

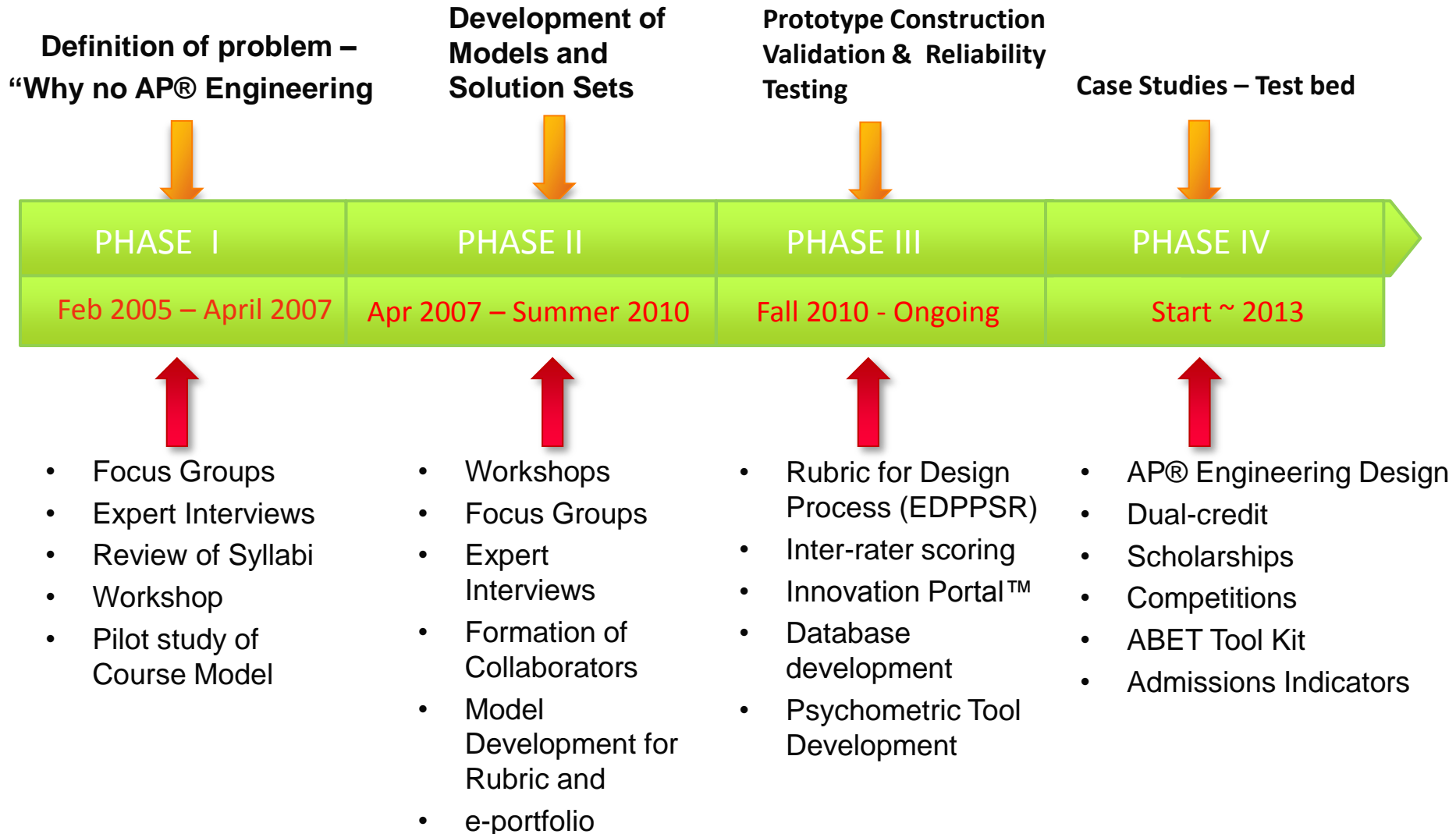
The Development and Implementation of a Potential AP for Engineering Design Using a Rubric-Based e-portfolio

