Nomination for the Design Science Award of the INFORMS Information Systems Society (ISS), 2008

I.   Cover Statement

A. **Name of nominee and affiliation:** Dr. Hsinchun Chen, McClelland Professor, Director, Artificial Intelligence Lab, Management Information Systems Department, University of Arizona, Tucson, Arizona, USA, hchen@eller.arizona.edu, 520-621-4153

B. **Name of nominator and affiliation:** Dr. Daniel Zeng, Management Information Systems Department, University of Arizona, Tucson, Arizona, USA, zeng@eller.arizona.edu, 520-621-2748

C. **Nominating project: COPLINK (Artificial Intelligence Lab, MIS Department, University of Arizona)**

D. **Goals, Accomplishments and Contributions:** Funded by the National Institute of Justice and the NSF Digital Government Program, the COPLINK project aims to develop information sharing, data mining, and knowledge management technologies for law enforcement community and to understand the associated social and organizational impacts. Based on a ten-year partnership between the UA MIS Artificial Intelligence Lab and various US law enforcement agencies, the project developed an award-winning XML-based (GJXDM, Global Justice XML Data Model) data warehousing logical mapping approach for linking diverse public safety legacy databases and information sources, resulting in efficient information sharing within and across agencies. The project also developed significant data mining and knowledge management research for criminal relationship identification, criminal network analysis and visualization, criminal deception detection, crime spatial-temporal pattern analysis and visualization, public safety workflow and ontology modeling, and law enforcement technology acceptance assessment. Much of the research has been published in major conferences and top-tier MIS and CS publications, including: Communications of the ACM, ACM Transactions on Information Systems, Journal of the American Society for Information Science and Technology, Decision Support Systems, etc. The COPLINK research has generated unique contributions in Information Systems design science related data models, computational algorithms, visualization methods, and web-based system design, especially for digital government information sharing, adversarial data mining, and dark network analysis. The COPLINK system, which has been quoted as a national model for public safety information sharing and analysis, has been adopted in more than 1600 law enforcement and intelligence agencies in 20 states in the US. It has become the largest public safety information sharing system in US (as reported recently by the Washington Post in 2008), revolutionizing law enforcement IT. Dr. Chen is also the founder of the Knowledge Computing Corporation, a university spin-off company and a market leader in law enforcement and intelligence information sharing and data mining. The COPLINK research had been featured in the New York Times, Newsweek, Los Angeles Times, Washington Post, Boston Globe, and ABC News, among others. The COPLINK project was selected as a finalist by the prestigious International Association of Chiefs of Police (IACP)/Motorola 2003 Weaver Seavey Award for Quality in Law Enforcement in 2003. Due to the success of the COPLINK research many public safety agencies have reported significantly improved information sharing and collaboration, more effective crime analysis and case closure, and more timely response to crime incidents, resulting in significant reduction in crime rate and improved citizen safety. Many other countries in Asia and Europe are also in the process of adopting similar COPLINK technologies for their communities.

E. **Design Science Relevance:** The COPLINK system is an end-to-end Information System for the public safety community. Related research began with two years of careful user studies and focus groups with the Tucson and Phoenix police departments and detailed data mapping and logical design based on the (then) new Global Justice XML Data Model (GJXDM). New mathematical models, data mining algorithms, and visualization methods were subsequently developed by the AI Lab researchers and refined based on real-life law enforcement data, crime cases, and continuous feedback from the law enforcement personnel (Tucson Police Department had provided in-kind support of one full-time veteran officer to the COPLINK project for over a decade). Significant algorithm evaluations, user experiments (with police officers and detectives), and technology acceptance studies (with several large agencies) were conducted. The COPLINK research has generated unique contributions in Information Systems design science related data models, computational algorithms, visualization methods, and web-based system design, especially for digital government information sharing, adversarial data mining, and dark network analysis.

