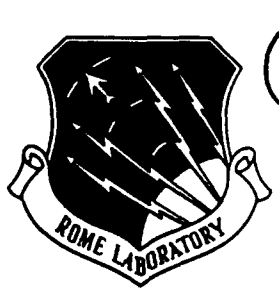

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December 1991

ANALYSIS OF OBSERVATION REPORT DATABASES/ KNOWLEDGE BASES

Linguistic Research Institute

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Rome Laboratory
Air Force Systems Command
Griffiss Air Force Base, NY 13441-5700

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This project developed software for implementing situation analysis of knowledge bases/data bases based on State of Affairs methodology, using off-the-shelf commercial software as a platform. Capability for event-subevent inferencing and for resource contention analysis were developed.

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Table of Contents

I. INTRODUCTION

C3I analysts need to view and interpret data at many levels in order to assess whether or not a developing situation is an isolated incident or part of a large scale incident important to National Command Authorities.

Event-subevent inference is a methodology to legitimize the conclusion that a large scale condition is developing or is present, based on the occurrence of some number of component occurrences. This involves part-whole methodology rather than the more familiar deductive, inductive or statistical reasoning.

The present study extends the functionality of database operation by demonstrating part-whole processing using ordinary database formats for knowledge base representations based on the State of Affairs methodology. This capability provides new support for intelligence analysis.

II. METHODOLOGY

The State of Affairs approach is designed to provide, and exploit, representations of the world of ordinary things and everyday experience. It does so by providing (a) a formal system which mutually implicates the basic reality concepts of object, process, event, and state of affairs and (b) logical schemas for specifying the information needed to

distinguish one process, or kind of process from another, one object from another, etc. These are presented below.

The fundamental notion of State of Affairs has two important connections. First, a state of affairs corresponds directly to (a) a statement in a natural language and (b) what would be called a "fact" in ordinary discourse. Second, a row in a relational data base, which in that context would be called "a relation" corresponds to a particular state of affairs. Thus, operations on data bases are natural exemplars of state of affairs operations.

A. State of Affairs as a Formal System

The State of Affairs system is presented in Table 1 as a "Rewrite" system couched as a set of Transition Rules. No attempt has been made to reduce the system to a minimum set of rules.

Table 1. State of Affairs Transition Rules

1. A state of affairs is a totality of related objects and/or processes and/or events and/or states of affairs.
2. A process (or object or event or state of affairs) is a state of affairs which is a constituent of some other state of affairs.
3. An object is a state of affairs having other, related objects as immediate constituents. (An object divides into related, smaller objects.)
4. A process is a sequential change from one state of affairs to another.
5. A process is a state of affairs having other, related processes as immediate constituents. (A process divides into related, sequential or parallel, smaller processes.)
6. An event is a direct change from one state of affairs to another.
7. An event is a state of affairs having two states of affairs (i.e. "before" and "after") as constituents.
8. That a given state of affairs has a given relationship (e.g., succession,

incompatibility, inclusion, common constituents, etc.) to a second state of affairs is a state of affairs.

8a. That a given object or process or event has a given relationship to another object or process or event is a state of affairs.

9. That a given object, process, event or state of affairs is of a given kind is a state of affairs.

10. That an object or process begins is an event and that it ends is a different event.

10a. That an object or process occurs (begins and ends) is a state of affairs having three states of affairs ("before," "during," and "after") as constituents.

The recursive structure of the SA System should be noted explicitly. It is this structure which permits us to represent actual or hypothetical phenomena at different "levels of generality" or "degrees of granularity" simultaneously and to move from one level to another. Event-subevent "inferencing" and Part-Whole analyses depend on traversing levels of description.

B. *State of Affairs as Descriptive Formats*

The Transition Rules provide implicit definitions of the basic reality concepts of Object, Process, Event, and State of Affairs. As such they are universal, and they apply equally to all objects, processes, events, and states of affairs. To reach a representational capability we require a parametric analysis of the domain of processes (objects, events, states of affairs). To give a parametric analysis of a Domain is to specify the ways in which one Element of the Domain can, as such, be the same as (or different from) another Element of the Domain. When we do this with the concepts defined by the Transition rules, the result is a set of

parameters such that when we specify their values, that distinguishes a particular process (object, etc.) from any other process. When we partially specify the parametric values, that distinguishes a kind of process from any other kind. The approach results in the "Descriptive Formats" shown below. Each descriptive format is a schema (and a set of prompts) for specifying the information which distinguishes one process (object, etc.) from another.

Table 2. The Basic Process Unit (BPU)

P-Name A: The process "Name" of process A.

P-Description A: The "Description" of A. It specifies:

I. P-Paradigms: The major varieties of P-NameA. This is a technical option. If only one paradigm exists, it will be the same as P-NameA. For each paradigm, the following is specified:

(a) Stages in 1-K: These are "Names" of subprocesses within A. They are systematically specified, e.g., as P-NameA11, P-NameA12, ..., P-NameA1K for Paradigm 1. For each stage, specify:

(1) Options 1-N: These are the various exemplars of the process (stage) in question. That is, these are the various ways in which that process could happen. Each Option is systematically indexed as P-NameA111, P-NameA112, ..., P-NameA11N. Each of these can now be expanded (decomposed) on the model of P-NameA.

(b) Individuals

(c) Elements

(d) Eligibilities

(e) Contingencies

(f) Versions

Table 3. The Basic Object Unit (BOU)

O-NameA: The "object" name of ObjectA. (This is an expression which identifies the object. It may be expanded to a list of names, each of which is the name of this same object.)

O-DescriptionA: The "description" of O-NameA. It specifies the following.

I. O-Paradigms: (O-Paradigm, O-Name1A, O-Name2A, etc.): These are alternative decompositions of O-Namek into immediate constituents. For each paradigm the following is specified.

(1) Constituents: etc.

(2) Relationships 1, 2, ...m: These are given by a list of relationships. Each item on the list is specified as follows.

(A) Name: An expression which identifies an N-place relationship (state of affairs). Note that N is not constant for different items on the list 1, 2, ... m.

(B) Elements: A list of N elements, each of which is one of the members of the N-place relationships.

(C) Individuals: A list of individuals which are constituents of O-Name1A.

(D) Eligibilities: A specification of which individuals may or must participate as which Elements in the relationship by virtue of their constituency in O-Name1A.

(E) Contingencies (Attributional or co-occurrence): Specification of conditions under which an individual eligible to be a given Element is that Element.

(3) Attributes of O-Paradigm (i.e. of O-NameA as consisting of the structure given by the relationship involved in a given paradigm).

Table 4. The Basic State of Affairs Unit (SAU)

SA-NameA: The "Name" of state of affairs A. This may be given by any identifying reference, such as a sentence ("The man shot the bear"), a sentential clause ("the shooting of the bear"), a simpler locution ("the shooting"), or a conventional symbol (SA-NameA).

SA-DescriptionA: The "Description" of SA-NameA. It specifies:

(I) Relationship: An explicit identification of an N-place relationship, or attribute. (A property is a 1-place attribute.)

(II) Elements: A list of the N elements, or logical roles in the Relationship. These are distinguished as 1st, 2nd, ..., Nth elements.

(IIa) Eligibilities: Each of the N elements is characterized as being either necessarily or optionally an object, process, event, state of affairs, attribute, or concept.

(III) Individuals: A list of N Individuals identified as individuals by a name, number, symbol, etc. (Note that "individual" is not the same as "object.")

(IIIa) Classification: Each of the N Individuals is identified as an object, process, event, state of affairs, attribute, or concept.

(IV) Assignments: The N Individuals are placed in one-to-one relation with the N Elements, with each Individual being identified as the exemplar of the corresponding Element in the state of affairs SA-NameA.

(V) Expansions: An expansion consists of the recursive use of the SAU (as developed to this point) in one of the following ways:

(1) Elaborating the Classification of a given Individual as an object, process, event, or state of affairs by giving a SAU description of it (via Rule 1, 3, 5, or 6). This will amount to using BPU, BOU, Event, or SAU formats.

(2) Elaborating the Classification of a given Individual as an Attribute by giving a SAU description in which the Attribute is the Relationship.

(VI) Contingencies:

(1) Since contingency statements are possible within BPU and BOU representations and the latter may occur as expansions, such contingency statements will qualify as contingencies within the full SAU also.

(2) Co-occurrence constraints such that the use of a particular "Name" (in general, referring terminology, either technical or nontechnical) for any Element within the full SAU is contingent on the use of particular other "Names" for other Elements.

(3) Co-occurrence constraints such that the use of a particular Element is contingent on its being that element (or an Element) of the SAU within which it is an Element. (Note that stages, options, and paradigms within a BPU or BOU will qualify as Elements here.)

III. CHARACTERISTICS OF A STATE OF AFFAIRS APPROACH

The general character of the SA approaches to information analysis and interpretation involves the following.

First, it involves the construction of a priori representations of the domain of interest. "A priori" refers to the fact that the representations are constructed independently of the specific facts or information that is to be processed, and usually prior to the acquisition of those facts.

Second, the primary representations are multilevel. The lower levels correspond to measurements or observational data. That is, they are relatively concrete, limited in scope, and correspond to the kinds of fact which are ascertainable by observation. The higher levels correspond to more general states of affairs which bear a whole-part relation to the lower levels.

