

Changing the Formula to Change Thinking At NASA

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This is the story of a well – meaning, committed team with a clear and compelling vision, caught in a counter – productive systemic structure. It is an example of how our own well- meaning behavior – in this case the behavior of the total organization – can create the forces that prevent us from reaching our shared vision. It is also a story of how seeing the total system and its interconnections clearly, allows us to make undiscussables into productive conversations which change our thinking, behavior and our systemic structures.

It is also a story of creating a new paradigm for learning. A paradigm shift from an academic model to a pragmatic, adult based learning approach. Where work and learning become synonymous in what we have begun to refer to as *work is learning is work*.

BACKGROUND

The project we are about to describe was undertaken with the Earth Sciences Enterprise, one of five enterprises in the National Aeronautics and Space Administration (NASA). The enterprise is composed of a small staff at NASA Headquarters and personnel largely concentrated in three NASA Centers. Earth Sciences is an enterprise that operates in a matrix structure with Headquarters providing overall direction and funding and the centers providing the technology and implementation capability.

Actual work gets done through Program Managers and requires cooperation and collaboration among centers and between the centers and Headquarters. In the mid-90's, in response to an effort to downsize NASA Headquarters, the Program Management function was transferred from Headquarters to the centers.

Over the years Headquarters became aware of a disconnect in roles and responsibilities that was affecting operational efficiency. In some cases centers appeared to be taking on too much responsibility, evidenced by their as not defining problems to Headquarters early in the program cycle. In some cases they were taking on too little responsibility, for example, bringing funding problems to Headquarters rather than making trade-offs at the center level. Mike Luther, the executive responsible, wanted to explore whether the use of Organizational Learning tools and methods could resolve the Program Management effectiveness issue.

As part of the High Performing Federal Agencies Team, NASA began to introduce Learning Organization theories, methodologies and tools in 1998. The formula used was to find what we referred to as “learning-ready leaders.” Those individuals interested in making a change in their organization and who were searching for help. The method we used for introducing the concepts of learning organizations was the

“learning laboratory.” For NASA, a learning laboratory was a two to three day event that involved the introduction of the Organizational Learning concepts as described in Peter Senge’s book “The Fifth Discipline” (1990), using examples from NASA as much as possible to ground the understanding. Six of these labs were conducted from 1998 to 2001.

THE ENGAGEMENT PROCESS

Christine Williams, the internal consultant responsible for NASA’s Organizational Learning effort, Fred Simon, Chris’s outside consulting support, and Mike Luther met for breakfast one morning.

The breakfast was a mutual exploration around Organizational Learning efforts under way at NASA, the relationship between Earth Sciences Headquarters and center Program Managers, and the relationship between the centers and the Earth Sciences Enterprise. After about an hour, we concluded that the issue might be much larger and broader than initially defined. We decided to conduct exploratory interviews with the Headquarters executives and with the center program leadership.

Chris and Fred interviewed most of the senior Earth Sciences Enterprise personnel, the key Center Directors, and some individuals outside the enterprise who had knowledge of its functioning. The questions we used are shown in Exhibit 1. They ranged from the vision of the organization to the details of specific job contributions and success enablers and inhibitors.

At the end of the interview process Chris, Fred and Mike met again to discuss the broad findings. We agreed that the issues for the enterprise appeared to be much broader than Program Management and that they involved several NASA-wide mental models and systemic structures (to be explained later in the article). We decided, as a first step, to build on an Earth Sciences Enterprise retreat held earlier, by conducting a follow-on two-day workshop. We wanted to change the focus of the workshop, however, based on recent findings of effectiveness.

In 2001, NASA commissioned an independent contractor to analyze and assess the success of our efforts to date. Success was defined as the integration of learning tools into day-to-day efforts, the observation of behavioral changes and the observation of a positive impact on mission results, even if it could not yet be measured.

The assessment revealed that, for the most part, the learning tools were not being actively used. While some participants noted infrequent use of learning organization terminology such as “left hand column” to describe a particular incident, and others stated that they did experience some personal growth as a result of the laboratory, for the most part the impact was minimal. In addition, these learning laboratories appeared to have no lasting impact on organizational results, with the exception of one instance. Individuals involved in this instance noted that operational effectiveness and their relationships with another center organization had greatly improved.

