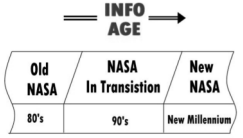
NASA FBC TASK

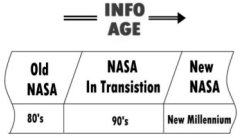


Definition of FBC

- It's both a State of Mind and a Methodology, a Teaming Spirit
  - ✓ It's delivering ever-increasing performance in Human/Robotic Space Missions, quicker, with reduced risk, increased safety, and lower cost
  - ✓ It started as a spirited, people oriented approach to project implementation – with a challenging target, under cost and schedule caps. With safety first, FBC Teams continually strive to:
    - *Innovate*
    - *Maximize efficient use of resources*
    - *Effectively cross organizational boundaries*
    - *Reduce risk*
  - ✓ Now it's a "healthy virus" spreading throughout NASA's institutions
    - All centers have it to some degree, but each has a "way to go."
    - They must create the environment for it to spread within Center and among Centers with HQ
    - The ultimate for NASA FBC is increased Center-to-Center teaming
    - The future is with the institutional support to FBC

Smaller core FBC Project Teams are being supported by multi-mission technology, engineering/management support teams, best tools, training, processes, standards, effective peer review, other checks and balances

NASA FBC TASK



Definition of FBC - *Continued*

- Only good teams with a good leader can do FBC, and good teams without a good leader cannot do FBC well. FBC requires the very best people for project leadership and teaming. There must be a careful mix of scarred experience and bright energetic youth bringing new enthusiasm with new methods.

- FBC Projects are like driving a finely tuned, high performance racecar. While margins are adequate, they are tighter to gain performance. There must be a good race track, support crew, and most importantly a professional driver.

- In generating future FBC Teams, a quantitative assessment of the leader and team's experience/expertise base is essential – **1st Badge of Courage: Leader/Team Certification**

- We are still in the early stages of FBC, completing the 1st and 2nd generation of Missions. It's one thing to do experimental FBC Projects, it's another to institutionalize FBC. The next generation FBC Projects will have the 1st and 2nd generation lessons learned database; a more experienced set of project implementers some "hot" off the "firing line" and some already with significant scars.

- As for any human endeavor, FBC Space Projects takes full team commitment – from winning Super Bowls, to climbing Everest, to competing in today's Info Age Industry. It takes complete, open and candid communication and total dedication from all people involved. All team members are System Engineers, looking out for the common good and helping each other. It's difficult to impossible to do FBC Projects with part-time help.

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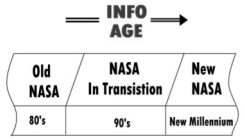

Definition of FBC *- continued*

✓ FBC is simply striving to become more efficient and innovative in government, industry and academia. It applies to all tasks and missions, robotic and manned, large and small

✓ It's NOT stuffing a fixed mission scope within arbitrary cost and schedule caps

✓ In properly implemented FBC Projects, scope, risk, cost and required reserves are determined for a carefully defined mission scope in a thorough upfront planning process – pre-project phase

✓ The FBC Project Team must "own" its plan, including full acceptance of cost and schedule caps

✓ If cost and schedule must be capped at the outset, then Mission scope must be sized to allow

for development on a realistic Project Plan - as with Mars Pathfinder where NASA HQ gave the project the flexibility to adjust scope to fit

FBC MISSIONS CAN TAKE AS LONG AS <u>25 YEARS</u>! It may take this long to carefully plan and implement a series of life detection Missions lead by a proper group of scientists. FBC Projects should take as long as it's necessary to get the job done – challenged but prudently challenged

AJS
March 2000
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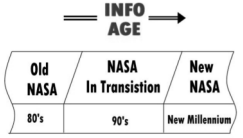
NASA FBC TASK



Categories of NASA Missions

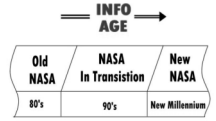
- For projects less than or equal to, say, $200Mil, the Project Manager and key Project Staff can get their "arms around this Project", know the team members personally and closely, and obtain performance/status on a daily and weekly basis - *before* monthly Project metrics are published. FBC is easier to do for a Project in of this size category. With less investment at stake, more risk can be taken to strive for major breakthroughs. Missions of the size category can function as Trailblazer Missions. But, this is no excuse for failure, and rigorous project planning and control and continuous risk assessment and mitigation are still essential. There is no reason to believe that the mission success rate should not be greater than 8/10, and failures due to implementation mistakes are not tolerated.

