TA 13 Ground and Launch Systems Processing
Roadmap Panel Discussion

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Discussed in this briefing

From NASA Draft Ground and Launch Systems Processing Roadmap for Technology Area 13
LCC are determined during the conceptual design phase

- Shuttle ground systems developed piecemeal, after vehicle design was complete
  - clean-sheet operations optimizations were not possible
  - costs were high - $
- Process optimization is very difficult due to:
  - constraints imposed by the vehicle design
  - resistance of existing organizations and procedures.
- Major LCC are difficult to reduce later in the development life cycle.

According to the MSFC Engineering Cost Office:

- “80% of Life Cycle Costs (LCC) are determined by decisions made during the conceptual design stage.
- The best detailed design engineering will not correct a flawed concept selection.”

4 From page 14 of the 3/12/02 Project Cost Estimating and Analysis pitch presented at the recent 2nd Gen PP&C training session.
All Phases of Operations Considered

- Maintenance Mgt & Control
  On-Time Vehicle Availability

- Operations Control & Management
  Real-Time Relevant Data

- Flight Operations
  One system for ground & flight operations

- Ground Support Equipment & Tooling
  Improved Maintenance Performance

- Interactive Electronic Media
  Focused Tasks
  Real-Time Revision Updates

- Portable Maintenance Aids
  Improved Safety & Quality
  Hazard De-Confliction

- Task Scheduling & Tracking
  Increased Vehicle Availability
  Increased efficiency

- Facility Maint & Control
  Optimized Utilization

- Mission/Flight Planning
  Automation, Cost Savings

- Spares & Inventory Control
  Accurate Forecasting, Increased Vehicle Availability

- Early Checkout @ Customer Facility

Disparate ground operations create challenges for ground systems.
ACCMS Benefits Relative to Shuttle Baseline

- STAS 3B studies estimated annual savings of $250M/Yr
- Technicians represent 19% of the total ground operations task
- Infrastructure & Mgt is 42% of current Shuttle Operation
- ACCMS targets reductions through automation and integration of disparate systems
- Common ground systems reduce O&S costs for infrastructure by as much as half

ACCMS Could Provide A Reduction In Ground Infrastructure & Support of @ 30-40%

2011 Comment: Benefits of system integration were difficult to quantify, but studies did point to significant benefits
Mainframe-Based Systems—SPDMS
- Automated Line Replaceable Unit Tracking System (ALRUTS)
- Automated Management Document Control System (AMDCS)
- Automated Ordnance Control System (AOCS)
- Automated Support Requirements System (ASRS)
- Computer Aided Planning and Scheduling System (CAPSS)
- Document Accounting and Control System (DACS)
- Data Dictionary (DD)
- Deviation Index Logging System (DILS)
- Deferred Processor (DP)
- Information Management System (I/M)
- Integrated Operations System (IOS)
- Material Support System (MSS)
- Non-Conformance Data Interface (NCDI)
  - Operations and Maintenance Requirements and Specification Change Processing (OMRSCCP)
  - Operations and Maintenance Planning (OMRSP)
  - Operations and Maintenance Requirements and Specifications—Flow Planning (OMRSPF)
  - Operations and Maintenance Requirements and Specifications and Software Engineering Watch Assessment (OMRSRA)
- Problem Reporting And Corrective Action System (PRACA)
- Reports Processing Management System (RPMS)
- Shop Floor Control/Data Collection (SFC/DC)
- Shop Floor Control/Resource Tracking (SFC/RT)
- SPDMS Person-User Data System (SPUDS)
- Transaction Security Administration System (TSAS)
- Wire List Maintenance (WILMA)

COTS-Based Systems
- PSDI’s Maximo Computerized Maintenance Management System (CMMS)
- PeopleSoft’s Distribution and Manufacturing supply chain support system
  - Documentum’s Enterprise Documentation Management System (EDMS)
  - Schedule Publisher
  - WAD (Work Assignment Doc) Authoring and Validation Environment (WAVE)
- Integrated Client/Server Applications
  - Automated Support Requirements System—Client/Server (ASRS-CS)
  - Document Distribution System (DDLS)
  - Ground Processing Scheduling System (GPSS)
  - Operations and Maintenance Requirements and Specifications—Flow Planning Client/Server (OMRSPF-CS)
  - Shuttle Connector Analysis Network (SCAN)

