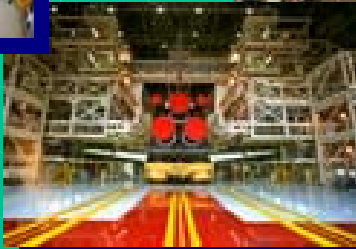
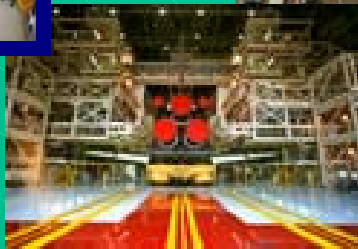


Space Shuttle Processing Combating FOD



United Space Alliance Overview

- **United Space Alliance (USA) is the world's leading space operations company, established in 1996 as a joint venture between The Boeing Company and Lockheed Martin Corporation.**



United Space Alliance Overview

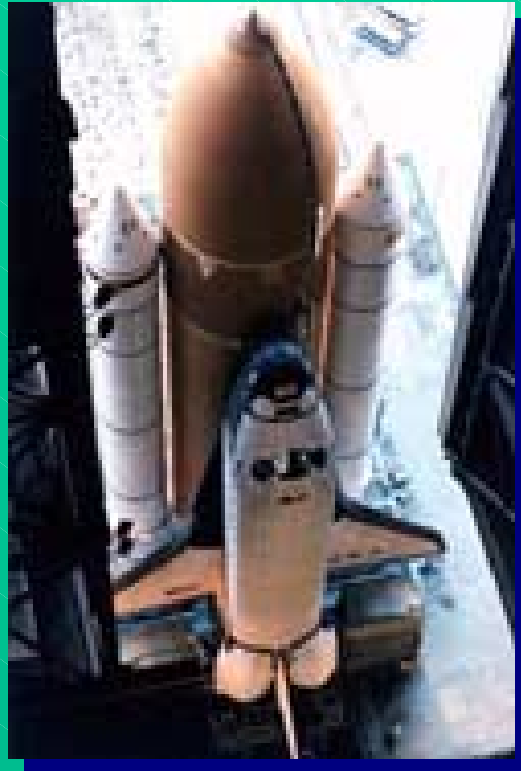
USA, chartered to manage and conduct space operations, is responsible for:

- **Maintenance of multi-purpose space systems**
- **Systems associated with NASA's human space flight program**
- **Space Shuttle applications**
- **Other reusable launch and orbital systems**



United Space Alliance Overview

- As the prime contractor for NASA's Space Shuttle Program, United Space Alliance is responsible for the day-to-day operation and management of the U.S. Space Shuttle fleet.



Ground to Space and Back:

- The USA team contends with multiple environmental and operational challenges that intensify potential FOD control challenges:
- **Attitudinal**
 - Horizontal Processing and Modifications
 - Vertical Integration
 - Shuttle Transporting and Pad Operations
- **Operational**
 - Ascent
 - On Orbit
 - Descent



Working in a Horizontal Plane:

- There are three hangars (processing centers) that are used to support assembly, test, and maintenance of the Orbiters. In these facilities a multitude of unique ground support systems are used to support each processing flow.



Working in a Horizontal Plane:

- While in the OPF, the Orbiter is completely surrounded by movable platforms (left, right, forward, aft, above, below) and test equipment to aid processing.



Working in a Horizontal Plane:

- During processing major disassembly and reconfigurations are performed including payload bay re-configuration, modifications incorporation, systems test and maintenance performance to prepare for the mission; even the main engines are removed and replaced each flow.



Nose Towards the Sky:

- The Orbiter is lifted horizontal then rotated about its axis 90 degrees to be lifted 275 feet from the facility floor while in the vertical position. Considerable damage could result in the event that FOD is left internal or adjacent to the flight elements.



Operational Environment:

- After a three-mile trek, the Space Shuttle is exposed to the beach environment at the LC-39 Launch Pad located adjacent to the Atlantic Ocean.



Operational Environment:

- During launch, debris residing near or on the Pad structure transforms into uncontrolled projectiles that could induce damage to the Space Shuttle system.



