Real Time Data System (RTDS)

Control Center Technology Conference
June 18, 1991

DF24/Troy A. Heindel
NASA Lyndon B. Johnson Space Center

- Goals
- Traditional MCC Technologies
- RTDS Technologies
- Show & Tell
- Growth of RTDS
- Side-by-Side Comparison
- Comparison of Functionality
- Technology Gap
- Technology Transfer in MCC
- Questions Raised
- Future Directions
- Closing Thought

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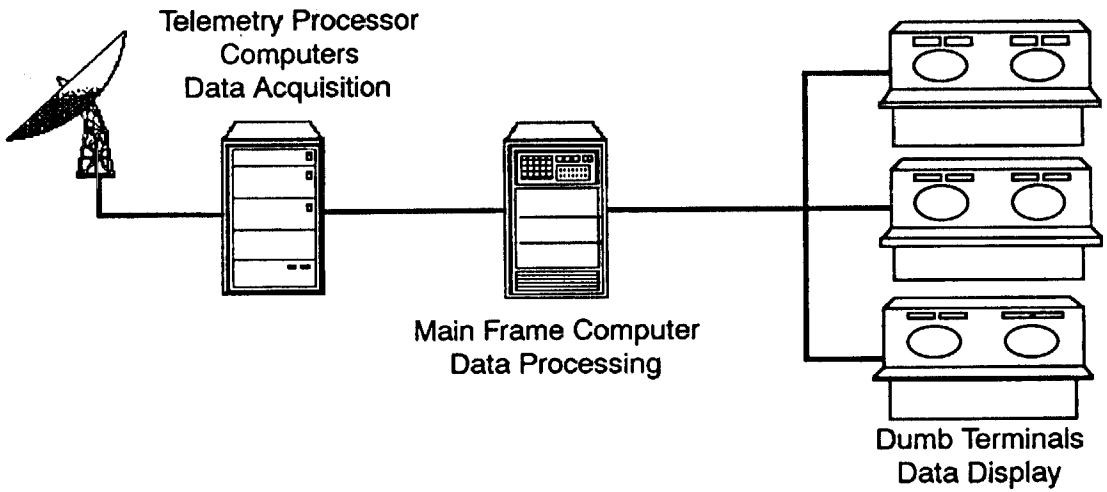
Goals

- Increase the quality of flight decision making
- Reduce/enhance flight controller training time
- Serve as a near-operations technology test-bed

Traditional MCC Technologies

- Hardware



- Software
  - Mostly Assembly Language

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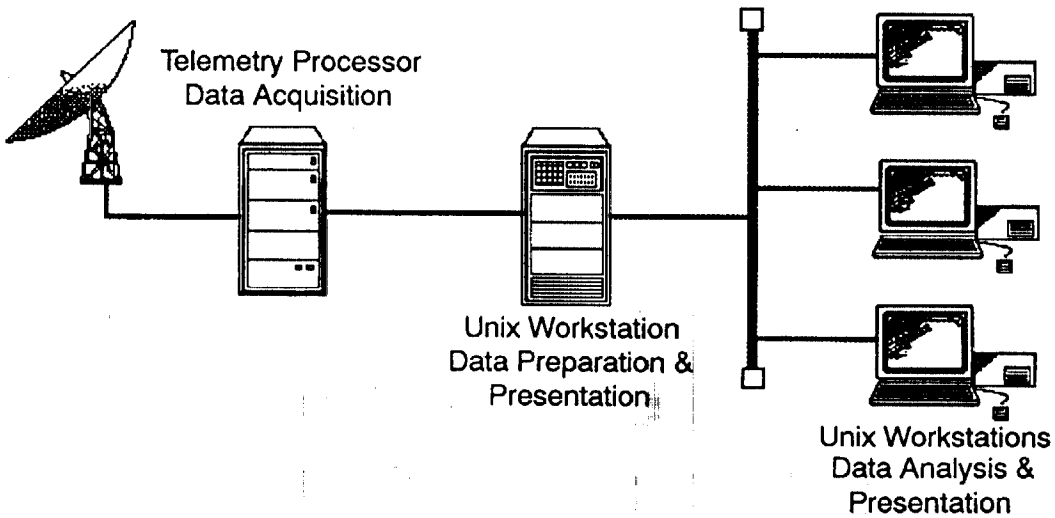
RTDSTechnologies

