2006-750: COMBINING REQUIREMENTS AND INTERDISCIPLINARY WORK

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Combining Requirements and Interdisciplinary Work

Abstract

The author discusses an interdisciplinary approach to helping students learn to write a system requirements specification (SRS). This approach has been refined during use over the last three years and involves students in the first quarter of their junior year. Software engineering students enrolled in a required requirements course act as the requirements team over an eight-week period while biomedical engineering students who are ready to begin the requirements phase of their capstone design project act as clients. Each of the requirements and client teams consists of four to six members. The experience was documented in ASEE conference papers in October of 2004[1] and June of 2005[2].

Benefits of the process and its placement in the curriculum include requirements engineers and clients being of approximately equal academic and professional maturity and the clients having done substantial technology and problem domain research but no product design. Additionally, the requirements are written for a real product that the clients will design and implement over the coming 21 months.

This paper discusses methods used to foster this collaboration, including team training given to the software engineers, assignments given throughout the quarter, interim process review meetings with all involved parties, and the development of rubrics for evaluating presentations and the final SRS. Results are presented and discussed, along with a look at student assessment of the course over three years. Finally, conclusions are drawn from the third iteration of this collaboration and future work is discussed.

I. Introduction

The author has recently completed his third year teaching requirements to third-year software engineering (SE) students at Milwaukee School of Engineering. This paper discusses an interdisciplinary teaching process that has been developed over that time period by the author and his colleagues in the SE and biomedical engineering (BE) programs. In brief, realizing that SEs must often develop requirements for products outside of their core expertise, the SE faculty require their students to work with clients who are actually developing a product. Some background information, such as what requirements are and why SEs must be able to develop them, are not covered in the current work; readers interested in these topics are encouraged to see previous papers by the author and his colleagues[1, 2].

The purpose of this paper is to present and discuss the process used. To that end, all the key methods applied are presented: (1) introducing the BE client teams to requirements, (2) client team project presentations to the requirements teams, (3) team training, (4) the four assignments, (5) interim general meetings for process review, (6) informal reviews of work in progress, (7) a group presentation rubric, (8) a final report rubric, (9) student self-assessment of course outcomes, and (10) student feedback on the course.

II. Background

At Milwaukee School of Engineering, a 10-week requirements course is taken by SE students in the fall quarter of the junior year. Most of the textbook[3] is covered. The key elements of the requirements process taught, in order, are the work context diagram (showing the relationship between the product designed and adjacent systems, such as users, systems, and other products), business events (which initiate a response by "the work", the system to be designed), use cases, functional requirements, non-functional requirements, fit criteria, prototyping and scenarios, and requirements reuse.

Up to the 2002–2003 academic year, the student requirements teams, consisting of four to six members, were paired with clients from industry who the faculty had recruited to participate. A major hurdle in these projects, which lasted for about eight weeks of the term, was that in-person meetings were often difficult to arrange between the student engineers and their clients.

The SE faculty felt that it was especially important for the students to have repeated, face-to-face contact with the clients while learning the requirements process. Thus, when preparing for the 2003–2004 academic year, the SE faculty considered various groups within the university that might act as clients. The BE program includes an extended design experience that begins with readings after the freshman year, continues with one-credit courses each term through the end of the junior year and two-credit courses each term of the senior year, and culminates with the university's design project show held the day before graduation. The BE students work with the same advisor throughout the design project experience. Requirements are done early in the BE junior year, so having the junior SEs work with the junior BEs seemed ideal.

The first year of the collaboration, 2003–2004, was somewhat rough. On the end-of-quarter surveys, one SE student commented that "including outside majors adds a large layer of frustration." SE students also expressed concern that design decisions were already being made by the clients and that motivating communication was difficult as the BE students were only taking a one-credit class, while the SE students were taking a three-credit class. The SE faculty decided that clearer communication throughout the term was called for.