They also reported that they found the laboratory enjoyable and valuable and that it left a great impression because the skills taught were relevant and immediately applied to their problems.

In analyzing the difference between this instance and the others we found four distinct differences.

Successful Learning Laboratories	Unsuccessful Learning Laboratories
<ul style="list-style-type: none"> ■ The event was designed as an organizational intervention and targeted a specific problem. ■ The event was shorter and introduced concepts and tools only as needed to address the issue at hand. ■ There was a committed and engaged leader present during the entire process. ■ The goals of the laboratory were near term, addressed immediate needs, and were focused and clear to all participants. 	<ul style="list-style-type: none"> ■ The intervention was designed as a learning event using relevant organizational issues. ■ The event was two and one-half to three days and introduced all learning concepts and tools regardless of their need or direct relevance. ■ The leader was present only at the start of the process and did not remain engaged. ■ The goals of the laboratory addressed long-term change, and goals were unclear.

Armed with this analysis, we decided to put the total focus on the work that had to be done by the enterprise, introducing the Organizational Learning tools and methods only when needed to advance the work and only in ways that would not interrupt the flow of the work being done.

THE WORKSHOP

We brought together Headquarters executives and center Program Managers from six centers, for a two – day offsite workshop.

The workshop began with an evening dinner at which the head of the Earth Sciences Enterprise, Dr. Ghassem Asrar, spoke to the group. He stated that NASA could no longer afford to think of itself as a distinct group of enterprises or centers and that it was time to come together, to draw on each others strengths to create a seamless, proactive team. Dr. Asrar challenged the participants to move beyond conducting experiments to the delivery of knowledge that will allow U.S. and world leaders to make better-informed decisions – a change from a focus on process to a focus on results. To accomplish this he said, we

need to change to a more team-oriented collaborative enterprise, with society-focused objectives. “ To honestly assess our unique role in the Government and the world and to focus on those things that only NASA can deliver.”

The next morning, we began with a further discussion of the Earth Sciences vision. The vision that evolved was “Science for Society” – understanding the earth as one whole system including providing decision makers with timely, accurate data to address inter-related economic, societal and social issues. The group seemed to have a clear vision and they were individually and collectively committed to that vision.

The next step was to address those factors essential to success in achieving the vision. We created two lists; one defining Enterprise success and one that defined team success:

Enterprise Success

- Success would be defined in terms of benefits to society and National relevance.
- Success measures would be defined using agreed upon measures for results regarding:
 - Cost, schedule and consistent ground rules for when programs would be cancelled, and
 - Amount of science achieved per dollar spent
- Priorities would be set and maintained [it is not alright to do the wrong things well].
- -Politicization of results or of priority setting would be avoided [one story fits all].

Team Success

- Use interdisciplinary/inter-center approach/teamwork.
- Engage the assets of the entire science community and international partners.
- Build more effective alliances/understand others’ roles and problems and appreciate them.
- Specifically define roles and responsibilities.
- Competitiveness through optimized collaboration.
- Build excellent communication ↑, ↓, ←, →.
- Develop a high quality workforce (mission and team)
- A focus on the success of the Enterprise rather than success of each flight mission

We then chose some of the success factors, such as collaboration and trust, and asked them to consider whether they really are a team and whether they believed they needed each other to achieve their shared vision.

We had the participants break into smaller groups to explore all the people they depend upon or who depend upon them to do their jobs and to achieve their vision. We also had them try to map the relationships and interconnections.

Given these relationships, we introduced the concept of Mental Models – the deep assumptions underlying our behavior – and asked them about the Mental Models each of them hold about the Earth Sciences Enterprise and the organizations and people they relate to. Some of the Mental Models expressed were:

- We work to deliver science for society, until Congress tells us otherwise
- Centers have to compete with each other to get enough projects to survive and to maintain their core competencies.
- We could deliver more if the centers would only cooperate with Headquarters and each other.
- Headquarters doesn't trust or value the centers.

We discussed the Mental Models as a group and Fred pointed out that, given these Mental Models, it is difficult to maintain consistent focus and priorities.