- **The proposed mission success rates are for failures due to the inherent risk of the Mission and not due to mistakes. Failure due to mistakes is not acceptable and must be a order of magnitude less. Examples of inherently high risk missions are DSI, Solar Probe, Europa Orbiter, and the Shuttle Tether Mission where the tether broke.**

- For missions larger than $200mil, Project Management is further removed from day-to-day action and things get more complicated. There are many more interfaces, external spot lights, reviews, need for more structure, documentation, etc. Put in the human element and complexity, Project Management challenges are maximized. Now many agencies outside of NASA get involved with the human element. These missions of high national importance cannot fail. However, there is no reason not to employ FBC principles to Project Management and to each of the many project elements.
- As an example of the degree of difficulty with size, consider a $2 billion Robotic Project. In a rather simplistic manner, this Project can be broken down into ten $200mil Project FBC approaches. But what is the probability of 10 FBC Projects going right? Then add in the many complex interfaces and inter-dependencies that must exist among these ten FBC sub-projects and you can begin to appreciate why larger Projects are much harder to do. A large Project replicates the basic Project organization structure, say, for a $200mil Project, over and over again throughout its total Project structure such that it begins to look like a fractal in a chaotic system.

- **Large and complex Projects by the nature of their complex structure verge naturally on chaotic behavior.**

NASA FBC TASK



CATAGORIES OF MISSIONS

- Moving to **"NEWGROUNDS"** Technically or Programmatically
- Challenging cost and schedule caps
- Higher Risk • Potential for Major Payoff
- Flexible • Less Oversight and visibility
- Run by an experienced Entrepreneur/Leader

NOTIONAL MISSION SUCCESS RATES

TRAILBLAZER ROBOTIC
<200mil$

> 8/10

- Higher National priority/Cost • More Margin
- Lesser risk • Potential for major payoff
- More formal methods
- More oversight and visibility
- Run by an experienced Manager/Leader

CLASSIC ROBOTIC
>Billion$

> 95/100

- Highest National priority/cost • Most Margin
- Least risk • Potential for major payoff
- Most formal methods
- Most oversight and visibility
- Run by an experienced Manager/Leader

HIGHEST PRIORITY
Human
Multi-billion$

> 99/100 (Greater than 999/1000 for Crew Safety)

THE HIGHER THE NATIONAL PRIORITY, THE LARGER NUMBER OF "SPOTLIGHTS." THE HIGHER THE COST AND COMPLEXITY, THE HIGHER THE MANAGEMENT CHALLENGE. BUT ALL PROJECTS ARE IMPLEMENTED WITH SPIRITED TEAMS USING FBC METHODS

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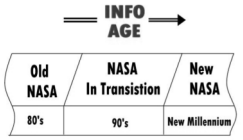

Rules of Engagement for FBC Projects

- In the past, with fewer Missions, Project Managers gained “on the job training” over ten to twenty years, working up through the ranks. Project Management principles were handed down from one generation to the next through this “on the job” experience accrual process. Today, with many Projects, this is not usually the case, and mentors, training, checks and balances and guideline documents like NASA 7120 and JPL’s Design Standard become much more important.

- Still, a certain degree of experience and expertise must reside with each Project Team and certification is essential including training. The best way to teach Rules of Engagement for FBC Projects is having new Project Teams hear the stories, the lesson learned from experienced teams. This should be a mandatory process for Project Team certification and team building taught by NASA’s Academy of Program and Project Leadership.

- The Rules of Engagement for FBC Projects are nothing new and have been applied throughout the history of NASA - being built up from the 60’s over hard lessons learned. FBC rules go back to basics: use common sense; stress the need for good up front planning; a stable environment; good execution with thorough space qualification; test; simulation and training; and effective checks and balances.

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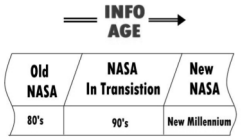

Rules of Engagement for FBC Projects

✓ Form and motivate an excellent team, a mix of experience and bright energetic youth bringing new enthusiasm and new methods
- Go to the best sources of expertise in NASA, industry, academia
- Co-locate physically and/or electronically, do concurrent engineering
- Team with Mission Assurance to develop the Project Mission Assurance Plan

***Certify each Team - BADGE OF COURAGE #1**

✓ Establish a challenging but realistic Mission Target

✓ Establish upfront agreements and maintain them

✓ Size Mission scope within resources to provide for acceptable risk and adequate reserves

✓ Develop a thorough Project Plan according to NASA 7120.5A, tailoring its rules/guidelines to Projects' needs

✓ Conduct rigorous system and subsystem engineering to established standards (like JPL's Design Standards)

✓ Conduct continuous, rigorous risk assessment and mitigation throughout development and operations

***Establish/Maintain a Mission Risk Signature - BADGE OF COURAGE #2**

✓ Balance use of available and advanced technology to maximize Mission success *(Note 1)*

✓ Establish/maintain metrics for Mission Risk and Technical/Cost/Schedule Performance

***Establish/Maintain Rules of Engagement and its Metric - BADGE OF COURAGE #3**

✓ TEST, TEST, TEST and TEST as you FLY *(Note 2)*

✓ Then TRAIN, TRAIN, TRAIN *(Note 3)* Flight OPS Teams must contain key members of the Development Team

