Teamwork: Understandings and Resources from the Seidenberg School

The CSIS Assessment Team and the Rest of the CSIS Faculty
Teamwork:
Understandings and Resources from the Seidenberg School

No matter what process engineers use to achieve their system objectives, they must form and manage an engineering team.... Software engineering curricula are getting better at teaching students how to form and work on effective teams, but many have a long way to go.

Every software team has four important roles to fill. These roles can be spread out among several people.

Peter J. Denning and Richard D Riehle
"The Profession of IT: Is Software Engineering Engineering?"
Communications of the ACM
March 2009; Vol. 52, No. 3, pages 24-26

Background

In the summer of 2006, the 11-point, "a through k" program outcomes promulgated by ABET were adopted as the learning outcomes for the Seidenberg program leading to the bachelor of science in computer science. Accompanying the technical outcomes were several on "soft skills." One of these was outcome d, the ability to function on teams working to accomplish a common goal.

Collaborative projects at that point had been a prominent part of CS312, "Research Methods in Computers and Society," and CS389, "Software engineering." In CS312, teams undertook the investigation of a hypothesis. In CS389, teams undertook the development of an application. At the suggestion of the ABET evaluators who examined the BS in CS program in Fall 2006, teamwork was added to the learning objectives for CS241, "Data Structures and Algorithms I." There, students now collaborate on a programming project. The ABET evaluators, in addition, stressed the need for a rubric that would, for students, convey the elements of teamwork skills and, for instructors, guide the assessment of teams' functioning (apart from the quality of the product). The ABET evaluators also emphasized the need to assess the program's effectiveness relative to the teamwork outcome. Both the rubric developed by the Associate Director of Assessment and CS faculty as well as the questions framed by CS Curriculum Committee for the annual summative assessment (i.e. the test given to graduating seniors) are herein.

Teamwork skills had been on the minds of Seidenberg faculty members in all departments for years before the Fall 2006 ABET visit. The CSIS Advisory Board had emphasized importance of teamwork in the early 1990s when queried about aligning the curriculum to industrial needs. Their admonition was continually reinforced as survey after survey by the National Association of Colleges and Employers rated teamwork as one of the skills most valued by employers (just trailing behind communication skills). This was the reason for introducing the collaborative Web page project in CIS101 back in 2002.
Besides being a fixture in CS389, team development projects had been the centerpiece for over twenty years in CS615 and CS616, the software engineering sequence in the masters in computer science program. The faculty regularly teaching these courses was adept at managing student collaborations, but this did not include everyone. Many faculty members, such as those likely to teach CS 241 (and CIS101), felt inadequately equipped to guide students in effective collaboration and to ferret out individuals' grades for contribution to team efforts. This was expressed on two different Assessment Days [Assessment Tracking Form for Computer Science, Spring 2007, line 11; Assessment Tracking Form for Computer Science, Fall 2007 - Spring 2008, line 32]. The upshot was a resolution to produce a written document on teamwork skills and the pertinent principles of group dynamics.

Purpose of this Technical Report

This Technical Report fulfills requests to improve the accessibility of the aforementioned document. Two other materials that may be useful in conjunction with teaching, managing, and grading teamwork are included here as well. Each must be considered a work in progress, definitely not ready for outside publication. No author is indicated on any because contributions, revisions, and extensions came from many Seiderberg faculty members over time. Several individuals, however, must be singled-out for their high level of involvement: Andreea Cotoranu, the Associate Director of Assessment in the Seidenberg School, Professor Mary F. Courtney, and Professor Charles C. Tappert.

Five pieces not included here but of interest are the reports by Professor Tappert on the team projects in the masters-level capstone classes in Computer Science and Internet Technology:


Allen Stix, Editor
A Short Primer on Techniques for Effective Teamwork

I. Prerequisites for Effective Teamwork

There are several prerequisites for effective teamwork that are so fundamental they should not need to be mentioned:

** Team members must be present for scheduled meetings at agreed-upon times.

** Email should be answered promptly; timeliness is more important than spelling, grammatical, and mechanical perfection.

** Team members must treat each other courteously; personal sentiments must not be allowed to get in the way of goal attainment. (Teammates do not need to be friends, but they do need to maintain constructive working relationships.)

** Team members must listen to what the others have to say. ("Overactive deviants" can be managed by thanking them for their observations/opinions/suggestions, adding that "we would now like to hear what the others have to say." Non-germane issues can be managed by identifying them as "currently off topic" or, less gently, as "off topic.")

II. Team Governance

Effectiveness requires decision-making and conflict resolution. Groups work best when they select a **team coordinator** who is understood to have the authority, and responsibility, for initiating communications, assigning tasks, monitoring progress, and supervision. When disagreements cannot be settled through group discussion, the coordinator is empowered to make the choice or judgment. (Power is "control over social activity." Authority is "power accepted as legitimately conferred.") The coordinator's empowerment prevents detrimental standstills. "Coordination" refers to keeping the team's members working in the same direction, and the individual accepting the role of coordinator must be proactive in doing this.

