The Software Revolution, Inc

Modernization of the
Naval Warfare Systems Command (NETWARCOM)
Engineering Operational Sequencing System (EOSS)

Project Case Studies

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Abstract

History: The US Navy, under the auspices of the Navy E-Business office, undertook a major pilot program to assess the feasibility and business value of using commercial automated transformation software to convert legacy code into modern, object oriented, NMCI compliant code. The Navy selected a unique widely used Navy legacy information system written in VMS VAX BASIC for the pilot. The Engineering Operational Sequencing System (EOSS) provides standard propulsion plant procedures and operating criteria for every ship in the U.S. Navy fleet. EOSS was chosen by the Navy Functional Area Manager (FAM) office for its extreme complexity, and the perception that automated modernization of EOSS into NMCI compliant code would be extremely difficult. Science Applications International Corporation (SAIC), prime contractor, awarded The Software Revolution, Inc. (TSRI) a sole source contract. Modernized into J2EE, the modern EOSS system has enhanced performance and eased maintenance to a web browser. For modularity and flexibility, TSRI designed an 5-tier architecture for the modern system. Components residing in the first 4 tiers were implemented on a Sun Solaris server and those in the final tier run on a Windows IIS server. The existing EOSS system was transformed to the new design as follows:

- •Original VAX-Basic EOSS code was transformed into Java, preserving exact functionality
- •Telnet sessions and terminal I/O were replaced by SSL web connections and html pages
- •The VAX flat file database system was replaced by an Oracle relational database accessed through a JDBC based API
- •Scheduled processes on the VAX system were replaced by UNIX system “cron” processes
- •FTP sessions to and from external sessions work the same way as before, using a Java FTP library

(A) The Data Tier became Oracle 9i (or optionally Microsoft SQL Server).
(B) The Data Access Tier Sun J2EE Java using JDBC. Perform I/O operations on the relational database in place of the original VAX flat file operations.
(C) The Business Logic Tier contained all EOSS Java code grouped into Java application with logic invoked separately, invoked and managed by a master “broker”, enabling multiple simultaneous, multi-threaded execution instances.
(D) The Presentation Tier encompasses all functionality related to generating the user interface in a browser user interface.
(E) The Web Tier is a IIS web server running VB Scripts and providing SSL communication with end user browser sessions. It communicates with the Presentation Tier using ADO.

Speaker BIO & Contact Info

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Philip Newcomb is CEO/CTO of The Software Revolution, Inc (TSRI), a company that has completed over 35 automated modernization projects for systems as diverse as satellite command and control, strategic warfare planning, ballistic missile early warning, health care, logistics, engineering operational sequencing, etc. Philip is a prominent contributor to the Object Management Group (OMG) ADM task force that is defining industry-based modeling standards and best practices for Architecture Driven Modernization (ADM) to support Model Driven Architecture (MDA). He leads the joint submission team of ADM TF members that is defining the ASTM standard. Philip was a research scientist at Boeing Artificial Intelligence Laboratory for 12 years before founding TSRI in 1994. He was co-Chair of the Working Conference for Reverse Engineering (WCRE) in 1995. With over 30 technical publications and a wealth of practical knowledge, Philip has contributed at the intersection of the fields of reverse-engineering, automatic programming and formal methods for over 20 years.

The Software Revolution is building OMG ADM compliant services, products and technology under his technical and executive leadership.

The Software Revolution, Inc.

- **Offices in Kirkland, Washington**
- **Established in 1995:**
  - 1995 - 1999 Focused on Y2K Remediation
  - 2000 Returned to System Modernization Roots
  - Steady Sales Growth Since 2000
- **Technology Rooted in Early Artificial Intelligence Projects**
  - 1983 USAF Knowledge Based Software Assistance (KBSA) Program
  - 1988-1994 Boeing Artificial Intelligence Lab
- **Member OMG Architecture Driven Modernization Task Force**
  - Abstract Syntax Tree Meta-Modeling (ASTM) Standard
  - ASTM Tutorial, leading ASTM Joint Submission Team
- **Awards**
  - Northrop Grumman “Small Business of Year” Award 2002
  - Raytheon “Supplier of Value” Award 2005
  - Small Business Administration’s 2005 “Administrators Award of Excellence”
- **100% Customer Satisfaction:** All are Reference Accounts

