SUPPLEMENTARY MATERIALS II-C-3: ENGINEERING THE ORCHESTRA, PART II—COMPOSITION EXAMPLE

Supplemental Materials II-C-3 gives a final project composition from this course. The performance shows a student combining flute, clarinet, guitar, and trumpet—an unusual instrumentation that combines four non-homogeneous instruments.

Engineering the Orchestra, part II, Final Project Composition https://youtu.be/g4wS3piRKHw

SUPPLEMENTARY MATERIALS II-D: "CREATING THE RENAISSANCE ENGINEER", A WHITE PAPER PRESENTING A VISION FOR OUR NEW COLLEGE, JANUARY 2001

My white paper, "Creating the Renaissance Engineer", written in January 2001, helped define Olin College:

Engineering, Entrepreneurship, the Arts

What we do that no one else does

Franklin W. Olin College of Engineering – Creating the Renaissance Engineer

Scientifically Astute,

Artistic,

Entrepreneurial

A place where LdV might like to drop by

Olin's mission does not stop after a student graduates. Rather it is carried forward, an integral part of each graduate, into creative endeavors far and wide. What assures the creativity? A mind able to triangulate its corners.

The Renaissance, a time of fluid boundaries between science and art, produced feats of engineering design, artistic mastery, and an entrepreneurial spirit that continue to inspire and motivate humankind. At FWO, our students learn to speak the languages of engineering, science, mathematics, the arts, and business—not as separate subjects—but all together. We emphasize this essentially trilingual approach (engineering/science/math, arts, entrepreneurship)

because we believe that a mind able to reach all its corners becomes a fully functioning intelligence capable of reaping the kind of "breakthrough" thinking that moves the human condition further.

Olin students create in many fields while at the College—in engineering, mathematics, science, art/music/film/video/writing/theater/performance, and business—just as they will after graduating. We believe that pursuing projects and knowledge in all of these concentrations fuels an individual's creativity, as does the ability to communicate these pursuits to a larger audience. It is this synergistic creativity that is ultimately Olin's goal—to produce and enhance the resilient, resourceful, artistic, intelligent, and technically astute individual who will take these gifts and basically go out and change the world in some way. This catalyst for change touches another of Olin's core values: that change be beneficial to human kind. Philanthropy, ethics, and communication figure prominently in the FWO worldview. Towards that end, our faculty includes social scientists with specialties in past and current ethical and historical issues, as well as experts in communication so that our students have the skills to reach others with their ideas.

Given the emphasis on creating in multiple fields which, by its very nature, often necessitates "going out on a limb", students' participation and ever-increasing fluency in EEA (Engineering, Entrepreneurship, the Arts) helps them become more confident in their abilities. Ultimately—after an undergraduate education steeped in "doing" and "thinking" both singly and collaboratively—they find themselves comfortable with risk, having spent part of their undergraduate years becoming acquainted with it. A high comfort level with risk provides a key character trait of the entrepreneur, where entrepreneur is defined broadly as an independent, active, self-sufficient individual who can articulate a vision and bring it to fruition [sschiffman]. Risk-tolerance enables graduates to pursue business opportunities, inventions, innovative projects, not to mention dreams, new theories, and ideas from which others may shrink or cast as impossible. Of course, history is awash with great ventures that were so summarily dismissed. Olin graduates are not shrinking violets and they do not take no for an answer! They are a little bit uppity (though respectfully so).

With FWO's faculty embodying engineering, science, mathematics, the arts, and business (in cooperation with Babson College), as well as in specialty areas such as professional ethics, technological history, communication, and educational psychology, the College's essentially multidisciplinary approach encourages close connections with other nearby institutions. FWO exists within the BBOW community—Brandeis, Babson, Olin, Wellesley. Babson College, ranked no. 1 for its programs in entrepreneurship, offers a rich array of business-oriented classes. Brandeis and Wellesley enjoy solid reputations for their liberal arts curricula. Professors from these schools (and other Boston area campuses such as MIT, BU, Boston College, Harvard, etc.) can be asked to teach courses on the Olin campus that they successfully teach on their home campuses. Teaching well-developed courses at FWO may be a particularly attractive offer for sabbaticals. Olin can also start a series of FWO "Guggenheims" to bring in various scholars on a visiting basis. Professors that are brought in from other schools can provide a steady input of more humanities offerings, as well as a wider array of technical courses not offered at FWO. In this way, our college can offer additional studies in the humanities, math, science, and engineering through its partnership in BBOW, Olin "Guggenheims", and invited guest lecturers