F. **University-based Research:** The COPLINK project was conceived in 1997 and developed at the University of Arizona's Artificial Intelligence Lab (headed by Dr. Hsinchun Chen) with the research funding support from the National Institute of Justice and the National Science Foundation (1997-2008). More than 50 research staff and Ph.D., MS, and BS students contributed to the project, from database design and algorithm development, to user study and system evaluation. Subsequently, the COPLINK technologies were licensed to the university spin-off company Knowledge Computing Corporation for additional commercial development. Many of the former AI Lab students became key employees and engineers at KCC, including: Chief Technology Officer, Director of Engineering, System Manager, etc.

G. **A List of Supporting Documentation Items** (online files of journal papers and newspaper articles are attached): (1) G. Wang, H. Chen, and H. Atabakhsh, "Automatically Detecting Deceptive Criminal Identities," Communications of the ACM, Volume 47, Number 3, Pages 71-76, 2004. (2) J. Xu and H. Chen, "Criminal Network Analysis and Visualization," Communications of the ACM, Volume 48, Number 6, Pages 101-107, 2005. (3) B. Marshall, S. Kaza, and H. Chen, "Using Importance Flooding to Identify Interesting Networks of Criminal Activity," Journal of the American Society for Information Science and Technology, Volume 59, Number 13, Pages 2099-2114, 2008. (4) "A Google for Cops," NEWSWEEK, March 3, 2003. (5) "An Electronic Cop that Plays Hunches," New York Times, November 2, 2002. (6) "Spiral Up, and other management secrets behind widely successful initiatives," by Jane C. Linder, American Management Association Book, 2008, Chapter 10 "Coplink: An Unconventional Collaboration Revolutionizes Law Enforcement" (a detailed case study about the COPLINK project conducted by the author).

II.   Supporting Documentation

A. **Peer-Reviewed COPLINK Related Papers:** The COPLINK project has generated more than 15 journal papers and 30 conference publications. Some of the most relevant journal publications are listed below. Selected papers are included in the nomination packet.

- R. V. Hauck, H. Atabakhsh, P. Ongvasith, H. Gupta, and H. Chen, "Using Coplink to Analyze Criminal-Justice Data," *IEEE Computer,* Volume 35, Number 3, Pages 30-37, 2002.

- H. Chen, D. Zeng, H. Atabakhsh, W. Wyzga, J. Schroeder, "COPLINK: Managing Law Enforcement Data and Knowledge," *Communications of the ACM*, Volume 46, Number 1, Pages 28-34, January 2003.

- H. Chen, J. Schroeder, R. V. Hauck, L. Ridgeway, H. Atabakhsh, H. Gupta, C. Boarman, K. Rasmussen, and A. W. Clements, "COPLINK Connect: Information and Knowledge Management for Law Enforcement," *Decision Support Systems,* Special Issue on Digital Government, Volume 34, Number 3, Pages 271-286, February 2003.

- G. Wang, H. Chen, and H. Atabakhsh, "Automatically Detecting Deceptive Criminal Identities," *Communications of the ACM*, Volume 47, Number 3, Pages 71-76, 2004.

- G. Wang, H. Chen, and H. Atabakhsh, "Criminal Identity Deception and Deception Detection in Law Enforcement," *Group Decision and Negotiation*, Volume 13, Number 2, Pages 111-127, 2004.

- C. Lin, P. J. Hu, and H. Chen, "Technology Implementation Management in Law Enforcement: COPLINK System Usability and User Acceptance Evaluations," *Social Science Computer Review (SSCR)* special issue on Digital Government, Volume 22, Number 1, Pages 24-36, 2004.

- J. Xu and H. Chen, "Fighting Organized Crimes: Using Shortest-Path Algorithms to Identify Associations in Criminal Networks," *Decision Support Systems*, Volume 38, Number 3, Pages 473-488, 2004.

- W. Chung, H. Chen, L. G. Chaboya, C. O'Toole, and H. Atabakhsh, "Evaluating Event Visualization: A Usability Study of COPLINK Spatio-Temporal Visualizer," *International Journal of Human-Computer Studies,* Volume 62, Number 1, Pages 127-157, 2005.

