Mentoring the Project Coach: Effective Propagation of Pedagogical Techniques, Resources, and Know-How*

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A common obstacle faced by faculty serving as coaches for student teams in multidisciplinary capstone design courses is the lack of teaching paradigms that can serve as a guide when making pedagogical and team-management decisions. We have addressed this challenge by creating a document entitled IPPD Coach Guide—A Resource for Mentoring Project Teams that compiles a set of best practices and catalogs resources available in our Integrated Process and Product Design program, with the goal of enhancing the coach's effectiveness in directing the evolution of the design project and assisting students in reaching all learning objectives. The guide serves as a tool that enables the propagation of pedagogical techniques, identifies available administrative and material resources, and archives the program's historically acquired know-how. This paper describes the mechanics followed to arrive at the generation of the guide, including the methodology used for harvesting collective knowledge from the most experienced faculty coaches, using techniques ranging from a directed faculty-retreat event to systematic idea mapping exercises, and including management approaches such as a challenge-question environment and the adoption of affinity-group analysis. The guide can also be used to recruit and train new coaches, to establish policies, and to serve as a contextual framework for extramural program reviews. A brief overview of the contents of the guide is provided including succinct representative examples of the material. The guide may serve as an example tool that could be of utility to other capstone design courses interested in promoting improved uniformity in quality of pedagogical delivery and increased coach effectiveness.

Keywords: capstone design; product and process design; multidisciplinary design; mentoring; senior engineering design; capstone design pedagogy

1. Introduction

The University of Florida offers the Integrated Product and Process Design (IPPD) program [1–4] as an undergraduate capstone design course. The program lasts for two consecutive semesters spanning a total of eight months, and the students work in small multidisciplinary teams directed by a faculty member serving as design Coach. The design project is proposed and financially sponsored by an industrial partner recruited from a diverse commercial pool that includes the chemical-processing, parts-manufacturing, microelectronics, pharmaceutical, aerospace, defense, and food industries, among many others. Typically 25 projects are undertaken each year with the participation of approximately 150 students and 23 faculty coaches. In general, each coach leads only one project per academic year, but a few faculty simultaneously manage a second team. The program was launched in 1995, and since then over 2000 students representing more than 12 academic disciplines have participated in more than 360 projects, with approximately 80 industrial sponsors (over 75% of the projects come from repeat sponsors). Of the 19 faculty coaches who participated in the program in the 2010–2011 academic year, 10 have coached for 10 or more years, 4 for more than 5 years and the rest for less than 5 years. The coach leads his or her team through a design-and-build sequence for a unique product and an accompanying manufacturing process. Hence, the projects vary widely in terms of the types of the engineering knowledge that is required to execute the requested design.

Not only is the nature of the design projects very different every year, but also the composition of the student team assigned to a given coach changes in a significant fashion. The team typically consists of five to six students recruited from the chemical, electrical, mechanical and aerospace, industrial, civil, and environmental engineering disciplines, as well as from materials science, packaging, computer sciences and business majors. Each multidisciplinary team is formed in a fashion that best fits the requirements of a specific design project. As a consequence every year the coach may find himself or herself working with a team of vastly different curricular backgrounds. The IPPD Director manages the course lectures, which tend to follow classical classroom-teaching pedagogical patterns. In contrast, each coach interacts with his or her team via weekly workshops, and is hence constrained to adopt a less traditional venue for pedagogical delivery to suit the course format.

The diversity of projects and student teams poses a challenge to the coach's ability to perform his or her pedagogical duties with efficacy. For example, the coach's pedagogical and management techniques that may have led to the successful design of a new chemical-sensor in the preceding academic year may not be easily adaptable for deployment with a new team of students working on the design of a fuel-cell power generator in the current year. In addition, in a preceding year the coach may have led a team composed of students with skills closely aligned with electrical and industrial engineering curricular topics, while in the current year the students may have no such academic preparation but alternatively may be well trained to address topics more typical of the chemical and material science curricula. The coach is then faced with the need to modify his or her pedagogical approach to appropriately suit the abilities of the current team of students, a process that often involves an inefficient, and potentially ineffective, trial-and-error approach.

When teaching a course that follows the more standard paradigm of teaching and learning through the use of lectures, homework assignments, quizzes and exams, most faculty can easily make pedagogical decisions that are conducive to implementing an effective educational strategy. Such decisions may be made based on the teachers' own prior experiences as undergraduate students, when they enrolled in many conventional-format courses. Such experiential reference frame can be used by the instructor to decide whether it would be effective to teach emulating the fashion in which his or her own teachers taught. More important, this type of personal experience can reliably guide the introduction of subtle improvements based on what is perceived by the instructor as being particularly efficacious, and assist in the rejection of what is deemed to be of lower pedagogical value.

