

Link Analysis

ORION Scientific Systems

19800 MacArthur Boulevard, Suite 480
Irvine, California 92612

8400 Westpark Drive
McLean, Virginia 22109
www.orionsci.com

Link Analysis is an extremely powerful analytic tool that has been in the law enforcement and intelligence arsenal for over twenty years. Used effectively in countless analyses and investigations, it graphically portrays the linkages between and among individuals, cells, and groups. The technique analyzes the connections among people, places, and objects, to identify latent group structures and relationships, and isolate communications paths, hierarchical relationships, factors that promote group strength and cohesiveness, and organizational vulnerabilities to disruption, penetration, or interdiction. It is ideal for revealing the hidden connections among perpetrators and the structure of clandestine, organized criminal entities including intelligence operations, terrorist groups, organized crime syndicates, and narcotics cartels. It is also extremely useful to track relationships among the individuals and groups involved in the illegal transfer or diversion of special technologies.

Link Analysis is used to make explicit the formal and informal command and control characteristics of a group. In application, it can reveal:

- the structure and division among command level units,
- the chain of command to subordinate or tier units,
- connections to surface or front organizations,
- distribution networks for exchange and deployment of money, personnel, information, intelligence, equipment, supplies, or contraband, or
- basic unit cell structures.

Despite its effectiveness in supporting complex analyses and investigations, the technique has traditionally been underutilized because of its relatively high cost in

manpower. Large cases often contain hundreds or thousands of observations relating dozens, if not hundreds, of suspects. Creating and manipulating the resulting diagrams *by hand* can take hundreds of manhours, and each new fragment of information can literally send analysts "back to the drawing board."

ORION Scientific Systems (ORION) has been performing basic and applied research with the goal of automating the link analysis process since the late 1970s. Initial strides in the automation of link diagrams were made under the sponsorship of the DARPA Cybernetics Technology Office, in efforts to provide automated tools to support counterterrorism analysis and counterforce planning. Early efforts focused on developing the necessary utilities to draw, store, and display link diagrams. As technology matured, it became possible to evolve link analysis from a simple "drawing tool" to a fully automated, increasingly intelligent set of analytic routines.

The current generation of automated link tools provide analysts with high-powered, fully functional, user friendly modules to automatically draw and manipulate link diagrams. The tools use traditional link diagramming techniques to represent people, using circles, called NODES. The NODES are then connected with solid or dotted lines of varying thickness called EDGES. The system color codes nodes to show their connections as cells, group membership, or participation in activities. The system uses BOXES to group NODES to show cell, intra-group, or incident functions or relationships.

Analysts can customize diagrams, move or group nodes, boxes, or cells, and zoom or pan large displays. Entire cells can be color coded and highlighted. Structures can be isolated and analyzed using a powerful set of "*what-if*" tools. The system additionally provides the ability to annotate the diagram with text and symbols, to label,

comment, or draw attention to special relationships within the diagram. The system also preserves all the original source data used to produce the diagram, and makes that data immediately available to the analyst through a click of the mouse. Thus, the rationale behind any connection, and the original source data to substantiate any element of the diagram, can be retrieved and reviewed at any time.

Another variant of the tool utilizes a 3D display technology with full tilt pan and rotate capabilities, while live in the diagram. This supports analysis of extremely large and complex data sets, such as those involved in 100,000 node (and larger) Telephone Toll analysis investigations. With rapid expansions in the size of the data set the link tools can manipulate and the introduction of companion CONCEPT searching techniques, the tools are increasingly applicable to “intelligent” document filtering for automatic diagram creation; money laundering investigations involving hundreds of thousands of transactions; and comprehensive searches of historical electronic message and file archives.

Artificial Intelligence (AI) provides a fruitful development path for link analysis tools. Despite the increasing benefits of automation, link analysis remains a largely manual process. Automated link tools are still largely drawing tools. They facilitate the creation and manipulation of large diagrams, but their categorization and analysis are still more art than science and based more on visualization than on metrics drawn from the data points themselves. AI provides avenues that promise: 1) greater utility of link diagramming through determining optimal nodal placement and group clustering, and 2) better analysis by identifying and cataloguing typologies of group or activity structures which may be used to describe, identify, and exploit strengths or weaknesses in group internal structures.

Mr. Eric Zidenberg is a Senior Associate for ORION. He manages all of ORION's international client initiatives dealing with ORION Link Analysis and related tools. He also manages multiple statewide systems to include the California Department of Justice system. This project supports a user group supporting over 100 networked sites who utilize the ORION link analysis tools for gang tracking. Other clients include the Joint Drug Intelligence Group in Los Angeles and Houston. Mr. Zidenberg has worked hand in hand with customers to develop specialized link and advanced analytic applications. Additionally, he has developed and conducted specialized link analysis training courses. Mr. Zidenberg has a B.S. in Information Science from Christopher Newport University and a M.S. in Counseling from California State University.

Ms. Barbara Skiffington has over 15 years of hands-on experience in applying Artificial Intelligence (AI) and Information Technologies (IT) to projects for the Department of Defense (DoD), Federal government agencies, and commercial entities. Technologies implemented include expert systems, neural networks, database management systems, geographical information systems (GIS), statistical processing, signal processing, and pattern recognition algorithms. Ms. Skiffington is ORION's Program Manager for the automation of the National Reconnaissance Office personnel security process. This project integrates the following technologies related to AI and Link Analysis: 1) AI – Decision aid for the adjudication decision process, 2) Pattern Recognition – Identification of data patterns, 3) Neural Networks – Decision prediction aid, and 4) Link Analysis – Discovery of data relations for the investigative staff. Ms. Skiffington received a B.S. in Mathematics from James Madison University.

Mr. Craig Wooldridge is a software developer with over 18 years of experience. He is ORION's lead programmer in the advancement and development of Web-based link analysis products. Mr. Wooldridge's expertise lies in advanced software code technologies, graphical user interface, and database design and development. He has a wide range of experience spanning the development of operating systems to the development of real-time analytical systems. Mr. Wooldridge received a B.S. in Computer Science from the University of California, and a M.B.A. from California State University.