TSRI Mission

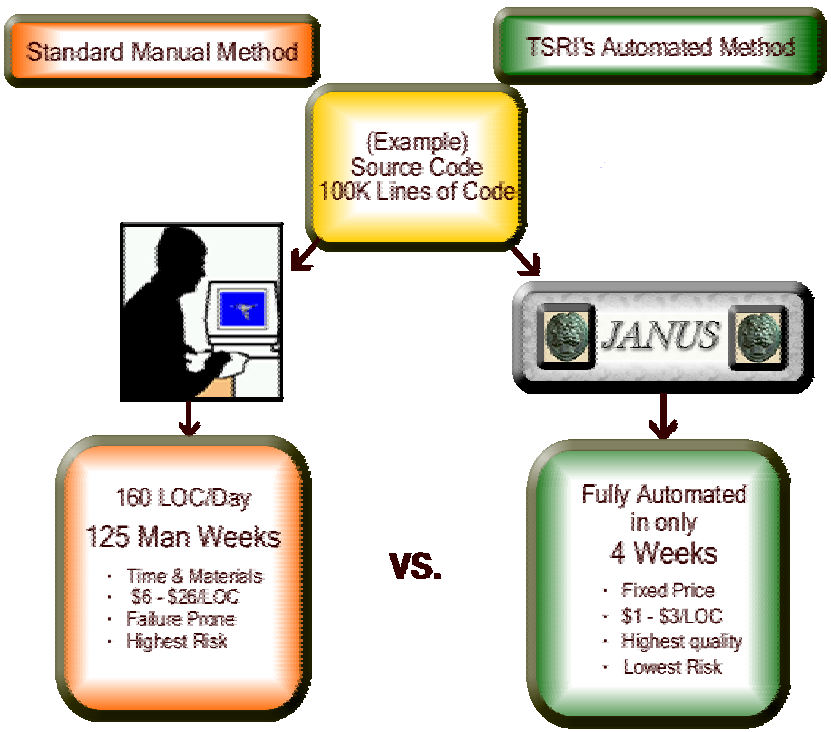
- **Migrate Valuable & Often-Irreplaceable Legacy System Software & Databases to:**
  - A Modern, Platform-Independent Target Language & Computing Environment
  - Without the Requirement for Manual Intervention

- **Provide Standards-Based Architecture Driven Modernization Technology & Services to Support:**
  - Highly Automated, Cost-Effective Legacy System Modernization
  - At a Fixed-Price & Guaranteed Quality
  - Between Any Combination of Source & Target Languages

Modernization Options

- **New System Development**
  - Failure Prone/High Risk
  - Expensive & Time Consuming
- **Manual Rewrite (Off-Shore)**
  - Expensive & Time Consuming
  - Failure Prone/High Risk
- **Commercial-Off-The-Shelf (COTS)**
  - Limited Functionality
  - Requires Supplemental Development & Integration
  - Hidden High Risk & Costs
  - Tied to Proprietary Vendor
- **System Re-Host**
  - Low Risk
  - Code Sustainment Problem Persists
  - High Maintenance Expense
- **Automated System Modernization**
  - Low Risk
  - Least Expensive
  - Uniform Product
  - Rapid Turn-Around