Unfortunately for the design-team coach, the IPPD capstone course at the University of Florida does not include homework assignments or exams, because the deliverables that comprise the design project take their place. In addition, the coaches do not participate in the lecture component of the course. Given that most faculty members did not have the opportunity to take as a student any courses with a structure similar to that of the IPPD program, there is therefore an absence of a reference paradigm that the coach can emulate and refine.

The pedagogical literature addressing the needs of instructors leading capstone courses is vigorously growing in content and accessibility, but it nevertheless still remains relatively small in scope and generality. Note that an instructor involved in the teaching of a standard course may easily learn, and

quickly implement, a number of pedagogical techniques well known for their effectiveness, such as cooperative-learning exercises, guided learning, mastery-progress (also known as self-paced learning), *etc.* [5]. In contrast, an IPPD coach finds that those standard techniques are not easily extrapolated for application under the constraints of a design-driven teaching environment, where many of these methodologies are simply ill suited for adoption.

The IPPD program holds weekly coaches' meetings, where pedagogical techniques of particular value to the workshop mode of student instruction are discussed. This effort, however, is only of limited impact for several reasons. First, the meetings need to address course-management issues that reduce the available time for discussion of other topics. Second, some repeat-participant coaches do not find it constructive to be redundantly exposed to a particular topic when the beneficiary may be only a first-time coach. And finally, some coaches find it impossible to attend all the meetings and may therefore miss the opportunity to become familiar with a best-practice that could be of particular usefulness for current design project circumstances.

In summary, the design-team coach faces pedagogical challenges that emerge as a consequence of radical annual changes regarding the nature of the design problem and the skill set of the student team. The coach is inhibited in his or her ability to overcome these challenges in an effective and efficient fashion because of the lack of a reference teaching paradigm readily available for emulation, and because of the relative scarcity of specific literature references. We have addressed these challenges through the creation of a document entitled *IPPD Coach Guide—A Resource for Mentoring Project Teams* [6] designed to provide a coach with rapid access to a set of best practices that can be adopted to respond to a variety of pedagogical scenarios that are in some sense unique to capstone course characteristics. The intention is to provide the coach with a tool that can assist in enhancing his or her ability to implement a more effective pedagogical experience. The feasibility of the guide-writing project was supported by our previous experience in creating another guide conceived as a resource for our industrial liaison engineers [7, 8]. Although that precedent document was of a rather reduced scope, it nevertheless served as an initial reference frame. We recognized, however, that the creation of a coach's guide was a significantly more ambitious project and hence accepted that it required a systematic development approach.

The creation of the *IPPD Coach Guide* was also motivated by other objectives. These include providing the coach with lists of all relevant program

resources available to support the teaching mission, assisting the IPPD director in recruiting new coaches who seek to be informed about the expectations of the program, and to serve as a framework that can assist extramural reviewers in conducting a meaningful analysis of the program.

2. Presentation

The creation of the guide involved the following steps: (*i*) compilation of a list of best practices, (*ii*) organization of the best practices into logical groups, and (*iii*) creation of a final document. We approached each step using systematic methodologies, as discussed below.

An IPPD faculty retreat was held in May 2009 to initiate the capture of a set of best practices. Additional goals of the retreat included fostering teamwork among the faculty (we must practice what we preach), and instilling in the faculty a feeling of ownership in the *IPPD Coach Guide*.

A graduate student who did not have prior experience with the IPPD program was present during the retreat and was charged with producing a first draft of the guide from the outline and the concepts collected from the coaches' efforts. His official role during the meeting was that of *Scribe*, with the responsibility of recording all findings. The choice of a student with no IPPD experience was made to introduce the benefit of a fresh perspective that could enable capturing details that a new participant would find particularly relevant but that a seasoned coach, or an experienced graduate student, might erroneously classify as obvious and not worthy of recording.

Approximately 15 faculty members and staff participated in the May 2009 IPPD retreat. Some of the most experienced IPPD coaches were present, providing an excellent opportunity to capture best practices directly from the practitioners. Two groups sitting on different round tables began the process of generating ideas using the Brain Writing technique [9]. Each participant wrote ideas on Post-it Notes^{TM}, which were affixed on an 11 inch by 17 inch sheet of paper. After 2 minutes, the participants in each group passed their idea sheets to a colleague located to their right, and received a sheet from another colleague with new posted ideas. The process of ideating and swapping continued for approximately 10 minutes, and then the sheets holding the idea notes were exchanged between tables. After four or five rounds of ideating and swapping, approximately 40 topic ideas were recorded.

Each table was then asked to use the Affinity Group [10] process to arrange the ideas into logical collections. After grouping the ideas, the table participants were asked to create category names for each grouping, and then arrange these names and ideas into a table of contents for the guide. Each work group presented their table of contents on a flipchart. The resulting flipcharts and raw ideas became the basis for the *IPPD Coach Guide*.