Third, the higher levels of description correspond to "interpretations" of the lower level facts. Given this structure, the thrust of the informational analysis is to move upward from the observational "givens" to the significant "interpretations" in some legitimate way. The issue of legitimacy arises because in general, neither deductive nor inductive methods are applicable. The higher level descriptions do not follow from particular observational data. This is why we hold them tentatively as "interpretations" rather than simply adding them to our body of "facts." And, in general, the data is not available to support an inductive probabilistic inference (though devices for making use of judged a priori probabilities do exist). The difficulty is not an artifact; it reflects reality. It can be exhibited clearly in a couple of examples.

1. Consider the case of motors (internal combustion engines) and carburetors. From the fact that a carburetor is known to be present, it certainly doesn't follow that there is a motor present (or vice versa). Further, the probability of a motor (either in general or in these circumstances) given the presence of a carburetor is surely conjectural (who has ever collected data that would support an inductive relative frequency probability statement here?). On the other hand, interpreting a motor based on a known carburetor is not just blind guesswork, either.

2. Six tanks are observed to move from point A to point B. From this it certainly doesn't follow that a general offensive is taking place. As for inductive probability, who has ever collected data on the relative frequency of cases where

six tanks moved from A to B and also that was part of a general offensive? Even if we introduce an intermediate level interpretation, e.g., "A group of tanks made an aggressive move" the difficulty remains the same. On the other hand, interpreting a general offensive based on a known aggressive tank movement needn't be blind guesswork, either.

In the SA approach the interpretive process follows part-whole lines rather than inductive or deductive ones. A high level SA description ("interpretation") is legitimized when enough of the component low or intermediate level SA's are taken to be present. This basic principle is subject to the following caveats.

1. For a given set of facts, competing interpretations may be equally legitimate.

2. Counter indications need to be taken into account.

3. Even reasonable conclusions may be controverted by further observation. Since the question of how much is "enough" in the way of constituent states of affairs is itself a matter of judgment, specific criteria may be introduced for automatic processing in particular cases or it may be left to a human user to make the interpretation.

IV. THE KNOWLEDGE BASE

The present study was designed to demonstrate part-whole processing, including event-subevent analysis. To accomplish this required a knowledge base to provide material for analysis. Because the use of data from operational settings was not feasible an experimental knowledge base was constructed.

A. Background

The construction of the knowledge base for this purpose was responsive to the following considerations.

1. Previous work made use of detailed process representations as a basis for event-subevent inferencing. At the time, it was noted that the sequential stage structure of the process representation was conceptually paradigmatic, but that in many cases the stages would have a more complex set of temporal relationships. Under those conditions it seemed desirable to deal with stages simply as parts of the process and handle their temporal relationships as a separate state of affairs.

2. Temporal relationships among parts are relatively distinctive to processes. In the other reality concepts, the more general relation of Part-Whole is

primarily involved.

3. The kinds of real world happenings which are of interest in the present context tend to be on a large scale (regional, national, international). The detailed process representations which would be needed to connect these significant events to observation reports would not be feasible within the scope of the present study.

4. As a result of recent world events it appears that political and economic happenings will be of no less interest than other kinds of occurrences.

Given the foregoing, the indicated course was to work primarily with State of Affairs representation. The construction and use of the knowledge base described below exploits the fact that (a) statements in ordinary discourse and (b) rows in a data base both correspond directly to states of affairs.

B. Design of the Knowledge Base

In the State of Affairs approach, a Knowledge Base corresponds to some domain of interest. Conventionally, the domain is delimited by specifying (a) a geographic region (which may be worldwide), (b) a period of time, and (c) a set of significant states of affairs. Our interest in a particular locale is not unbounded,

nor is it open-ended idle curiosity. Rather, we have certain significant states of affairs in mind, and our interest is in whether one or more or these is the case (or in which one of these is the case). "Interpretation" ultimately consists of affirming, denying, or taking some more noncommittal position in regard to these states of affairs. The latter includes offering interpretations which are intermediate between observational data and the ultimate interpretations which they may help point to. An expert system supports the analysis process if it helps in the legitimate movement up the interpretive ladder. The technical thrust of the present system is to provide resources, both explicit and implicit, for doing that.

For the present study the domain selected was a small, hypothetical, Central European country, Slovenia, over a period of several months. Most of the observation reports deal with happenings in the city of Karlory Vary. The geography of the city is as follows. The city is generally rectangular in shape, with the long axis running north-south. Running from west to east along the midline of the rectangle are (a) business district, (b) public buildings and the major public square, Masaryk Square, and (c) a large complex called Hadori Castle, housing the national, regional, and city governments. Karlory Vary University and its surrounding housing occupies most of the northwest quadrant. In this area are student oriented businesses such as Jenny's Tavern (a hangout for subversives) the University Restaurant, and the August Moon Teahouse. In the south and south central area are the industrial district, including a tractor factory,

a tank repair yard, and a munitions factory. The train station and rail yards occupy most of the southeast area.

Although the dates are nominally rendered as 1997 to emphasize the hypothetical character of the data, the milieu is modeled on circumstances prior to the fall of the Berlin wall. The significant states of affairs range over economic, political, and military ones, with the political being the focus of interest from an observational standpoint. The high level significant states of affairs which were selected were the following.

1. Slovenia is preparing to invade its southern neighbor.
2. Slovenia is preparing for military defense.
3. Slovenia is in a high state of military readiness.
4. There is a high level of political instability in Slovenia.
5. There is a high level of economic strain in Slovenia.
6. There is a high level of political repression in Slovenia.
7. There is general economic prosperity in Slovenia.
8. There is general public satisfaction in Slovenia.

A state of affairs focus, as against a process focus, was selected as being most responsive to the considerations described above. (Note that of the eight significant states of affairs listed above, only the first two would be plausibly represented as processes.) With respect to the significant SA's, a part-whole analysis was conducted by asking, "What

more limited states of affairs would be (or could be) constituents of this state of affairs?" This approach surfaced a certain kind of problem in establishing continuity between the significant SA's and observation reports. For example, consider "There is a high level of political instability in Slovenia." Constituent states of affairs would include (a) "There is a high level of serious public demonstrations" and (b) "There is a high level of strikes, slowdowns, and work stoppages." In contrast, observation reports are likely to be reports of a single episode, e.g. "Four hundred students demonstrated for over an hour in Masaryk Square this noon, protesting new student quotas at the University before they were dispersed by a squad of 12 policemen."

Two parallel solutions were (a) doing quantitative analyses on the data base and (b) Factor Space A (below), with possible quantitative analyses also. Provision was made in the knowledge base of a table of observation reports covering roughly the same range as the eight significant SA's above. No attempt was made to dovetail these precisely with the eight significant SA's, since the presence of extraneous, irrelevant, or uninterpretable data is to be expected in an operational setting. In order to facilitate the process of interpretation, a set of low level redescriptions (of observations) was developed.

These are designated as Fact Types. In introducing Fact Types, we move from asking "What was the actual fact?" to "What kind of fact is this?" We arrive at the answer to the latter by dropping some of the concrete details of the observational data. For example, "At around noon on June 7, 400 students demonstrated for over an hour in

Masaryk Square protesting the new student quotas at the University before a squad of 12 policemen dispersed the crowd" is the reported fact. This fact qualifies as an instance of several kinds of fact simultaneously:

a. Students demonstrate at place X at time Y over issue Z.

b. Police clash with students.

c. A serious demonstration occurred at place X and time Y.

d. N policemen were at place X at time Y

Because Fact Types have such a close logical relation to observed facts one can start with an observed fact and classify it as to the Fact Type(s) it instantiates by simple inspection and with no analysis or very minimal analysis. Correspondingly, such "coding" of the observations into Fact Types can be regarded either as a simple data transformation or as a lowest level interpretation.

The reason for introducing Fact Types is relatively clear-cut. It is these, rather than the bare particulars as such which are further interpretable. What potentially connects the particular observation to a significant interpretation is not that there were 400 students or that it occurred at 12 o'clock or in Masaryk Square. Rather, what counts is that it was a serious demonstration or that it was a police-civilian clash, etc.

Thus, the functionally primary data was not the observation reports (which appear in the

Reports table) but rather, the reported facts displayed in the form of the Fact Types in a separate table designated as the Fact File. The Fact File is literally a table of instantiated Fact Types. For example, Fact Type 032 in the Fact Types table is represented as follows.

032 [Police][Arrest][Students][Charges][Location]

The brackets indicate that these are placeholders, or variables, and particular observations will supply specific content for the placeholders. Thus, a particular instance of 032 might be represented as follows.

[6 police][Arrested][28 students][Rioting][Jenny's Tavern]

The Fact File is a compact form of representation which retains the particulars of the observations and the meaningfulness of the Fact Types. Because of this it lends itself to various kinds of analysis. For example, one can do a database search to find rows where the Fact Type is 032 and the content of the last placeholder is Jenny's Tavern. One can also search for occurrences of 032 and analyze this subset for trends such as increasing or decreasing frequency.

The Fact File also has fields for date/time, source, validity estimate, and report number.

