Generating Visual and Interactive Output from System Engineering Tools

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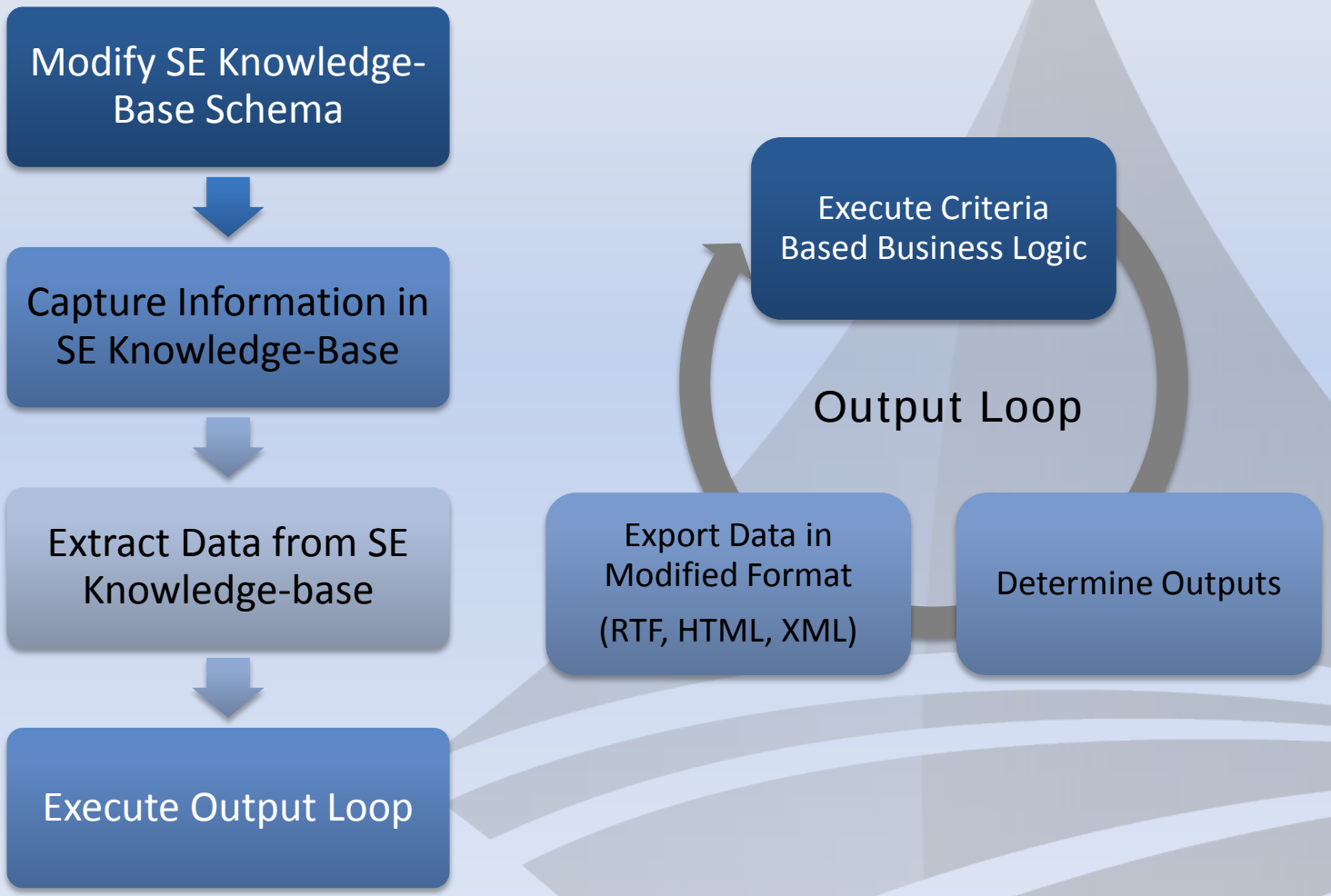
29 October 2009

Overview

- Methodology
- KBAD Schema
- Information Capture Process
- Risk Matrix Visualization
- TPM Capture and Visualization
- Expandable-Collapsible Tree Visualization
- Geo-Spatial Visualization

