TA 13 Ground and Launch Systems Processing Roadmap Panel Discussion

Bill Findiesen

William.h.findiesen-jr@boeing.com

714-317-3134

Boeing, Huntington Beach

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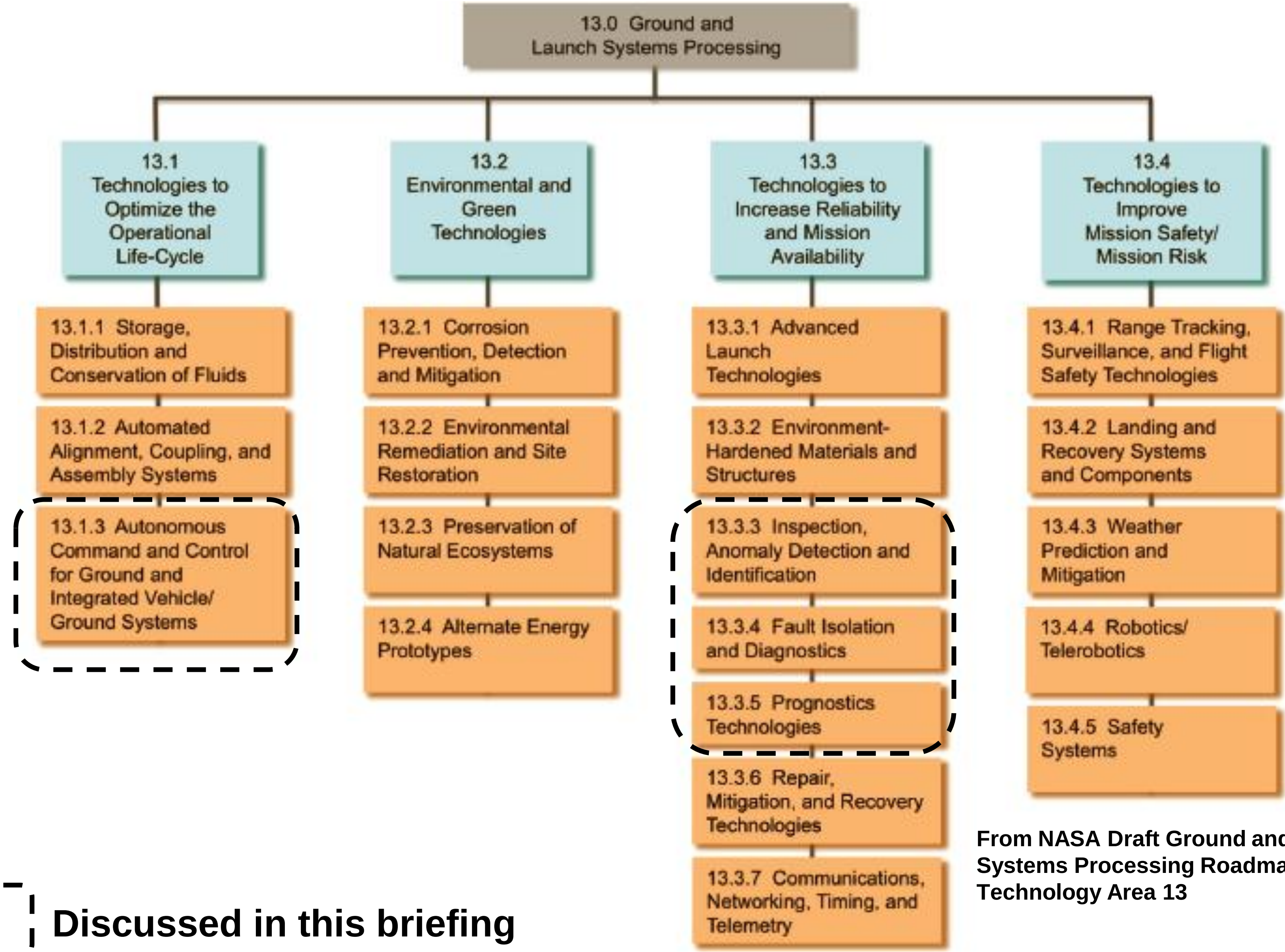
TA 13 Technology Area Breakdown Structure