Shuttle has many independent systems + manual processes

Ground Operations teams have been very creative about compensating shortfalls in vehicle operability
Baseline Management: ACCMS Operational Architecture

Cradle To Grave – ACCMS is involved throughout Lifecycle

Early capture and correlation of DATA is essential for **Basis of Certification** and validation of operational procedures and limits.
Automation & Integration of Current Independent Maintenance Systems

**Objective**: Annual Reduction in Operations Costs, Safety Enhancement, Increased Vehicle Availability

**What**: New Ground-System Technologies: state-of-the-art information systems & software technology with command & control systems.

**How**: Integration & Automation of vehicle health, scheduling, maintenance management, technical data, support equipment, logistics, and the technician:

- Real time planning & control
- Optimized scheduling Logistics
- Advanced human-machine interface
- De-confliction of hazardous operations
- Real-time diagnostic resolution,
- Focused maintenance procedures,
- Task accomplishment tracking, verification
- Validation of vehicle health

Mission Assurance, Launch Reliability and Safety Could Benefit Greatly from Integrated Ground Systems Technologies
<table>
<thead>
<tr>
<th>Technologies to Optimize the Operational Life-Cycle</th>
<th>Relative Rank</th>
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<tbody>
<tr>
<td>• Storage, Distribution &amp; Conservation of Fluids</td>
<td>Med</td>
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<tr>
<td>• Automated Alignment, Coupling, &amp; Assembly Systems</td>
<td>Med</td>
</tr>
<tr>
<td>• Autonomous Command &amp; Control for Ground and Integrated Vehicle/Ground Systems</td>
<td>Hi</td>
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<tr>
<th>Environmental and Green Technologies</th>
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<tbody>
<tr>
<td>• Corrosion Prevention, Detection, &amp; Mitigation</td>
<td>Low</td>
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<tr>
<td>• Environmental Remediation &amp; Site Restoration</td>
<td>Low</td>
</tr>
<tr>
<td>• Preservation of Natural Ecosystems</td>
<td>Low</td>
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<tr>
<td>• Alternate Energy Prototypes</td>
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<th>Technologies to Increase Reliability and Mission Availability</th>
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<tr>
<td>• Advanced Launch Technologies</td>
<td>Hi</td>
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<tr>
<td>• Environment-Hardened Materials and Structures</td>
<td>Med</td>
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<tr>
<td>• Inspection, Anomaly Detection &amp; Identification</td>
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<tr>
<td>• Fault Isolation and Diagnostics</td>
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<tr>
<td>• Prognostics Technologies</td>
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<tr>
<td>• Repair, Mitigation, and Recovery Technologies</td>
<td>Med</td>
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<td>• Communications, Networking, Timing &amp; Telemetry</td>
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<td>• Range Tracking, Surveillance &amp; Flight Safety Technologies</td>
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<tr>
<td>• Landing &amp; Recovery Systems &amp; Components</td>
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<tr>
<td>• Weather Prediction and Mitigation</td>
<td>Low</td>
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<tr>
<td>• Robotics / Telerobotics</td>
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<td>• Safety Systems</td>
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Discussed in this briefing
Key Needs for Ground Systems

• Provide capability that extends into the full range of prelaunch, launch, mission operations and post landing services in a more integrated manner.
  • The intent is to validate vehicle/payload interfaces early and carry that certification through to launch site.

• Checkout and control system may need to interface with design and lab test equipment as well.
  • Applications/test routines developed at the factory could be built on to perform prelaunch testing and launch.

• KSC doesn’t support mission ops on shuttle but should have a system which is capable of doing so in case it is needed for future vehicles.
  • This would include incorporation of mission planning, range tracking software and interfaces and communications capability.

• Additional needs:
  • post landing and support and refurbishment
  • scalable to handle small factory test to integrated launch ops.

• New technology using immersive HCI (Human-Computer Interaction), advanced simulation and modeling, intelligent software, smart sensors, etc. could enhance the control and monitor capabilities.

• Flexible systems that can interface with diverse payloads and vehicles
• Modularity of ground control and checkout systems to take advantage of new applications as they become available