

BIOGRAPHICAL INFORMATION

Tom Helmer
Solution Architect
KEMA Inc

Joined KEMA in 2003. As a Solution Architect, Mr. Helmer provides clients with specialized expertise in all aspects of both system and software engineering, including a full range of utility engineering and operations applications, their underlying database design and development and the design and development of their integration architectures using EAI middleware technologies. He has over 11 years experience designing and integrating utility solutions around WMS, GWD, GIS, OMS, DPS, SCADA, CIS and ERP technologies.

Selected Professional Experience:

- Serves as the solution architect for the New Jersey Natural Gas Strategic Implementation Plan (SIP). Put together strategic implementation roadmap including GIS vertical applications, useful business based integrations with CIS, their back office financial systems (JDEdwards), Engineering Analysis (Stoner), Graphic Job Design, Work Management, Mobile Workforce Management (MDSI), and Mobile GIS systems, data conversion, training and OCM tasks. The emphasis on this assignment is to develop a solid business case and a realistic GIS implementation plan
- Serves as the solution architect for the Northeast Utilities Dynamic Operations Display Board (DODB) project. He is responsible for laying out the architecture to integrate the DSCADA and CONVEX systems with the OMS (CES) and to integrate the new schematic viewer module from CES.
- Served as the solution architect on the Progress Energy Strategic Implementation Roadmap (SIR). This project involved evaluating the two merged companies' (CP&L and FPC) complete EDRP solutions: MWM (MDSI, Intergraph), GIS (Intergraph), OMS (ABB, Intergraph), DPS (CYME), SCADA (Siemens), WMS (STS STORMS, In-house), GWD (Intergraph, Tellus) and their integrations including to MMIS (Indus Passport). The project developed their combined 'to-be' solution and an implementation roadmap on how to decommission current systems. The emphasis for this project was to develop a unified approach to common business systems and to include a new focus on enterprise asset management (EAM) technologies such as performance forecasting, load forecasting and asset investment decision-making tools.
- Served as a Technical Consultant for the Southern California Edison (SCE) Wires project in the deployment of a WMS (Indus PassPort) and its integration with SCE's ERP system consisting of in-house systems for CIS, material management, portable job design, corporate accounting, timekeeping, and human resources. Configured and customized the DOORS requirements management product to support the gathering of all business requirements, system functional requirements, and software designs. Supported the complete traceability between business requirements, the system functional requirements, and the software designs.
- Served as solution architect on the Rochester Gas and Electric (RG&E) PRIDE project. Their EDRP solution involves the integration of: GIS (ESRI ArcGIS/ArcSDE), OMS (CES Centricity), Mobile Workforce Management (MWM-MDSI Advantex), WMS (STS STORMS), GWD (CVG CWIM) and DPS (Stoner Associates SynerGee) with the clients' Customer Information System (SPL CISPlus), Enterprise Resource Planning (SAP R3), Interactive Voice Response System (IVR), and SCADA system (Siemens Spectrum). The major integration infrastructure related technologies being used are IBM's MQSI and MQSeries EAI products, Oracle's RDBMS, and IBM's Clustering and SAN technologies for disaster recovery.

