

Keys to Successful Partnership Aerospace Projects

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This paper reports on the lessons learned by project managers from numerous aerospace projects that involved true partnering (vs. arms-length subcontracting) between a NASA Center and a for-profit aerospace company, and will suggest specific actions to do and not do that increase the chances for mission success.

Nomenclature

TRL = Technology Readiness Level

I. Introduction³

MANY aerospace projects involve multiple organizations as a result of a need to access a diversity of expertise and disciplines and the desire of Congress to maximize outsourcing to industry.⁴ Projects that push or go beyond known technologies, or that involve technologies rated below TRL 6⁵, tend to require a particularly close partnership⁶ between organizations, because requirements and deliverables cannot be clearly specified in advance. This article reports on the findings of a study exploring the success and failure factors of partnership-based projects, as perceived by project managers who participated in them.

In the study participants' view, the success or failure of a mission almost never depends on technological factors or engineering competence. Those who work on aerospace projects almost always have been verified to have a high degree of engineering competence. The participants believed, rather, that success and failure are almost always a consequence of human factors such as how well the members of the participating organizations communicated and worked together. (Many of the participants also reported feeling surprised by this realization.)

One participant visualized the human factor as a "relationship bank account." The inevitable major problems and obstacles during development and flight can be visualized as bank account withdrawals. If the withdrawals cause an "account overdraft" a high degree of conflict between the organizations, accompanied by a lowered probability of mission success, was likely.

The study indicates that those engaged in partnership-based missions should

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³ The views and opinions expressed in this paper are those of the authors and of the individuals interviewed during the study, and not of the authors' organizations or JPL.

⁴ While this article is based on a study of projects requiring cooperation between groups from two different entities, we have found that many of the same factors apply when success requires cooperation between groups within a single organization.

⁵ TRL stands for Technology Readiness Level, a measure of how ready a technology is for flight. The range is from technology in the conceptual stage to having successfully flown on a number of missions.

⁶ In this paper the terms "partner," "partnering," and "partnership" refer to the mental context of a relationship between two organizations, not to organizations forming or operating as legal corporate partnerships. That is, regardless of the contractual arrangements, two organizations can relate as subcontractors (deliverables well specified in advance, vendor operates relatively independently of the customer) or as partners (deliverables cannot be well specified in advance, vendor and customer operate somewhat seamlessly as a single team or organization).

- 1) Take early actions that build the relationship bank account.
- 2) Act to maintain the account at a sufficiently high level during the mission.

One study does not constitute the definitive word on this topic. The results do, however, suggest that follow-up work holds promise. And they open up a new approach to improving the budget, schedule, and performance aspects of many aerospace projects.

II. The Study

The Civil Space Division of Ball Aerospace & Technologies Corp. (Ball) provides total missions, spacecraft, subsystem, and components to NASA, typically contracting through Jet Propulsion Laboratory (JPL). Ball and JPL were both interested in determining the predominant success and failure factors for space missions in which they needed to operate as a single, seamless organization. This type of relationship contrasts with a more classic subcontractor-customer relationship, in which a customer can completely specify a well-defined product in advance, such as with an off-the-shelf component, and then not be involved until delivery.

The study involved 28 confidential one-on-one interviews with project managers and executives at JPL and Ball, all of whom had participated in space projects involving a partnership of the two organizations. Some of the missions also involved other partnering organizations.

III. Summary of Findings

The following three points summarize the findings of the study:

- 1) **Mutual Respect:** Despite interpersonal and organizational conflicts, participants typically had high respect for the technical capability of the members of the partner organizations and recognized their common love of space.
- 2) **Impact of Human Factors:** People skills such as communication, building relationships, working out conflicts, and operating as a team were seen as the dominant factors in determining the success of a project. Almost all comments addressing the reasons for mission success or failure dealt with people issues. Very few comments were made about technical problems, and almost all of these were seen to have their roots and/or solution in management or people relationships. As one interviewee said, "No NASA mission in recent decades has failed because of engineering or technical incompetence. It was always a people problem."
- 3) **Impact of Jargon and Process Disconnects:** Differences in jargon and processes, such as methods for problem solving, decision-making, testing, and delivery, have a critical impact on the success of the project. For success, these disconnects between partnering organizations must be resolved early in the project.

