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Leadership challenges in ISS operations: Lessons learned from junior and senior mission control personnel

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Abstract

The International Space Station (ISS) is operated by a multi-national, multi-organizational team that is dispersed across multiple locations, time zones, and work schedules. At NASA, mission control personnel have had to find ways to address the leadership challenges inherent in such work, but have not had systematic training on how to do so. We interviewed 12 junior controllers and 14 senior controllers to examine the major leadership challenges they face and to highlight the solutions that they have found most effective to surmount them. We compare the perspectives of the two groups. Further, we contextualize our survey results with new analyses of standardized questionnaire data from 186 mission control personnel and a contrasting group of 30 space station crewmembers. The interview data showed that respondents had substantial consensus on several leadership challenges and on key strategies for dealing with them, but junior and senior controllers' perspectives were different. The questionnaire data showed that the US mission control sample reported a level of support from their management that compared favorably to national norms. Although specific to space station personnel, our results are consistent with recent management, cultural, and aerospace research.

1. Background

The International Space Station (ISS) is operated by a multi-national, multi-organizational team that is dispersed across multiple locations, time zones, and work schedules. This is an unprecedented level of global cooperation, and mission safety is constantly at stake. At NASA, both junior and senior mission control personnel have had to be pioneers in finding ways to address the leadership challenges inherent in such work, and have not had systematic training in how to do so.

Complex as it is, operating the ISS is about to become even more challenging as additional control centers in Japan and Europe join in ISS operations. Currently, the ISS is operated bilaterally from control centers in the US and Russia. Thus, it is important to take the opportunity now to prepare the NASA team for future multilateral operations.

The goals of this study were to examine the major leadership challenges faced by NASA ISS mission control personnel and to highlight the approaches that they have found most effective to surmount them. In a previous work [1], we presented a more detailed literature review, a transcript of the structured interview questions, and detailed results from our original sample of senior controllers. The goal of the present paper is to supplement that work with a new comparison sample of

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junior controllers as well as new analyses of a different dataset that also included mission control personnel [2,3].

2. Methodology

2.1. Participants

2.1.1. Interview participants

We interviewed 14 senior and 12 junior flight controller personnel involved in various aspects of mission planning and the conduct of day-to-day operations onboard the ISS. Consistent with the demographics of the population of flight controllers, the senior sample included 13 men and 1 woman, and the junior sample included 6 men and 6 women. All 26 respondents were white, and all appeared to be from the American cultural mainstream. We did not collect specific age information, but senior controllers appeared to range in age from their 30s to late 40s, while the junior controllers were mostly in their late 20s. All participants had worked with international partner flight controller counterparts in developing ground and on-board procedures for crewmember activities. Interview participants were anonymous in the sense that records of their identities were not kept, and identifying information was removed from their data, although their identities were known to the senior author (J.L.C.).

2.1.2. Questionnaire participants

To further explore the meaning of the interview findings, we also conducted new analyses of data from a previous questionnaire study of 13 American astronauts, 17 Russian cosmonauts, and 150 US and 36 Russian mission control personnel supporting the ISS or Mir space stations. This dataset has been extensively described elsewhere [2–5].

All participants provided informed consent, and the study procedures were approved by human subjects committees at the University of California/San Francisco, and at the NASA Johnson Space Center.

2.2. Procedure

Interview participants were requested to describe their observations and perceptions of the cultural and leadership challenges associated with the job of operating the ISS. All participants received a written copy of the interview questions as well as a verbal explanation of the goals of the study. Both written and verbal responses were accepted. Additional unstructured discussion or follow-up questioning took place as needed to achieve clarity. Verbal responses were transcribed as verbatim notes by the senior author (J.L.C.). The content of the transcripts (written responses and/or transcribed verbal responses) was independently categorized by the authors into emergent themes, and the two resulting coding systems were integrated through discussion until consensus was achieved about the categories. The entire dataset was then recoded using the final coding system.

Questionnaire participants completed a standardized well-established instrument designed to measure group interpersonal climate called the Work Environment Scale [6] on a weekly basis. They endorsed statements about their work group for the previous week as either “true” or “false”. Subscales were produced for data analysis by combining the scores from nine related WES items. Differences between subgroups of respondents were assessed using a one-way ANOVA of weighted means, to adjust for the varying number of observations per person. Results from a model that included a “country x crew” interaction term are reported here for the Supervisor Support subscale.

3. Results

Interview participants were consistent and substantially in agreement in identifying key leadership challenges associated with the ISS. They identified solutions that they found to be helpful for meeting these challenges. Table 1 lists our consensus issues and the percent of respondents mentioning at least one example of the issue. Respondents gave a wealth of specific details supporting each of these items, but it is beyond the scope of this paper to present a thorough review of them.

3.1. Leadership challenges in operating the ISS

Operating the ISS involves the same fundamental leadership challenges as any large project, but here we set those aside in order to focus on the special challenges that are posed by the extra complexity of operating the ISS versus previous space missions. Participants highlighted four main types of leadership challenges.

3.1.1. Team members dispersed across sites, organizations, time zones

The first leadership challenge (noted by 100% of our senior and 92% of our junior respondents) is that team members are dispersed across sites, organizations,