

ASSESSMENTS FOR CAPSTONE ENGINEERING DESIGN

developed by

Transferable Integrated Design Engineering Education (TIDEE) Consortium

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INTRODUCTION AND OVERVIEW

The world faces challenges of global proportions that are complicated by significant human dimensions. Problems are ill-defined, rapidly-changing, and must satisfy needs of widely-varied stakeholders: users, business and technical personnel, and society at large. To succeed, the engineer of the 21st century must be a broadly-educated, competent, highly-adaptive professional. Engineering educators are challenged to prepare a generation of engineering professionals that are more versatile, socially conscious, and able to collaborate and communicate effectively across cultural boundaries.

Much important professional preparation can be achieved in capstone engineering design courses, where students engage in semi-authentic team-based design projects with real stakeholders. To achieve the lofty educational goals in these courses, educators must set clear achievement targets for professional growth and design learning, facilitate well-crafted educational experiences for students, and provide timely learner-focused feedback to students. Educators also need effective performance measures to monitor student achievement, support grading, and document achievements for program accreditation.

The Transferable Integrated Design Engineering Education (TIDEE) consortium has addressed these challenges. Design educators from approximately ten universities and colleges have developed assessments that both facilitate learning and measure student achievement as part of design-related performances. [1, 2] Formative assessments (learning tools) teach students how to design effectively and to advance in professional practice. Summative assessments provide definitive measures of student achievement in these same areas of performance.

These assessments have been under development since the early 1990s under funding from the National Science Foundation. Throughout this period, they have been pilot tested at multiple institutions and in different types of capstone design project settings. Extensive evaluation is being conducted for assessment instrument validity and scoring reliability during the 2008-2009 academic year.

This information packet provides condensed details of the framework for the assessments developed, assessment assignments for different areas of performance, scoring scales used to score and interpret student responses, and methods being employed to validate the assessments.

DEVELOPMENT OF ASSESSMENTS

Areas of Design Performance

The **TIDEE** assessment tools address outcomes for learner development and solution development in capstone engineering design courses. Outcomes lie in four areas of performance:

Professional Development: Individual demonstration of improved knowledge, skills, and behaviors essential to engineering practice

Teamwork: Team member contributions and team processes employed to support team productivity in design

Design Processes: Practices implemented that effectively and efficiently facilitate the production of valuable design project assets

Solution Assets: Design results that meet needs and deliver satisfaction and value to key project stakeholders

Focusing on these performance areas ensures that students learn to grow professionally, both as individuals and as members of design teams. It also ensures that students learn and document achievement in their development of effective design processes and in delivering and defending high quality design solutions.

Performance criteria for these four areas are defined below.

Professional Development: Individuals document professional development in technical, interpersonal, and individual attributes important to their personal and project needs, professional behaviors, and ways of a reflective practitioner.

Teamwork: Team member behaviors and team processes contribute to constructive relationships, joint achievements, individual contributions, and information management that synergistically yield high productivity.

Design Processes: Designers reflectively use design tools and information throughout problem scoping, concept generation, and solution realization activities to co-develop problem understanding and a responsive design solution.

Solution Assets: Designers deliver and effectively defend solutions that satisfy stakeholder needs for functionality, financial benefit, implementation feasibility, and impacts on society.

Assessment Framework

TIDEE assessments are created as an integral part of the National Research Council’s assessment triangle, shown in Figure 1. [3] This calls for a **model** of design learning, **observations** of performances that exhibit desired achievement, and **interpretation** of performance results.

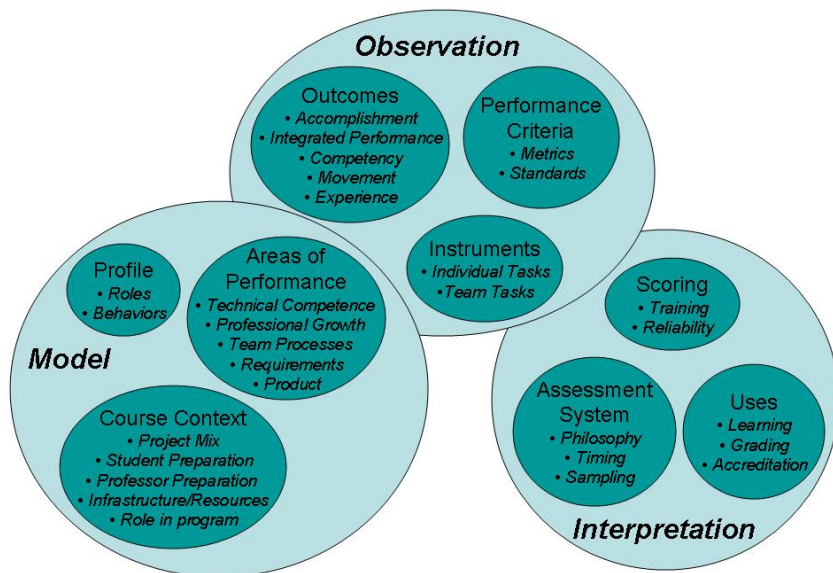


Figure 1. Assessment Triangle (NRC, 2001, *Knowing What Students Know*, National Academy Press)

The model for learning includes abilities to define and explain principles and processes important to design, abilities to apply knowledge in design activities, abilities to critique performance, and abilities to advance one’s own understanding and achievement through reflective practice. [4] Observations are made based on students’ written explanations, analyses, and planning of design and professional performances,

as well as oral presentations and delivery of design products. Interpretation of results is based on a 5-point scale used to distinguish performances ranging from novice to expert for each set of assessment questions.

Summative Assessments

Summative assessments measure milestones of achievement against defined standards of performance. The TIDEE assessments include a number of summative assessment measures corresponding to the performance criteria stated above for the four areas of performance. Table 1 lists and defines the purposes of TIDEE’s summative assessments. Figure 2 illustrates the approximate timing of each in the context of a 10 to 15-week design project.

Table 1. TIDEE Summative Assessments and their Purposes

Assessment Name	Purposes of Assessment
Growth Achieved	Document and extend application of individual professional development achievements
Teamwork Achieved	Document and extend application of effective team practices (member contributions and team processes) developed
Design Reflection	Identify and describe design process actions that have produced and can produce quality in design solutions
Proposed Solution	Present and defend the design solution that best satisfies the broadly-defined design problem

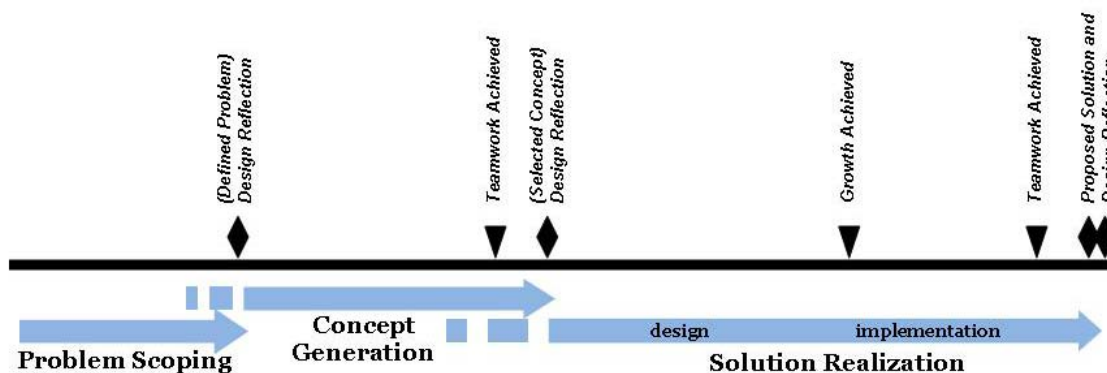


Figure 2. Timing for Employing TIDEE Summative Assessments

Formative Assessments

Several of the TIDEE assessments have been developed primarily to support student learning, so they are considered formative assessments. Their formative intent is achieved best when they are correctly introduced to students as “tools to aid the instructor in coaching student improvement.” Students are asked to demonstrate the true state of achievements so that feedback from others can focus on actual needs. The formative assessments are listed and their purposes stated in Table 2. Figure 3 illustrates the timing of the formative assessments in reference to the summative (in **bold**) assessments.

Table 2. TIDEE Formative Assessments and their Purposes

Assessment Name	Purposes of Assessment
Growth Planning	Plan personal/professional growth needed for the project
Growth Progress	Review achieved growth, plan steps to better achieve desired growth
Professional Practices	Review professional practices, plan steps to improve practices
Team Contract	Identify consensus operating procedures for team activities and climate
Team Member Citizenship	Review member contributions and coach one another in teamwork
Team Processes	Review and refine processes used to support team performance
Problem Scoping Processes	Review and refine processes used in defining solution requirements
Concept Generation Processes	Review and refine processes used in selecting a solution concept
Solution Realization Processes	Review and refine processes used in delivering a proposed solution
Defined Problem	Present and defend the problem definition for which a solution is sought
Selected Concept	Present and defend the concept with potential to resolve the problem

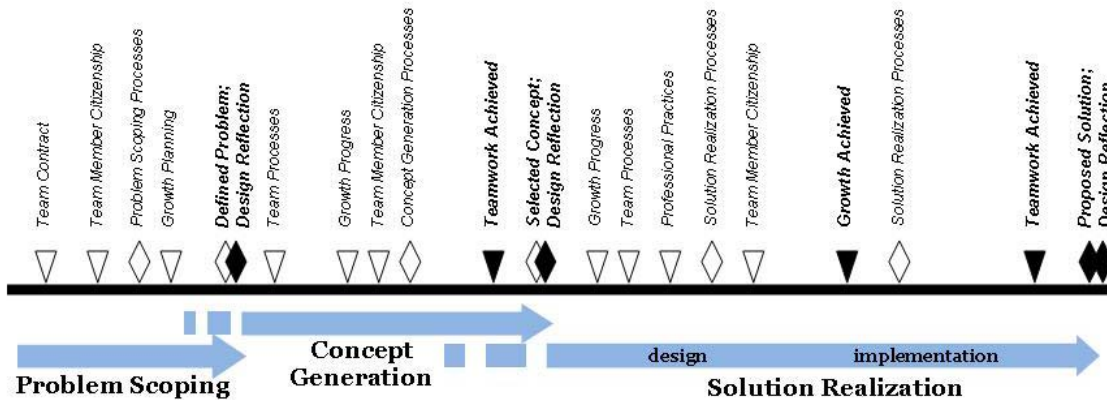


Figure 3. Timing for Employing TIDEE Formative and Summative Assessments

Relationships among Assessments

As noted in Tables 1 and 2, multiple TIDEE assessments (some formative, one summative) address outcomes in each area of performance. Four address professional development: Growth Planning, Growth Progress, Professional Practices, and Growth Achieved. Four address teamwork: Team Contract, Team Member Citizenship, Team Processes, and Teamwork Achieved. Four address design processes: Problem Scoping Processes, Concept Generation Processes, Solution Realization Processes, and Design Reflection. Three address solution assets: Defined Problem, Selected Concept, and Proposed Solution.