Two major changes were made in response to this for the following year (2004–2005). First, the SE faculty gave a presentation to the BEs very early in the quarter on requirements, the requirements process in general, and the process for this collaboration in particular. Second, a midterm debriefing was scheduled such that all involved BE and SE students faculty could attend. A third important change occurred in response to earlier curriculum changes that had propagated through; for the SEs, requirements became a four-credit course, with a two-hour lab scheduled each week that the students could use for teamwork on their projects at a time when the instructor was available.

With these changes, the second year of the collaboration went much better. The dedicated lab time was helpful for the SEs, and roughly half of the BE teams were coincidentally free during at least one hour of the lab, making meeting with the client teams easier than in the past. Requests were made when the timetable of courses was developed to schedule common times between the SE requirements and BE design class to ensure that times were available for regular joint meetings, but the faculty were informed that this coordination of class time between majors was not feasible. Positive student comments at the end of the term included "group work and interaction between BEs helpful—makes you look deeper into the problem" and "a somewhat 'real-world' lab." When asked what could be improved, comments included "start BE collaboration sooner; another BE-SE meeting to check up on process." The faculty agreed.

The major change made for the following year (2005–2006) was the addition of a second midterm debriefing. Additionally, the SE faculty had identified a need to give the students additional help in forming effective teams, so a one-hour lecture was dedicated to this early in the term.

With these changes, the third year of the collaboration seemed to improve further. Incidentally, all of the BE projects contained a major software component this year, whereas there was a mix in previous years. In addition to some of the normal assessment measurements that are taken by the SE program, it was decided that the design and introduction of rubrics for key deliverables, the final group oral presentation and the final SRS, was needed. This brings us to our current process, which is explained in more detail in the following section.

III. Methods, Results, and Discussion

Each of 10 key methods used to execute and evaluate the course and collaborative experience is presented and discussed in the following sections. Results are presented when appropriate.

A. BE Introduction to Requirements

During the first week of the quarter, the SE requirements faculty give a presentation to the BE students. This includes a discussion with the students about how they determine what is the right product to build; as students make key points, they are refined by the professor into part of the requirements process, building an overview of the process on the chalkboard. The benefits to the students are then presented (having "expert assistance" in developing their requirements and a "fresh look" by domain non-experts), along with the details of the process (assignments, deadlines, and meetings, which are a subset of what is presented below). An additional purpose of this meeting is to open the lines of communication, emphasizing to the students that in addition to their primary professor, they have additional faculty resources to call on during their requirements phase.

B. Presentation of Client Projects

At the end of the second week of classes, a one-hour meeting with all the BE and SE students is scheduled during which the BE students give brief project presentations and answer any questions from the faculty and SE students. After this meeting the SE students give their instructors feedback on which projects they would most like to write requirements for and which other SE students they wish to work with. Then, the SE faculty put the SE teams together and assign each team to a BE project, notifying the students, so that they can begin work on their first assignment, which is due two weeks after this meeting.

C. Team Training

Near the end of the second week of classes, or at the first meeting during the third week of classes, just as teamwork on the first assignment is about to begin, a lecture in the SE course is dedicated to teamwork. After presenting background material and discussing the intended benefits of teams, the four stages of team growth (form, storm, norm, perform) are presented and methods for more quickly reaching the "perform" stage are discussed. These include key constructive behaviors (reacting positively first, not poaching another member's work, and building consensus), establishing roles, a well-defined decision process, running effective meetings (use of agendas, action items, and minutes), and establishing team ground rules.

D. The Four Assignments

Four assignments are given throughout the term, with each assignment lasting two weeks and the first assignment being introduced near the end of the second week of the term. A written report is due at the conclusion of each assignment in the fourth, sixth, eighth, and tenth week. In our quarter system, the tenth week is the last week of classes and immediately precedes an exam week.

The first assignment is titled "Project Blastoff," following the process of the text[3]. This assignment includes documenting measurable project goals, identifying all relevant stakeholders, creating a work context diagram (which shows the relationship between the product and adjacent systems, such as users, systems, and other products), creating a glossary, identifying and tracking risks, and documenting project constraints. The lecture material supporting the first assignment is scheduled to occur roughly a week before the assignment, giving the students time to absorb and be quizzed on it before executing it with their clients. Their roles as elicitors who must solicit, process, document, and present problem domain knowledge are routinely emphasized to the SE students.