- P. J. Hu, C. Lin, and H. Chen, "User Acceptance of Intelligence and Security Informatics Technology: A Study of COPLINK," *Journal of the American Society for Information Science and Technology,* special issue on Intelligence and Security Informatics, Volume 56, Number 3, Pages 235-244, 2005.

- J. Xu and H. Chen, "CrimeNet Explorer: A Framework for Criminal Network Knowledge Discovery," *ACM Transactions on Information Systems*, Volume 23, Number 2, Pages 201-226, April, 2005.

- J. Xu and H. Chen, "Criminal Network Analysis and Visualization," *Communications of the ACM*, Volume 48, Number 6, Pages 101-107, 2005.

- Y. Xiang, M. Chau, H. Atabakhsh, and H. Chen, "Visualizing Criminal Relationships: Comparison of a Hyperbolic Tree and a Hierarchical List," *Decision Support Systems*, Volume 41, Number 1, Pages 69-83, 2005.

- J. L. Zhao, H. H. Bi, H. Chen, D. Zeng, C. Lin, and M. Chau "Process-Driven Collaboration Support for Intra-Agency Crime Analysis," *Decision Support Systems,* special issue on Intelligence and Security Informatics, Volume 41, Number 3, Pages 616-633, March 2006.

- G. Wang, J. Xu,, H. Chen, and H. Atabakhsh, "Automatically Detecting Criminal Identity Deception: An Adaptive Detection Algorithm," *IEEE Transactions on Systems, Man, and Cybernetics, Part A*, Volume 36, Number 5, Pages 988-999, 2006.

- J. Schroeder, J. Xu, M. Chau and H. Chen, "Automated Criminal Link Analysis Based on Domain Knowledge," *Journal of the American Society for Information Science and Technology,* Volume 58, Number 6, Pages 842-855, 2007.

- J. Xu and H. Chen, "The Topology of Dark Networks," *Communications of the ACM*, Volume 51, Number 10, Pages 58-65, 2008.

- B. Marshall, S. Kaza, and <u>H. Chen</u>, "Using Importance Flooding to Identify Interesting Networks of Criminal Activity," *Journal of the American Society for Information Science and Technology,* Volume 59, Number 13, Pages 2099-2114, 2008.

- <u>H. Chen</u>, "Intelligence and Security Informatics for International Security: Information Sharing and Data Mining," Springer, 2006.

B. **Project Web Site and Funding:**

- **Project web site: http://ai.arizona.edu/research/coplink/index.htm**

- "Spiral Up, and other management secrets behind widely successful initiatives," by Jane C. Linder, American Management Association Book, 2008, Chapter 10 "Coplink: An Unconventional Collaboration Revolutionizes Law Enforcement" (a detailed case study about the COPLINK project conducted by the author).

The COPLINK related research has received more than $6M in government research funding for over a decade and $4.6M in venture funding.

- NSF, Digital Government Program, "COPLINK Center: Social Network Analysis and Identity Deception Detection for Law Enforcement and Homeland Security," $600,000 (IIS-0429364), September 2003-August 2007. (UA matching: $75,000)

- NSF, Information Technology Research (ITR) Program, "COPLINK Center for Intelligence and Security Informatics – A Crime Data Mining Approach to Developing Border Safe Research," $700,000 (EIA-0326348), September 2003-August 2007. (UA matching: $175,000)

- Department of Homeland Security (DHS), CNRI, "BorderSafe Initiative Phase-2," $780,000, June 2004-October 2005. subcontract: Tucson Police Department. (UA matching: $100,000)

- Department of Homeland Security (DHS), CNRI, "BorderSafe Initiative Phase-2 DHS Relevance Extension (CBP)," $200,000, October 2004-October 2005. (UA matching: $15,000)

- NSF, "NSF/CIA KDD ARJIS/COPLINK Border Safe Research and Testbed," (in collaboration with TPD and San Diego ARJIS), $751,996 (EIA-9983304), supplement to "COPLINK Center: Information and Knowledge Management for Law Enforcement," March 2003-March 2004. (UA matching: $62,500)

- NSF, Digital Government Program, "COPLINK Center: Information and Knowledge Management for Law Enforcement," $1,600,000 (EAI-9983304), July, 2000-March, 2004.