Within each performance area, some assessments are formative (to guide learning) and others are summative (to score performance). Typically, the formative assessments are used during development processes, and the summative ones at the end of period of development. For example, Growth Planning, Growth Progress, and Professional Practices guide professional development; Growth Achieved measures professional development achieved in the end. The design processes assessments review and guide process development within a stage (phase) of design; the solution assets assessment measures quality of the product emerging from that phase. For example, Problem Scoping Processes guides the process; Defined Problem measures quality of the problem definition produced in that phase.

Note that the Defined Problem assessment may be seen as a summative assessment for the Problem Scoping Phase or as a formative assessment for the entire solution development process. Note also that the Design Reflection assessment is actually used three times, once in conjunction with each of the solution deliverables (Defined Problem, Selected Concept, and Proposed Solution); it prompts students to reflect on how the design process produced quality in the corresponding solution asset.

Table 2. Assessment Instruments Explained and Grouped by Type

LEARNER DEVELOPMENT [PROFESSIONAL DEVELOPMENT AND TEAMWORK]			
	FORMATIVE ASSESSMENTS	SUMMATIVE ASSESSMENTS	
TYPE OF LEARNER DEVELOPMENT	PROFESSIONAL DEVELOPMENT (INDIVIDUAL)	<p>GROWTH PLANNING [I]: Rate importance and your level in listed professional attributes. Describe impacts of your shortcomings; define growth plans and criteria for success.</p> <p>GROWTH PROGRESS [I]: Describe steps taken, evidence of impacts achieved, next steps for achieving professional development in a selected area.</p> <p>PROFESSIONAL PRACTICES [I]: Rate importance and your performance for listed areas of professional/ethical responsibility; describe understanding and impact; describe an opportunity for improvement and a plan to improve performance.</p>	<p>GROWTH ACHIEVED [I]: Rate current importance and your level in listed professional attributes; check areas of greatest growth; describe gains, impacts and broader applicability of achieved professional development.</p>
	TEAMWORK (TEAM)	<p>TEAM CONTRACT [T]: Define a consensus contract: team relationships, collective achievements, individual responsibilities, team communication, and leadership.</p> <p>TEAM MEMBER CITIZENSHIP [I]: Rate members of team (including self) on contributions and effectiveness. For each member, identify a key strength and how it benefits the team, a desired improvement and steps to achieve this.</p> <p>TEAM PROCESSES [I]: Rate importance and effectiveness of processes for: relationships, achievements, responsibilities, and information. Describe an effective process (with evidence); describe opportunity and plan to improve.</p>	<p>TEAMWORK ACHIEVED [I]: Rate your team's performance, importance of member contributions, level of member contributions; relative contributions of members; describe greatest teamwork strengths, impacts, and broader applicability.</p>
SOLUTION DEVELOPMENT [DESIGN PROCESSES AND SOLUTION ASSETS]			
	MID-PHASE FORMATIVE ASSESSMENTS	END-OF-PHASE SUMMATIVE ASSESSMENTS	
DESIGN PHASE IN SOLUTION DEVELOPMENT	PROBLEM SCOPING PHASE	<p>PROBLEM SCOPING PROCESSES [T]: At mid-phase in problem scoping, define process components planned/used; assess process status; explain process strengths; propose process improvement.</p>	<p>DEFINED PROBLEM [T]: Prepare a formal proposal submitted to stakeholders defining project requirements; include: executive summary, stakeholder needs, and solution specifications.</p> <p>DESIGN REFLECTION [I]: At end of problem scoping phase, rate your confidence in design work to-date; explain a strength; propose a process iteration to improve the design process.</p>
	CONCEPT GENERATION PHASE	<p>CONCEPT GENERATION PROCESSES [T]: At mid-phase in concept generation, define process components planned/used; assess process status; explain process strengths; propose process improvement.</p>	<p>SELECTED CONCEPT [T]: Prepare a formal proposal submitted to project stakeholders justifying a proposed design concept; include revised executive summary and solution specifications.</p> <p>DESIGN REFLECTION [I]: At end of concept generation phase, rate your confidence in design work to-date; explain a strength; propose a process iteration to improve the design process.</p>
	SOLUTION REALIZATION PHASE	<p>SOLUTION REALIZATION PROCESSES [T]: At mid-phase in solution realization, define process components planned/used; assess process status; explain process strengths; propose process improvement.</p>	<p>PROPOSED SOLUTION [T]: Prepare a formal design report submitted to project stakeholders defending the developed design solution; include revised executive summary and solution specifications..</p> <p>DESIGN REFLECTION [I]: At end of solution realization phase, rate your confidence in design work to-date; explain a strength; propose a process iteration to improve the design process.</p>

Some exercises are completed by individuals [I] while others are completed collectively by members of each team [T]. Note that Design Reflection assessments are done by individuals so everyone on a team has the opportunity to learn independently from this reflection process.

The following sections present condensed assessment instruments with corresponding scoring rubrics.

PROFESSIONAL DEVELOPMENT ASSESSMENTS

Professional development assessments prompt students to develop personal abilities or attributes that improve their professional contributions to their design projects. Twelve attributes/abilities are identified in three areas of need: technical abilities, interpersonal abilities, and individual attributes. The twelve **attributes/abilities** identified as professional development opportunities are:

- | | | |
|--|--|--|
| Technical
<input type="checkbox"/> Analyzing information
<input type="checkbox"/> Solving problems
<input type="checkbox"/> Designing products
<input type="checkbox"/> Researching questions | Interpersonal
<input type="checkbox"/> Communicating
<input type="checkbox"/> Collaborating
<input type="checkbox"/> Relating inclusively
<input type="checkbox"/> Leading others | Individual
<input type="checkbox"/> Practicing self-growth
<input type="checkbox"/> Being a high achiever
<input type="checkbox"/> Adapting to change
<input type="checkbox"/> Serving professionally |
|--|--|--|

Students are asked to self-rate levels of performance based on these definitions:

- Low (L)** I exhibit little of this ability/attribute, lack confidence, and may be stagnant in it
Medium (M) I exhibit moderate level of this ability/attribute, am not fully capable, need to grow it
High (H) I exhibit strength in this ability/attribute, am fully capable, could help others grow it

Students self-rate importance of abilities/attributes based on these definitions of importance:

- Low (L)** Not relevant to the project or to my personal/professional life
Medium (M) Moderately important to the project and/or my personal/professional life
High (H) Important or very important to the project and my personal/professional life

Growth Planning Assessment

Student Assignment – Growth Planning

ASSIGNMENT: Growth Planning
Personal abilities/attributes (see list above) are important to your own professional development and to project success. For each ability/attribute listed, use definitions given to indicate (a) its <u>importance</u> to your personal and project success, and (b) your <u>current development level</u> .
From the list, identify an ability/attribute that is important and needs to be developed further to enhance your team or project success. In 200 to 300 words, describe your shortcoming(s) with this ability/attribute and your plan to overcome these to benefit your project or team. Specifically, give details that illustrate: (a) how the shortcoming might impact your project or team negatively (or has already), (b) steps you can take to reach your desired development level, and (c) evidence that will tell you that you have achieved your growth goal.

Instructor Scoring – Growth Planning

SCORING: Growth Planning					
	1 <i>Novice</i>	2 <i>Beginner</i>	3 <i>Intern</i>	4 <i>Competent</i>	5 <i>Expert</i>
Understanding impacts	Unable to state proper impacts of the shortcoming	Vague statement of impacts; weak understanding	Acceptable statement of impacts; moderate grasp	Clear statement of impacts; good comprehension	Clear explanation of impacts; insightful comprehension
Plan to achieve growth	No plan presented, or plan unrelated to stated goal	Vague plan given; little potential to reach stated goal	Usable plan defined; moderate potential to reach stated goal	Valuable plan given; good potential to reach stated goal	Excellent plan; highly likely to reach stated challenging goal
Evidence for growth	No clues about evidence for successful growth	Vague allusion to evidence for successful growth	Reasonable types of evidence for desired personal growth	Clear statements of suitable evidence for successful growth	Clear, measurable, suitable criteria for successful growth

Growth Progress Assessment

Students are asked to review progress in professional development relative to goals set earlier in Growth Planning. They are asked to reference their growth to one of the following twelve abilities/attributes:

Technical

- Analyzing information
- Solving problems
- Designing products
- Researching questions

Interpersonal

- Communicating
- Collaborating
- Relating inclusively
- Leading others

Individual

- Practicing self-growth
- Being a high achiever
- Adapting to change
- Serving professionally

Student Assignment – Growth Progress

ASSIGNMENT: Growth Progress
<p>Identify the ability/attribute (from list above) that you targeted earlier for professional development:</p> <p>In 200 to 300 words, describe your progress and revised plans for achieving your targeted professional development. Give specific details that illustrate:</p> <p>(a) steps taken to achieve your targeted professional development,</p> <p>(b) evidence of impacts of your professional development to-date on project or team success,</p> <p>(c) additional steps you will take to achieve your targeted professional development.</p>

Instructor Scoring – Growth Progress

	SCORING: Growth Progress				
	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
Steps taken	No action taken, or action unrelated to stated goal	Vague action taken; little relevance to stated goal	Useful actions taken; moderate relevance to stated goal	Valuable actions taken; relevance to stated goal	Strategic actions taken; high value to challenging goals
Evidence for growth	No mention of evidence of successful growth	Vague allusion to evidence of successful growth	Reasonable types of evidence of desired personal growth	Clear statements of suitable evidence of successful growth	Clear, quantitative, suitable evidence of successful growth
Additional steps	No plan presented, or plan unrelated to stated goal	Vague plan given; little potential to reach stated goal	Usable plan defined; moderate potential to reach stated goal	Valuable plan given; good potential to reach stated goal	Excellent plan; highly likely to reach stated challenging goal

In addition to assigning a score to represent the level of the student's performance, instructors also provide written comments and suggestions for improvement.

Professional Practices Assessment

Seven areas of professional and ethical responsibility are identified to prompt students:

- Health, safety, well-being
- Work competence
- Communication honesty
- Financial responsibility
- Property ownership
- Sustainability
- Social responsibility

Students rate **importance** of an area of professional development using these definitions:

- Low (L)** Not relevant to the project
- Medium (M)** Moderately important to the project
- High (H)** Important or very important to the project

When students rate their present achievement **level**, they use these definitions:

- Not Applicable (NA)** I have not had an opportunity to exercise this responsibility in my project.
- Low (L)** I have demonstrated little proficiency in this area of responsibility.
- Medium (M)** I have demonstrated moderate proficiency in this area of responsibility.
- High (H)** I have consistently demonstrated proficiency in this area of responsibility.

