INTERNATIONAL SPACE STATION

6 Partners, 7 Cultures, One Space Station

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Authors' Bios

Jonette Stecklein
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Ms. Stecklein leads the International Space Station Program Requirements Team for NASA. She is responsible for the development and maintenance of the Program-controlled specifications, including the Space Station System, United States, and International Partner Segment Specifications. Previous assignments within NASA have included Chief Engineer of the Artemis (Common Lunar Lander) Project, an in-house development of a robotic lander. Ms. Stecklein was the 1995-1996 President of the Texas Gulf Coast Chapter of INCOSE, and is an active member of the INCOSE Requirements Working Group.

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Mr. Norris is a Senior Specialist Engineer at Boeing and is lead of the International Partner Requirements Team. Mr. Norris is focal for the Russian requirements effort and works directly with engineers from the Russian firms, RSC-Energia and the Khrunichev State Research and Production Space Center. Mr. Norris oversees his team's efforts in their work with the engineers from the European Space Agency, the National Space Development Agency of Japan, the Canadian Space Agency, and the Italian Space Agency. Mr. Norris' 11 year stint at Boeing has included System Integration for the V-22 tiltrotor and Airforce Mission Planning Systems.

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Acronyms

ASI - Agenzia Spaziale Italiana (Italian Space Agency)
BIVP - Bilateral Integration and Verification Plan
C&DH - command and data handling
CM - Configuration Management
COU - Concept of Operations and Utilization
CSA - Canadian Space Agency
ECLSS - environmental control and life support system
ESA - European Space Agency
FGB - Functional Cargo Block (acronym from Russian spelling)
GAO - Government Accounting Office
GN&C - guidance, navigation and control
ICD - Interface Control Document
IP - International Partner
IRD - Interface Requirements Document
JEM - Japanese Experiment Module
KhSC - M. V. Khrunichev State Research and Production Space Center
MOU - Memorandum of Understanding
ISS - International Space Station
ISSA - International Space Station Alpha
LEO - Low Earth Orbit
NASA - National Aeronautics and Space Administration
NASDA - National Space Development Agency of Japan
PNP - Probability of No Penetration
RSA - Russian Space Agency
SSF - Space Station Freedom
TIM - Technical Interchange Meeting
U.S. - United States

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Outline

- **What is Space Station?**
  - **ISS Vehicle**
  - **ISS Partners**
- **Challenge of the Business Cultures**
  - **Defining the work environment**
- **Challenge of Establishing Agreements**
  - **Identify the agreements that bridged the cultures**
- **Result .... Modified Program Processes**
  - **Describe what was modified to implement the agreements**

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What is Space Station?

- INSERT COLOR PICTURE CHARTS OF STATION HERE
- INSERT IN HANDOUT PACKAGE STATION DIAGRAM HERE

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What is Space Station? On-Orbit Vehicle

End-to-End Width (Wingspan)	**356 feet**
Length	**290 feet**
Weight	**470 tons (940,000 pounds)**
Operating Altitude	**220 miles (average)**
Inclination	**51.6 degrees to the Equator**
Atmosphere	**14.7 pounds per square inch (same as Earth)**
Crew	**up to 7**

Assembly will take over 4 years and require over 40 launches from the U.S. and Russia. The completed space station will be a permanent, multipurpose manned facility for conducting research and science experiments in a microgravity environment.

For more info, surf the world wide web at http://station.nasa.gov

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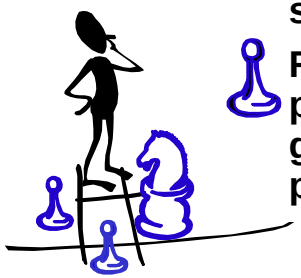
What are the pieces?

- **ASI (Agenzia Spaziale Italiana) participates with a Mini Pressurized Logistics Module (MPLM) which provides a pressurized volume used to resupply and return ISS containerized cargo requiring a pressurized environment.**
- **CSA (Canadian Space Agency) provides external robotic operations support (a 55 foot robot arm with a 125 ton capability) for the ISS. CSA assists in external operations of the ISS by servicing attached user payloads, transport of equipment and payloads, and berthing/deberthing of the Orbiter and ISS modules.**
- **ESA (European Space Agency) contributes the Attached Pressurized Module (APM) which is a laboratory facility developed for the purpose of supporting microgravity research and supports internal mounted user payloads.**
- **NASA (National Aeronautics and Space Administration) is providing a laboratory, a habitation module containing a galley, shower, sleep stations, interconnecting Nodes, Truss Segments, and Photovoltaic Arrays, an airlock for Extravehicular Activity (EVA), Command and Data Handling (C&DH), thermal control, guidance and navigation, primary power, life support, and communications.**
- **NASDA (National Space Development Agency of Japan) is providing an experiment module for the purpose of supporting microgravity research. The JEM supports internal and external mounted user payloads, provides pressurized and unpressurized logistics support, and is equipped with an exposed platform with robotic arm support.**
- **RSA (Russian Space Agency) is providing research laboratories, a Russian EVA airlock, primary life-support, hygiene, reboost, habitation functions, and provides for guidance/navigation control, Russian power, thermal control, communications, data processing, crew and cargo resupply, and assured crew return .**



Challenge of the Business Cultures

- Defining the work environment

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Challenge of the Business Cultures

- **Culture**
  - **Learned filter between the individual and the outside world.**
  - **Internally consistent system of interconnected, hidden "rules."**
  - **Individuals from different cultures play by a different set of communication rules.**
    - The "rules" are culturally defined, not universal truths.
  - **Key to managing cultural differences is to learn about ourselves, our hidden "rules."**
    - We'll attempt to make these rules more visible by contrasting the American business culture with other cultures.

- **Cultural Dimensions**
  - **Context**
  - **Time**
  - **Politeness**

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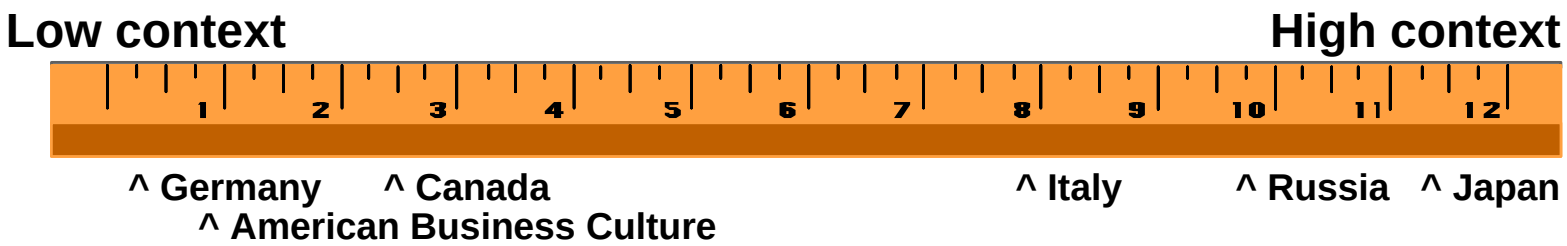
Challenge of the Business Cultures



*Not to Scale

<u>Context:</u> describes the way people organize and store information.

- **Low Context**
  - Important: What you do, the activities that join you.
  - Change is preferred to stability.
  - Less distinction between insiders and outsiders.
  - FOCUS: Get things done
- **High Context**
  - Important: Who you are, the people you are dealing with.
  - Stability is more important than change.
  - Greater emphasis on social rank.
  - Talk around the point. Listener's job to draw conclusions.
  - FOCUS: Establish and enhance human contact.
- **Low context: Objectives & Goals are Primary.**
- **High context: objectives accomplished as a natural by-product of sound relationships.**

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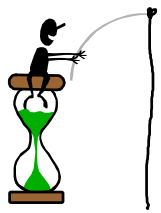
Challenge of the Business Cultures

View of Time

- **Monochronic: Time is a linear highway connecting past, present, and future**
  - Time is concrete, valuable, and in short supply.
  - Time is the ruler against which progress is measured.
  - Interruptions are distracting, disorienting.
- **Polychronic: time is a swirling, amorphous sea; "right now" is a small point within it.**
  - time is abstract & abundant.
  - time perceived as a profusion of processes all going at once, each with natural ebbs & flows.
  - Multi-task. Interruptions are part of the normal fabric of things.

