Spring 2015

The Final Frontier: Preparing Astronauts for Teamwork and Leadership in Long Duration Space Missions

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BACKGROUND

As NASA pushes the edges of space exploration, the degree of autonomy afforded to the portion of the team residing in space is expected to increase due to communication delays and increased distance from Earth [1]. Therefore, it becomes imperative that teams have the leadership capacity to address the temporal dynamics of diversity and other stressors and the resulting rifts that can occur. While traditional leadership notions have focused on leadership residing within a single individual, recent views of leadership in complex environments argue for leadership being distributed within the team. Initial research has shown that shared distributed leadership facilitates team performance in complex environments. However, we do not yet fully understand how leadership may be manifested within LDDEM small teams. Here we begin to highlight the nature of leadership in isolated, confined environments through the theoretical lens of shared/distributed leadership.

PURPOSE

Investigate the nature of team leadership in isolated, confined environments

- What leadership behaviors are functional
- Structure of leadership

METHOD

- Historiometric analysis of archival data sources in isolated, confined environments
- Series of historic events which had similar characteristics of LDDEM were identified
  - Long duration ocean races
- Raters trained to extract critical incidents related to team leadership
  - Long duration ocean races (62 critical incidents)
- 2 Ph.D.s and 1 graduate student independently sorted critical incidents into categories and assigned labels. Consensus meeting held.
- 3 raters conducted a back translation of the incidents.

RESULTS

Table 1. Leadership Behaviors During Transition Phase in ICE environments

Leadership Behavior	Definition	Freq
Compose/ Restructure Team • Team Focus • Leadership Focus	Selecting a cohort of individuals who will be successful in completing the task. Includes redeploying attributes, capabilities, and replacing members (Morgeson et al., 2010)	6%
Establish Expectations/Goals	Involves establishing performance expectations and setting team goals (Morgeson et al., 2010)	5%
Structure & Plan	Involves determining or assisting in determining how work will be accomplished, who will what, and when the work will done (Morgeson et al., 2010).	11%
Train & Develop	Providing targeted training to the team through instruction or demonstration, or coaching (Morgeson et al., 2010)	3%
Sensemaking	Involves identifying, interpreting essential environmental events, and communicating this interpretation to the team (Morgeson et al., 2010)	10%
Provide Feedback	Giving, seeking, and receiving task-feedback; Providing constructive feedback regarding errors and offering advice for improvement (Cannon-Bowers et al., 2005).	5%

RESULTS

Table 2. Leadership Behaviors During Action Phase in ICE environments

Leadership Behavior	Definition	Freq
Monitor Team	Monitoring and evaluating the team's progress toward task completion, the resources available to the team, the team's external environment, and team member performance (Morgeson et al., 2010)	8%
Challenge Team	Challenging and confronting the team's assumptions, methods, and processes in an effort to find the best ways of accomplishing the team's work (Morgeson et al., 2010)	5%
Perform Team Task	Participating, intervening, or performing some of the team's task work (Morgeson et al., 2010)	5%
Solve Problems • Technical • Team	Engaging in/supporting the team in problem assessment, solution development, solution implementation (Morgeson et al., 2010)	21%
Provide Resources	Includes obtaining and providing informational, financial, material, and personnel resources for the team (Morgeson et al., 2010)	5%
Encourage Team Self-Management	This refers to those behaviors that foster team autonomy and team self management (Morgeson et al., 2010)	5%
Support Social Climate	Behaviors serving to support the socio-emotional health of the team and fostering team cohesion (Morgeson et al., 2010)	16%
Recognize/ Utilize Expertise	Recognizing and using member's expertise no matter their status.	3%
Manage Team Boundaries	Communicating and coordinating with key constituents outside of the team; buffering the team from external forces and events to integrate the team's work (Morgeson et al., 2010)	3%
Self-Management	These behaviors represent the leader's willingness and desire to engage in self-development. Self initiated.	5%

Table 3. Degree of Leadership Distribution

	Hierarchical Leadership	Shared Leadership
Compose Team	4	0
Establish Expectations/Goals	2	0
Structure & Plan	2	5
Train & Develop Team	1	1
Sensemaking	5	1
Provide Feedback	1	0
Monitor Team	2	4
Challenge Team	0	1
Perform Team Task	1	0
Solve Problems	3	10
Provide Resources	0	1
Encourage Team Self Management	2	1
Support Social Climate	5	5
Recognize/Utilize Expertise	0	2
Manage Team Boundaries	0	2
Self-Management	1	0
Total	29	33

DISCUSSION

Based upon this analysis, the following preliminary conclusions are offered:

1) Evidence was found for the hierarchical leader creating the conditions for shared leadership to emerge through behavioral modeling
2) Team problem solving, supporting social climate, structure and planning, and sensemaking most frequently used behaviors
3) Shared leadership was primarily seen in team problem solving
4) While still present boundary spanning activities become less prevalent in these environments
5) Focus on proactively readying the team to be resilient in the face of environmental change

ACKNOWLEDGEMENT: This work was supported by the NASA grant (NNX14AK54G) to Dr. Shawn Burke, Principle Investigator, Dr. Eduardo Salas and Dr. Marissa Shuffler, Co-Principle Investigators. The views expressed in this work are those of the authors and do not necessarily reflect the organizations with which they are affiliated or their sponsoring institutions or agencies.