Student Assignment – Professional Practices

ASSIGNMENT: Professional Practices
The list (given above) identifies areas of professional and ethical responsibility to be demonstrated by engineering and other professionals. For each area of responsibility, identify its importance to your project and the level of proficiency you have demonstrated to-date in the context of your project. For each responsibility, please select the choice (see definitions) that best describes: (a) its importance to your project's success, and (b) your current performance level in the context of this project.
From the list, select an area of professional responsibility that is important to your project and that you have demonstrated a moderate or high level of proficiency in the context of your project. In 200 to 300 words, describe your understanding of this professional responsibility and how you applied it in the context of your project. Specifically, describe: (a) what this responsibility means to you in this project, with examples, and (b) ways you have demonstrated this responsibility in your project, with specific impacts observed.
From the list, select an area of professional responsibility that is important to your project but that you have demonstrated a relatively low level of application to-date. In 200 to 300 words, describe an opportunity you see for more fully applying this professional responsibility and how you can capitalize on this opportunity in the context of your project. Specifically, describe: (a) what the opportunity is and its possible impacts, and (b) a plan of action with steps to better fulfill this responsibility and benefit your project.

Instructor Scoring – Professional Practices

SCORING: Professional Responsibility Demonstrated					
	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
Understanding of responsibility	Misunderstood or unable to explain any elements of it	Little understanding; few elements fit the responsibility	Moderate grasp of responsibility; some relevant detail	Credible grasp of responsibility; good examples, definition	Impressive grasp; insightful description & great examples
Effective demonstration of responsibility	Strength not used or not used well; no impacts cited	Strength used casually, passively; obscure impacts	Strength used fairly well; not purposeful; some good impacts	Strength used well, purposefully; clear positive impacts	Strategic use of strength; impressive documented impacts

SCORING: Professional Responsibility Opportunity					
	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
Understanding of opportunity	Vague description of opportunity; does not see benefits	Weak description of opportunity; implies benefits	Okay description of opportunity; vague benefits	Good explanation of opportunity; good definition of benefits	Superb explanation of opportunity; insightful on benefits
Plans to capitalize on opportunity	No plan or unclear; unreasonable to implement	Vague plan or weak plan; difficult to implement	Reasonable plan; may be possible to implement	Clear, strong plan; reasonable to implement well	Impressive plan; likely embraced by all and implemented

Growth Achieved Assessment

These abilities/attributes are offered for student selection in this exercise:

Technical

- Analyzing information
- Solving problems
- Designing products
- Researching questions

Interpersonal

- Communicating
- Collaborating
- Relating inclusively
- Leading others

Individual

- Practicing self-growth
- Being a high achiever
- Adapting to change
- Serving professionally

Students use these definitions for ratings of importance:

- Low (L)** Not relevant to the project
Medium (M) Moderately important to the project
High (H) Important or very important to the project

Students use these definitions for ratings of achievement levels:

- Not Applicable (NA)** I have not had an opportunity to exercise this responsibility in my project.
Low (L) I have demonstrated little proficiency in this area of responsibility.
Medium (M) I have demonstrated moderate proficiency in this area of responsibility.
High (H) I have consistently demonstrated proficiency in this area of responsibility.

Student Assignment – Growth Achieved

ASSIGNMENT: Growth Achieved
What are your perceptions of your development level and the importance of the abilities/attributes (listed above), after having gained experience in a team design project? For each ability/attribute, use definitions given to indicate: (a) its importance to your personal and project success, and (b) your current development level.
Identify (check) one or more abilities/attributes listed above that have been important to your project success and in which you experienced significant personal growth. In 300 to 400 words, discuss your most valued personal and professional development achievements from this project and their broader applicability. Give details that illustrate: (a) specific abilities or understandings you gained through this project experience (b) evidence of positive impacts your professional development had on your project or team (c) ways in which your professional development will benefit you in the future.

Peer Feedback – Growth Achieved

A summary table is created for self-ratings of the individual student and combined ratings for the team: importance and level of achievement for each ability/attribute.

Instructor Scoring – Growth Achieved

	SCORING: Growth Achieved				
	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
Significant gains	No gains identified or not of much significance	Vague description of gains; few and little significance	Some gains; few notable; moderate significance	Several gains of notable value; described well	Strategic gains of major importance; described well
Evidence of impact	No mention of evidence of successful growth	Vague allusion to evidence of successful growth	Reasonable types of evidence of desired personal growth	Clear statements of suitable evidence of successful growth	Clear, quantitative, suitable evidence of successful growth
Future benefits	No idea of future benefits from growth gained	Vague idea of future benefits from growth gained	General idea of future benefits from growth gained	Good understanding of several benefits from growth	Insightful and broad in seeing future benefits from growth

TEAMWORK ASSESSMENTS

Team Contract Assessment

Twelve **team processes** are identified as relevant to team effectiveness:

- | | |
|---|--|
| (1) building an inclusive supportive team | (2) gaining buy-in and interdependence |
| (3) resolving conflicts to enhance teamwork | (4) establishing shared team goals |
| (5) managing tasks to achieve team goals | (6) producing competent consensus outputs |
| (7) allocating responsibilities to members | (8) achieving quality work from members |
| (9) facilitating team member growth | (10) achieving effective in-team communication |
| (11) managing stakeholder communication | (12) building shared knowledge assets |

Student Assignment – Team Contract

ASSIGNMENT: TEAM CONTRACT
<p>As a team, rate the importance of the team processes (listed above) to your team's productivity. Use these ratings: Low: Managing this process will not significantly affect the productivity of the team. Medium: Managing this process may affect team productivity, but it is not crucial to productivity. High: Managing this process is crucial for the team to be highly productive.</p>
<p>As a team, define consensus expectations about productive within-team relationships. What constitutes the relationships needed for productive, enjoyable teamwork? How are relationships developed and maintained?</p> <p>Describe what the team will do to make all members of the team feel safe and valued, and see that this inclusive climate capitalizes on contributions of every member. Describe how the team will build member commitment and establish strong team identity to sustain team energy over the long term. Define the strategy your team will use to resolve conflicts that arise and leverage these challenges into opportunities for growing team performance.</p>
<p>As a team, define consensus expectations about team goals and joint achievements. How will goals be used to drive overall team performance?</p> <p>Define the team and project goal(s) to which all team members are committed. Describe how your team will establish plans, execute plans, and review progress with regard to achieving team goals. How will these processes be managed, and by whom? Describe how your team will conduct meetings and joint work so that synergies yield high quality work products (decisions, ideas, reports, prototypes, etc.) that benefit from contributions of all members.</p>
<p>As a team, define your consensus expectations about individual team member contributions. How will work be allocated, performance standards be established, and performance reviewed to ensure member productivity?</p> <p>Define how work will be allocated to individual members of the team. Address issues of leadership, backup, and fairness. Describe your team's plan for achieving high performance from each team member. Address work standards and accountability that ensure success. Who is responsible to whom, on what timeline? Describe your team's plans for growing team member capabilities and responsibilities over the duration of your project. How will you prepare members for growth and leadership in a complex, changing world?</p>
<p>As a team, define consensus expectations about handling of project information. How will communication within and outside the team be managed? How will ideas and decisions be documented?</p> <p>Define how notifications, records of meetings, exchange of information, and other in-team communications be conducted to empower all members for success. What communication protocols should be followed by each member? Define communication expectations for your team interactions with key outside stakeholders. With whom will you communicate regularly? Who is responsible? How will appropriate confidentiality be maintained? Define how project information assets will be developed and safeguarded. What project records will be maintained and by whom? How will personal design journals and team records be developed to produce greatest value? How will documentation be monitored?</p>
<p>Complex projects require shared leadership – different individuals leading different portions of the project. As a team, identify for each member the leadership or backup responsibilities for which this person is accountable to the team.</p> <p>(a) Describe in 50 to 100 words your rationale for selecting areas for making assignments and individuals to lead these areas. (b) Assign each member to important roles and identify key responsibilities of each role.</p>

Peer Feedback – Team Contract

SCORING: Team Contract (Tabulation of Student Responses)			
Area	Team Process Name	Importance* to Team	Importance* to Class
Team Relationships	Building an inclusive supportive climate		
	Gaining buy-in and interdependence		
	Resolving conflicts to enhance teamwork		
Joint Achievements	Establishing shared team goals		
	Managing tasks to achieve team goals		
	Producing competent consensus outputs		
Member Contributions	Allocating responsibilities to members		
	Achieving quality work from members		
	Facilitating team member growth		
Team Information	Achieving effective in-team communication		
	Managing stakeholder communication		
	Building shared knowledge assets		

* Importance defined earlier

Instructor Scoring – Team Contract

SCORING: Team Contract					
	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
Team Relationships	Absent or poor plan to reach inclusiveness, member commitment, conflict resolution	Unclear, vague plan to get inclusiveness, member commitment, conflict resolution	Good but incomplete plan for inclusiveness, member commitment, resolving conflicts	Good, practical plan to get inclusiveness, member commitment, conflict resolution	Feasible, insightful plan for inclusiveness, member commitment, growth from conflict
Joint Achievements	Ill-defined team goals; no plan for managing project work or building consensus outcomes	Unclear team goals; vague plan for task management; unclear consensus process	Good team goals; plan to schedule project tasks; only voting for consensus	Strong team goals; plan to track work progress; open input to reach consensus	Inspiring team goals; ongoing review of schedule; leveraging to enhance outcomes
Member Contributions	Unclear, unfair work allocation; no defined expectations; no vision for member growth	Unfair work allocation; vague expectations, no review; no intent of member growth	Fair, unwise work allocation; general standards, no review; vague growth plan	Fair, effective work allocation; clear standards & review; good growth plan	Strategic work allocation; inspiring standards & review; effective growth plan
Team Information	No plan for internal or stakeholder information transfer; project records informal only	Unclear plan for internal and external exchanges, vague records guidelines	Understandable plan for internal & external exchanges and project records	Implementable plan for internal and external exchanges and project records	Effective, flexible plan for internal & external communication and defensible records
Roles and Responsibilities	Few members and areas assigned; weak rationale; ill-defined responsibilities	Key areas omitted; vague, unconvincing rationale; unclear responsibilities	Major areas assigned; good rationale for most; good set of responsibilities	All important areas; sound rationale for assignments; clear responsibilities	Insightful grouping of areas; rationale for team growth; explicit responsibilities

Instructors also provide written comments and suggestions.