Illustrated

- Americans convey respect through use of time.
  - College Class, Wait time for a Professor to arrive.
  - Russians: time is not a commodity.
- Americans convey commitment through willingness to commit to scheduled dates; for Russians, precision scheduling is not related to commitment



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Challenge of the Business Cultures

Politeness

- **Expressive Politeness**
  - Value outgoing, involved, spontaneous behavior.
  - Express personal emotions and opinions.
  - Typically engage in conversation with strangers, humorous remarks.
  - GOAL: Generate empathy, feeling, involvement.
- **Reserved Politeness**
  - Focus is on decorum, consideration, and respect for others.
  - Strong use and reliance on standard rules of etiquette.
  - Avoid expressions of personal feelings. Giving advice deemed presumptuous.
  - GOAL: Show respect. Avoid embarrassing oneself or others.

Illustrated: Meeting new people, on best behavior.

- **Expressive: Americans show that they are friendly and happy.**
- **Reserved: Japanese demonstrate that they are credible and polite.**
- **Misunderstandings often occur.**
  - American may view other as cold, aloof, snobby.
  - Japanese may view other as forward, familiar, poorly brought up.

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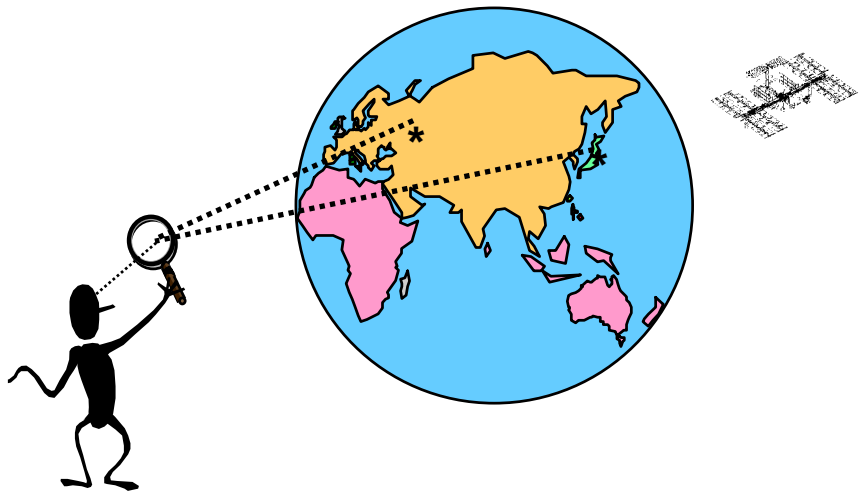
FOCUS

- **Each international contributor has unique cultural dimensions.**
- **Japan and Russia exhibit the most distinct differences when contrasted to U.S. business culture.**
- **Our focus will be on these partners.**
  - Easiest to convey the subtleties.
  - Most impact to ISS program.



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Challenge of the Business Cultures: Japan

- **Hierarchical Society / Interdependence**
  - **Society structured, rigid, homogeneous.**
  - **Position is everything.**
  - **Group decisions**
    - Individual is not empowered to make agreements.
- **Reserved Politeness**
  - **Build others up and lower yourself.**
- **Long-Term Time Scale**
  - **Japanese do a TREMENDOUS amount of upfront planning.**
    - A Systems Engineer's dream (?)
  - **Will gladly forgo early results to ensure their processes are complete and in place.**
  - **Once committed, extremely reluctant to change.**
    - Japanese contribution to Space Station Program has not changed since Space Station Freedom.

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Challenge of the Business Cultures: Japan

- **Challenges of Language**
  - **Very good at reading, writing English. (vocabulary)**
  - **Understand only about 50% of conversational English.**
  - **Write it down. Fax it early. Expect questions the day after.**
- **NO!**
  - **Rude. Japanese will avoid at all costs.**
  - **Anything other than a clear, specific Yes! consider as No.**
    - "I'll do my best."
    - "It might be difficult."
    - "Hmmm, that is a good idea…"
    - When pressed: "I don't speak English." (But you're speaking in Japanese.)
- **When agreement is not agreement**
  - **YES does not mean "I agree."**
  - **YES does not mean "I understand."**
  - **YES means "I'm listening."**
    - 'Aizuchi'
    - Conversation is always 2-way.

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Challenge of the Business Cultures

- **Russian Work Environment**
  - **Strong Executive Level Management.**
    - Exercises control over most decisions.
  - **Information flows through management.**
    - Need to have **correct** recipient (target) identified.
      - Can be lost in a Black Hole.
      - Can result in casualties of wrong person tasked.
  - **Signature authority rarely delegated.**
  - **Teams exist as islands unto themselves.**
  - **Many signatures required.**
  - **Professions are extreme depth, lifetime specialist.**
    - Apprentice/Journeyman/Master.
    - Emphasis on people; not on paper.

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Challenge of the Business Cultures

- **Russian Personal Relationships**
  - **Trust in people as opposed to trust in institutions.**
  - **Relationships are HIGHLY valued.**
  - **Relationships > Contracts**
  - **Consistency in relationship is crucial.**
    - No fair weather friend relations.
    - Courtesy, tokens of friendship, all help the daily business grind.
    - Russians never forget!
      - Don't contradict yourself.
        - "I'm sorry, my religion prevents me from drinking," then 2 years later, "Yes, I would love a drink."
    - The U.S. is perceived as continually changing jobs/focals.
  - **Nurture Relationships at highest AND lowest levels.**
    - Mountains have been moved because of strong personal worker-bee ties.
  - **Relationships should be a <u>regular</u> agenda item.**

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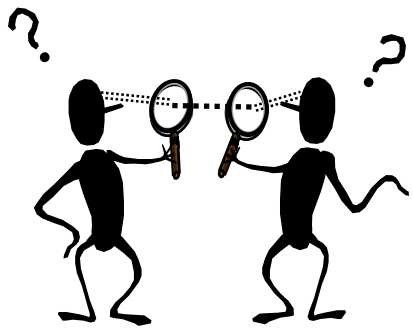
Challenge of the Business Cultures: the 7th Culture

The 7th Culture: NASA and Boeing

- **Corporate Culture**
  - NASA: Political dynamic
  - Boeing: Profit dynamic
- **Company Culture**
  - NASA: Partnership with the contractor. Rough out requirements and refine together.
  - Boeing: Independent work environment. Hired to do the job.
- **Role perceptions**
  - Insight/oversight
- **View of NASA Role in IPT**
  - NASA: Full Partner
  - Boeing: Additional Support
- **View of Contract**
  - NASA: Guideline
  - Boeing: Strict Interpretation



Challenge of Establishing Agreements

- Identify the agreements that bridged the cultures

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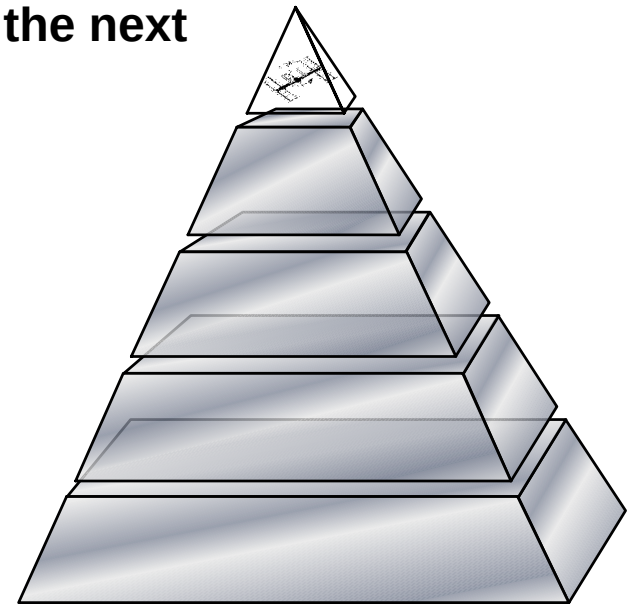
Challenge of Establishing Agreements

- **The Layers of Agreements.**
  - **Agreements to build ISS exist on many levels.**
    - Government to Government.
    - Agency to Agency.
    - Contractor to Contractor.
  - **Each agreement becomes a stepping stone to the next agreement.**
    - High level agreements define commitments.
    - Lowest level (specifications) define ISS requirements.