Three principles of leadership are: (1) that the leader will lead, (2) that the leader will not ask for what cannot or will not be done, and (3) that instructions are precise and requirements are definite.

Regarding 1: If the leader does not set priorities, make timely decisions, etc. a void will exit. Either progress will suffer or another individual will take the reins (and, in so doing, become the de facto leader).
Regarding 2: A precedent of non-adherence to group procedures, disregard of group decisions, and the non-completion of group-assigned tasks is equivalent to the leader’s having lost the power to lead.

Regarding 3: As a rule, people aim to please. They are deprived of this opportunity, and coordination suffers, when the jobs they have taken on are unclear.

The importance of a team coordinator is exemplified by the fact that the first job of a jury is to select a foreman.

One reason for public inaction in the face of an emergency is that no individual feels (s)he has the authority to bark orders.

To behavioral scientists, a “team” is a small, informal, task-oriented group. Small means two to maybe fifteen members. The upper limit is fuzzy, but what’s important is direct, spontaneous communication between any two individuals when meeting face-to-face. Face-to-face communication includes talking, listening, gestures, glances, nods, shakes of the head, frowns, etc. in which meanings can be transmitted from one person to another and back again.

These mechanisms are important in idea sifting. Good ideas are met with kinesics (body language) like nods and eye contact along with requests for more information and questions, all of which leads to further examination and development.

Informal means that each of the members has roughly the same status in the organization beyond the team’s confines. In other words, each individual is a student in CS241 or in CS389 or in CIS101.

If the CS241 instructor were to be in the work group with her students, this would change the team’s dynamics relative to leadership. The group would automatically expect her to be in charge. A well-known demonstration of this effect is to have the instructor walk into the classroom, say “let’s begin,” then take a seat at one of the desks. Time goes by without anything happening; in fact, the whole period can elapse without a student coming to the front and taking over.

Task-oriented means that the team exists for a specific purpose. It has something to create and deliver, a problem to solve, or a goal to achieve.

Being a group means that the team has an identity extending over a period of time. An identity denotes a shared stake in its collective success.
It is better for the leader to be chosen through a group process than appointed, especially when its members are all strangers to the instructor. A leader selected by the group is more likely to be an individual in which the team has confidence. This is important inasmuch as that will make for a larger "zone of indifference," the behavioral scientists' term for the extent to which the team accepts the leadership without conscious deliberation. The person selected will tend to high on self-confidence, sociability, determination, energy, and the information and skill related to the task. While task competence is a must, it is neither necessary nor desirable for the leader to be the primary source of instrumental (task-specific) ideas. The leader's attention should focus, foremost, on process, prioritization, decision-making, tension-management, and integration. An empirical truth is that it does not work for a single individual to supervise activity and act as the technical expert.

III. Division of Responsibility

Assigning realms of responsibility to individuals works well for getting jobs done nicely and punctually. When a specific person owns a particular sector, it is likely to be well attended.

In CIS101, where a Website on some subject is to be developed by a group, one individual may be given responsibility for the intellectual content. This person would do the background research, write the report, collect the images, and decide upon the links to be present. Another may be given responsibility for the Website itself, including creating and debugging the HTML. A helpful role is always quality control. This person takes responsibility for inspecting and providing feedback on everything: the scope and appropriateness of the content; the quality and mechanical correctness of the text; and the site's functionality and appearance.

In CS389, where a software system is to be developed, the roles could be archivist/documenter, architect/designer, implementer, and quality control.

How responsibilities are sliced-up makes little difference so long as everything that needs to be done is under someone's care. In a small team one individual may need to accept two or more roles. Three things are crucial: (i) that role-players' understand the extent of their responsibility, so they attend to all that needs to be done, but without duplicating the work being done by another; (ii) that the leader coordinates, insuring that work is turned out on time and that individuals talk to each other as needed; and (iii) an appreciation that everyone is a stakeholder and needs to pitch-in when assistance is called for -- different roles entail the different amounts of work at different times. It is common sense that teams should advantageously apply the different strengths of its member.

When assigning individuals to groups, check that the right mix of abilities is present.

It is vital that the groups, and individuals on each group, have access to necessary resources.
A good software team should have the hybrid strength of many different skills and personalities. The team should be an interlocking set of specialists held, together by a few generalists. It should never be made up solely of programmers.

Sidney Dijkstra

From: "Interview with Professor Sidney Dijkstra" by Meilir Page-Jones
http://www.wayvs.com/ws_content/alisd.html

IV. Resolving the Tension between Fostering a Constructive Climate ~and~ Grading

With all team projects, there is a concern that one or two high ability, driven students, with sufficient time will end up doing the lion's share of the work. This leads to two questions:

Does noting and rewarding the value of individuals' contributions make teams more effective and lead to strengthened engagement and increased learning? [Yes it does.]

If so, is there a technique for gauging the quality/quantity/utility/helpfulness of what respective students put into the mix, especially if groups are running in something of a black-box mode (i.e. with dynamics not transparent to the instructor)? [Yes, it's explained below.]