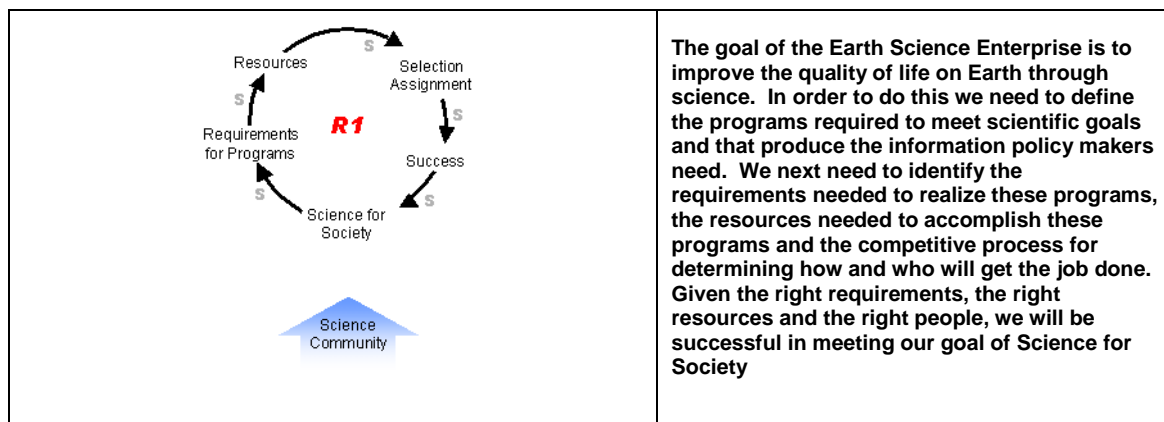
To which one of the participants said: “Well DUH!”

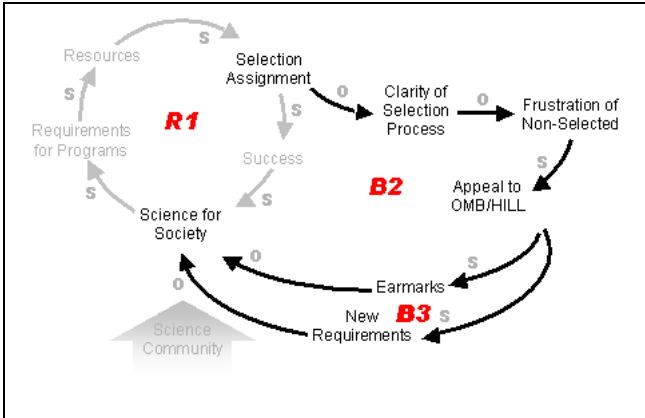
The translations of his reaction was that they already knew about these conflicting priorities and have been living with them as best they can for a long time, but they believed they were beyond the group's capability to influence. The consensus was that the best they could do was to try to deliver quality, timeliness and cost-effectiveness on the projects they could control for as long as the projects might last.

It was at this point that we introduced the discipline of Systems Thinking (Senge, 1990) and its concepts of counter-intuitive cause and effect within a systemic structure. That night, Chris and Fred mapped the systemic structure that they could infer from what they heard implicit in the day's conversations, and the next morning it was presented to the group.

