

THE ROLE OF TESTING IN TODAY'S
COMPETITIVE ENVIRONMENT OF COST
REDUCTION, ACCELERATED SCHEDULES
AND RELIANCE ON COMMERCIAL
STANDARDS

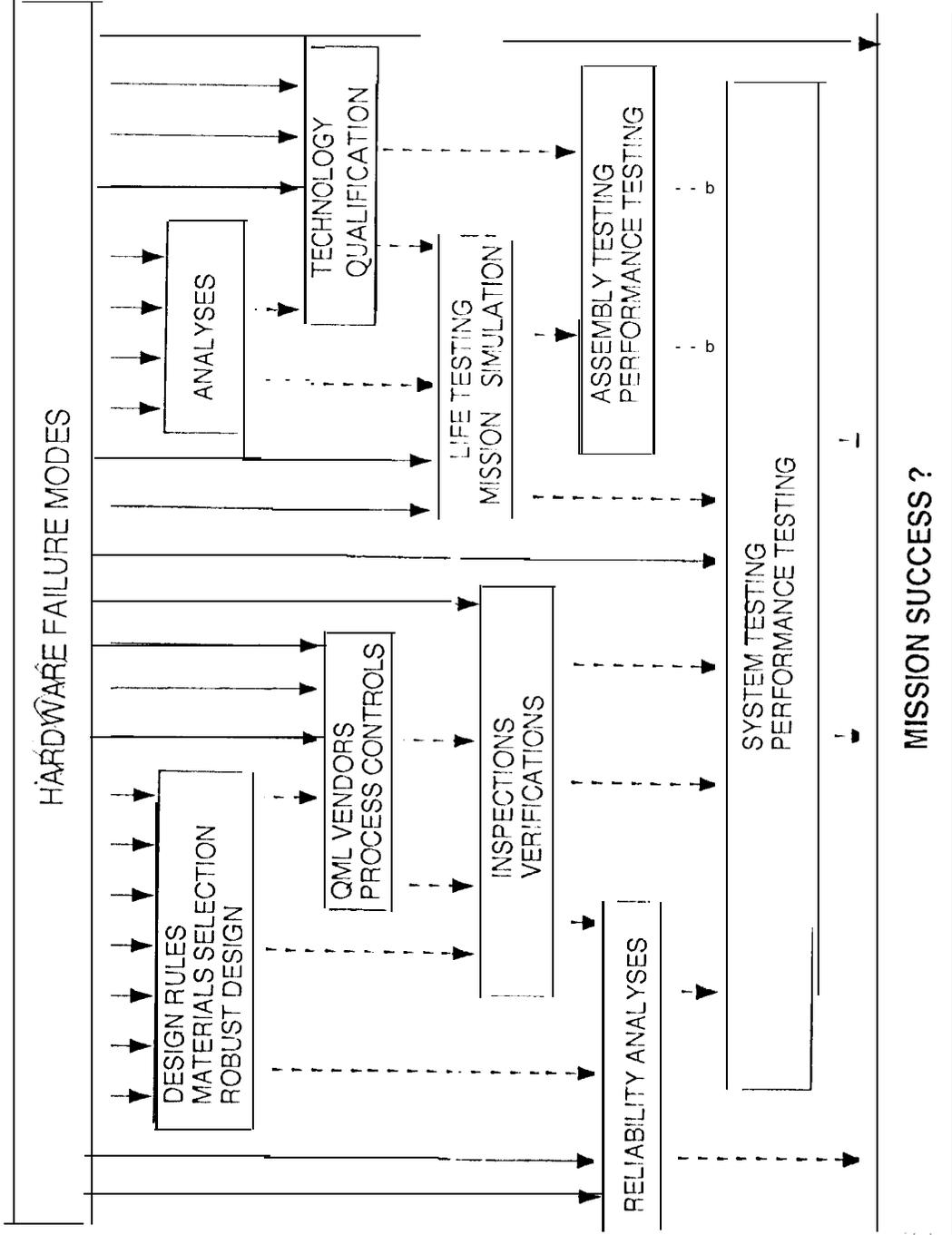
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TESTING IN THE BIG PICTURE

TESTING IS PART OF AN INTEGRATED SUITE OF ACTIVITIES
INTENDED TO ENSURE RELIABLE/ADEQUATE
PERFORMANCE IN THE USAGE ENVIRONMENT

- At JPL, we like to think of Mission Assurance activities as a collection of individual PACTS=
 - Preventions (Design Rules, Materials and Parts Selection, Redundancy, etc.)
 - Analyses (Environmental. Structural. Worst Case Analyses. Functional Simulations, etc.)
 - process Controls (Inspections, documentation, Standard Manufacturing Processes, etc.)
 - Tests (Environmental, Life, Functional, Screening, etc.)
- These are the sum of all of the activities removing potential failures from the system
- Testing is an integrated part of the PACT Implementation process
- Relevant metrics Effectiveness as part of the overall process are necessary to justify any PACT activity

WATERFALL CHART



PART FAILURES - A GENERIC CASE STUDY

DESIGN RULES AND MARGINS, PARTS PROCURED TO A STANDARD, PARTS INSPECTED, TESTED AND ANALYZED, MANUFACTURING PROCESS CONTROLS, BOARDS INSPECTED, TESTED AND ANALYZED, UNIT ASSEMBLY PROCESS CONTROLS, UNITS INSPECTED, TESTED AND ANALYZED, SUB-SYSTEM ASSEMBLY PROCESS CONTROLS, SUB-SYSTEMS INSPECTED, TESTED AND ANALYZED, SYSTEM ASSEMBLY PROCESS CONTROLS, SYSTEM INSPECTED, TESTED AND ANALYZED