Team Member Citizenship Assessment

In this exercise, students address twelve types of team member contributions in four aspects of teamwork:

Team Relationships	1. Engages members with respect
	2. Commits, encourages involvement
	3. Resolves conflicts constructively
Joint Achievements	4. Helps establish shared goals
	5. Follows plans to achieve team goals
	6. Works synergistically with others
Member Contributions	7. Delegates/completes tasks, as needed
	8. Performs competently to team standards
	9. Enables development in self and others
Team Information	10. Strives for fully-informed members
	11. Communicates well with stakeholders
	12. Documents achievements well

Student Assignment – Team Member Citizenship

ASSIGNMENT: TEAM MEMBER CITIZENSHIP
<p>Rate the importance of different types of team member contributions for their impact on the team's success. Use the following definitions for importance ratings:</p> <p>Low: This contribution does not significantly affect the success of the team by its presence or absence. Moderate: This contribution may affect quality and efficiency, but the team can complete its work with or without this contribution. High: This contribution is critical for the team to complete its work and to achieve quality and efficiency.</p>
<p>Rate members of your team (including yourself) on their contributions to an effective team. Assign the person a rating of 1 to 5 for each contribution, based on definitions given above.</p> <p>5 = <i>Extraordinary</i>: Models ideal professional responsibility; consistently exceeds expectations 4 = <i>Very Good</i>: Faithfully meets expectations; does not fail without a compelling excuse 3 = <i>Good</i>: Usually meets expectations; occasionally allows failure to occur 2 = <i>Fair</i>: Occasionally meets expectations; too frequently fails to perform as expected 1 = <i>Poor</i>: Rarely meets expectations; consistently is unreliable or performs inadequately</p>
<p>Identify relative contributions (%) of each team member to project achievements this term with respect to:</p> <p>(a) project time invested and (b) value added to project</p>
<p>For each of your team members (including yourself), identify a personal strength that is valued by the team. For each member, choose one of the 12 team member contributions (see list), and write an encouraging analysis of the identified strength. In 50 to 100 words for each person, describe:</p> <p>(a) what elements make this contribution or attribute strong (b) how this strength impacts the team.</p>
<p>For each of your team members (including yourself), identify a personal ability or behavior that, if improved, could benefit your team. For each person, choose one of the 12 team member contributions (see list) to improve, and suggest ways for improving the ability or behavior identified. In 50 to 100 words for each person, describe:</p> <p>(a) elements of this contribution or behavior that can be improved (b) specific steps suggested to achieve the improvement.</p>

Peer Feedback – Team Member Citizenship

Peer Ratings of Member Contributions						
	Member Contributions or Actions	Importance*		Team Mean Rating (all ratings for all members)	Student Mean Rating (all members' ratings of me)	
		Student	Team			
Team Relationships	1. Engages members with respect					
	2. Commits, encourages involvement					
	3. Resolves conflicts constructively					
Joint Achievements	4. Helps establish shared goals					
	5. Follows plans to achieve team goals					
	6. Works synergistically with others					
Member Contributions	7. Delegates/completes tasks, as needed					
	8. Performs competently to team standards					
	9. Enables development in self and others					
Team Information	10. Strives for fully-informed members					
	11. Communicates well with stakeholders					
	12. Documents achievements well					
	Overall Mean Rating:					

* Importance: 1 = Low, 2 = Medium, 3 = High

Rating key:

- 5 **Extraordinary:** Models ideal professional responsibility; consistently exceeds expectations
- 4 **Very Good:** Faithfully meets expectations; does not fail without compelling excuse
- 3 **Good:** Usually meets expectations; occasionally allows failure to occur
- 2 **Fair:** Occasionally meets expectations; too frequently fails to perform as expected
- 1 **Poor:** Rarely meets expectations; consistently is unreliable or performs inadequately

Peer Ratings of Member Effectiveness				
	Percentage Scores for Student's Team		Percentage Scores for Student	
	Mean	Standard Deviation	Mean	Standard Deviation
Time Invested				
Value Added				

Instructor Scoring – Team Member Citizenship

SCORING: Member Strengths					
	1 <i>Novice</i>	2 <i>Beginner</i>	3 <i>Intern</i>	4 <i>Competent</i>	5 <i>Expert</i>
Understanding of strengths	Misunderstood or unable to explain the strength	Little understanding; little attempt to explain the strength	Moderate grasp of the strength; some relevant evidence	Credible grasp of the strength; good list of evidence	Impressive grasp; insightful description of evidence
Benefits to team	No mention of benefits	Casual mention of benefits; minor encouragement	Moderate mention of benefits; some encouragement	Clear mention of benefits; helps motivate future use	Insightful description of benefits; guides and motivates use

SCORING: Member Coaching					
	1 <i>Novice</i>	2 <i>Beginner</i>	3 <i>Intern</i>	4 <i>Competent</i>	5 <i>Expert</i>
Opportunity	Vague description of opportunity; no details	Weak description of opportunity; few details	Okay description of opportunity; some general details	Good explanation of opportunity; some specific details	Superb explanation of opportunity; insightful details
Suggestions	No suggestions or useless steps; none to implement	Mostly vague steps; most are difficult to implement	Reasonable steps; some possible to implement	Clear, strong plan; most steps possible to implement	Impressive plan; steps clear, likely to be implemented

Team Processes Assessment

The following twelve team processes are used in this exercise:

Building an inclusive supportive climate	Gaining buy-in and interdependence
Resolving conflicts to enhance teamwork	Establishing shared team goals
Managing tasks to achieve team goals	Producing competent consensus outputs
Allocating responsibilities to members	Achieving quality work from members
Facilitating team member growth	Achieving effective in-team communication
Managing stakeholder communication	Building shared knowledge assets

Student Assignment – Team Processes

ASSIGNMENT: TEAM PROCESSES	
<p>Rate importance of team processes (listed above) to your team's productivity. Use these ratings:</p> <p><i>Low:</i> Managing this process does not significantly affect the productivity of the team.</p> <p><i>Medium:</i> Managing this process may affect team productivity, but it is not crucial to productivity.</p> <p><i>High:</i> Managing this process is crucial for the team to be highly productive.</p> <p>Rate the effectiveness of the same processes, using these ratings:</p> <p><i>Ineffective:</i> Process and expectations poorly defined; actions unproductive; rare improvements.</p> <p><i>Moderate:</i> Process and expectations generally clear; moderately productive; process improvements triggered by problems.</p> <p><i>Effective:</i> Process and desired performance well understood; typically productive; improvements driven by regular review of process</p>	
<p>Identify a process (see list) used most effectively by your team. In 200 to 300 words, describe your understanding of this process and how your team made it effective in the project context. Cite details to illustrate:</p> <p>(a) goals of this process and evidence you would see if goals were achieved, and</p> <p>(b) actions your team took and impacts you achieved with this process.</p>	
<p>Identify a process (see list) that is important and somewhat underdeveloped by your team. In 200 to 300 words, describe an opportunity you see to benefit your project from better development of this team process and explain how you can achieve this in the context of your project. Cite specific details that illustrate:</p> <p>(a) what the opportunity is and its possible impacts on your team's success, and</p> <p>(b) steps your team can take and how they will be implemented to benefit your project.</p>	

Instructor Scoring – Team Processes

SCORING: Effective Team Process					
	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
Understanding	Misunderstood or unable to explain the process	Little understanding; little evidence fits the process	Moderate grasp of the process; some relevant criteria	Credible grasp of the process; good list of relevant criteria	Impressive grasp; insightful description of key criteria
Achievement	Process not applied, or used poorly to improve teamwork	Process applied casually; minor effects on teamwork	Process applied fairly well; moderate effect on teamwork	Process applied purposefully; clear benefits to teamwork	Process applied expertly; impressive benefits to teamwork

SCORING: Improving a Team Process					
	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
Opportunity	Vague description of opportunity; does not see benefits	Weak description of opportunity; implies benefits	Okay description of opportunity; vague benefits	Good explanation of opportunity; good definition of benefits	Superb explanation of opportunity; insightful on benefits
Action Plan	No plan or unclear; unreasonable to implement	Vague plan or weak plan; difficult to implement	Reasonable plan; may be possible to implement	Clear, strong plan; reasonable to implement well	Impressive plan; likely embraced by all and implemented

Teamwork Achieved Assessment

The following descriptors are used to characterize team effectiveness overall:

Forming	Defining tasks, setting acceptable behavior, finding where to begin, over-depending on few people, jumping to solutions, too polite to generate serious discussion
Challenging	Arguing among members, showing defensiveness, setting unrealistic goals, resisting team tasks, questioning others' credibility, choosing sides, passing blame, rude
Accepting	Trying for harmony, expressing opinions relatively openly, sharing information, showing minor resistance to team tasks, learning the best ways to do things
Collaborating	Balancing contributions, focusing on goals and results, solving problems together, reaching consensus, encouraging criticism and constructive conflict, sharing accountability, meeting commitments, elevating standards

The following twelve team processes are used in addressing team performance.

Building an inclusive supportive climate	Gaining buy-in and interdependence
Resolving conflicts to enhance teamwork	Establishing shared team goals
Managing tasks to achieve team goals	Producing competent consensus outputs
Allocating responsibilities to members	Achieving quality work from members
Facilitating team member growth	Achieving effective in-team communication
Managing stakeholder communication	Building shared knowledge assets

Student Assignment – Teamwork Achieved

ASSIGNMENT: TEAMWORK ACHIEVED
Check the descriptor (see definitions) that best fits your team at this stage in its development: forming, challenging, accepting, collaborating
Rate how important each of the (12 listed) types of team member contributions has been to your team's success. Use the following definitions for importance ratings: <i>Low:</i> It has not significantly affected the success of my team by its presence or absence. <i>Moderate:</i> It has affected quality and efficiency of my team, but it was not vital to our success. <i>High:</i> It was vital to my team, both in complete our work and in achieving quality and efficiency.
Please rate members of your team (including yourself) on their contributions to making your team effective. 5 = Extraordinary: Models ideal professional responsibility; consistently exceeds expectations 4 = Very Good: Faithfully meets expectations; does not fail without a compelling excuse 3 = Good: Usually meets expectations; occasionally allows failure to occur 2 = Fair: Occasionally meets expectations; too frequently fails to perform as expected 1 = Poor: Rarely meets expectations; consistently is unreliable or performs inadequately
Identify relative contributions (%) of each team member to overall project achievements: (a) time invested, and (b) value added to project.
For each team member (including yourself), write a 50-100 word summary of the team member's performance and to what extent this impacted the team.
Identify (see list) one or more processes your team used effectively to achieve a high level of team performance.
In 300 to 400 words, discuss your most valued teamwork achievements. Give details of: (a) specific teamwork abilities or understandings you gained through this project experience, (b) evidence of impacts that strong teamwork had on your project success, and (c) ways in which your new teamwork knowledge and skills will benefit you in the future.