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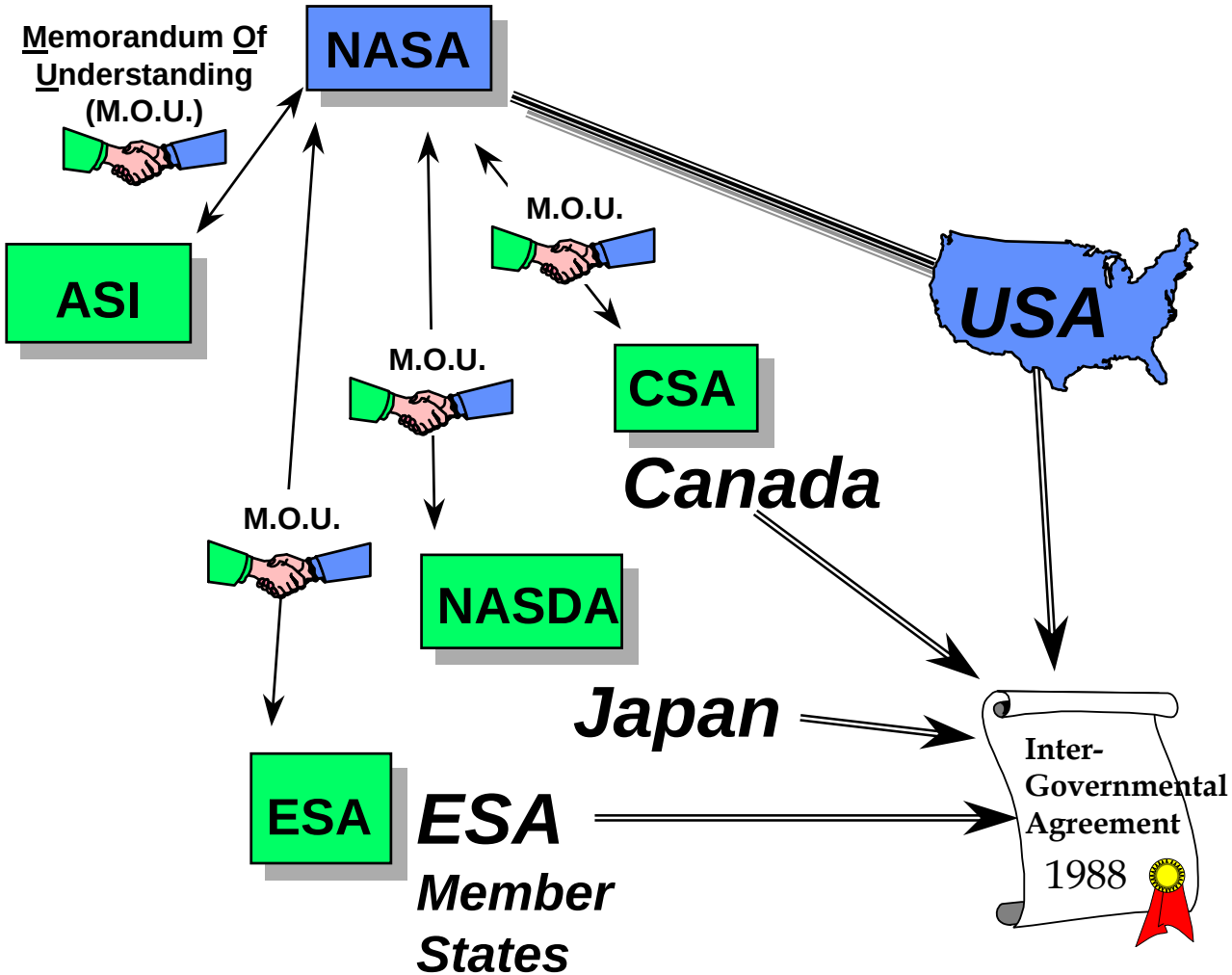
Quick Look Top Level Agreements



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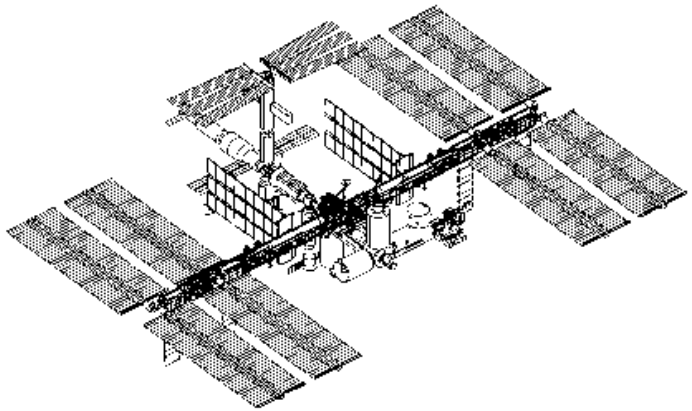
The Layers of Agreements



Goal: Design, Build, and Test a Safe, Survivable, 'assemble-able' Space Station.

= Functional and Design Requirements Documents

- *Intergovernmental Agreement*
- *Memorandum of Understanding*
- *Joint Program Plan*
- *Joint Management Plan*
- *Concept of Operation and Utilization*
- *Space Station System Specification*
- *Segment Specifications*
- *End Item Specifications*
- *Interface Control Plan*
- *Interface Control/ Interface Requirements Documents*
- *Bilateral Implementation Plans (Verification, HW/SW exchange, etc.)*

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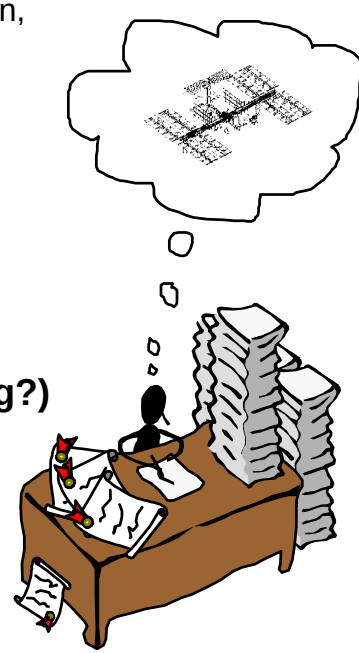
The Long Path to Requirements

- **Inter-Governmental Agreement (Let's cooperate!)**
  - Government to Government Agreement to establish long-term cooperative framework for the detailed design, development, operation, and utilization of the ISS.
- **Memorandum of Understanding (Okay, what do you want of me?)**
  - Agency to Agency agreement that details the roles and responsibilities in the detailed design, development, operation, and utilization of the ISS. Establishes management structure, interface, and planning activities.
  - Joint Program Plan (Here's my manager and team, where are yours?)
  - Establishes the top level inter-relationships between NASA and the corresponding partner agency. Authorizes the Joint Management Plan.
- **Joint Management Plan (What do the agencies plan, verify, deliver?)**
  - Defines the joint documentation to be developed (COU, specs, ICDs), approved, and maintained.
- **Concept of Operations & Utilization (How do we envision the Station operating?)**
  - Establishes principles of operation and utilization of the ISS.
- **System Specification (What are the requirements for the station?)**
  - Defines performance and design requirements for the ISS.
  - Allocates performance and design requirements to the Partner Segments.
- **Segment and End Item Specification (What are my specific segment and end-item requirements?)**
  - Defines the performance and design requirements for the segments and end items.
  - Allocates performance and design requirements to the end items and lower level components.



