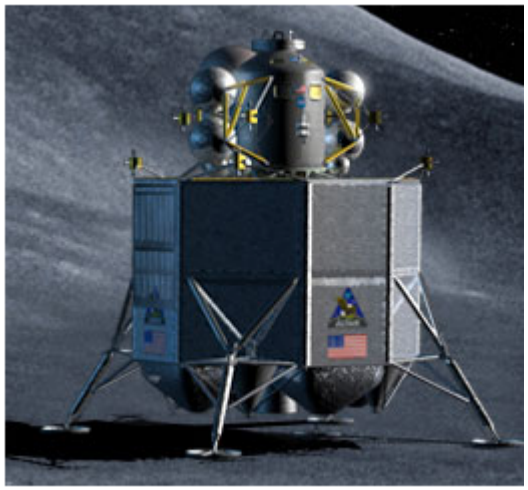
Leveraging Collective Knowledge:
NASA's Constellation Program
Nancy Dixon, Common Knowledge Associates

Every organization has the problem of how to save the knowledge it has created, but after the cancelation of the Constellation program (CxP), NASA has that problem in spades. NASA has been working on Constellation, the human space flight program that was to replace the Shuttle, for 5 years now, at a cost of 9 Billion dollars – so saving that knowledge is critical.

On February 1, 2010 the Obama administration announced the cancelation of Constellation. The administration's intention was to pay private companies to shuttle astronauts to and from the Space Station, while NASA was to turn its attention to developing advanced technologies and demonstrations, including heavy-lift propulsion research.

In the 5 years NASA worked on Constellation it accrued an enormous amount of new knowledge, for example, new habitats for astronauts living on the moon or Mars, more sophisticated space suits, and of course many new vehicles including, Ares I and V, the Orion crew capsule, and Altair Lunar Lander. With the ending of the Constellation program, the engineers and scientists who created all that knowledge were ready to disperse to other NASA projects, or in many cases leave NASA altogether to work for other organizations. Without some direct intervention the "know how" accumulated over 5 years would have been lost.



NASA learned its lesson about losing knowledge early in 1990. They experienced the sad recognition that much of the knowledge about how to build the Saturn V rocket that took the astronauts to the moon, had retired along with the engineers who had been encouraged to take early retirement. David Delong wrote about NASA' loss in **Lost Knowledge**, Oxford Press 2004.

Dave Lengyel, who headed NASA's Risk and Knowledge Management Program was committed to ensuring that Constellation's knowledge would not be lost. But the task of saving it was an enormous one. The program

was spread across NASA's ten centers from the Kennedy Space Center in Florida to the Jet Propulsion Lab on the West coast, each working on a different aspect of the program.

What Lengyel needed in order to meet his commitment, was a knowledge capture strategy that would provide direction over the next year as the program shut down. The capture strategy needed to include:

* how to identify the most critical knowledge to be retained
* effective methodologies for capturing knowledge
* how the captured knowledge should be formatted so it would be most useful to other parts of NASA or to the commercial companies that might eventually use it
* effective knowledge transfer techniques for a wide range of explicit and tacit knowledge
* an estimate of the potential cost of capturing and storing five years of work
* a way to prepare engineers with the skills to effectively capture and then transfer what they have learned

Lengyel chose to address that need by leveraging NASA's collective knowledge to create a knowledge capture strategy. He invited 35 people who had worked on the Constellation program to a two-day meeting in Huntsville Alabama for the purpose of jointly developing the knowledge capture strategy. Before arriving each had been asked to construct a knowledge map that identified and prioritized the knowledge in their part of the project. The group was given only minimal instruction in how to construct such a map, which resulted in a great variety of formats and content.

The first afternoon of the meeting, following the usual introductions and welcomes, the group did a walk-around their maps, each of which had been blown up to poster size. During their walk-around, which was formatted much like a poster session, they examined each other's maps and gained ideas about how they might revise or add to their own. They learned different ways to prioritize the knowledge, ways to illustrate levels of expertise, the need for more than one POC, etc. The knowledge map session ended with high-spirited voting for the most useful

map. Each attendee was given three dots to distribute among the maps based on what each found to be most useful. The many discussions about the merits of the maps led to a number of insights about the elements a knowledge map needed to display in order to make it a valuable tool for knowledge capture.

A second activity that same afternoon was a panel discussion of KM thought leaders, myself among them, who were asked to talk about best practices in knowledge capture and transfer from other organizations. The panel got the NASA engineers thinking about what did and did not work in other organizations and generated a lively conversation about what had worked at NASA in the past.

The next day was a day-long knowledge café, complete with all the trappings including red and white checkered tablecloths and menus. The menus had nothing to do with food, rather each menu was a list of

questions to be discussed at that table. We called the table facilitators, Sous Chefs, and the Maître D' was Dave Lengyel himself, wearing a chef's apron. The idea behind a knowledge café is for participants to have a conversation that is as open and as fervent as they would have at a sidewalk table on the streets of Paris. And that is exactly the kind of conversation that happened in Huntsville. Each table addressed a different issue related to knowledge capture and transfer, with participants moving from table to table until they had engaged in all of the topics. Each facilitator stayed at his own table to help jump-start each new conversation and to take notes on what was being said.

At the end of a very busy day a number of the engineers commented on the experience:

"I got 6-8 new things to put in my plan."

"It was huge dose of reality and grounded me in the difficulty in doing this. It needs to be carefully planned out."

"Very powerful. There were experts from different disciples and I sure took away more than I gave. The networking was good."

"I was blown away by the diversity of ideas on frameworks."

