www.chisystems.com/culturemap#ImmunizationDPT"/>
<indicator rdf:resource="http://www.chisystems.com/culturemap#MedicalISENT"/>
<indicator rdf:resource="http://www.chisystems.com/culturemap#MedicalITRACE"/>
<indicator rdf:resource="http://www.chisystems.com/culturemap#OutofPocketHealthExpenditure"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#MedicalISENT -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#MedicalISENT">
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#MedicalIndicatorType"/>
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#PrimaryIndicatorType"/>
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
<description rdf:datatype="&xsd;string">Positive and negative sentiments expressed medical availability (W-ICEWS iSENT social media data).</description>
<name rdf:datatype="&xsd;string">Sentiment</name>
<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Day"/>
<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Medical"/>
<utility rdf:resource="http://www.chisystems.com/culturemap#Negative"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#MedicalITRACE -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#MedicalITRACE">
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#MedicalIndicatorType"/>
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#PrimaryIndicatorType"/>
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
<description rdf:datatype="&xsd;string">Description Here</description>
<name rdf:datatype="&xsd;string">News</name>
<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Medical"/>
<utility rdf:resource="http://www.chisystems.com/culturemap#Positive"/>
<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Week"/>
</owl:NamedIndividual>
<!-- http://www.chisystems.com/culturemap#MobileCelluarSubscriptions -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#MobileCelluarSubscriptions"/>
<!-- http://www.chisystems.com/culturemap#MobileCellularSubscriptions -->
<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#MobileCellularSubscriptions">
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#MediaIndicatorType"/>
<rdf:type rdf:resource="http://www.chisystems.com/culturemap#SecondaryIndicatorType"/>
<name rdf:datatype="&xsd;string">Cell Phone</name>
<description rdf:datatype="&xsd;string">The number of subscriptions to a public mobile telephone service using cellular technology, that provide access to the public switched telephone network (World Bank data).</description>
<units rdf:datatype="&xsd;string">per 100 people</units>
<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Media"/>
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			<utility rdf:resource="http://www.chisystems.com/culturemap#Positive"/>
			<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#Month -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#Month">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#TemporalGranularity"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#Negative -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#Negative">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#Utility"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#Neutral -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#Neutral">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#Utility"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#Old -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#Old">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#Recency"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#OutofPocketHealthExpenditure -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#OutofPocketHealthExpenditure">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#MedicalIndicatorType"/>
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#PrimaryIndicatorType"/>
			<name rdf:datatype="&xsd;string">Health Exp.</name>
			<units rdf:datatype="&xsd;string">Percentage</units>
			<description rdf:datatype="&xsd;string">This includes gratuities and in-kind payments, goods, and services
that contribute to the restoration or enhancement of the health status of individuals or population groups (World Bank data).</description>
			<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Medical"/>
			<utility rdf:resource="http://www.chisystems.com/culturemap#Negative"/>
			<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#PercentHighwaysPaved -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#PercentHighwaysPaved">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#PublicWorksIndicatorType"/>
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#SecondaryIndicatorType"/>
			<name rdf:datatype="&xsd;string">Paved Rds</name>
			<units rdf:datatype="&xsd;string">Percentage</units>
			<description rdf:datatype="&xsd;string">The percent of total roads that are paved (CIA
Factbook).</description>
			<utility rdf:resource="http://www.chisystems.com/culturemap#Positive"/>
			<atmospheric rdf:resource="http://www.chisystems.com/culturemap#PublicWorks"/>
			<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#Philippines -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#Philippines">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#Region"/>
			<countryCode rdf:datatype="&xsd;string">PHL</countryCode>
			<name rdf:datatype="&xsd;string">Philippines</name>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#PoliticalStability -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#PoliticalStability">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#PrimaryIndicatorType"/>
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#StabilityIndicatorType"/>
			<units rdf:datatype="&xsd;string">Index</units>
			<name rdf:datatype="&xsd;string">Stabilty</name>
			<description rdf:datatype="&xsd;string">This measures perceptions of the likelihood that the government will
be destabilized or overthrown by unconstitutional or violent means (World Bank data).</description>
			<utility rdf:resource="http://www.chisystems.com/culturemap#Positive"/>
			<atmospheric rdf:resource="http://www.chisystems.com/culturemap#Stability"/>
			<temporalGranularity rdf:resource="http://www.chisystems.com/culturemap#Year"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#Positive -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#Positive">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#Utility"/>
		</owl:NamedIndividual>
		<!-- http://www.chisystems.com/culturemap#PublicWorks -->
		<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#PublicWorks">
			<rdf:type rdf:resource="http://www.chisystems.com/culturemap#AtmosphericType"/>
			<name rdf:datatype="&xsd;string">Public Works</name>
			<indicator rdf:resource="http://www.chisystems.com/culturemap#ElectricPowerLosses"/>
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		<indicator rdf:resource="http://www.chisystems.com/culturemap#ImprovedRuralWater"/>
		<indicator rdf:resource="http://www.chisystems.com/culturemap#ImprovedUrbanWater"/>
		<indicator rdf:resource="http://www.chisystems.com/culturemap#PercentHighwaysPaved"/>
		<indicator rdf:resource="http://www.chisystems.com/culturemap#PublicWorksISENT"/>
		<indicator rdf:resource="http://www.chisystems.com/culturemap#PublicWorksITRACE"/>
	</owl:NamedIndividual>
	<!-- http://www.chisystems.com/culturemap#PublicWorksISENT -->
	<owl:NamedIndividual rdf:about="http://www.chisystems.com/culturemap#PublicWorksISENT">
		<rdf:type rdf:resource="http://www.chisystems.com/culturemap#PrimaryIndicatorType"/>
		<rdf:type rdf:resource="http://www.chisystems.com/culturemap#PublicWorksIndicatorType"/>
		<rdf:type rdf:resource="http://www.chisystems.com/culturemap#VisibleEntity"/>
		<description rdf:datatype="&xsd;string">Positive and negative sentiments expressed regarding public works
(W-ICEWS iSENT social media data)</description>
		<name rdf:datatype="&xsd;string">Sentiment</name>
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Appendix B: CultureMap System User Documentation

Release Notes

This represents the software user documentation for version 2.0 of the CultureMap software developed under contract N00014-08-C-0323.

Contents

Launching the Application

Requirements:

- Standard Windows, Mac and Linux web browsers. Certified to work with:
    1. Chrome (36.0.1985.143 or later)
    2. Firefox (31.0 or later)

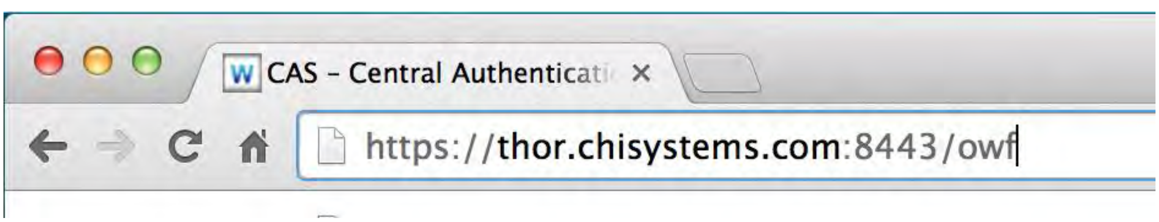
    Note: Application is not certified under Internet Explorer

Prior to launching the application:

- Ensure that the CultureMap application framework is installed on a server accessible on your network and that your administrator provides you with the URL path to access the CultureMap application.