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Phases and Timelines

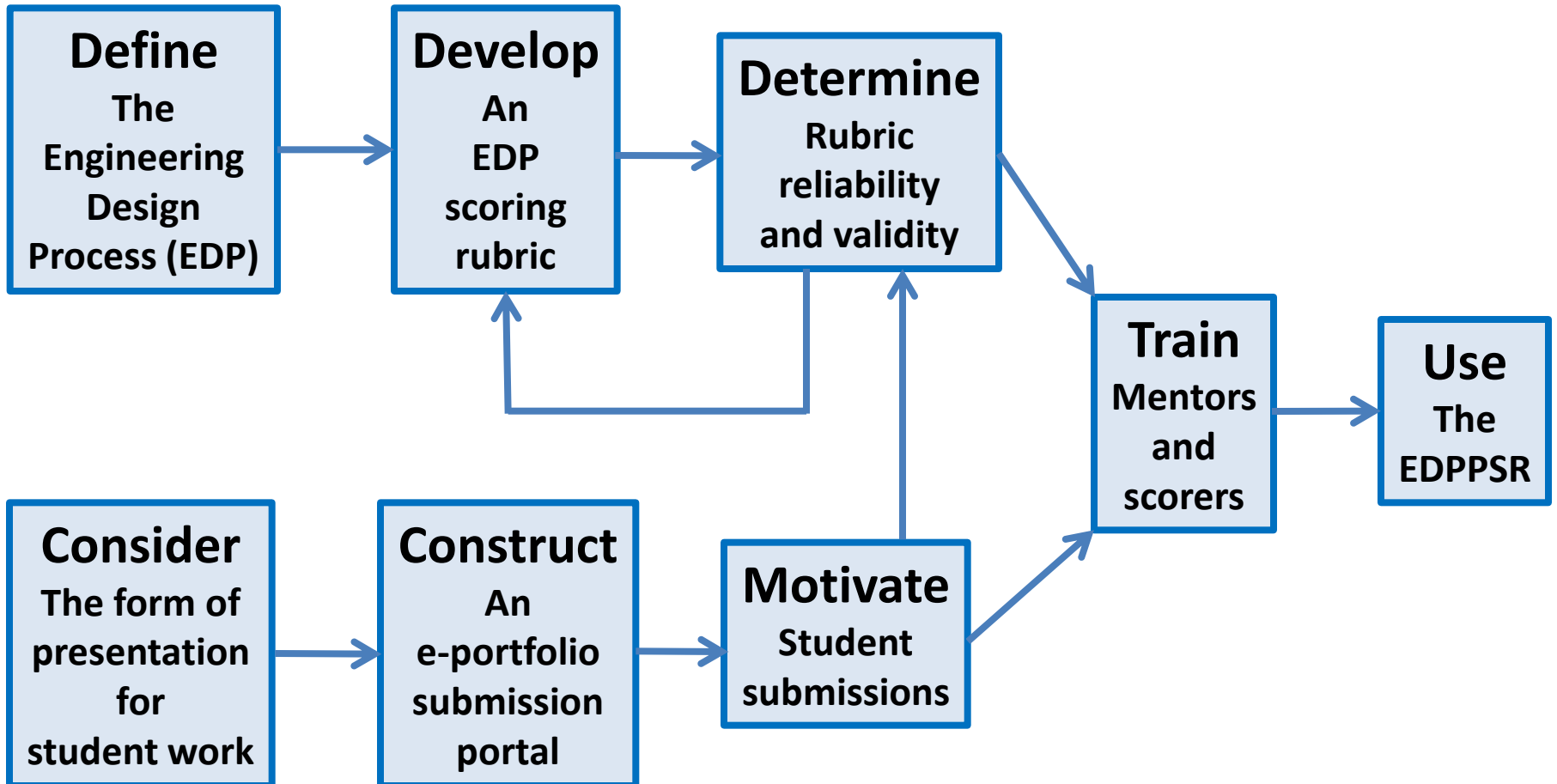
EDPPSR e-portfolio and Case Studies



Questions to Consider

- How can this rubric be applied?
- How might it impact the teaching and learning of Engineering Design?
- What is the greatest barrier to rubric use in secondary school programs (grades 9 – 12)?
- What is the best avenue for informing faculty about the rubric?
- If students matriculate with AP Engineering Design credit:
 - How might your program benefit/ change / be changed by enrolling such students?
 - How might your program apply the credit?
- When might your faculty want to learn more about this rubric and e-portfolio?

