Innovation Portal / Engineering Design Process Portfolio Scoring Rubric
Element goals with Reflective Questions

What should I be trying to communicate in each element of my portfolio?

Component I: Identifying, Articulating, and Justifying a Problem

The Element Title - **Element A**: Identification and definition of the problem

Reflective Question - ***What exactly is the problem I/we have found and where did the information to create the problem statement come from?***

A "5" from the Rubric - "The problem is clearly and objectively identified and defined with considerable depth and consistent precision of detail as elaboration"

The Element Title - **Element B**: Justification of the problem

Reflective Question - ***Who in fact says that this really is a "problem" that needs to be solved and why should anyone believe them?***

A "5" from the Rubric - "The justification addresses all angles or aspects of the problem (producer, distributor, consumer, end-user) and is based on comprehensive, timely, and consistently credible sources; it offers consistently objective detail from which goals and measurable design parameters can be determined"

The Element Title - **Element C**: Documentation and analysis of past and current solution attempts

Reflective Question - ***What are all of the methods, or actions that are being used or have been developed to try and solve this problem and exactly why doesn't each of them really solve the problem?***

A "5" from the Rubric - "Documentation of past and current attempts to solve the problem is drawn from a wide array of clearly identified and consistently credible sources; the analysis of past and current attempts to solve the problem—including both strengths and shortcomings—is consistently clear, detailed, and supported by data (measurable)"

The Element Title - **Element D**: *Identification, definition, and justification of solution design goals, parameters and constraints*

Reflective Question - ***Now that I know what the problem is and why current solutions are not solving the problem well enough, what are the measurable things a new design would have to accomplish to be seen as a real solution (in order of importance) and how did I/we determine these design goals?***

A "5" from the Rubric - "Design goals, parameters, and constraints are all clearly listed, formatted, prioritized and detailed; these design goals, parameters, and constraints presented are consistently objective, measurable, and would with certainty lead to a tangible and viable solution to the problem identified; there is evidence that goals, parameters, and constraints have been validated by multiple qualified representatives of end-users, stakeholders, and field experts"

Component II: Generating an Original Solution

The Element Title - **Element E**: *Demonstration of design process thinking and analysis*

Reflective Question - ***What brainstorming or idea generation techniques did I/we use to help define a possible solution and how can it be shown that I/we kept all of the design goals in mind throughout the entire process?***

A "5" from the Rubric - "The process for generating and verifying possible design solutions was comprehensive, deeply iterative, and consistently defensible, virtually ensuring a viable and well-justified design directly and objectively based upon the design parameters; the plan of action has considerable merit and easily supports repetition and testing for effectiveness by others"

The Element Title - **Element F**: *Application of mathematics, science, and engineering principles*

Reflective Question - **How do I/we show that the initial ideas have merit to try and that we are not just proposing a trial and error only process for developing a prototype?**

A "5" from the Rubric - "Technical understanding of the problem and justification of the merit of the design as a possible solution to that problem are substantiated with considerable references to math, science, and engineering principles related to the design constraints, project goals, and design criteria; All functional claims of the proposed solution are supported with sound and detailed content evidence; the review and verification [validation] of that evidence by two or more experts (qualified consultants and/or project mentors) is provided"

The Element Title - **Element G**: *Demonstration of design viability*

Reflective Question - ***How do I/we know that if the proposed design is developed, that it has sincere merit beyond the lab as a real solution? Could the proposed solution design realistically get into the hands of the people the design is trying to help and how do I/we know that?***

A "5" from the Rubric - "There is substantial credible evidence provided that the proposed design can be developed and implemented in a functional and sustainable manner; detailed documentation of review of a basic production and marketing plan by two or more qualified professionals is included"

Component III: Constructing a Testable Prototype or Process

The Element Title - **Element H**: *Demonstration of sufficiency of prototype design process*

Reflective Question - **How do I/we show and explain the process used to move from "idea to mock-up to testable attribute" for each of the design goals?**

A "5" from the Rubric - "The prototype design process involved substantial purposeful and test-driven iteration; it was supported by clear and thorough explanation of the choices made as the design evolved and of how the final iteration could be improved for testing purposes; the prototype design process facilitated testing by suitable means (e.g., physical and/or mathematical modeling) to the fullest extent realistically possible so that the solution design addresses all of what should be considered primary goals"

The Element Title - **Element I:** *Demonstration of sufficiency of final prototype iteration*

Reflective Question - ***How can I/we explain and prove to others that if tested the final prototype design or prototyping process will be able to yield real evidence of how well the design met each of the goals of the project?***