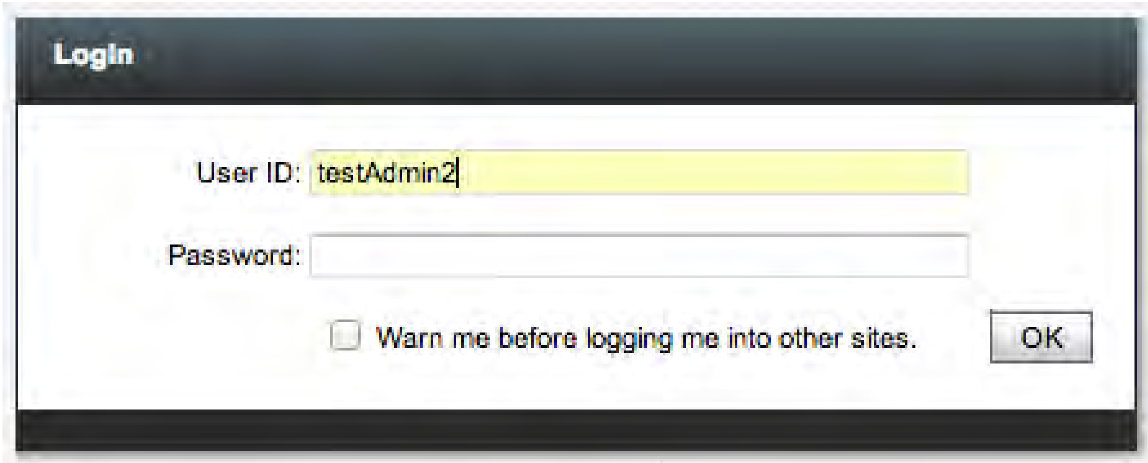
Start the application by pointing your web browser to the network server URL.

- For example, accessing a vpn-protected CultureMap server hosted at CHI Systems:



Login:

After successful connection to the CultureMap server, you should see the login window in your browser:



The default User ID is 'testAdmin2' and default password is 'password'

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Getting Started

Before attempting to invoke a visualization, you should be aware of the CultureMap concepts related to the visualization process and data filtering. You should also be familiar with the layout of the application's graphical user interface, which includes both application-wide data-related controls and visualization-specific controls.

Once familiar with the application's basic concepts and user interface, creating a visualization will be a simple process. These concepts are described in Data and Visualizations below.

Contents

Data and Visualizations

The CultureMap application combines data from a number of sources and presents then to the user as a single data source. Although potentially drawn from multiple, heterogeneous sources, the consolidated data source is homogeneous so that analytics can be run against this data. When using the application, you are presented with a single set of data types and relations.

After selecting data types and relations of interest, you will choose the type(s) of visualization you require to support the analysis at hand. Alternate visualizations of the selected data set may be viewed simultaneously through the use of the Mashup feature which can act as a storage facility for saving intermediate analysis results/visualizations and comparing data over time for trends and patterns of interest.

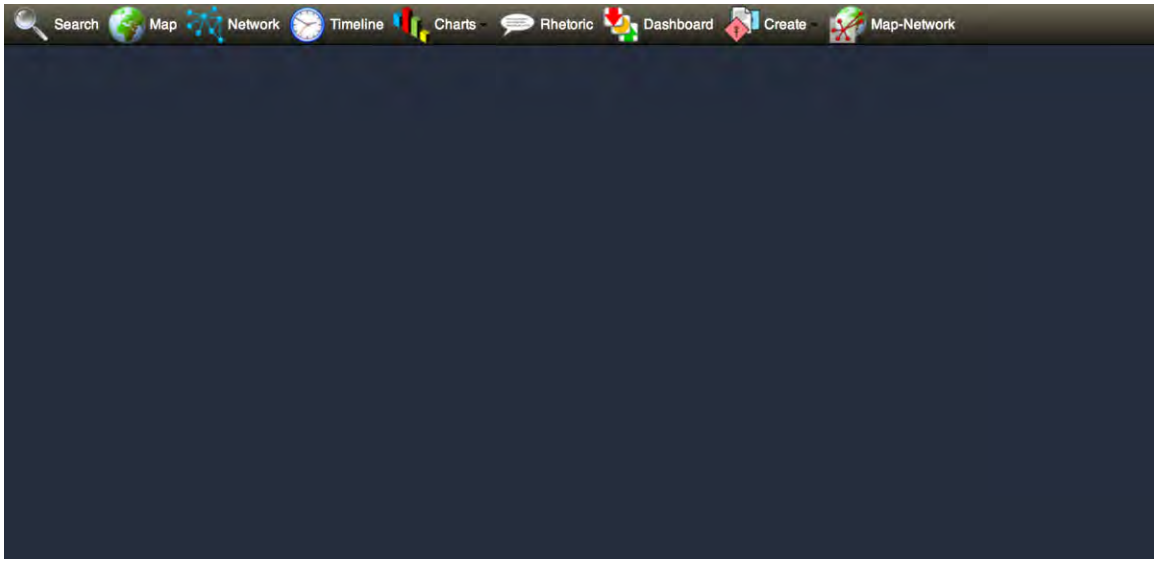
Based on the examination of visualization results, you may choose to modify the set of data elements/relations visualized through the Search filter/keywords. As soon as the revision of data type and relation selections is completed ("Search" button clicked), all your open visualizations will be updated.

Finally, many visualizations are linked to the Timeline. For example, an open Pie Chart is dynamically updated as the time-selection on a Timeline presenting events from a Search is modified

Contents

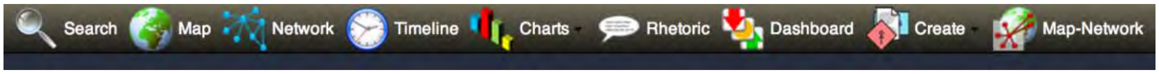
Controls and Visualization Windows

All controls and visualizations are presented within a single application window. The example below shows the *Menu* bar (to the top left) and a *Visualization panel* contained within the larger application window (blue region).



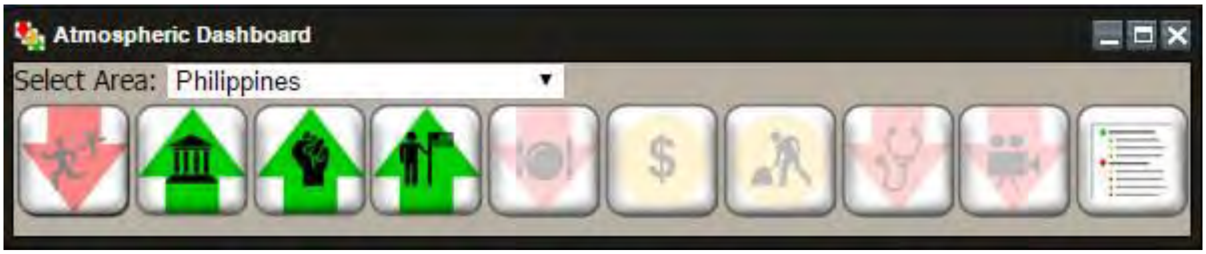
The Menu bar is organized into clickable icons, each invoking a visual function. These visual analytics are largely tied to Search results/filters and interconnected (e.g., Pie Chart is dynamically updated as the time-selection on a Timeline presenting events from a Search is modified):

- Dashboard – provides a summary-level aggregation of atmospherics
- Search – can be used to search/filter for data from the data-repository
- Map – provides a geo-map visualization of events, social media, OSINT data
- Network – provides a network-view of events, social media, OSINT data
- Timeline – provides a timeline view/control of events, social media, OSINT data
- Charts – provides Trend/Pie charts events, social media, OSINT data
- Rhetoric – provides a world cloud of events, social media, OSINT data
- Create – enables user to create/maintain "mashups" of analytics and restore later
- Map-Network – hybrid network-over-a-map (not implemented)



Clicking a corresponding icon will invoke that function and display the corresponding visual analytic. Clicking on the 'X' for a visual analytic will close it.

The dashboard presents a high-level summary of the Area Atmospherics for the region specified. A threat-oriented dashboard approach allows the user to quickly assess the state and trend of local atmospherics and drill down to underlying details. To open the CultureMap dashboard, click on the 'Dashboard' menu option.



Clicking on an atmospheric icon expands the display to show specific indicators associated with that atmospheric. Clicking on the last icon on the dashboard shows the full set of atmospherics and their sub-indicator values. The buttons are color coded red/amber/green for the threat level indicated by the current state of each atmospheric. The recent threat trend is indicated by the presence of an embedded red or green arrow or amber circle in the icon

The indicator charts allows the user to click a single bar in the chart and load the associated data into CultureMap search results. This, in turn, allows the user to immediately examine the full range of visualizations for that data. For example, clicking on a spike in a sentiment chart allows the user to immediately open a word cloud visualization to examine the content of the sentiment spike. This means that an analyst user can go directly from a color coded alert regarding a recent negative change in an atmospheric of interest, to the various semantic, geographic, or temporal details of the indicator data which was responsible for the alert.

