

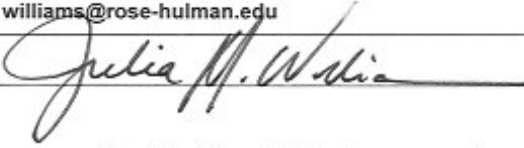
Council for Higher Education Accreditation

2007 CHEA Award for Institutional Progress in Student Learning Outcomes

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Application Summary

Rose-Hulman Institute of Technology (<http://www.rose-hulman.edu>) has pioneered the development and refinement of the Rose Portfolio System (REPS). REPS is used to assess student learning in ten Institute Learning Outcomes. The results of student performance are used by academic departments to measure student learning and to direct changes to curricula and programs. The results are also used at the Institute level to ensure the quality of academic programs. Based on our experience in electronic portfolio development and in assessment methodology, we believe we are making a significant contribution to student learning outcomes assessment, portfolio assessment, and accountability in higher education.

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CRITERION 1: ARTICULATION AND EVIDENCE OF OUTCOMES

Rose-Hulman Institute of Technology is a private, undergraduate college of 1900 students located in Terre Haute, Indiana (<http://www.rose-hulman.edu/>). Its emphasis is on educating undergraduates to pursue careers in the fields of mathematics, engineering, and science. We have a strong track record of creatively developing and rigorously assessing pedagogies for teaching in these fields. For example, we were innovators of the Integrated First Year Curriculum for Science, Engineering, and Mathematics, a curriculum designed to help students understand unifying ideas across seemingly disparate technical disciplines; our experience with the Integrated First Year Curriculum led to our invited participation in the National Science Foundation-sponsored "Foundation Coalition," a nationwide coalition of schools applying current learning theories to revitalize fundamental engineering courses. In addition to our curricular innovations, we have led the field of engineering, mathematics, and science education in the use of technology in the classroom; we were among the first colleges to require the use of laptop computers (beginning in 1995), and we were one of the first campuses to use Maple (a computer algebra system) in all first-year calculus classes. We continue to produce new technology-enabled "studio" courses (in, for example, physics and electrical engineering), that link hands-on learning in laboratory sessions with theories and concepts from traditional lectures. For these and other education innovations, Rose-Hulman Institute of Technology has been ranked first by engineering educators as the nation's best college or university that offers the bachelor's or master's degree as its highest degree in engineering for the eighth straight year; this ranking is published in the 2006 edition of "America's Best Colleges" guidebook by U.S. News & World Report.

Our commitment to undergraduate education is reflected in our Institute-wide assessment process that includes a defined set of Institutional learning outcomes and the Rose-Hulman electronic portfolio project, the RosE Portfolio System (REPS). In 1997, we began the process of developing a set of Institute-wide student learning outcomes, outcomes that would constitute the set of skills all Rose-Hulman students develop by the time of graduation. These outcomes were designed based on input from a wide variety of constituents: faculty, alumni, industry (those who hire our graduates), graduate schools, and other sources. By the end of the 1997-1998 academic year, we had a set of ten Institute Student Learning Outcomes defined with specific performance criteria. These ten learning outcomes were adopted by the faculty of the Institute and subsequently published in Rose-Hulman official documents, like our course catalogue and web pages:

- RH 1. Ethics** - A recognition of ethical and professional responsibilities.
- RH 2. Contemporary Issues** - An understanding of how contemporary issues shape and are shaped by mathematics, science, & engineering.
- RH 3. Global** - An ability to recognize the impact of global societies on citizens and professionals.
- RH 4. Culture** - An ability to understand diverse cultural and humanistic traditions.
- RH 5. Teams** - An ability to work effectively in teams.
- RH 6. Communication** - An ability to communicate effectively in oral, written, graphical, and visual forms.
- RH 7. Problem Solving** - An ability to apply the skills and knowledge necessary for mathematical, scientific, and engineering practices.
- RH 8. Interpreting Data** - An ability to interpret graphical, numerical, and textual data.
- RH 9. Experiments** - An ability to design and conduct experiments.
- RH 10. Design** - An ability to design a product or process to satisfy a client's needs subject to constraints.