In the last thirty minutes of the retreat a small group of faculty volunteered to create a more comprehensive table of contents for the *IPPD Coach Guide*. This working group presented the table of contents to the other retreat participants and included on-the-spot modifications based on the input received.

After the retreat event the Scribe's role was changed to that of *Draft Editor*, with the assignment to write the retreat findings into an initial document and to include into that draft literature citations to a variety of mentoring and management techniques that were identified during the retreat. The Draft Editor asked for editorial contributions from all IPPD faculty, a process implemented using *Google Docs* [11], an Internet-hosted editing system that allowed storing and group sharing of the work-in-process document. This approach eliminated the practice of e-mailing drafts to multiple recipients and made available to everyone an always up-to-date file for review. A working draft of the *IPPD Coach Guide: A Resource for Mentoring Project Teams*, Release 1.0, was made available in August 2009 for use in the 2009–2010 academic year.

3. Discussion

The following sections discuss the contents and intended uses for the *IPPD Coach Guide*.

3.1 Overview of the guide's contents

The Table of Contents of the *IPPD Coach Guide* is reproduced in Appendix A.1, and selected sections of the guide are included in Appendix A.2. A publicly available copy of the complete document can be retrieved from the *Institutional Repository of the University of Florida* at the address http://ufdc.ufl.edu/IR00000413/00001. In this section we provide a succinct descriptive overview of the guide, highlighting key components.

The *IPPD Coach Guide* begins with a message from the IPPD Director outlining in brief the expectations for the coaches. Next, the roles of all IPPD stakeholders are defined, including the IPPD Director, IPPD Advisory Board, liaison engineers, and the students. A set of job titles within a student team, such as team leader, facilitator, finance and travel coordinator, webmaster, and research librarian, are specified. The next section is devoted to providing a detailed set of expectations for the faculty coach. Howe, Lasser, Su and Pedicini's survey on the content of capstone design courses

revealed that there exists 'consistent difference between faculty, student, and industry responses about importance, proficiency, and expectations' [12]. Faculty tend to deemphasize professional skills in favor of deeper technical understanding, whereas industry maintains that professional skills are fundamental to the success of employees. Furthermore, the study reports that industry's assessments of student technical and professional abilities are lower than the corresponding assessment of the same qualities resulting when students rate themselves. Therefore, establishing clear coach expectations is mandatory if the coach's natural inclinations to overemphasize technical depth are to be overcome, and the student's unrealistic self perceptions are to be tempered. This section also provides guidance on fulfilling the sometimes conflicting roles of coach and of evaluator, drawing from the best practices compiled by McManus in the 2006 book entitled *Coaching People: Expert Solutions to Everyday Challenges* [13]. Tips for staying on schedule, being an effective motivator and communicator (Berg and Szabo [14]) are also included in this section, along with a brief discussion on the benefits of allowing students to experience some failures (a process characterized as 'burn and learn') to promote effective risk taking.

The next two sections of the guide move the focus away from the formulation of expectations on the behavior of the coach, and seek to complement that approach by introducing management concepts for guiding teams, and for handling the inevitable conflicts that may arise when people are organized into groups that must complete challenging work. The management concepts section emphasizes planning. It starts by offering guidelines for running the initial team meeting, organizing and planning effective meetings, and includes tips on selecting and managing student team leaders. The Team Memory Jogger^{TM} was a particularly useful resource for identifying clear, easy-to-implement practices [15]. The conflict management section emphasizes early intervention, how to spot problems in the team, the process for 'terminating' problematic team members, and escalation procedures for addressing inactive project sponsors. The student-termination section includes a discussion on various 'team killing' behaviors that were identified by Felps, Mitchell, and Byington in their 2006 organizational behavior study 'How, when, and why bad apples spoil the barrel: Negative group members and dysfunctional groups' [16]. The authors became aware of this work following a Public Radio interview with Felps in 2008 [17].

Techniques for assessing student performance and assigning grades are defined in the next section of the guide. The evaluation guidelines, in place since the inception of the IPPD program in 1995, are consistent with those provided for the students' benefit in the course syllabus.

The last sections of the guide include descriptions of the available administrative support, including succinct descriptions of travel and purchasing procedures, and a list of computer resources dedicated to the program. The final section consists of a set of frequently asked questions. A bibliography and end-notes with citations comprise the remaining elements of the *IPPD Coach Guide*. An early version of the guide included a glossary of terms and an appendix defining expected skills and capabilities of the various student disciplines that participate in IPPD (for instance, an industrial engineering major can be expected to develop a project plan, a detailed business case, a facility layout, a quality and manufacturing plan, and a decision support application). The glossary and skills content sections were removed from the guide to reduce the length of the document. These elements will eventually be maintained on a website to be accessed through links within the guide.