For long-lived groups in organizations, cooperation and effectiveness are higher when the credit for collective achievement is the same for all. This is so because competition for recognition can lead personal interests to undermine dedication to purpose and cooperation. However, other factors predominate in student teams. If one person thinks it is simply more expedient to do everything on his or her own, neither that person nor anyone else will have a team experience. The grading system should not permit this. On the other hand, suppose the team is attempting to work but there are one or two individuals who fail to do their share. Not only are the idlers not acquiring their quota of learning, but they are hampering progress and making for dissatisfaction, complaints, and quandaries about how the team is to deal with them. Gradewise, it is unfair to compensate those who do not participate appropriately on an academic par with those who responsibly extend themselves.
An excellent technique for grading teamwork, recommended by Charles C. Tappert, is the "self and peer evaluation chart" that he uses in his masters-level, capstone computer science and Internet Technology courses. The process works as follows:

The instructor grades the team's deliverable. For instance, the instructor's grade on the product could be 85%.

Each team member, individually, completes a confidential questionnaire in which (s)he rates each team member's contribution, including their own.

A rating of + means an adequate but average contribution.
A rating of ++ means an above average contribution.
A rating of +++ means a below average contribution.

Multiple + signs can be used to signify an extra strong contribution.
Multiple - signs can be used to signify an extra weak contribution.

The total number of +s assigned by a specific team member must equal the total number of -s. This, for example, prevent a team member from evaluating everyone as above average.

The chart contains a row from each team member (e.g. member 1, 2, 3, and 4) as well as column for each member's evaluations. It may look like this:

<table>
<thead>
<tr>
<th>Team Member</th>
<th>Evaluation by Team Member 1</th>
<th>Evaluation by Team Member 2</th>
<th>Evaluation by Team Member 3</th>
<th>Evaluation by Team Member 4</th>
<th>Summary</th>
<th>Grade Computation</th>
<th>Grade</th>
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<tr>
<td>1</td>
<td>+</td>
<td>=</td>
<td>+</td>
<td>+++</td>
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<td>2</td>
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<td>-</td>
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<td>--</td>
<td>85% - 6%</td>
<td>79%</td>
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<tr>
<td>3</td>
<td>-</td>
<td>=</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>85% - 2%</td>
<td>83%</td>
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<tr>
<td>4</td>
<td>=</td>
<td>=</td>
<td>-</td>
<td>+</td>
<td>=</td>
<td>85%</td>
<td>85%</td>
</tr>
</tbody>
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This chart was created by Prof. Tappert and appears in "Assessment of Student Work on Geographically Distributed Information Technology Project Teams" printed in the Proceedings of the Michael L. Gargano 7th Annual Student-Faculty Research Day, held on Friday, May 8, 2009.

There is nothing sacrosanct about the adjustment rate of 2% per + or -. In addition, columns with evaluations from others may be included as well (e.g. a project's customer or the instructor), and the team leader's +s and -s may be accorded extra weight. Teammates' evaluations may be elicited mid-way through the project as well as at the conclusion.
Professor Tappert's concluding questionnaire also asks each team member for:

- the number of hours per week (s)he spent on project work
- a description of their specific contributions
- thoughts on their strengths, and how these were used
- how their performance as a team member could have been better.

In addition to these personal questions, students are asked for general comments on things that enhanced or detracted from the team's effectiveness. These "after action" reflections extend and reinforce what was learned from the collaborative experience and supply the instructor with insights that may be used to improve the experience.
Questions for Assessing Teamwork Knowhow (Answers Circled)

1. true  false  Teams work more effectively when one member has decision-making power over the group's activities and takes responsibility for communicating, coordinating, monitoring, working out compromises, and supervising.

2. true  false  In a small, informal, task-oriented group; it is important that the individual who assumes the lead is the one who is best liked.

3. true  false  Little disagreement over new ideas among team members is an indicator that the team is working effectively toward its objective and that everyone feels comfortable interpersonally.

4. true  false  Effective teamwork requires conflict resolution and decision-making. Small, informal, task-oriented groups work best when an individual is selected to serve as a team coordinator who is understood to have the authority and responsibility for initiating communications, assigning tasks, monitoring progress, and supervision.

5. true  false  The leader's instructions should be as nebulous as possible. When they are precise, definite, and clear people feel micro-managed and recoil.

6. true  false  Effectiveness is maximized when the individual designated as leader is the group's "sociometric star" (that is, the person best liked).

7. true  false  It is usually a good idea to put different members of the team in charge of particular activities. For instance, in developing a webpage, one person might assume chief responsibility for its content. Another person might assume responsibility for the site's appearance and usability. Yet another might be in coding the HTML and other technical matters.
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<tr>
<td><strong>Rubric for Collaborative Projects -- Evaluating Team Dynamics and Products</strong></td>
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<td><strong>Team Governance</strong></td>
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<td><strong>Group cohesion</strong></td>
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<td><strong>Communication, coordination, and supervision</strong></td>
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<td><strong>Effective use of abilities and skills</strong></td>
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<td><strong>Division of labor</strong></td>
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<td><strong>Project quality</strong></td>
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