The second assignment is titled "Major Use Cases." Building on the first assignment, the students must list all relevant use cases and thoroughly document a few of them. Here, the emphasis is on building consensus on key interactions between the system and the user. At this stage, the use cases serve to clarify the interactions that should and must occur without unduly constraining the product to be developed.

The third assignment is titled "SRS." While writing the system requirements specification (SRS), students write the non-functional and functional requirements needed to support the previously documented use cases. In addition to their basic description, all requirements must have a rationale (an explanation of why it is needed) and a fit criterion (a binary, measurable indicator of success or failure of a solution to meet the requirement). For certain simpler requirements in which the rationale or fit criterion is inherent in the description, it does not need to be stated separately. Two of the requirements are selected for complete specification, which includes documentation of references, relevant standards, owner or technical expert, expected effects on customer satisfaction, conflicts with other requirements, and dependencies on other process artifacts (*e.g.*, use case steps).

The fourth and final assignment is titled "Final Project Report" and also includes a postmortem report. In this assignment, students must ensure that all feedback from their instructor and clients has been considered. Additionally, students are asked to evaluate and improve the usefulness of the SRS (specifically, its ability to be of use to the clients), applying techniques used in class to identify missing or ambiguous items. Finally, in the postmortem report, students must comment on their and the process' successes and failures, with an emphasis on how they will apply this information the next time they need to complete a similar task.

E. Interim Process Review Meetings

At the end of the fourth and seventh weeks, meetings were held at which all the BE and SE students were present along with all of the involved faculty. At the first meeting, the faculty asked a few questions of the students to make sure they understood the process and to find whether they had any concerns. This lead to a discussion of constraints vs. design decisions and the benefit of deferring design decisions until after the requirements are sufficiently understood. Additionally, several of the SE and BE students said that they were interested in continuing their collaboration beyond the current quarter.

At the second meeting, several options for continued project collaboration were presented to the students, including various options involving the SE senior design project, technical electives, and SE "application domain" electives, which are nine credits that must be taken in a concentrated area (*e.g.*, biomedical engineering, computer networking, accounting). Various questions about the usefulness of the activities, the workload, and what could be done better were then asked of both the BEs and SEs.

Some of the BEs noted that they found the use cases helpful for forcing them to identify key interaction issues before it is too late to easily make changes to the system. Additionally, their conversations with the SEs gave them a better understanding of what is possible in software, allowing them to think beyond what they initially and internally assumed were constraints. The BEs noted that they were generally spending two to four hours per week on their one-credit design course, with roughly half of that time spent interacting with the SEs, reviewing requirements documents, etc.

From the SEs, we learned that they think the teams should have been formed earlier than at the end of the second week and that knowing about the options for collaboration beyond the current quarter earlier would have been helpful. Some of the SEs also noted the challenge of getting everything needed (collaboration, writing, review) for each assignment in a two-week window. They noted that the need to establish a timeline was presented during the team training, but that the professors should have emphasized this point even more heavily. Additionally, the SEs were curious about how useful their documents were to the BEs. The author passed along to the students that many of the BE teams had used the requirements artifacts and had given credit to the SEs in funding proposals they had recently submitted. The other SE instructor noted that, in industry, requirements engineers often wonder how their document is used during development, implementation, and testing; sometimes the document is not used sufficiently. Thus, the SE faculty plan to follow up with the BE faculty and students in the coming quarters to determine how useful this collaboration was in the overall project.

F. Informal Reviews of Work in Progress

The weekly two-hour lab meeting, available for the two most recent offerings of the course, allows the SE professors to informally but carefully review the work in progress of the students. Sometimes this means marking up a printout of a key part of document (a couple of use cases, several requirements, etc.) and other times it means discussing the overall structure of the work (whether a use case should be split into two, whether a particular item is a constraint or a non-functional requirement, etc.). Some of these items are readily offered as questions by the students, but for the less proactive students, the professors initiate these informal reviews with students.