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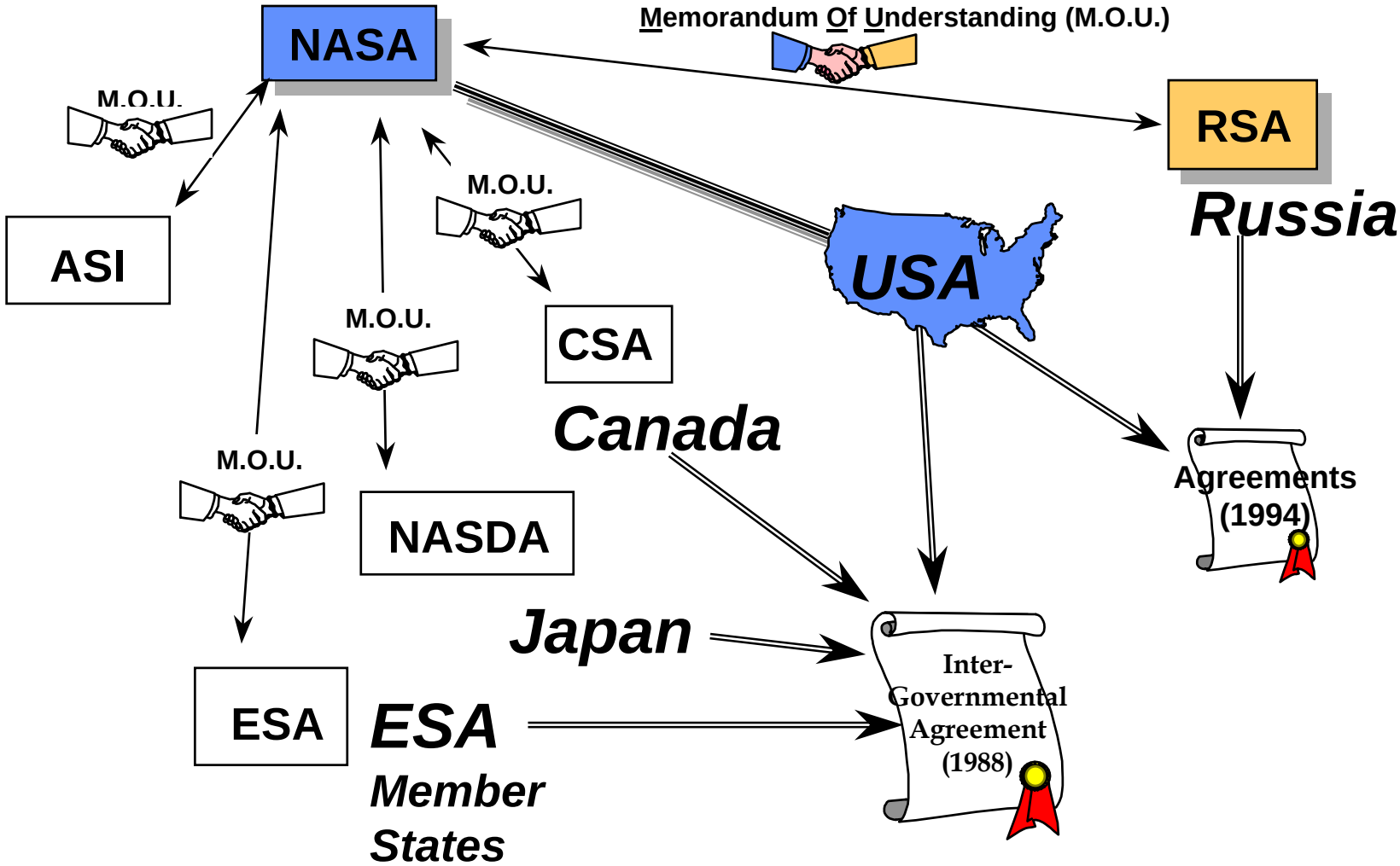
Quick Look Top Level Agreements



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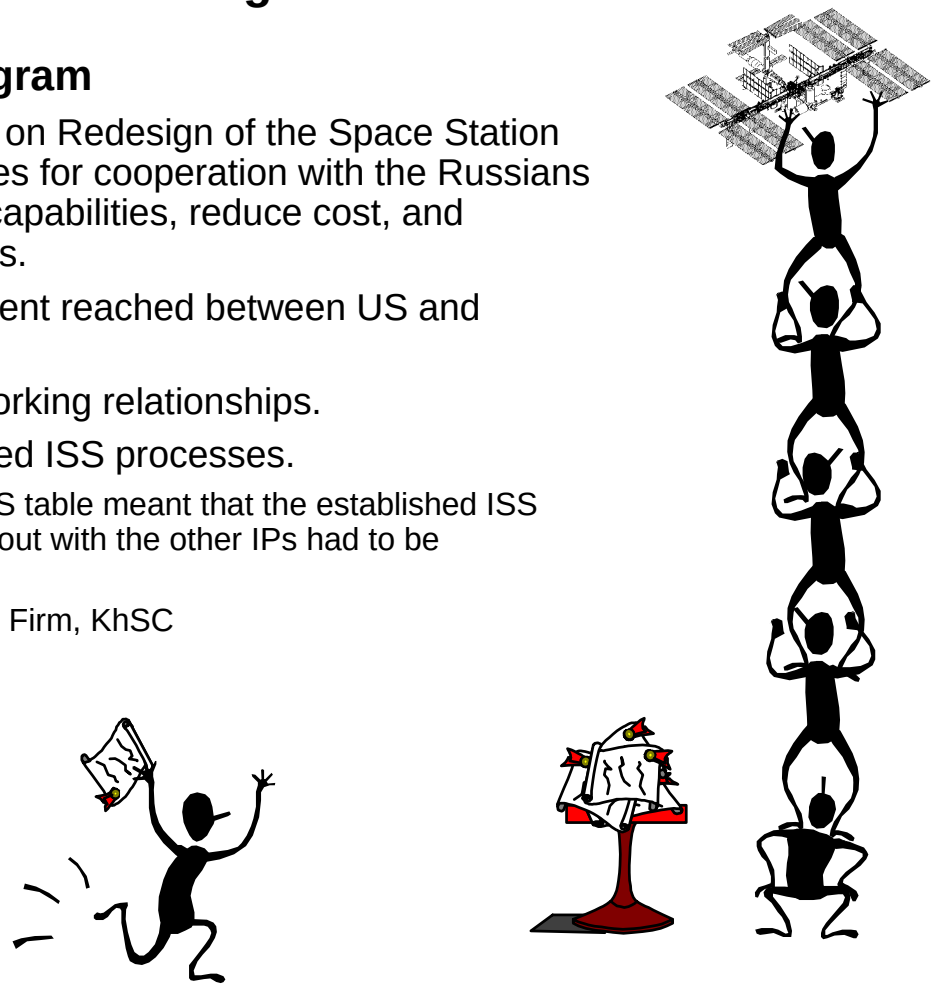
Challenge of Establishing Agreements

- **Significant Changes to Space Station Program**
  - **Russian Newcomer to the Program**
    - June 1993, Advisory Committee on Redesign of the Space Station recommend pursing opportunities for cooperation with the Russians as a means to enhance station capabilities, reduce cost, and provide alternative station access.
    - 1994: New government agreement reached between US and Russia
    - MOUs developed to establish working relationships.
    - Pulling Russia into the established ISS processes.
      - The introduction of RSA to the ISS table meant that the established ISS processes that had been worked out with the other IPs had to be negotiated with Moscow.
      - 1995 US buys FGB from Russian Firm, KhSC



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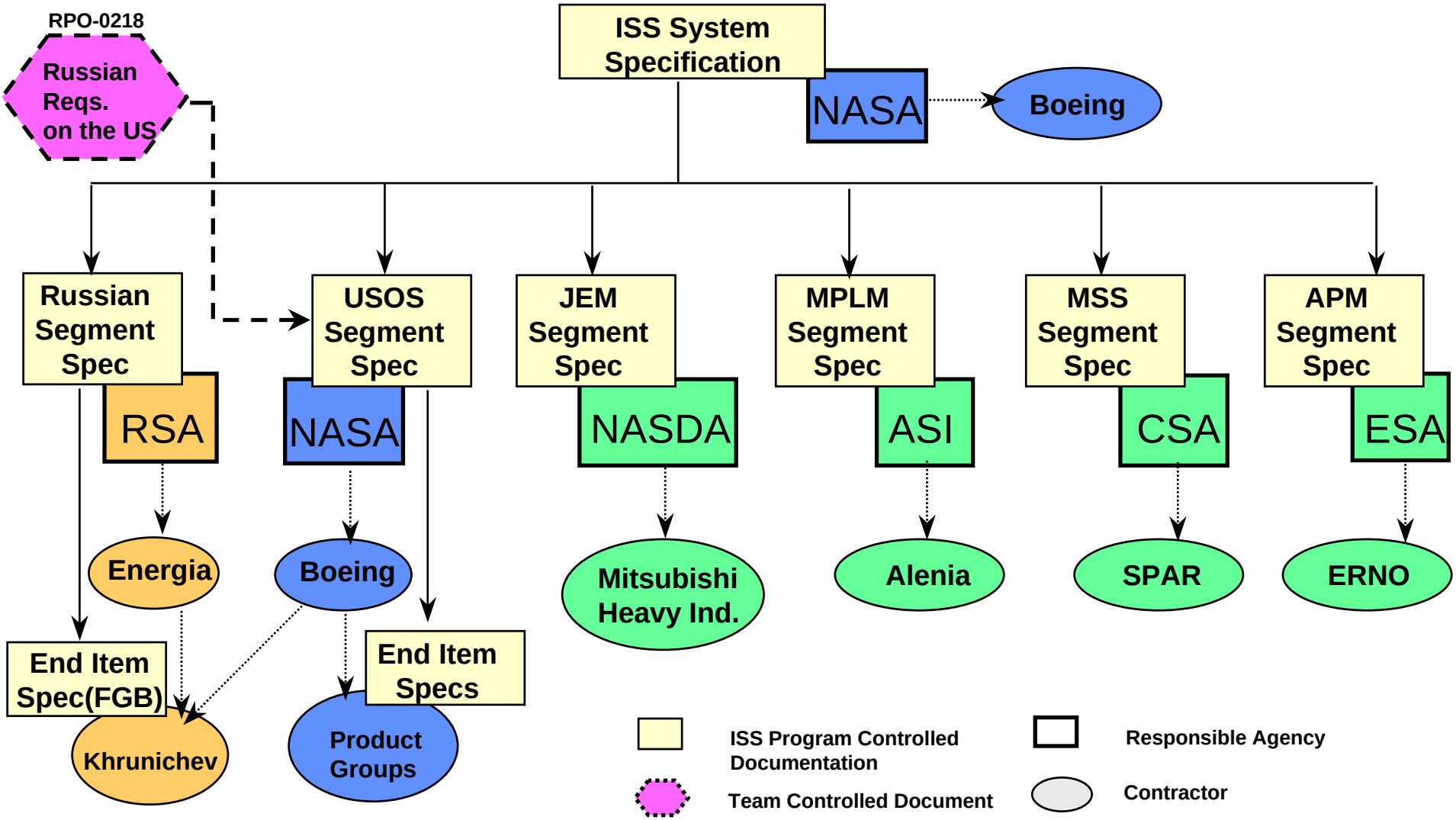
Top Level Agency/Specification Relationships



