The Human-Human Interaction Behind HCI: *High Performance Teamwork*

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The Organization Behind the Design

The Water Cube, National Swimming Center in Beijing

Complex problem solving in a complex team –
1. design the facility to represent the “green games”, the “high tech games” and the “people’s games”
2. use new technologies, new materials
3. Work with a culturally diverse, distributed, international team of architects and engineers (>100 engineers and specialists, spread across 20 disciplines & 4 countries)
4. But…build it in a box!

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The Outcome –
• highly innovative design and design process
• design portrays the way in which humanity relates to the water; coexistence of humans and nature; flat ceiling signifies peace and stability
• structural solution based on the formation of soap bubbles

Source: Zou & Leslie-Carter
The Team Behind the Disaster

Nov. 10, 1999: Metric Math Mistake
Muffed Mars Meteorology Mission
By Lisa Grossman in November 10, 2010 | 7:00 am |
Categories: 20th century, Disasters, Space Exploration

A disaster investigation board reports that NASA’s Mars Climate Orbiter burned up in the Martian atmosphere because engineers failed to convert units from English to metric.

The $125 million satellite was supposed to be the first weather observer on another world. But as it approached the red planet to slip into a stable orbit Sept. 23, the orbiter vanished. Scientists realized quickly, it was gone for good.

“It was pretty clear that morning, within half-an-hour, that the spacecraft had more or less hit the top of the atmosphere and burned up,” recalled NASA engineer Richard Cook, who was project manager for Mars exploration projects at the time.

A NASA review board found that the problem was in the software controlling the orbiter’s thrusters. The software calculated the force the thrusters needed to exert in pounds of force. A separate piece of software took in the data assuming it was in the metric unit: newtons.

“The units thing has become the lore, the example in every kid’s textbook from that point on,” Cook said. “Everyone was amazed we didn’t catch it.”
Move to Team Science

Studies of 19.9 million research articles over 5 decades as recorded in the Web of Science database, and an additional 2.1 million patent records from 1975-2005 found three important facts.

1. For virtually all fields, research is increasingly done in **teams**

2. Teams typically **produce more highly cited research** than individuals do (accounting for self-citations), and this team advantage is increasing over time.

3. Teams now produce the **exceptionally high impact research**, even where that distinction was once the domain of solo authors.

Sources: Wuchty, Jones, and Uzzi, 2007a, 2007b
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Move to *Virtual* Team Science

The trend toward virtual communities was *not* driven by a growth in teamwork by scientists working with other co-located scientists. Using the Web of Science database to analyze the collaboration arrangements of over 4,000,000 papers over a 30 year period, they found that:

1. Team science is increasingly composed of co-authors located *at different universities*.

2. These “*virtual communities of scholars*” produce *higher impact work* than comparable co-located teams or solo scientists.

3. This change is true for all fields and team sizes, as well as for research done at elite universities.

Source: Jones, Wuchty, Uzzi, 2008
The Successes are by Teams, but not all Teams are Successful

Study of NSF-funded project teams finds collaborations involving more universities produced fewer patents, publications, and other knowledge outcomes, especially when more than one discipline was represented in the project.

Distance & Disciplinary Differences Most Challenging

Source: Cummings & Kiesler, 2008
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Distance & Disciplinary Differences Most Challenging

But, prior experience mitigates the harmful effects of distance and disciplinary differences

Source: Cummings & Kiesler, 2008
Building the Team That Built Watson

David Ferucci led the team behind Watson, the victorious “Jeopardy” computer. “For the scientist in me,” he says, “it was an irresistible challenge.”

By DAVID A. FERRUCCI
Published January 7, 2012

THE assignment was one of the biggest challenges in the field of artificial intelligence: build a computer smart enough to beat grand champions at the game of “Jeopardy.”

When I stepped up to lead the team at I.B.M., that would create this computer, called Watson, I knew the task would be formidable. The computer would have to answer an unpredictable variety of complex questions with confidence, precision and speed. And we would put it to the test in a publicly televised “human versus machine” competition against the best players of all time.

It was not easy finding people to join the Watson team in the mid-1990s. Most scientists I approached favored their own individual projects and career tracks. And who could blame them? This was an effort that, at best, would mingle the contributions of many. At its worst it would fail miserably, undermining the credibility of all involved.
The Most Frustrating Aspects of Teamwork?