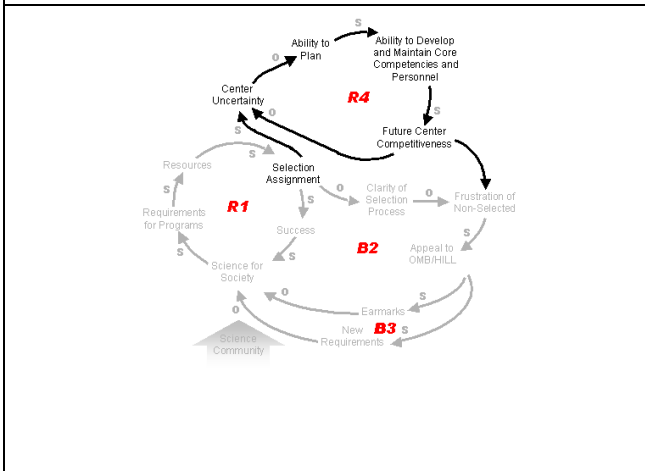
THE EARTH SCIENCES ENTERPRISE STORY

Earth Sciences Enterprise System Diagram Showing the Leverage Points

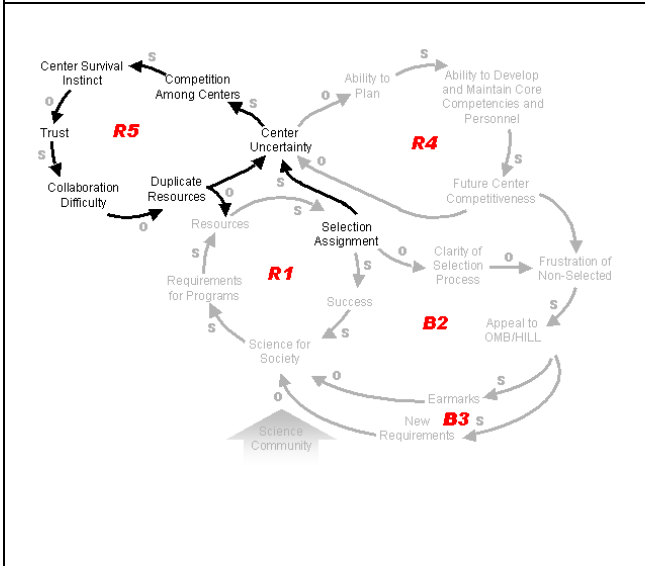




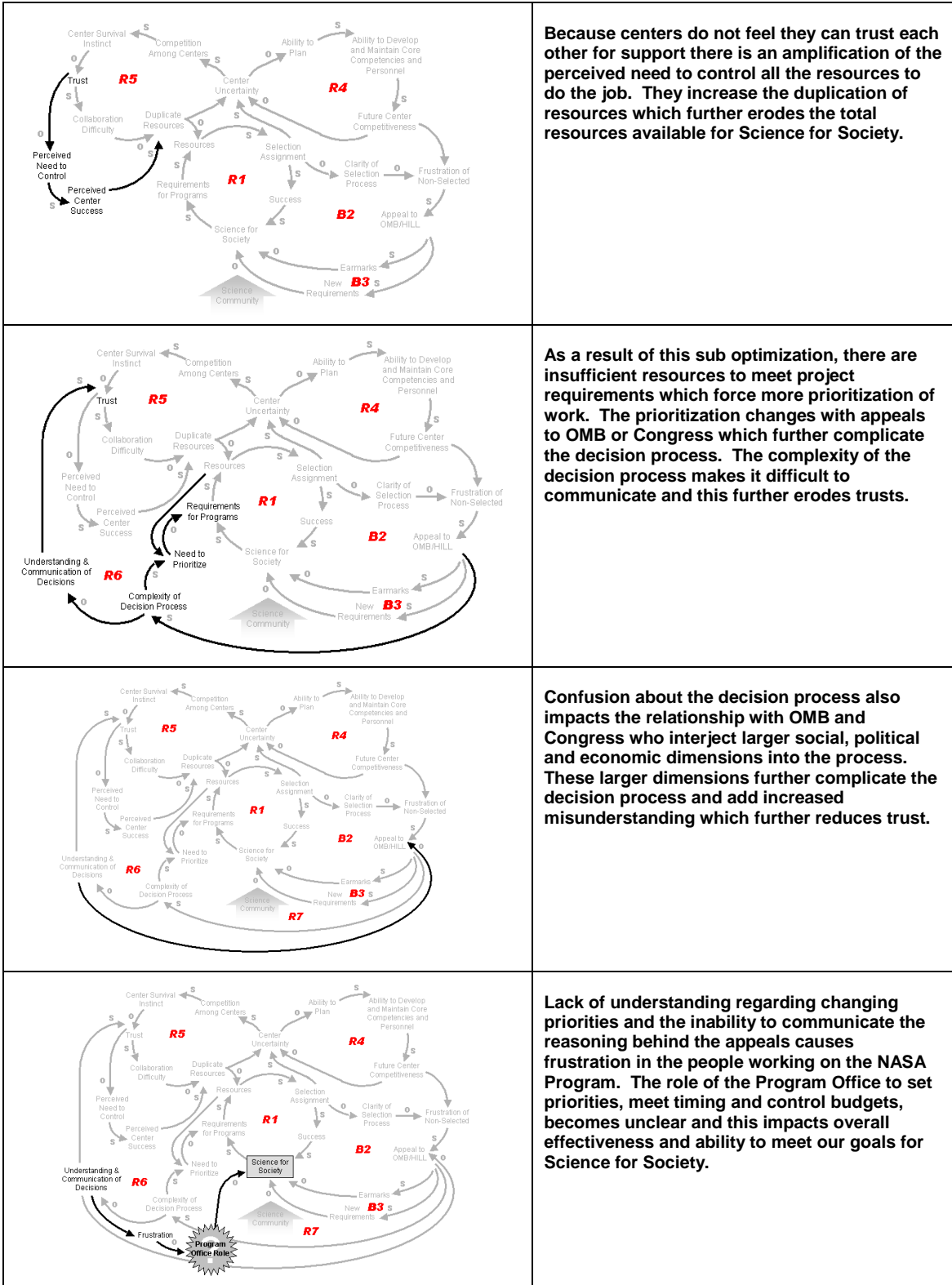
The process of how and who we select to get the job done is not always clear. This lack of clarity causes those not selected to mistrust the process. This mistrust can lead to an appeal to the Office of Management and Budget (OMB) or their Congressional Representative. An appeal can cause OMB or Congress to question whether the Agency is following its guidance. If OMB and Congress feel further guidance is needed they may respond by earmarking spending for specific purposes or add new requirements. The actions do not add resources so they frequently reduce the Agency's planned use of funds for Science for Society.