The faculty approval of the Institute outcomes reflects an important dimension of our assessment process design. All the engineering programs at Rose-Hulman, as well as the computer science program, are accredited by ABET, Inc., and one component of maintaining accreditation is to publish, assess, and report on achievement of student learning outcomes in each program. In addition, we are accredited as an institution by the North Central Association of the Higher Learning Commission; NCA also requires that we demonstrate achievement in student

learning. We believed we could leverage the demands for both program and institutional accreditation if we designed Institutional outcomes in a way that could map efficiently to program outcomes. For example, ABET-accredited programs must show that students can demonstrate skills for working in teams (only one of the 11 outcomes specified by ABET). By defining a teams outcome for the Institute, we gained cooperation from all of our programs; they agreed to use the data collection method (the RosE Portfolio System) and the portfolio rating results in their own self-study reports to submit to their accrediting boards. REPS is the data collection and assessment mechanism for six of the ten Institute learning outcomes (Ethics, Contemporary issues, Global, Culture, Teams, Communication); each program assesses and evaluates student learning for the four outcomes that are specifically technical in nature (Problem solving, Interpreting data, Experiments, and Design).

In addition to defining student learning outcomes, we also needed to develop an effective and efficient data collection method. Thus, our work on defining student learning outcomes occurred simultaneously with our work to design an electronic portfolio system for the purpose of data collection for evidence of student learning. At that time, there were no electronic portfolios available commercially that reflected our assessment model. We therefore began to construct our own portfolio. Our decision to develop an electronic portfolio was based on the fact that we had initiated an Institutional laptop computer requirement for all students in 1995 (one of the first colleges to do so). Thus, all students used an Institute-specified laptop computer with a pre-installed software suite. We believed we could make the portfolio assessment process both effective and efficient if all dimensions of the process—from student submission to portfolio evaluation—occurred within an electronic system. REPS was first used during the summer of 1998 to evaluate a set of student submissions for a pilot project. Every year since then, we have used REPS to collect, evaluate, and report out achievement in student learning outcomes to students, faculty, employers, graduate schools, and various accrediting agencies.

The assessment process begins with faculty identifying the outcomes that are addressed in their courses. All faculty members submit quarterly Curriculum Maps that show which of the Institutional learning outcomes are addressed in their courses. A review of these Curriculum Maps demonstrates which courses will provide students with opportunities to develop their skills in the learning outcomes. After the Curriculum Maps are analyzed, faculty members determine which assignments in their courses will provide the best evidence of student achievement in the outcome. Faculty members teaching courses in technical communication, for instance, identify specific assignments in their courses that can show evidence of improvement in their students' communication skills. Once the assignments have been identified, faculty members direct students to submit those assignments to their RosE Portfolios. Each student has a portfolio that he/she maintains over the course of their time at Rose-Hulman.

We collect evidence of student learning for all ten Institute learning outcomes every year. At the end of the academic year, a team of faculty portfolio raters are trained; they then rate all submissions to the RosE Portfolio System over a two-day Rating Session, using pre-defined evaluation rubrics. Once the ratings are completed, the portfolio rating results are compiled and analyzed by the Office of Institutional Research, Planning and Assessment. Each department then receives a report that contains detailed portfolio results for all student majors (from freshman through to seniors). Departments use this data to make improvements in their curricula to address any deficiencies in student achievement. A complete description of the portfolio rating process is included under Criteria 2 of this application.

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CRITERION 2: SUCCESS WITH REGARD TO OUTCOMES

In order to determine students' success in achieving the Institutional student learning outcomes, all student submissions to the RosE Portfolio System are assessed each year by a team of trained faculty raters. The purpose of the RosE Portfolio Rating Session is to assess evidence of student learning in six non-technical Institute outcomes: Ethics, Contemporary Issues, Global, Culture, Teams, and Communication. Evidence of student learning in these six outcomes is collected each year through assignments made by faculty in technical and non-technical departments. For example, some engineering faculty require that students submit documents from capstone senior design courses as evidence for the Teams outcome. Humanities and Social Sciences faculty require that students submit documents produced in their courses for evidence of the Global and Culture outcomes. Definition of performance criteria and rubrics, collection of documents, and assessment and evaluation of evidence for technical learning outcomes is the province of technical departments (although many departments use the same portfolio collection and assessment methodology described below).