3.2 Uses for the guide

The primary functions envisioned for the *IPPD Coach Guide* include use as:

1. a training resource for new coaches
2. a repository for standards of practice
3. a uniform collection of policies and procedures
4. a tool for recruiting new coaches
5. a reference framework for producing meaningful and useful program assessments by external reviewers.

The *IPPD Coach Guide* serves as a tool for the IPPD Director to train new faculty through the 'Teach-the-Teacher' paradigm. Faculty time is in short supply, and the guide provides an efficient structure for educating our coaches.

Uniform standards of practice address such items as how often should the coach meet with the team, how should the team be organized, and how should the coach provide feedback to the team. The standards of practice compiled in the guide establish a minimum set of expectations for the coach to meet.

Uniform policies and procedures address items such as how to assign grades to the team and to individuals, how to refer issues to the IPPD Director (for example, what to do if the sponsor becomes inactive), and how to deal with low performing team members. A procedure for terminating a disruptive or counterproductive team member is documented.

Potential coaches need to know what is expected of them before they commit their time, energy and talent to the IPPD program. The guide provides a structural support for enabling insightful and con-

tent-rich discussions between a newly recruited coach and the IPPD Director, helping to clearly identify the expectations for the coach.

The *IPPD Coach Guide* will also provide external reviewers with a set of standards upon which to produce meaningful and useful program assessments. We expect the guide to be an invaluable resource during the 2012 ABET assessment at the University of Florida.

4. Conclusions

A working version of the *IPPD Coach Guide* issued as Release 0 was distributed to the IPPD coaches in August 2009. In April of 2010 the guide was revised, leading to the publication of Release 1.0, including refinements motivated by experiences gained during the academic year. A first improvement was inspired on the processing of three cases involving conflict management that arose in that period of time, and that led to rewriting in a more formal fashion the guide section entitled 'Termination of Team Members' (See Section 4.4 in Appendix A.2) in a more formal fashion, placing higher emphasis on procedural steps. Reflection on the root causes of the three conflict-management cases led to a second refinement, namely, the introduction in the guide of a reference to the 2006 paper by Felps, Mitchell, and Byington [16] (see footnote *xii* in the guide), which provides an insightful and useful description of conditions that promote the emergence of dysfunctional student teams. Finally, a professional technical writer was hired to improve the aesthetics of the document, and to bring about an enhanced uniformity of style. In the period in question the guide proved to successfully fulfill one of its intended uses, namely, serving as an information platform to recruit prospective coaches who were considering joining the program in the next academic year. Two inquiries were received, and both prospective coaches reported that the guide satisfactorily addressed their key questions regarding the role they would play as coaches in an engineering program that otherwise is difficult to explain given its non-conventional operational marquee.

Feedback was solicited from all coaches participating in the program. The authors noted that coaches who for the first time joined the program in August of 2009 had completely read the guide by April of the following year, even though the guide had not been designated as required reading. In contrast, most other coaches read only selected parts, without a uniform pattern that revealed preferred themes or sections. It was commonly argued that the main reason for the relatively low use of the guide by the seasoned coaches was that the document was perceived to be rather lengthy. In an effort to reduce the document length, a glossary section and an appendix listing discipline-specific skills were excised from the guide; however, the resulting document was still deemed to be rather extensive. It is obvious that the adoption barrier imposed by the document length must be overcome to prevent a significant reduction of the impact of the guide. We intend to mitigate this adverse feature by offering an annual workshop for coaches that will present the contents of the guide with the assistance of faculty who are experienced speakers, a strategy that holds excellent potential as an effective remedial measure because our coach workshops routinely enjoy high participation.

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Appendix

A.1 *Table of Contents of the IPPD Coach Guide*

This Appendix contains the entire table of contents of Release1.0 of *the IPPD Coach Guide*, included here to describe the complete scope of the guide.

Table of Contents—IPPD Coach Guide

A.2 *Selected Excerpts from the IPPD Coach Guide*

This Appendix presents excerpts from Release 1.0 of the *IPPD Coach Guide*. More specifically, Sections 2 to 4 of the guide are provided in their entirety. Minor editorial changes have been introduced to satisfy formatting constraints.

The sections included here contain a balance of innovative components and potentially controversial elements. The complete guide in its original format can be accessed from the permanent *Institutional Repository of the University of Florida* available at the location http://ufdc.ufl.edu/IR00000413/00001, and can also be retrieved through the search engine in the repository portal http://ufdc.ufl.edu/ufirg and using the search keywords 'IPPD Coach Guide.'