Double clicking on a bar within a chart brings up a list of four search options, allowing the user to 1) search over the time period represented by the bar itself versus searching over a wider time span for context, and 2) search for iTRACE/iSENT instances associated with the indicator represented by the chart versus searching for actors related to that indicator. Selecting a search option opens the search window (if not already open), loads the required search parameters, executes the search, and updates all open visualizations accordingly.

Data for specific regions, where data is available, can be selected using the pic-list under 'Select Area' option on the dashboard. As charts can be stacked, this enables to user to compare across atmospherics for a given region, but also to compare atmospherics across regions.

Search Controls

Search and Keyword Filter controls are provided to limit visualizations to entities and relations of interest.

The Search panel contains the following search types for specifying/limiting visualizations:

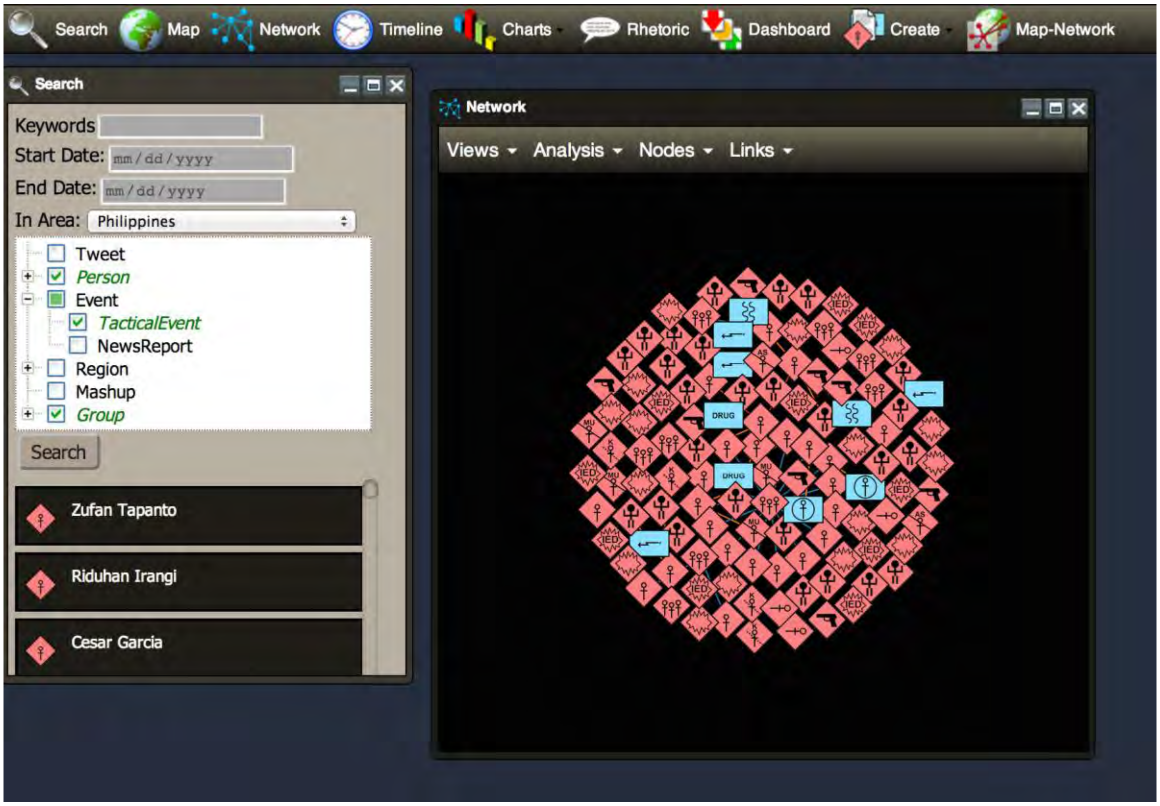
- **Tweet** – Twitter instance data [where ingested in a given installation]
- **Person** – Persons (Blue/Red) extracted from ingested OSINT data
- **Event**
    - TacticalEvent - [where ingested in a given installation]
    - NewsReports – extracted from iTRACE data feeds
- **Region** – [not currently implemented]
- **Mashup** – Used to find/delete saved mashups
- **Group** – Groups (Blue/Red) extracted from ingested OSINT data

Whenever you click the "Search" button at the bottom of the Search panel, all visualization windows will be updated to represent the data set specified by the current filter settings. Until the "Search" button is clicked, changes in the filter settings will have no effect on new or existing visualizations.

For Example, to use the Search to final all Persons, Tactical Events, and Groups:

1. Click on 'Search' menu to invoke the Search panel

2. Click on ‘Person’, ‘TacticalEvent’ and ‘Group’ types
3. Click the ‘Search’ button in Search Panel
4. Click on ‘Network’ menu to view the Network



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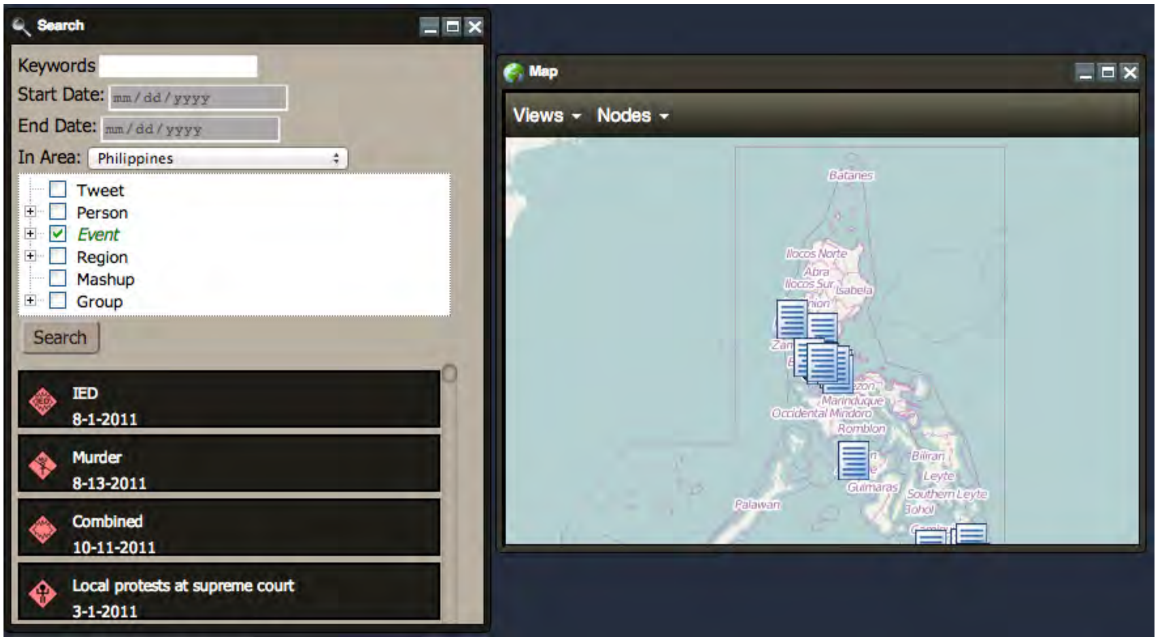
Map

The Map view is intended for use as a geo-based view that can display a sub-set of Search results (primarily for geo-located Search result data). This includes search types:

Event:TacticalEvent
Event:NewsReports
Tweet [for those Tweets that have geo-location data]

For example, to search for all Event types:

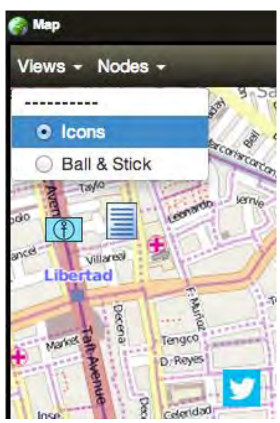
1. Click on ‘Search’ menu to invoke the Search panel
2. Click on ‘Event’ type
3. Click the ‘Search’ button in Search Panel
4. Click on ‘Map’ menu to view the event data on the map