IV. Mutual Respect

A. Findings

Regardless of individual conflicts, two strong bonds between the members of JPL and Ball tended to transcend individual conflicts: a high respect for each other's technical capability and a (mostly unarticulated) common love of space.

B. Implications of these Findings

- 1) Relationships between people in partnering organizations can be built on an existing strong foundation of mutual respect for technical ability and a common love of space.
- 2) Significant improvements in aerospace project performance are unlikely to come from improving engineering competence or increasing technical reviews.

V. Impact of Human Factors

A. Findings

People skills such as communication, building relationships, working out conflicts, and operating as a team were seen as the dominant factors in determining the success of a project. The personal relationships between the project managers from each of the partner organizations had the greatest impact on project success or failure.

One participant visualized the human factor between partnering organizations as a “relationship bank account.” Given the complexity and pressures of most aerospace missions, he said, it was almost certain that a mission was going to experience major problems and obstacles during development and flight, comparable to bank account withdrawals. If the relationship bank account is too small when withdrawals occur, an “account overdraft” results: a high degree of conflict between the organizations, characterized by blaming and finger-pointing. There are now two problems — the technical issue itself and a breakdown among people working together. This combination significantly lowers the probability of mission success. If the relationship account is sufficiently healthy when withdrawals occur, the partnership can quickly solve the problem and recover, and the mission is likely to be successful.

B. Implications of these Findings

- 1) **Establish Strong Relationships Early:** To build a reserve that can be drawn upon when the inevitable problems occur, establish strong personal and inter-organizational relationships from the very beginning of a project. One highly successful partnership spent the first six months primarily establishing how they were going to work together and building relationships. Even while working on technical problems, they used them as case studies of how to work together. Here are some of the rules this partnership established:
 - a. Establish and communicate each team member’s guiding principles, for example mission success, recognition, future business, and contractor fee.
 - b. No complaints about a partner organization. Statements such as, “Those guys at ABC are always late” are prohibited. You can talk only about specific people and specific behavior. Generalizations that cause schisms between organizations are ruled out.
 - c. In most cases partner vendors are not required to inform the customer of a problem for 24 hours, providing vendors time to analyze the situation and begin to think of solutions. This prevents the customer from leaping to conclusions, assigning blame, and intervening before giving time to the vendor for adequate investigation and thought. Teams used the 24 hours to establish a go-forward plan that, in most cases, included the vendor and customer in the solution. That put a deposit rather than a withdrawal into the relationship bank account.
 - d. All partners are invited to all project meetings except those that determine vendor performance fees. This led to openness, peer relationships, and ownership that generated proactive creative thought, particularly by the vendors.
 - e. Agree in writing how various types of decisions are to be made. For example, a document signed by all parties specified what decisions a vendor could make without informing the customer and what decisions required the customer’s prior approval. This clarified the appropriate actions in thousands of cases and reduced almost to zero accusations of acting in “bad faith,” which undermine a partnership.
- 2) **Agree on Management Baseline Upfront:** In the upfront portion of the program, all partners must define and agree on a clear baseline, including roles and responsibilities and the decision-making processes, and agree how to manage that baseline. This written agreement should also describe how changes to the baseline are to be recognized, documented, and acted upon.
- 3) **Maintain the Relationship:** Continuously address the changes needed, for example in decision-making, over the project life cycle. Relationships, like living organisms, grow and change over time. Maintaining a good relationship needs to be an ongoing topic of concern and needs to remain on the agenda for discussion and action.
- 4) **Relationships of trust are professional and personal.** Many forms of communication and trust building take place initially at the personal level. When people learn that they can depend on one another in difficult times, the personal and professional tend to overlap and reinforce each other. In a professional partnership, therefore, expect team members to limit their trust to those with the same organizational badges until trust in others develops. For example, on one project the JPL project manager (the customer) visited each partnering vendor at least one day every month, whether there was a clear topic for discussion or not. Going to the vendor was seen as a sign of respect, which enhanced the relationship, and his actions communicated the importance of maintaining a good relationship with the vendor. Furthermore, the JPL project manager saw things and people during his visits that he would not have encountered at JPL meetings. Even without a prior agenda, there was always something to talk about, and when technical issues were not at

the forefront, relationship topics often came up that would otherwise have been written off as “not important.” These topics could have caused major problems had they been left to fester.

