Case Study: Automated Materiel Tracking System

The Automated Materiel Tracking System is a Web-based solution created for real-time tracking of more than 1 million materiel pieces transferred between Air Force Materiel Command (AFMC) divisions and the Defense Logistics Agencies at Hill Air Force Base, Utah; Tinker Air Force Base, Oklahoma; and Warner Robbins, Georgia. It works equally well on traditional and wireless local area networks, and was created to replace the present manual data entry and paper-based tracking system, which was labor-intensive, error-prone, and difficult and cumbersome to gather and extract reliable, useful data. The replacement system needed to not only track where and when a material order was placed and delivered, but also act as an efficient data-sharing bridge between intercompany departments. The new system had to provide full-database interfaces over a variety of operating systems and environments and dynamically manipulate legacy and newly gathered data utilizing existing standard office suite software. Data had to be Web-accessible from mid-tier, desktop-level hardware as well as from the hand-held, radio frequency-based computers in the field.

The Automated Materiel Tracking System (AMTS) had to offer end users what technology has always promised: cost-effective, easy, real-time access to a myriad of time-sensitive and detail-specific information. AMTS needed to function as the technology bridge between different operating systems and data structures, and allow access to an incredible amount of data from multiple virtual sites and geographical locations with a seamless interface, so the user need only point and click to obtain needed information. AMTS had to level the playing field by offering a way for simplistic, complex and legacy systems to communicate with each other, allowing end users to quickly and easily extract data as usable information employing various hardware input and output options.

Myron Anderson, OO-ALC/LGN, sponsored the prototype of the AMTS solution, which was successfully implemented in the summer of 1999 at Hill Air Force Base Within days of the prototype deployment, end users were able to provide empirical data on the timeliness of the receipt of the materiel. Collected date and time stamps could prove when an item was ordered, readied for shipping, and delivered to a specific location. Part of the project's success is its ability to access and manipulate Web-enabled information from the desktop, as well as on handheld scanning units used in the field via wireless local area network (LAN) and Internet technologies. AMTS is projected to go online simultaneously at Tinker and Warner Robbins in the first quarter of 2000. Although the project began for Air Force use only, the Navy has expressed interest in implementing AMTS at its depot locations.

AMTS Development Research

The project began as a way to track all materiel movement activities *between* AFMC divisions and a Defense Logistic Agency (DLA). It expanded to track the actual delivery sites within each AFMC division. The AMTS' expanded project scope included Hill Air Force Base with approximately 30 delivery sites, handling approximately 700 transactions daily; Tinker Air Force Base with approximately 100 delivery sites, handling approximately 2,000 transactions daily; and Warner Robbins Air Force Base with approximately 150 delivery sites, handling approximately 3,000 transactions daily.

The original AMTS required distinctions in individual process steps involved in a materiel delivery transaction, including:

- Receipt of the requisition by the DLA's Depot Supply System.
- Material picking process.
- Packing process.
- Transporting and shipping.
- Final receipt of the materiel by the maintenance customer.

The main challenge presented for the project was to find a way to determine and track if and at what time a materiel order was involved in each step of a delivery transaction. Although the materiel shipping and delivery movements were tracked on paper manifests, discrepancies were common regarding the *requested* delivery time and location vs. the *actual* delivery time and location. Delivery urgency specifications (needed within two or four hours, etc.) usually dictated the final transportation cost of an item; the exact time between order acceptance and final delivery needed to be tracked in a way that could satisfy shipping *and* receiving parties of the transaction.

The original paper-based manifest system required data entry of a 14-character alphanumeric string package identification code at each point along the delivery route. This process was very labor-intensive and prone to data entry errors. Quantitative metric data was difficult to compile and, once compiled, not always accurate or reliable. As a solution, hand-held laser bar code scanners became an intrinsic portion of AMTS, significantly reducing data entry errors.