In some other classes, most notably senior design, many professors are moving to mandatory, formal reviews of documents two to three days before they are due. These reviews are essentially ungraded, but a penalty is assessed if the review version is late or if it is substantially incomplete. Students overwhelmingly respond positively to this opportunity to get detailed feedback on the quality of their work before a grade is assigned. However, given all the milestones and coordination that the teams must do in each two-week period, the faculty were reluctant to introduce mandatory, formal document reviews in the requirements class.

G. Group Presentation Rubric

Each SE student team is required to give a 15–20 minute presentation that counts for 5% of the course grade. In this presentation, they summarize the goals and context diagram before presenting a few functional and non-functional requirements, with an emphasis on how the requirements can be traced back to use cases, goals, etc.

In an effort to increase the actual and apparent objectivity of the evaluation of the presentation, and to let students know, very specifically, how they will be evaluated, a group presentation rubric was developed [Appendix A]. This rubric was created by modifying one that the author developed for senior design presentations and which has been in use for nearly two years. Three requirements-specific sections were added: Use Case(s), Functional and Non-functional Requirements, and Postmortem Report. The students were evaluated on 10 criteria; from early versions of the senior design rubric, we learned that more criteria become cumbersome for rating an oral presentation. For six of the criteria, one score is assigned for the entire team, while individual scores are assigned for the other four criteria. Each criterion has a weight, allowing a numeric average to be computed for each team. Many faculty map this average to a 0–100 score. The rubric is a summative assessment tool and has two main uses: course-level assessment (a somewhat objective method of comparing student achievement across years) and determination of student grades.

H. Final Report Rubric

For the same reasons that a rubric was developed for group presentations, one was developed for the final report [Appendix B]. It was developed from first principles for a requirements final report. As with the previous rubric, it was provided to students well in advance of the assignment due date so that they could focus their work on what the instructors considered important. And, again, faculty using the rubric have the option of establishing a direct mapping of rubric scores to assignment scores, potentially easing their grading process. The faculty member who used this new rubric during the 2005–2006 offering of the course found that it significantly reduced his grading effort, while not seeming to reduce the quality of the feedback provided; additionally, he felt that it made it easier to objectively and fairly evaluate multiple reports.

I. Self-assessment of Course Outcomes

Our assessment process includes a student self-assessment of course outcomes. Per the process, this does not need to be completed every year. For the requirements course, it was completed in the first and third years of the BE collaboration. These results are summarized in Figure 1.

