An advanced, comprehensive Testability Engineering and Maintenance System

TEAMS™ Tool Set

www.teamqsi.com

Kevin Cavanaugh, Chief Operating Officer
Who is Qualtech Systems, Inc.? 

- Software Company Incorporated June 1993 in Connecticut, located in Wethersfield, CT
  - 14 employees and growing (SBA certified Small Disadvantaged Business (SDB))
  - Selected for NASA Space Act Award in April 2002 for Significant Scientific and Technical Contributions
  - Selected for Award of Aviation Week and Space Technology - Technical Innovations 2002

- QSI leaders have over 100 years of combined experience in Integrated Diagnostics/RM&T, algorithm design, implementation, and software product development - Five members of QSI staff have doctoral degrees, two of whom are IEEE Fellows - Collectively, our principals have written over 400 journal and conference papers - QSI is a recognized technology leader

- Key People / Recognized Experts from QSI
  - Dr. Krishna Pattipati - CEO/President
  - Mr. Kevin Cavanaugh - Chief Operating Officer
  - Dr. David Kleinman - R&D and Business Development
  - Dr. Somnath Deb - Chief Engineer
  - Dr. Amit Mathur - Senior Research Scientist
  - Dr. Sudipto Ghoshal - Senior Research Scientist

- Products and Services:
  - Integrated TEAMSTM Tool Set: TEAMSTM, TEAMS-RTSTM, TEAMATESTM, TEAMS-KBSTM, TEAMS-RDSTM
  - ID&T engineering, Software Design and Development, IVHM architecture, IETM reasoners, R&D, TPS Engineering, Modeling, and RM&T Engineering

Comprehensive Integrated Diagnostics and IVHM Solutions
A Comprehensive ("Common Model") Software Solution for Designing, Deploying, and Supporting Systems for the Entire Life Cycle

**What is the TEAMS™ Tool Set?**

**TEAMS™**
- Simple, Intuitive, Modeling
- Rigorous Diagnostic Analysis
- Design Evaluation & Optimization
- Knowledge Capture/Retention

**TEAMS-KB™**
- Model Management
- On-Line Support
- Data Logging
- Information Management

**TEAMS-RT™**
- Real-Time Embedded Diagnostics
- Compact, Ultra-Fast Reasoning
- Accurate Diagnostics
- Passive, Non-Intrusive Diagnostics

**TEAMS-RDS™**
- Server
- Remote, Thin Client Diagnostics
- Large Scale Solution
- Telemaintenance & After Market Services
- Cost Effective Solution

**TEAMATE™**
- Interactive Diagnostics
- Dynamic, Adaptive Reasoner
- Class V IETM
- Optimized Procedures
What are TEAMS™ models?

TEAMSTM IS NOT:

• a Simulation
• a Rule-Based Model
• a Case-Based Model
• a Statistics-Based Model

TEAMSTM IS:

• A Cause and Effect, Multi-Functional Model of the Failure Behavior of the System
• A Graphical, Understandable way of representing the RM&T aspects of the design for the Life Cycle
• A Visual model that supports V&V and Long Term Model Maintenance and Updates
• The least expensive, most cost effective modeling approach available

Most OEMs already do these “models” in their current processes ..... Except they do not have the graphical representation, the analysis & optimization features, and the ability to implement these models in the systems!
What analysis can **TEAMS™** provide?

- Hardware Properties
- Variety of Analysis Options
- Signal Processing
- Test Properties
- Graphical Feedback
- Detailed Diagnostic Strategy
- Testability Figures of Merit
- Optimized Diagnostic Tree
- FMECA
- Variety of Text Reports
How can the Tool Set be applied?

- Very Fast, Low Overhead, Model Based Real Time Reasoning Using ALL test results - Failed Tests, Failing Tests, and Passing Tests
- Continuous, Non-Intrusive Diagnostics
- Extracted DIRECTLY from the Modeling & ANALYSIS environment (TEAMS™)

Example embedded application running on NASA Ames UH-60 “RASCAL” Helicopter
TEAMATE collects/logs maintenance actions including time required and other maintenance management data

TEAMATE™

- Extracted DIRECTLY from the Modeling & Analysis environment (TEAMS™)
- Intelligent, Model Based, Dynamic, Adaptive, Maintenance Procedures

• Dynamic Reasoner
• Adapt to Resources
• Maintenance History
• Collect/Time Actions
• Present Diagnostics
• Present Repair Steps
• Present Test Steps

To client CMMS and/or E-Commerce Systems

TEAMATETM

Models (Configurations)
Maintenance History
Maintenance Results

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TEAMATE™ can be used to Intelligently sequence Test Equipment - Using Knowledge from the TEAMS™ Model

JAHUMS-ARMY: ETEDS at the T700 Engine Test Cell, GEAE, Lynn, 1/30/02
How can the Tool Set be applied?

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Manage System Health Information

Examine Systems Health and Detailed Diagnostic Information

Perform Optimized Testing and Maintenance

Diagnostic Data

RDS Server

TEAMS-RDS™

TEAMS-RT™

TEAMATE™

TEAMS-KB™

Internet

How can the Tool Set be applied?
How Does Work?

RDS Client
- RDS Protocol Library

RDS Broker
- Distributed RDS Server
  - RDS Protocol
  - OCI/ODBC

Common Application Agent

TEAMATE
- process test results
- assess system health
- handle redundancy & modes
- multiple simultaneous failures

TEAMS-RT
- next best test
- manual/automatic test procedures
- operating constraints
- rich content presentation

Database Agent

TEAMS-KB
- Model Management
- Diagnostic Logs
- Parameter Updates
- Scheduled Maintenance
- Content Management
- Configuration Management

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How are **TEAMS™** Tools Used in JAHUMS?
What are the Tool Set Benefits?

Case History: JAHUMS (Joint Advanced Health and Usage Monitoring System) - Army and Navy Rotorcraft advanced On-board and Off-Board IVHM Solution - ROI Analysis/Study conducted by Sikorsky Aircraft for DoD ACTD using actual field data, models, and simulations

a. **Scheduled Maintenance** reduction = 50%
b. **Troubleshooting time** (FI time in MTTR) reduction = 75% using intelligent, dynamic fault isolation procedures vs standard fixed troubleshooting trees
c. **False Removals** and Unnecessary Spares Consumption reduction = 80% via accurate model based reasoners and cross system reasoning (IVHM function to control/isolate cascading failure)
d. **Training Requirements** reduction = 20% via enhanced automation and intelligent procedures
e. **Aircraft Readiness** improvement = 38% with fewer maintenance personnel (from 4 down to 1) via improved fault isolation performance and enhanced automation

* Data compiled for helicopter engines only based on approximately 400 operating hours per year.

Data showed approximately $30,000 in SAVINGS per year, per engine - Helicopter Engines with 400 Operating Hours