- Served as Lead System Architect for the Cinergy EDSIP project that involved the design and integration of their EDRP systems: GIS (Smallworld), GWD (CVG), OMS (CES), DPS (ABB), MWM (UP) and WMS (Indus Passport) with their CIS and back-office ERP systems which included MMIS (Indus PassPort).
- Served as Lead System Architect for the IES Utilities (Alliant Energy) project in the system deployment to a merger partner, which integrated five technologies for their EDRP systems: GIS (Smallworld) OMS (CES), WMS (STS Storms), GWD (CVG), DPS (Stoner), and CAD/MDT (MDSI).
- Served as Lead System Architect, Program Manager, and Project Engineer for Kentucky Utilities over a four-year period, integrating and developing GIS (Smallworld), SCADA (Leeds&Northrup), OMS (CES), WMS (Logica WMIS), GWD (CVG), CIS, and call processing systems. This enterprise wide integration project used Oracle, DB2, Sybase Omni Server, and internally developed CICS transactions
- Served as Lead System Engineer for the Ohio Edison project, responsible for all phases of a pilot system implementation. This effort involved the designing and developing the data model and end user applications, training end users, developing data conversion QA/QC procedures and tools and performance monitoring and tuning of the system for pilot users. The technologies deployed were: GIS (GeoVision), GWD (GeoVision), OMS (DB2 based) and WMS (Logica WMIS).
- Served as solution architect on the City Utilities Strategic Implementation Roadmap (SIR). This project involved evaluating their current systems and developing their future state integrated business processes and system architecture. The project developed their 'future-state' solution and an implementation roadmap on how to deploy new technologies while decommissioning current systems. The emphasis for this project was to develop a sound business case for a five year implementation roadmap that would deploy at the future state an integrated system of: CIS, GIS, GWD, WMS, OMS, MWM, DPS, SCADA and their back office financial system (Peoplesoft). The assignment included an in-depth functionality review of the major GWD vendors: Miner&Miner ArcFM, GENS Smallworld Design Manager, Cook-Hurlbert Expert Designer and Itron LD-Pro.
- Served as solution architect on the Northeast Utilities (NU) Transmission strategic implementation plan. The project developed the high level implementation and budgetary estimates for their new suite of technologies to support getting new transmission projects approved by state boards quicker, to support transmission congestion analysis, to support transmission designs, to support transmission project management, to support transmission asset investment analysis and to support transmission maintenance and inspection work flow management.
- Served as solution architect for the Consolidated Edison corporate mapping strategy study. This project effort developed the business strategy for geographic record use and standards across the enterprise. The goal of the project was to leverage information technology to improve business processes, optimize the energy delivery assets of the company, and significantly reduce operating costs through the consolidation and standardization of GIS technology for all business units. A key task performed was the audit of their 16 currently deployed mapping and records systems.
- Served as Lead System Architect for the City of Portland project. A GIS Hub has been developed for citywide distribution of heterogeneous GIS/RDBMS data sources and is deployed to nine city bureaus.
- Served as system architect for the REMU SIP. Developed the system architecture and budgetary estimate required for the board of directors approval of the deployment of a suite of EDRP technologies that included GIS (ESRI), GWD (CVG), MWM (MDSI), OMS (CES), WMS (STS) and integration to their ERP back office systems, their CIS and their distribution planning systems.
- Served as solution architect on the PacifiCorp SPU project. This project involves evaluating the functional requirements required by a GIS product to be the single point of entry in an integrated EDRP system deployment centered on Oracle RDBMS technology and TIBCO EAI technologies. High availability and disaster recovery are centered around Sun Microsystem technologies and Veritas technologies. The solution included integration to their CIS (in-house) and back-office ERP (SAP R3, in-house) systems.

- Served as Lead GIS Database Designer for the City of Riverside, California, in a multi-participant project that served the Department of Planning, the Department of Public Works, the Water Department, the Electrical Department, and Wastewater Management, integrating both ESRI and Oracle products.

Professional Experience:

KEMA, Inc., Englewood, Colorado: 2003 to Present

Solutions Architect

SchlumbergerSema (Convergent Group, UGC Consulting): 1992 to 2003

Solutions Architect

As a Solutions Architect, Mr. Helmer provided clients with specialized expertise in all aspects of both system and software engineering, including a full range of engineering and operations applications, their underlying database design and development and the design and development of integration architectures using EAI middleware technologies.

Mr. Helmer has made significant contributions to company standards and professional service offerings which were vital to growing the company from a consulting company to a consulting and system integration company, including developing the company's:

- Data modeling methodology, including the selection of supporting CASE tools and the development of productivity metrics.
- EDRP systems integration methodology to support multi-vendor operational systems for GIS, GWD, OMS, DPS, WMS, CAD/MDT, SCADA, CIS, and ERP based on technology-leading trends in the enterprise application integration (EAI) arena.
- Enterprise spatial data warehouse integration design for multi-vendor GIS and RDBMS.
- Automated GIS QA/QC tools and conversion methodology.