Construction of an Engineering Design Process Portfolio Scoring Rubric (EDPPSR)



The Motivation for Engineering

- **AP[®]** – Parents and school systems view AP[®] as a pathway to college placement and acceptance.
- **Weighted GPA** – Honors, gifted and talented, and AP impact the weighted average.
- **Inclusion** – Level the ‘playing field’ and increase diversity.
- **Align Project-based Activities** – Recognize student achievements in both formal and informal education settings.
- **Student learning trajectories** – Research and document for: design process, problem-solving, team work, and creativity.

The Research Reviewed

- **Existing standards and accreditation** for secondary and undergraduate Introductory *Engineering / Design courses and programs*
- **Existing preparatory pathways** including current AP®, International Baccalaureate and Dual-enrollment models.
- **Comparative analysis** of existing *Introduction to Engineering* and / or *Design* courses.
- **Bridging** of formal classroom courses to informal activities such as FIRST Robotics.
- **Preparation of teachers** in engineering and design content and assessment.
- **Assessments** that include rubrics and an electronic portfolio – perhaps **modeled after AP® Studio Art.**

Common Syllabi Elements

- **Design process**
- Problem solving
- Creative thinking
- Teaming
- Technical and engineering communications
- Ethics
- Basic computer tools
- Time management
- Project management
- Modeling
- Apply mathematics and science knowledge
- What it means to be an engineer
- Role in society

Synopsis of findings relative to design

- **Design** incorporates many of the Syllabi elements.
- **No single framework existed that could:**
 - **capture the design process** fully or well,
 - **Or benchmark each element** of the process to a commonly accepted set of referenced artifacts.
- Design is a **stepwise, artifact driven framework** typically practiced over time and is an iterative process.
- **Many informal and formal** opportunities to practice design.
- The Design Process is **not unique to Engineering – Architecture, Fashion, etc.**
- In essence, the learning and practice of design is an **apprenticeship process.**

The Relevance of the Portfolio

- Currently, a **student's transcript is the most widely applied and utilized model** for representing a student's learning and practice of the design process.
- However, **the transcript provides a series of one-dimensional, snapshots** or Grade Point Average – GPA.
- The assessment process most often used to generate the grade is a **multiple-choice test**, which for the past century, been central to the **definition of competency**.
- Given the **potential richness and complexity of evidence to demonstrate proficiency in the design process**, the **portfolio-based assessment** offers a promising alternative.

Toward AP Adoption

➤ Basic College Board Criteria

1. **Recognition and acceptance** by the post-secondary constituents. Willingness of large numbers of US higher education institutions to grant credit and exemption from an existing undergraduate course.
2. **Availability of professional development** and related curriculum and instructional resources for teachers.
3. A sustainable **financial model**.

About AP Courses & Exams

- **In 2011-2012 there are 34 Courses and Exams**
 - 3 Studio Art Subjects with Portfolio Assessments
 - 31 Subjects with 3 Hour Summative Exams
- **AP reported scores 1 through 5**
 - 5: Extremely well qualified (A)
 - 4: Well qualified (A-, B+, and B)
 - 3: Qualified (B-, C+, and C)
 - 2: Possibly qualified
 - 1: No recommendation
- **Cutpoints established** using college comparability studies and panel based standard setting.
- Need **Performance Level Descriptions** to clarify meaning

Launching an AP Subject

- Involves data gathering with Higher Ed and K-12
- Funding to support course development
- Exam development and piloting
- Teacher professional development
- Feasibility and business case analysis
- Colleges and universities agree to award credit/placement for successful exam scores
- Sufficient interest in the course and that schools have the ability and willingness to offer it

Evidence Centered Course & Exam Design Model

- Develop **curricular framework** based on claims of what students should know and be able to do and evidence that would demonstrate competency
- Develop **performance level descriptors** to describe what students in each category know and are able to do based on their test performance
- Develop **measurement tasks** to solicit evidence
- Create an **assessment framework**

Iterative process with ongoing validation

Evidence of Validity

- The curriculum and exam reflect engineering design courses and the assessment reliably and validly measures intended content. This might include:
- Content experts agree on importance of what's included in course
- Large scale curriculum study of first-year engineering courses