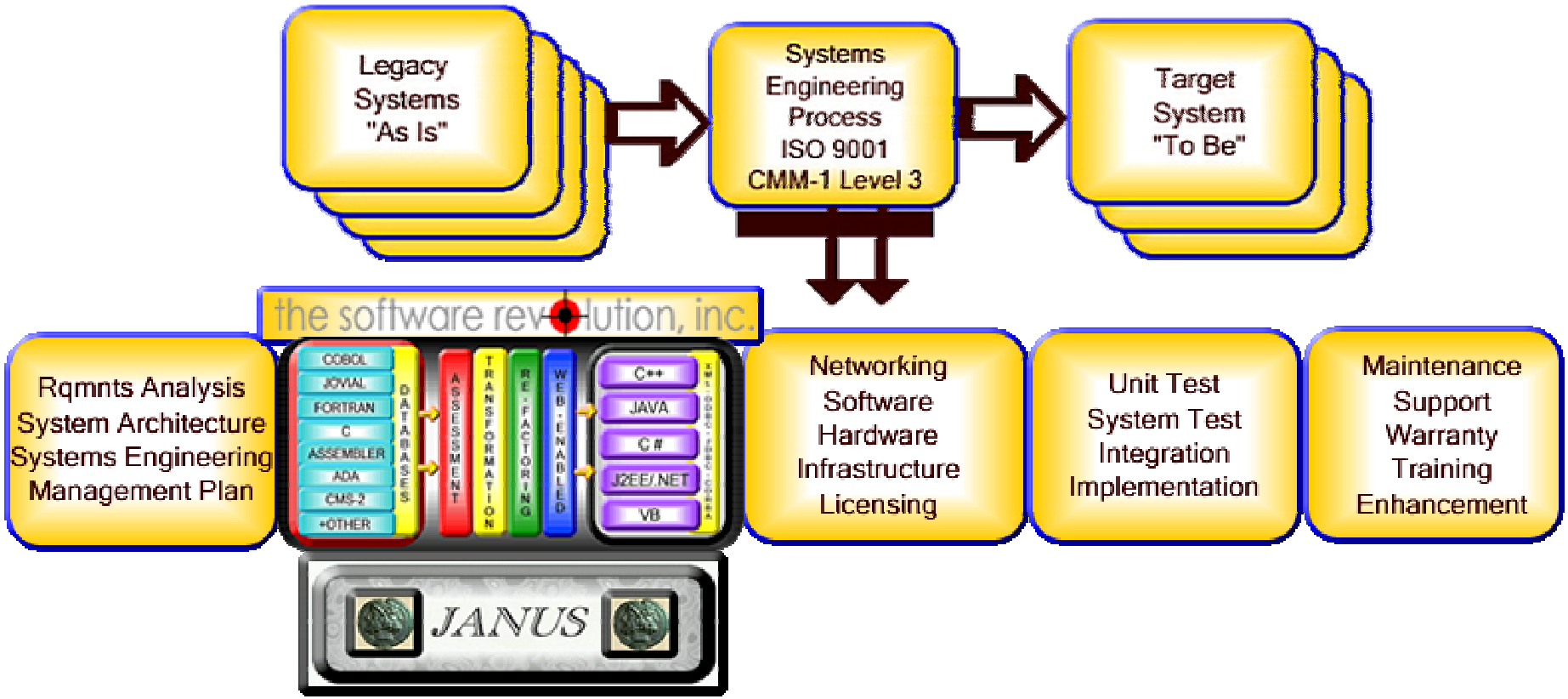
Approach Comparison



Automated Modernization Value Proposition

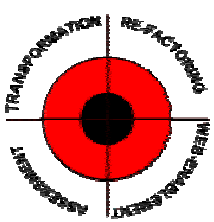
- **Dramatically Improves Success Rate of Projects**
- **Highest-Quality Uniform Code & Data Bases**
- **Integrated, Tested & Operational Software**
- **Highly Maintainable & Extensible Code**
- **Lower Cost**
- **Shortens Schedule**
- **Scalable & Adaptable Solutions:**
  - Highly-Efficient Technology
  - Services Adjust to New Requirements
  - Scalable to Projects of Any Size

Legacy System Migration
End-to-End Systems Engineering Process



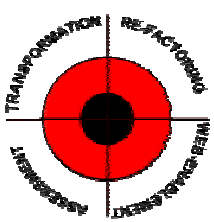
TSRI

Legacy Source Code	System Application
COBOL (4 Dialects)	• Administration • Logistics • Health Maintenance • Finance
ADA	• Aircraft Display • Satellite Terminal • Mission Planning
Assembler	• Strategic Missile Defense
Jovial	• Satellite Tracking • Aircraft Control • Command & Control
CMS-2	• Tactical Weapons Display
Fortran	• Weather Tracking • Strategic Missile Defense • Strategic Warfare Planning
C	• Homeland Defense • Strategic Missile Defense
VAX Basic	• Shipboard Engineering
MUMPS	• Hospital Operations



EOSS Modernization Case Study

- **Modernized NETWARCOM Engineering Operational Sequencing System (EOSS)**
- **Pilot Performed Under Auspices of Navy E-Business Office (December 2004)**
- **Contracted thru SAIC**
- **Application Size: 40K LOC**



EOSS Modernization Challenge

"As Is" EOSS System

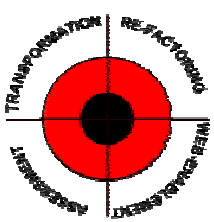
- EOSS Accountability system is written in VAX Basic Language
- Multiple Indexed Sequential Access Method
- Telnet Session Interface non-compliant with NMCI security practices

"To Be" EOSS System

- Java 2 Enterprise Edition (J2EE)
- N-Tier Architecture
- Oracle 9i Database Management System
- 100% Compliance with NMCI Security Requirement
- Full DITSCAP Certification
- Operationally Fit

Business Motivation for EOSS Upgrade

- **Transition to Single Secure Enterprise Network (NMCI) Forcing DON to Modernize Legacy Systems**
- **Functional Area Managers (FAMs) & Central Design Agencies (CDAs) Facing Large & Costly Modernization of aging systems**
- **Many Aging Applications Fail to Meet NMCI Security Requirements**
- **Naval Surface Warfare Center EOSS System Failed to Meet Security Requirements:**
  - EOSS was Quarantined
- **Modernization Options - Replace or Upgrade**
- **DON Pilot Undertaken to Measure Effectiveness of Manual Re-engineering Against TSRI Automated Alternative**

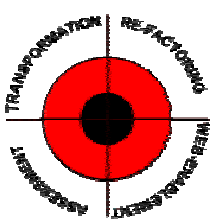


Goals of EOSS Pilot

- **Challenge TSRI to:**
  - Address New Source/Target Language Pair
  - Perform on Firm Fixed Price (FFP) Basis
  - Automatically Transform EOSS System While Retaining 100% of Original Functionality
  - Modernize EOSS to Meet NMCI Requirements
  - Successfully Work with Navy to Make System Operationally Fit
- **Compare Modernization Approaches:**
  - Use Gartner Group Manual Cost per Line of Code Metrics
  - Execute TSRI's Automated Pilot on EOSS
  - Develop ROI Analysis
  - Analyze/Validate Automated Approach for:
    - Future Use
    - Scalability

TSRI's Pilot Project Tasking

- Tool Set-Up
- Target Architecture & Interface Design
- "As Is" Documentation
- Code Transformation
- Database Conversion
- Automatic Re-Factoring
- Test Plan & Procedure Development
- System Delivery & Instruction
- System Testing
- "To Be" Documentation



Pilot Results

- **Pilot Successfully Completed**
- **Completed On-Time & On-Budget**
- **100% Automation Achieved in TSRI Transformation Process**
- **EOSS Ported to New Environment**
- **Business Logic - Original Functionality Preserved**
- **Terminated Need for Mainframe Computer & Contractor Support**

Pilot Results (Cont.)