✓ Best: Designers become testers become operators

✓ Work openly and candidly inside the team with thorough communication. Communicate openly and candidly externally to the Project

Support yearly Independent , Formal Reviews, but also Peer-Review all key decisions, results and events, responding to all action items. Projects own their Peer-Review Process

Note 1: It may be that Demo's of advanced technology are included in Mission scope and upfront agreements

Note 2: Early proof of concept tests, early end-to-end flight-ground functional/interface tests, extensive subsystem and system space QUAL an performance tests and burn-ins, using flight operations H/W and S/W in spacecraft system tests

Note 3: Initiate flight operations training, both standard and contingency sequences, in the test bed and with the flight system in ALTO before launch

ATLO = Assembly, test, launch, operations

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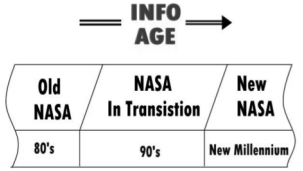

Rules of Engagement for FBC Projects *Continued...*

- There is nothing new here in these FBC Rules of Engagement
  - ✓ It's just back to basics, lots of hard work, team effort and follow through on the details
  - ✓ It's never thinking that you are done. You can never stop penetrating into how things work, how they reflect reality, match the expected environment
  - ✓ It's being paranoid about failure, staying humble, never getting smug or complacent
  - ✓ It's never thinking that you know it all, that you really know anything. Its asking for help from others, getting your work critiqued, no matter the bruised ego
  - ✓ It's thoroughly debating all the hard issues, no one person usually knows the answer. It must be a collective effort by a team
- A "Green, Yellow, Red" metric chart does wonders
  - ✓ Use them to track procurements, deliveries into spacecraft integration and test, etc
  - ✓ On Pathfinder, a vendor seeing that we carried his delivery status at "red" asked: "Does that chart go to NASA HQ?" The answer: "Yes"

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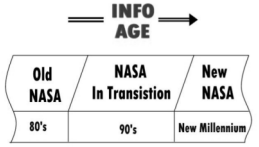

Example

Rules of Engagement

Project Performance Check List Metric for Year _____

- Stable Agreements
- Certified, Capable Team
- Funding Availability
- Project Plan and Implementation Status
- Adequate Reserves
- Safety and Mission Assurance Plan and Implementation Status
- Risk Assessment and Mitigation Plan and Implementation Status
- Mission Engineering to Standards and Implementation Status
- Flight-GND System Engineering to Standards and Implementation Status
- Sub-System Engineering to Standards and Implementation Status

- System/Sub-System Space Qual Plan and Implementation Status
- FLT-GND S/W Development Plan and Implementation Status
- SUBS/SYS Test, SIM, PERF Demo Plan and Implementation Status
- GDS/OPS DEV Plan and Implementation Status
- Flight OPS Training Plan and Implementation Status
- Peer Review Plan and Implementation Status
- Problem Resolution Status
- Documentation Status
- Configuration Control Status

■ = Acceptable ■ = Cautionary ■ = Major Problem

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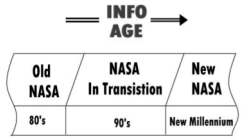

Risk Assessment and Mitigation

- ✓ The currently high Mission failure rate will be reduced by:
  - ✓ Eliminating mistakes, mis-management, mis-engineering by re-emphasizing Project implementation and design, especially in ensuring a Mission scope match to resources.
  - ✓ Certifying of Project Teams, including thorough training and exposure to the 1st generation FBC Mission lessons learned
  - ✓ Ensuring that Project adhere to FBC Rules of Engagement, including effective checks and balances through Peer Reviews and Independent Annual Reviews
  - ✓ Providing Project Teams with improved institutional support, especially in advanced technology and methods
- ✓ Project and Program risk assessment and mitigation is a continuous activity throughout development and operations. **There is nothing magic or overly complicated about this process**. Again, it's simply back to basics, common sense, discipline and **follow through on details.** Good Project Management has always been about risk mitigation. See the FBC White Paper, dated July 1999, in the Appendix for an outline of a Project Risk Assessment and Mitigation Process.
- ✓ Each Project must generate and maintain a risk signature, both for Programmatic, cost and schedule, and for mission risk. It's ok that a FBC Project starts out with high technical and programmatic risk. This is what FBC is all about – as long as there is a good risk assessment and mitigation and this initial risk is retired prior to launch and continuously throughout operations to acceptable levels. The FBC Project Manager and the Project Team are obligated to state when risk cannot be reduced to acceptable levels.
- ✓ Mission failure due to mistakes, mis-management, mis-engineering is never acceptable. Mission failure for a difficult Mission where everything was done correctly to mitigate risk is at least "honorable," while still very traumatic for the Project Team.