Evidence of Validity

- Strong positive correlations between assessment scores and grades in college engineering courses
- Students who take engineering course report feeling prepared for subsequent courses
- Empirical studies show that students who earn a high score on the exam perform well when placed directly into subsequent courses (longer-range goal)

Portfolio Assessments

- AP Studio Art courses have high-level content requirements but they do not have an in-depth curricular framework
- While this allows maximum flexibility and independence for teachers and students, we found that it would be beneficial for new faculty to have a curricular framework and supporting materials to use if desired
- Two optimal paths for creating a successful portfolio
 - Structured course in subject
 - Portfolio of work created based on independent project(s)
- How might you envision your college students contributing to our teaching materials and resources for the K-12 engineering community?

Developing an accessible e-portfolio resource

The screenshot shows the top section of the Innovation Portal website. At the top left is the logo for "InnovationPortal Beta" with a green and white circular graphic. To its right is the tagline: "Identify a Problem. Go after a solution. Document your work. Connect with Opportunities." Further right, there is a user account link: "My Portfolio | Mail, Logout" and a search bar with a "Search" button. Below this is a green navigation bar with links: "Home", "About the Innovation Portal", "Sponsors & Partners", "How to Use the Portal", "FAQs", and "Report Beta Testing Issues". Underneath the navigation bar are four buttons: "View", "Edit", "Track", and "Convert". The main content area features three images of students: a male student working on a circuit board, a female student smiling, and two male students working together on a project. To the right of these images is a text block: "The Innovation Portal enables ...students to create, maintain and share digital portfolios. The portfolios can be used to meet a class requirement or they can be used to submit the portfolio to a scholarship or open contest. The contest owners - or anyone else invited by the student - can evaluate a student's portfolio." Below this text is a call-to-action area with a dark grey button that says "Register Now!" and a green button that says "Sign In!". At the bottom of the page, there are four green boxes, each with an icon and a title: 1. "Project Resources" with a wrench icon, describing a collection of resources from instructors and professionals. 2. "How the Portal Works" with an information icon, explaining the organization around the engineering design process. 3. "Connect Your Organization" with a power icon, describing the standardized format for submission. 4. "Opportunities for Recognition" with a star icon, describing how the portfolio speaks volumes about talents and capabilities. Each box has a "Learn More" button at the bottom.

InnovationPortal Beta

Identify a Problem. Go after a solution.
Document your work. Connect with Opportunities.

My Portfolio | Mail, Logout

Search

Home About the Innovation Portal Sponsors & Partners How to Use the Portal FAQs Report Beta Testing Issues

View Edit Track Convert

The Innovation Portal enables
...students to create, maintain and share digital portfolios. The portfolios can be used to meet a class requirement or they can be used to submit the portfolio to a scholarship or open contest. The contest owners - or anyone else invited by the student - can evaluate a student's portfolio.

Register Now! or Sign In!

Project Resources
We collect resources, examples and advice from hundreds of instructors and design process professionals to help you build your portfolio.
[Learn More](#)

How the Portal Works
The IPortal is organized around the engineering design process itself, rather than specific lessons from a given course or curricula, ...
[Learn More](#)

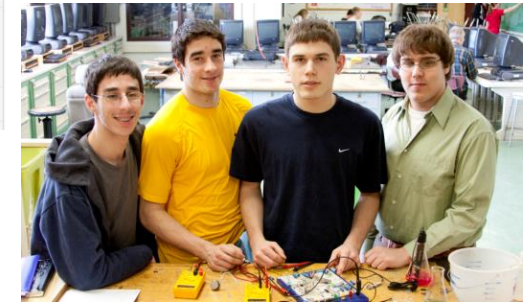
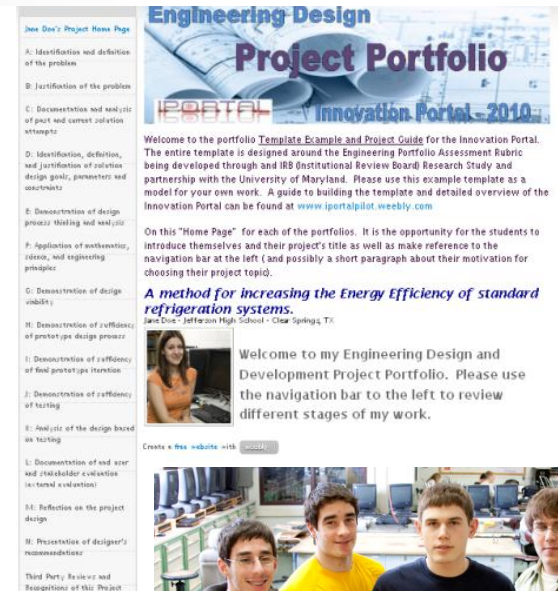
Connect Your Organization
The online and standardized format for submission of student work provides industry and post-secondary representatives with a cohesive, uniform product.
[Learn More](#)