2.1 *Faculty Coach Expectations*

2.1 Preamble

A pilot survey that focused on the content of capstone design courses revealed that there exists 'consistent difference between faculty, student, and industry responses about importance, proficiency, and expectations.' The **faculty** heavily emphasized technical aptitude with the understanding that professional skills 'are buried in the process of achieving the outcome.' However, the **industry** perspective showed that professional skills by themselves are fundamental to the success of employees. The **student** responses revealed that students feel proficient in both technical and professional topics. The industry respondents felt such a perspective may be inflated, given the students' limited experience. It is crucial that a mentor of the design projects understands

and takes to heart the purpose of the courses. The program has the opportunity to impart a unique blend of technical and professional skill sets to the students involved, and the mentors are a crucial link in this process of learning.[1]

2.2 Evaluator and Coach

It is important to know the various roles expected while coaching the student team. There is often a tension between the interrelated roles of the evaluator/coach:

> *As evaluator, one reviews the performance of his/her direct reports. As coach, one looks for ways to help them grow and improve. This dual role might make it hard for direct reports to be coached. A coach should be trusted to share ones weaknesses and shortcomings, but a direct report might be hesitant to confide such information for fear of admitting errors that will affect their performance evaluation. If this trend exists amongst most of the members of a group, this might have a direct impact on the ability to manage and meet the group's goals. The best way to cope with the dual roles of an evaluator and a coach is to create an atmosphere of trust. Direct reports feel comfortable sharing and opening up to those who show interest in their long-term development and provide both support and autonomy.*[2]

Consider the following expectations to help span the roles of coach and evaluator[3]:

1. **Have a positive tone.** Be sincere and clear in your intentions to help the students.
2. **Be an active listener.** Instead of listening partially while thinking of a reply, one should listen both to what the student *is* saying and what the student *is not* saying. The coach should not stay focused merely on the words, emotions, and body language, but he or she should also discern the ideas between the sentences.
3. **Ask open-ended questions.** Often times it is the *question* that determines the quality of the answer given. Open-ended questions are very helpful in inviting people to share ideas and participate. Consider the following examples of when to use open-ended questions:

   - To explore alternatives: 'What would happen if . . .'
   - To uncover attitudes or needs: 'How do you feel about our progress to date?'
   - To establish priorities and allow elaboration: 'What do you think the major issues are with this project?'

   Closed-ended questions are more direct and lead to 'yes or no' answers. They can be used in the following situations:

   - To focus the response: 'Is the project on schedule?'
   - To confirm what the other person has said: 'So, the critical issue is cost?'

2.3 Schedule

Staying on schedule is crucial. Because each student has different commitments and schedules, the team's time together is extremely valuable. Thus, maintaining a good schedule during team meetings increases the utility of that scarce resource—time. The following tips can be used to help meetings run more efficiently:

- Include times for each agenda item. One of the best paths to a productive meeting is a meeting agenda that allows the team members to know what to expect and how to best prepare for the discussions.
- Designate a person to act as a timekeeper. A team should be flexible and account for any unexpected run-off agenda items. The group should decide which discussions are acceptable to run longer than originally planned, and not cut important discussions short just to enforce the agenda. The team leader should plan the agenda to include enough time to comfortably cover each important agenda item.
- Set a good example by being on time for workshops and meetings.
- Get silent students involved in meetings by asking each team member to provide a brief weekly update, and asking for input during decision-making activities.[4]

2.4 Motivation

- Focus on positive reinforcement: 'You showed excellent initiative in testing the evaluation board. Next time, please double check that you've connected the power to the appropriate terminals.'

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[1] Howe, S., R. Lasser, K. Su and S. Pedicini, Content in Capstone Courses: Pilot Results from Faculty, Students, and Industry, *Proceedings of the American Society of Engineering Education Conference*, 2009, pg. 27.
[2] McManus, Patty, *Coaching People: Expert Solutions to Everyday Challengers*, Boston: Harvard Business School Press, 2006, pp. 43–44.
[3] McManus, Patty, *Coaching People: Expert Solutions to Everyday Challengers*, Boston: Harvard Business School Press, 2006, pp. 21–24.
[4] GOAL QPC, *Team Memory Jogger*, pg. 156.

- Provide honest feedback.
- Consider the following quote when dealing with difficult students: 'It's a shame that your peers view you as arrogant. It will limit what you can accomplish in life.'[5]

2.5 Style

- Be flexible and adaptable. Some teams respond to a more formal setting while others are comfortable with a more casual atmosphere.
- Retain individuality of style.

2.6 Special Topics & Project Details

- Be prepared to give special lectures on project-specific subjects.
- Be comfortable and informed about the engineering aspects of project.
- Review weekly progress reports before submitting to the liaison.
- Deliver anything promised to students.