The internal response to this lack of clarity at the Center level is an increased feeling of uncertainty about their future. The more uncertainty in the process, the less centers are able to plan effectively. The less they are able to plan effectively, the more difficult it becomes to develop and maintain people and core competencies. This further reduces the Center's ability to be competitive. The perceived concern that they will be "non-selected" more often leads to further uncertainty about their future. Fear of their ability to be competitive in the future can also add them to the group of non-selected who feel a need to appeal. This further reduces the ability to meet the goals of Science for Society for the same reasons as above.



On the human side, center uncertainty created by the lack of clarity in the selection process has caused some centers to compete for every contract possible and to see each other as competitors. This competition feeds the survival instinct - those things people instinctively do for survival further erodes the ability of centers to trust each other. This lack of trust makes collaboration difficult, if not impossible. When centers feel they cannot rely on each other and that they can only survive if they take care of themselves, they make sure they are self-sufficient. This causes them to duplicate resources that could be available from other centers. The cycle continues to get worse as centers become more uncertain. When centers duplicate resources less total resources become available to the main goal of Science for Society. We end up optimizing the parts and sub-optimizing the whole.



The highest leverage areas in the systemic structure were identified as:

- How we determine, as a science and policy-making community, what constitutes “Science for Society”
- How we assign project work fairly and transparently, and
- How we measure success.

The map allowed the group to see, for the first time, that the causes for some of their most difficult issues of inconsistent priorities lack of resources, and inability to collaborate were effects of other well-intended actions.

The focus of the group changed from being victims of inconsistent direction and insufficient resources, to identifying the systemic leverage points in the map and the Mental Models behind them. Their work plan changed from fixing Program Management (a pattern solution), to finding more systemic and far reaching solutions.

Five leverage points were identified and then narrowed to three:

- Determining what is “Science for Society” and the appropriate processes and participants to establish the national and global priorities for the right scientific questions to pursue.
- Determining how we define and measure “Success” – moving from a mission or technology focus to a program focus and, ultimately, to measuring success by how well the scientific questions are answered and the answers are found useful by policy and decision makers.
- The “Selection / Assignment” process –
 - Determining what only NASA can do and assuring that the competitive bidding process does not jeopardize long-term center competencies to perform those essential functions.
 - Assuring transparency and fairness in the assignment/selection process.
 - Creating an environment where trust can be maintained between NASA and the larger scientific community, between NASA and Congress, and among the NASA Centers.

The group divided into three teams to address each of the leverage points. The questions we asked the teams to consider were:

- For each of the key leverage points, what do we want to achieve?
- What must be the Mental Models – the deep underlying assumptions behind our behavior – in the Earth Sciences Enterprise and in NASA as a whole, for us to succeed?
- What would the systemic structures have to be, consistent with the new Mental Models?
- What actions must we take to get there from here?
- Whose help do we need to achieve these actions?