Opportunities for Recognition
Your portfolio speaks volumes about your talents and capabilities. You can access contests and opportunities right from the Innovation Portal.
[Learn More](#)

www.innovationportal.org

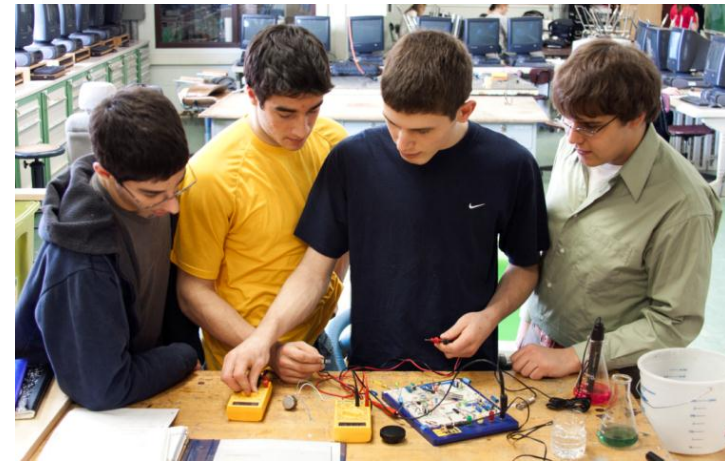
What makes the Innovation Portal special?

- Non-profit developed, higher education guided
 - Motivated by teachers
 - Available for anyone to use
 - Developed and maintained by PLTW
 - Repository + resource
 - Higher ed guidance on development
- Student centered
 - Students “own” their password protected accounts and data
 - Students control access and IP (teachers, scholarship committees, competition judges, AP reviewers)
- EDPPSR template for entire site



What has guided Portal development?

- Desire to build a functional, open access engineering design repository
- Internet accessible yet secure
- Accessible for multiple uses
- Standard guide for portfolio development (The EDPPSR)
- Opportunity to serve as a central “bulletin board” for:
 - Opportunity announcements
 - Teacher training materials



Create, organize, and manage portfolios

[Home](#)[About](#)[FAQ](#)[Resources & Examples](#)[News](#)[Contact Us](#)[Dashboard](#)[Profile & Password](#)[Announcements](#)[Report Problems](#)

Portfolios

[Create New Portfolio](#)

Your Portfolios

Title ▲

Created

University of Virginia ENGR 1520

10/21/2011 - 10:47

[Manage Members](#)

Other Portfolios

You have not yet accepted any invitations to another persons portfolio.

Pending Invites

Title

Role

Created

No pending invitations.

Building a portfolio

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University of Virginia ENGR 1520



Saved

[View](#)[Edit](#)

The design of the Innovation Portal allows the student users to either build their portfolio directly in the site or to upload critical documents and images for access by others.

Document:



Portfolio_Introduction.PDF

University of Virginia ENGR 1520

[Manage Portfolio Members](#)

[Snapshots](#) [Reviews](#)

[Submit to Opportunities](#)

Portfolio Elements

[Portfolio Home](#)

A [Presentation and justification of the problem](#)

[Resources](#)[EDPPSR](#)

B [Documentation and analysis of prior solution attempts](#)

[Resources](#)[EDPPSR](#)

C [Presentation and justification of solution design requirements](#)

[Resources](#)[EDPPSR](#)

D [Design concept generation, analysis, and selection](#)

[Resources](#)[EDPPSR](#)

E [Application of STEM principles and practices](#)

[Resources](#)[EDPPSR](#)

Building a portfolio

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Element C: Presentation and justification of solution design requirements



Saved

[View](#)[Edit](#)

Please see the pdf file below for the contents of this portfolio subsection.

