Knowledge Foundations of Effective Collaboration*

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• What collaboration is and how it fits into NCW
• Why teams fail, with some famous examples
• How collaboration works
• What people need to know, and what happens if they don’t know
• Applying cognitive focus
A Definition
Expert Leverage Focus

- Experts integrating perspectives to better interpret the situation and problem, identify candidate actions, formulate evaluation criteria, and decide what to do

- By collaborating, the team comes up with a better solution than any one team member could working alone
• Collaboration enables teams to “make better lists”
  – Better views on what is happening, the reasons for these occurrences, and their impacts on the team mission
  – Better set of candidate actions to take in response to these impacts
  – Better set of criteria to consider when evaluating the desirability of these actions
  – Better estimates of possible consequences of the alternatives being considered
Collaboration Within the NCO Conceptual Framework

A Robustly Networked Force Enables…

Robust Physical and Information Networks

Robust Social Networks (People, Organizations and Processes)

Better Quality Networking and Information Sharing

Which can lead to …

Improved Situation Awareness/Understanding

Enhanced Collaboration/Interactions

More Agile Command and Control

Which can contribute to …

More Agile Force Elements/MCPs

Which ultimately leads to …

Dramatically Improved Effectiveness

Physical Domain
Information Domain
Cognitive Domain
Social Domain
Why Collaboration Fails

• The problem’s too hard for our team to succeed
  – EBR decides to form a basketball team, with the goal of beating the Lakers next year

• The team doesn’t know how to succeed
  – We’ll have a curling team instead, with goal of winning a game in Vienna. But the team doesn’t know how to organize and train

• The team members don’t care about the goals and don’t want to do the work
  – Who wants to do curling anyway. We want to play pinochle instead
Famous Examples of Cognitive Failures

The Bay of Pigs, 1962
A talented and intelligent policy team, but Groupthink doomed the team to an unworkable plan with disastrous results.

The Iranian airline shootdown, July 3, 1988
Well trained team on Vincennes, but misunderstandings of each others information and perspectives led to a tragic mistake.
How Collaboration Works
Knowledge-Centered Collaboration Theory

• Theory
  – Specifies the knowledge team members need to interact effectively for the benefit of the team

• Applications
  – Methodology for educating team members on teamwork, tracking team progress, alerting to problems, and recommending solutions
  – Assessing improvements to collaboration and teamwork after introduction of new tools, processes, or organization
  – Selecting collaboration tools
  – Allocating knowledge responsibilities among team members, both human and computers
Premises
Knowledge Basis for Collaboration

• Knowledge is central to collaboration and teamwork
  – Teams whose members know what they need to know can work together effectively. Those that do not are prone to various kinds of predictable errors, with the type of error dependent on the type of knowledge deficiency

• Knowledge must be distributed among members of a team
  – Everybody does not need to know everything for a team to be effective. But every team member does need to know how to get the knowledge he or she needs.

• Individuals need to know about both “taskwork” and teamwork
  – Taskwork knowledge is what team members need to carry out their tasks were they acting alone
  – Teamwork knowledge is what team members need to know to work together effectively

• The collaborative dialog helps generate the needed teamwork and taskwork knowledge
  – Team members exchange ideas to clarify issues and reach consensus to put in place the knowledge and understandings that team members must have to achieve the team’s mission.
Building Blocks of Collaboration and Teamwork

Team Set Up and Adjustment
- Form team
- Review goals
- Identify tasks
- Determine roles

Group Problem Solving
- Brainstorm
- Prioritize
- Discover differences
- Negotiate
- Reach consensus

Synchronize and Act
- Mass effects
- Lay groundwork
- Hand off tasks
- Backup
- Cue to situation

Individual and Shared Understandings
- About plan, goals, tasks, and situation
- About team members backgrounds, activities, and status
- About team status
The Central Role of Knowledge

Information → Needed Team Member Knowledge
- The twelve knowledge enablers
  - What team members need to know to work together effectively

Effective Team Behaviors
- Team synchronization:
  - Well oiled machine or Keystone Cops?

→ Product Quality or Action Effectiveness
Evaluative Knowledge—the Basis of Team Cognitive Glue

What do my teammates know?

Do they know enough?

How aligned is it with others?

Is the alignment enough?

What needs to be communicated?

How best to communicate?
The Twelve Enablers

• Represents basic cognitive foundations for effective collaboration

• At a level useful for diagnosis and recommendations
  – Deficiencies in enablers are the underlying causes of teamwork problems
  – Risks and symptoms map easily to enablers
  – Recommendations follow directly from them

• Generalizes well known critical C2 and decision functions for teams
Knowledge Enablers
Foundational Knowledge

Goals

Plans

Dependencies

Others

Business rules

Task skills
Knowledge Enablers
Real Time Understanding and Assessments

Activity Awareness

Mutual Understanding

External Situation

Plan Prospects

Task Progress

Decision Factors
Principal Enabler Dependencies

Preparation
- Objectives
- Plan
- Dependencies
- Knowing each other
- Task skills
- Interaction methods

Plan, with objectives and dependencies

Execution
- Activity awareness
- Situation Awareness
- Task Assessment
- Mutual Understanding
- Plan Assessment
- Decision Making

Activity data
Situation data
Take Action
Some Consequences of Knowledge Gaps

A team that doesn’t know where it’s going may have difficulty getting there

Chaos

People making mistakes keep making them

Can’t prioritize work or predict results of actions

Broken tasks don’t get fixed

People let them down and lose trust in one another

Team members work at cross purposes

Fights, hurt feelings, and people quitting the team

Team keeps implementing a bad plan that can’t work

Failed tasks

Bad decisions, bad outcomes, and a failed mission
Applications

• Diagnosing and fixing problems
• Metrics
• Tool selection
• Computer/robot rules
Diagnosing and Fixing Problems
Collaboration Advizor Tool

• Expert system software
  – Alerts to possible knowledge problems
  – Warns of consequences
  – Shows areas of agreement/disagreement
  – Suggests ways to improve
Metrics*

- **Infrastructure metrics**
  - How much infrastructure facilitates needed knowledge

- **Knowledge Metrics**
  - Adequacy of team knowledge

- **Behavioral symptoms of knowledge problems**

- **Criteria for product quality or action effectiveness**

*Most extensively documented in “Command Performance Assessment System” (Kirzl, Noble, Leedom)
Knowledge-Based Tool Selection

- Communication (e.g., e-mail)
  - Common support to all knowledge areas
- Common awareness tools (e.g., COP)
  - Especially important for mutual understanding
- Knowledge and document management (e.g., common document repositories)
  - Task assessment, and indirectly helps gain knowledge of others
- Management support (e.g., project management tools)
  - Plan understanding, task and plan assessment
- Group process support (brainstorming tools)
  - Task assessment and business rules
- Shared development (shared applications)
  - Task assessment and activity awareness
## Knowledge-Based Computer-Robot Roles

<table>
<thead>
<tr>
<th>Goals</th>
<th>Computers</th>
<th>People</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explicit goals associated with concrete measurable objectives</td>
<td>Unstated goals implied by cultural norms</td>
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| Business rules | Rules for distributing information, accepting edits, enforcing formal permissions | Understanding reasons for rules, so know when to break them |

| Mutual Understanding | Extent of likely agreement/disagreement based on shared information | Extent of likely agreement/disagreement based knowledge of person |
Summary

• Knowledge is essential to collaboration and teamwork

• Knowledge-Centered Collaboration Theory describes needed team knowledge

• Knowledge perspective supports
  – Diagnosing and fixing team problems
  – Collaboration metrics
  – Tool selection
  – Role allocation