Hughes Aircraft Company: 1982 to 1992

Laboratory Database Technologist

Mr. Helmer served as Laboratory Database Technologist, specializing in the study of the integration of spatial and relational data structures. Mr. Helmer also worked on internal company engineering and IR&D projects related to adopting object-oriented principles to Hughes' standard software engineering and database design methodologies.

Software Engineer

As a Software Engineer, Mr. Helmer's experience includes six years of developing real-time software following DoD standards. He also has practical experience using numerous CASE tools to support various structured software analysis, design, and test methodologies. His projects have included modifying a commercial operating system to support a multiprocessor real-time debugger; developing a task-to-task communication system for a multiprocessor environment; an automated quality control checking system for GIS data; and designing a distributed heterogeneous data access system. For four years, Mr. Helmer managed a team that designed, developed, and populated a database used to generate command and control applications. He also participated in company-funded pilot projects to verify that their software engineering methodology incorporated Object-Oriented Analysis, Object-Oriented Design, and rapid prototyping concepts.

While working at Hughes Aircraft Company, he developed two in-house, screen-based 4GLs, one for a database engineering environment and the other for a Command and Control Information System. The database engineering environment was developed to support the following database design lifecycles: conceptual data model, logical data model, physical database generation (schema generation with indices), and transaction testing. The environment provided full traceability of all data elements to all software transactions.

Senior System Engineer

As a Senior System Engineer, Mr. Helmer's experience included being the Lead System Engineer for proposal efforts involving the Alberta Land-Related Information System (LRIS) and the Bureau of Land Management ALMRS. He was also a key contributor to NASA's EOS/Dis Phase D RFP response. All of the proposals required an integrated solution for a wide range of heterogeneous data sources centered on distributed spatial data warehousing technology.

Education:

M.S., Hughes Fellow, Computer Science, University of Southern California, 1984.

B.S., Phi Beta Kappa, Computer Science, University of Southern California, 1982.

Professional Affiliations:

Association Computing Machinery (ACM)

Institute of Electrical and Electronics Engineering (IEEE)

GITA

USING GIS TECHNOLOGY TO MAXIMIZE OPERATIONS DATA MARTS

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ABSTRACT

This paper proposes to go over the various components of the architectures for geographic information systems, preventative maintenance systems, outage management systems, mobile workforce management, distribution planning systems, SCADA archival information management systems, work management systems and ERP systems, discussing the levels of integration required to bring the operational information into the suite and highlighting the benefits derived from bringing together operational and non-operational SCADA collected information to the energy delivery domain.

INTRODUCTION

From the substation to the control center, utilities have made large investments on the automation of operational systems. These implementations have paid off by enabling utilities to improve productivity, maintain or improve customer service, and handle system growth with fewer personnel due to attrition of aging workforces. This push to automate has also positioned utilities to further leverage their investments by integrating the operational (real-time) and non-operational (historical) data embedded in these automated systems to optimize asset management.

PHASES OF AUTOMATION

Phase 1: Facilities Health and Wealth and Workforce Automation

Automation is an evolutionary process. The first phase of utility automation has focused on installation of computerized systems for the management of outages, customer information, work orders, mobile work forces, facility location information and other critical operations. A major aspect of automation has included the implementation of intelligent electronic devices, including relays, meters and digital fault recorders to feed both operational and non-operational event information from the substations to the SCADA control center or to the utility engineer's desktop. The emphasis for this first stage has been to monitor and control the assets and to provide automation tools for the workforce.

These systems have given personnel instantaneous access to status and analog information relating to components and sub-systems throughout the distribution network. Alarms and monitors put outage locations, breaker positions, load measurements and dozens of other data points at the fingertips of personnel as events occur. Whether this operational and non-

operational information is streaming in from the remote substation or from the dispatch center, personnel are better equipped to make decisions that quickly restore gas or electric service to customers.

Phase 2: Integration of Energy Delivery Systems for Workforce Optimization

The second phase of automation evolution has involved the integration of two or more technologies to form operations business systems. Achieving enterprise-wide access has been the driving force behind the automation integration trend. By linking SCADA, substation automation (SA), outage management (OMS), customer information (CIS), work management (WMS), mobile workforce management (MWM) and geographic information systems (GIS), utilities have created operational threads that share operational and non-operational data and provide all personnel in the organization with access to information on the overall health of the distribution network.