Peer Feedback – Teamwork Achieved

Peer Ratings for Team Development Stage				
	Forming	Challenging	Accepting	Collaborating
Number				

Member Contribution Peer Ratings						
	Member Contributions or Actions	Importance*		Team Mean Rating (all ratings for all members)	My Mean Rating (all members' ratings of me)	
		To Me	To Team			
Team Relationships	1. Engages members with respect					
	2. Commits, encourages involvement					
	3. Resolves conflicts constructively					
Joint Achievements	4. Helps establish shared goals					
	5. Follows plans to achieve team goals					
	6. Works synergistically with others					
Member Contributions	7. Delegates/completes tasks, as needed					
	8. Performs competently to team standards					
	9. Enables development in self and others					
Team Information	10. Strives for fully-informed members					
	11. Communicates well with stakeholders					
	12. Documents achievements well					
Overall Mean Rating:						

* Importance: 1 = Low, 2 = Medium, 3 = High

Member Effectiveness Peer Ratings			
Percentage Scores for Student's Team		Percentage Scores for Student	
Mean	Standard Deviation	Mean	Standard Deviation
Time Invested:			
Value Added:			

Student performance summarized by team members:

- A:
- B:
- C:
- D:

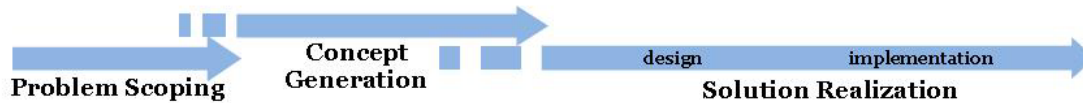
Instructor Scoring – Teamwork Achieved

SCORING: Member Contributions					
	1 <i>Novice</i>	2 <i>Beginner</i>	3 <i>Intern</i>	4 <i>Competent</i>	5 <i>Expert</i>
Contributions	Low effort; inadequate contributions in several areas; unacceptable	Moderate contributions in several areas; several are lacking	Moderately good contributions in most areas; few lacking	Strong contributions overall; minor deficiency in 1 or 2 areas	Very strong contributions; well balanced; no areas of weakness
Impacts on Team	Little benefit to team; some negative impacts on team achievement	Some general benefits mentioned, but no specifics cited	Moderate benefits to team; several cited but without clear evidence	Clear stated benefits; evidence cited; key to team success	Major documented benefits; key to team success & enjoyment

DESIGN PROCESSES ASSESSMENTS

Problem Scoping Processes Assessment

Design process activities change as a design project progresses. Three major phases of design activity include: (1) problem scoping, (2) concept generation, and (3) solution realization. These processes are assessed in similar ways, as shown in the corresponding assessments.



Student Assignment – Problem Scoping Processes

ASSIGNMENT: PROBLEM SCOPING PROCESSES
<p>Rate how effectively your team implemented, or is currently implementing, each of the listed processes. Use the following definitions for effectiveness ratings:</p> <p>Not Applicable (NA) = Process not yet begun Low Effectiveness (L) = Poorly defined process, very limited scope, incomplete or of little value Moderately Effective (M) = Generally understood process, moderate scope, results partially complete and somewhat useful Highly Effective (H) = Well understood process; implemented broadly and competently; results credible and valued; process improved when needed for greater effectiveness</p> <p>For each of these three problem scoping processes, identify the effectiveness level that best describes your team's execution of the process to date: (1) information gathering, (2) interpreting and prioritizing needs, (3) identifying and setting target specifications</p>
<p>As part of the problem scoping effort, several smaller processes or activities are employed. For example, teams may conduct focus groups with potential users, apply objectives tree techniques, or conduct patent searches. Some of these processes may be finished, some in-process, and others only planned at this time. List steps (activities/methods) used or planned and identify the completion status of each. Use these definitions of completeness: N = Not yet started; B = Begun; M = Moderate progress; C = Complete. Identify each item by name or brief description. List the full set of steps you believe your team will use in problem scoping.</p>
<p>Please rate your team's overall progress relative to where you should be at this time: (a) ahead of schedule, (b) on schedule, (c) slightly behind, (d) moderately behind, (e) dangerously behind</p>
<p>Identify which of the problem scoping processes has been implemented most effectively by your team: (a) information gathering, (b) interpreting and prioritizing needs, (c) identifying and setting target specifications. For the selected process, explain what your team did and what impacts it is having on your problem definition. In 200 to 300 words, describe your process in ways that demonstrate your understanding of the process and how it has been used effectively. Provide: (a) details of what you did (what was done, with whom, and how) (b) specific impacts of your process on producing a high quality definition of the problem.</p>
<p>Identify which of the problem scoping processes has been most underdeveloped by your team: (a) information gathering, (b) interpreting and prioritizing needs, (c) identifying and setting target specifications. For the selected process, explain what your team needs to further develop and how you would achieve the desired level of development. In 200 to 300 words, describe your process in ways that demonstrate your understanding of the process and how to make it highly effective. Describe: (a) details of what is underdeveloped (and its impacts on your problem definition) (b) specific action plan to make your process effective in producing a high quality problem definition.</p>

Peer Feedback – Problem Scoping Processes

Progress Ratings by Students		
Rating of Overall Progress	By Student	By Team
Dangerously behind		
Moderately behind		
Slightly behind		
On schedule		
Ahead of schedule		

Instructor Scoring – Problem Scoping Processes

SCORING: Problem Scoping Activities					
	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
Number of activities	Little activity; no significant progress on any steps*	More than 1 activity; significant progress on 1 major step*	More than 3 activities; progress on 2 major steps*	More than 5 activities; progress in 3 major steps*	Over 10 activities in 3 major steps*; 2 steps completed
Activities selected	Activities unclear, not defined or credible	Activities mostly informal, ill-defined; lack clarity	Some activities well-defined; some ill-defined	Most activities well-defined; suitable for quality results	All activities well-defined, credible; yield good results
Progress to-date	Dangerously behind; need substantial action	Moderately behind; need quick, focused intervention	Slightly behind; need minor adjustments in a few areas	On schedule; continue review and revision to succeed	Ahead of schedule; continue with focus on improving quality

*Major steps include: information gathering, prioritizing needs, and defining specifications

SCORING: Effective Problem Scoping Process					
	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
Description of process	Missing description or unable to explain the process	Vague description; little/no evidence of understanding	Moderate grasp of the process; some relevant details	Credible grasp of the process; good details to support	Impressive grasp; insightful description and supporting detail
Impacts of process	Process had not benefited the problem definition	Process has given minimal value to problem definition	Process has given moderate value to problem definition	Process has added good value to problem definition	Process has added impressive value to problem definition

SCORING: Improving a Problem Scoping Process					
	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
Opportunity	Vague description of opportunity; does not see impacts	Weak description of opportunity; vaguely implies impacts	Okay description of opportunity; unclear definition of impacts	Good explanation of opportunity; good definition of impacts	Superb explanation of opportunity; insightful on impacts
Action Plan	No plan or unclear; unreasonable to implement	Vague plan or weak plan; difficult to implement	Reasonable plan; may be possible to implement	Clear, strong plan; reasonable to implement well	Impressive plan; likely embraced by all and implemented

Instructor provides comments and suggestions for improvement.

Concept Generation Processes Assessment

Student Assignment – Concept Generation Processes

ASSIGNMENT: CONCEPT GENERATION PROCESSES
<p>Rate how effectively your team implemented, or is currently implementing, each of the listed processes. Use the following definitions:</p> <p>Not Applicable (NA) = Process not yet begun</p> <p>Low Effectiveness (L) = Poorly defined process, very limited scope, incomplete or of little value</p> <p>Moderately Effective (M) = Generally understood process, moderate scope, results partially complete and somewhat useful</p> <p>Highly Effective (H) = Well understood process; implemented broadly and competently; results credible and valued; process improved when needed for greater effectiveness</p> <p>For each of these four concept generation processes, identify the effectiveness level that best describes your team's execution of the process to date: (1) identifying functions, (2) generating concept ideas, (3) evaluating potential concepts, (4) synthesizing final concept</p>
<p>As part of the concept generation effort, several smaller processes or activities are employed. For example, teams may brainstorm together or individually, apply mental block breaking methods, or use a variety of decision making methods to identify their best concept. Some of these processes may be finished, some in-process, and others only planned at this time. List steps (activities/methods) used or planned and identify the completion status of each. Use these definitions of completeness: N = Not yet started; B = Begun; M = Moderate progress; C = Complete. Identify each item by name or brief description. List the full set of steps you believe your team will use in concept generation.</p>
<p>Please rate your team's overall progress relative to where you should be at this time: (a) ahead of schedule, (b) on schedule, (c) slightly behind, (d) moderately behind, (e) dangerously behind.</p>
<p>Identify which concept generation process has been implemented most effectively by your team: (a) identifying functions, (b) generating concept ideas, (c) evaluating potential concepts, (d) synthesizing final concept.</p> <p>For the selected process, explain what your team did and what impacts it is having on your concept generation and selection. In 200 to 300 words, describe your process in ways that demonstrate your understanding of the process and how it has been used effectively. Provide:</p> <p>(a) details of what you did (what was done, with whom, and how),</p> <p>(b) specific impacts of your process on producing a high quality selected concept.</p>
<p>Identify which of the concept generation processes has been most underdeveloped by your team: (a) identifying functions, (b) generating concept ideas, (c) evaluating potential concepts, (d) synthesizing final concept. .</p> <p>For the selected process, explain what your team needs to further develop and how you would achieve the desired level of development. In 200 to 300 words, describe your process in ways that demonstrate your understanding of the process and how to make it highly effective. Describe:</p> <p>(a) details of what is underdeveloped (and its impacts on your concept generation),</p> <p>(b) specific action plan to make your process effective in producing a high quality selected concept.</p>

Peer Feedback – Concept Generation Processes

Progress Ratings by Students		
Rating of Overall Progress	By Student	By Team
Dangerously behind		
Moderately behind		
Slightly behind		
On schedule		
Ahead of schedule		

Instructor Scoring – Concept Generation Processes

SCORING: Concept Generation Activities					
	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
Number of activities	Little activity; no significant progress on any steps*	More than 1 activity; significant progress on 1 major step*	More than 3 activities; progress on 2 major steps*	More than 5 activities; progress in 3 major steps*	Over 10 activities in 4 major steps*; 2 steps completed
Activities selected	Activities unclear, not defined or credible	Activities mostly informal, ill-defined; lack clarity	Some activities well-defined; some ill-defined	Most activities well-defined; suitable for quality results	All activities well-defined, credible; yield good results
Progress to-date	Dangerously behind; need substantial action	Moderately behind; need quick, focused intervention	Slightly behind; need minor adjustments in a few areas	On schedule; continue review and revision to succeed	Ahead of schedule; continue with focus on improving quality

*Major steps include: decomposing functions, generating concept ideas, evaluating potential concepts, synthesizing final concept

SCORING: Effective Concept Generation Process					
	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
Description of process	Missing description or unable to explain the process	Vague description; little/no evidence of understanding	Moderate grasp of the process; some relevant details	Credible grasp of the process; good details to support	Impressive grasp; insightful description and supporting detail
Impacts of process	Process had not benefited the problem definition	Process has given minimal value to problem definition	Process has given moderate value to problem definition	Process has added good value to problem definition	Process has added impressive value to problem definition

SCORING: Improving a Concept Generation Process					
	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
Opportunity	Vague description of opportunity; does not see impacts	Weak description of opportunity; vaguely implies impacts	Okay description of opportunity; unclear definition of impacts	Good explanation of opportunity; good definition of impacts	Superb explanation of opportunity; insightful on impacts
Action Plan	No plan or unclear; unreasonable to implement	Vague plan or weak plan; difficult to implement	Reasonable plan; may be possible to implement	Clear, strong plan; reasonable to implement well	Impressive plan; likely embraced by all and implemented

Instructor provides comments and suggestions for improvement.