Factor Spaces

Also part of the knowledge base are three Factor Spaces. A generic view of Factor Spaces as components of an information system is as follows.

A Factor Space is based on a two-way table. Generically, the column headings are referred to as Variables and the row identifiers are referred to as Items. Items and Variables are connected by a specified type of relationship, R. One or more persons makes quantitative judgments about the relation R between each Item and each Variable. That is, the person judges (on a 0-9 point scale) the degree to which the Item has the relation R to the Variable. These judgments fill the cells in the table.

Each Variable may be regarded as a reference axis in a Euclidean space with orthogonal reference axes. As a result of the judgments, each item can be represented as a point in an N-dimensional space or, alternatively, as a profile with N components. The spatial representation can be used as an indexing system for indexing the items. Items which have high coordinates on a given reference axis have a high degree of the relationship R to the corresponding Variable. Items which are closer together in the N-space are similar in their relationships to each of the Variables.

Where redundancy among the Variables is expected to be a problem, the Variables can be intercorrelated and the correlation matrix factor analyzed. The result is an M-dimensional space in which the original Variables no longer correspond to reference

axes but instead are represented as unit vectors. The cosine of the angle formed by two such vectors corresponds to the correlation between the two variables. Since the variables do not correspond to reference axes, the reference axes of such a Factor Space may not be readily interpretable.

Factor Space A

For this factor space, the Variables are the eight significant states of affairs listed above and the Items are the Fact Types. The relation R (and the nature of the quantitative judgment) should be noted carefully: "The degree to which this states of affairs (Fact Type) would be an integral part of this state of affairs (Significant SA) if it were to continue to occur or occurred repeatedly."

Although the instruction for the judgment requires careful and complex wording, the judgment itself is not particularly difficult for a person. The selection of this instruction reflects the difficulty noted above, namely that the significant SA's, e.g., "political instability" mostly involve constituents which consist of repeated occurrences of particular sorts of happenings, whereas observation reports almost always refer to a single occurrence of some kind, and the combination prevents us from making a direct connection from the observation report to the significant SA.

In Factor Space A, if a given Fact Type has a high coordinate value on a reference axis

defined by one of the significant SA's, e.g., political instability, that marks it systematically as the right kind of event for making that interpretation, but it carries no implication that one should make the interpretation. Rather, it makes it easy and convenient to look at a collection of such occurrences, including possibly trend analyses, and decide (automatically or by inspection) whether "political instability" is what they all add up to.

Because the interpretability of the reference axes in this space is essential and because each of the eight significant SA's was treated as being of intrinsic, independent interest, no factor analysis was performed. (Similarly, for Factor Space B, below.) The reference axes of this space therefore correspond to the eight significant SA's. Functionally, Factor Space A is a special kind of an "Indications" space.

Factor Space B

For this factor space, the Variables are the eight significant SA's and the Items are the Fact Types. The relation R, and the corresponding instruction for making the judgments was "the degree to which this state of affairs (the Fact Type) would, if it continued or occurred repeatedly, counterindicate the presence of this state of affairs (the Variable)."

Factor Space B is the complement to Factor Space A. Where the latter gives indications, Factor Space B gives counterindications.

Factor Space C

The first two factor spaces make use of the Fact Types as Items. These, Fact Types, represent a clerical level encoding for the observation reports, and the Fact File, which consists of the observation reports coded as instantiated Fact Types, is the main functional database for observations. However, although the encoding involved in going from observation reports to Fact Types is minimal, it would be desirable to have the capability for automatically analyzing the observation reports directly without any prior human intervention. Factor Space C provides this capability.

Factor Space C makes use of the following 16 variables:

1. Antigovernment Activity
2. Civilian Population
3. Cost/Price/Money
4. Governmental Unit/Agency
5. Industry/Agriculture
6. Military Activity
7. Military Equipment/Facility
8. Military Unit/Personnel
9. Official/Official Action

10. Police Action

11. Production

12. Structure/Location

13. Transportation

14. University Students

15. University/Administration

16. Violence/Conflict

These variables represent a qualitative analysis of the dimensions of the conceptual domain corresponding to the set of placeholders in the entire set of Fact Types.

The Items are a sample of 134 terms taken from the observation reports and the Fact Type placeholders. (Note that the set of Fact Types was itself generated as an intermediate level of description between the observation reports and the Significant SA's.)

The instruction for Factor Space C was the following. "To what extent does this (the Item)refer to the same kind of phenomenon as this (the variable)?" Judgments were made on the usual 0-9 scale. Thus, this Factor Space is a variation on the notion of a "Category Space."

SA Processes

It is almost never the case that a general state of affairs such as the eight significant SA's listed above emerges abruptly from a neutral background. Instead, there is typically some recognizable course of events which we can point to (if only after the fact) and say "That's how it developed." Further, for a given significant SA there will in general be more than one way that it could develop.

Mapping these developmental sequences calls for process representation. Using the process/paradigm/stage/option notation, each distinct developmental sequence is represented as a paradigm.

Processes of this sort are designated as "SA processes" to distinguish them from Social Practices, which are behavioral processes. Previous work with process representation and process analysis has relied entirely on Social Practice representations. In order to provide a model for SA process analysis, one of the eight significant SA's (political instability) was selected and three developmental paradigms were constructed. These representations are given in the SA Processes table. The corresponding SA Eligibility table carries the information relating Fact Types to possible constituency in significant states of affairs.

Resource Analysis

Many processes and states of affairs involve the temporary or permanent expenditure of certain kinds of resource (personnel, time, money, fuel, equipment, etc.). If the amount of the resource available at a given time can be established with some confidence, the resource availability will help set limits to what could be the case at any given time. E.g., you can't have three things going on at a given time if collectively they require significantly more of the resource than is available. Apparent violations of this requirement are grounds for reevaluating (a) the amount of resource available or (b) the occurrence of the resource-using processes or SA's, and they may be grounds for holding in abeyance all of the conclusions involved in the resource conflict.

In the present case a relevant limited resource was identified as the number of policemen available at a given time of day. This can be calculated from the Table of Organization of the police department. Given that, it would be possible to detect when observation reports conflict in that they imply more police personnel than were available during the period in question.

V. Analyzing Observation Reports

As noted above, the "raw" data is a set of observation reports which are found in the "Reports" table. The analysis capability may be divided into two major modes. In the Structured Mode, we make systematic use of a SA-structured framework for interpretation. In the Open Mode we use the analysis capabilities to generate intermediate level descriptions without any explicit reference to an interpretive framework.

A. Structured Approach - SA Analysis

In this approach we begin with the fact that our interest in the Domain is limited to the question of whether any one of a finite set of states of affairs is the case. These are designated as Significant SA's, and in the present Knowledge Base, eight significant SA's are represented. The interpretation/analysis question is which, if any, of the significant SA's is the case. The task is to answer this on the basis of a set of (mostly observation) reports which, in general, will vary in regard to length, level of description, content, format, source, etc. The general interpretive framework is a multilevel description in which observation reports will fall at relatively low levels and the ultimate interpretations (the significant SA's) will fall at the highest levels. Lower level states of affairs are constituents of higher level states of affairs, and a higher level state of affairs can be presumed to be the case if enough of its constituent states of affairs are present.

a. The first step is the encoding, by inspection, of the observation reports in terms of the Fact Types which are derived as constituents of the Significant SA's. This is a clerical level task; the degree of interpretation required is minimal. The major disadvantage is that the necessity for human processing at such an early stage may constitute a significant bottleneck. There are two major advantages. The first is that it takes us from the heterogeneity of the actual reports to a standard set of frames (the Fact Types). The second is that it guarantees that we are dealing with appropriate and convenient relevant facts. There is no need to try to accomplish the parsing and semantic analysis of the reports by automatic means when they are so easily done by humans.

b. Instances of Fact Types are facts of a certain type. Such facts are constituents of larger scale, intermediate level states of affairs, and ultimately they are constituents of the significant SA's. The constituency relationship introduces complexity into the analysis because it is possible to have the same kind of high level SA (including significant SA) with different sets of constituent SA's. Because of this the significant SA's are analyzed into a set of (possible) constituents at the level of Fact Types, but then two kinds of specification are needed. The first is a count of occurrences of instances of constituent Fact Types. The second is a specification of how much is enough.

An example is found in the SA process analysis (see below). The intermediate level SA of "minor political unrest" has associated with it a set of four potential constituent SA's which are Fact Types such as

002 [Students] [Demonstrate against] [Target] [Issue]

Any occurrence of any of the four fact types will be counted in deciding whether the SA "minor political unrest" is the case except that instances of Fact Type 024 are counted only if there are occurrences of one or more of the other three (this is specified in a Contingency statement).

In the interest of flexibility and in the absence of substantive norms, the decision as to "how much is enough" is left to the analyst. This flexibility extends to the choice of what calendar period is subjected to the question "is (was) there minor political unrest during this period?"

B. Structured Approach - SA Process Analysis

A general state of affairs such as "there is currently a state of political instability in Slovenia" does not appear out of the blue. In general, there will be a recognizable developmental sequence which eventuated in this Significant SA. In general, one can say a priori, "Given this significant SA, here are the major ways

it could have come about." And, in general, what we distinguish as the major ways it could have come about can be redescribed in more technical terms as prototypical scenarios or in the language of Process Representation, as Process Paradigms.