This sharing of information has further enhanced the ability of personnel to make faster and smarter decisions that get customers back online more quickly or identify minor problems before they cascade into bigger ones. Not only has enterprise-wide information allowed personnel to schedule and perform work more efficiently, it has enabled them to maintain the assets more effectively by planning equipment upgrades and squeezing longer lives out of aging components. This second phase has emphasized the optimization of the productivity of the workforce and of individual assets.

Phase 3: Integration of Energy Delivery Data Marts for Asset Optimization

This transition from enhancing personnel performance to optimizing sets of interacting assets will push automation into its next phase of evolution – integration of operational and non-operational data archives. Until now, the automation of systems has successfully revealed *what* is happening in the distribution network. The information that can be culled from the integration of both operational and non-operational data stored in data marts embedded within automated systems is capable of telling personnel *why* specific events happened and *which* investment choices to make in the future.

Emerging analytic functionality can also help identify parts of the network that are at the greatest risk of potential failure. Such heads-up information can aid utilities to proactively replace and/or reinforce weak links to reduce the probability of unplanned events.

This knowledge will yield benefits far beyond those now offered by simple automation and integration. By combining and analyzing historical event information, utilities will improve the operations, maintenance and design of distribution network systems and components.

INTEGRATING DATA MARTS

Data marts are archives of the operational and non-operational data recorded by automated systems. The advantage many utilities already have is that these databases of irreplaceable

system performance information were installed during the implementation of the various automation systems, and they have been archiving data ever since. For some utilities, this means a decade of historical performance logs is available for integration and analysis.

Each data mart contains valuable information relevant to the system that recorded it:

- SCADA contains operational data and non-operational data from all of the field devices connected to the SCADA system.
- SA contains operational data for SCADA and the data warehouse, as well as valuable non-operational information from all substation devices for the data warehouse, and subsequently for MWM and other utility systems.
- OMS archives the time, duration and cause of outages, customers impacted by the outage, actual operating network configurations, and switching logs.
- WMS maintains a history of all work orders pertaining to maintenance and installation of various distribution facilities and construction crew productivity.
- MWM keeps records of preventative maintenance performed on equipment and infrastructure in the field as well as personnel productivity.
- CIS maintains billing and load data and tracks trouble calls made by customers as well as levels of customer service response they have experienced.
- ERP records the financial investment in each component and its current book value.

Most automated systems are installed by the vendor with built-in data marts developed specifically to archive data for that problem domain. If the vendor hasn't supplied a data mart, utilities themselves typically have built their own data mart or archival information system to move historical information out of the operations systems. Some third party vendors have specialized in replacing several SCADA and SA historical information systems with a single historical information system of the historical information typically collected in SCADA and SA domains.

Many utilities routinely mine their data marts using analysis software provided by the vendor. Typically data marts are utilized individually and they provide great insight into operations. For instance, analysis of historical work order logs can reveal which transformers or valves have been particularly troublesome and may require refurbishment or replacement. Review of ERP archives enables utilities to determine revenue generated from individual infrastructure components, a valuable calculation when replacement or upgrading is under consideration. Analyzing MWM historical information provides insight into developing metrics and monitoring workforce performance. Analyzing WMS data mart information can lead to reengineering the company's engineering design standards and their associated compatible units, optimizing the targeted percentages of work performed by contractor and company crews and provide the total historical investments a company has in an asset.

The next step is to analyze these data marts as cohesive units, a logical consideration since these automated systems work together within the context of utility operations. However, the stumbling block to analyzing these data sets in an integrated fashion has been the lack of a practical methodology or a product designed to handle related sets of facilities both from

their role in an operational system and in their inherit relationships based on their physical locations.

A solution to this problem lies in GIS, a technology that many automated utilities already have invested in. Within the utility, the GIS is typically used as an asset repository of the distribution network and all of its components. The GIS ties these individual components and systems to a land base. The architecture of the GIS is perfectly suited for integration of these other operational and non-operational data marts because it is designed to accept inputs of different data sources and relate them to sets of facilities for thematic analysis based either on the facilities operational roles or inherently based on their locations.