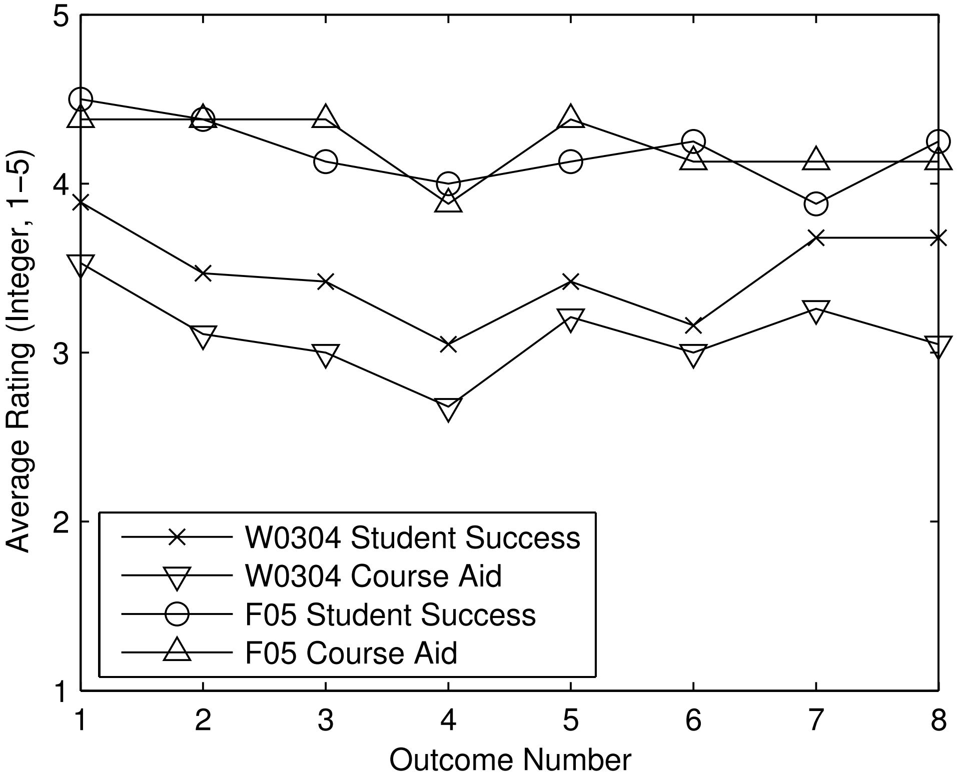

Figure 1: Self-assessment outcomes for the first and third offerings with a joint BE-SE project. Our assessment process did not require collecting data for the second offering. The range of standard deviations is 0.52 to 0.99. In the first offering, 19 of 20 students replied, while 8 of 12 students replied for the third offering. The same electronic survey process was used in each case and students were notified that not completing the survey would result in a small deduction on their final exams. There appears to be a significant increase in both perceived success and perceived aid offered by the course. Beyond the small samples, a confounding factor is that the first offering was team taught (perhaps this had a negative effect) while the second offering was taught by a single lecture instructor. The scales used and the eight outcomes are documented in previous work[1], but they are not relevant for this high level evaluation, so they are not included here.

J. Course Improvement Questionnaire

Our assessment process also includes a survey of the students regarding the course and instructor for every offering. This survey is administered via a paper form during the final week of class. The results for the three offerings are summarized in Figure 2.