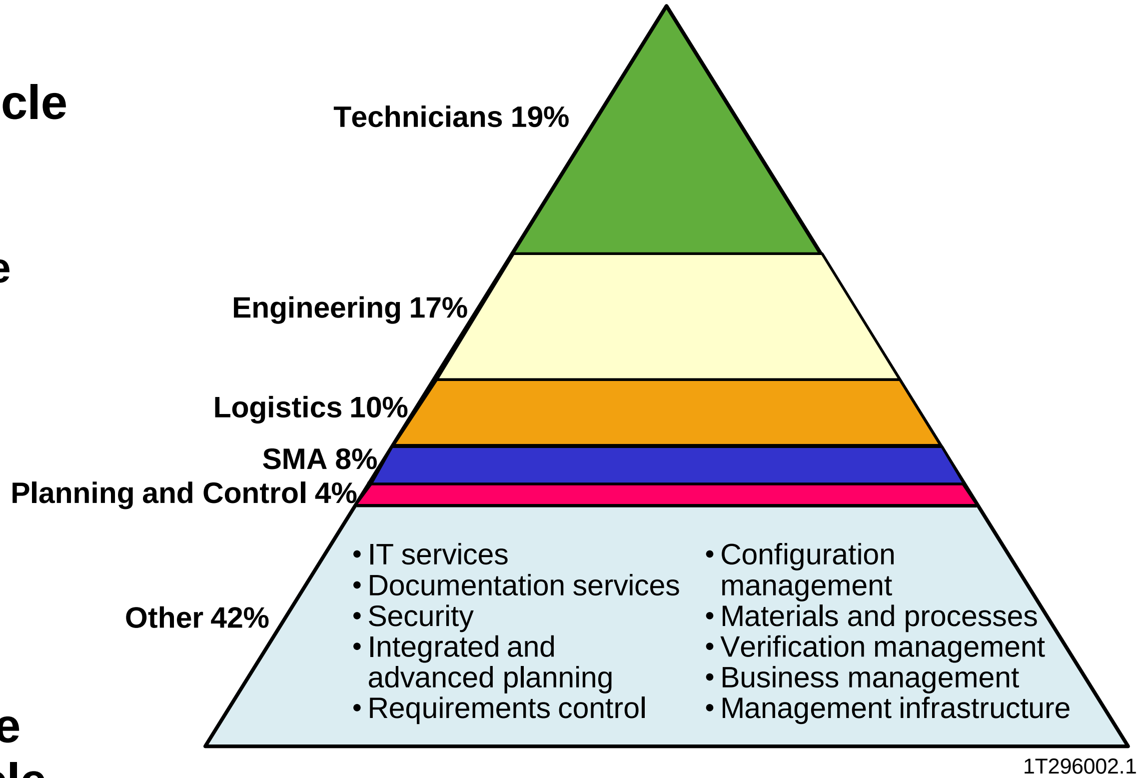


From NASA Draft Ground and Launch Systems Processing Roadmap for Technology Area 13

Discussed in this briefing

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[4]:
  - "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 the3/12/02 Project Cost Estimating and Analysis pitch presented at the recent 2nd Gen PP&C training session.

All Phases of Operations Considered

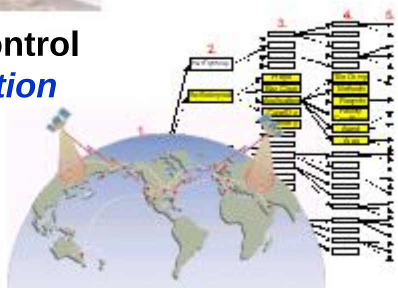

Maintenance Mgt & Control
On-Time Vehicle Availability

Operations Control & Management
Real-Time Relevant Data

Flight Operations
One system for ground & flight operations

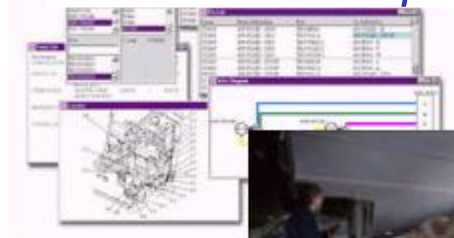
Ground Support Equipment & Tooling
Improved Maintenance Performance