- Hardware



- Software
  - Unix, C Language, X-Windows, MOTIF, G2 Expert System Tool

Show & Tell

- BOOSTER Main Engine Program
- BOOSTER Flight Controller (Tom Kwiatkowski)
- Jet-Control Expert System
- Fuel Cell Monitoring System (FCMS)
- Data Processing Systems Data Monitoring and Analysis Tool (DDMAT)
- DATACOMM Expert System

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Growth of RTDS

- Road Map of Flight Control Disciplines
- RTDS Technology Deployment 1987-1989
- RTDS Technology Deployment 1990-1991

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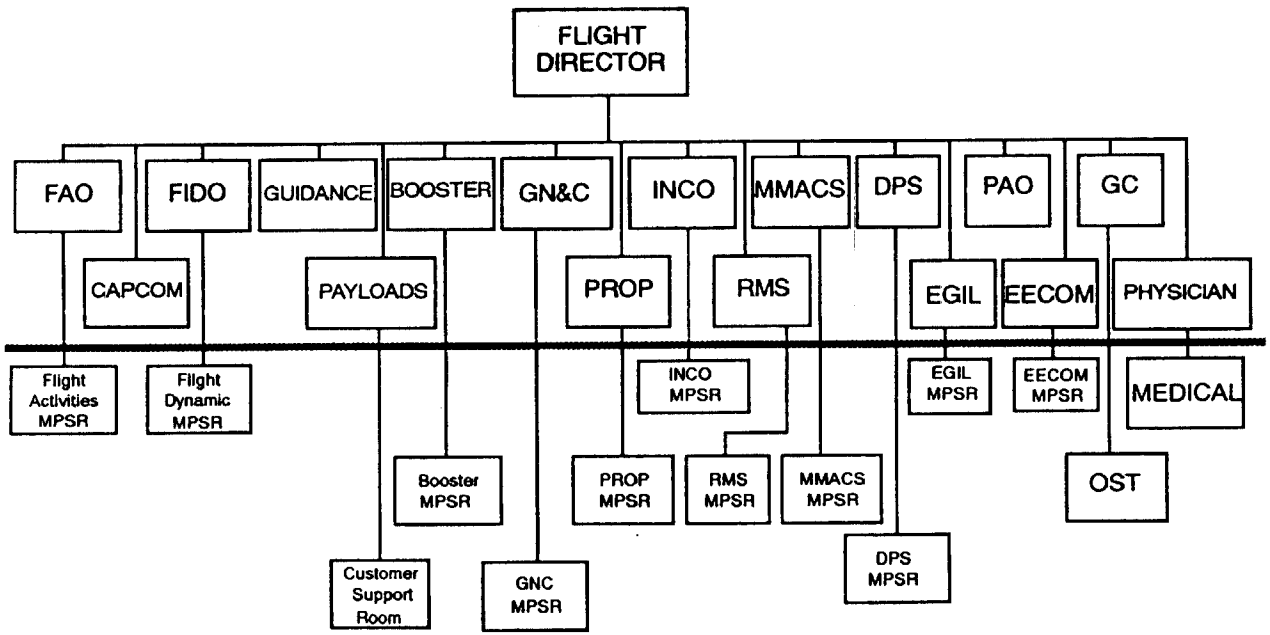
Road Map of Flight Control Disciplines