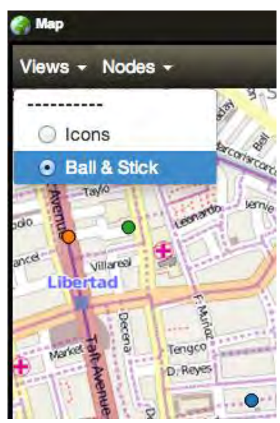


Map Views

Icons within a map, changeable under Map 'Views' menu, can be displayed as either:

- Icons
- Ball-and-Stick



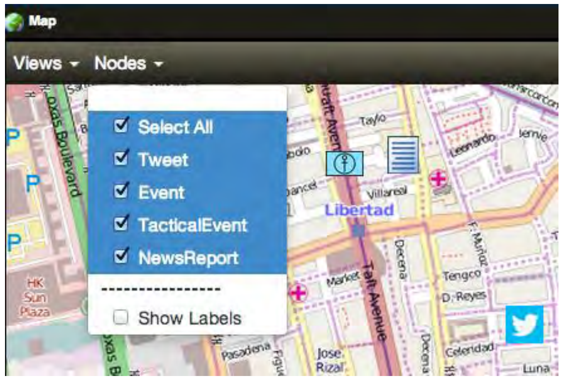


- To **zoom** the map in/out, move the mouse-wheel forward/back.
- To **pan** the map, click-and-hold the left-mouse button and pan.

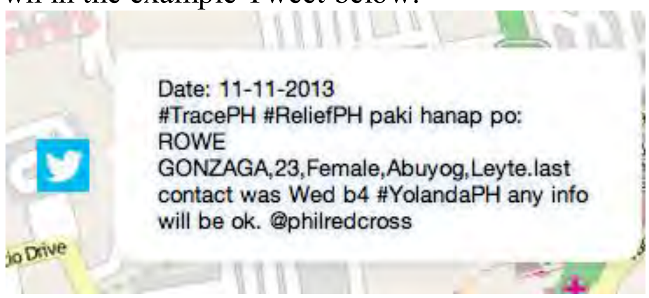
Icons on a map can be individually filtered using the 'Nodes' menu for types:

Tweet
Event
Event
TacticalEvent
NewsReports

- Additionally, all events can be filtered on using 'Select All'. 'Show Labels' toggles the icon names on/off.



- Meta-data available for a given icon on a map can be viewed as a pop-up by hovering over an icon, as shown in the example Tweet below.



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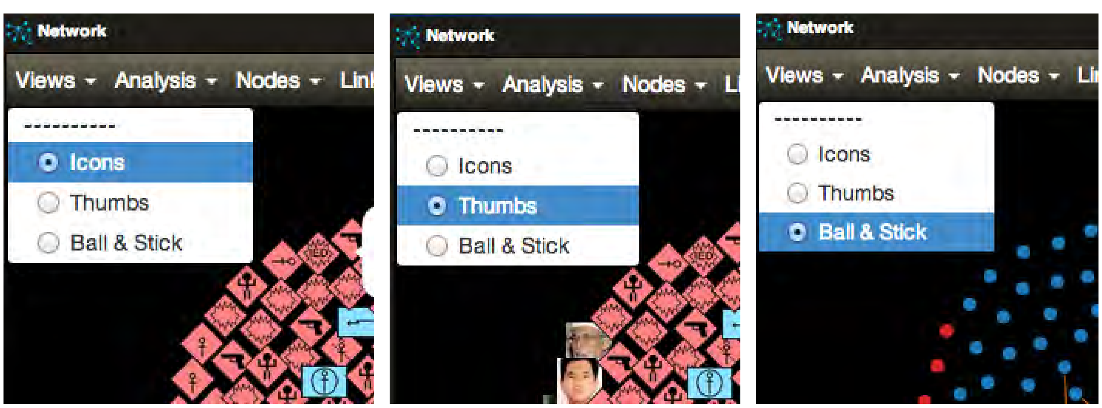
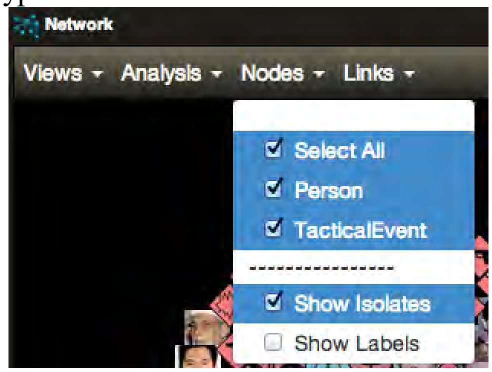
Network View

In the Network View (shown below), entities are represented as Icons, Thumbs, or Ball-and-Stick, and can be selected through the 'View' Network menu. To show/hide a menu, click on it to show and click-again to hide.

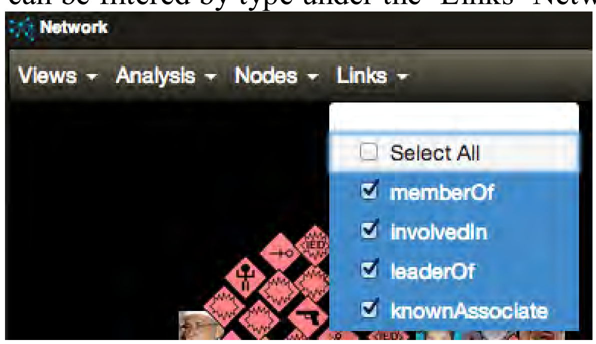


Relations are represented as color-coded lines between entities. The display slowly reorganizes its layout, bringing relation-linked groups of entities closer together.

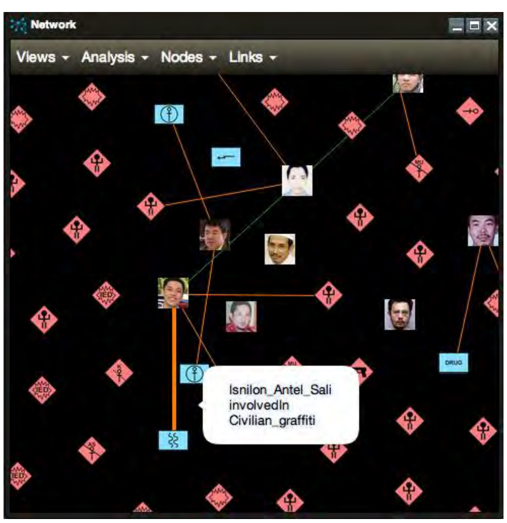
Nodes can be filtered by type under the 'Nodes' Network menu.

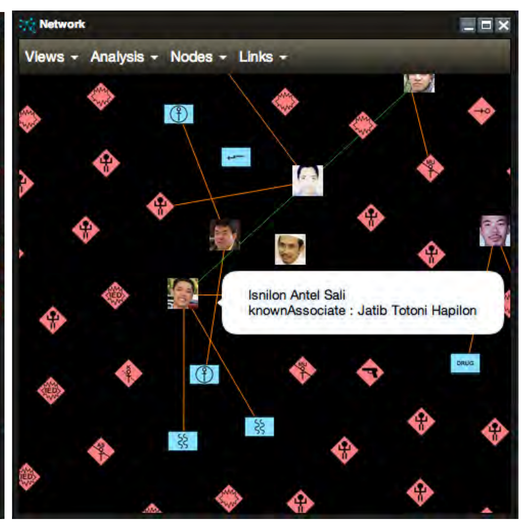


Links between Nodes can be filtered by type under the 'Links' Network menu.