- **“As Is” & “To Be” System Architecture Mapped & Documented**
- **Redundant & Dead Code Removal Improved EOSS Maintainability**
- **Navy Subject Matter Experts Tested Modernized System Extensively**
- **System Now “Operational”**
- **Capable of NMCI Access from Any Worldwide Location**

Approach Comparison Summary

- **Manual Estimate to Transform Code - $366K to $1.6M:**
  - Based on Gartner Group Estimates of $6 to $26 per Line-of-Code (LOC)
  - Average Cost of $16 per LOC Used for Pilot Comparison
  - Cost is Transformation Only – No Other Support Implied in Gartner Group Estimate
- **TSRI Actual Pilot FFP Transformation Cost per LOC:**
  - $45,380 for 39,993 LOC
  - $1.13per LOC

Approach Comparison Summary (Cont.)

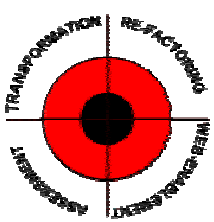
- **Total Project Cost of All TSRI Automated Modernization Services & Full Set-Up of New Language:**
  - $5.68 Including Set-up Price of $97.5K – 65% reduction
  - $4.08 Excluding Non-Recurring Set-up Price – 75% reduction for Future Like Conversions
- **Many TSRI Costs Would be Non-Recurring for Additional VAX Basic Systems**
- **Small Code Base Size of EOSS Did Not Allow for Economy-of-Scale Benefits of TSRI's Automated Technology**
- **Re-Engineering Time Significantly Reduced:**
  - Navy Estimated 76 Weeks Flow-Time Using Manual Approach
  - TSRI's Automated Approach Used 75% Less Time

Five-Year Cost/Benefit Summary

Description	FY04
Annual Gross Productivity Savings	$ 953,120
Cumulative Gross Productivity Savings	$ 953,120
Cumulative System Costs (TSRI Modernization)	$97,474
Cumulative Total Net Cash Flow	$855,646
Lifecycle Return on Investment (ROI)	2.47:1

Technical Lessons Learned

- **Additional Re-Factoring Would Have Been Required & Funded to:**
  - Achieve a More Modern User Interface Employing HTML Forms-Based User Interfaces
  - Achieve Better Modularity, Layering & Encapsulation Objectives.
  - Redesign Applications to Make Better Use of Modern Relational Database Function

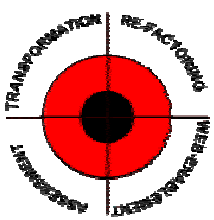


Navy Findings

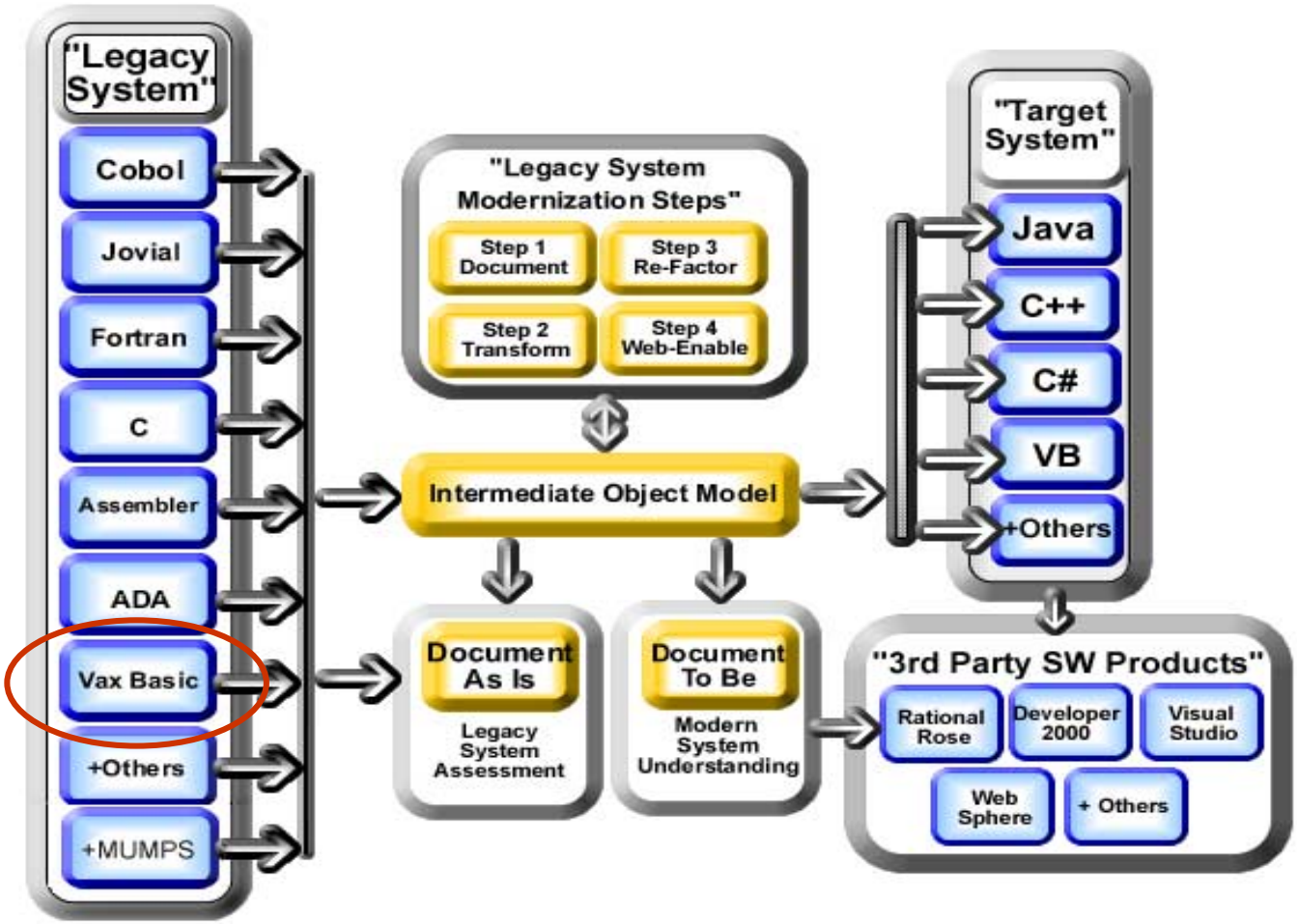
- **Fully Supports Modernization of Old/Obsolete Systems Where Support is Expensive & Difficult to Obtain**
- **Produces Code that is:**
  - Fully Modernized
  - Web-Enabled
  - Fully Documented
  - Operationally Fit
- **Conducive to Merging Overlapping Applications by Combining Single Application into Suite of Applications**
- **Has Potential to Reduce Number of Applications & Data Stores at Significant Cost Savings**