from Boston area colleges and universities who are asked to teach a particular course for which they are "famous" and "revered" on their own campus.

At Olin we cultivate a student who invents, pursues entrepreneurial activities, engages in innovative projects not only in engineering/science/math but also in the arts and business. Professional ethics, historical context, communicative ability, and a philanthropic bent inform all they undertake.

Graduates are fluent in art, science, and entrepreneurship—three disciplines whose legacies have perhaps most affected the human condition. By speaking these languages, students cannot help but make the analogies, leaps of faith, and mental discourse that spurs invention. Each of these languages is powerful in its own right, presenting a richness of fundamental thought and expertise that models practically everything they might undertake in life. The innate entrepreneurial/scientific/artistic streak in each of them develops through a well-designed FWO curriculum, a rich array of entrepreneurial studies available at Babson College, as well as contact with peers, faculty, the FWO and Boston area communities. With a mind able to navigate its full space, the Olin graduate bursts forth with a kind of synergistic creativity that, coupled with the ability to apply fundamentals, IS the Renaissance Engineer—entrepreneurial, artistic, enlightened, and scientifically astute.

In creating the Renaissance Engineer, FWO builds a readily identifiable image such as those associated with other institutions, e.g., the University of Chicago (great books), Harvard (elective system), William and Mary (colonial college). Conveying breadth and depth, art, science, and the individual's ability to carry a vision forward (entrepreneurship), the Renaissance Engineer embodies a highly marketable image to all of our constituencies (students, parents, industry, academia, faculty, administration, alumni—at home and abroad). The "*Renaissance Engineer—Entrepreneurial, Scientific, with a flare for the Arts*" gives us an institutional identity that is at once marketable and memorable. It exudes longevity, allowing an admissions interpretation with virtually endless variations.

How the "Renaissance Engineer" might benefit FWO

A Possible solution for some issues we are wrestling with:

AP credit – What do we do about students who enter with enough AP credits to basically skip their first year of college? We might build a curriculum which now challenges them to think about these fields in an entirely new way, in conjunction with engineering/science/math, entrepreneurship and the arts. For example, a student entering with AP physics might find at FWO not the standard Mechanics class, but rather Mechanics and Sculpture, Mechanics with Applications to Civil Engineering, Mechanics and the Human Body, and/or Mechanics Applied to Architecture. Similarly, a student with AP chemistry might find that Olin's core course in chemistry is linked with environmental concerns. Ditto for the AP biology student, who might find not "standard-issue" biology, but rather "The Science and Business of Biology" or "Biology and Art".

The Great Leveler --- How do we handle students who are already walking encyclopedias in certain fields, e.g., a student who knows calculus like the back of her hand? Here are two possible approaches:

(1) "What's so great about Calculus" addresses all the mathematical fundamentals but with a worldly twist: students figure out how to apply what they are learning to everyday life.
(2) "Variation in Science and Art" focuses on systems that vary with time, i.e., dynamical systems, and the differential equations that model them. Students learn all about the usefulness of diffeqs and simultaneously are exposed to the concept of variation in art, music, and science.
(3) "Calculus and the Newtonian World" exposes students to all the concepts and fundamentals of calculus in tandem with a history of the cultural and scientific world that Newton inhabited.