Methodology



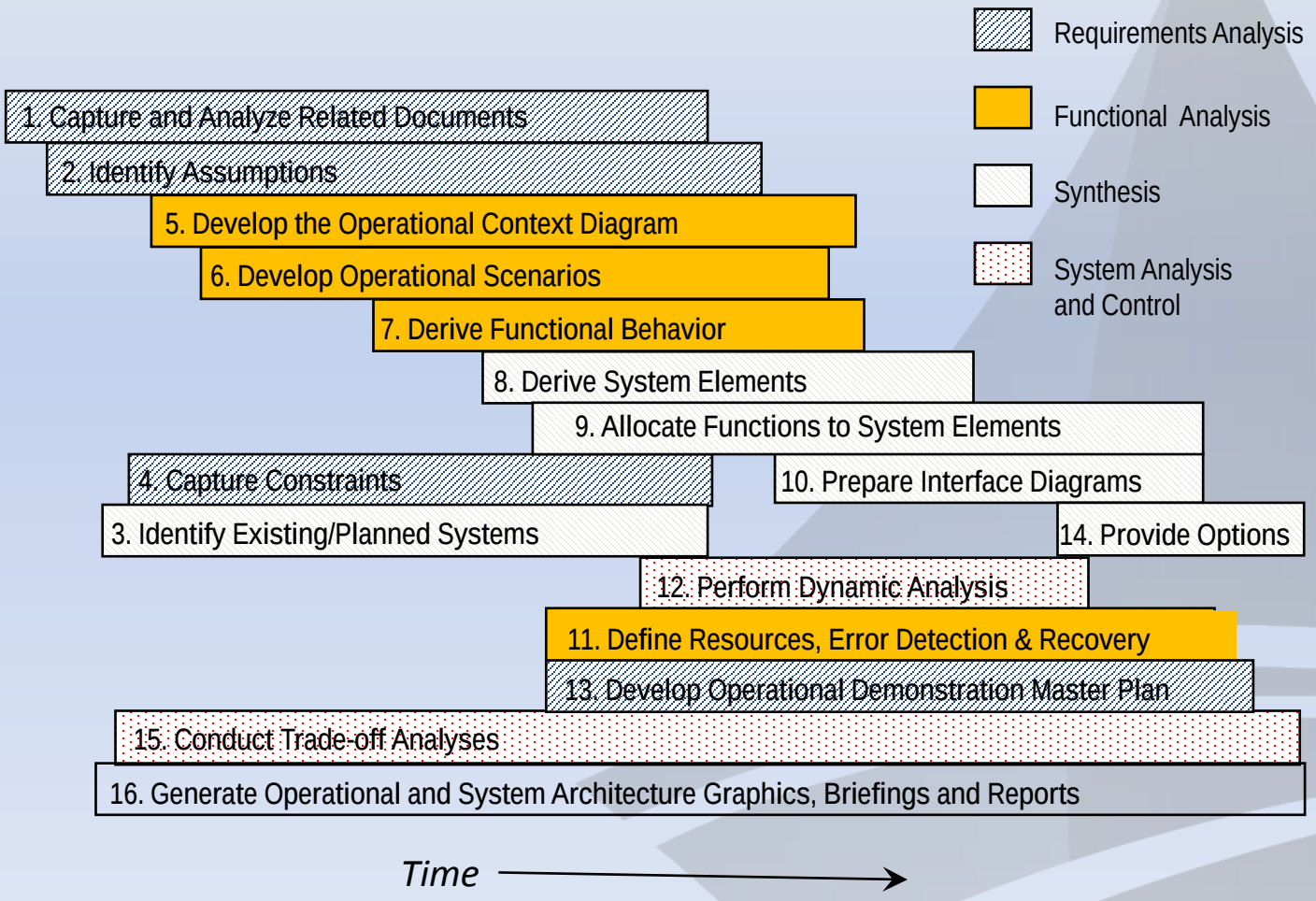
KBAD Schema

KBAD* Element	CORE Elements	Rationale
Action	Function/Operational Activity	Provide overall class for actions
Artifact	Document	Recognized not just documents
Asset	Component/Operational Element	Provide overall class for assets
Characteristic	type of Requirement	Way to capture metrics and other characteristics of an element
Cost	attribute of Component	Broadens capture of costs
Input/Output	Item/Operational Information	Clearer name
Issue	Issue	Same
Link	Link/Needline	Provide overall class for transmission
Location	none	Captures geolocation information
Risk	Risk	Same
Statement	type of Requirement	Clearer name
Time	attribute of Function	Broadens capture of times

The KBAD Schema supports the capture of data items and relationships utilized in the examples.