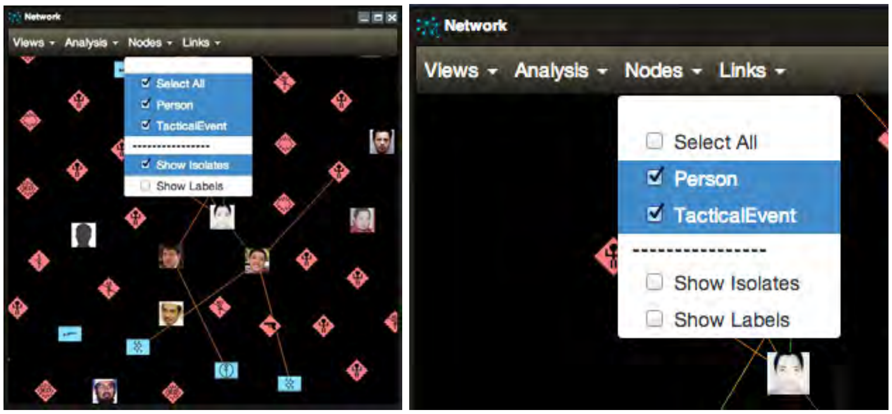


Both entities and relations are labeled in the display by hovering-over the link or entity that then displays a pop-up.





Individual Nodes in a Network can be moved around for custom-defined network diagram layouts by clicking-and-dragging a given node. Additionally, isolates (i.e., nodes without links) can be filtered under ‘Nodes” Network menu to further de-clutter a busy network view.

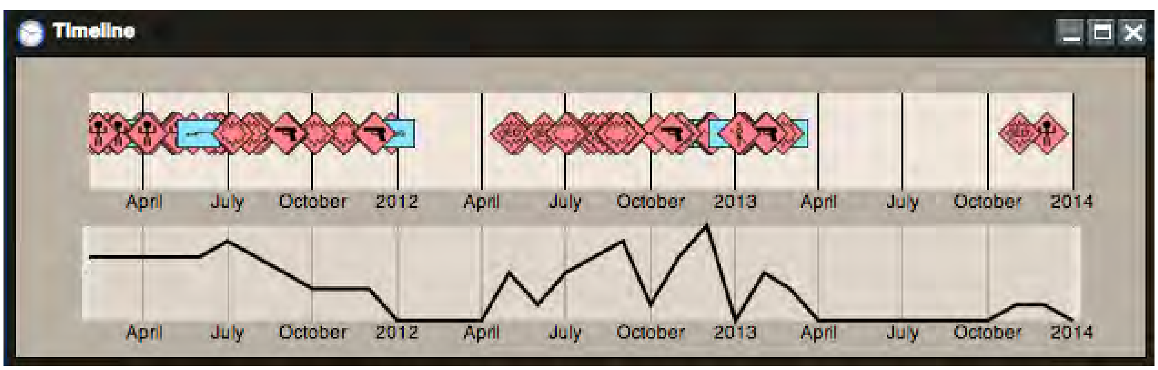


[Contents](#)

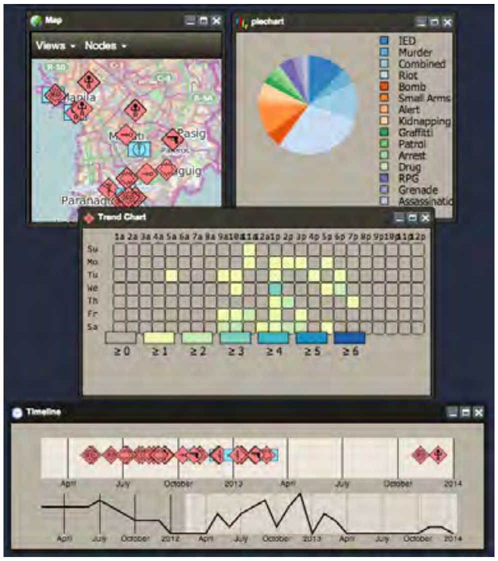
Timeline

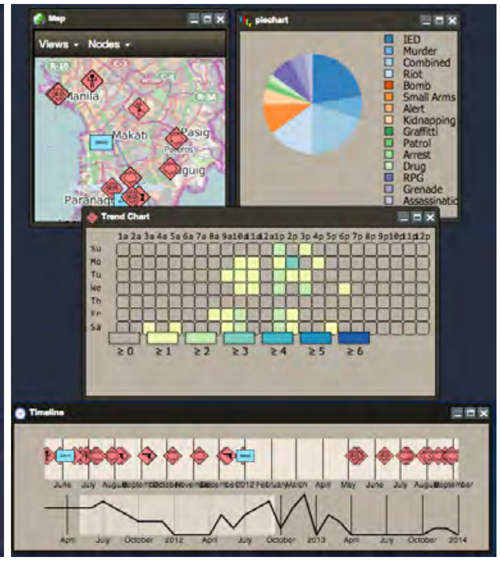
The timeline acts as both a display element – to display temporal information for Search results as a time-based frequency chart – and as a Control element, to enable to user to perform a Time-based filter that effects the open existing visualizations.

To invoke the Timeline, click on the ‘Timeline’ menu.   As in the example below, the Search results are displayed in the Timeline.



To use the Timeline as a temporal control, simply open other tied visualizations (i.e., Map, Trend Chart, or Pie Chart) and user the time-control sliders to change the beginning/end time. The open tied visualizations will update accordingly. Additionally, the time-control slider can be moved left/right to move forward/back in time.





Trend Chart

The Trend Chart can be invoked by clicking on the 'Charts' menu and selecting 'Trend Chart'. The Trend Chart is useful for examining temporal trends within data. It shows a 'heat map' of the relative frequencies of any information contained in the Search results that has time-stamped data associated with it.

The Trend Chart below shows an example view of the Event search results below.

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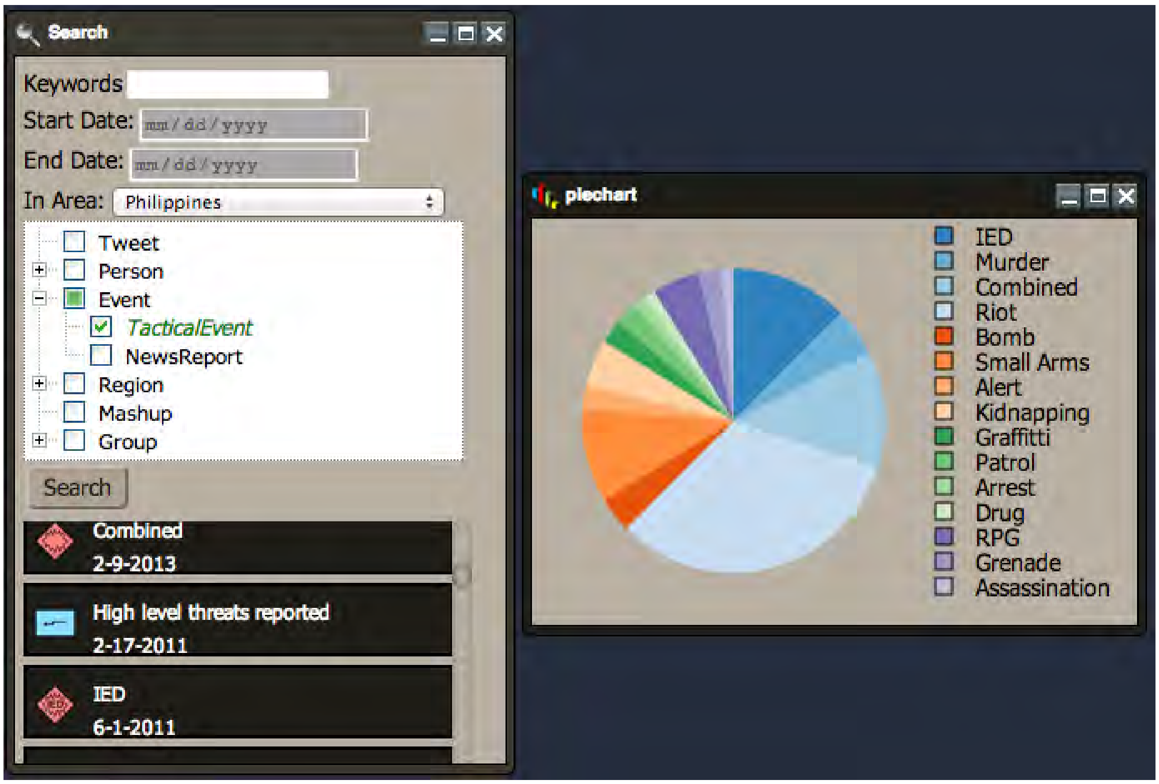
Pie Chart

The Pie Chart can be invoked by clicking on the 'Charts' menu and selecting 'Pie Chart'. The Pie Chart is useful for examining relative proportions within data. It shows the proportions of categories of any information contained in the Search results.

