
Factors Related to Successful Engineering Team Design

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Research Questions

- How do teams of scientists and engineers differ, if at all, from other types of teams?
- What theoretical models can we use to understand the actions of engineering teams?

Outline

- Definition of teams
- Brief Review of Team Research
- NASA Research
- Subsequent Work on Developing the Engineering Team Performance Scale (ETPS)

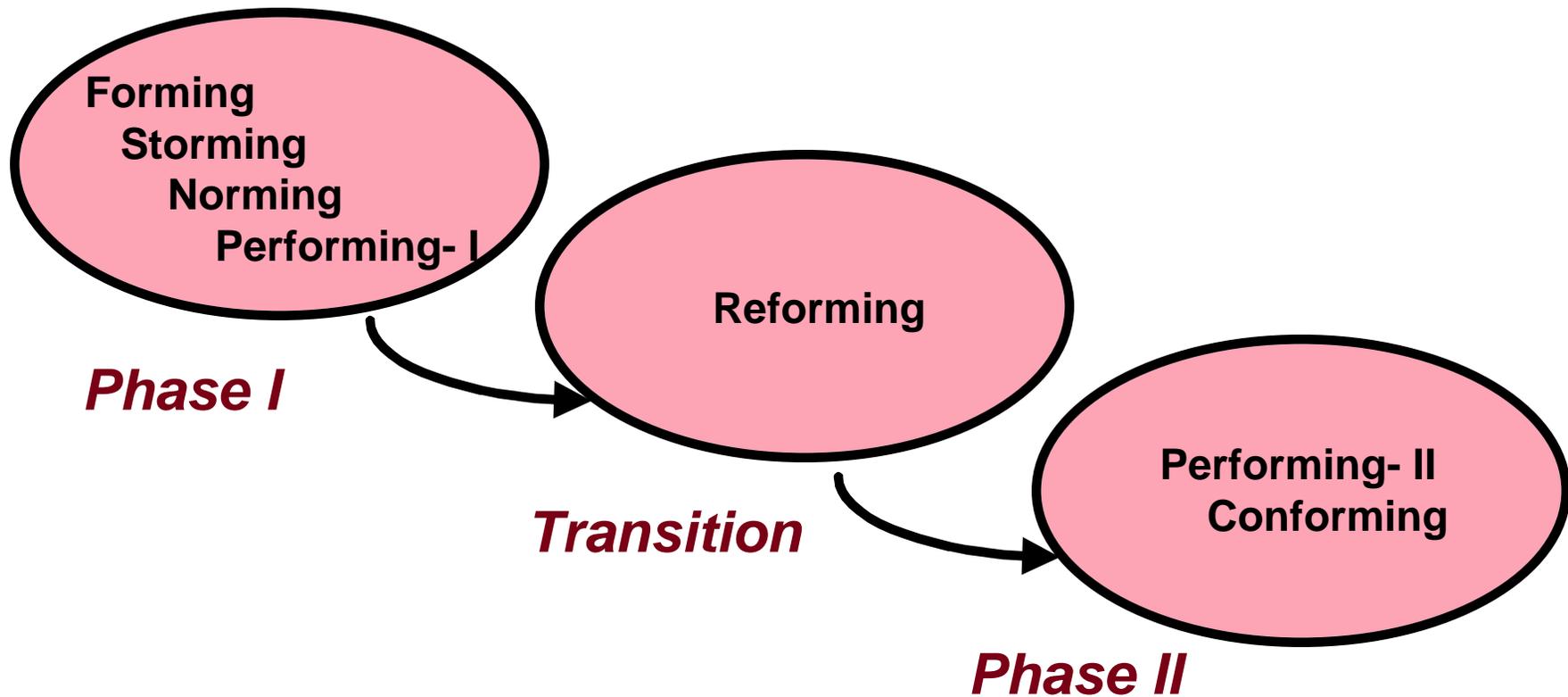
Definition of Team

- Components of a Team:
 - » two or more individuals
 - » focused on a specific problem or task
 - » require interdependent and cooperative interactions
 - » often have a specific life span
 - » mutual or shared outcome

Theories of Team Behavior

- Tuckman's "forming, storming, norming, performing, adjourning" stages.
- A "midpoint" exists in a team's existence (Gersick).
- Non-linear staging within teams (McGrath).
- Teams are "open" systems (Gersick; Morgan, et al.)