Navy Findings (Cont.)

- **Supports Integration of Legacy System into NMCI Architecture Once System is Modernized**
- **Modernized Code Format Supports Future System Modifications Derived from Changing Functional Requirements**
- **Initial Investment in VAX Basic Code Transformation Will Result in Significant Future Cost Savings:**
  - Maintenance
  - Cost Avoidance

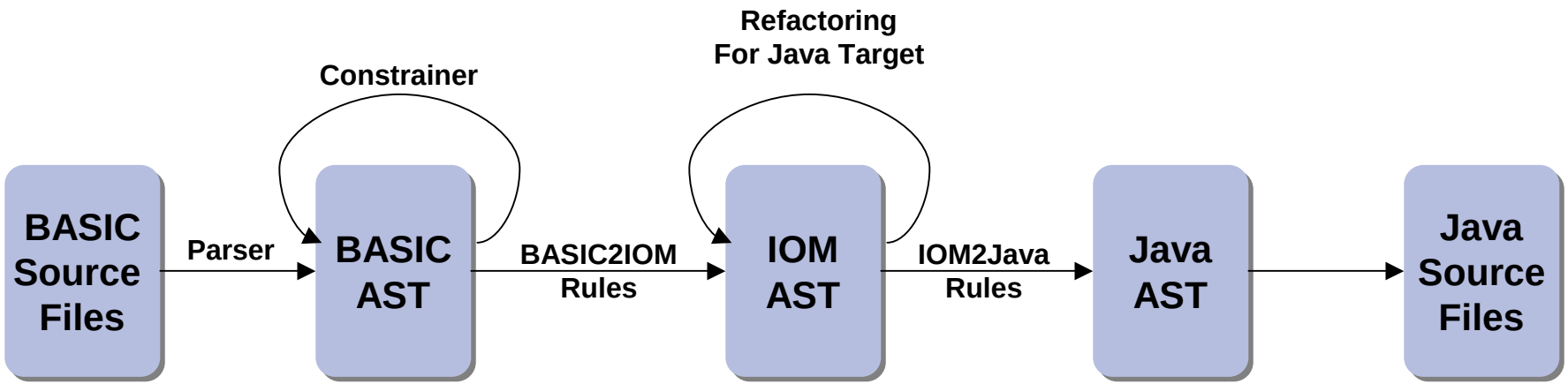


TSRI's *JANUS*™ Toolset



Over $25 Million Invested

Conversion / Transformation Process



- **AST – Abstract Syntax Tree**
  - In Memory Tree Base Representation of System
- **Constrainer**
  - Adds Symbol Linkage & Expression Types to AST Nodes
- **IOM – Intermediate Object Model**
  - TSRI Developed Language Neutral Model into Which All Source Languages are Mapped & Target Languages Emitted

Automated Assessment/Documentation

- **Provides "As Is" Software Documentation:**
  - Design & Architecture
  - Rules, Threads, Data Models, Logic
  - Software Pattern Discovery
- **Supports Development of Baseline Transformation Metrics:**
  - Redundant & Re-Useable Code
  - UML Functional Analysis & Design
  - Current & Predicted Code Properties
  - Potential Code & Data Size Reductions