The teams worked on these questions and developed some preliminary thoughts. Before proceeding, however, the teams presented the in-process results to Dr. Ghassem Asrar, the head of the Earth Sciences Enterprise on the last day of the workshop. The purpose of the presentation was to obtain agreement that we were on the right track to proceed. Dr. Asrar supported our direction, but also believed that the results of the workshop had

implications for the larger system. The systems map and team preliminary findings were taken to a NASA Leadership meeting where they were discussed and continuation of the work was supported.

The next two workshop sessions were targeted at continuing the team efforts to build high-leverage action plans for the key areas identified on the map. Our objective was to develop an integrated plan for presentation to the NASA Leadership group three months later.

The New Earth Sciences Enterprise Plan For Action

The next meeting was held on August 19, 2002 with the head of the Earth Sciences Enterprise and the Directors of all of the NASA Centers. At that meeting the team obtained an endorsement for the work they had done to date and support for the proposed next steps, including:

--Actions to improve Earth Sciences' focus on answering key scientific questions well instead of on conducting missions. These actions would include recommendations regarding how to group the key scientific questions into broader themes that can be more effectively prioritized and managed.

--Processes and organizational change recommendations as necessary to improve the Enterprises ability to mobilize in delivering the objective data needed by policy-makers and decision-makers. These recommendations will take into account that the major policy and decision requirements are rarely direct outcomes of responses to the scientific questions. Instead, they usually require input from many of the broad theme areas simultaneously.

--Implementation, as part of the Earth Sciences Enterprise strategic planning process, of an approach to identifying key center strategic capabilities that only NASA can provide and that are necessary to achieve the two points above. This would include initiating appropriate dialogues regarding capabilities and identifying an action plan to provide developmental assignments and assure project work to maintain and improve the identified capabilities over time.

--Establishing appropriate measurement processes to assure that the focus of all employees will be on success of the Enterprise rather than on success of individual missions and projects. This would include both how well the key scientific questions are answered and the degree to which decision-makers use and are helped by the information provided.

As a result of this effort to date, the Earth Sciences Enterprise realized that the changes they want to make are dependent upon shared understanding of the larger goals, improved communications and changes in behavior, and not on a particular organizational structure. With the organizational structure identified as a non-relevant

factor at this stage, the Enterprise chose to move forward using the existing structure. This decision freed the individuals in the organization to focus their energy on improving effectiveness rather than worrying about their positions.

The decision, not to change the organizational structure as a means to achieve change, is a very different response from what has traditionally been the practice at NASA. By analyzing the systems diagram discussed earlier, the Earth Sciences Enterprise realized that there are inherent barriers in their current structure. However, they also saw that barriers would exist in any structure they decided to adopt, so they chose to stay with the one they had been working in and best understood while they focused on removing the barriers.

Using our learning from this workshop, we have created new approaches that are yielding faster, more effective and apparently sustainable results.

Interview Questions

1. Tell me something about yourself, why you joined NASA and why you joined Earth Science?
2. What was it like to work here when you first came here?
3. What is it like to work here now?
 - What stories would you normally talk about in the office to friends regarding NASA and Earth Sciences today?
4. What are the goals of your organization? What is its reason for being?
5. How do your goals contribute to the goals of Earth Science? Of NASA? What are the conflicts between your goals and those of the larger organization?
6. What is your role? What do you do? How do you make a difference?
 - Who do you regard as your customers?
 - Who else needs your input?
 - Who do you work with to achieve your results?
 - Who else do you need input from?
 - Who do you regard as your best allies?
7. How do you think your role has changed over the last few years and how is it continuing to change?
 - How are things working for you before and after?
8. How do you know you have done a good job?
 - How does your boss know?
 - What is celebrated here?
 - What is rewarded? How?
 - Are there any disconnects between what they tell you is important and what is rewarded? How do you feel about that?
 - How are decisions made?
 - What would you do if you discovered that important goals were not being met?
9. What gets in the way of doing your job the best way possible?
 - Who/What frustrates you?
 - What do they do?
 - Why do you think they do that?
 - What would they say they do?
 - What would they say about you and what you do?
 - What do they do that really adds value?
10. What keeps you up at night?
 - What really worries you about what is going on in Earth Science?
 - What worries you about what is going on in the rest of NASA?
 - Who else thinks this is a problem?
11. What would you like to see change at work to make your job more satisfying and to make you more effective?
 - What would have to happen to get those things changed?
 - How could you contribute to that change?
 - Whose help do you need?