- NSF/CIA, Knowledge Discovery and Dissemination (KDD) Program, "COPLINK Testbed for Homeland Security Data Mining," $201,000, September 2002-June 2003.

- City of Tucson, "Coplink Concept Space: An Intelligence Analysis Tool," $250,000, January-September, 2000.

- National Institute of Justice, "COPLINK: Database Integration and Access for a Law Enforcement Intranet," $1,200,459, July 1997-January 2000 (subcontract to H. Chen, PI, University of Arizona: $941,887).

- Knowledge Computing Corporation (venture funding, 2000-, $4.6M): KCC received exclusive licensing from the University of Arizona for the Artificial Intelligence Lab COPLINK technologies. The company received more than $4.6M in VC funding and currently has 80 employees with $14M revenues in 2007.

C. **Awards and COPLINK in the Press**

- Tucson Police Department (TPD) COPLINK project received the PTI Technology Solutions Award in the mid-size, public-safety category, January 27, 2003.

- TPD COPLINK program won the Best of Breed Award based on the responses from the Digital Cities Survey 2002, Center for Digital Government, 2003.

- **COLINK project recognized as a finalist (among a field of 144 nominations) by the prestigious International Association of Chiefs of Police (IACP)/Motorola 2003 Weaver Seavey Award for Quality in Law Enforcement, IACP Conference, Philadelphia, PA, October 23, 2003.**

- **"National Dragnet Is a Click Away," COPLINK system featured in cover page as the largest information sharing system for the US public safety agencies. The Washington Post, March 6, 2008.**

- "LAPD hopes to Add High-Tech Partner to Force," The COPLINK computer program can mesh data in minutes, a task that can take a detective weeks. Los Angeles Times, January 2, 2004.

- "Cops Could Hit the Links Soon: New Search Engine Would Catalog, Interpret Data for Investigations," Los Angeles Daily News, December 6, 2003.

- "Software Joins Cops on the Beat: COPLINK program links databases, speeds police investigations," COPLINK deployed at the state of Alaska. Anchorage Daily News, November 23, 2003.

- "Software Helps Police Draw Crime Links," A front page story about COPLINK deployment at the Boston Police Department, Boston Globe, July 17, 2003

- **"Google For Cops: Software Helps Police Search for Cyber Clues to Bust Criminals," ABC News, April 15, 2003. Also appeared on TechTV.**

- **"A Google for Cops," COPLINK was considered as the Google search engine for cops, featured in NEWSWEEK, March 3, 2003.**

- "Sniper probe to get help from Tucson," Arizona Daily Star, October 23, 2002.

- "Tucson cops, local software to help in D.C. sniper probe," Tucson Citizen, October 23, 2002.

- **"An Electronic Cop that Plays Hunches," COPLINK system was used to assist in DC sniper investigation and the project was featured in New York Times, November 2, 2002.**

- "Super Detective: When University of Arizona professor Hsinchun Chen combined police databases for a consortium of city police agencies, a super-detective was born." Featured in DG (Digital Government) Online Special Issue on Homeland Security, December 2001.

- "Coplink Sifts and Shares Information – Fast," Featured in POLICE The Law Enforcement Magazine, July 2001.

- "Software for Data Searchers," Featured in Law Enforcement Technology, April 2001.

- "Information Sharing Systems: Coplink," Featured in The POLICE CHIEF, March, 2001.

- "Technology developed in Tucson is helping police catch criminals faster. COPLINK product let police agencies rapidly share crime information across jurisdictional lines," Featured in Arizona Daily Star, January 7, 2001.

- "Changing the Rules of the Game. How Coplink is helping police departments match evidence across boundaries of time and space," Featured in FCW.com, April 3, 2000.

- "Coplink: Database Detective," Summer, 1999, TECH Beat (cover article).