C. Semistructured Approach

Conceptually and in reality, the low level Fact Type SA's are connected to the Significant SA's by intermediate SA's. That is, in general, Fact Type SA's are constituents of intermediate SA's, and these are constituents of higher level intermediate SA's, . . . and these are constituents of Significant SA's. However, a connection can be made directly from Fact Type SA's to significant SA's. (This would be like saying, "The float valve is part of the carburetor which is part of the motor which is part of the automobile.)

Factor Spaces A and B (indications and counterindications) facilitate this kind of analysis. These two Factor Spaces represent a quantification as compared to the kind of discrete analysis noted above. Instead of associating a discrete set of Fact Type SA's with a given Significant SA, <u>all</u> the Fact Types were judged (with respect to <u>each</u> of the eight significant SA's) as to the extent to which repeated occurrences or continued occurrence would qualify as a constituent of the Significant SA.

Because of this, if we are interested in a particular Significant SA such as "Political Instability," we can do a simple count of instances of these Fact Types which have the highest coordinate values on the "Political Instability" reference axis. Only simple numerical methods (such as counting, averaging, establishing increase or decrease trends, comparing averages for two periods of time) are needed for this kind of analysis. (This kind of analysis in Factor Space A (indications) can be compared with the same analysis n Factor Space B (counterindications).)

Here again, the question of how much is enough is left to the analyst; the foregoing kind of analysis brings the relevant date in the relevant form for making that judgment. Unquestionably, rules of thumb could be used to specify criteria for making the entire process an automatic one (probably for default purposes). However, it appears that the relevant numerical norms will reflect specifics such as the number and kinds of sources; thus, these numerical criteria are better developed in an operational or near-operational setting.

A related kind of analysis is the following. Instead of focusing on a single Significant SA, and asking "Is this the case?" we can examine all eight simultaneously and map occurrences (instances) of those Fact Types which are most closely associated with each Significant SA comprising the Factor Space. Thus, by simple counting we can develop a profile of the frequency with which

happenings indicating each of the Significant SA's are occurring during a given time period. In an operational system such profiles could be generated and updated automatically.

D. Open Approach

This type of analysis makes minimal use of the interpretive framework and instead makes use of the fact that the Fact File (the instances of Fact Types) and the observation reports are in data bases and can be queried using standard database techniques. (The observation reports could be appended to the Fact File by creating an extra column in the table.)

1. Relational DB Searches

The following are paradigmatic search specifications in a relational data base. [Give me all rows where]

(a) The value of F-Type is "032"

(b) The value of F-Type is "032) and the value of E4 is "Jenny's Tavern."

(c) The value of F-Type is "107" or "108" and the value of E3 is "Karlory Vary" and the value of E4 is "grater than 12 and less than

100."

This kind of search makes subsets of the table readily available for whatever purposes the analyst has in mind.

2. "Fuzzy"" Relational DB Searches

Standard relational database searches are accomplished by string matching. For example, query (a), above includes the string "032." This string is matched with the values i the F-Type column and it requires an exact match to select that row of the table.

There are many cases where what we really want is not captured by a precise, concrete specification such as "032," but rather, by such locations as "something of this general kind" or "anything that's pretty much like this example."

Factor Spaces provide this kind of capability when the items which are indexed in the Factor Space are also values of one or more of the columns in the data base. This is because "anything that is pretty much like this example" can be operationalized as "this example and any other that is close to it in the Factor Space." The limitation here is that the nature of

the Factor Space is determined by the kind of judgment that was made relating Items to Variables, and it is only in this respect that two items which are close together in the Factor Space are "pretty much the same thing." For example, two items which are close together in Factor Space A are similar in the extent to which they are qualitative indicators of each of the eight Significant SA's.

Thus, in the present context, it would be possible to implement a request such as the following. "For each value of F-Type in a row where Source=02, get me that row and any other row where the value of F-Type is close to this F-Type value in Factor Space A." Roughly speaking this request will return data which includes photo-reconnaissance reports (source=02) and any other data which deals with the same sort of facts.

3. Statistical Summaries

The Fact File contains reports of occurrences of particular kinds (Fact Types). Given that we can retrieve particular kinds of data by means of database searches, we can then analyze occurrences that fit the same specification.

(a) We can count the number of occurrences in a given time period.

For example, "There have been seven student demonstrations in the last three months," or "There have been 39 occurrences of F-Types which are high on "Political Instability" in Factor Space A in the last three months."

(b) We can average the occurrences over time, e.g. "Student demonstrations have been occurring at the rate of .54 per week over the last three months."

(c) We can compare rates of occurrence in different time periods, e.g., there have been more student demonstrations in the last three months than there were a year earlier.

(2d) We can analyze the occurrences for the presence of trends, e.g. "Student demonstrations have been increasing in frequency over the past year." This can be done on a purely numerical basis, e.g., "They've gone from .20 per week last year to .54 per week in the last three months." It can also be done on a statistical test basis, e.g. "A Sign test shows a significant tendency for student demonstrations to increase in frequency over the last six months." (In this test one would compare each interval between demonstrations with the previous interval.)

VI. Software

Software was developed for performing some of the major kinds of analyses described above.

A. Platform

The software developed for performing these analyses makes use of an existing platform, KDS^{T} (Knowledge Dictionary System^{T}), a proprietary, commercially available software environment of Ellery Systems, Inc., Boulder, Colorado.

B. Event-subevent analysis

This software accomplishes part-whole analysis, including event-subevent inferencing (see V. A and V. B, above).

C. Resource conflict analysis

This software analyzes resource allocations over competing processes or states of affairs and detects cases where reported events are incompatible because they jointly require more of a given resource than is available. In such cases the reports of those events are ignored in further processing in that analysis.

APPENDIX A

KNOWLEDGE BASE TABLES

The knowledge base consists of the following:

Fact Type Table
SA Process Representation
Significant States of Affairs List

Factor Space A
Factor Space B
Factor Space C

The Fact Type Table and the SA Process representation are presented below.

FACT TYPE TABLE

F-Type	Element-1	Relation	Element-2	Element-3	Element-4
001	ethnic minorities	demonstrate against	target/issue	location	low violence
002	students	demonstrate against	target/issue	location	low violence
003	people	demonstrate against	target/issue	location	low violence
004	ethnic minorities	demonstrate against	target/issue	location	significant violence
005	students	demonstrate against	target/issue	location	significant violence
006	people	demonstrate against	target/issue	location	significant violence
007	police	physical clash	ethnic minorities	location	violence rating
008	police	physical clash	students	location	violence rating
009	police	physical clash	people	location	violence rating
010	police	increase repression	ethnic minorities	issues	methods
011	police	increase repression	students	issues	methods
012	police	increase repression	people	issues	methods
016	central government	restricts	government officials	aspect	‡
017	central government	restricts	military personnel	aspect	‡
018	people	sabotage	facility	aspect	method
019	terrorists	kill/injure	people	number	method
020	terrorists	destroy/damage	military property	method	‡
021	terrorists	destroy/damage	civilian property	method	‡
022	group a	violent clash	group b	location	issue
023	workers	strike	facility	date/duration	issue
024	workers	slowdown	scope	date/duration	issue
025	farmers	withhold	products	location/scope	duration/interval
026	people	illegal departure	from country	date/interval	number
027	people	illegal entry	to country	date/interval	number
028	monetary unit	worth less	value in dollars	date/interval	‡
029	police	arrest	group members	number	date/interval
030	troublemaker	incites	group	target/action	issue
031	police	break up/disrupt	group demonstration	location	issue
032	police	arrest	students/number	charges	location
033	people	produce less	industrial products	time interval	location/scope
034	people	produce less	agricultural products	time interval	location/scope
035	police	arrest	citizens	charges	location
036	students	boycott classes	institution	issue	date/duration
040	people	produce more	industrial products	time interval	location/scope
041	people	produce more	agricultural products	time interval	location/scope
042	students	decrease frequency	demonstrations		
043	students	decrease seriousness	demonstrations		
044	people	decrease frequency	demonstrations		
045	people	decrease seriousness	demonstrations		
046	police	decrease repression	ethnic minorities		
047	police	decrease repression	students		
048	police	decrease repression	people		
049	people	decrease sabotage	facilities		
050	people	decrease destruction	property		
051	people	decrease strikes	facilities		
052	people	decrease amount	illegal emigration	country	
053	monetary unit	worth more	previous value	current value	dollar value
058	military unit	has personnel	amount	date yymmdd	
059	military unit	has equipment	amount	date yymmdd	