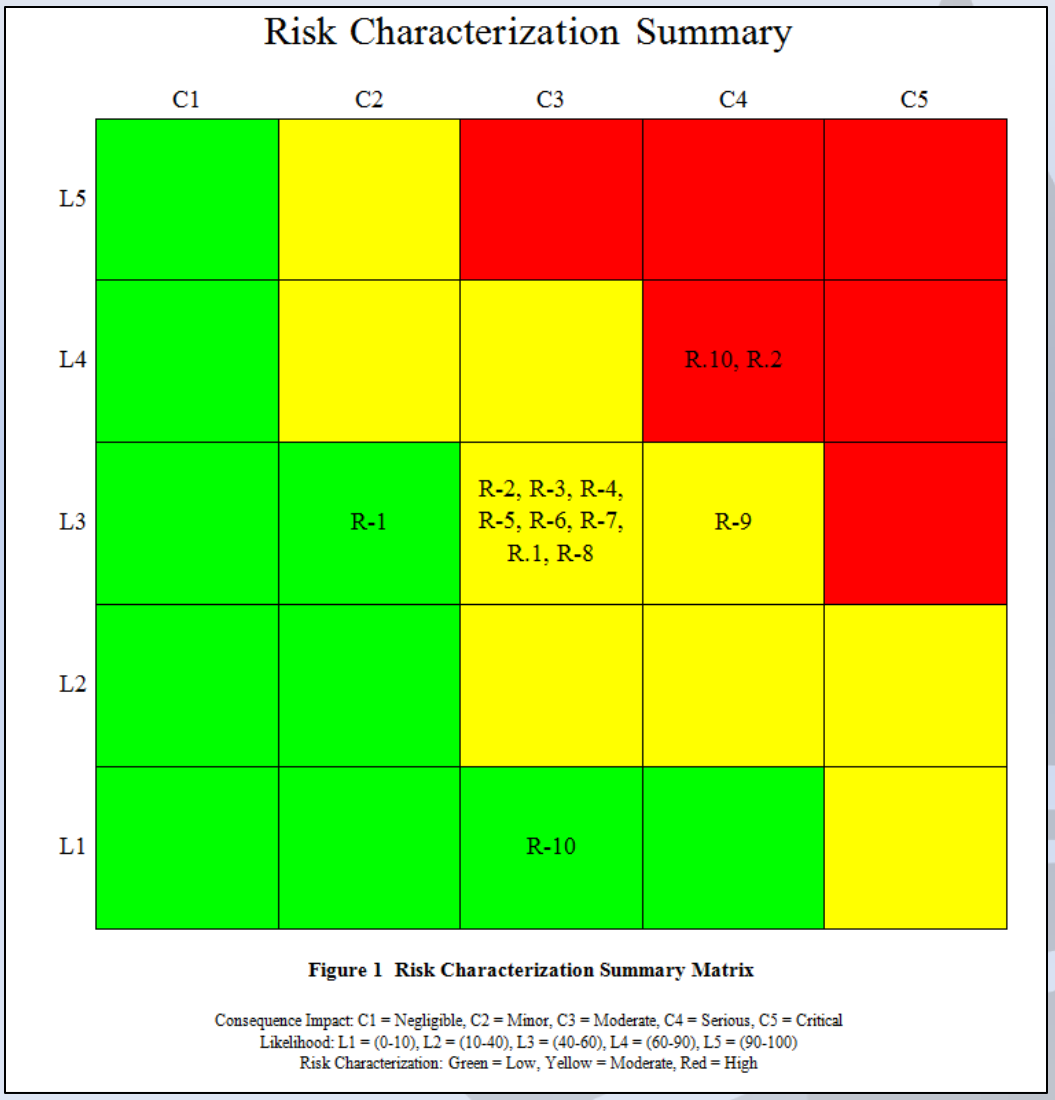
*Knowledge-Based Analysis and Design

Capture Information in SE Knowledge-Base



The KBAD middle-out approach has been proven on a variety of projects.