Facility Maint & Control
Optimized Utilization



Mission/Flight Planning
Automation, Cost Savings

Interactive Electronic Media
Focused Tasks
Real-Time Revision Updates



Portable Maintenance Aids
Improved Safety & Quality
Hazard De-Confliction

Disparate ground operations create challenges for ground systems


Spares & Inventory Control
Accurate Forecasting,
Increased Vehicle Availability

Payload Integration


Early Checkout @ Customer Facility

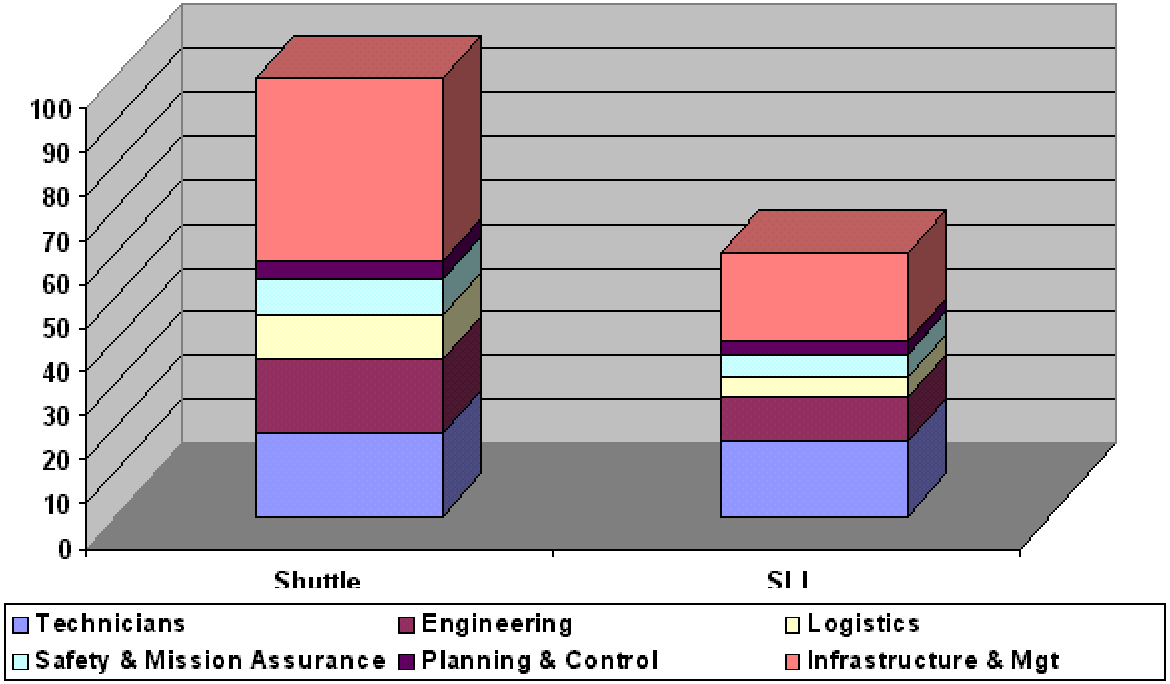
Task Scheduling & Tracking
Increased Vehicle Availability
Increased efficiency

Public Released Data From 2002 NASA Space Launch Initiative TA4 Operations Boeing Advanced Checkout Control and Maintenance Contract

ACCMS Benefits Relative to Shuttle Baseline

2nd Generation RLV

- 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

Public Released Data From 2002 NASA Space Launch Initiative TA4 Operations Boeing Advanced Checkout Control and Maintenance Contract

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Root-Cause Analysis: Shuttle Maintenance & Logistics - Identified about 100 Non-Integrated Data Systems

2nd Generation RLV

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 [illegible] Change Processing (OMRSCP)
- Operations and Maintenance R[illegible] Documentation (OMRSD)
- Operations and Maintenance Req[illegible]ecifications—Flow Planning (OMRSFP)
- Operations and Maintenance Requirements and Sp[illegible] Assessment (OMRSRA)
- Problem Reporting And Corrective [illegible]
- Release Processing (RP)
- 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 A[illegible]oc) Authoring and Validation Environment [illegible]

[illegible] Client/Server Applications

- Automated Support Requirements System—Client/Server (ASRS-CS)
- Document Distri[illegible]n (DDLS)
- [illegible]ystem (GPSS)
- [illegible]equirements and Specifications—Flow P[illegible] Client/Server (OMRSFP-CS)
- Shuttle Connector Analysis Network (SCAN)