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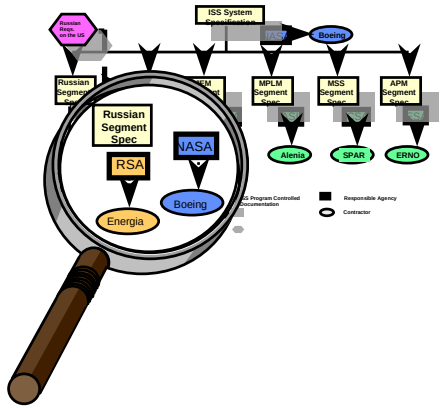
Challenge of Establishing Agreements

Specification Tree



- **Flow down of System Requirements to Russia**
  - **"U.S." view**
    - Actually, the view of Requirements Team, representing System Spec.
    - A dispassionate, standard flow down of requirements from the System Specification to the Russian Segment Specification.
  - **Russian view**
    - As a Full Partner, Separate but Equal
    - "U.S." imposed requirements on Russia, so Russia would impose requirements on U.S.
  - **Clever solution**
    - This issue surfaced during a Major TIM - grinding the meeting to a halt.
      - "No, it doesn't make systems engineering 'sense'" - would have left a stalemate.
      - Inserting the Russian imposed requirements directly into spec tree was unwieldy.
    - Decision to accept new document but controlled at the Team level.
      - Team traces Russian imposed requirements to rqmts. already controlled within spec tree.
      - Senior NASA and RSA management would sign the document.
    - Document loaded into electronic database with other "ISS" documents.

Result … Modified Program Processes

- Describe what was modified to implement the agreements

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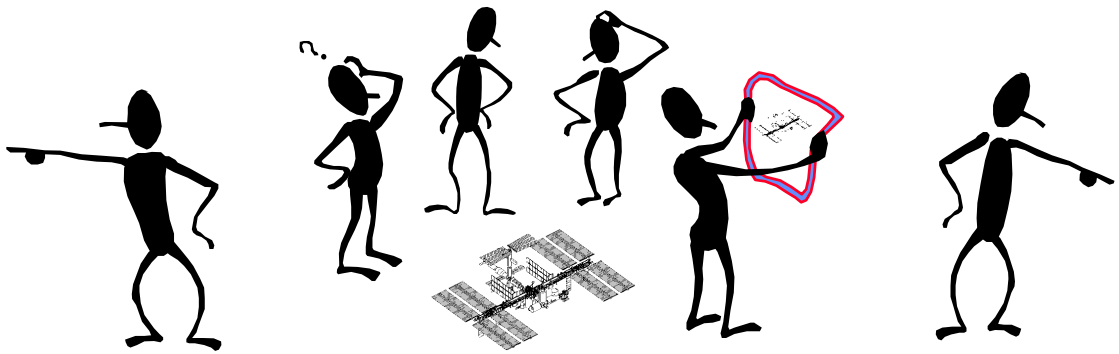
Modified Program Processes

- **Why would program processes be modified?**
  - **The IPs have different ground rules for playing the game.**
  - **The ISS tends to be a "program of consensus" as opposed to a typical "program of direction."**
  - **Conscious program decision to limit penetration into IP management of processes/function.**



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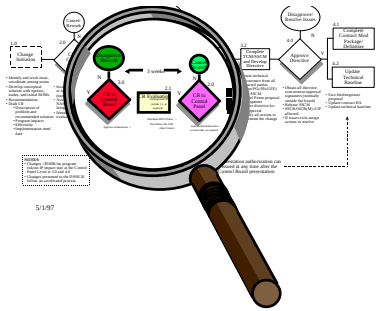
Modified Program Processes

Change Process



- **Working requirement changes with Russia**
  - **Russia not around when Change Process developed.**
  - **A stop gap measure developed.**
    - Developed by Russia and U.S.
      - The persons who use the process developed the process.
  - **Stop gap measure shelters Russia from ISS change process.**
  - **Change process uses TIM Team structure to approve changes.**
    - Changes developed and agreed to by co-located teams.
    - Other partner impacts identified.
    - Ratified by Team 0 (Management Team).
    - Incorporated into working draft specifications.
    - US side enters change into ISS standard change process.
    - After approval, change incorporated into official specification.
    - No Software Change Notices (individual change paperwork).
  - **In-parallel/on-going attempt to bring Russia into the ISS change process fold.**

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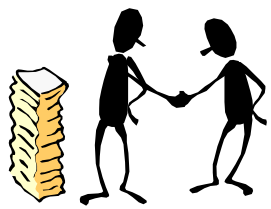
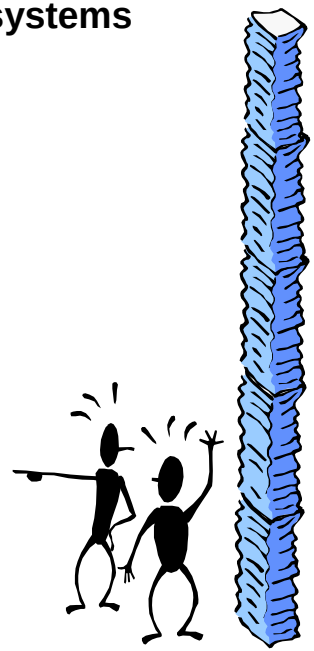
Modified Program Processes

- **Would the "Team 0/Protocol" system work with other Partners?**
- **Enablers with Russia:**
  - **Most Russian changes affect only the U.S. to Russian interfaces. (bilateral vs. multilateral)**
  - **The use of protocols is not as revered in other camps.**
  - **Russia's culture context supports the hierarchical structure needed.**
  - **Larger existing infrastructure within NASA to support the process with Russia.**
  - **Requires rigorous "hands on" and is dependent on the practice of good systems engineering principles and management buy-in from both sides.**
  - **ANALYSIS**
  - **Russia risks implementing a change before integrated on the program.**
    - & vice-versa: Program updated before Russian agreement.
  - **Mitigation by issue generation, risks, and metrics may not be enough.**
  - **Should we/could we apply Roy's CM Process to whole of ISS?**





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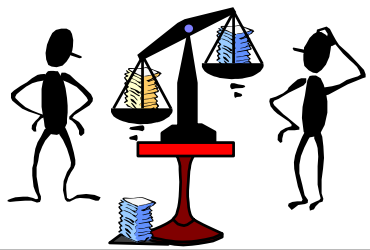
Modified Program Processes

Meets or Exceeds Standards Exercise

- **NASA not the customer, but the integrator.**
  - **Could not unilaterally impose its "standard" aerospace industry standards on the international contributors.**
  - **No authority.**
    - Other countries have their own industry and manufacturing standards that they trust.
  - **Not practical.**
    - Designers, technicians in other countries were familiar with their own standards.
- **Meets or Exceeds Evaluation Performed.**
  - **ESA, NASDA, CSA, ASI**
    - Primarily manufacturing standards: Materials & Processes, EEE Parts.
  - **Russia**
    - Broadened to include almost all of the standards, Fracture Control to Human Factors to Coatings.