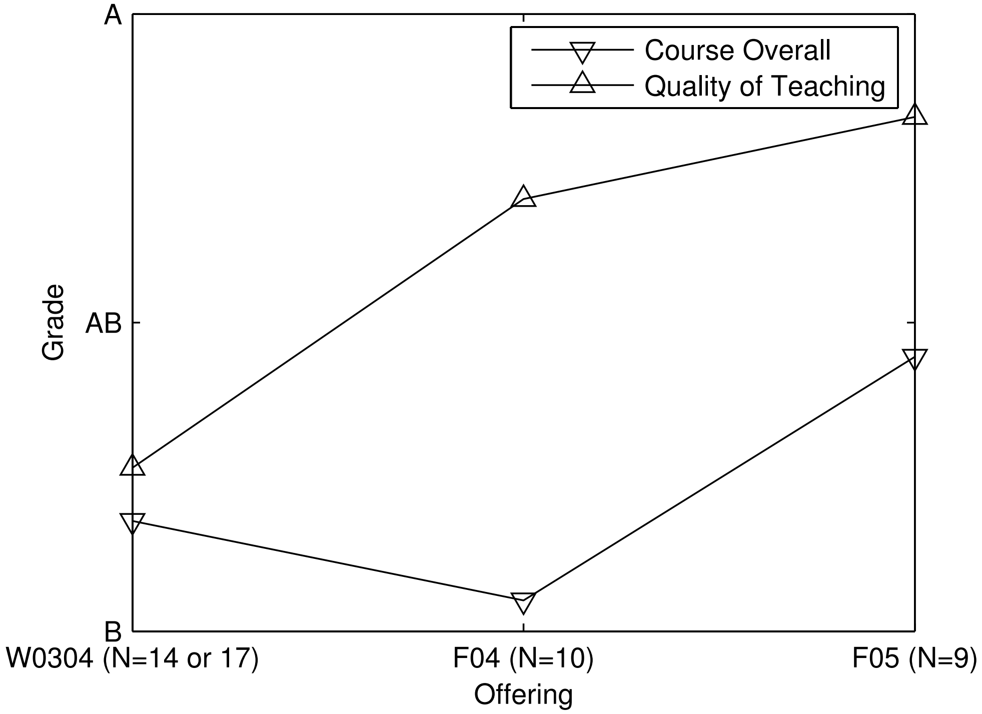

Figure 2: Student assessment of the course and of quality of teaching for all three offerings. Students rank each item using grades on a half-letter scale (A, AB, B, BC, etc.). The range of standard deviations is 0.25 to 0.70 (the highest standard deviation decreases to 0.45 with little effect on the mean if the highest and lowest value in each category/offering combination are ignored). In the first offering, 17 of 20 students replied (although only 14 provided a "course overall" rating), while 10 of 13 students replied for the second offering, and 9 of 12 students replied for the second offering. There appears to be a slight significant increase in each category, but, surprisingly, the major improvement did not occur in fall 2004, when the most significant process changes were made. Beyond the small samples, a confounding factor is that the first offering was team taught.

IV. Conclusions

It is worthwhile to measure the success of a course and improvements made to it in a variety of ways. We consider the following types of measures here: (1) student evaluations, (2) faculty evaluations of specific student work products (*e.g.*, SRS), and (3) faculty evaluations of student learning (*e.g.*, oral and written tests). Regarding evaluations by students (1), the data strongly suggest that, taken together, the improvements made over the last three offerings of the course resulted in significant increases in student evaluations of their own performance and of the course. Evaluations of student work products (2) are problematic due to the small sample size; notwithstanding this, rubrics were implemented in the most recent offering that may enable us to make these kinds of measurements. Regarding (3), different final exam methods were used during each offering (common final between sections with and without team teaching and a non-common final exam), making any comparison of final exam results across years highly suspect. Similar issues exist for the midterm exams.

V. Summary and Future Directions

The first of the three types of measures discussed above seems to indicate a fair probability that the collaboration process is working well and has improved learning outcomes as perceived by the students. Additional measures are desirable and the developed rubrics, which over time will provide data of the second form discussed above, seem likely to provide this. In addition to pursuing application of the presentation and final report rubrics, followup with the BE clients and their advisors as they complete their design projects as discussed in III-E may provide additional data regarding the quality and usefulness of student work products.

Bibliography

1. D. Suri and E. Durant, “Teaching Requirements through Interdisciplinary Projects,” in Proc. ASEE North Midwest Regional Conference, CD-ROM, Milwaukee, WI, 2004.
2. D. Suri and J. Gassert, “Gathering Project Requirements: A Collaborative and Interdisciplinary Experience,” in Proc. ASEE Annual Conference, CD-ROM, Portland, OR, 2005.
3. S. Robertson and J. Robertson, Mastering the Requirements Process, Addison-Wesley, 1999.

Appendix A

MSOE SE-3821 Requirements Group Presentation Rubric

Date and Time:	Wednesday 9 November 2005 9:00 AM
Team:	I Just Want to Immobilize Your Hand
Advisor:	Dr. Durant
Evaluator:	Dr. Durant