The Pie Chart below shows an example view of the Event search results below.



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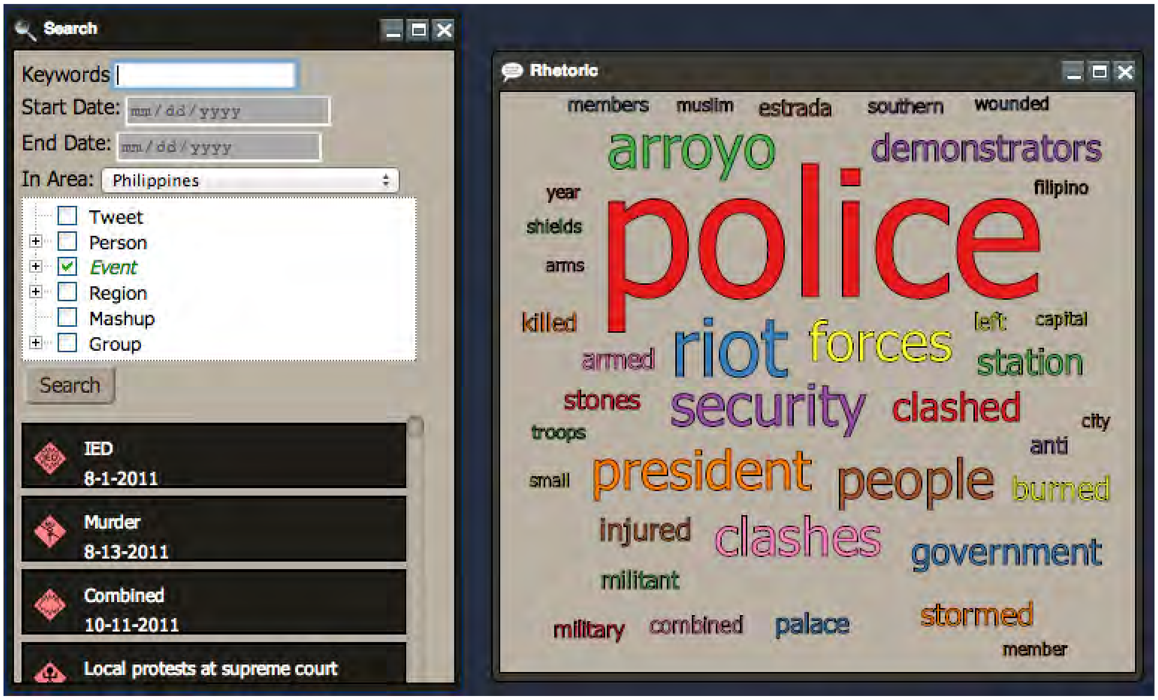
Rhetoric

The Rhetoric Word Cloud can be invoked by clicking on the 'Rhetoric' menu. The Rhetoric Word Cloud is useful for examining key topics frequently mentioned in a set of Search results. It shows the most frequently occurring terms in the Search results (e.g., Tweets + Events) and displays their relative proportional frequency as the size of the most salient terms.

The Rhetoric Word Cloud below shows an example view of the Event search results below.



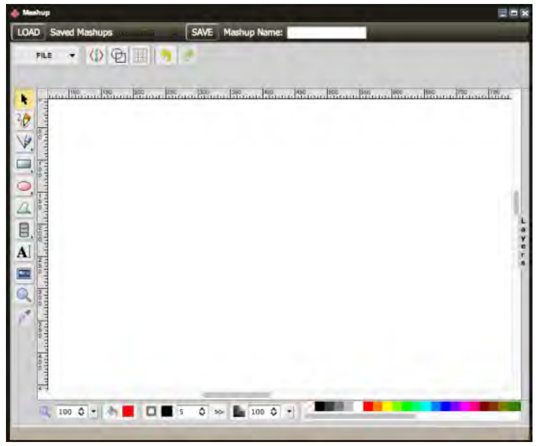
Mashup

The mashup can be used as a means to save, store, and manage collections of visual analytics. These stored analytics can be 'restored' from the mashup, thus enabling a user to resume analysis on saved intermediate analyses.

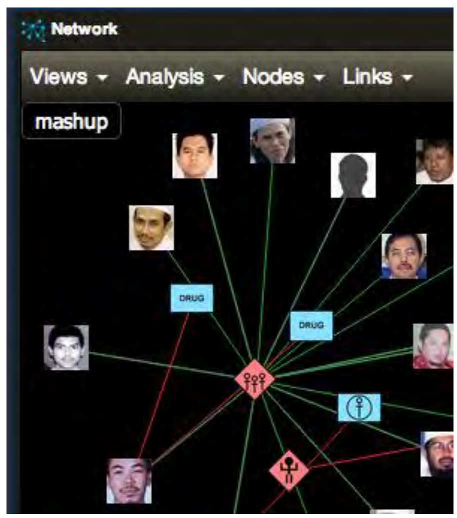
The CultureMap analytics that can be stored in the mashup are:

Map
Network
Timeline
Trend Chart
Pie Chart
Rhetoric (Word Cloud)

To open the Mashup, click on the 'Create' menu and 'Mashup' sub-menu. As seen below, you will be presented with a blank Mashup.

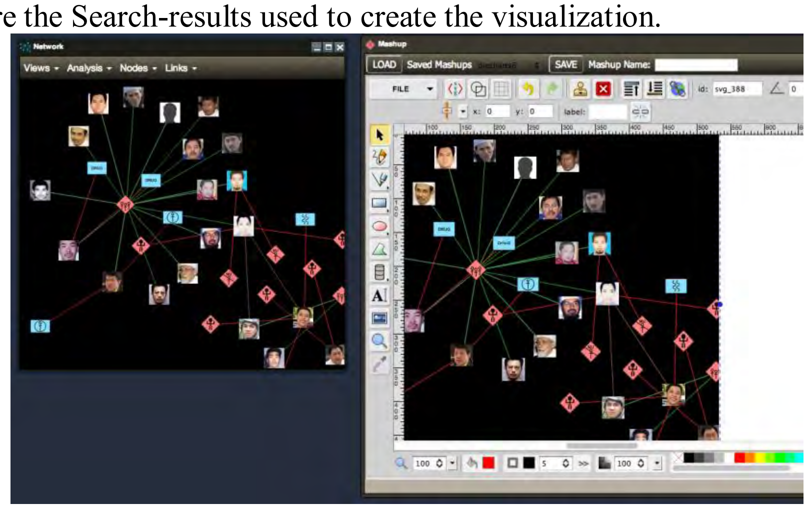


To pull an analytic into the mashup, hover over the upper left-corner of a mashable analytic, as seen in the examples below, if the element is mashable, a ‘mashable’ button will appear. Click on this ‘mashup’ button.



:

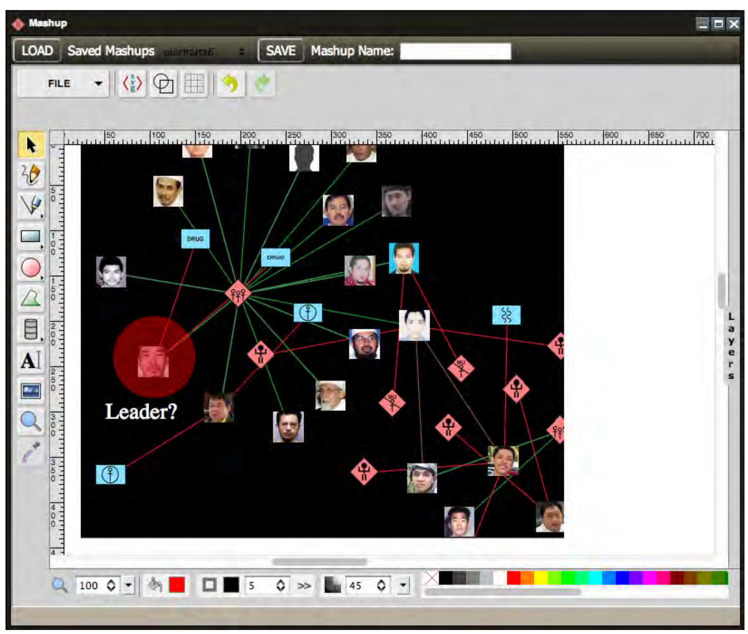
This will store the Search-results used to create the visualization.