By the following morning the table facilitators were ready to formulate a draft plan based on their table discussion. A sophisticated framework for the knowledge capture emerged as well as detailed steps in the process. Even in this final step everyone in the room was able to comment and improve upon what the facilitators offered using Think Tank. The Think Tank software

enabled each person to use their own laptop to project their reactions and comments for everyone to see during the facilitators' summaries.

This meeting was an excellent example of leveraging collective knowledge and illustrates the three elements that need to be in place to make use of the knowledge that resides in the minds of those doing the work, 1) joint sensemaking, 2) cognitive diversity, and 3) organizational transparency.

1. Joint Sensemaking.

Dave Lengyel could certainly have sat at his desk at NASA headquarters and drawn up a knowledge capture strategy, but that plan would not have been able to take into account the unique aspects of each of the Center's needs. It would not have been as rich nor as comprehensive as the plan the group was able to develop together. Moreover, had Lengyel constructed it on his own, he would then have had the job of selling the plan to those who would implement it – never an easy task with a plan conceived at headquarters! The Knowledge Café gave everyone the opportunity to fully express their thinking and needs and to understand the needs and thinking of their colleagues.

For joint sensemaking to occur the leader, in this case Dave Lengyel, has to take responsibility of convening the conversation – and that task itself requires a number of skills.

- **Framing the conversation:** Before the meeting was held Lengyel had thought through what the issues were that were facing this group. Early on he provided the rationale for the meeting, then developed the topics to be addressed, and just before the meeting posed questions for the facilitators to ask.
- **Identifying who needs to be in the conversation:** In more traditional meetings people are invited on the basis of who needs to be informed. For joint sensemaking the criteria is different, it is who can inform the conversation. Lengyel convened people who had been working on the project and would therefore know the most about what needed to be captured. He also invited engineers from the space shuttle program who had already been engaged in knowledge capture for the shuttle. Others that would be tangentially impacted by the plan were invited, e.g. a CxP information systems representative, the head of CxP records management and the head of CxP security. The meeting was by invitation only - no one was required to attend - so of course Lengyel had more people wanting to come than he had room for.
- **Designing high interaction activities:** The meeting involved several different interactive processes; the walk-around and voting for the maps, the knowledge café that generated content, and Think Tank to refine the

plan.
This was the first time Lengyel had used walk-arounds, but knowledge cafés were a process he had used several times before. Several of the participants had also been involved in other knowledge cafés.

Using small groups as the unit of conversation: Smaller groups create conversations with more depth, authenticity and rigor. The café groups in Huntsville ranged from 3-7 and were different each time the group moved from table to table, which greatly enhanced networking. One of the practices of joint sensemaking is to alternate between small group conversations, where the hard work of knowledge creation is accomplished, and large group meetings where the knowledge can be integrated. This alternation was practiced and effective at the Constellation meeting.

Forging connection before content: To work on difficult issue, participants need first to gain a sense of who others are, the skills they bring, the experience they represent, and the hopes they have. Round table introductions, as useful as they are, are never enough to build the kind of

connections needed to do difficult work. The Constellation meeting started in the afternoon, with the panel and the knowledge maps, and then spent the first evening with a group dinner and drinks to that built the connections this group needed to do the hard work in the knowledge café the following day.

Configuring the physical space: One of the responsibilities of a convener is to make sure the space is conducive to the type of activity planned. As happens in many situations, the meeting space

in Huntsville turned out to be too small for the number of people who showed up. Lengyel quickly re-configured the physical space by rounding up enough patio tables so that several of the café sessions were held outside in true sidewalk café style.

2. Cognitive Diversity

Cognitive Diversity (as differentiated from identity diversity) increases the possibility that a group will generate new and more creative ideas. The inclusion of people from different disciplines provides a larger set of problem solving strategies and perspectives on an issue.

The Constellation group was naturally diverse coming, as they were, from many NASA Centers across the country. Even so their experience was limited to NASA's culture and an engineering approach to issues. By bringing in KM thought leaders, myself and Larry Prusak, Lengyel provided the group with new ways of thinking about knowledge capture and transfer. Lengyel invited in several other sources of cognitive diversity:

- Ed Hoffman from NASA's Project Management program, APPEL, who brought a social science perspective
- a representative from Lockheed (a recipient of Constellation knowledge)
- a Marshall Space Flight Center History Office representative
- a NASA Engineering and Safety Center representative
- John Adams from the Defense Acquisition University (DAU) who brought in-depth knowledge about how other government organizations have dealt with shut downs based the work DAU has been doing developing insight into smart shut downs. The cognitive diversity at the meeting made a difference. As one participant noted,

"It opened my mind. I had in my head what KM was and now I have a very different way of thinking about it."

• Organizational Transparacy

Organizational transparency is the willingness of an organization to be open both about its knowledge and its problems. It is, of course, not possible to leverage the collective knowledge of an organization unless the collective is fully apprised of the issues the organization is facing. Being a government agency funded by Congress, NASA had the advantage of all employees being

fully apprised of the pending shut down of Constellation. So in this situation a certain level of transparency was built in.

In two additional ways the meeting in Huntsville demonstrated organizational transparency. First, as just described, the meeting made itself open to ideas from outside NASA. This meant that those of us from outside became privy to the problems and complaints voiced by the participants, but more importantly allowing us to offer a new way of thinking about many of the issues participants raised.

Secondly, organizational transparency was demonstrated by Lengyel himself who was willing to say to NASA seniors as well as to participants at the meeting, "I need to draw on the collective knowledge of the organization to address this issue." The acknowledgement by leadership that "I don't have all the answers" is the pre-requisite and the first step in leveraging collective knowledge.