Risk Matrix Example



Risk Matrix Example - Logic

1. Extract Risks of interest.
2. Create lists of risks for each Risk Matrix cell by examining the risks' consequences and likelihoods.
3. Begin streaming RTF file up to first cell.
4. Set cell color. The cell colors are fixed.
5. Insert risks for given cell.
6. Etc.

TPM Example

	Technical Performance Measures					
	Current	Projected	Threshold	Objective	Units	Imp.Dir.
Hardware Assets						
SBPG Ground Element						
TPM: Ground Element MTTR	60.0	31.0	30.0	15.0	minutes	Negative
SBPG On-Orbit Element						
TPM: On-Orbit Element Lifespan	13.0	15.2	10.0	15.0	years	Positive
TPM: On-Orbit Element Transmission Efficiency	0.63	0.65	0.65	0.75		Positive
TPM: On-Orbit Element Weight	6500.0	5800.0	6000.0	5000.0	kg	Negative
System Functions						
Execute Maneuver Commands						
TPM: Characteristic_001	10.0	13.2	11.0	13.0	seconds	Positive
Issue Maintenance Alert						
TPM: Characteristic_002	0.95	0.97	0.95	0.98		Positive
Collect Solar Energy						
TPM: Characteristic_003	0.65	0.66	0.6	0.65		Positive

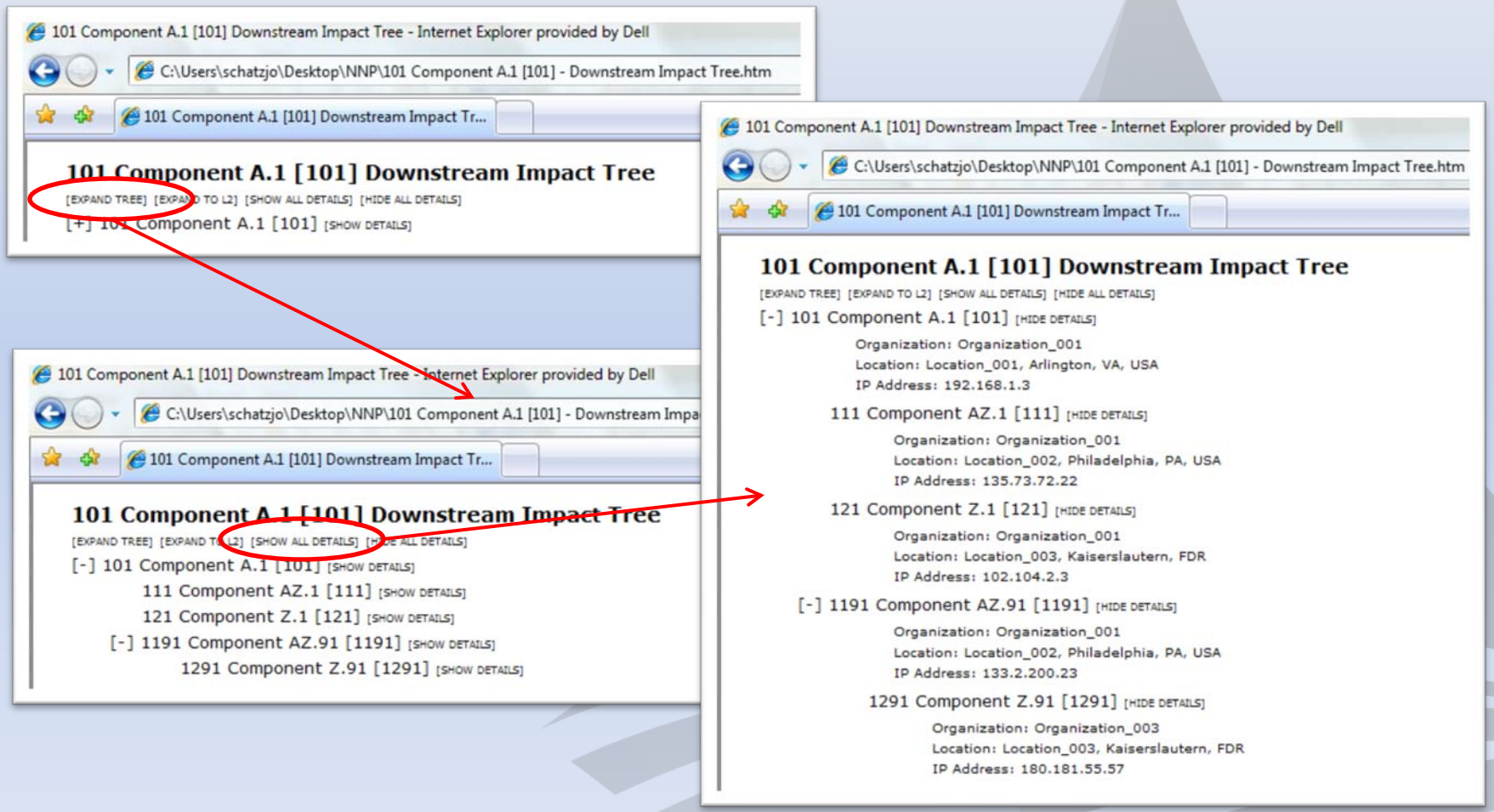
Figure 1 SBPG Context Performance Parameters Matrix