						Name:	John	Paul	George H.	Ringo	Yoko	George M.
	Beginning - 1	**Developing - 2**	**Accomplished - 3**	**Exemplary - 4**	**Team or Individual?**	**Weight**	**Member 1 Score**	**Member 2 Score**	**Member 3 Score**	**Member 4 Score**	**Member 5 Score**	**Member 6 Score**
Group Balance and Rapport	One main speaker; members show annoyance or dissatisfaction with other members	Most group members participate; members are civil but uncoordinated or awkward	All group members have significant participation; members are comfortable with each other	Well-balanced participation by all group members; members are in sync with each other	Team	10%	2	2	2	2	2	2
Comfort, Delivery, and Articulation	Speech and physical mannerisms clearly indicate nervousness or extreme discomfort	Reasonably fluid, but noticeably nervous, fidgeting, some distracting speech mannerisms	Fluid, few nervous mannerisms, little to no fidgeting	Confidence-inspiring comfort, articulation, and flow	Individual	5%	1.2	2.3	4	3.5	1.2	3.8
Audience Awareness	Mostly unaware of audience	Minimal eye contact	Presence and direction shown towards audience	Audience is involved (at least mentally) in presentation	Individual	5%	1.2	2.3	4	3.5	3.2	3.8
Background, Goals, and Work Context	Minimal background pertaining to project point-of-view presented, goals and context mostly incomplete	Some background given but significant pieces missing, goals and context incomplete	Background adequate, goals and work context sufficient to support presentation	In-depth, appropriate information leads audience into the rest of the presentation	Team	10%	3	3	3	3	3	3
Use Case(s)	Do not reflect primary business events	Appropriate in scope, but superficial in detail, not providing enough information for design. Or, the UCs specify significant design constraints that are unjustified.	Purpose of the UC is clear and there is sufficient detail to support clear Rs, but some key items are missing. UCs cover most major functionality. Unjustified design constraints are kept to a minimum.	UCs are clear and present a solid basis for requirements, without specifying design.	Team	15%	2.6	2.6	2.6	2.6	2.6	2.6
Functional and Non-functional Rs	Severely incomplete in detail and coverage	Approach sufficient coverage, but are mostly ambiguous or key facts are not mentioned	Rs provide a sound basis for design, but traceability is not covered well. Only a small amount of ambiguity is present	Rs are traceable to UCs or other process artifacts; Rs cover key functionality and qualities per the goals and UCs. They are unambiguous.	Team	15%	3	3	3	3	3	3
Questions or Anticipation of	No consideration of another point-of-view	Response shows lack of understanding	Adequate response given	Response to another point-of-view shows insight	Individual	10%	4	1	3	3.5	2	2.2
Information Quality	Inaccurate information given	Most information accurate	Information accurate	Accurate, in-depth information enhances presentation	Individual	10%	2.2	2.3	1	3	2.2	3.6
Postmortem Report	Missing or superficial	Some useful comments on the process are provided, but the key points of the postmortem are missed.	The report makes good observations of the process aspects, but is not sufficiently introspective and focused on the project goals and purpose.	The report is introspective, considers both the team's and client's point of view, and includes usable insight into what worked and did not work.	Team	10%	2.3	2.3	2.3	2.3	2.3	2.3
Amount of Time	< 55% of nominal or cut off abruptly	< 65% or cut off	< 75% or rushed at end	75-100%	Team	10%	3.2	3.2	3.2	3.2	3.2	3.2
						100%	**2.63**	**2.45**	**2.69**	**2.89**	**2.53**	**2.85**

References

http://www.scarborough.k12.me.us/middle/contribute/quest/grouprbr.html
http://westy.jtwn.k12.pa.us/users/mjr/rubrics.html
http://lrs.ed.uiuc.edu/Students/abeling/407/group_presentation_rubric.html
http://www.ncrel.org/mands/FERMI/prairie/9prairie/9rub1.html
SE-3821 final report rubric, SE-3821 final report specification
Original material by Dr. E. Durant

Notes

Appendix B

MSOE SE-3821 Final Requirements Report Rubric

Evaluation Date and Time:	Monday 14 November 2005 10:00 AM					
Project:	I Just Want to Immobilize Your Hand					
Client or Client Advisor:	Dr. Fennigkoh					
SE-3821 Professor:	Dr. Durant					
Evaluator:	Dr. Suri					
Team Members:	John	Paul	George H.	Ringo	Yoko	George M.