060	people	produce more	military equipment	time period		
061	people	produce more	ammunition	time period		
062	military personnel	increase in number	personnel category	location	time interval/date	
063	military unit	activated	type of unit	location	date yymmdd	
064	military unit	increases number	equipment	equipment category	time period/date	
065	military unit	upgrades	equipment	equipment category	type of upgrade	time/date
066	military unit	increases number	personnel	personnel category	time period	
067	military unit	upgrades	facilities	facility category	upgrade category	
070	people	produce less	military equipment	equipment category	time period	
071	people	produce less	ammunition	ammunition category	time period	
072	military unit	decreases number	personnel	personnel category	time period	
073	military unit	deactivated	date			
074	military unit	decreases amount	equipment	equipment category	time period	
080	military unit	increases maintenance	equipment	equipment category	time period	
081	military unit	increases repair	equipment	equipment category	time period	
082	military unit	increases number	training classes	training category	time period	
083	military unit	increases size	training classes	training category	time period	
084	military unit	increases number	exercises	type of exercise	time period	
085	military unit	adds kinds	exercises	type of exercise	time period	
086	military unit	upgrades	defences	type of upgrade	type of defence	
087	military unit	increases number	inspections	type of inspection	time period	
088	military unit	holds exercise	type of exercise	location	size of operation	
089	military unit	increases number	equipment	equipment category	time period	
090	military unit	adds kinds	equipment	equipment category	time period	
091	military unit	decreases repair	equipment	equipment category	time period	
092	military unit	decreases number	training classes	type of class	time period	
093	military unit	decreases size	training classes	type of class	time period	
094	military unit	decreases number	exercises	type of exercise	time period	
095	military unit	decreases kinds	exercises	kinds eliminated	time period	
096	military unit	decreases maintenance	equipment	equipment category	time period	
107	rail traffic	is	location	number		
108	people A	fight	people B	location	number	
109	official	estimates amount	ag production	region	amount	
110	people	estimate amount	ag production	region	amount	
111	people	estimate amount	industrial production	region	amount	
112	people	estimate amount	military production	region	amount	
113	tanks	in	tank repair yard			
114	persons x	meet with	persons y	persons z	location	
115	person	observed at	location	type of person		
116	persons	gather at	location			
117	official	appoints	person	office/rank		
118	official	announces	text/fact			
119	people	begin construction	facility/structure	type of facility/struct		
120	people	work on	facility/structure	type of facility/struct		
121	people	complete construction	facility/structure			
122	rail traffic	is	from location a	to location b	number	
123	military personnel	in transit	from location a	to location b		

SA PROCESS REPRESENTATION

SA PROC	1. The SA-PROC Table contains the sample Part-whole relationships for the SA processes involved in the "Political Instability" SA process. (Separate proceses are identified by process numbers, which are used here and in SA-PW, SA-ELIG, and CONTIN.
SA PW	2. Table SA-PW contains the Part-whole relationships for the "Political Instability" SA process where each of the parts is a necessary component of the whole.
SA ELIG	3. Table SA-ELIG contains the Part-whole relationships for the "Political Instability" SA process where each of the parts is optionally a component of the whole.
CONTIN	4. Table CONTIN continues the Contingencies which are part of the representations for the processes shown in SA-PROC and SA-ELIG
SA-ESEI	5. This version of SA-PROC is the form used in the current implementation. It combines the information in 1, 2, and 3, above.

SA-PROC TABLE

Proc_No	PPSO	Process
01	1.0.0.0	Development of Political Instability
	1.1.0.0	Groundswell of Unrest
	1.2.0.0	Economically based unrest
	1.3.0.0	Fomented Political Instability
02	1.0.0.0	Groundswell of Unrest
	1.0.1.0	Minor political Unrest
	1.0.2.0	Significant political Unrest
	1.0.3.0	Major political unrest
03	1.0.0.0	Minor Political Unrest
	1.0.1.1	Fact type 001
	1.0.1.2	Fact type 002
	1.0.1.3	Fact type 003
	1.0.1.4	Fact type 004
04	1.0.0.0	Significant Political Unrest
	1.0.1.1	Fact type 001
	1.0.1.2	Fact type 002
	1.0.1.3	Fact type 003
	1.0.1.4	Fact type 004
	1.0.1.5	Fact type 005
	1.0.1.6	Fact type 006
	1.0.1.7	Fact type 018
	1.0.1.8	Fact type 023
	1.0.1.9	Fact type 024
	1.0.1.10	Fact type 026
05	1.0.0.0	Major Political Unrest
	1.0.1.1	Fact type 001
	1.0.1.2	Fact type 002
	1.0.1.3	Fact type 003
	1.0.1.4	Fact type 004
	1.0.1.5	Fact type 005
	1.0.1.6	Fact type 006
	1.0.1.7	Fact type 007
	1.0.1.8	Fact type 008
	1.0.1.9	Fact type 009
	1.0.1.10	Fact type 018
	1.0.1.11	Fact type 023
	1.0.1.12	Fact type 024
	1.0.1.13	Fact type 025
	1.0.1.14	Fact type 026
06	1.0.0.0	Economic Deterioration
	1.0.1.0	Negative economic indications increase
	1.0.1.0	Negative economic changes occur
07	1.0.0.0	Negative economic indications increase
	1.0.1.1	Fact type 018
	1.0.1.2	Fact type 024
	1.0.1.3	Fact type 025
08	1.0.0.0	Negative economic changes occur
	1.0.1.1	Fact type 028
	1.0.1.2	Fact type 033
	1.0.1.3	Fact type 034
09	1.0.0.0	Fomented political Instability
	1.0.1.0	Minor political unrest
	1.0.2.0	Fomented unrest
010	1.0.0.0	Fomented Unrest
	1.0.1.1	Fact types 030, 001
	1.0.1.2	Fact types 030, 002
	1.0.1.3	Fact types 030, 003
	1.0.1.4	Fact types 030, 004
	1.0.1.5	Fact types 030, 005
	1.0.1.6	Fact types 030, 006
	1.0.1.7	Fact types 030, 018
	1.0.1.8	Fact types 030, 023

	1.0.1.9	Fact types 030, 024
011	1.0.0.0	Economically Based Unrest
	1.0.1.0	Economic Deterioration
	1.0.2.0	Significant Political Unrest
	1.0.3.0	Major Political Unrest

SA-PW TABLE

WHOLE_SA	PART_SA
Groundswell of Unrest	Minor Political Unrest Significant Political Unrest Major Political Unrest
Fomented Political Instability	Minor Political Unrest Fomented Unrest
Economically Based Unrest	Economic Deterioration Significant Political Unrest Major Political Unrest

SA-ELIG TABLE

S O A	ELIGIBLE INSTANCE
Development of Political Instability	Groundswell of Unrest Economically Based Unrest Fomented Political Instability
Minor Political Unrest	ftype 001 ftype 002 ftype 003 ftype 024
Significant Political Unrest	ftype 001 ftype 002 ftype 003 ftype 004 ftype 005 ftype 006 ftype 018 ftype 023 ftype 024 ftype 026
Major Political Unrest	ftype 001 ftype 002 ftype 003 ftype 004 ftype 005 ftype 006 ftype 018 ftype 023 ftype 024
Economic Deterioration	Negative economic indications increase Negative economic changes occur
Negative economic indications increase	ftype 018 ftype 024 ftype 025
Negative economic changes occur	ftype 028 ftype 033 ftype 034
Fomented unrest	ftypes 030, 001 ftypes 030, 002 ftypes 030, 003 ftypes 030, 004 ftypes 030, 005 ftypes 030, 006 ftypes 030, 018 ftypes 030, 023 ftypes 030, 024

CONTIN TABLE

P_No_	C_No_	Constraint/contingency
002	01	1.0.2.0 begins after 1.0.1.0
	02	1.0.3.0 begins after 1.0.2.0
003	01	1.0.1.1 meets criteria for "minor demonstration"
	02	1.0.1.2 meets criteria for "minor demonstration"
	03	1.0.1.3 meets criteria for "minor demonstration"
	04	1.0.1.4 counts only if 1.0.1.1 or 1.0.1.2 or 1.0.1.3 is also the case
	05	1.0.0.0 meets criterion for "standing condition x" or for "increase of x"
004	01	1.0.1.1 is (meets criteria for) "significant demonstration"
	02	1.0.1.2 is "significant demonstration"
	03	1.0.1.3 is "significant demonstration"
	04	1.0.1.4 is "significant demonstration"
	05	1.0.1.5 is "significant demonstration"
	06	1.0.1.6 is "significant demonstration"
	07	1.0.0.0 iff 1.0.1.1 or 1.0.1.2 or 1.0.1.3 or 1.0.1.4 0r 1.0.1.5 or 1.0.1.6
	08	1.0.0.0 is case of (meets criteria for) "standing condition x" or "increase of x"
005	01	1.0.1.1 is "major demonstration"
	02	1.0.1.2 is "major demonstration"
	03	1.0.1.3 is "major demonstration"
	04	1.0.1.4 is "major demonstration"
	05	1.0.1.5 is "major demonstration"
	06	1.0.1.6 is "major demonstration"
	07	1.0.0.0 is a case of "standing condition x" or "increase of x"
006	01	1.0.0.0 iff either 1.0.1.0 or 1.0.2.0
	02	1.0.1.0 and 1.0.2.0 cover the same time period
007	01	1.0.0.0 is a case of "standing condition x" or "increase of x"
009	01	1.0.2.0 begins after 1.0.1.0
010	01	1.0.1.1 is "significant demonstration" or "major demonstration"
	02	1.0.1.2 is "significant demonstration" or "major demonstration"
	03	1.0.1.3 is "significant demonstration" or "major demonstration"
	04	1.0.1.4 is "significant demonstration" or "major demonstration"
	05	1.0.1.5 is "significant demonstration" or "major demonstration"
	06	1.0.1.6 is "significant demonstration" or "major demonstration"
	07	1.0.1.7 iff 1.0.1.1 or 1.0.1.2 or 1.0.1.3 or 1.0.1.4 or 1.0.1.5 or 1.0.1.6
	08	1.0.1.8 iff 1.0.1.1 or 1.0.1.2 or 1.0.1.3 or 1.0.1.4 or 1.0.1.5 or 1.0.1.6
	09	1.0.1.9 iff 1.0.1.1 or 1.0.1.2 or 1.0.1.3 or 1.0.1.4 or 1.0.1.5 or 1.0 1.6
	10	1.0.1.7 iff 018 is a case of "standing condition x" or "increase of x"
	11	1.0.1.8 iff 023 is a case of "standing condition x" or "increase of x"
	12	1.0.1.9 iff 024 is a case of "standing condition x" or "increase of x"
11	01	1.0.2.0 begins after 1.0.1.0
	02	1.0.3.0 begins after 1.0.2.0