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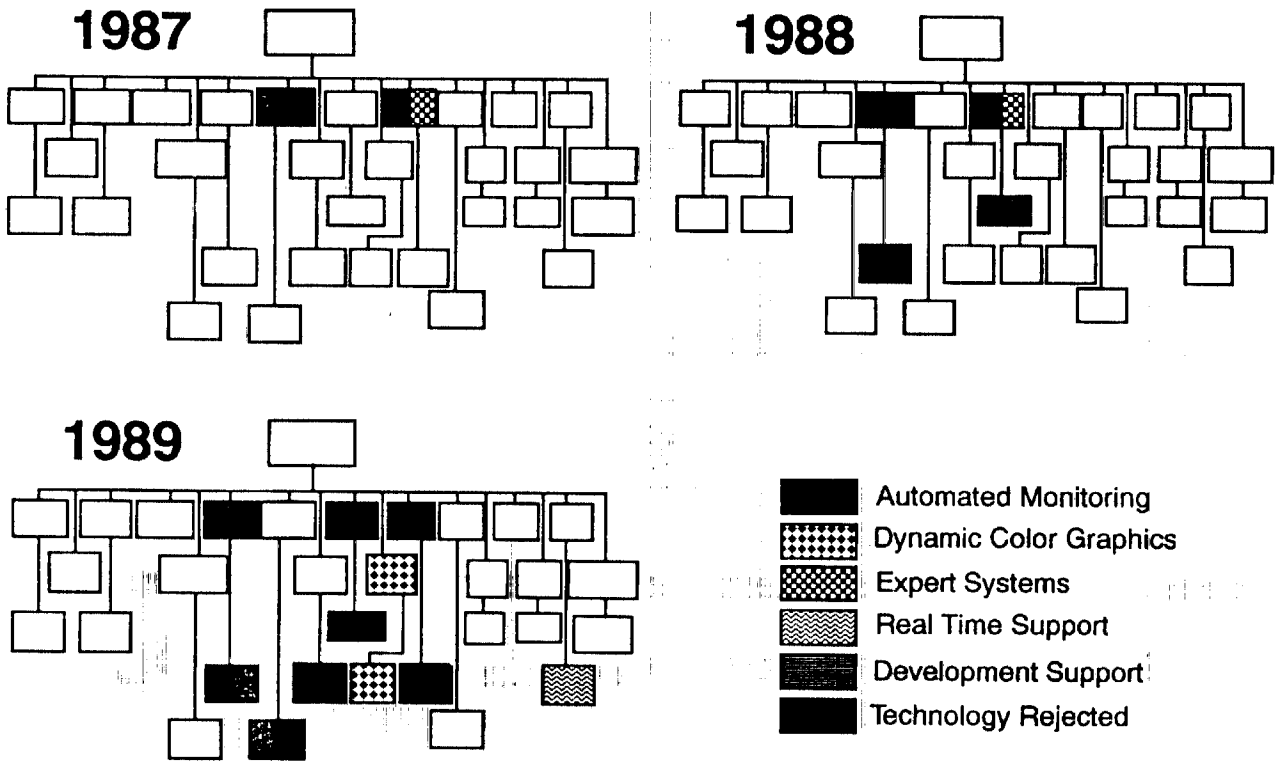
RTDS Technology Deployment 1987-1989