Benefits

- **Supports Transformation Business Case**
- **Identifies Performance Enhancement Opportunities**
- **Documents Existing System Structure**

Step 1

Automated Transformation

- **Rewrites Legacy Code into Object-Oriented Code:**
  - C++, Java, C#
  - Coupled to Relational or Object-Oriented Databases
  - Interface, Data and Database Conversions
- **Provides Target Object-Oriented Software:**
  - Uniform
  - Compiler-Ready
  - Fully Documented
  - Test Ready

Benefits

- **Reduces Hardware & Software Ownership Costs**
- **Avoids Time & Cost of COTS-Based Solutions**
- **Provides Greater Flexibility for Tailoring System Architecture & Functionality**

Step 2

Automated Re-Factoring

- **Starts the Re-Engineering of Target Components:**
  - Automatic:
    - Removes Dead & Redundant Code & Data
  - Semi-Automatic
    - Merges & Consolidates Duplicate Code & Data
    - Reorganizes & Improves Design of Code & Data
    - Removes “As Is” Flaws From “To Be” Software
- **Creates Reusable Components for:**
  - Optimization, Packaging, & Redistribution
  - Integrating into Parallel Multi-Processor Distributed N-Tier Operational Environments

Benefits

- **Improves Software Maintainability**
- **Enhances Software Performance**
- **Supports Component-Based Reusability**
- **Supports Consolidation of “Stove-Pipe” Systems**

Step 3

Automated Web-Enablement

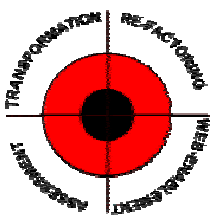
- **Transform Legacy Applications into:**
  - Java using J2EE Components
  - C++ or C# Using Microsoft .Net Components
  - C++ Using CORBA Components
- **Re-Factor Derived Components to:**
  - Segregate Client-Side Web-Browser & UI Code
  - Segregate Server-Side Data Manipulation & Access Code
- **Creates Flexible & Extensible Components that Support Future Enhancements**

Benefits

- **Quick Exploitation of Web-Environment Leveraging Legacy System**
- **Improved product & Service Quality Through Enhanced Communications**
- **Supports Lower Cost hardware Options & Flexible Operational Environment**

Step 4

TSRI Customers/Partners



Project Case Study Matrix

Customer/Project	Source - Target Pair	"As Is"	Transform	Re-Factor	"To Be"	Web Enable
NEA	COBOL to C++	X	X	X		X
Northrop Grumman (REMIS)	COBOL to C++	X	X	X	X	X
CSC (FBISHED)	COBOL to C++	X	X	X	X	
STG (DODAAD)	COBOL to C++		X	X	X	
Premera	COBOL to C++	X	X	X	X	
DynCorp (VSCRS-I)	COBOL to C++		X			
One Star (VSCRS-II)	COBOL to C++		X	X	X	
STG (VSMIS)	COBOL to C++	X	X	X	X	
Telos (DURS)	COBOL to Java		X			X
USAF (CAMS)	COBOL	X				
Oregon (OPERS)	COBOL	X		X	X	
Northrop Grumman (JMPS)	Ada to C++	X	X	X		
Raytheon (MCS)	Ada to C++		X	X		
DSR (E-2C)	Ada to C++		X			
Boeing (ALCA)	Jovial to C++		X			
CSC (CCS-C)	Jovial to C++	X	X			
TRW (MILSTAR)	Jovial to C++	X	X			
TRW (BMEWS)	Jovial to C++		X			
USAF (F-16 DECIS)	Jovial to C++					
Litton/PRC (USSTRATCOM)	Jovial to C++		X			
Raytheon (TCS)	Fortran to C++		X	X		
ITT (Assessment)	Fortran	X				
Lockheed Martin (I-SPAN)	Fortran to C++		X			
Litton/PRC (USSTRATCOM)	Fortran to C++		X			
SAIC (EOSS)	Vax-Basic to Java	X	X	X	X	X
Litton/PRC (USSTRATCOM)	Assembler to C++		X			
ITT (Assessment)	C	X				
CSC (R2UPLD)	C to C++	X	X	X	X	
LMCO (P-3C)	Ada to C++		X	X	X	
ITT (SENSOR)	Ada to Java		X	X	X	
SAIC (VHA)	MUMPS to Java	X	X	X		
CSC (ETMS)	Assessment	X				
Thales-ATM (ETMS)	Ada to C++ & Java		X		X	
NGIT (MPEC)	Fortran to Java	X	X	X	X	
EDS (Pilot)	PL 1 to Java		X	X	X	
Raytheon (Patriot Missile)	Fortran to C++	X	X	X	X	
Raytheon (VDAC)	Fortran to Java		X		X	

Project Summaries

The National Endowments for the Arts (NEA) attempted a manual modernization of three Wang COBOL administrative sub-systems. This manual effort ended in complete failure after two years of effort. NEA engaged TSRI to document, transform, re-factor, and web-enable these sub-systems. With these automated services, NEA attained a successful modernization, which TSRI subsequently enhanced to meet the latest Congressional reporting mandates.