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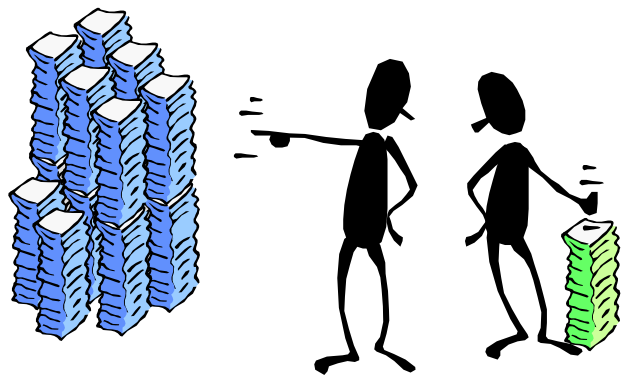
Modified Program Processes

- Challenges for the Verification of the ISS
  - Cost prohibitive to perform extensive penetration of verification requirements, plans and procedures on all IP hardware/software.
  - The ISS elements are being manufactured around the world.
  - Element/hardware development/launch schedules make it impossible to perform integrated testing of flight elements.
  - Different approaches to verification.
  - Different levels of simulation and testing capability.



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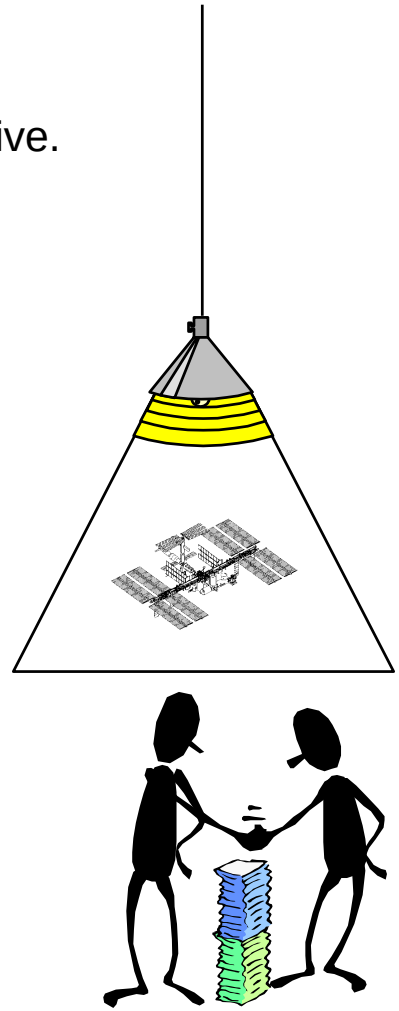
Modified Program Processes

- Effective Verification Diversity:
  - NASA recognizes proven space agencies use different methodologies and philosophies to accomplish a common objective.
  - NASA insight into IP verification through Bilateral Integration and Verification Plan (BIVP).
    - BIVP identifies the verification methods unique to the IPs.
  - Verification requirements contained in specifications, IRDs, and ICDs and are jointly agreed.
  - Process Sampling
    - "Confirmation" exercise to ensure that the other partner is indeed performing what was advertised.



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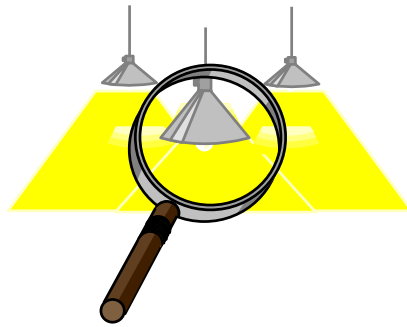
Modified Program Processes



- NASA and the IP agree each are responsible for verification and certification of their own modules.
- NASA/IP(s) are each responsible for their own side of the mating interface verification.
- ESA, NASDA
  - ESA and NASDA did not want verification requirements in their segment level specifications.
  - Emphasis on interface verification as documented in the interface control/interface requirements documents.
  - Emphasis on test planning and traceability into the lower level ESA/NASDA documentation.
- RSA
  - Some vehicles of the RS segment represent existing design with a long flight history.
  - Verification will be based on flight experience and/or certification or verification from previous applications.
  - New verification will be performed for ISS requirements which represent a delta from the existing design.
- IP provides data necessary to perform overall integrated verification.

“Hold firm when you must,

Compromise when you can”

➪- Calvin and Hobbes, 1991

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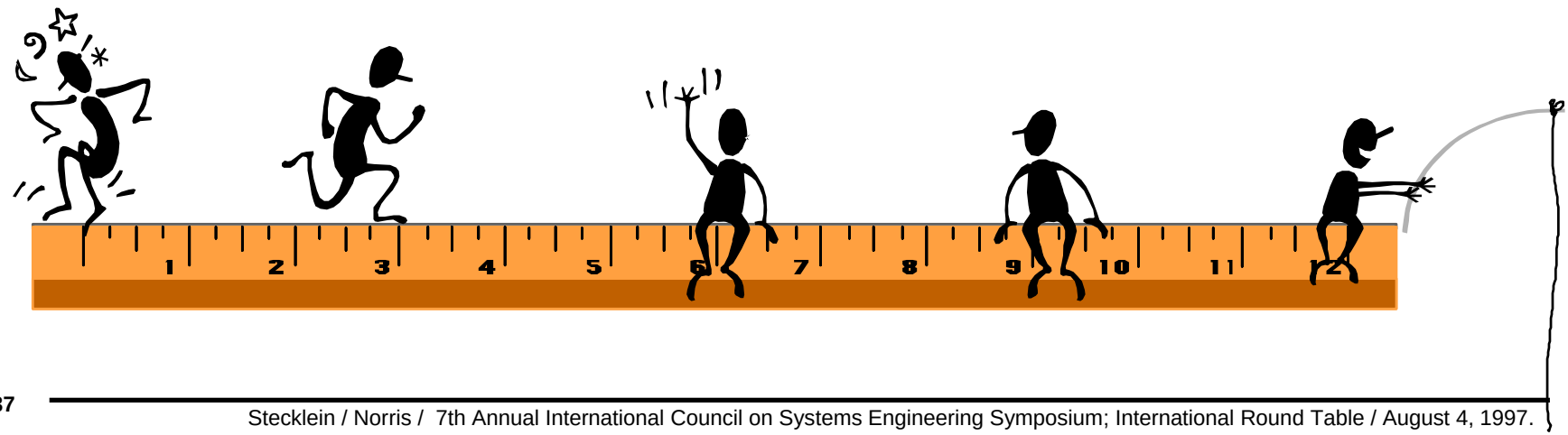
Managing Cultural Differences

- **Be Mindful of Cultural Dimensions:**
  - **Friction cues**
    - Emotional clues that our own “rules” have been broken.
  - **Experienced by low context people**
    - Feeling frustrated, confused, boredom, feeling nothing is getting done, exhausted.
  - **Experienced by high context people**
    - Feeling rushed, hurt, confused; spelling things out feels insulting or intrusive.
- **Do your homework about your partner.**



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Best Systems Engineering Practices

- **When working within the Russian Team, more people adhered to the Requirements Best Practices.**
  - **Near term pain vs. long term gain forced the practice.**
    - Cultural dimensions enhanced the discipline.
    - Clockwork integration for at least two partners
    - Pro: All voting teams, including management, are on site.
    - Con: Everything drops for 2 weeks when a Russian TIM occurs.
- **Implementing Systems Engineering Best Practices are even more critical when dealing with the IPs.**
  - **Extensive cross team integration.**
  - **Horizontal and vertical integration of requirements.**
  - **Absolute minimum set of requirements defined.**
  - **Constructive meetings.**
  - **Metrics.**

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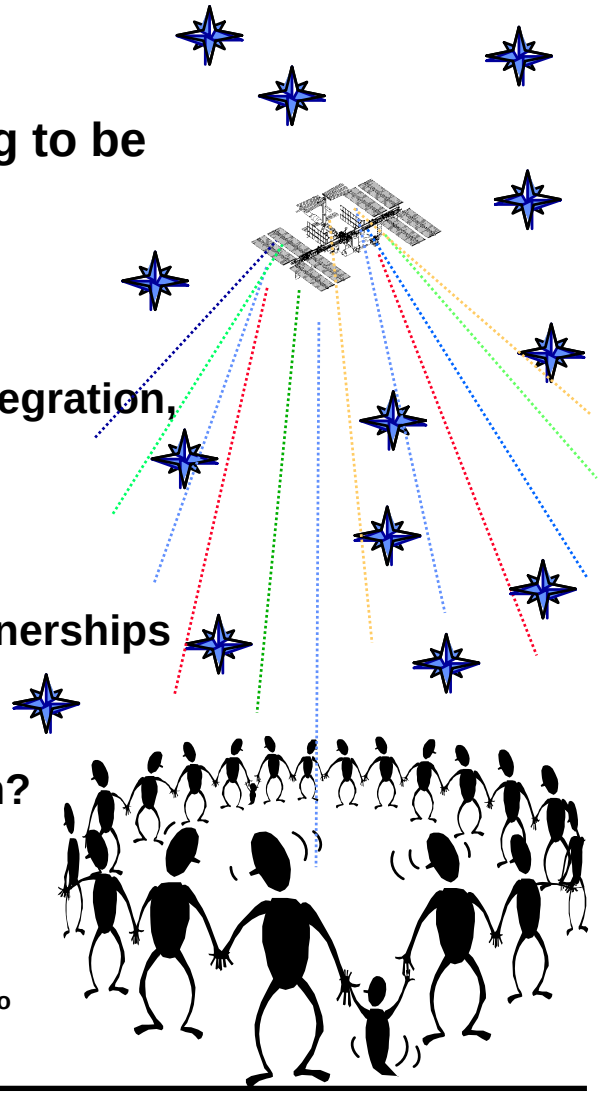
The World's Space Programs in 2050

Based on the International Space Station cooperative experience, what are the world's space programs going to be like in 2050?