Solution Realization Processes Assessment

Student Assignment – Solution Realization Processes

ASSIGNMENT: SOLUTION REALIZATION PROCESSES
<p>Rate how effectively your team implemented, or is currently implementing, each of the listed processes. Use the following definitions for effectiveness ratings:</p> <p>Not Applicable (NA) = Process not yet begun Low Effectiveness (L) = Poorly defined process, very limited scope, incomplete or of little value Moderately Effective (M) = Generally understood process, moderate scope, results partially complete and somewhat useful Highly Effective (H) = Well understood process; implemented broadly and competently; results credible and valued; process improved when needed for greater effectiveness</p> <p>For each of these four concept generation processes, identify the effectiveness level that best describes your team's execution of the process to date: (1) selecting components, (2) analyzing solution, (3) optimizing solution, (4) validating solution</p>
<p>As part of the solution realization effort, several smaller processes or activities are employed. For example, teams may select parts from supplier catalogues, analyze performance using finite element methods or stochastic modeling, or conduct durability tests or user surveys to evaluate product acceptance. Some of these processes may be finished, some in-process, and others only planned at this time. List steps (activities/methods) used or planned and identify the completion status of each. Use these definitions of completeness: N = Not yet started; B = Begun; M = Moderate progress; C = Complete. Identify each item by name or brief description. List the full set of steps you believe your team will use in solution realization.</p>
<p>Please rate your team's overall progress relative to where you should be at this time: (a) ahead of schedule, (b) on schedule, (c) slightly behind, (d) moderately behind, (e) dangerously behind.</p>
<p>Identify which of the solution realization process has been implemented most effectively by your team: (a) selecting components, (b) analyzing solution, (c) optimizing solution, (d) validating solution.</p> <p>For the selected process, explain what your team did and what impacts it is having on your proposed solution and documentation. In 200 to 300 words, describe your process in ways that demonstrate your understanding of the process and how it has been used effectively. Provide:</p> <p>(a) details of what you did (what was done, with whom, and how), (b) specific impacts of your process on producing a high quality proposed solution.</p>
<p>Identify which of the solution realization processes has been most underdeveloped by your team: (a) selecting components, (b) analyzing solution, (c) optimizing solution, (d) validating solution.</p> <p>For the selected process, explain what your team needs to further develop and how you would achieve the desired level of development. In 200 to 300 words, describe your process in ways that demonstrate your understanding of the process and how to make it highly effective. Describe:</p> <p>(a) details of what is underdeveloped (and its impacts on your solution realization), (b) specific action plan to make your process effective in producing a high quality proposed solution.</p>

Peer Feedback – Solution Realization Processes

Progress Ratings by Students		
Rating of Overall Progress	By Student	By Team
Dangerously behind		
Moderately behind		
Slightly behind		
On schedule		
Ahead of schedule		

Instructor Scoring – Solution Realization Processes

SCORING: Solution Realization Activities					
	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
Number of activities	Little activity; no significant progress on any steps*	More than 1 activity; significant progress on 1 major step*	More than 3 activities; progress on 2 major steps*	More than 5 activities; progress in 3 major steps*	Over 10 activities in 4 major steps*; 2 steps completed
Activities selected	Activities unclear, not defined or credible	Activities mostly informal, ill-defined; lack clarity	Some activities well-defined; some ill-defined	Most activities well-defined; suitable for quality results	All activities well-defined, credible; yield good results
Progress to-date	Dangerously behind; need substantial action	Moderately behind; need quick, focused intervention	Slightly behind; need minor adjustments in a few areas	On schedule; continue review and revision to succeed	Ahead of schedule; continue with focus on improving quality

*Major steps include: selecting components, analyzing solution, optimizing solution, validating solution

SCORING: Effective Solution Realization Process					
	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
Description of process	Missing description or unable to explain the process	Vague description; little/no evidence of understanding	Moderate grasp of the process; some relevant details	Credible grasp of the process; good details to support	Impressive grasp; insightful description and supporting detail
Impacts of process	Process had not benefited the problem definition	Process has given minimal value to problem definition	Process has given moderate value to problem definition	Process has added good value to problem definition	Process has added impressive value to problem definition

SCORING: Improving a Solution Realization Process					
	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
Opportunity	Vague description of opportunity; does not see impacts	Weak description of opportunity; vaguely implies impacts	Okay description of opportunity; unclear definition of impacts	Good explanation of opportunity; good definition of impacts	Superb explanation of opportunity; insightful on impacts
Action Plan	No plan or unclear; unreasonable to implement	Vague plan or weak plan; difficult to implement	Reasonable plan; may be possible to implement	Clear, strong plan; reasonable to implement well	Impressive plan; likely embraced by all and implemented

Instructor writes comments and suggestions for improvement.

Design Reflection Assessment

The Design Reflection assessment is employed multiple times, as shown in Table 2.

Student Assignment – Design Reflection

ASSIGNMENT: DESIGN REFLECTION	
Rate your confidence level that your team's design at this stage is sound and impressive with respect to each of the following requirements: (a) satisfying user needs, (b) technical feasibility, (c) financial attractiveness, (d) social acceptability. Use these rating definitions: <i>Very Low.</i> Do not understand this type of requirement or how to satisfy it <i>Low.</i> Have limited understanding of this type of requirement and how to satisfy it <i>Moderate.</i> Have moderate understanding of this type of requirement and moderate confidence in satisfying it <i>High.</i> Have good understanding of this type of requirement and good confidence in satisfying it <i>Very High.</i> Have expertise with this type of requirement and confidence to deliver excellence in satisfying it	
Examine the greatest advances you have made in your design work to see if these suggest ways to maximize the effectiveness of your design processes. Begin by identifying which steps have yielded the greatest success to-date; then reflect on the effectiveness of these steps. In 200 to 300 words, explain: <ol style="list-style-type: none"> what actions produced the most significant advances in the quality of your design to-date, and how these actions were initiated, how these actions transformed or markedly advanced your work, and what this suggests about making design processes effective. 	
Describe what steps your team could use now to overcome a weakness in your design process. In 200 to 300 words, explain: <ol style="list-style-type: none"> what missing information, lack of ideas, or other obstacle is limiting quality of your design to-date, and what these limitations are, and what actions you should take to revisit earlier (perhaps much earlier) steps or explore new paths to overcome troublesome obstacles, and how these actions might markedly advanced your work. 	

Peer Feedback – Design Reflection

Requirement Type	Design Confidence Ratings									
	Ratings by Student					Ratings by Team				
	VL	L	M	H	VH	VL	L	M	H	VH
Satisfying user needs										
Technical feasibility										
Financial attractiveness										
Social acceptability										

Instructor Scoring – Design Reflection

SCORING: Strength in Design Process					
	1 <i>Novice</i>	2 <i>Beginner</i>	3 <i>Intern</i>	4 <i>Competent</i>	5 <i>Expert</i>
Analysis of Process	No clue about quality or causes of quality in design	Vague ideas about quality or causes of quality in design	Moderate grasp of design quality and causes of quality	Credible grasp of quality design and causes of quality	Insightful grasp of quality and causes of quality in design
Ways to Advancement	No idea how to make design processes effective	Vague ideas for making design processes effective	Tells how to make minor improvements to design processes	Defines ways to make substantive process gains	Identifies keys to make transformative advances in design

SCORING: Targeted Iteration					
	1 <i>Novice</i>	2 <i>Beginner</i>	3 <i>Intern</i>	4 <i>Competent</i>	5 <i>Expert</i>
Challenge to Quality	No idea of obstacle or its impacts on quality	Vague idea of obstacle and/or its impacts on quality	General grasp of obstacle and its impacts on quality	Good grasp of obstacle and how it limits design quality	Fully understands obstacle; insightful on quality impacts
Action Plan and Results	No plan or goals unclear; results very unlikely	Vague plan or weak goals; results unlikely	Reasonable plan and goals; minor results likely	Clear, strong plan and goals; sizable results likely	Impressive plan and goals; major advances likely

SOLUTION ASSETS ASSESSMENTS

Defined Problem Assessment

Solution Assets are major deliverables that build toward a final design solution. The normal sequence is: defined problem, selected concept, and proposed solution; however, each of these is affected by the others. Thus, the Solution Assets assessments include some common components to document possible changes that occur as the solution development process continues.