AFMC and DLA staff members identified specific features and benefits:

- Conversion of several legacy data information systems.
- Point-and-click ease of use (for access, query, input, assessment report functions).
- Online help features.
- Standardized, customizable tracking procedures and reporting functions.
- Easy, low complexity updating procedures.
- Lower costs and time required to manually investigate a shipping discrepancy.
- Information protection on the client intranet with client-designated levels of authorization.
- Overall system security (to prevent malicious and accidental breaches).
- Ability to utilize wireless portables for use in tracking purposes and Internet access over a wireless LAN for dynamic data access and manipulation
- Designed to be as lightweight as possible and work on a desktop computer with performance as low as 486/33MHz with no appreciable performance hit.

Additional requested enhancements to the original system included tracking

depot maintenance items returning to the supply system, clearing of in-transit records, tracking of issues from other supply systems, and developing a series of analysis tools to ensure peak performance and continual improvement.

AMTS Development Process

Bar Coding Challenges

Untethered mobility is a major requirement for the project. Having a scanning terminal physically connected to a LAN would severely hamper productivity. In addition to substantially decreasing data entry errors, the portable computers' wireless LAN technology complemented the AMTS solution. And, the wireless capability also allows for Internet access, using any Web browser (i.e. Netscape or Explorer), and allows easy access to AMTS information for immediate use in the field.

To begin a transaction within AMTS, a bar coded manifest is generated from the DLA Depot Supply System. This physical manifest accompanies the materiel order as it flows through individual steps within the shipping and delivery process. At each step in the delivery process, the bar code is scanned and logged into AMTS to track its progress and timing, and the data are then recorded with time and date stamp verifications. The system allows for data capture of the following data elements:

- Item(s).
- Shipping and delivery locations.
- Ordering and delivering parties.
- Receiver of goods.

As data reliability was a major issue, standard and specialized business and logic rules were implemented in the design to ensure data integrity, with data elements routinely checked for appropriateness in fields and string length. Additionally, tables were put in place to either allow or deny a transaction. For example, if an item's destination was scheduled for warehouse A but was delivered to warehouse B, AMTS would produce an appropriate error message so the problem could be investigated and corrected.

Data Structure Challenges

Although the legacy information systems were developed using leading-edge technology at the time, they were originally developed and populated before the desktop PC became available. There were also several versions of systems, each written in its own flavor of database language. Additionally, the legacy reports and query capabilities were very elementary in nature due to the archaic database design structure, and data access was difficult due to mainframe architecture. In essence, AFMC had legacy data only, and it needed searchable, formattable, information, which could be accessed and manipulated in real time, merged with new AMTS data, and used in statistical and accountability reports in standard existing commercial off-the-shelf software, such as Microsoft Access, Excel, and PowerPoint.

Although the AMTS prototype was developed in Access and Excel, releases of the software are also available in two other versions to meet existing standardized environments or preferences:

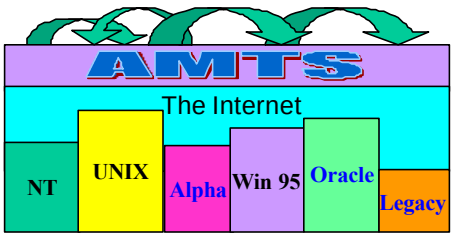
- Oracle 8i with a Visual Basic interface.
- SQL with a Visual Basic interface.

AMTS also uses Microsoft's remote scripting technique to create a dynamic, Web-based user interface. Utilizing their Internet Information Server, Scripting Engines 5.0, and Internet Explorer 5.0, this technique allows for HTML-based Web pages to interact with the server without having to reload the page with each transaction.

Remote scripting uses client-side VBScript, Jscript, or JavaScript on the Web page for data verification and rapid data entry. The client-side script then calls methods through Microsoft's Remote Scripting Jscript Applet that refers to procedures and functions coded in server-side VBScript or JavaScript on an Active Server Page. These procedures and functions interact with server components via .dll files developed in Visual Basic. The .dll files interface with the Oracle 8 database through ODBC connectivity to access, update, and retrieve data. Data are then returned to the .asp page and manipulated further if necessary before being returned to the client-side script on the .htm page where the data can be dynamically displayed without reloading the entire page. The effect is a seamless, active user interface much like a Visual Basic form on an Internet browser.