- **Will we ever do anything like this again?**
- **Will the hassles of too many cultures, too difficult an integration, too many agendas convince us not to?**
- **Will the benefits of cost sharing, knowledge gained, and relationships formed convince us that international partnerships are the best approach?**
- **What does this mean in the context of space exploration?**



Apologies to Dr. Seuss

BACKUP CHARTS

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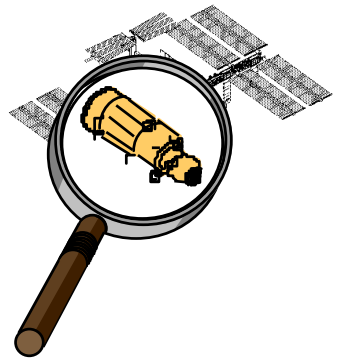
Challenge of Establishing Agreements

- **Sample Case: Establish performance and physical requirements for the FGB.**
  - **Obtaining documentation and drawings of the FGB was extremely difficult.**
    - Most KhSC drawings cannot be readily mass produced and exist as red-lined drawings on the manufacturing floor.
    - Most “standards” documentation is considered proprietary and/or of national security classification.
  - **KhSC not convinced of merits of MIL-STD-490 format.**
    - Traceability.
    - System level 3.2 versus 3.7 allocation/ 3.2.2 to 3.6 design constraints.
    - Section 4.0 verification for every “shall.”
  - **The U.S. division of functional capabilities (e.g. Thermal, ECLSS, C&DH) did not correspond to the Russian division of capabilities.**



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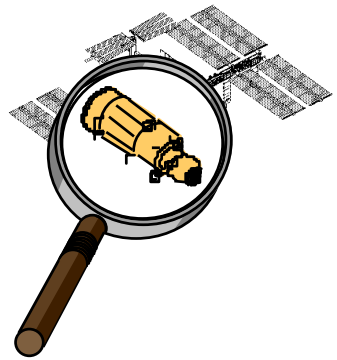
Challenge of Establishing Agreements



- **US broad system level requirements versus KhSC's preference for design level requirements.**
- **Had to negotiate requirements with both KhSC and Energia**
  - FGB functionally part of the overall Russian Segment.
- **Working documents/contracts in both Russian and English.**
  - Established English as the official contractual language if "version" disputes existed.
- **KhSC's contracts with its subcontractors are usually about 1 page long.**
  - Difficult to flow down standard clauses required by U.S. government.
- **Loss of innocence**
  - Within one year of dealing with the West, there was a notable transition in philosophy from "KhSC will sign a protocol and do whatever it takes to build it" (high context, polychronic) to a contract retentive "show me the money, show me where that requirement is in my contract" (low context, monochronic).

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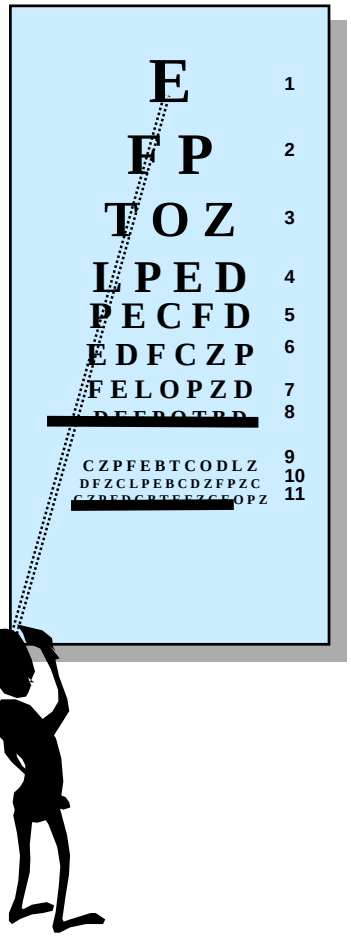
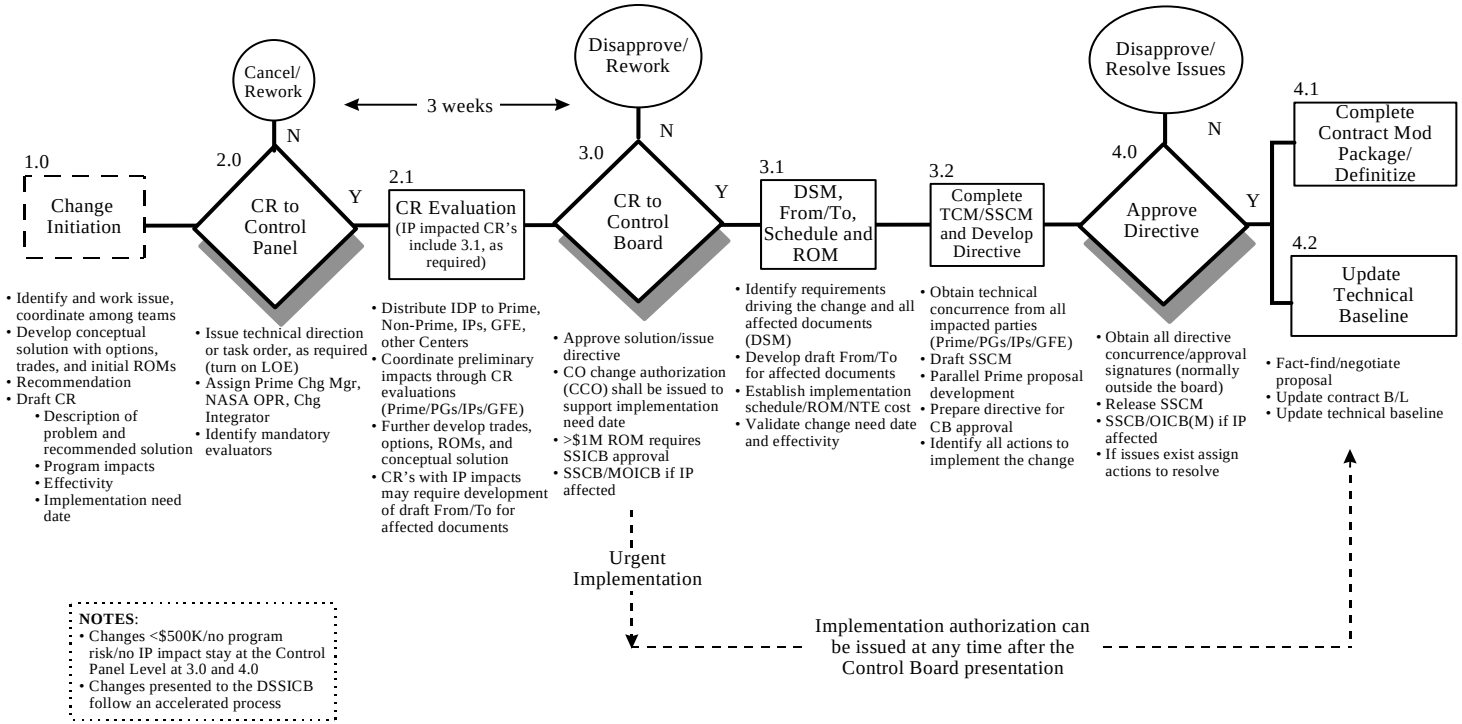
Challenge of Establishing Agreements



ISS Change Process



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Challenge of Establishing Agreements

Objectives of Change Management Process

- **Communicate change proposals; Collect impacts; Make decisions.**

Tension between two Program needs:

- Full coordination of change proposals versus quick decision.