A "5" from the Rubric - "The final prototype iteration is clearly and fully explained and is constructed with enough detail to assure that some level of objective data demonstrating the success with which each stated goal has been met can be determined through testing, mathematical modeling, or detailed expert reviews; all attributes of the unique solution that could be tested or modeled mathematically are addressed in the prototyping design, and a well-supported justification is provided for those that cannot be tested or modeled mathematically and thus require expert review"

The Element Title - **Element J**: *Demonstration of sufficiency of testing*

Reflective Question - ***How do I/we explain and justify the testing process used to learn the effectiveness of each of the goals of this design? Why would anyone believe that my/our testing procedures had merit to try?***

A "5" from the Rubric - "The testing procedure targeted each of the stated design goals and provided a consistently clear and logical explanation of how it would yield objective data regarding the effectiveness of the design after opportunity for professional review; the explanation of the results of multiple trials is fully supported with numerous appropriate pictures, graphs, and/or charts and there is substantial documentation that testing data was reviewed by a mentor in the science field; a consistently detailed plan for improvement of each portion of the testing based upon lessons learned during the testing process was formulated and attempted wherever possible"

Component IV: Analyzing Test Data

The Element Title - **Element K**: *Analysis of the design based on testing*

Reflective Question - **What did I/we learn from testing about how well this design met the stated goals? How well do I/we trust the data and why?**

A "5" from the Rubric - "The analysis of the effectiveness with which the design met stated goals includes a consistently detailed explanation [and summary] of the data from each portion of the testing procedure and from expert reviews, generously supported by pictures, graphs, charts and other visuals; the analysis is enhanced by comprehensive reflection on the quality of test data and their interpretation and a substantive and suitable plan of action as a consequence of that reflection; the analysis includes an overall summary of the implications of all data for proceeding with the design and solving the problem"

The Element Title - **Element L**: *Documentation of end user and stakeholder evaluation (external evaluation)*

Reflective Question - ***What to the experts and end-users related to this project think of the testing results and my/our conclusions about the effectiveness of this design solution?***

A "5" from the Rubric - "Documentation of project evaluation by multiple, demonstrably qualified end-users, stakeholders, and field experts is consistently specific, detailed, and thorough, and is sufficient in at least one category to yield a statistically significant analysis of that evaluation data; evaluations consistently include specific questions, concerns, and opinions regarding each part of the testing procedure and data analysis"

Component V: Reflecting and Formulating Recommendations

The Element Title - **Element M**: *Reflection on the project design*

Reflective Question - ***If I/we were going to do this project over should be done to improve the value or reliability of the current results?***

A "5" from the Rubric - "The project designer(s) provides a consistently clear, insightful, and comprehensive reflection on, and value judgment of, each major step in the project; the reflection includes a substantive summary of lessons learned that would be clearly useful to others attempting the same or similar project"

The Element Title - **Element N**: Presentation of designer's recommendations

Reflective Question - ***What could be done to improve this design and what insight or advice could I/we give to anyone who wanted to attempt these recommendations?***

A "5" from the Rubric - "The project designer includes consistently detailed and salient recommendations regarding the conduct of the same or similar project in the future; recommendations include caveats as warranted and specific ways the project could be improved with consistently detailed plans for the implementation of those improvements"

Component VI: Documenting and Presenting the Project

(Not included in the e-portfolio as a navigation or Element tab but rather used to assess the portfolio as a whole)

The Element Title - **Element O**: Presentation of the project portfolio

Reflective Question - **Can anyone who reviews this portfolio clearly understand each component and the work as a whole without further explanation?**

A "5" from the Rubric - "The portfolio provides consistently clear, detailed, and extensive documentation of the design process and project that would with certainty facilitate subsequent replication and refinement by the designer(s) and/or others; attention to audience and purpose was abundantly evident in the choice of mode(s) of presentation, professionalism of style and tone, and the variety, quality, and suitability of supporting materials"

The Element Title - **Element P**: Writing like an Engineer

Reflective Question - ***Were the explanations, descriptions and text based information written with the reviewer in mind?***

A "5" from the Rubric - "Abundant evidence of the ability to write consistently clear and well organized texts that are developed to the fullest degree suitable for the audience and purposes intended (to explain, question, persuade, etc.); texts consistently demonstrate the ability to adjust language, style and tone to address the needs and interests of a variety of audiences (e.g., expert, informed, general/lay audience) and to use a wide variety of forms which are commonplace among STEM disciplines (e.g., notes, descriptive/narrative accounts, research reports); where required by convention, appropriate documentation in standardized form (e.g., APA) is consistently evident."