Due to security concerns with Java and ActiveX applications' open-ended environments, Visual Basic was designated as AMTS' programming language. The main interface of AMTS is Web-enabled; if a user were to exit AMTS to access another site, he or she could introduce a hostile application back into the host network, posing security and data integrity risks. This was a major concern.

Again, AMTS utilizes any Web editor or browser to capture, query, and display information. The ability to use existing, industry-standard software allows for quick, cost-effective use of AMTS at the desktop level or in the field, regardless of database interface.



Bridging the Technology

Not only does AMTS level the playing field and provide full database interface with any operating system environment; it also acts as a technology bridge between intercompany departments or distinct companies or entities.

During beta testing at Hill Air Force Base, AFMC and DLA personnel commented that the user-friendly graphical interface design and online help functions allowed them to sit down and begin using the AMTS software immediately. In just a few days after implementation, end users were able to extract data elements from their legacy systems and combine it with current AMTS data and produce reliability reports using existing off-the-shelf database software.

Conclusion

AMTS is a synthesis of advanced automated data input, proven database technology, and malleability offered by a Web interface. All this is brought together in a single application set that provides realistic information from reams of data. AMTS is available now and is in daily use, supplying timely and reliable information while providing cost-effective and hard empirical metrics.

About the Author

Jim Restel is working with Productive Data Systems on a Web-enabled OO-ALC/LA Supervisor's handbook and AMTS for OOALC/LGN. He is a Defense Infomation Systems Agency Information Warfare Staff Officer, and was the first reservist assigned to Automated Systems Support and Information Security Team (ASSIST)/DoD-Computer Emergency Response Team (CERT). He is a technical advisor to the DoD Joint Web Risk Assessment Cell. Restel has also been a Contingency Plans Staff Officer at the Ogden ALC Readiness Center and a War Plans Officer in Germany and Texas.

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Sixth Annual Joint Aerospace Weapon Systems Support, Sensors, and Simulation Symposium and Exhibition (JAWS S³) is scheduled for June 25-30 in San Antonio, Texas

Over the years, this event has addressed target acquisition, the dirty battlefield, the electromagnetic spectrum and its impact on smart and brilliant weapons, and a host of other relevant topics.

This year's conference will feature dialogue up and down the "defense system RDT&E food chain" between the labs and the theaters of operation.

JAWS S³ will focus on the connectivity of various levels of modeling and simulation and their connectivity in support of this mission. JAWS S³ 2000 will feature senior-level decision-makers, who are in a position to impact the directions on these important defense issues, sharing their insights.

— Jim O'Bryon, Deputy Director, Operational Test and Evaluation/Live Fire Testing, Office of the Secretary of Defense

Contact Dr. Asha Varma via electronic mail at varmaa@navair.navy.mil for more information.

Defense@E-Business
April 24-25, 2000
Crystal City Hilton
Arlington, Va.

Distributed Networked Computing for a Secure Defense

The Office of the Secretary of Defense (OSD C3I) is hosting a Distributed Networked Computing Forum called DEFENSE@E-BUSINESS on April 24-25, 2000 in Arlington, Va. at the Crystal City Hilton. DEFENSE@E-BUSINESS is a two-day best practices forum specifically designed for the needs of enterprise system designers, architects, CIOs, and CTOs.

Government IT leaders, integrators, industry practitioners and industry groups will collaborate in sharing lessons learned in developing secure and interoperable frameworks for E-business. You are invited to participate in this annual industry-specific forum and help usher in "Distributed Networked Computing for a Secure Defense."

Confirmed Speakers Include

Dr. V Garber, OSD C3I
Dr. Susan Gragg, ICON
Amy Robinson, Discovery
Paul Kendall, DOJ
Larry Cogut, PTO
General Anthony Bell, Air Force
Tony Scott, GM
Terry Santaviccia, NSA

Registration and Hotel Information

Register online at www.theotg.com
Registration fees are as follows:
Commercial $395
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Meals are an additional charge of $50
Reserve your room at the Crystal City Hilton by calling (703)418-6800

Conference information is available at www.theotg.com