The Naval Network Warfare Command (NETWARCOM) required modernization of a Navy legacy information system written in VAX-Basic. TSRI's automated tool-set transformed the VAX-Basic code into J2EE/Java. TSRI also made several design adaptations to preserve the system's functionality, while modernizing its architecture and allow web-enablement

TSRI was selected for Northrop Grumman's "2002 Small Business of the Year Award" for services provided in this REMIS system Tandem COBOL85 and Tandem SQL modernization to C++ and Oracle9i. The automated services provided by TSRI included "As Is" documentation, transformation to C++, re-factoring, "To Be" documentation, and web-enablement.

Project Summaries

The US Navy required the Ada to C++ modernization of a Multi-band SATCOM Terminal. Raytheon selected TSRI for the automated assessment, transformation and re-factoring of this system.

The US Air Force's WDAC system fuses radar and satellite data to create fine-scale weather products for operational commanders. Raytheon contracted TSRI for a 100% automated transformation of the system's Fortran code into J2SE/Java. Users of the new WDAC will also now be able to access weather data through secure internet protocols.

Computer Sciences Corporation (CSC) engaged TSRI to support the modernization of a legacy system consisting of both C and COBOL for the Bureau of Citizenship & Immigration Services. Automated services provided by TSRI included "As Is" documentation, transformation to C++, re-factoring, and "To Be" documentation.

Project Summaries

Premera Blue Cross needed to modernize an automated assembly system. TSRI was contracted to assess the system, transform its legacy Wang COBOL into C++, and re-factor the modern system. The legacy system was capable of self-generating COBOL code. After TSRI's efforts, the modern system accurately self-generated equivalent C++ code

U.S. AIR FORCE

The U.S. Air Force's Weapons System Cost Retrieval System was written in COBOL, ran on an AMD-5890 platform, and used a flat file data base. TSRI was engaged to perform the COBOL to C++ transformation and to separate data manipulation commands from the business logic allowing for an upgrade to a relational database

The U.S. Air Force's Core Automated Maintenance System consisted of a Unisys DMS 2200 database and over 3.5 million lines of Unisys COBOL code. TSRI generated 120 Gigabytes of high-fidelity UML documentation to facilitate integration of CAMS' functionality with the Integrated Maintenance Depot System.

Project Summaries

The Oregon's Public Employees Retirement System required the modification and integration of two subsystems comprising over 250,000 lines of COBOL II code. TSRI's assessment and refactoring services reduced the complexity, eliminated redundancy and removed obsolete functionality to support the consolidation the two subsystem

The Defense Technical Information Center attempted to manually modernize and web-enable a UNISYS 2200 COBOL application. The time and expense in transforming less than one third of the system into Java prompted the selection of TSRI's automated solutions to complete the project. The cost savings for DTIC are estimated at over $440,000.

Computer Sciences Corporation (CSC) engaged TSRI to support the modernization of a legacy COBOL system for the Bureau of Citizenship & Immigration Services. Automated services provided by TSRI included "As Is" documentation, transformation to C++, re-factoring, and "To Be" documentation.

Project Summaries

STG, Inc. awarded a contract to TSRI for the transformation, re-factoring and documentation of a Department of Defense administrative system. This modernization involved the automated transformation of HP COBOL into object oriented C++ and re-hosting the system's database.

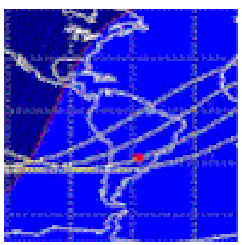
The U.S. Navy's carrier-based E-2C Aircraft required a display system modernization. Digital Systems Resources (DSR) contracted TSRI to provide automated Ada to C++ transformation of its Mission Computer Fault Isolation Program.

Northrop Grumman engaged TSRI for the Ada to C++ modernization of the Joint Mission Planning System (JMPS). TSRI's automated services included documentation, transformation, and re-factoring of the legacy code.

Project Summaries

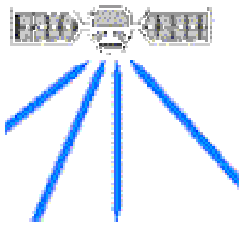
The US Navy required the Ada to C++ modernization of a Multi-band SATCOM Terminal. Raytheon selected TSRI for the automated assessment, transformation and re-factoring of this system.

The USAF completed a year long manual modernization of a 50,000 line JOVIAL module from the F-16 cockpit. TSRI's automated transformation of the same module attained C++ code of comparable quality to the manually converted code. The Air Force was further impressed when a single TSRI engineer automatically transformed a 2nd similar JOVIAL module into C++ in only 15 minutes.



Lockheed Martin engaged TSRI to demonstrate their automated transformation capabilities for the US Strategic Command. The demonstration involved an 80,000-line Fortran test sample. In the final demonstration it took only 20 minutes to automatically transform the legacy Fortran into a functionally equivalent C++ module.