Value Characterization: Green = Exceeds Objective, Yellow = Between Threshold and Objective, Red = Does Not Meet Threshold

TPM Example - Logic

1. Extract TPMs for systems of interest.
2. Begin streaming RTF file up to first System row.
3. Insert System name.
4. Stream up to the system's first TPM.
5. Insert TPM name.
6. Compare current and projected values against threshold and object values taking improvement direction into account.
7. Determine cell color based on predetermined criteria.
8. Insert color coded cells with current and projected values.
9. Etc.

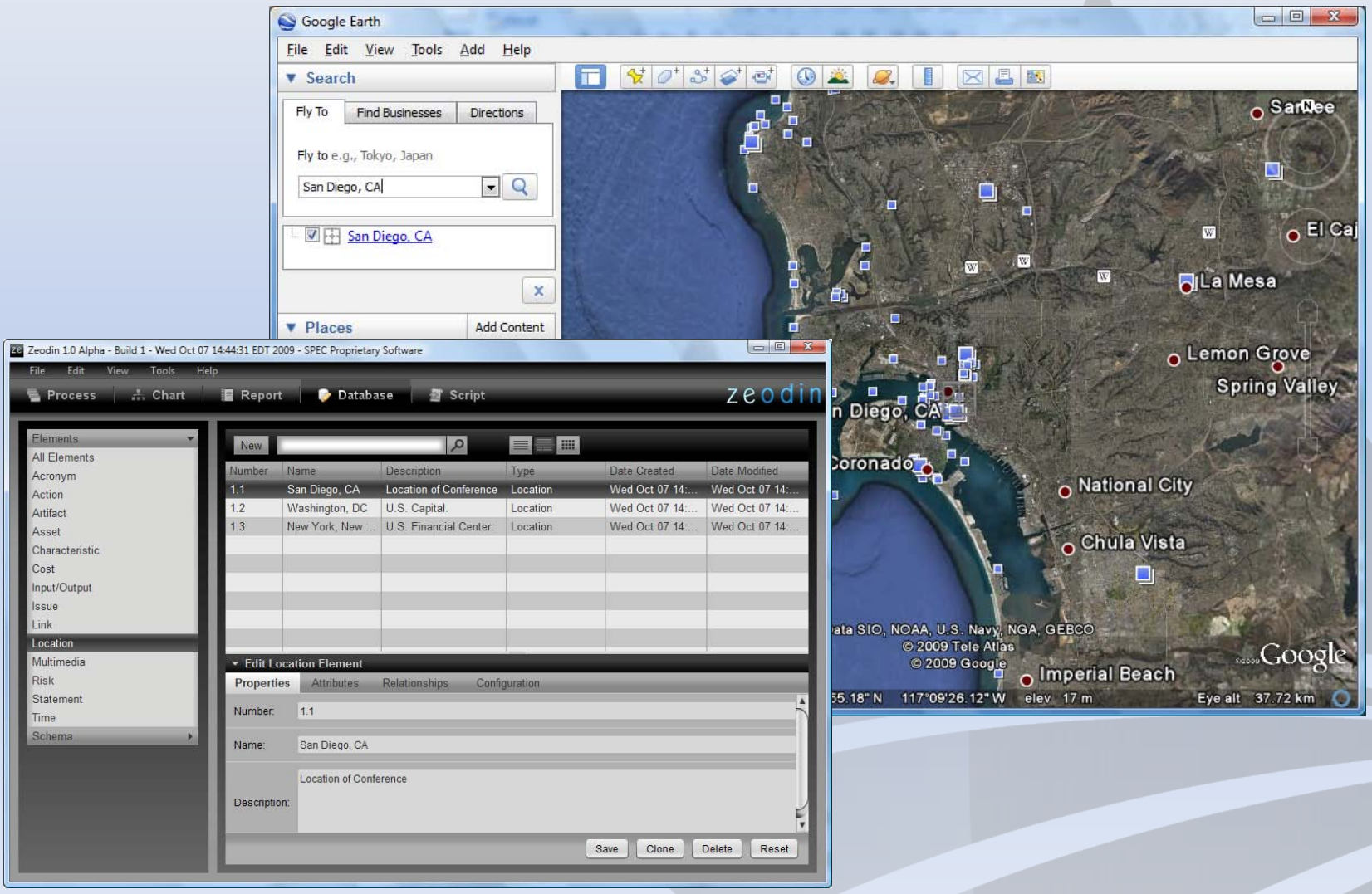
Expandable-Collapsible Tree Example



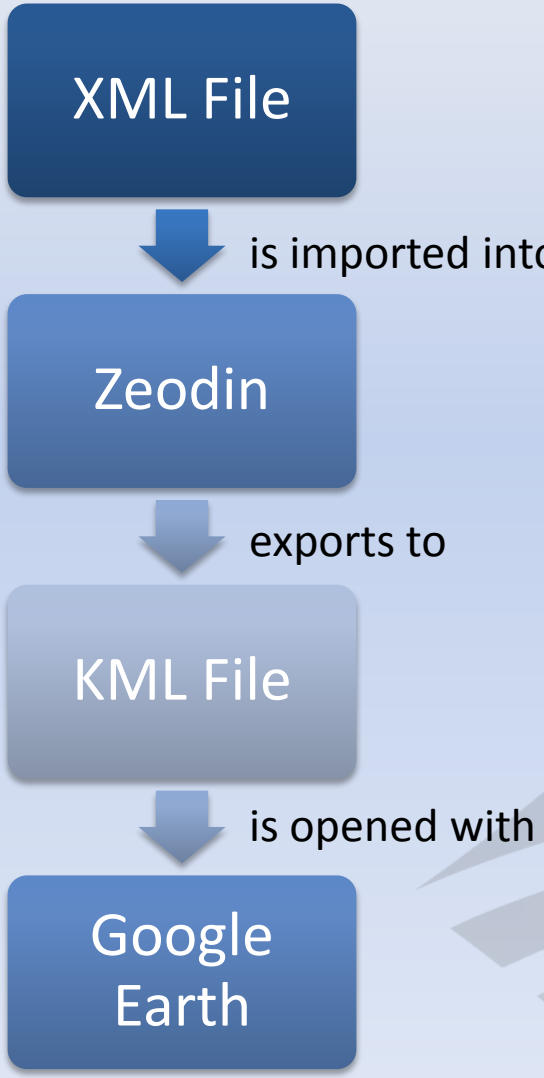
Expandable-Collapsible Tree Example - Logic

1. Write JavaScript and CSS files.
2. Extract nodes in an interconnected nodal network.
3. Generate index file of all nodes.
4. Iterate through nodes doing the following for each:
    1. Generate expandable tree branches and leaves. Prevent closed loops.
    2. Begin streaming HTML file with JavaScript and CSS files referenced.
    3. Store controls and tree data in JavaScript node array.
    4. Store starting positions in JavaScript position array.
    5. Encode nodes into HTML file as absolutely positioned items with embedded JavaScript commands to access Document Object Model (DOM) for hiding or showing nodes.

Geo-Spatial Example



Geo-Spatial Example - Logic



1. Generate KML header information.
2. Extract assets from SE Knowledge-Base.
3. Iterate through assets streaming asset specific KML.

Summary

- Use of other products for visualization is necessary, since most SE tools provide poor graphics for a general audience
- Output from COTS Products can be modified to enhance visualization
- Most tools provide scripting that enable creative visualization