2.7 Communication

- Emphasize communication with the company liaison.
- Discuss effective writing and presentations.
- Remember that this is an educational experience for the students.
- The following useful language-skill tips can greatly assist the coach in communicating with the student team:
  - Use **not-knowing skills** by maintaining a posture of curiosity and an ability to set aside one's expertise and listen.
  - Use **client's key** words to formulate students' next questions.
  - Circumvent problems and get to details of the solutions and desired changes by asking **suppose questions**: 'Suppose your frustration is resolved, what . . .'
  - Ask **difference questions** to help explore alternate solutions: 'What difference would it make? Is it different for you? Who would notice the difference?'
  - Use good **reason questions** to discover students' motivations: 'You must have a good reason to be . . .'
  - Ask **relationship questions** to help bring perspective to a discussion: 'What would your best friend say . . .'
  - Allow for disagreement without alienating others by using the **tentative language** of negotiation and collaboration: 'Could it be that you are thinking . . .'
  - **Take responsibility for change** instead of blame for mistakes.[6]

2.8 Benefits of Failure

The coach should allow students to 'burn and learn.' IPPD is an experiential learning course. As such, coaches should adopt an attitude of 'fail often to succeed sooner.' Students should be allowed to make mistakes and learn from them. Coaches should encourage student leadership and student initiative and emphasize that risk taking is expected; if students aren't making mistakes, then they probably aren't taking enough risks.

2.9 Anecdotes from Personal Coaching Experiences

Situation: The team leader is not performing, is late, and missing meetings; team morale is low.

Coach Action: During a team meeting, the coach announces, 'time to vote in a new leader,' without first confronting the underperforming student.

Result: The student did not have an opportunity to correct his performance deficiencies and was caught off guard during the team meeting. The student was embarrassed in front of his peers; his behavior did not improve, and he dropped further out of the team. A better solution would have been to confront the student privately, provide an action plan for improvement, monitor the results, and then act.

3 Management Concepts for Coaches

3.1 Initial Team Meeting

The first meeting is crucial in setting the team's tone and work ethos. The outcome of the project is often determined by what is achieved during the initial team meetings. The coach should set clear rules during the

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[5] Pausch, Randy, *The Last Lecture*, New York: Hyperion Books, 2008, pg. 68.
[6] Berg, Insoo Kim and Peter Szabo, *Brief Coaching for Lasting Solutions*, New York: W.W.Norton, 2005, pp. 75–84.

first meeting by discussing meeting minutes, weekly memos, team member roles, and responsibilities. During this time, it is beneficial to determine the team members' roles and agree upon a team purpose.

- Divide students into pairs and have them learn about their partners and then introduce each other by presenting the following information about their partners:
  - Home town.
  - Major.
  - Why they enrolled in IPPD.
  - What intrigues them about this project.
- Review with the students the project summary sheet and discuss the project's context (why it is important for the sponsor, what are the envisioned deliverables, how will the deliverables be used for the sponsor, *etc.*).
- Brainstorm ideas for a team name and logo.
- Learn details about the students by collecting the following materials from each team member:
  - Resume.
  - Brief written biography.
  - Written skills-inventory (e.g., welding, fabrication, soldering, building computers, auto/bike repair, carpentry, computer programming, writing, *etc.*).
- Establish expectations:
  - Clearly define a team purpose statement that helps establish and identify the expectations for each team member and for the team as a whole. The expectations for the team should be visible from the beginning. After expectations are decided, they should be written down and revisited during subsequent meetings.
  - Distribute the written purpose statement and discuss each of the following **14 expectations**.

  As a coach, I expect:
  1. Every team member to take initiative.
  2. Everyone to devote 10 to 15 hours a week, on average, and to provide evidence of this effort in an up-to-date design.
  3. Everyone to come to class or to alert me in advance if you cannot attend (attendance to class is a requirement to obtain a grade of A).
  4. Everyone to develop a professional attitude and demeanor.
  5. Everyone to be prepared—read the book and the Engineer Training Manual, consult the weekly schedule, and learn and practice the IPPD process.
  6. Everyone to bring design notebooks to every project activity and keep good records.
  7. Everyone to participate in project presentations.
  8. Everyone to attend all meetings and workshops and to arrive on time.
  9. Each team member to work at developing competencies in areas where they are weak (e.g., leadership, public speaking, planning, writing, analysis).
  10. Individual and team accountability.
  11. Aggressive follow up on important tasks before they become urgent.
  12. Team members to ask for help when they need it—nothing good ever comes from avoiding a problem
  13. Everyone to check email at least twice daily and to respond to all inquiries and requests in less than 24 hours.
  14. Everyone to treat IPPD like a job.

3.2 Organizing & Planning

A productive meeting can be the reason for energizing a team and giving it the momentum required to achieve success. The table given below is a general sequence of events for a successful meeting that can be used to help a new team plan its meetings.[7]

• BEFORE	• DURING	• AFTER		
• *1. Plan*	• *2. Start*	• *3. Conduct*	• *4. Close*	• *5. Follow Up*
• Clarify meeting purpose and outcomes	• Check-in	• Cover one item at a time	• Summarize discussions	• Distribute meeting notes promptly
• Select methods to meet purpose	• Review agenda	• Manage/moderate discussions	• Review action items	• File agendas, notes, and other documents
• Develop and distribute agendas	• Set or review ground rules	• Maintain focus and pace	• Plan for next meeting	• Do assignments
	• Clarify Roles		• Evaluate the meeting	
			• Thank participants	

[7] GOAL QPC, *Team Memory Jogger*, pg. 74–75.