For its part, Ball worked hard to make visiting JPL customers feel part of the team. They were provided with 24-hour access badges, desk space, and full access to computing facilities (particularly access to their JPL e-mail and printers). Enabling team members from different organizations to overcome firewalls and other obstacles and access each other’s databases promoted efficient project monitoring — and a strong relationship.

- 5) **The Critical Nature of Communication:** Clear, open, consistent, frequent, and high-quality communication is critical to establishing and maintaining the personal relationships that contribute to success. Partnerships benefit from monthly face-to-face meetings, annual retreats, and opportunities for informal social interaction, among other types of communication. Often, however, such “soft activities” are the first to be cut when budgets tighten. This study indicates that such “economies” are likely to lead to costly project setbacks.

VI. Impact of Jargon and Process Disconnects

A. Findings

Every organization, even those within the same industry, develops unique jargon and processes. These differences, if undistinguished and resolved, can cause relationship problems and incompatibilities in technical design and implementation processes.

The study uncovered major differences between JPL and Ball, stemming from these factors:

- 1) JPL is operated under contract to the government as part of a not-for-profit educational institution.⁷ Ball is a public for-profit corporation. Some within JPL felt that it was somehow “immoral” to make a profit on the space program, or illogical that one would lessen the chances of mission success by allocating money to profit rather than to decreasing risk.
- 2) Some of Ball’s jargon and processes derived from Earth-orbit missions. JPL’s jargon and processes are generally oriented to deep-space missions. For example, Ball spoke of “commissioning,” JPL of “characterization.”
- 3) JPL and Ball use slightly different processes for solving problems, a relationship disconnect which almost caused the failure of the Deep Impact mission. JPL first asks, “Regardless of cost and schedule, what is the best way to solve this problem?” Then, cost, schedule, and risk considerations are analyzed to make the tradeoffs clear. Ball tends to include cost, schedule, and risk considerations in the initial problem solution analysis. This difference led to significant conflicts and misunderstandings until the varying approaches were uncovered, understood, and resolved.
- 4) The life cycle stages of a project were considerably different.
- 5) Even a term as seemingly innocuous as “mission success” had subtle differences of meaning that caused relationship schisms and subsequent mission problems. A commitment to mission success is fundamental to both JPL and Ball. However, the differences in definition caused each organization to suspect that the other was not committed to mission success, and therefore was a danger to the mission. This led to numerous personnel conflicts, additional work and costs stemming from a lack of trust, and decisions that sometimes endangered the continuation of the mission.

B. Implications of these Findings

- 1) **Develop dictionaries:** It is useful for each partner to draw up a list of its typical jargon words and phrases and their commonly understood meanings. Making a list of the other organization’s jargon is also useful, particularly because some jargon is so deeply rooted in a corporate culture that only outsiders recognize it as jargon. After drawing up their lists, the parties spend time determining equivalent terms (sometimes subtle distinctions can be critical) and resolving what terms will be primarily used. These “dictionaries” are then distributed, discussed, and continuously updated. Updating is essential due to the problem of not knowing what you don’t know. It would have been impossible at the outset of the Deep Impact partnership to uncover the disconnect concealed in the phrase, “mission success,” but once discovered it was easily resolved.

⁷ Formally, JPL is a federally funded research and development center (FFRDC), operated by Caltech, a private, not-for-profit educational institution, under contract to NASA, an agency of the U.S. federal government.

- 2) **Uncover Process Disconnects:** A session in which each partner explains its processes, starting with the project life cycle, can shed a great deal of light, particularly if the participants listen for disconnects (versus listening for agree/disagree). Critical processes also include requirements, specification, communication, documentation, problem solving, decision-making, testing, reviews, integration, operation, management style, and completion of contract.

VII. Conclusion

To create a highly performing team that can navigate through loosely defined, incomplete requirements while uniting to achieve mission success on schedule and on budget requires addressing the relationship between the partnering organizations. Building common ground and establishing professional and personal relationships are high priorities for success. Establish success criteria for the team that include all partners. Find ways to track performance, communicate that performance, and show appreciation for a job well done. Grade the personal and team relationships in the same way you would grade a technical review.

Creating this approach is simple when people see its value: excellent team performance based on a unified approach to issue identification and resolution. Remember, a common “love of space” drives these projects. The rest can be easily coached.