Student Assignment – Defined Problem

ASSIGNMENT: DEFINED PROBLEM
<p>Your team should prepare a formal written definition of the problem you are solving, for review by project stakeholders. As a proposal for continuing your design project, it should at least summarize the following: your project and results expected, your analysis of stakeholder needs, and your derived design specifications.</p> <p>Your instructor will specify the required sections in this report and give instructions for the form in which this information is to be submitted.</p>
<p>To communicate your project effectively to others, you need to explain it in words that are meaningful to your audience (instructor, students, sponsor, society, etc.). In the space below, write a 100 to 200 word paragraph that describes the problem or opportunity being addressed, what will be delivered by your design team, and the benefits that should come from your solution. Show your understanding of the core problem, the solution, and benefits offered by the solution. The quality of your writing will also be evaluated.</p>
<p>Design solutions must satisfy the needs of a broad set of “stakeholders” to be successful.</p> <p>A <u>stakeholder</u> is any person or group that has an interest, investment, or share in the project. Examples include investors, management, end users, manufacturers, suppliers, society, etc.</p> <p>A <u>need</u> is a stated desire, often very general. Examples include: cost-effective, attractive, safe</p> <p>For each stakeholder category (user or customers, business or financial, technical, society or organizations), identify persons or groups (and number of people) queried to determine their needs. Then list the most important needs they identified (using their terminology).</p>
<p>Identify the most important specifications to be met by your solution. Be specific so these can be used to determine your solution’s success. When possible, cite standards, codes, or norms to be met.</p> <p>A <u>specification</u> is a performance target that can be used to judge the success of your solution.</p> <p>For each specification, provide:</p> <ul style="list-style-type: none">(a) a brief definition or description of the specification(b) a value or target evidencing when the specification has been achieved(c) an importance weighting: 10 = essential, 8 = important, 5 = moderately important, 1 = unnecessary(d) an estimate of achievability: 10 = achieved, 8 = certain, 5 = fairly certain, 3 = unlikely, 1 = impossible(e) status: N = new, G = greatly revised, M = moderately revised, U = unchanged

Instructor Scoring – Defined Problem

SCORING: Executive Summary					
	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
Problem or Opportunity	Uninformed; too broad, narrow, or off-target	Vague understanding; questionable details	Fair understanding; some reputable detail	Good understanding; substantive good detail	Superb understanding; extensive proven detail
Solution Envisioned	Very vague idea; no vision for applicability	General idea; simple vision for usefulness	Good idea; reasonable vision for usefulness	Feasible solution; good vision for usefulness	Superb solution; clearly useful, feasible
Benefits of Solution	Unlikely or very limited benefits possible	Small benefits; very narrow beneficiaries	Moderate benefits; narrow beneficiaries	Good benefits; multiple varied beneficiaries	Many varied benefits; many beneficiaries
Writing Quality	Many errors; not understandable	Several errors; unclear; not interesting	Few errors; clear; somewhat interesting	Very few errors; clear; very interesting	Error-free; clear; highly attractive, compelling

SCORING: Stakeholder Needs						
<i>Group</i>	<i>Factor</i>	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
VOICE OF CUSTOMER (users)	Group Sampling	Omitted most or all important members	Included few important members	Included some important members	Included most key & some other members	Expertly sampled key members & others
	Understanding of Needs	Narrow and very shallow grasp	Somewhat narrow and shallow grasp	Good grasp, possibly narrow or shallow	Very good grasp; few minor gaps remain	Thorough grasp; defensible data
VOICE OF BUSINESS (financial)	Group Sampling	Omitted most or all important members	Included few important members	Included some important members	Included most key & some other members	Expertly sampled key members & others
	Understanding of Needs	Narrow and very shallow grasp	Somewhat narrow and shallow grasp	Good grasp, possibly narrow or shallow	Very good grasp; few minor gaps remain	Thorough grasp; defensible data
VOICE OF TECHNOLOGY (technical)	Group Sampling	Omitted most or all important members	Included few important members	Included some important members	Included most key & some other members	Expertly sampled key members & others
	Understanding of Needs	Omitted most or all important members*	Included few important members*	Included some important members*	Included most key & some other members*	Expertly sampled key members & others*
VOICE OF SOCIETY (social)	Group Sampling	Omitted most or all important members	Included few important members	Included some important members	Included most key & some other members	Expertly sampled key members & others
	Understanding of Needs	Omitted most or all important members*	Included few important members*	Included some important members*	Included most key & some other members*	Expertly sampled key members & others*

SCORING: Solution Specifications						
		<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
QUALITY	Clarity	Ill-defined; not measurable	Vague; general expectations	Ok description, not quantitative	Clear targets, some measurable	Specific measurable performance targets
	Abstractness	Prevents any creativity, flexibility	Limits creativity and flexibility	Allows some creativity, flexibility	Enables creative approaches	Encourages creative approaches
COMPLETENESS	Functionality	Ignores most important needs	Addresses few important needs	Addresses several important needs	Addresses most vital needs, some others	Addresses all vital, many other needs
	Financial	Ignores financial needs, opportunities	Vaguely mentions cost limitations	Sets cost limits for project budget	Sets project budget and ROI target	Sets budget, ROI; targets opportunities
	Feasibility	Ignores most important issues	Addresses few important issues	Addresses several important issues	Addresses most vital issues, some others	Addresses all vital, many other issues
	Social Impact	Ignores major social & safety issues	Vaguely mentions social, safety issues	Defines some social, safety requirements	Cites important codes for compliance	Embraces all relevant codes & standards

Instructor provides comments and suggestions for improvement.

Selected Concept Assessment

Student Assignment – Selected Concept

ASSIGNMENT: SELECTED CONCEPT
<p>As a team, prepare a formal conceptual design report that justifies continuation of your design project. Document your team's concept generation and concept selection achievements. Present your selected design concept with detail to demonstrate how it meets functional, economic, technical, and societal needs. The report should present your selected concept and defend its viability for satisfying project requirements.</p> <p>Your instructor will provide you instructions regarding the (written or oral) format of your selected concept report. Your presentation quality, technical content, and appearance should be suitable for a professional proposal.</p>
<p>To gain attention of busy people, you need to communicate your project's potential benefits clearly and compellingly. Write a revised 100 to 200 word description of your project and its likely benefits. Demonstrate your understanding of the need being addressed, the potential solution, and promising benefits to users, investors, support personnel, and society. The quality of your writing will be evaluated.</p>
<p>Often as concepts are identified, refined, and selected, earlier definitions of solution specifications are better understood and revised. In the table below, please list your revised specifications (description and target) and assess their potential for yielding a quality design solution. Use the following definitions to complete the corresponding column for each specification:</p> <p>Weighting: 10 = essential, 8 = important, 5 = moderately important, 1 = unnecessary Achievability: 10 = achieved, 8 = certain, 5 = fairly certain, 3 = unlikely, 1 = impossible Status: N = new, G = greatly revised, M = moderately revised, U = unchanged</p>
<p>Creative, viable concepts for a design solution or component parts may arise from many and varied sources. In the spaces below, please document your team's ten most valuable ideas and their sources.</p> <p>What was the wackiest idea generated by your team (even if not in top 10)? Describe it. Approximately how many design concepts did your team record? ____ Consider seriously? ____</p>
<p>Please describe the design concept selected by your team for continued development. In 300 to 400 words:</p> <p>(a) describe its key components and how they fit together to provide the potential solution desired, (b) explain how critical requirements are met (functional, financial, technical, and social/legal).</p>

Instructor Scoring – Selected Concept

SCORING: Executive Summary					
	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
Problem or Opportunity	Uninformed; too broad, narrow, or off-target	Vague understanding; questionable details	Fair understanding; some reputable detail	Good understanding; substantive good detail	Superb understanding; extensive proven detail
Solution Envisioned	Very vague idea; no vision for usefulness	General idea; simple vision for usefulness	Good idea; reasonable vision for usefulness	Feasible solution; good vision for usefulness	Superb solution; clearly useful, feasible
Benefits of Solution	Unlikely or very limited benefits possible	Small benefits; very narrow beneficiaries	Moderate benefits; narrow beneficiaries	Good benefits; multiple varied beneficiaries	Many varied benefits; many beneficiaries
Writing Quality	Many errors; not understandable	Several errors; unclear; not interesting	Few errors; clear; somewhat interesting	Very few errors; clear; very interesting	Error-free; clear; highly attractive, compelling

		SCORING: Solution Specifications				
		<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
QUALITY	Clarity	Ill-defined; not measurable	Vague; general expectations	Ok description, not quantitative	Clear targets, some measurable	Specific measurable performance targets
	Refinement	No additions or improvements	Very minor tweaks; minor improvement	One or more notable improvements	Several revisions cause improvement	Several revisions; some transformative
COMPLETENESS	Functionality	Ignores most important needs	Addresses few important needs	Addresses several important needs	Addresses most vital needs, some others	Addresses all vital, many other needs
	Financial	Ignores financial needs, opportunities	Vaguely mentions cost limitations	Sets cost limits for project budget	Sets project budget and ROI target	Sets budget, ROI; targets opportunities
	Feasibility	Ignores most important issues	Addresses few important issues	Addresses several important issues	Addresses most vital issues, some others	Addresses all vital, many other issues
	Social Impact	Ignores major social & safety issues	Vaguely mentions social, safety issues	Defines some social, safety requirements	Cites important codes for compliance	Embraces all relevant codes & standards

		SCORING: Concepts Generated				
<i>Group</i>	<i>Factor</i>	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
CONCEPTS	Number of Ideas	Very few (possibly <10)	Small number (possibly <20)	Moderate (possibly ~50)	Many ideas (possibly ~100)	Very many (possibly >100)
	Relevance to Needs	Vaguely related to overall need, not to components	Vaguely related to overall & few component needs	Moderately related to overall & some component needs	Clearly related to overall and most component needs	Well focused on overall and all key component needs
	Creativity in Ideas	Little or no creativity evident in ideas	Moderate creativity in a few ideas	Moderate creativity in several areas	Good creativity in several areas	Impressive creativity in many areas
SOURCES	External	Little or no use of external sources	Very few outside sources used	Moderate use of few outside sources	Good use of several outside sources	Effective use of many outside sources
	Internal	Very little use of team and members	Moderate use of team or individual members	Moderate use of team & individual members	Good use of team & individual members	Effective, synergistic use of team members

		SCORING: Concept Selected				
<i>Group</i>	<i>Factor</i>	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
DESCRIPTION	Clarity	Vague, confusing; not understandable	Some parts ok; some parts unclear	Generally understandable	Overall and parts understandable	Very clear; gives deep understanding
	Integration	Relationship among parts very confusing	Several parts do not seem to fit the whole	Most parts fit into a working whole	All parts fit into an integrated whole	Integration of parts is effective, beautiful
JUSTIFICATION	Function	No explanation how function will be met	Inferences that function will be met	Simple analysis that function will be met	Good analysis predicts function met	Solid case proves function will be met
	Financial	No mention of solution finances	Unjustified claims that costs reasonable	Uses costs to justify concept	Uses cost/benefit to justify concept	Uses life-cycle cost/benefit of concept
	Technical	Ignores technical/feasibility of concept	Lightly discusses feasibility of concept	Defends at least one aspect of feasibility	Defends multiple aspects of feasibility	Strong evidence for key feasibility aspects
	Social	Ignores social, legal, safety issues	Vaguely explains one social dimension	Defends concept in multiple social areas	Good defense in key social dimensions	Solid defense in all key social dimensions

Instructor provides written comments and suggestions for improvement.