- It is important that the meeting starts and ends on time as this shows respect to those who made an effort to be available. The meeting facilitator must be prepared to redirect discussions as needed to stay focused on the goals.
- Require meeting minutes and meeting agenda and insure delivery to the liaison within 24 hours.
  Establish weekly liaison-teleconference with the coach present.
  Conduct weekly individual team member updates.

3.3 Student Resources Available

It is the responsibility of the coach to educate the students and encourage them to use the following resources:

- The IPPD Design Stations.
- Other professors if coach/liaison does not know an answer.
- Guidelines and standards for holding meetings and preparing presentations.
- Previous team PowerPoint presentations.

3.4 Selecting and Managing the Team Leader

The team leader provides the leadership needed in a project team to accomplish the objectives and goals of the team. Thus the person chosen to fill this position should possess qualities that are conducive to achieving goals, from both a personal level and an organizational level. The team leader is also a team member and should share in the team member responsibilities. When selecting a team leader, the coach should look for the following skills:

1. Leadership skills.
2. Ability to develop people.
3. Communication skills.
4. Interpersonal skills.
5. Ability to handle stress.
6. Problem-solving skills.[8]
7. Facilitation skills.
8. Task-coordinating skills.
9. Project-management knowledge.

The coach may opt to select the team leader a few weeks after the initial meeting, after the personalities and people skills of the team members are more evident. Team leadership may also be rotated to allow all team members to learn from the experience.

4 Conflict Management

4.1 Preamble

Everyone on a team brings his or her own cultural/social backgrounds and experiences to the table, and it is only natural to have differences in opinion between team members. These differences can often lead to conflicts that can be destructive and hinder the realization of the full potential of the team; conversely, the conflicts can help in the development of new ideas and give opportunities to gain new information, bring alternatives to the table, and encourage team building. The team leaders, members, and coaches should acknowledge from the beginning that conflicts are inevitable and should reach a consensus at the initial meetings on ways to deal with conflicts when they arise.

4.2 Intervention

The coach should consider intervening if the team is not progressing satisfactorily due to problems associated with the current team leader. Offering compliments as a form of intervention can help encourage the team members to adjust behavior to align with the best interests of the team. Coaches should intervene immediately if a personal attack occurs by encouraging students to keep their comments focused on the topic at hand instead of directed towards the person with whom the disagreement occurred.[9] Also, a coach should be sure that no one is using judgmental language. If the problem persists, it should be brought to the attention of the IPPD director for further action. Do not let things slide—nothing good comes from avoiding a problem.

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[8] Gido, Jack and James Clements, *Successful Project Management,* 3rd Ed. Ohio: Thomas South-Western, 2006, pg. 304.
[9] Berg, Insoo Kim and Peter Szabo, *Brief Coaching for Lasting Solutions*, New York: W. W. Norton, 2005, pp. 227–229.

4.3 Identifying Problems within a Team

The coach should be aware of the following seven sources of conflict:

1. **Work Scope**: differences in opinion regarding how the work should be done and how much work should be done.
2. **Resource Assignment**: a lack of resources or too few team members assigned to a certain task.
3. **Schedule**: the estimated time required for the project or the sequence of tasks related to the assignment.
4. **Cost**: decisions and purchases made that may compromise budgetary guidelines.
5. **Priorities**: prioritizing multiple tasks related to the project or other courses.
6. **Organizational Issues**: the team leader and the coach are not able to set clear ground rules regarding expectations and requirements. This may be due to poor communication, lack of information sharing and untimely decision-making. Poor attendance at team meetings or advisor meetings and a lack of responsibility of specific tasks are just some of the signs of an organizational issue of a team member.
7. **Personal Differences**: natural and inevitable consequence of team settings where different people with different individual values and attitudes join together to accomplish a goal.[10] It is important for the coach to understand the difference between members who are feuding and members who are merely in disagreement. The feud may have existed long before the team existed. The coach should not make it a goal to end the feud, but to find a way to allow the team to move forward.[11]

4.4 Terminating Team Members

There are times that certain conflicts are irresolvable in the short term even after honest efforts are made. Also, the efforts invested in conflict resolution can take away valuable time from the team objectives and will likely drag down the whole team. The coach, in consultation with the team leader, is able to discharge a team member to protect the efforts and hard work of the rest of the team.

All members of the team are expected to engage fully in the project activities. Members who fail to contribute a reasonable share can be terminated from the team, in which case the terminated member will receive a failing grade in the course for the semester.