Rating submissions to the RosE Portfolio has followed the same basic methodology since the system was initiated in 1998. Rose-Hulman faculty members (usually up to 14 each year) are hired as portfolio raters. Attempts are made to involve faculty from many different departments on campus to ensure objectivity in rating and broad-based familiarity and participation in the process. Raters work for two days together in a computer laboratory and are compensated for their work. The Rating Session Coordinator facilitates the process and assigns pairs of raters to rate student submissions for a particular outcome. For example, a mechanical engineering faculty member and a chemistry faculty member may work as a rating pair assessing the student files submitted to Communication Outcome.

The rating process consists of four steps.

1. First, faculty portfolio raters review the rating rubric associated with the learning outcome. The rating rubrics were developed by faculty members who serve on the Commission for the Assessment of Student Outcomes (CASO), the Institute-wide committee charged with maintaining the outcomes assessment process. Each year faculty portfolio raters review the rating rubric, as well as the comments made by the faculty portfolio raters who evaluated the same outcome in previous years. As part of their training to be raters, the rating team discusses the rubric while comparing it to student documents that were rated during previous rating sessions. The purpose of this work is to ensure calibration: between the two faculty raters, and between the current faculty raters and each previous faculty rater team. Calibration like this helps ensure consistency in rating from year to year.
2. Second, REPS requires that each rater team rate a set of three shared documents. The rating is made on the basis of a pre-established Rating Rubric; raters answer "Yes" or "No" for a single rating question: "Does this document meet the standard expected of a student who will graduate from Rose-Hulman." Student achievement is measured as either "Yes/Pass" or "No/Fail." Raters also have the opportunity to mark the document as "Yes/Pass/Exemplary" to designate student submissions that represent superior achievement for a particular outcome. In order to ensure consistency in rating between the raters, REPS uses an Inter-Rater Reliability (IRR) process. When they read and evaluate the set of three shared documents, the raters must agree in their rating. If their ratings are not identical, REPS prohibits them from continuing on with the rating process. Raters then discuss their ratings, checking their evaluation against the Rating Rubric for the outcome; they then come to agreement on how they will evaluate the shared document set. IRR is a key component of REPS; it ensures that raters look for the same qualities and features in order to rate documents. This helps the faculty raters to calibrate their ratings against

each other and ensures consistency in rating.

3. Third, if the raters agree in their IRR, the system then allows them to proceed with a set of ten documents, each rater reading and rating a different set of ten documents. REPS records their rating for each document. The system also introduces a shared file every ten documents in order to check that the raters have maintained their Inter-Rater Reliability. Failure to rate the shared document identically will cause the system to stop the raters so that they can recalibrate their evaluation before moving on to another document set. Thus, IRR continues to validate rating throughout the rating process.
4. Fourth, the raters can provide comments about the rating session or about the student submission in the Comment boxes. In addition to the work of rating, faculty raters also record the rubrics they used and collect sample documents in order to provide next year's raters with material for calibration. They may also suggest changes to rating rubrics or to learning outcomes, although revisions must be reviewed and approved by CASO before they are implemented into REPS.

We are now in the ninth year of using REPS for assessment of student learning outcomes, but we do not rely on REPS alone to provide us with data regarding student achievement. In addition to using REPS, we employ a number of other assessment methods to determine if students are achieving the stated learning outcomes.

First, each program at Rose-Hulman uses data collected from a number of sources to evaluate the effectiveness of curricula. The need for a curricular revision could be indicated by low ratings on student course evaluation surveys or poor levels of achievement in departmental assessment of student work. In that case, the program uses the information from these sources to make appropriate changes to the curriculum, checking the progress of the change at regular intervals in order to measure improvements.