Document:



Element C Presentation and justification of solution design requirements.PDF

University of Virginia ENGR 1520

[Manage Portfolio Members](#)[Snapshots](#) [Reviews](#)[Submit to Opportunities](#)

Portfolio Elements

[Portfolio Home](#)

A Presentation and justification of the problem

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[Resources](#)[EDPPSR](#)

F Consideration of design viability

[Resources](#)[EDPPSR](#)

Connecting to resources...

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Element C Resources - Presentation and justification of solution design requirements



These resources and examples are specific to helping students develop a comprehensive and robust portfolio entry for Element C

"Presentation and justification of solution design requirements"

EXAMPLES: Annotated Portfolio Examples for Element C

1. Snow Clear LED Traffic Signal Visor - (PDF) averaged reviewer score = 1
- 2.
- 3.

IDEAS and RESOURCES: Presentation and justification of solution design requirements

and the rubric

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Presentation and justification of solution design requirements

Score	Description
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5	Design requirements are listed and prioritized, and they are consistently clear and detailed; these design requirements presented are consistently objective, measurable, and they would be highly likely to lead to a tangible and viable solution to the problem identified; there is evidence that requirements represent the needs of, and have been validated by, many if not all primary stakeholder groups.
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4	Design requirements are listed and prioritized, and they are generally clear and detailed; these design requirements presented are nearly always objective and measurable, and they would be likely to lead to a tangible and viable solution to the problem identified; there is evidence that requirements represent the needs of, and have been validated by, several primary stakeholder groups.
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3	Design requirements are listed and prioritized, and they are generally clear and somewhat detailed; these design requirements presented are generally objective and measurable, and they have the potential to lead to a tangible and viable solution to the problem identified; there is evidence that requirements represent the needs of, and have been validated by, at least a few primary stakeholder groups.
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Convening of expert panels

- **Students upload artifacts** (e.g., notes, learning logs/journals, data displays, models, drawings and schematics, online automation, videotape, etc.) from a variety of contexts—formal and informal, secondary and undergraduate level project activities.
- Once the e-portfolios have been collected, and permission granted, trained **reviewers will evaluate to make determinations regarding students' engineering design process proficiency.**

The June 22 and 23 EDPPSR Workgroup

➤ **Activities (Facilitated by Dr. Gail Goldberg):**

- ✓ **The Innovation Portal** as a platform for creating and accessing e-portfolios
- ✓ **Key elements** rubric design (language and format)
- ✓ **Judgment-based scoring sessions:** holistic, analytic, and modified (focused) holistic – 11 Experts, 4 Secondary Experts, and 2 Scribes (Secondary, Community College, Four-year)

➤ **Sampling of Initial Findings:**

Key Questions Underlying Workshop Activities	What We Learned as a Result of Workshop Activities
What, if anything, that might contribute to an element score decision is not cued for via the score point descriptors (but should be).	Nothing major was identified; minor additions may be made to the descriptors
Are there any instances in which the language of a score point descriptor leads to perceived errors in assignment of score level (cognitive dissonance)?	Some instances of unrealistic demand were noted and will be corrected – e.g. consultation and involvement of experts that would impact weighting and substitution

Next Steps

- **Continue the research** to address the College Board's Criteria.
- **Review portfolios** across '**Challenges,**' **programs and faculty** committed to participate (FIRST®, SeaPerch®, PLTW, TN Tech, UMD, USNA, UVA, and Vanderbilt).
- **Understand, define and document** how the EDPPSR / e-portfolio aligns to grades 10 to 16 informal activities, Introduction to Engineering courses, course related design projects and CAPSTONE courses.
- **Develop and test** training processes for the scorers / raters, teachers, faculty and mentors.
- **Develop scoring and reporting tools.**

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- Multiple Kern Family Foundation awards – Ms. Karen Wilken (PD)
- NSF PRIME Award 1118755 – Dr. Mary Moriarty (PO)

- **Note:** Research conducted under a series of IRB protocols from 2005.

Questions to Consider

- How can this rubric be applied?
- How might it impact the teaching and learning of Engineering Design?
- What is the greatest barrier to rubric use in secondary school programs (grades 9 – 12)?
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