Mashup Annotations

Mashups can be annotated using a set of annotation tools contained within the Mashup tool, as shown below, these include:

- Arrow (select tool)
- Freehand
- Line
- Circle
- Freehand Polygon
- Shapes
- Text Labels
- Graphics



Appendix C: CultureMap Preliminary Classifier Analysis Results

=== Evaluation result ===

Scheme: NaiveBayes

Correctly Classified Instances	220	88.3534 %
Incorrectly Classified Instances	29	11.6466 %
Kappa statistic	0.7815	
Mean absolute error	0.0758	
Root mean squared error	0.2699	
Relative absolute error	20.5866 %	
Root relative squared error	63.0712 %	
Coverage of cases (0.95 level)	89.1566 %	
Mean rel. region size (0.95 level)	34.0027 %	
Total Number of Instances	249	

=== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	ROC Area	Class
0.88	0.067	0.898	0.88	0.889	0.956	NONE
0.94	0.155	0.874	0.94	0.906	0.921	Sentiment...Negative
0.438	0.004	0.875	0.438	0.583	0.914	Sentiment...Positive
0.884	0.11	0.884	0.884	0.878	0.935	Weighted Avg.

=== Confusion Matrix ===

a	b	c	classified as
88	11	1	a = NONE
8	125	0	b = Sentiment.Government.Negative
2	7	7	c = Sentiment.Government.Positive

```
=== Evaluation result ===
Scheme:         BayesNet
Correctly Classified Instances        222        89.1566 %
Incorrectly Classified Instances      27         10.8434 %
Kappa statistic                 0.8027
Mean absolute error             0.0771
Root mean squared error         0.2351
Relative absolute error         20.9447 %
Root relative squared error     54.9489 %
Coverage of cases (0.95 level)        96.3855 %
Mean rel. region size (0.95 level)    40.6961 %
Total Number of Instances       249
=== Detailed Accuracy By Class ===
TP Rate     FP Rate     PrecisionRecall     F-Measure   ROC Area
   Class
0.97        0.121       0.843     0.97      0.902       0.972       NONE
0.872       0.052       0.951     0.872     0.91        0.967
   Sentiment...Negative
0.563       0.013       0.75      0.563     0.643       0.973
   Sentiment...Positive
0.892       0.077       0.895     0.892     0.89        0.969       Weighted
Avg.
=== Confusion Matrix ===
  a    b    c    <-- classified as
 97    2    1    a = NONE
 15  116    2    b = Sentiment.Government.Negative
  3    4    9    c = Sentiment.Government.Positive
```

=== Evaluation result ===

Scheme: ClassificationViaClustering

Correctly Classified Instances	148	59.4378 %
Incorrectly Classified Instances	101	40.5622 %
Kappa statistic	0.2291	
Mean absolute error	0.2704	
Root mean squared error	0.52	
Relative absolute error	73.4675 %	
Root relative squared error	121.5209 %	
Coverage of cases (0.95 level)	59.4378 %	
Mean rel. region size (0.95 level)	33.3333 %	
Total Number of Instances	249	

=== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	ROC Area	Class
0.54	0.255	0.587	0.54	0.563	0.642	NONE
0.707	0.491	0.623	0.707	0.662	0.608	Sentiment...Negative
0	0.026	0	0	0	0.487	Sentiment...Positive
0.594	0.367	0.568	0.594	0.579	0.614	Weighted Avg.

=== Confusion Matrix ===

a	b	c	classified as
54	45	1	a = NONE
34	94	5	b = Sentiment.Government.Negative
4	12	0	c = Sentiment.Government.Positive

```
=== Evaluation result ===
Scheme:         J48 (C4.5 implementation)
Correctly Classified Instances        207        83.1325 %
Incorrectly Classified Instances      42         16.8675 %
Kappa statistic                  0.6923
Mean absolute error              0.121
Root mean squared error          0.3169
Relative absolute error          32.8623 %
Root relative squared error      74.0645 %
Coverage of cases (0.95 level)        87.1486 %
Mean rel. region size (0.95 level)    37.2155 %
Total Number of Instances        249
=== Detailed Accuracy By Class ===
TP Rate     FP Rate     PrecisionRecall     F-Measure  ROC Area
   Class
0.87        0.121       0.829    0.87       0.849      0.901     NONE
0.835       0.164       0.854    0.835      0.844      0.841
   Sentiment...Negative
0.563       0.021       0.643    0.563      0.6        0.786
   Sentiment...Positive
0.831       0.137       0.83     0.831      0.83       0.861     Weighted
Avg.
=== Confusion Matrix ===
  a    b   c     classified as
 87   13   0     a = NONE
 17  111   5     b = Sentiment.Government.Negative
  1    6   9     c = Sentiment.Government.Positive
```

+ Randomize

=== Evaluation result ===

Scheme: SMO

Options: -C 1.0 -L 0.0010 -P 1.0E-12 -N 0 -M -V -1 -W 1 -K "weka.classifiers.functions.supportVector.PolyKernel -C 250007 -E 1.0"

Relation: atmospheric-weka.filters.unsupervised.instance.Randomize-S42-weka.filters.unsupervised.attribute.Remove-R3-weka.filters.unsupervised.attribute.StringToNGramVector-R1,3-W1000-prune-rate-1.0-C-N0-L-S-stemmerweka.core.stemmers.SnowballStemmer-M1-tokenizerweka.core.tokenizers.WordTokenizer -delimiters " \r\n\t.,;:\'\"()?!"

Correctly Classified Instances 229 91.9679 %

Incorrectly Classified Instances 20 8.0321 %

Kappa statistic 0.8505

Mean absolute error 0.0546

Root mean squared error 0.2249

Relative absolute error 14.8306 %

Root relative squared error 52.5641 %
Coverage of cases (0.95 level) 93.1727 %
Mean rel. region size (0.95 level) 34.2704 %
Total Number of Instances 249
=== Detailed Accuracy By Class ===
TP Rate FP Rate Precision Recall F-Measure ROC Area Class
0.95 0.047 0.931 0.95 0.941 0.984 NONE
0.947 0.103 0.913 0.947 0.93 0.966
Sentiment.Government.Negative
0.5 0.004 0.889 0.5 0.64 0.923
Sentiment.Government.Positive
Weighted Avg. 0.92 0.074 0.919 0.92 0.916 0.97
=== Confusion Matrix ===
a b c <-- classified as
95 5 0 | a = NONE
6 126 1 | b = Sentiment.Government.Negative
1 7 8 | c = Sentiment.Government.Positive
=== Evaluation result ===
Scheme: NaiveBayes
Relation: atmospheric-weka.filters.unsupervised.instance.Randomize-S42-
weka.filters.unsupervised.attribute.Remove-R3-
weka.filters.unsupervised.attribute.StringToNGramVector-R1,3-W1000-prune-rate-1.0-C-N0-L-
S-stemmerweka.core.stemmers.SnowballStemmer-M1-
tokenizerweka.core.tokenizers.WordTokenizer -delimiters " \r\n\t.,;:\'\"()?!"
Correctly Classified Instances 218 87.5502 %
Incorrectly Classified Instances 31 12.4498 %
Kappa statistic 0.7666
Mean absolute error 0.0821
Root mean squared error 0.2839
Relative absolute error 22.3187 %
Root relative squared error 66.3542 %
Coverage of cases (0.95 level) 88.755 %
Mean rel. region size (0.95 level) 33.8688 %
Total Number of Instances 249
=== Detailed Accuracy By Class ===
TP Rate FP Rate Precision Recall F-Measure ROC Area Class
0.87 0.054 0.916 0.87 0.892 0.95 NONE
0.932 0.181 0.855 0.932 0.892 0.911
Sentiment.Government.Negative
0.438 0.009 0.778 0.438 0.56 0.909
Sentiment.Government.Positive
Weighted Avg. 0.876 0.119 0.875 0.876 0.871 0.927
=== Confusion Matrix ===
a b c <-- classified as
87 12 1 | a = NONE
8 124 1 | b = Sentiment.Government.Negative