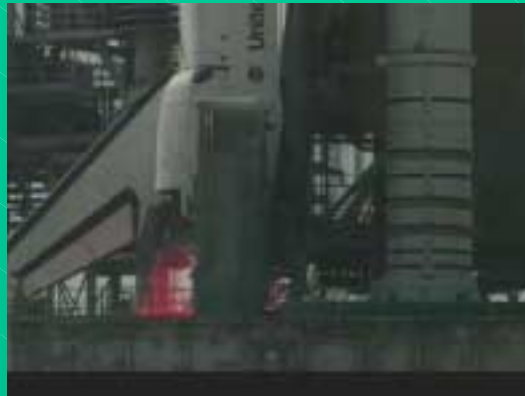
Operational Environment:

- Debris located in crevasses and remote compartments internal to the Space Shuttle can also become dislodged during the launch phase of the mission as a result of vibration. FOD migrates while the Orbiter is in space and settles upon re-entry to the atmosphere.



The USA Program:

- **USA Work Practice has incorporated the philosophy of “Clean As You Go.” Each team member is responsible for monitoring his or her immediate work site and manufacturing processing center.**



The USA Program:

- USA Ground Operations has adopted a Processing Debris & FOD program based on the risk or potential risk that is imposed on the flight element.



Processing Debris:

- Since the shuttle and other flight elements go through several phases on the journey to flight readiness, it is not unusual for an area of the shuttle to be under-going modification while an adjacent area receives routine testing and is closed (ready) for flight. Therefore, debris that is created during routine processing and testing that does not pose an immediate risk to the flight element is classified as “processing debris”.

Processing Debris:

- A walk down is performed daily for any flight element or area that is accessible for work. The performance of the walk down and the results of any observations are entered into the database at the completion of the walk down. The walk down information can be entered on a PDA and uploaded to the database at the end of the shift, eliminating the requirement for personnel to make manual entries to the database.

FOD:

- **When an area of the flight element is determined to be ready for flight it goes through a final close out inspection where any debris that is found during or subsequent to the close out inspection is classified as FOD and is documented in the FOD database section of the data warehouse. Metrics for both processing debris and FOD are created to determine measure performance and initiate preventative/corrective actions as required.**

FOD:

- When the USA Inspector records completion of the close out inspection in the database they are required to record information regarding any debris or non-flight items discovered. This information is linked and automatically populates the FOD database.



The Database:

- **Integrated Quality Support Database (IQSD) is a cold-fusion web based data warehouse for information pertaining to various quality systems and metrics. The IQSD houses the data entered for Processing Debris walk downs, Closeout inspections and FOD observations, just to name a few. The database is viewable and searchable by all USA personnel.**

Using the Data:

- **Managers utilize the information in this database to track the occurrences of walk downs and the debris/FOD that is observed. This assures that preventative and corrective actions can be implemented in a timely and effective manner.**