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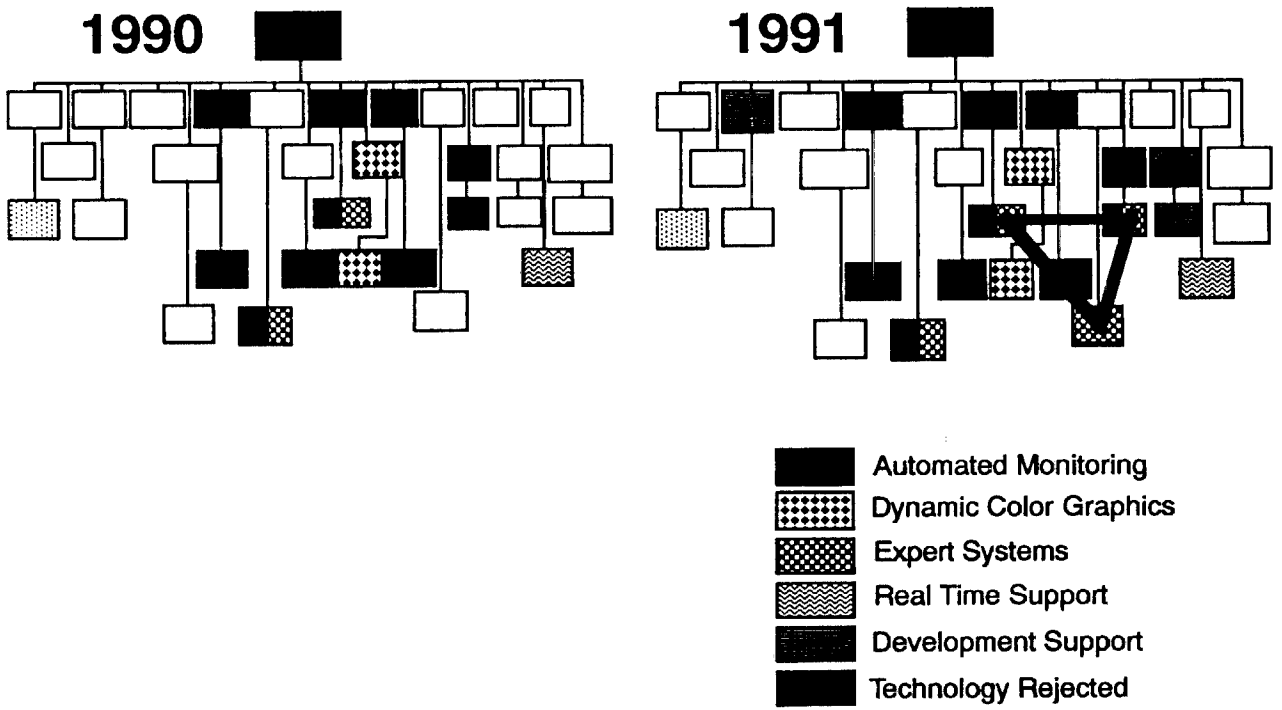
RTDS Technology Deployment 1990-1991



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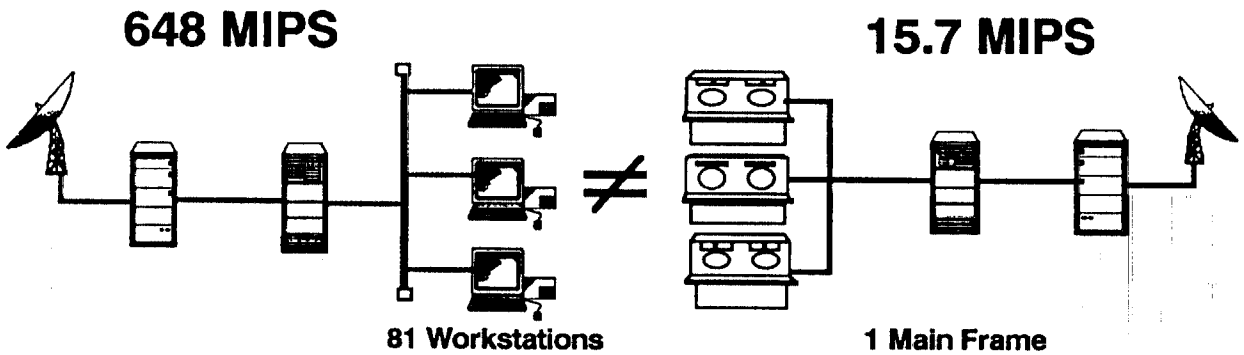
Side-by-Side Comparison



- They look similar, but they are very different...
  - Iterative Prototyping vs. A-B-C Requirements
  - Distributed vs. Centralized
  - Open Systems vs. Proprietary Systems
    - RTDS will run on almost any Unix workstation
      - Makes GAO very happy!