Second, we collect information regarding alumni satisfaction through our annual Alumni Survey. This instrument, focusing on academic dimensions of the RHIT experience, asks alumni to evaluate two elements related to student learning outcomes: 1) how important is the outcome to the alumnus' current position (in industry, in graduate school, etc.) and 2) how well did the alumnus' education at Rose-Hulman prepare him/her in this outcome. The outcomes listed on the Alumni Survey are the ten Institute learning outcomes, as well as program-specific outcomes. Given the alumni data, programs can review curricula and propose revisions. For instance, in previous Alumni Surveys for graduates of the civil engineering program, respondents indicated that they thought their program needed to offer more courses in transportation. As a result of their responses, as well as data from the program's Advisory Board and other sources, changes were made to increase the number of course offerings in transportation topics.

Third, we also use information regarding graduation rates, retention rates, and placement rates to gauge institutional and program effectiveness. Information regarding these rates is published on the website of the Office of Institutional Research, Planning and Assessment in the Common Data Set. Because it is published publicly, the information is available to students, faculty, staff, alumni, prospective students and their families, as well as industry, graduate schools, and interested members of the community. These rates indicate that we are fulfilling our mission "to provide the best undergraduate education in engineering, mathematics, and science in an environment of individual attention and support." For instance, for the cohort of all full-time bachelor's (or equivalent) degree-seeking undergraduate students who entered our institution as freshmen in fall 2005 (or the preceding summer term), the percentage of students who were enrolled at our institution at the start of official enrollment in fall 2006 was 91.7%. In addition our placement rate for graduates (into industry, graduate school, etc.) remains consistently in the 97-99% range, an indication that we are successfully preparing students for careers and further education.

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CRITERION 3: INFORMATION TO THE PUBLIC ABOUT OUTCOMES

RosE Portfolio Rating Results from the annual Portfolio Rating Session are compiled for each department and program on our campus. The student achievement in learning outcomes then is used by each department to evaluate the effectiveness of curricula and to enact curricula change if necessary. These data are also provided to accrediting agencies to demonstrate successful achievement of student learning outcomes. At Rose-Hulman, our five, long-standing engineering programs are accredited by ABET, Inc. The fact that these programs are accredited appears on materials such as departmental brochures, web pages, etc. Currently four new programs are undergoing accreditation review for the first time: biomedical engineering, computer science, optical engineering, and software engineering. Once these programs have received accreditation, this fact will be stated in their materials.

Achievement in student learning outcomes is also reported by the institution to its accrediting agency, the North Central Association of the Higher Learning Commission. Rose-Hulman is participating in the Academic Quality Improvement Project (AQIP) of the NCA. AQIP is an accreditation program that focuses on quality improvement processes within an institution. These processes must be ongoing and address all facets of the institution, from student learning and facilities to creating collaborative relationships and planning for the future. As a member of AQIP, Rose-Hulman has prepared a Systems Portfolio, a comprehensive picture of the institution in nine specified areas:

- Helping Students Learn
- Accomplishing Other Distinctive Objectives
- Understanding Students' and Other Stakeholders' Needs
- Valuing People
- Leading and Communicating
- Supporting Institutional Operations
- Measuring Effectiveness
- Planning Continuous Improvement
- Building Collaborative Relationships

The AQIP Systems Portfolio is accessible to students, faculty, and staff of Rose-Hulman. Rose-Hulman's status as an accredited institution is also stated in our promotional materials.

One important conduit for information to the public about student outcomes achievement is the conferences at which faculty make presentations and give papers. As part of their professional development, faculty who have served as portfolio raters and/or who have been engaged in program assessment for their departments give presentations and papers at national conferences like the American Society for Engineering Education Conference, the Higher Learning Commission Conference, and the Association for Institutional Research Conference, to name only a few. As faculty report on their research in engineering, mathematics, and science education, they present data that are gathered in the courses they teach. Rose-Hulman faculty members are also publishing articles in journals in their respective disciplines. Often the topics address issues of student learning and pedagogical research.