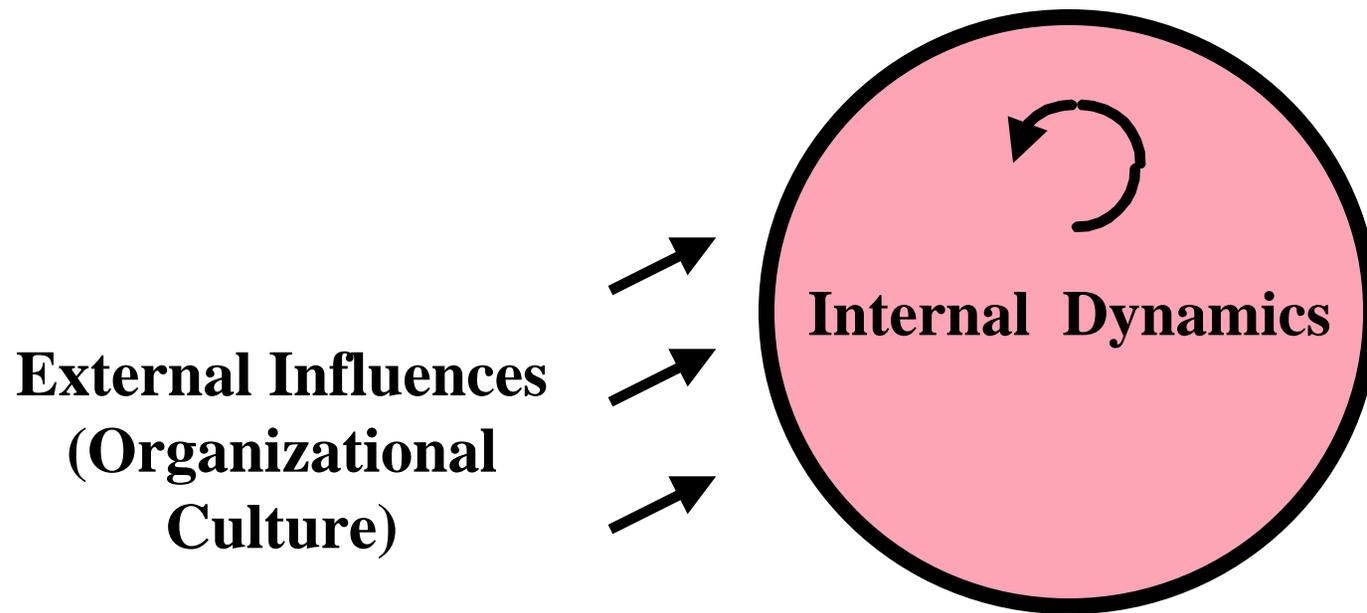
Current Approach to Team Behavior



NASA Study - Background

- Previous work indicates scientists & engineers seek “creative tensions” (Pelz & Andrews, 1976).
- NASA environment - research with potential applications in aeronautics.
- How do engineering design teams fit the current theories of team behavior?

Team Factors Examined



Survey Procedure

- Survey distributed at branch meetings.
- 49 of 91 NASA engineers & scientists responded.
- Written Survey
 - » External Influences on a Team (20 items)
 - » Internal Influences on a Team (40 items)

External Influences

- Job time allotted by supervisor for team service is appropriate. (4.69)
- Assigned job priority to team service is commensurate with team responsibility and efforts. (4.58)
- Service on the team is professionally rewarding. (4.33)
- External resources (e.g., staff & budget) are assigned to the team. (4.32)

External Resources

- Relevant information that is external to the team is available to the team. (4.43)
- Team sponsor is technically competent to evaluate team product. (4.41)
- The product or task is well-defined before the team meets. (4.23)
- Team has the ability to alter or refine its goal or product. (4.14)

Internal Team Dynamics (Team Maintenance)

- There is a sense of “team responsibility” among the team members. (4.64)
- Not all team members may agree with the approach or method taken to completing the task, but are supportive of the “team decision.” (4.30)
- The team leader is able to wear a variety of “hats” depending on the team’s needs. (e.g., from directive to facilitative) (4.12)

Internal Team Dynamics (Task Debate and Dialogue)

- The team openly and critically debates various solutions to the problem based on their scientific and technical merits. (4.51)
- The team engages in “healthy” debate over various approaches to the problem or task early on. (4.43)
- The team experiences a point during its lifetime where it steps back and critically examines where it is going. (4.35)
- Debate and critical evaluation of member ideas are encouraged. (4.29)

Internal Team Dynamics (Role of Time)

- Team members take the time to explain their ideas and methods so that team members learn from each other. (4.26)
- The team uses time to understand the technical approaches and methods of its members. ((4.02)
- The team spends time “exploring” new or potentially high-risk, high-payoff methods to completing its task. (4.00)

Conclusions from NASA Data

- Current theories on teams better explain engineering team behavior than “traditional theories:”
 - » “open” system with external influences
 - » existence of a transition point
 - » debate and conflict resolution critical to team success
- Unlike traditional business teams:
 - » greater emphasis on decision-making
 - » less emphasis on task performance

Engineering Team Performance Scale (ETPS)

- 29 items based on 7 dimensions:
 - » Team Approach to Problem or Task
 - » Team Leadership
 - » Task Coordination
 - » Organizational Support
 - » Communication & Feedback
 - » Team Roles & Norms
 - » Personal Performance on Team

Example Item from “Communication & Feedback”

- 1 Open and frank communication among team members never really developed.
- 2 Small cliques developed within the team.
- 3 Communication that occurred among team members was most often task related.
- 4 Some team members shared feelings, but others seemed to be guarded.
- 5 Communication among team members was open and fairly wide-ranging.

Scoring of the ETPS

- Calculate the Mean Rating per Item

Successful
Team

5 or less "1 & 2" Ratings

18 or more "4 & 5" Ratings

10 or more "1 & 2" Ratings

12 or less "4 & 5" Ratings

Unsuccessful
Team

ETPS Reliability & Validity

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Test-Retest Reliability (n = 22)	.95
with <i>Team Character Inventory</i> (n = 48)	.96
with Participants' Ratings (n = 48)	.80
with Team Sponsor Ratings (n = 17)	.59
with Team Leader Ratings (n = 7)	.45

Additional Issues for the ETPS

- Validating the ETPS with intact teams from NASA or industry as both a “diagnostic” tool as well as an “evaluation” instrument.
- Identifying contributions of specific items to overall team success.
- Developing web-based ETPS form.