SA-ESEI TABLE

EVENT	T	SUBEVENT	RULE
Political Instability	1	Or1	orp(
Or1	1	Groundswell of Unrest	GrSwUn()
Or1	1	Fomented Political Instability	FoPoIn()
Or1	1	Economically Based Unrest	EcBaUn()
Groundswell of Unrest	1	And1	andp(
And1	1	Minor Political Unrest	MiPoUn()
And1	1	Significant Political Unrest	SiPoUn()
And1	1	Major Political Unrest	MaPoUn()
Fomented Political Instability	1	And2	andp(
And2	1	Minor Political Unrest	MiPoUn()
And2	1	Fomented Unrest	FoUn()
Economically Based Unrest	1	And3	andp(
And3	1	Economic Deterioration	EcDe()
And3	1	Significant Political Unrest	SiPoUn()
And3	1	Major Political Unrest	MaPoUn()
Minor Political Unrest	1	Or2	orp(
Or2	1	Fact Type 001	FT(1)
Or2	1	Fact Type 002	FT(2)
Or2	1	Fact Type 003	FT(3)
Or2	1	Fact Type 004	FT(4)
Significant Political Unrest	1	Or3	orp(
Or3	1	Fact Type 001	FT(1)
Or3	1	Fact Type 002	FT(2)
Or3	1	Fact Type 003	FT(3)
Or3	1	Fact Type 004	FT(4)
Or3	1	Fact Type 005	FT(5)
Or3	1	Fact Type 006	FT(6)
Or3	1	Fact Type 018	FT(18)
Or3	1	Fact Type 023	FT(23)
Or3	1	Fact Type 024	FT(24)
Or3	1	Fact Type 026	FT(26)
Major Political Unrest	1	Or4	orp(
Or4	1	Fact Type 001	FT(1)
Or4	1	Fact Type 002	FT(2)
Or4	1	Fact Type 003	FT(3)
Or4	1	Fact Type 004	FT(4)
Or4	1	Fact Type 005	FT(5)
Or4	1	Fact Type 006	FT(6)
Or4	1	Fact Type 007	FT(7)
Or4	1	Fact Type 008	FT(8)
Or4	1	Fact Type 009	FT(9)
Or4	1	Fact Type 018	FT(18)
Or4	1	Fact Type 023	FT(23)
Or4	1	Fact Type 024	FT(24)
Or4	1	Fact Type 025	FT(25)
Or4	1	Fact Type 026	FT(26)
Economic Deterioration	1	Or5	orp(
Or5	1	Negative Econ Indications Increase	NeEcIn()
Or5	1	Negative Economic Changes Occur	NeEcOc()
Negative Econ Indications Increase	1	MoreThanX1	morep(
MoreThanX1	1	X1	SA->X[1]
MoreThanX1	1	Fact Type Increase 001	FT_inc(
Fact Type Increase 001	1	Fact Type 018	18
Fact Type Increase 001	1	Fact Type 024	24
Fact Type Increase 001	1	Fact Type 025	25
Negative Economic Changes Occur	1	Or7	orp(
Or7	1	Fact Type 028	FT(28)
Or7	1	Fact Type 033	FT(33)
Or7	1	Fact Type 034	FT(34)
Fomented Political Instability	1	And4	andp(
And4	1	Minor Political Unrest	MiPoUn()
And4	1	Fomented Unrest	FoUn()
Fomented Unrest	1	Or8	orp(
Or8	1	And6	andp(
Or8	1	And7	andp(
Or8	1	And8	andp(
Or8	1	And9	andp(
Or8	1	And10	andp(
Or8	1	And11	andp(
Or8	1	And12	andp(
Or8	1	And13	andp(
Or8	1	And14	andp(
Economically Based Unrest	1	And5	andp(
And5	1	Economic Deterioration	EcDe()
And5	1	Significant Political Unrest	SiPoUn()
And5	1	Major Political Unrest	MaPoUn()
And6	1	Fact Type 001	FT(1)
And6	1	Fact Type 030	FT(30)
And7	1	Fact Type 002	FT(2)
And7	1	Fact Type 030	FT(30)

And8	1 Fact Type 003	FT(3)
And8	1 Fact Type 030	FT(30)
And9	1 Fact Type 004	FT(4)
And9	1 Fact Type 030	FT(30)
And10	1 Fact Type 005	FT(5)
And10	1 Fact Type 030	FT(30)
And11	1 Fact Type 006	FT(6)
And11	1 Fact Type 030	FT(30)
And12	1 Fact Type 018	FT(18)
And12	1 Fact Type 030	FT(30)
And13	1 Fact Type 023	FT(23)
And13	1 Fact Type 030	FT(30)
And14	1 Fact Type 024	FT(24)
And14	1 Fact Type 030	FT(30)

APPENDIX B

DATA BASE TABLES

The Data Base Consists of the following:

REPORTS 1. Reports Table:

This table contains the original observation reports in one of the columns and auxiliary information in other columns.

F-FILE 2. Fact File:

This table contains the information from the observation reports in the form of instantiated Fact Types. These are the primary "events" involved in the event sub-event inferencing.

REPORTS

[Reports Table]

R-No-	Report	Date	Time	Src	Vldy	F-Type
001	Rail traffic in K Vary Province is 48 F/F cars, 28 tank cars	06 01 97	11 45	01		107
002	Three students arrested at Jenny's Tavern for fighting	06 01 97	23 00	03		032
003	Production at K Vary tractor factory was reported by plant personnel to be down slightly for the month	06 10 97	00 00	06		033
004	Agriculture Minister Antonin Modari announced that this year's K Vary wheat crop is estimated at 43 million tons, up 2 percent from last year.	06 11 97	00 00	14		109,123
005	6 tanks photographed in the K Vary tank repair yard on 06/01	06 01 97	11 45	01		113
006	AP reports government estimates of national wheat production for this year at 84 million tons, down one percent from last year.	06 12 97	00 00	10		109
007	A student mentioned that 3 students were arrested in Masaryk Square for attempting to organize a demonstration.	06 15 97	00 00	04		032
008	Photos show that rail traffic in K Vary Province on 06/15 is 43 F/P cars and 26 tank cars	06 15 97	11 45	01		107
009	Photos show 6 tanks in the K Vary tank repair yard and 8 in the Praha tank repair yard. 06/15, 11 45	06 15 97	11 45	01		113
010	06/17, 18 05. Recon photos show rail traffic in K Vary Province is 20 F/P cars and 8 tank cars.	06 17 97	18 05	07		107
011	Informant reports that the President of K Vary University had a 3 hour meeting with the minister of the interior and the K Vary chief of police at the president's office on 06/20	06 20 97	00 00	06		114
012	Police are reported to have arrested 10 students for rioting at Jenny's Tavern 06/21 at around 2300 hours	06 21 97	23 00	04		032
013	Several hundred people gathered in Masaryk Square for about an hour at around 1700 hours. Several speeches were made to small groups. The crowd never acted as a unit. Police were visible on side streets (e.g., 4th street and Revolution Avenue).	06 21 97	17 00	03		116
014	President Bonar Pils of K Vary U appointed Gidar Molnar to be Head of the Chemistry Department and Vaclav Cenovic as Head of the Computing Science Department. Both Cenovic and Molnar are strongly conservative	06 22 97	00 00	04		117
015	The President of K Vary U a 2300 hours curfew for students. The curfew will be enforced by the police department.	06 25 97	14 00	03		118
016	Photos show rail traffic in K Vary Province is 40 F/P cars and 24 tank cars 06/29 11 45.	06 29 97	11 45	01		107
017	Photos show 5 tanks in the K Vary tank yard and 8 tanks in the Praha tank yard 06/29 11 45.	06 29 97	11 45	01		113
018	Students report that around 15 students were arrested by the police at Jenny's Tavern for rioting at curfew time 06/30	06 30 97	22 00	04		032
019	Photos show that construction is beginning on a 300 foot extension on the south end of the north-south runway at K Vary Airfield. 06/30 11 45.	06 30 97	11 45	01		119
020	Four railroad cars with an estimated 200 troops reportedly passed through K Vary train station on the way to K Vary Airbase at around 700 hours. 06/30	06 30 97	07 00	04		
021	The administrative Dean of KVU announced that the quota for incoming students in Sept was 1200. This is a reduction of 300 from the quota for the past year. 07/01	07 01 97	00 00	06		118
022	300 students gathered in the Quad at KVU to protest the reduction in student quota for the coming year. speeches were made. A boycott of classes was threatened by Tadik Havel, one of the speakers.The demonstration lasted three hours. 7/5 1500 hours	07 05 97	15 00	03		002
023	Photos show Rail traffic in K Vary Province is 42 f/p cars and 25 tank cars 7/13 1145 xxx	07 13 97	11 45	01		107
024	Photos show 7 tanks in the K Vary tank repai	07 13 97	11 45	01		113