Rose-Hulman has also contributed to the national conversation on the subject of student learning outcomes by hosting the annual Best Assessment Symposium, a conference dedicated to the exchange of ideas relevant to assessment and accreditation. The conference, now in its ninth year, brings together faculty and administrators

from a variety of public and private institutions. For three days in the spring (the 2007 conference will be April 12-14 on the campus of Rose-Hulman), conference attendees engage in working sessions and learn about the latest developments in assessment and evaluation. Each year faculty of Rose-Hulman have presented at the conference to show how the RosE Portfolio System has been used in our assessment and evaluation process.

Interest in REPS has also resulted in significant partnerships, most recently with Angel Learning, Inc., located in Indianapolis, Indiana. Angel Learning recently developed its own electronic portfolio, but they are consulting with us with regard to the assessment and evaluation methodology that is used in REPS.

The Rose-Hulman web pages provide the public with information regarding student achievement in many areas. Under the "News" link, recent articles highlighted the following evidence of student achievement:

- Rose-Hulman Fall Career Fair Attracts 440 Recruiters to Interview Students
- Rose-Hulman Team Places Third in Civil Engineering's Big Beam Design Contest
- Electrical and Computer Engineering Professor Picks Rose-Hulman Because of Emphasis on Teaching
- Professor Showcasing Model-Based Design of Hybrid Vehicles at International Conferences
- Rose-Hulman Students Expand Entrepreneurial Talents in University Entrepreneurial Challenge
- Student Claims First Place in National Freshman Math Competition

In addition to public information available on the Rose-Hulman web pages, information regarding Rose-Hulman students' achievement is featured regularly in our alumni magazine *Echoes* and in other national publications like the IEEE magazine *Spectrum* and the ASEE magazine *Prism*.

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CRITERION 4: USING OUTCOMES FOR IMPROVEMENT

The responsibility for evaluating student learning outcomes achievement is distributed across the institution. At each level, portfolio results that have been produced through the RosE Portfolio System are assessed and evaluated to determine strategies for improvement.

At the Institute level, two committees are charged with assessing and evaluating the student learning outcomes process. The Commission on the Assessment of Student Outcomes (CASO) reviews the results of the portfolio ratings each year and develops strategies to improve the portfolio process. CASO also maintains the assessment rubrics used by the portfolios raters. After the summer Portfolio Rating Session is concluded, CASO members review the comments, ideas, and suggestions provided by the portfolio raters for possible changes to the assessment rubrics. All changes are discussed by CASO and implemented in the following year's Portfolio Rating Session. In addition, CASO periodically reviews the list of student learning outcomes to determine if the outcomes should be revised. For instance, during the 2006-07 academic year, CASO is engaged in a process to determine if other outcomes should be added to the list of ten Institute outcomes. The need for change could reflect changes in educational trends, such the growing need for our graduates to operate successfully in global, cross-cultural environments (such as international design teams). CASO will provide feedback to the Institute and recommend changes; the final approval for these changes will be made by the faculty of the Institute.

The second Institute committee charged with evaluating the success of the student learning outcomes process is the Quality of Education Committee. This committee takes a high-level approach to evaluating REPS. The members of the committee compare the annual portfolio results and make recommendations regarding changes to the process; CASO, on the other hand, addresses changes to the process mechanisms, like rating rubrics. The recommendations of the QEC are also presented to the Institute for final approval.

At the program level, departments are engaged in evaluating REPS results and making changes to their own curricula. Academic departments review the results of the portfolio evaluations each year during their departmental retreats. At that time they can evaluate the level of student achievement in both the program and the Institute student learning outcomes. The portfolio results can indicate places in the curriculum where changes need to be made. For instance, when students in one program seemed not to be achieving the department's defined achievement benchmark in the Contemporary issues outcome, members of the department faculty consulted their Curriculum Maps to ensure that students had been given adequate opportunities to develop their skills in this outcome. At that point, faculty members recognized that students had been given adequate opportunities; the problem seemed to lie in the assignments students were being asked to submit. After a review of the assignments, faculty members responsible made changes to the work students were asked to do, ensuring that students specifically addressed the outcome in their assignments. The following year, student performance in that outcome increased significantly.