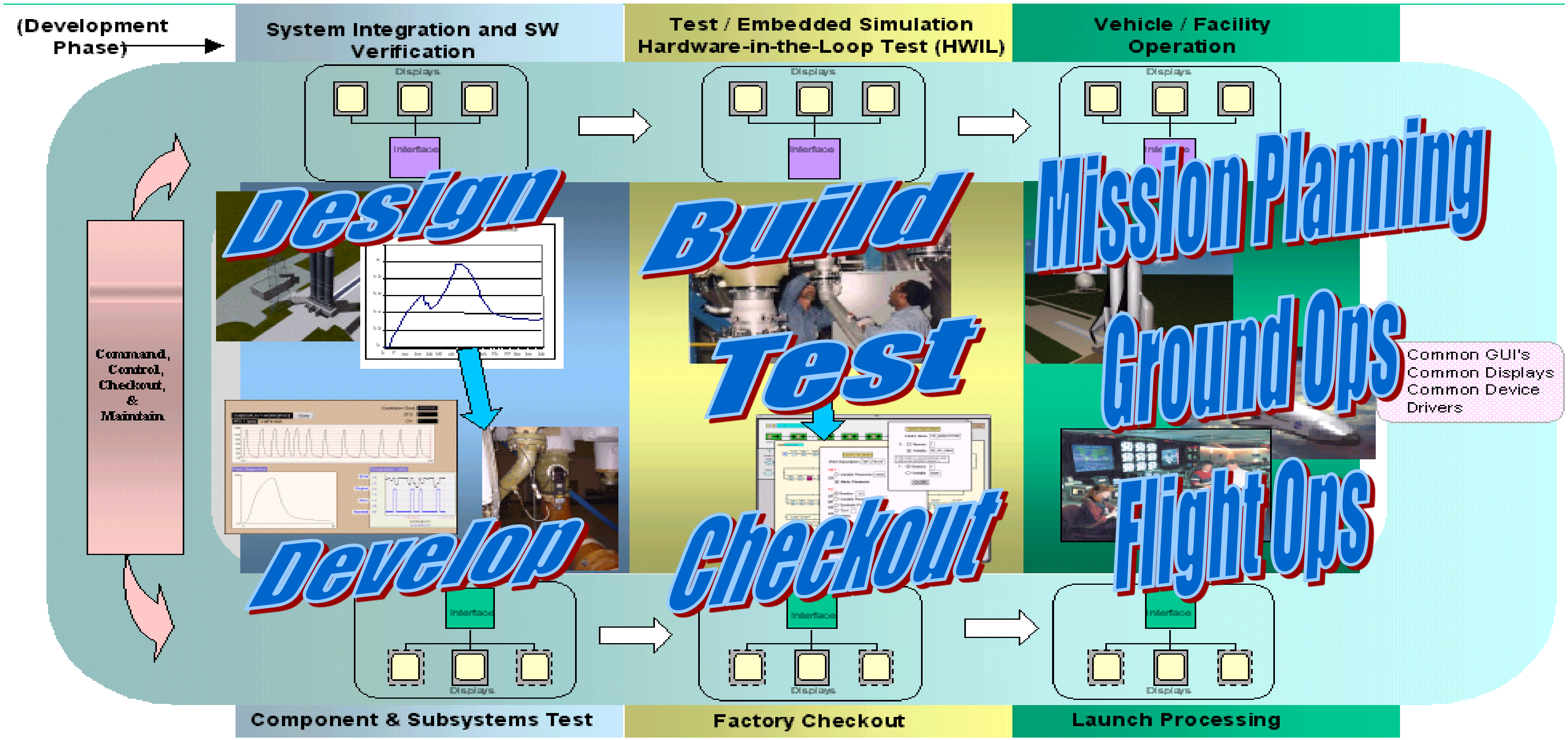
[illegible]everal data systems that have been developed [illegible] the various STS Integration Engineering [illegible]: Space Shuttle Cargo Integration, Systems Integration, Requirements Integration, Software Engineering Integration, and Ground System Projects Office. Following are some of the data systems:

- Integrated Data Management (IDS)
- Integration Requirements Implementation Status (IRIS)
- Special Daily PRCB (SDPRCB)
- Unexplained Anomaly Board (UAB)
- Prime Material Review Board (PMRB)
- KSC Integration Management System (KIMS)
- Design Engineering Watch (DEW)
- KSC Integration Documentation (KID)

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

TA13 Ground and Launch Systems Processing Roadmap

Technologies to Optimize the Operational Life-Cycle	Relative Rank
• Storage, Distribution & Conservation of Fluids	Med
• Automated Alignment, Coupling, & Assembly Systems	Med
• Autonomous Command & Control for Ground and Integrated Vehicle/Ground Systems	Hi
Environmental and Green Technologies	
• Corrosion Prevention, Detection, & Mitigation	Low
• Environmental Remediation & Site Restoration	Low
• Preservation of Natural Ecosystems	Low
• Alternate Energy Prototypes	Hi
Technologies to Increase Reliability and Mission Availability	
• Advanced Launch Technologies	Hi
• Environment-Hardened Materials and Structures	Med
• Inspection, Anomaly Detection & Identification	Hi
• Fault Isolation and Diagnostics	Hi
• Prognostics Technologies	Hi
• Repair, Mitigation, and Recovery Technologies	Med
• Communications, Networking, Timing & Telemetry	Hi
Technologies to Improve Mission Safety/Mission Risk	
• Range Tracking, Surveillance & Flight Safety Technologies	Low
• Landing & Recovery Systems & Components	Hi
• Weather Prediction and Mitigation	Low
• Robotics / Telerobotics	Hi
• Safety Systems	Hi

(green)	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**