A Project Differentiator --- What might distinguish FWO's approach to project-based learning from that of Harvey Mudd, MIT, Aalborg, and others? At Olin, projects are undertaken where the number of tapped fields keeps increasing as the undergraduate calendar progresses to graduation day. So, for example, a possible plan might be:

Year 1: engineering and math/science (physics/chemistry/biology)
Year 2: engineering, math/science, business
Year 3: engineering, math/science, business, visual arts
Year 4: engineering, math/science, business, visual arts, music

Possible Suggestions for a Graduation Requirement:
a technical capstone experience and an artistic capstone experience
a technical capstone experience and a business capstone experience

a technical capstone project and a project that combines art and science
a technical capstone project and another that combines engineering and business
a technical capstone project and another that combines science/math and business
a technical capstone project and another that combines the arts and business
a technical capstone project and another that combines any relevant field and business

a technical capstone project and a multidisciplinary project

Benefits for the Student
Active use of multiple areas of the mind
Fluency in multiple languages (engineering/science/math, the arts, and business)
Strong grasp of ethical, historical, and professional issues in engineering and science
Communication skills
Philanthropic education
A catalyst for agility, versatility, resourcefulness
Climate for invention
Real heroes: artists, scientists, and engineers have moved culture throughout the ages
Synergistic creativity

Benefits for the Faculty

The Renaissance model is multidisciplinary
Everyday communication across a broad spectrum of fields
Exposure to visiting faculty
Ongoing invention and development
Imaginative environment because of the unusual confluence of EEA (Engn, Entrep, the Arts)
Students whose skill set, grasp of fundamentals across disciplines, inventiveness, and insight increase from year-to-year
Resourceful, confident, agile group of alumni with whom further ties can be productive

Benefits for the FWO community
Multiple languages spoken
A core mission that encompasses many of the passions/interests of staff, students, and faculty
Emphasis on accessing all of a mind's potential
An environment that nurtures and encourages exploration
Synergistic creativity
Enterprising intellectual community as a result of that creativity
Stimulating an original, distinctive mission unlike that of any other institution yet one that many aspire to and have tried to implement
Inspiration and motivation

Benefits for FWO's continued ability to thrive and pursue its mission with excellence
The boon to creativity provided by access to more of the mind carries graduates into many facets of world society where their influence is felt in both large and small ways

This creativity engenders new theories, ideas, inventions, business opportunities for Olin, its grads, and the communities they live in

FWO could become linked in the minds of many with Leonardo, motivating gifted students, faculty and staff to work here

FWO's Renaissance model of science with art and business is associated with the depth that the term "Renaissance" connotes, engaging parents in its mission

FWO's incorporation of business and entrepreneurship (broadly defined) assures parents and students that graduates will be prepared for some of challenges and practicalities of life

FWO's emphasis on philanthropic, ethical, and historical issues inspires and motivates good works, including some that assure Olin's future

Agile, inventive, resourceful group of alumni with whom FWO maintains close, "affectionate" ties

Probable Longevity of the "Renaissance Engineer"
Olin may enjoy preeminence in "creating the Renaissance Engineer" for quite some time—perhaps always, since we will have been the first to do so. Unlikely to be challenged by existing schools due to high departmental walls, Olin's Renaissance approach might take seed in a new

college adopting all or part of our model. Or it might inspire something similar within an existing institution (e.g., an experimental college within a university setting). Any of these spin-offs would be great. Part of our mission is to export what we accomplish. Many schools have tried to build bridges between their engineering and arts departments. These tend to take on the appearance of some art applied to engineering or engineering applied to art. No college or university has been able to successfully put in place a program that produces the Renaissance engineer. Yet so many are wrestling with this concept. They want it. But with many departments and faculty involved (each with its, her, and his own agenda), that consensus often waters down to a bit of this and a squirt of that.

What separates the science and art focus of Olin from other universities that have programs in place that incorporate art with engineering, e.g., the electronic arts option at Renssalaer?

For starters, we define entrepreneurial activity broadly enough to ensure its timeliness for years to come, and shield FWO from association with a hot item that could at some point not enjoy its current popularity.) Secondly, we emphasize the Renaissance model which places a high premium on fluency in both science and art, not bits of science and a bit of art, but an in-depth understanding of the fundamental principles presented from various angles.