Benefiting from Data Mart Integration

The power of the GIS resides in its ability to pinpoint the location within the operational system where events occurred or are projected to occur, and to be able to view a networked set of related facilities. This enables engineers to begin associating events by location and time as well as by their engineering function related set. By layering these associated data points in the GIS, utilities can identify the multiple smaller events that occurred (or at risk of occurring) leading up to a major event such as an outage. Incidents that once seemed unrelated suddenly appear as understandable trends through the view of the GIS. A simple use of the GIS in this fashion is to overlay the outage event cause codes from the OMS data mart with the preventative maintenance historical results that may be found in the WMS data mart, the GIS asset repository, the MWM data mart or its own CMMS data mart or even the combination of all of these since probably no single system records all preventative maintenance related activities. Typically tree trimming and vegetation management information are not in the same system as pole inspections and probably not in the same system that recorded routine maintenance work completion codes on facilities. On top of these, one can now layer environmental related conditions such as soils and weather and potentially capital improvement projects done in the same geographic areas but by different business units (water, gas, electric) or by supporting municipalities (road improvements, sewer improvements, CATV, etc...).

Another example is to use the integration power of the GIS to feed the operational composite view from multiple data marts or historical archives to one of the off-the-shelf engineering analysis packages. With the operational data marts from the SCADA, SA, OMS, Metering problem domains being fed in from the GIS, these modeling tools can be given much finer granularity of information and the exact system configuration during peak loading conditions and outage events which can be applied to measure system performance and predict infrastructure reliability. The asset management benefits provided from this analysis will impact operations, maintenance and design programs.

By integrating and analyzing archived operational data, utilities provide their personnel, specifically the engineering staff, with valuable system performance and reliability information that can result in more productive use of assets. This information will enable the utility to better understand where future investments should be focused in the replacement, maintenance and upgrading of facilities. This is of course done today, but the peak load

SCADA data is usually not available on-line for the planning engineer and already associated with the exact system configuration as provided by the OMS data mart switching logs and correlated with premise level metering information that has been generated based on weather and profiled against actual readings. With this realistic performance information, the engineer can create what-if scenarios in the modeling tools to determine how asset modifications might improve the distribution during peak times. The changes can be prioritized by how well they enhance performance and reliability so that equipment modifications offering the best return on investment can be included in the following year's capital improvement program.

Maintenance operations would experience similar advantages. Personnel would have more accurate details of how each sub-system and component performed under actual operating conditions, especially during outage events and how long and often they were pushed past their rated peak operating values. Based on this information, the utility can prioritize where funding should be allocated to better maintain the infrastructure that really needs attention and defer work on equipment that is performing above specifications. This moves maintenance engineering well past just a periodic timeframe or number of operations based paradigm and should allow utilities to target their spending where it is required and still stay within their forecasted reliability and performance requirements.

The cost savings will flow into system design work as well. Planning engineers seek to optimize switching and conductor materials in the design of new installations. With better performance and predicted reliability information available to them, they can model the impacts of scaling material quality up or down. The planners will then have a more accurate and cost-effective view of what quality materials should be used in a specific installation, saving money by not over-building the equipment.

GIS technology would be a natural choice for those serious about developing an enterprise asset management investment decision tool that needs looks at the operational and non-operational data marts for historical revenue, historical costs, current value, forecasted performance, forecasted reliability, forecasted revenues and forecasted required preventative maintenance investments.

SUMMARY

For most utilities, the main pieces of the data mart integration puzzle already exist. Data marts in the OMS, WMS, MWM, CIS, ERP and SCADA problem domains need to be linked with GIS technology to perform thematic analysis based on operational interacting sets of facilities, based on time intervals, based on category of facility, based on environmental conditions. Companies need to tap into the integration power of GIS technology to feed integrated operations data to an engineering analysis tool for better performance and predicting reliability of current and proposed facilities. The integration framework we use today for integrating energy delivery systems with front office CIS systems and back office ERP systems can easily be extended to include the integration of the individual problem domain data marts.