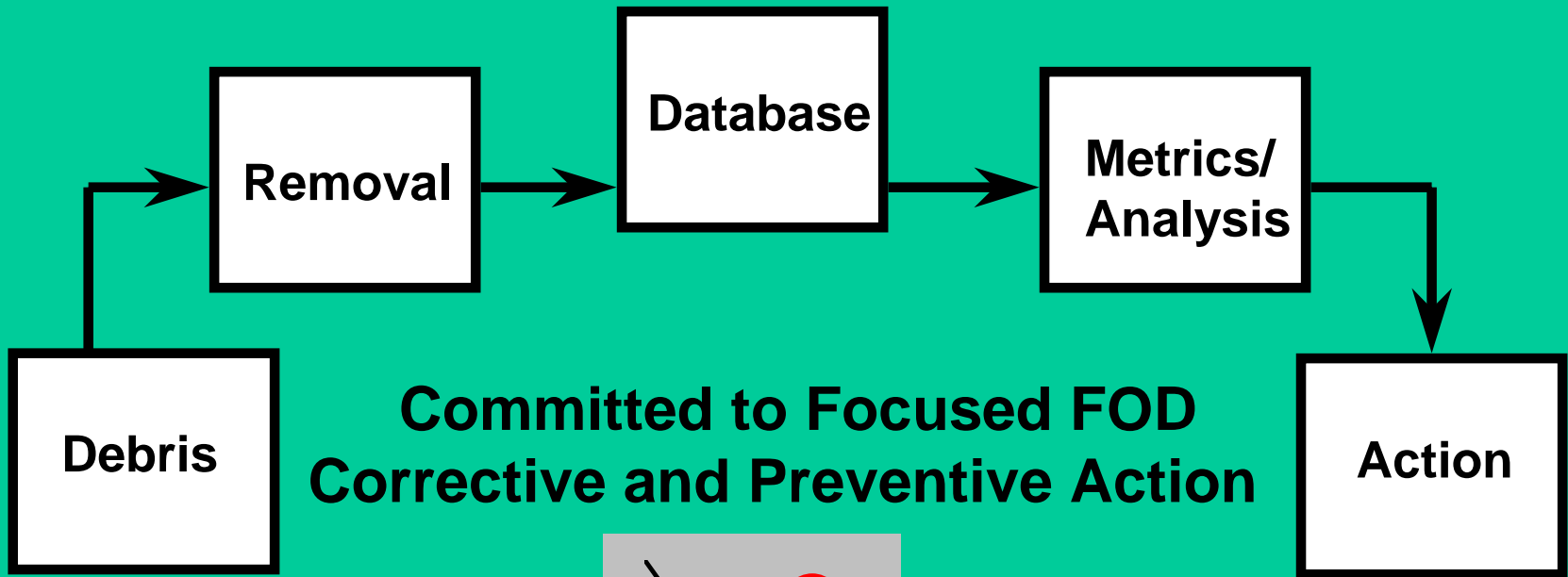


Benefits:

- **Employees take ownership of their areas.**
- **Walk downs, cleaning and observations are recorded on a real-time basis.**
- **Managers have immediate access to observations and trends for their work area.**
- **Managers have insight into problems and can implement necessary actions for improvement.**



Computerized Process & Metrics:

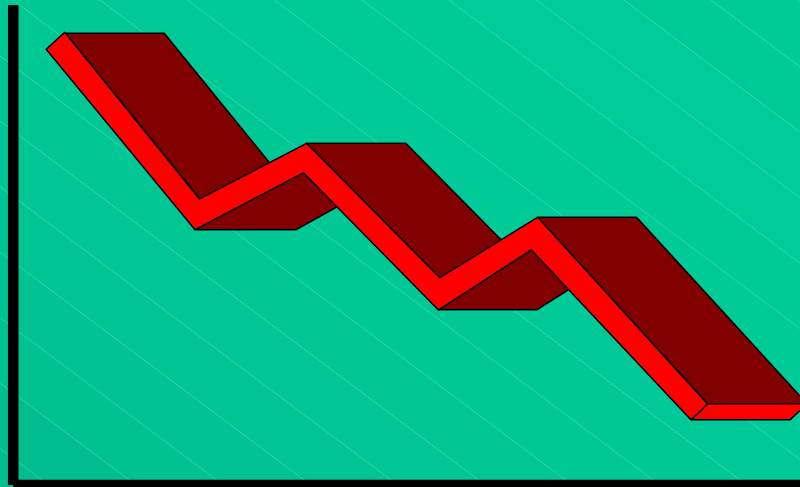


**Committed to Focused FOD
Corrective and Preventive Action**



FOD Database Summary:

- The database is a working tool to aid the FOD prevention program and initiatives.
- FOD Free Measurements
- Work Location/Zones
- Debris Type/Description
- Detection Method/Activity



Initiatives:

- Development of baseline metrics and benchmarking with historic trending
- Data validation and metrics
- Continued development of corrective and preventive action based on analysis and metrics



Paths to a FOD Free Environment:

- **Combating FOD with individual empowerment, a skilled team, ownership, pride, access to data, and use of an aggressive FOD prevention system provides the means to successfully combat FOD.**