0 9 7 | c = Sentiment.Government.Positive

=== Evaluation result ===

Scheme: BayesNet

Options: -D -Q weka.classifiers.bayes.net.search.local.K2 -- -P 1 -S BAYES -E weka.classifiers.bayes.net.estimate.SimpleEstimator -- -A 0.5

Relation: atmospheric-weka.filters.unsupervised.instance.Randomize-S42-weka.filters.unsupervised.attribute.Remove-R3-weka.filters.unsupervised.attribute.StringToNGramVector-R1,3-W1000-prune-rate-1.0-C-N0-L-S-stemmerweka.core.stemmers.SnowballStemmer-M1-tokenizerweka.core.tokenizers.WordTokenizer -delimiters " \r\n\t.,;:\'\"()?!"

Correctly Classified Instances 222 89.1566 %
Incorrectly Classified Instances 27 10.8434 %
Kappa statistic 0.8032
Mean absolute error 0.081
Root mean squared error 0.2429
Relative absolute error 21.9933 %
Root relative squared error 56.7708 %
Coverage of cases (0.95 level) 96.3855 %
Mean rel. region size (0.95 level) 40.4284 %
Total Number of Instances 249

=== Detailed Accuracy By Class ===

	TP Rate	FP Rate	Precision	Recall	F-Measure	ROC Area	Class
	0.97	0.114	0.851	0.97	0.907	0.978	NONE
	0.865	0.06	0.943	0.865	0.902	0.965	Sentiment.Government.Negative
	0.625	0.013	0.769	0.625	0.69	0.975	Sentiment.Government.Positive
Weighted Avg.	0.892	0.079	0.895	0.892	0.89	0.971	

=== Confusion Matrix ===

```
  a   b   c   <-- classified as
 97   3   0 |   a = NONE
 15 115   3 |   b = Sentiment.Government.Negative
  2   4  10 |   c = Sentiment.Government.Positive
```

- URI

=== Evaluation result ===

Scheme: SMO

Options: -C 1.0 -L 0.0010 -P 1.0E-12 -N 0 -M -V -1 -W 1 -K "weka.classifiers.functions.supportVector.PolyKernel -C 250007 -E 1.0"

Relation: atmospheric-weka.filters.unsupervised.instance.Randomize-S42-weka.filters.unsupervised.attribute.Remove-R3,4-weka.filters.unsupervised.attribute.StringToNGramVector-R1-W1000-prune-rate-1.0-C-N0-L-S-stemmerweka.core.stemmers.SnowballStemmer-M1-tokenizerweka.core.tokenizers.WordTokenizer -delimiters " \r\n\t.,;:\'\"()?!"

Correctly Classified Instances 222 89.1566 %
Incorrectly Classified Instances 27 10.8434 %
Kappa statistic 0.7973
Mean absolute error 0.0705

Root mean squared error 0.2542
Relative absolute error 19.1673 %
Root relative squared error 59.4032 %
Coverage of cases (0.95 level) 91.1647 %
Mean rel. region size (0.95 level) 34.672 %
Total Number of Instances 249
=== Detailed Accuracy By Class ===
TP Rate FP Rate Precision Recall F-Measure ROC Area Class
0.9 0.054 0.918 0.9 0.909 0.965 NONE
0.932 0.155 0.873 0.932 0.902 0.951
Sentiment.Government.Negative
0.5 0.004 0.889 0.5 0.64 0.942
Sentiment.Government.Positive
Weighted Avg. 0.892 0.105 0.892 0.892 0.888 0.956
=== Confusion Matrix ===
a b c <-- classified as
90 10 0 | a = NONE
8 124 1 | b = Sentiment.Government.Negative
0 8 8 | c = Sentiment.Government.Positive
=== Evaluation result ===
Scheme: NaiveBayes
Relation: atmospheric-weka.filters.unsupervised.instance.Randomize-S42-weka.filters.unsupervised.attribute.Remove-R3,4-weka.filters.unsupervised.attribute.StringToNGramVector-R1-W1000-prune-rate-1.0-C-N0-L-S-stemmerweka.core.stemmers.SnowballStemmer-M1-tokenizerweka.core.tokenizers.WordTokenizer -delimiters " \r\n\t.,;:\'\"()?!"
Correctly Classified Instances 216 86.747 %
Incorrectly Classified Instances 33 13.253 %
Kappa statistic 0.7522
Mean absolute error 0.0872
Root mean squared error 0.2924
Relative absolute error 23.6841 %
Root relative squared error 68.3347 %
Coverage of cases (0.95 level) 87.9518 %
Mean rel. region size (0.95 level) 33.8688 %
Total Number of Instances 249
=== Detailed Accuracy By Class ===
TP Rate FP Rate Precision Recall F-Measure ROC Area Class
0.86 0.054 0.915 0.86 0.887 0.947 NONE
0.925 0.19 0.848 0.925 0.885 0.909
Sentiment.Government.Negative
0.438 0.013 0.7 0.438 0.538 0.914
Sentiment.Government.Positive
Weighted Avg. 0.867 0.124 0.866 0.867 0.863 0.924
=== Confusion Matrix ===
a b c <-- classified as

86 13 1 | a = NONE
8 123 2 | b = Sentiment.Government.Negative
0 9 7 | c = Sentiment.Government.Positive

=== Evaluation result ===

Correctly Classified Instances 220 88.3534 %

Incorrectly Classified Instances 29 11.6466 %

True Positive Rate: 0.884

False Positive Rate: 0.11

Overall Precision: 88.4%

Overall Recall: 88.4%

=== Confusion Matrix ===

a	b	c	classified as
88	11	1	a = NONE
8	125	0	b = Sentiment.Government.Negative
2	7	7	c = Sentiment.Government.Positive

Scheme: BayesNet

Options: -D -Q weka.classifiers.bayes.net.search.local.K2 -- -P 1 -S BAYES -E weka.classifiers.bayes.net.estimate.SimpleEstimator -- -A 0.5

Relation: atmospheric-weka.filters.unsupervised.instance.Randomize-S42-weka.filters.unsupervised.attribute.Remove-R3,4-weka.filters.unsupervised.attribute.StringToNGramVector-R1-W1000-prune-rate-1.0-C-N0-L-S-stemmerweka.core.stemmers.SnowballStemmer-M1-tokenizerweka.core.tokenizers.WordTokenizer -delimiters " \r\n\t.,;:\'\"()?!"

Correctly Classified Instances 222 89.1566 %
Incorrectly Classified Instances 27 10.8434 %
Kappa statistic 0.8032
Mean absolute error 0.0809
Root mean squared error 0.2434
Relative absolute error 21.9758 %
Root relative squared error 56.8689 %
Coverage of cases (0.95 level) 96.3855 %
Mean rel. region size (0.95 level) 40.4284 %
Total Number of Instances 249

=== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	ROC Area	Class
0.97	0.114	0.851	0.97	0.907	0.979	NONE
0.865	0.06	0.943	0.865	0.902	0.966	Sentiment.Government.Negative

0.625 0.013 0.769 0.625 0.69 0.977 Sentiment.Government.Positive

Weighted Avg. 0.892 0.079 0.895 0.892 0.89 0.972

=== Confusion Matrix ===

```
  a   b   c   <-- classified as
 97   3   0 |   a = NONE
 15 115   3 |   b = Sentiment.Government.Negative
  2   4  10 |   c = Sentiment.Government.Positive
```

+ TD & IDF