- **IPs add to the tension.**
  - Language barrier; translations back and forth.
  - Strong hierarchical structure of some IPs.
  - Less-prevalence of office equipment to communicate the change.
    - e-mail, faxes, computers, etc.
  - Change proposal distribution system not in place on IP side.

- **U.S. adds to the tension.**
  - Assumed IPs had access to US master database information.
    - Database where all the changes in work were electronically located.
    - Some IPs did not know how to log on, use the system, etc.
  - Some copies of data sent via surface mail to IP.
    - Comments due in 4 weeks, yet surface shipping took 4 weeks.
  - Data “thrown over wall to IPs;” no confirmation of receipt.
  - Some IPs submitted comments but no feedback system in place to tell IP when comment was disagreed with and not incorporated.

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Challenge of Establishing Agreements

Coordination time lag led Program to make some decisions before IP input was received.

- **U.S. side of Program proceeding at risk, with expectation that IP decision would be "yes" to the change.**
- **Risk of fractured baseline.**
- **A few occasions resulted in entire change having to be re-negotiated with IP.**
  - IP could not support the design requirements demanded in the change.
  - New design had to be developed based on what the IP could support.

Further tension in complexity of Change Process.

- **Change Process changed 3 times in 3 years.**
- **Change Process updates focused on improving the proposal/costing flow between NASA and their Prime Contractor**
  - vs. improving the technical definition and coordination flow among all participants.
  - Inputs/suggestions were not solicited from the IPs, or other users.

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Challenge of Establishing Agreements

With Russia, Determining the technical standard: <u>Orbital Debris</u>

- 2-3 years, many, many arguments, and much persistence to resolve.
- We emphasize what we know, what's hurt us in the past.
- Programmatic, technical, cultural and psychological drivers.

- Spacecraft designed in the early 1970's did not protect for orbital debris.
- Environmental models of low Earth orbit developed.
  - Better characterization of LEO.
  - Throwing away more junk in orbit.
  - More satellites and spacecraft launched.
- Orbital debris protection taken seriously by NASA.
  - Orbital debris environment added to NASA specifications for SSF.
  - Additionally, 2 GAO reports on dangers of debris to SSF.
- ISSA: Determined and negotiated a common solution with IPs (NASA, ESA, NASDA).
  - Shielding such that probability of no penetration (PNP) is 90% across all of Space Station.
- Russia enters the Program.
  - Their off-the-shelf designs did not include protection for the orbital debris environment.
  - "Orbital Debris is not a concern. We've been up there for 20 years."
- 6 TIMs with no progress.
- Took a letter from NASA Administrator to get Russian attention.
  - Finally, Russia began to talk with us.
- Negotiations could begin.

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Challenge of Establishing Agreements

With Russia, Determining the technical standard: Leak Testing

- **Russians sensitive to loss of pressure problems.**
- ➪ **As a culture and personally.**
  - Soyuz 11 depressurization.
  - Department of Leak Testing at Energia and each of its subcontractors.
  - 4 vacuum tests of each module during its buildup prior to launch (3 at the factory, 1 at the launch pad).
- **This approach was not in the ISS Baseline.**
- ➪ **Similar to Russian view on orbital debris, leak testing was not part of NASA's historical set of concerns.**
  - Shuttle - there was no precise requirement (3 lb/day Shuttle, 0.1 lb/day on ISS) ability to return from orbit easily on Shuttle; logistic resupply of GN2 to ISS is constrained.
  - Manned thermal vacuum tests on Apollo prior to flight; cost convergence deleted element level leak test approach.
  - The large vacuum chamber infrastructure didn't exist.
- **Russia: 'So build a new vacuum chamber.' (polychronic)**
- **U.S.: 'No time. Space Station must be launched in 1997. (monochronic)**

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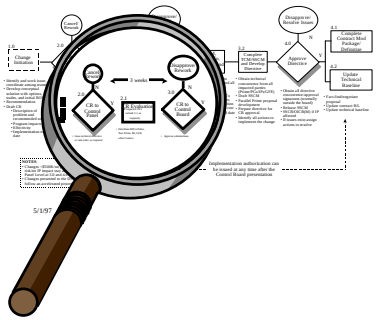
Modified Program Processes

TIM Process



- **Extremely formal TIM structure evolved with Russia:**
  - **Tim represent a major formal agreements process.**
  - **Russian TIMs have on-site signature-delegated management.**
  - **Entire TIM process flows around approval of protocols.**
  - **Protocols are recognized by Russia as far more than signed meeting minutes.**
    - Metal can be cut after management signature of protocols.
  - **Conscious decision to squeeze as much worth out of the meetings as possible.**
  - **A pre-meeting is set up between US and Russian management to agree to the occurrence of a TIM.**
    - Attendees identified and approved.
    - Each team submits goals and objectives for approval.
    - Prior to the TIM, the U.S. side holds a TIM “design review” where each team pitches daily schedules and is core drilled on objectives and goals.

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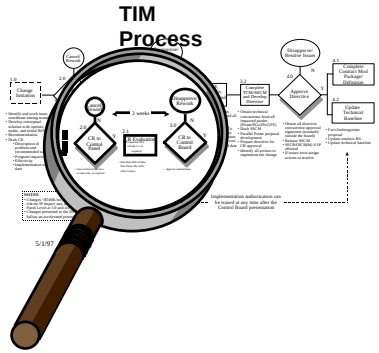
Modified Program Process



- **The TIM is held at one location.**
  - **Auditorium divided into teams.**
  - **Each team is assigned a number/cube.**
    - Team 2 is FGB, Team 8 is GN&C, Team 12 is Requirements, etc.
- **Management Supreme Court team developed.**
  - **Because Team numbers had already been assigned and used, the management team became, "TEAM 0".**
    - (The Russians see humor in this as well).
  - **Subteams report status and problems to Team 0 throughout the TIM.**
  - **Team 0 works through the problems unsolveable at the Team level.**
  - **Team 0 ratifies each Team's protocol at the conclusion of the TIM.**

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Managing Cultural Differences

- **Determine Paper Impacts**
  - **The US requires much data.**
    - Federal Laws.
    - Contract needs.
  - **Producing data**
    - "With all the reports you need, there'll be no one left to build the element".
  - **Receiving/translating data**
    - Every word will be thoroughly analyzed for context and meaning.
      - Expect arguments over nuances.
- **Force teams to justify data needs.**
  - **"Nice to haves" versus "must haves".**
    - 1 hour of upfront data planning = 1 month of negotiations

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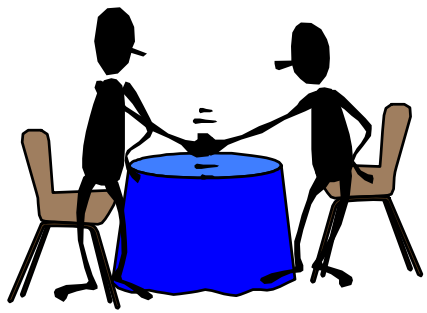
Managing Cultural Differences

- **Develop Structured Meetings**
  - **Develop specific meeting schedules.**
    - Typically, IPs are very skeptical of the value of meetings (aren't we all).
      - Common sense, use the 5Ps (Purpose, Product, Process, People, and Preparation).
  - **Develop specific goals.**
    - Know exactly who the people are that you need.
    - Know exactly the approvals required.
  - **Get very high-level management buy-in to ensure a successful conclusion of the meeting.**
    - Set up pre-negotiation meetings to agree on agenda
    - Determine open issues to be discussed.
    - Establish deadline for conclusion of the meeting.
    - Agree to location and list of participants.
  - **Capture and document each decision.**



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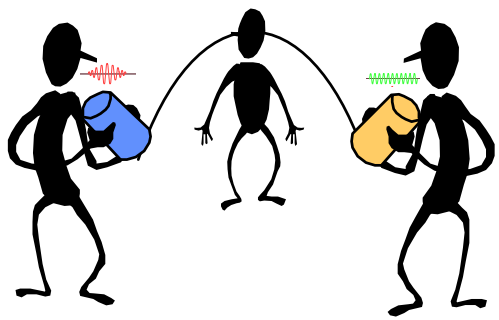
Managing Cultural Differences

- **Determine Communication Protocol**
  - **Establish communication protocol**
    - Flow through management only?
    - Specialist to Specialist?
    - Combination:
      - Permission from management then specialist to specialist.
  - **What are the methods of communication.**
    - E-mail and electronic mediums may not be available.
    - Time zone difficulties.
    - What is the language?
  - **Establish comparable level counterparts.**
    - Manager to manager.
    - Worker to worker.
  - **Talking “at” versus “through” interpreters**
    - Make the interpreter transparent.