r yard and 9 tanks in the Praha tank yard 7/13 1145

xxx

025	Several persons observed what appeared to be a tank exercise about 20 miles southwest of Karlovy Vary on 7/15 and 7/16. Largest est imate was 50 tanks involved.	07 15 97	00 00	06	088	
	xxx					
026	About 300 students gathered in front of the municipal wing of Hadori Castle to protest the 2300 hour curfew. Bonar Pils and the ch ief of police were burned in effigy. 7/20 1545	07 20 97	15 45	04	002	
	xxx					
027	Recon photos show rail traffic in K Vary Pro vince consists of 24 f/p cars and 8 tank car s. Also shows 6 tank cars in the K Vary tan k yard. 7/17 2000	07 17 97	20 00	07	107, 113	
	xxx					
028	Photos show rail traffic in K Vary Province is 44 f/p cars and 28 tank cars. 7/27 1145	07 27 97	11 45	01	107	
	xxx					
029	Photos show 7 tanks in the K Vary tank yard and 9 in the Praha tank yard. 7/27 1145	07 27 97	11 45	01	113	
	xxx					
030	Police have arrested 15 students in the last three nightsfor curfew violations or papers not in order. 7/30	07 30 97	00 00	04	029	
	xxx					
031	Workers in the Karlovy Vary Tractor Factory engaged in a slowdown for two days to protes t increases in food prices. 8/1	08 01 97	00 00	04	024	
	xxx					
032	AP reported from Vienna that 85 Slovenes hav e crossed the border into Austria illegally in the month of July. 8/3	07 xx 97	00 00	10	027	
	xxx					
033	A policeman reported sighting underground ag itator Filos Szenty in Masaryk Square but wa s not able to apprehend him. 8/5 1300	08 05 97	13 00	06	115	
	xxx					
034	Recon Photos show rail traffic in K Vary Pro vince is 30 f/p cars and 16 tank cars. 8/17 1800	08 17 97	18 00	07	107	
	xxx					
035	conversation with various students indicates that at least 15 students have been arreste d in the last 2-3 days on charges of curfew or papers violations. 8/20	08 20 97	00 00	04	032	
	xxx					
036	Satellite photos show railroad traffic in K Vary Province is 43 f/p cars and 26 tank cars. 8/24 1145	08 24 97	11 45	01	107	
	xxx					
037	Photos show 8 tanks in the K Vary tank yard and 10 in the Praha tank yard. 8/17 1800	08 17 97	18 00	07	113	
	xxx					
038	Satellite photos show 6 tanks in the K Vary tank yard and 8 in the Praha tank yard. 8/24 1145	08 24 97	11 45	01	113	
	xxx					
039	300 persons, mostly students, gasthered in t he University Quad area and marched to Masar yk Square. Protest was against the curfew and against police violence. After about an hour, police cleared the square using moder ate violence. 8/30 1500	08 30 97	15 00	03	002, 008	
	xxx					
040	Photos show a 250 foot extension to the N-S runway at K Vary Airfield is well under way . 9/7 1145	09 07 97	11 45	01	067	
	xxx					
041	Photos show K Vary Province rail traffic is 33 f/p cars and 10 tank cars. 9/7 1145	09 07 97	11 45	01	107	
	xxx					
042	Photos show 5 tanks in the K Vary tank yard and 7 in the Praha tank yard. 9/7 1145	09 07 97	11 45	01	113	
	xxx					
043	Workers at the Karlovy Vary and Plzen train yards have staged an unofficial slowdown for several days. Issue is not known. 9/8	09 08 97	00 00	03	024	

	xxx				
044	Over 40 students at KVU began a 2 day boycot t of classes to protest the new student quot a and the recently introduced curfew. 9/10	09 10 97	00 00	03	032
	xxx				
045	An explosion, commonly believed to be sabota ge, severely damaged a locomotive at the K V ary rail yard. 9/15 1400	09 15 97	04 00	03	018
	xxx				
046	About 400 people gathered in front of Hadori Castle for several hours in a silent protes t against food price increases. 9/17 1700	09 17 97	17 00	03	003
	xxx				
047	Photos show rail traffic in K Vary Province is 36 f/p cars and 20 tank cars. 9/17 1500	09 17 97	17 '	07	107
	xxx				
048	Recon Photos show 10 tanks in the K Vary tan k yard. 9/17 1500	09 17 97	15	7	113
	xxx				
049	Based on Satellite photos, wheat production for Slovenia is estimated to be 40 million tons.	xx xx 97	00 00	02	110
	xxx				
050	Photos of K Vary Province rail traffic show 28 f/p cars and 14 tank cars. 9/21 1145	09 21 97	11 45	01	107
	xxx				
051	Photos show 6 tanks in the K Vary tank yard and 7 in the Praha yard. 9/21 1145	09 21 97	11 45	01	113
	xxx				
052	The Minister of the Interior reportedly met with the President of KVU for two hours. 9/21 1700	09 21 97	17 00	06	114
	xxx				
053	Defects in tractors returned to the K Vary T ractor Factory as defective are believed by the manager of the factory to have been sabo taged by putting some forewign substance in the gas tanks.	09 xx 97	00 00	06	018
	xxx				
054	About 100 students joined around 200 other persons marching from Masaryk Square to Hado ri Castle to protest increases in food price s. 9/24 1700	09 24 97	17 00	04	006
	xxx				
055	Workers in the K Vary Munitions Factory are suspected of engaging in a slowdown, though no one admits it and the slowdown is margina l. 10/4	10 04 97	00 00	04	024
	xxx				
056	Photos of K Vary Province rail traffic show 29 f/p cars and 16 tank cars. 10/5 1145	10 05 97	11 45	01	107
	xxx				
057	Photos show 6 tanks in the K Vary tank repai r yard and 6 in the Praha yard. 10/5 1145	10 05 97	11 45	01	113
	xxx				
058	At this date it appears that police are incr easing surveillance of students and are stop ping more students at night checking papers and possible curfew violations. 10/15	10 xx 97	00 00	04	032
	xxx				
059	Photos show rail traffic in K Vary province is 40 f/p casrd and 24 tank cars. 10/17 1145	10 17 97	11 45	01	107
	xxx				
060	Photos show 10 tanks in the K Vary tank repa ir yard. Ground shows evidence of unusual amount of traffic. 10/17 1800	10 17 97	18 00	07	113
	xxx				
061	Photos show apparent completion of a 250 foo t addition to the north-south runway at K Va ry Airfield. 10/19 1145	10 19 97	11 45	01	121, 067
	xxx				
062	Six B-905's are reported to have arrived at K Vary Airbase. If so, these are the first B905's to be based at this airfield. Also, this would explain why the N-S runway was ex tended. 10/25	10 25 97	00 00	06	090,089
	xxx				
063	About four hundred students demonstrated in Masaryk Square for several hours at around 1700 hours on 10/27. Sixteen police	10 27 97	17 00	03	002,031,124, 127

dispersed the crowd. The students were protesting the new admission quota at the university. 10/27 1700

xxx

064 Four police entered Jenny's Tavern at around 1800 hours and spent two hours checking the papers of all persons present and warning about the curfew. Two persons were detained. 10/27 1800 — 10 27 97 1800 04 011,032

xxx

065 Four police entered the University Restaurant at around 1830 hours and checked the papers of all persons present. They arrested two students and left at around 2000 hours. 10/27 1830 — 10 27 97 1830 04 011,032

xxx

F-FILE

[Fact File]