Proposed Solution Assessment

Student Assignment – Proposed Solution

ASSIGNMENT: PROPOSED SOLUTION	
<p>As a team, prepare a formal written detail design report in the form of a proposal justifying implementation of your proposed solution. Begin with a brief introduction that includes your initial problem statement, your stakeholders, your design specifications, and the concept selected. Then fully describe your processes for producing the final solution: selecting component parts of your solution, evaluating their adequacy, synthesizing them into an integrated whole, and validating the quality of the proposed solution. Next, present your proposed solution with details that give evidence of the desired performance, financial returns, feasibility for implementation, and social impacts articulated in your design specifications. Conclude with recommendations for effectively advancing the proposed solution to the next stage of design: implementation of the solution.</p> <p>Your instructor will specify the (written and/or oral) format of your report(s) to present your proposed solution and to defend its viability. Your report(s) should exhibit communication quality, technical content, and appearance of a professional proposal.</p>	
<p>To gain attention of busy people, you need to communicate your project's potential benefits clearly and compellingly. Write a revised 100 to 200 word description of your project and its likely benefits. Demonstrate your understanding of the need being addressed, the potential solution, and promising benefits to users, investors, support personnel, and society. The quality of your writing will also be evaluated.</p>	
<p>Often as concepts are identified, refined, and selected, earlier definitions of solution specifications are better understood and revised. Please list your revised specifications (description and target) and assess their potential for yielding a quality design solution. Use the following definitions for characterizing each specification:</p> <p>Weighting: 10 = essential, 8 = important, 5 = moderately important, 1 = unnecessary Achievability: 10 = achieved, 8 = certain, 5 = fairly certain, 3 = unlikely, 1 = impossible Status: N = new, G = greatly revised, M = moderately revised, U = unchanged</p>	

Instructor Scoring – Proposed Solution

SCORING: Executive Summary					
	<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
Problem or Opportunity	Uninformed; too broad, narrow, or off-target	Vague understanding; questionable details	Fair understanding; some reputable detail	Good understanding; substantive good detail	Superb understanding; extensive proven detail
Solution Envisioned	Very vague idea; no vision for applicability	General idea; simple vision for usefulness	Good idea; reasonable vision for usefulness	Feasible solution; good vision for usefulness	Superb solution; clearly useful, feasible
Benefits of Solution	Unlikely or very limited benefits possible	Small benefits; very narrow beneficiaries	Moderate benefits; narrow beneficiaries	Good benefits; multiple varied beneficiaries	Many varied benefits; many beneficiaries
Writing Quality	Many errors; not understandable	Several errors; unclear; not interesting	Few errors; clear; somewhat interesting	Very few errors; clear; very interesting	Error-free; clear; highly attractive, compelling

SCORING: Solution Specifications						
		<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
QUALITY	Clarity	Ill-defined; not measurable	Vague; general expectations	Ok description, not quantitative	Clear targets, some measurable	Specific measurable performance targets
	Refinement	No additions or improvements	Very minor tweaks; minor improvement	One or more notable improvements	Several revisions cause improvement	Several revisions; some transformative
COMPLETENESS	Functionality	Ignores most important needs	Addresses few important needs	Addresses several important needs	Addresses most vital needs, some others	Addresses all vital, many other needs
	Financial	Ignores financial needs, opportunities	Vaguely mentions cost limitations	Sets cost limits for project budget	Sets project budget and ROI target	Sets budget, ROI; targets opportunities
	Feasibility	Ignores most important issues	Addresses few important issues	Addresses several important issues	Addresses most vital issues, some others	Addresses all vital, many other issues
	Social Impact	Ignores major social & safety issues	Vaguely mentions social, safety issues	Defines some social, safety requirements	Cites important codes for compliance	Embraces all relevant codes & standards

		SCORING: Proposed Solution				
		<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
PROOF OF PERFORMANCE	Functions considered	Very few, little breadth	Few, some breadth	Several, good breadth in types	Many, good breadth and measures	Many, insightful breadth & measures
	Analysis	No analysis; opinions only	Little analysis; vague inferences	Some analysis; simplistic methods	Good analysis; valid methods	Extensive analysis; best methods
	Strength of evidence	No evidence to support claims	Shallow evidence to support claims	Good evidence for some claims	Good evidence for all critical claims	Defensible evidence for important claims
PROOF OF PROFITABILITY	Development costs	Major concern; not defined	Moderate concern; weak justification	Minor concern; need clarification	Reasonable; good justification	Attractive; sound; fully justified
	Cost/benefit ratio	Major concern; not defined	Moderate concern; weak justification	Minor concern; need clarification	Reasonable; good justification	Attractive; sound; fully justified
	Market potential	Lacks potential to fit a market	Minor potential to fit a market	Some potential to reach a market	Good potential to serve a market	Likely to serve a growing market
PROOF OF FEASIBILITY	Producibility	Major concern; known problems	Moderate concern; expected problems	Minor concern; possible problems	No concern; known problems solved	Attractive; methods fully documented
	Usability	Major concern; known problems	Moderate concern; expected problems	Minor concern; possible problems	No concern; known problems solved	Attractive; usability fully documented
	Serviceability	Major concern; known problems	Moderate concern; expected problems	Minor concern; possible problems	No concern; known problems solved	Attractive; servicing fully documented
PROOF OF IMPACT	Environment	Possible serious negative impacts	Possible moderate negative impacts	Possible minor negative impacts	Likely only positive impacts	Certainly only positive impacts
	Legal/political	Possible serious negative impacts	Possible moderate negative impacts	Possible minor negative impacts	Likely only positive impacts	Certainly only positive impacts
	Health & safety	Possible serious negative impacts	Possible moderate negative impacts	Possible minor negative impacts	Likely only positive impacts	Certainly only positive impacts

		SCORING: Written Communication				
		<i>1 Novice</i>	<i>2 Beginner</i>	<i>3 Intern</i>	<i>4 Competent</i>	<i>5 Expert</i>
CONTENT EFFECTIVENESS	Completeness	Major sections absent/incomplete	Several crucial elements omitted	Nearly complete; some omissions	Largely complete; minor omissions	Complete in every detail
	Organization	Unclear; confusing	Difficult to follow	Can be followed	Easy to follow	Intuitive, inviting
	Effectiveness	Nearly pointless	Unclear message	Understandable	Credible, effective	Explicit, compelling
WRITING MECHANICS	Grammar, spelling, etc.	Many serious errors	Several errors	Few errors	Almost perfect	Flawless
	Style and tone	Inappropriate	Distracting	Acceptable	Effective	Tuned to reader
PROFESSIONAL STANDARDS	Crediting	No citations or all incomplete	Inadequate number and quality	Adequate in number and/or quality	Good number, quality, and use	Credible, complete; proficient use
	Appearance	Unacceptable	Amateurish	Common	Appealing	Professional

Instructor provides written comments and suggestions for improvement.

SCORING: Team Oral Presentation						
		<i>1</i> <i>Novice</i>	<i>2</i> <i>Beginner</i>	<i>3</i> <i>Intern</i>	<i>4</i> <i>Competent</i>	<i>5</i> <i>Expert</i>
CONTENT	Introduction	Absent, distracting, or inappropriate	Unappealing; incomplete; plain	Interesting; generally adequate	Inviting; largely adequate	Captivating; all aspects attractive
	Message content	Largely unclear; lacks substance	Portions unclear; little substance	Mostly clear; good substance	Clear; points well supported	Abundantly clear; fully substantiated
	Message organization	Broken, confusing; disorderly	Difficult to follow; aspects unclear	Can be followed; minor confusion	Easily followed without difficulty	Abundantly clear; intuitive, engaging
	Conclusion	Absent or only inferred	Weak; largely missing; vague	Satisfactory; basic summary	Good summary, presents case	Gripping summary and call to action
VISUAL AIDS	Quality	Poor; misleading	Ok; little information	Good; informative	Good; instructional	Superb; insightful
	Utilization	Very distracting	Minor distraction	Neutral to message	Aids message	Empowers message
IMPACT	Understanding	Caused confusion	General knowledge	Good grasp	Strong grasp	Valuable insights
	Audience response	Reject proposal	Not likely to act	May act favorably	Will act favorably	Embrace proposal

When scores are to be assigned to each person participating in a team presentation, the following information is used in combination with the team rating above to determine an individual's score.

SCORING: INDIVIDUAL ORAL PRESENTATION		
PRESENTER NAME	RATING	COMMENTS ON STRENGTHS OR AREAS TO IMPROVE

Use the following rating definitions to guide making an overall rating (1 to 5) for each presenter in the table above.

Factors	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
Grammar/wording	Many serious errors	Several errors	Few errors	Almost perfect	Flawless; precise
Voice/tone	Inappropriate	Distracting	Appropriate	Effective	Tuned to listener
Appearance	Embarrassing	Unappealing	Neutral; acceptable	Appealing; good	Professional, nice
Rapport	Distant; negative	Not inviting	Slightly engaging	Engaging	Highly engaging

ASSESSMENT VALIDATION PLAN

TIDEE assessments have been pilot tested in capstone design courses of project collaborators during their development and refinement. Beginning in fall 2008, assessment data is being collected for a comprehensive validation of the assessments. The validation study underway is summarized below.

Types of Validity

Several types of validity will be investigated:

1. Content validity
Relevance and completeness of the assessment's content in meeting the needs/purposes of the stakeholders (instructors, students, industry, programs, accrediting bodies)
2. Concurrent criterion validity
Comparisons of assessment results with other performance indicators (e.g., tests, instructor observations, judgments of student performance by outside "experts")
3. Value to stakeholders
Judgments from stakeholders indicating the value of the assessments to them, for their needs
4. Implementation factors
Identifying implementation and use issues/concerns with the assessments, and getting judgments from users as to the degree of each and suggestions for improvements
5. Reliability
Analysis of (a) the overall assessment reliability and the internal consistency of individual items and subsections, and (b) the consistency of scores from multiple raters (including trained raters (outside faculty), course instructors, and graduate students .

Methods

Methods used to collect validity evidence are given below.

- A. Data analysis of student scores
Will be used to collect the following evidence:
 - Reliability
 - Concurrent criterion validity; this may include:
 - Correlations between different TIDEE assessments (e.g., design processes to solution assets; growth planning to growth progress and then to growth achieved; one performance area to another; etc.)
 - Correlations of assessments to course grades
 - Correlations of assessments to external judges (e.g., for team presentations)
- B. Focus groups
Will be conducted with (1) industry engineers, (2) students in a graduate course on design learning, (3) faculty not associated with the project. Will be used to collect the following evidence:
 - Content validity
 - Value to stakeholders
- C. Post-Assessment questionnaires
Will be administered to students and instructors as they complete each assessment (following the feedback process). Will be used to collect the following evidence:

- Content validity
- Implementation factors
- Value to stakeholders

D. Exit interviews

Will be conducted at end of project with students and instructors currently using the assessments.

Will be used to collect the following evidence:

- Content validity
- Implementation factors
- Value to stakeholders

E. Exit surveys

Will be conducted at end of project with students and instructors currently using the assessments.

Will be used to collect quantitative ratings on individual assessment instruments:

- Content validity
- Implementation factors
- Value to stakeholders

Therefore, content validity will be addressed by (1) post-assessment questionnaires to students and instructors, (2) exit interviews with students and instructors, (3) exit survey with students and instructors, and (4) focus groups with engineers, Graduate students, and outside faculty. This is similar for each of the other pieces of evidence.

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