	Beginning - 1	**Developing - 2**	**Accomplished - 3**	**Exemplary - 4**	**Weight**	**Score**	**Comments**
Blastoff / Goals	Goals do not provide a rational product basis; list of stakeholders is superficial or incomplete	Goals are incomplete or unclear; stakeholders are superficially addressed	Goals are mostly complete, but the benefits and terminology are not always clear; stakeholders need to be defined in more detail	Goals are clearly articulated with documented advantages and measurement criteria; unambiguous terminology; comprehensive list of users and stakeholders	10%	2	
Context Diagram / Business Events	Data flows are missing or so limited as to be unusable for UC generation; adjacent systems are missing or not sufficiently described	Key adjacent systems are missing, or most adjacent systems are ill defined	The diagram is mostly complete, but categorization is missing or key interactions or events are missing	Diagram is clearly documented and adjacent systems are clearly and logically categorized into the 3 types; appropriate modeling techniques are used (*e.g.* , state diagram, ER diagram, mind maps); supporting materials referenced	10%	3	
Risks	Risks are superficial, not researched, and do not show evidence of being managed or tracked	Some relevant risks are raised, but are not presented in sufficient detail	Key relevant risks are present, along with some management and mitigation information, but key pieces are missing	Proper tracking and monitoring are shown: detail, severity, likelihood, notes / mitigation strategies, date last assessed	10%	2.2	
Glossary	Many terms are missing or there are numerous ambiguous usages	Most key terms are defined, but not in sufficient depth of be useful to the domain novice	The glossary is sufficient that a person working in the domain a short time would understand the document, but some terminology is overly redundant or ambiguous	As SRS is being read, all relevant terms were found in the glossary. Consistent terminology used throughout	10%	4	
Constraints / Assumptions	Missing	Stated but completely unjustified	Reasonable items listed with basic support that leaves the reader with a list of questions that need to be answered	Areas are addressed and clearly documented support material is provided as appropriate	10%	2.3	
Use Cases	Do not reflect primary business events and are not readily derivable from the work context diagram	Use cases are appropriate in scope, but superficial in detail, not providing enough information for design. Or, the UCs specify significant design constraints that are unjustified.	The purpose of the UC case is clear and there is sufficient detail to write good requirements, but some key items are missing from the template. UCs are appropriately chosen and cover most major functionality. Unjustified design constraints are kept to a minimum.	***All*** sections are appropriately completed: description, actors, preconditions, basic flow, alternative flows, exception flows, etc. The UCs are sufficiently wide reaching to encompass the project goals. Any assumptions, constraints and risks specific to the UCs are documented.	10%	3.2	
Functional Requirements	Severely incomplete in detail and coverage	FRs approach sufficient coverage, but are mostly ambiguous are missing many relevant items (*e.g.* , Rationale) that may be necessary for each individual requirement.	FRs provide a sound basis for design, but are mostly lacking in traceability. Ambiguity is present, but is the exception and not the rule.	FRs are traceable to UCs or other process artifacts; FRs cover virtually all functionality per the goals and Use Cases. They are complete and unambiguous.	10%	3.6	
Non-functional Requirements	Many categories unaddressed and measurement criteria are not provided	Most key categories are addressed, and coverage is nearly sufficient, but the NFRs are mostly ambiguous and missing many relevant items.	NFRs provide a sound basis for design, but are mostly lacking in traceability. Ambiguity is present, but is the exception and not the rule.	NFRs are provided in a variety of areas relevant to the project (operational, performance, security, political, cultural, etc.) and are properly traced to an artifact, most often a goal.	10%	4	
Basis for V&V	Most requirements do not have a measurement criterion specified.	The FC are mostly ambiguous or multipartite without sufficient justification.	Nearly all Rs are written with FC that are sufficient for deriving test cases. Most FC are reasonable and clearly supported, when needed.	All Rs (F & NF) are written with measurement criteria and can be used to derive test cases. The specified measurement criteria are logical, or means for determining them are discussed.	10%	1.2	
Postmortem Report	Missing or superficial	Some useful comments on the process are provided, but the key points of the postmortem are missed.	The report makes good observations of the process aspects, but is not sufficiently introspective and focused on the project goals and purpose.	The report is introspective, considers both the team's and client's point of view, and includes usable insight into what worked and did not work.	10%	1.2	
					100%	**2.67**	

Notes

Developed by Dr. Eric Durant and Dr. Deepti Suri