F-No	E-Date-MDY	E-Time	F-Type	Element-1	Relation	Element-2	Element-3	Element-
01	06 01 97	11 45	107	rail traffic	is	K Vary province	48	freight/passenge
02	06 01 97	11 45	107	rail traffic	is	K Vary province	28	tank cars
03	06 01 97	23 00	032	police	arrest	three students	fighting	Jenny's Tavern
04	06 10 97	00 00	033	workers	produce less	K Vary Tractor factory	month	xxx
05	06 11 97	00 00	125	Agriculture Minister	estimates	Wheat K Vary province	43 million tons	year 1997
06	06 11 97	00 00	123	Agriculture Minister	estimates	Wheat K Vary province	2 percent decrease	year 1997
07	06 01 97	11 45	113	tanks	in	K Vary Tank Yard	6	xxx
08	06 12 97	00 00	125	Government	estimates	Wheat Czechoslovenia	84 million tons	year 1997
09	06 12 97	00 00	123	Government	estimates	Wheat Czechoslovenia	1 percent decrease	year 1997
10	06 15 97	10 00	032	police	arrest	3 students	demonstration	Mazaryk Square
11	06 15 97	11 45	107	rail traffic	is	K Vary province	48	freight/passenge
12	06 15 97	11 45	107	rail traffic	is	K Vary province	26	tank cars
13	06 15 97	11 45	113	Tanks	in	K Vary Tank Yard	6	xxx
14	06 15 97	11 45	113	Tanks	in	Praha Tank Yard	8	xxx
15	06 17 97	20 05	107	rail traffic	is	K Vary province	20	freight/passenge
16	06 17 97	20 05	107	rail traffic	is	K Vary province	8	tank cars
17	06 20 97	00 00	114	K Vary U President	met with	Minister of Interior	K Vary Chief of Police	K Vary Universit
18	06 21 97	23 00	032	police	arrest	10 students	rioting	Jenny's Tavern
19	06 21 97	17 00	116	hundreds of people	gathered at/in	Mazaryk Square	xxx	xxx
20	06 22 97	00 00	117	KVU President	appointed	Gidar Molnar	Department Head	Chemistry
21	06 22 97	00 00	117	KVU President	appointed	Vaclav Cenovic	Department Head	Computing Scienc
22	06 25 97	14 00	118	KVU President	announces	Student curfew	2200 hours	xxx
23	06 29 97	11 45	107	rail traffic	is	K Vary province	40	freight/passenge
24	06 29 97	11 45	107	rail traffic	is	K Vary province	24	tank cars
25	06 29 97	11 45	113	tanks	in	K Vary Tank Yard	5	xxx
26	06 29 97	11 45	113	tanks	in	Praha Tank Yard	8	xxx
27	06 30 97	22 00	032	police	arrest	15 students	rioting	Jenny's Tavern
28	06 29 97	11 45	119	people	begin construction	runway extension	300 feet	K Vary Airbase
29	06 30 97	07 00	122	rail passenger cars	in transit	K Vary Train Station	K Vary Airbase	four
30	06 30 97	07 00	123	troops	in transit	K Vary Train Station	K Vary Airbase	est 200
31	07 06 97	11 00	118	Admin Dean K Vary Univ	announced	student quota	September admissions	1200 students
32	07 06 97	11 00	118	K Vary Univ	reduced	student quota	300 students	20 percent
33	07 05 97	15 00	002	students	demonstrated 3 hrs	student quota reduction	K Vary Univ Quad	violence 1
34	07 05 97	15 00	030	Tadik Havel	speech	students	KVU Administration	student reductio
35	07 13 97	11 45	107	rail traffic	is	K Vary Province	freight/passenger	42
36	07 13 97	11 45	107	rail traffic	is	K Vary Province	tank cars	25
37	07 13 97	11 45	113	tanks	in	K Vary tank yard	7	xxx
38	07 13 97	11 45	113	tanks	in	Praha tank yard	9	xxx
39	07 15 97	00 00	088	(unidentified units)	held exercise	tank exercise	20 miles SW of K Vary	est 50 tanks
40	07 20 97	15 45	002	est 300 students	protested	curfew	Hadori Castle	violence 3
41	07 17 97	20 00	107	rail traffic	is	K Vary Province	freight/passenger	24
42	07 17 97	20 00	107	rail traffic	is	K Vary Province	tank cars	8
43	07 17 97	20 00	113	tanks	in	K Vary tank yard	6	xxx
44	07 27 97	11 45	107	rail traffic	is	K Vary Province	freight/passenger	44
45	07 27 97	11 45	107	rail traffic	is	K Vary Province	tank cars	28
46	07 27 97	11 45	113	tanks	in	K Vary tank yard	7	xxx
47	07 27 97	11 45	113	tanks	in	Praha tank yard	9	xxx
48	07 30 97	00 00	029	police	arrest	students	15	3 days
49	08 01 97	00 00	024	workers	slowdown	K Vary Tractor Factory	2 days	food prices
50	07 xx 97	00 00	027	Slovenes	illegal entry	Austria	85	month
51	08 15 97	13 00	115	Filos Szenty	seen by policeman	Masaryk Square	underground agitator	xxx
52	08 17 97	18 00	107	rail traffic	is	K Vary Province	freight/passenger	30
53	08 17 97	18 00	107	rail traffic	is	K Vary Province	tank cars	16
54	08 20 97	00 00	032	police	arrest	15 students	curfew or papers	2 to 3 days
55	08 24 97	11 45	107	rail traffic	is	K Vary Province	freight/passenger	43
56	08 24 97	11 45	107	rail traffic	is	K Vary Province	tank cars	26
57	08 17 97	18 00	113	tanks	in	K Vary tank yard	8	xxx
58	08 17 97	18 00	113	tanks	in	Praha tank yard	10	xxx
59	08 24 97	11 45	113	tanks	in	K Vary tank yard	6	xxx

60	08 24 97	11 45	113	tanks	in	Praha tank yard	8	xxx
61	08 30 97	15 00	002	K Vary Univ students	marched	KVU Quad to Masaryk Sq	curfew, violence	violence 2
62	08 30 97	15 00	008	police	dispersed	student demonstrators	Masaryk Square	violence 6
63	09 07 97	11 45	067	people	constructing extension	K Vary Airfield	N-S runway	250 ft extension
64	09 07 97	11 45	107	rail traffic	is	K Vary Province	freight/passenger	33
65	09 07 97	11 45	107	rail traffic	is	K Vary Province	tank cars	10
66	09 07 97	11 45	113	tanks	in	K Vary tank yard	5	xxx
67	09 07 97	11 45	113	tanks	in	Praha tank yard	7	xxx
68	09 08 97	00 00	024	43 workers	unofficial slowdown	K Vary Train Station	several days	[issue unknown]
69	09 10 97	00 00	036	K Vary Univ students	boycott classes	K Vary University	quota, curfew	xxx
70	09 15 97	04 00	018	people	sabotaged	train sta, locomotive	explosion	xxx
71	09 17 97	17 00	003	est 400 people	silent protest	Hadori Castle	food prices	xxx
72	09 17 97	15 00	107	rail traffic	is	K Vary Province	freight/passenger	36
73	09 17 97	15 00	107	rail traffic	is	K Vary Province	tank cars	20
74	xx xx 97	00 00	110	photointerpretation	estimates amount	wheat production	Slovenia	40,000,000 tons
75	09 17 97	15 00	113	tanks	in	K Vary tank yard	10	xxx
76	09 21 97	11 45	107	rail traffic	is	K Vary Province	freight/passenger	28
77	09 21 97	11 45	107	rail traffic	is	K Vary Province	tank cars	14
78	09 21 97	11 45	113	tanks	in	K Vary tank yard	6	xxx
79	09 21 97	11 45	113	tanks	in	Praha tank yard	7	xxx
80	09 21 97	17 00	114	Minister of Interior	met with	K Vary Univ president	xxx	xxx
81	09 xx 97	00 00	018	people	sabotaged	K Vary tractor factory	tractors defective	xxx
82	10 04 97	17 00	003	300 people	marched to	Hadori Castle	food prices	violence 0
83	10 04 97	00 00	024	workers	slowdown	K V munitions factory	xxx	xxx
84	10 05 97	11 45	107	rail traffic	is	K Vary Province	freight/passenger	29
85	10 05 97	11 45	107	rail traffic	is	K Vary Province	tank cars	16
86	10 05 97	11 45	113	tanks	in	K Vary tank yard	6	xxx
87	10 05 97	11 45	113	tanks	in	Praha tank yard	6	xxx
88	10 15 97	00 00	011	police	increase stopping	students	papers, curfew	street checks
89	10 17 97	18 00	107	rail traffic	is	K Vary Province	freight/passenger	40
90	10 17 97	18 00	107	rail traffic	is	K Vary Province	tank cars	24
91	10 17 97	18 00	113	tanks	in	K Vary tank yard	10	xxx
92	10 19 97	11 45	067	K Vary Airbase	upgraded	airfield	N-S runway	250 foot extensi
93	10 19 97	11 45	121	people	complete	K Vary Airfield	runway	250 foot extensi
94	10 25 97	00 00	089	K Vary Airbase	increases number	airplanes	B-905 fighter-bombers	6
95	10 25 97	00 00	090	K Vary Airbase	adds new kind	airplane	B-905 fighter-bomber	6
96	10 27 97	17 00	002	400 students	demonstrate	student quota	Masaryk Square	
97	10 27 97	17 00	124	police	at	Masaryk Square	1700 hrs	16
98	10 27 97	17 00	127	major demo	at	Masaryk Square	1700 hours	
99	10 27 97	17 00	031	16 police	break up	Demonstration	Masaryk Square	student quota
100	10 27 97	18 00	124	police	at	Jenny's Tavern	1800 hours	4
101	10 27 97	18 00	032	4 police	detain	students	papers	Jenny's Tavern
102	10 27 97	18 30	124	police	at	University Restaurant	1830 hours	4
103	10 27 97	18 30	032	4 police	arrest	students	papers	University Resta

MISSION

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