The coach may decide to begin the process of terminating a team member who does not participate in team activities; refuses to produce deliverables on time; does not maintain expectations stated by the coach; demonstrates poor attendance; conducts him or herself unprofessionally during travel; receives extremely poor team-member evaluations; or commits an act of insubordination towards the coach, director, staff, or team leader in a fashion that compromises the timely progress, quality, or the success of the project.

The coach should provide to the team member in question a written description of the unacceptable actions/behaviors and an action plan for correcting the behavior. Progress on the action plan will be monitored and if satisfactory progress is made, then the student may continue with IPPD. Otherwise, the coach will consult with the director on a course of action and call for a termination meeting at which the team members will provide feedback regarding the potential termination. Finally, the offending student will meet with the coach and the director to determine if he or she can continue with IPPD. If the student is terminated, he or she will receive an appropriate grade and will not be allowed to register for the following IPPD semester.

4.4.1 Team-Killing Behaviors

Studies have shown that the overwhelming factor influencing the ability of a team to succeed is not the collected capability of the team, nor the competence of the top performer. Instead, team outcomes are most influenced by the capabilities and behaviors of the weakest members of the team.[12] There are three key team-killing behaviors to be aware of: **the jerk**, **the slacker**, and **the depressive pessimist**.

The jerk is a know-it-all who only values one opinion—his own. The jerk undermines the confidence and cohesiveness of the team by constantly shooting down others' ideas yet rarely offering any of his own. The constant idea rejections create an uncomfortable environment and kill creativity and productive discourse.

The slacker is never prepared and does not deliver. The slacker is a no-show at meetings, or is perpetually late. The slacker may be busy texting or e-mailing during team meetings. Eventually, the slacker is not assigned any work, and the team must scramble to cover for him, taking away valuable time from other sub-projects and leaving some unfinished.

[10] Gido, Jack and James Clements, *Successful Project Management,* 3rd Ed. Ohio: Thomas South-Western, 2006, pg. 465.
[11] GOAL QPC, *Team Memory Jogger*, pg. 140.
[12] Felps, W., Mitchell, T. R. and Byington, E, How, when, and why bad apples spoil the barrel: Negative group members and dysfunctional groups, *Research in Organizational Behavior*, 2006, Volume 27, pp. 202–213.

The depressive pessimist kills any team momentum by complaining, stalling, and whining. 'Why do I have to be here?,' 'Why do I have to do this?,' 'I don't care about this project,' 'Someone ran over my cat.' Eeyore, the donkey from the A. A. Milne *Winnie the Pooh* books fits this profile. The negative energy radiated by the depressive pessimist eventually wears down the team and crushes the spirit of the group.[13]

4.5 Dealing with an Inactive Sponsor

According to the Liaison Guide, the liaison engineer needs to be available—at the least—for the weekly teleconferences and for occasional consultations with individuals on the team. If the liaison engineer is doing less than that, the coach should contact the IPPD director to intervene.

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Prior to joining UF, Dr. Stanfill spent ten years with United Technologies where he designed gas turbine hardware for fighter aircraft, served as a key resource to the Carrier Corporation New Product Development Council Steering Committee, facilitated Design for X (DFx) workshops internationally, developed business process linkages between new product development and lean manufacturing, and developed and implemented manufacturing systems software. His interests include technology transfer, product development, design education, DFx, and entrepreneurship.

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Dr. Crisalle's research focuses on the analysis and design of advanced control systems, with applications to the chemical processing industries, the design and optimal operation of fuel cells, the manufacture of integrated microelectronic devices, the growth of thin-films for photovoltaic devices, and the development of on-line measurement instrumentation. He has published over 100 scientific papers and abstracts in journals and conferences. Through his academic career Dr. Crisalle has secured major research funds from the National Science Foundation, the Department of Energy, the National Renewable Energy Laboratory, and from private industrial sponsors.

Dr. Crisalle is interested in the development and deployment of novel teaching techniques. His pedagogical projects include the design of the Virtual Control Lab, a system of hardware and software elements that permit the development of control systems useful for teaching purposes. In 2008 Dr. Crisalle was inducted into the Academy of Distinguished Teaching Scholars of the University of Florida, and throughout his career has received many distinctions for his teaching work, including the University of Florida Teacher of the Year award (2002), the College of Engineering Teacher of the Year award (2007, 2002, 1995), the Florida Blue Key Distinguished Faculty Award (2006), and the Teaching Improvement Award (1994). In 2010 he received the *Innovative Excellence in Teaching, Learning and Technology Award* from the International Conference on College Teaching and Learning.

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[13] Felps, Will, # 370: Ruining It for the Rest of Us, *This American Life from WBEX Chicago* (public radio broadcast). Aired December 19, 2008.