Project Summaries



Litton/PRC required a proof-of-concept demonstration to illustrate the cost effectiveness and feasibility of automated tools in modernizing Fortran and Assembler code into a modern software language. The modernization strategy demonstrated by TSRI received outstanding marks by government evaluators for risk mitigation.

A Space and Naval Warfare Systems Command (SPAWAR) system required a Fortran to C++ modernization. Raytheon, the prime contractor, awarded TSRI a contract as the sole provider of automated assessment, transformation and re-factoring for this Fortran system while meeting stringent SPAWAR quality standards.

A US Air Force radar system required comprehensive documentation to assess its consolidation potential. This system exceeded one million lines of C and Fortran code. TSRI automatically generated documentation for all programs in the system.

Project Summaries

Boeing required a new version of a mission-critical avionics software package for its Advanced Light Weight Combat Aircraft. TSRI successfully converted the J73 JOVIAL into C++, delivering Boeing an accurate error free avionics package which compiled and linked cleanly.

In support of the MILSTAR satellite modernization effort, TRW contracted TSRI to assess and transform 143,000 lines of JOVIAL code. The automatically generated C++ upgrade of MILSTAR's primary control system was launched in 2004 and now provides enhanced communications for the United States Armed Forces.

Computer Sciences Corp. (CSC) won a down select as a subcontractor to Integral Systems, Inc. (ISYS) following a TSRI to demonstration of its automated J73 JOVIAL to C++ assessment and transformation capabilities. CSC then used TSRI's comprehensive JOVIAL documentation to identify the MILSTAR Mission Unique Software, allowing system integration.

Project Summaries

Using a module from the Ballistic Missile Early Warning System (BMEWS), TRW and TSRI performed an early demonstration of automated software re-engineering capabilities. The transformation of J3 JOVIAL into C++ established the initial framework for TSRI's automated tools and services, including automated assessment, transformation, re-factoring and web-enablement.

Lockheed Martin Corporation (LMCO) awarded a Sole Source contract to TSRI to transform the nearly 500K lines of Ada code in the Acoustic Signal Processing suite on-board the Navy's P-3C aircraft into C++. With transformation testing complete, TSRI is now automatically re-factoring the code.

ITT Industries awarded The Software Revolution, Inc. (TSRI) a third Sole Source contract to support the Service Life Extension Program (SLEP) of the Air Force's Ballistic Missile Early Warning System (BMEWS). The contract was part of ITT's System Engineering and Sustainment Integrator (SENSOR) contract with the Air Force's Electronic Systems Center. Under this contract, TSRI transformed the existing system's legacy Ada code into fully object-oriented Java and C++.

Project Summaries

The Veterans Health Administration (VHA) awarded a contract to Science Applications International Corporation (SAIC) and The Software Revolution, Inc. (TSRI) to develop and demonstrate an automated approach to the modernization of their legacy MUMPS application language into J2EE Java.

Computer Science Corporation (CSC) awarded TSRI a contract to begin the documentation process of the Federal Aviation Administration's (FAA's) Enhanced Traffic Management System (ETMS). TSRI's efforts ensured that CSC had a detailed understanding of the structure and flow of the ETMS applications code and database prior to making key ETMS modernization decisions.

Thales-ATM based in Paris, France awarded a contract to TSRI for demonstration of an automated approach to the transformation and documentation of the legacy Ada application language in a module of the European Air Traffic Management System into C++ and Java. Thales-ATM is now evaluating and selecting which new language target best suits their needs for modernization of the entire system.

Project Summaries

Northrop Grumman Defense Mission Systems (NGDMS) has awarded TSRI a contract to modernize the Air Force's Mission Planning Enterprise Contract Autorouter Fortran code to C#. Tasking includes Legacy Documentation, Code Transformation, Automatic Re-Factoring, System Integration & Test Support, and Final Documentation.

Electronic Data Systems (EDS) has awarded TSRI a contract to expand the automated capabilities of TSRI's *JANUS*™ toolset to encompass the automated modernization of the P/L 1 language. The effort will focus on the modification of *JANUS*™ to create the necessary P/L 1 gateway and on the ability to lift P/L 1 into the toolset's Intermediate Object Model (IOM).

Raytheon has awarded a contract to TSRI for modernization of a subset of legacy FORTRAN code of the Patriot Missile to C++. Upon demonstration of a fully automated transformation of that code where the transformed code also meets stringent coding standards, Raytheon plans to have TSRI move forward with the modernization of other portions of that system's code.

Language Count To-Date

Major Legacy Languages	Modernization Lines	Y2K Lines
Ada	1,442,600	2,000,000
Assembler	283,000	
C	829,000	29,000
CMS-2	220,000	
Cobol	2,503,000	1,602,000
Fortran	514,000	475,000
JCL	18,000	
Jovial	237,000	
MUMPS	120,000	1,302,000
P/L 1	50,000	
Natural	0	14,000
RPG	0	101,200
VAX Basic	38,000	
Total Lines Addressed	**6,254,600**	**5,523,200**
Historic Total TSRI Lines Addressed	**11,777,800**	