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Comparison of Functionality

	MAIN FRAME	WORKSTATION
SPCIALIZED PROCESSING	YES	YES
DATA DISPLAY	YES	YES
LIMIT SENSING	YES	YES
COLOR GRAPHICS	NO	YES
FAILURE DETECTION	NO	YES
EXPERT SYSTEMS	NO	YES
TOLERANT OF CHANGE	NO	YES
CONFIGURATION CONTROL	MATURE	POORLY UNDERSTOOD
YEARS IN USE	>20	5

TECHNOLOGY GAP

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Technology Gap

- There is a 15-20 year technology gap between traditional main frame based systems in the Mission Control Center and newer workstation-based systems
- The goals remain the same; the functionalities of the systems are vastly different
- New technologies require different data system management philosophy
  - As our only frame of reference, history works against us
  - Imposing traditional data system management philosophies on new-technology systems limits efficiency gains

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Technology Transfer in MCC

- In RTDS we are bridging the technology gap by providing portability to the Mission Control Center Upgrade (MCCU) workstations
- MCCU represents a large installed base of Unix based workstations lacking the advanced automation techniques and applications which have been developed and proven by RTDS over the past four years

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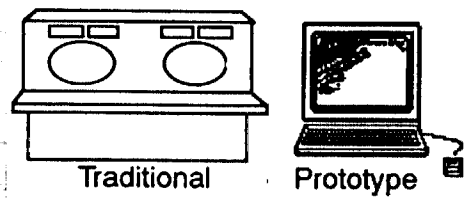
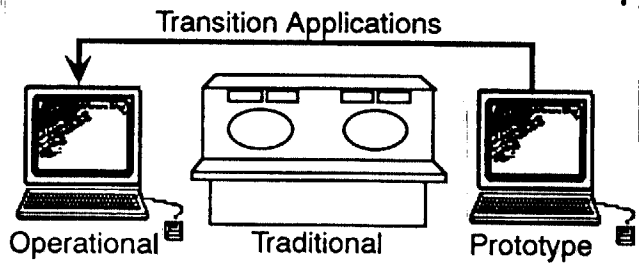
Technology Transfer in MCC

- **Phase I** - Demonstrate Technology



1987-1991

- **Phase II** - Transfer Successful Applications



1991-1992

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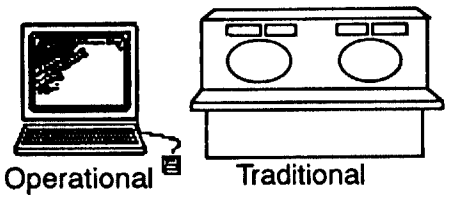
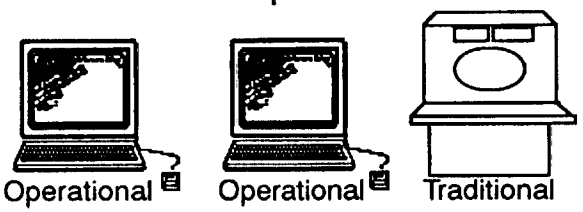
Technology Transfer in MCC

- **Phase III** - Remove Development Hardware



1992-1994

- **Phase IV** - Replace Traditional Main Frame Consoles



1994-1996

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Questions Raised

- RTDS has enabled flight controller users to rapidly develop real-time support applications which are far superior to traditional console tools
  - Development time has been cut from 2 years to less than 6 months, but
    - some applications could be considered mission critical
- **QUESTION**: Should users develop and maintain their own software?
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Questions Raised

- Applications resulting from new technologies can be 'smart'
  - Decision-making rationale is sometimes hidden with 'smart' systems
  - Operators are less tolerant of machines than other humans
    - Examine the terminology:
      - Machine Error: BUG
      - Human Error: MISTAKE
- **QUESTION**: How much of our jobs do we trust to automation technologies?