- SHOULD WE STILL BE SEEING PART FAILURES IN SYSTEM TEST? NO!
 - IS MORE BETTER?
 - MAYBE, BUT MORE COST AND SCHEDULE REQUIREMENTS
 - EVEN THROWING “THE KITCHEN SINK” MAY NOT BE ENOUGH
 - IS WHAT WE LEARNED BEFORE APPLICABLE TO TODAY’ S TECHNOLOGIES?
 - REMOVE REDUNDANT, NON-COST EFFECTIVE ACTIVITIES AND IMPROVE REMAINING ACTIVITIES

OBJECTIVES OF TESTING

- WORKMANSHIP/INFANT MORTALITY
 - MISSING PARTS, WRONG PART VALUES, POOR INTERCONNECTS, INADEQUATE BONDING, ETC.
 - FAILURES WITHIN THE FIRST 90 DAYS OF DEPLOYMENT
 - ETC.
- DESIGN VALIDATION
 - INTERFACE/TIMING ISSUES
 - FUNCTIONAL TESTING - DOES IT PERFORM AS INTENDED/PREDICTED?
 - MODEL VALIDATION AND PARAMETER UPDATES
 - OVERSTRESSED PARTS AND COMPONENTS
 - ETC.
- ROBUST DESIGN (OPERATIONAL AND ENVIRONMENTAL PREDICTION UNCERTAINTIES)
 - FUNCTIONAL AND ENVIRONMENTAL PERFORMANCE MARGINS
 - END-OF-LIFE SIMULATION
 - RELIABILITY AND FAULT TOLERANCE
 - ETC.

PROJECTS WANT TO REDUCE TESTING

.EASY, BIG TARGET

- BASED ON COST/SCHEDULE CONSTRAINTS
- REJECTION OF “OLD WAYS” OF DOING BUSINESS
 - “OLD WAY” IN MOST CASES IS CORPORATE CULTURE
 - BASED ON EVER-GROWING “LESSONS LEARNED”
 - THE SUM OF ALL LESSONS EVER LEARNED IS TOO MUCH
 - TOO COSTLY AND TIME-CONSUMING
 - EVERY LESSON LEARNED IS NOT APPLICABLE

.WHAT IS THE “NEW WAY”? - FASTER, BETTER AND CHEAPER (ALL 3)

- BASED ON AN INDIVIDUAL'S PERSONAL LESSONS LEARNED? NO.
- BASED ON COPYING ANOTHER CORPORATE CULTURE? MAYBE.
 - LOOK AT THE BIG PICTURE, MAY NEED THE WHOLE CULTURE
- BASED ON METRICS FOR EFFECTIVENESS? YES.
 - IF YOU CAN'T MEASURE IT, HOW DO YOU KNOW ITS ANY GOOD?
 - HAVE WE BEEN RESPONSIVE IN ESTABLISHING METRICS AND MEASURING TEST EFFECTIVENESS?
 - ARE THE EXISTING METRICS RELEVANT (I.E. BASED ON RELEVANT FAILURE PHYSICS OR EMPIRICAL NUMEROLOGY)

NASA/JPL CURRENT ACTIVITIES

•NASA/JPL FLIGHT PERFORMANCE ASSESSMENT

- FLIGHT PERFORMANCE IS THE ULTIMATE METRIC
- LOOKING FOR “ESCAPES” AND PACT EFFECTIVENESS

•JPL FLIGHT DEVELOPMENT PROCESS REENGINEERING

- VIRTUAL TESTING/PROJECT DESIGN CENTER
 - HOW ABOUT “VIRTUAL ANALYSES”?
- FLIGHT SYSTEM TESTBED
- FOCUS ON CONCURRENT TEAMS AND ACTIVITIES
- INFRASTRUCTURE DEVELOPMENT
 - HOW TO OPERATE WHEN EVERY PROJECT IS A “SKUNK WORKS”?
 - LEVERAGING LESSONS LEARNED AND CUMULATIVE TEST EFFECTIVENESS DATA TO IMPACT THE NEXT PROJECT DEVELOPMENT
 - SEAMLESS DATA EXCHANGE

•NEW MILLENNIUM MISSION ASSURANCE

•NASA/JPL PARTS AND PACKAGING PROGRAM

• NASA/JPL TEST EFFECTIVENESS PROGRAM

NASA/JPL TEST EFFECTIVENESS PROGRAM

- DATA SOURCES AND SYSTEMS
 - DATABASES
 - NASA/JPL FLIGHT AND GROUND ANOMALIES AND SSED
 - COMMERCIAL SCREENING DATA
 - WORKING GROUPS, SEMINARS, SURVEYS, STANDARDS
- METRICS DEVELOPMENT AND IMPLEMENTATION
 - RELATIVE TEST AND COST EFFECTIVENESS VERSUS FAILURE MODES
 - ROLE OF MARGINS AND INTERPLAY BETWEEN FACTS
 - ANALYSIS VERSUS TESTING, INSPECTIONS VERSUS TESTING, TESTING COMBINATIONS, LEVEL OF ASSEMBLY, DESIGN AND FABRICATION (DESIGNING FOR AND TESTING FOR THE “ILITIES”)
- METHODOLOGY DEVELOPMENT AND IMPLEMENTATION
 - SYNERGISTIC AND PHYSICS OF FAILURE BASED TESTING
 - QUALIFICATION METHODOLOGIES FOR ADVANCED TECHNOLOGIES
 - DEFECT DETECTION AND PREVENTION
 - RISK IDENTIFICATION AND MITIGATION STRATEGIES
 - MIXING AND MATCHING FACTS
 - ATS PAPER: PRESENTATION AND POSTER