- Developing/sustaining high motivation: 51%
- Minimizing confusion/coordination problems: 41%
- Fostering creativity/innovation: 37%
- Training: 31%

Source: Thompson, Making the Team, 2010
ABC’s of Team Success

**Affect** – “Collective Feeling”
- A shared desire to succeed
- A clear, compelling direction
- Members are willing to work on behalf of the team
- Members identify themselves as part of the team
- The team identity litmus test: “Can you name it?”
ABC’s of Team Success

**Behavior**—“Collective Doing”
- Plans for how to get where the team wants to go
- Effective communication patterns
- Coordination mechanisms
- Backup behavior, mechanisms for dynamic restructuring of the task
ABC’s of Team Success

Cognition – “Collective Thinking”

• Shared understanding of the task, the team’s operating environment, roles within the team, and norms for how things get done and how members interact

• Distribution of knowledge, with an accurate understanding of who knows what

• Distribution of work, with an accurate understanding of who does what
Jump Starting ABCs: The Team Contract

- What are they?
  - Team-generated guidelines for:
    - Establishing team procedures
    - Identifying expectations

- Why do they help?
  - Sets the rules and procedures which will guide teamwork
  - Creates an environment in which team can achieve goals
  - Aligns team members conceptualizations of the of task requirements and teamwork processes

- How can you make one?
  - During your first team meeting identify teamwork procedures you can agree to follow
  - Should be as specific as possible
Evidence Behind Team Contracts

“Devoting time to laying a foundation for both teamwork (through team “charts” or “contracts”) and taskwork (performance) strategies can pay large dividends in terms of more effective team performance over time” (Mathieu & Rapp, 2009)

Teams with good performance strategies AND good teamwork strategies have the best overall performance

From Mathieu & Rapp’s (2009) study of 32 teams of master’s of business administration students competing in a business strategy simulation
Evidence Behind Team Contracts

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Teams with “bad ideas” but good contracts catch up to the “good idea” teams

From Mathieu & Rapp’s (2009) study of 32 teams of master’s of business administration students competing in a business strategy simulation.
Discussion Topics for Team Contract

- **Communication**
  - Day, time, place for regular team meetings
  - Preferred method of communication
  - How will you make decisions? (by consensus? By majority vote?)
  - Method for setting and following meeting agendas
    - Who will set up the meeting and agenda, how will team members be notified, who is responsible for keeping the team on track during meeting?
  - Method of record keeping
    - Who is responsible for recording/disseminating notes?

- **Work Quality**
  - What is a realistic level of quality for team project goals?
  - What strategies will you follow to fulfill these standards?

- **Team Participation**
  - How will you ensure cooperation and equal distribution of tasks?
  - What strategies will you use to encourage ideas from all team members?

- **Personal Accountability**
  - Expected level of individual attendance and punctuality in meetings
  - Expected level of responsibility for fulfilling team assignments
  - Expected level of communication with other team members
Meet with your team to generate a 1 page contract that includes:

- Team name
- Statement of your team’s goal
- Regular meeting time and place (Virtual? Face to face?)
- Communication plan – How will you communicate with one another? (cell phones, email, skype, gchat?)
1. A crystal clear vision for the building design, that would allow parallel streams of activity to converge quickly and accurately, and help achieve alignment and buy-in from other project stakeholders.

2. Based on this vision, a detailed strategy for internal and external communication.

3. Develop bespoke planning and monitoring systems capable of tracking the performance of such a large and geographically diverse team in real time.

4. A strategy to lead and manage a large multidisciplinary team including an unusually high proportion of very detailed analysts, capable of pulling together to deliver the fast track design of such a complex Olympic venue.

5. Ensure the Water Cube design is of the highest quality despite the speed of delivery, fully interfaced between 20 Arup disciplines and the architects, and robust enough for handover to our Chinese design partners for detailing.

6. Establish semi-independent teams to progress the design, product research, and stakeholder engagement in parallel, to remove potential pinch points from specific key staff becoming overloaded.

7. Drive a Safety in Design agenda, to proactively reduce the risks during the construction, operation and future alteration of the building. This is particularly driven by China’s poor construction safety record, and the likely accelerated timeframe for the building’s construction.

8. A risk management strategy focused on the complex and dynamic nature of the Chinese market, and ‘the management of difference’ between Chinese and Australian stakeholders.

9. Actions to ensure the contract fee and scope of services are unambiguous, clearly understood by all parties, and adhered to for the duration of the project.

Source: Zou & Leslie-Carter (2010)
Two Ways to Lead Your Team

Flawed Process

Failure Outcome

- Predictable Failure

Vigilant Process

“Unlucky”

Successful Outcome

- “Lucky” Nonreplicable success
- Predictable success

Research on Teams

Understand the determinants of multidisciplinary team success
Surveys assess teamwork
Findings will be presented at the end of the project
All findings will be anonymous, & will not affect your grade

Figure 6. Dyadic perspective on work in groups.