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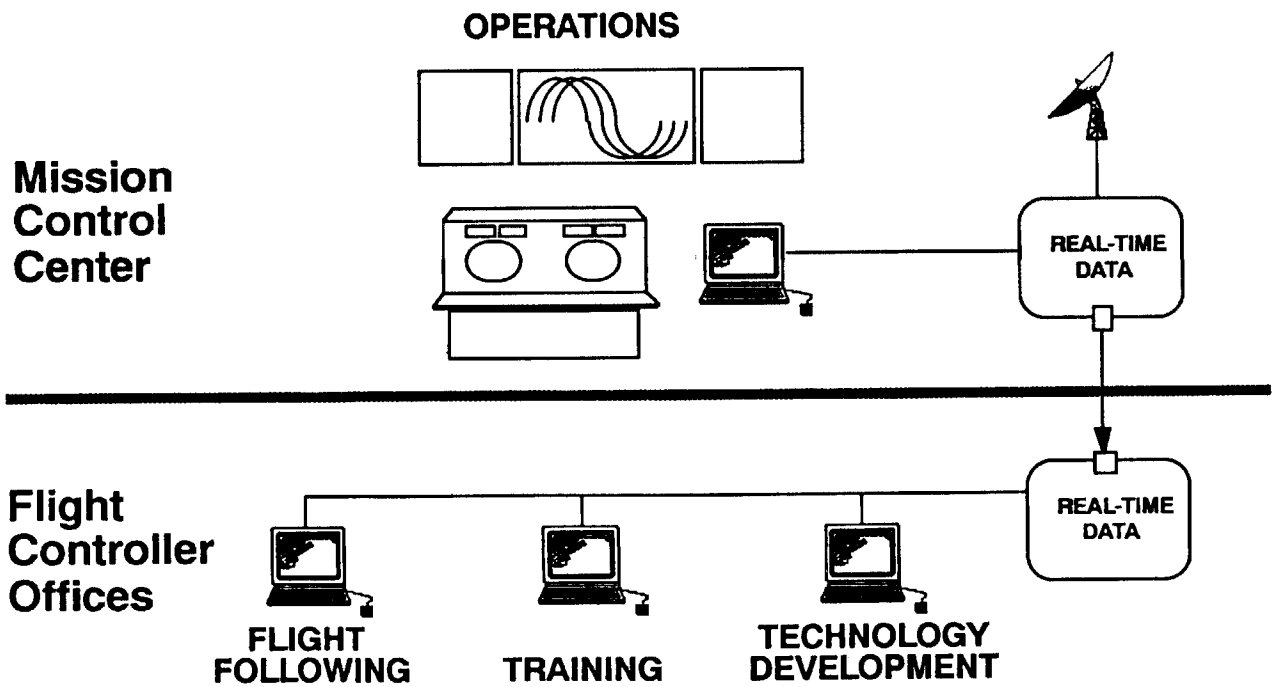
Future Directions

- Provide RTDS in Office Environment (1991-1992)
- Cooperative Expert Systems (1991-1992)
- Technology Testbed (1992)
- Space Station Freedom (1991-?)

Provide RTDS in Office Environment (1991-1992)



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Cooperative Expert Systems (1991-1992)

- Three previously developed expert systems are being modified
- Model for cooperative system is flight control team
  - The "You better be listening" model

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Technology Testbed (1992)

- The Procedural Reasoning System is a promising expert system software tool developed by Stanford Research Institute (SRI) in cooperation with ARC
- PRS will be interfaced with real-time shuttle telemetry from RTDS and evaluated during simulations and missions
- ARC LAN-Link to RTDS
  - Provide real-time data feed to AI researchers at ARC

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Space Station Freedom (1991-?)

- Sammi-Fred has been chosen as the on-board Space Station Freedom display builder (X-Windows, Client-Server)
- Integrated Sammi-Fred display builder with real-time Shuttle telemetry
- RTDS is working with the Space Station Training Division to build stand-alone flight controller training capabilities similar to those produced for Shuttle by RTDS

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Closing Thought

"Companies [Government Agencies] that are preoccupied with the present will always be on the defensive, playing catch-up. Companies [Government Agencies] that strive to look ahead will have a better chance of succeeding."

Murray Weidenbaum, Director
Center for the Study of American Business
at Washington University
During keynote speech at ICA conference

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