

In Search of the Sweet Spot: Engineering, Arts, and Society in Design Curricula

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This paper presents the results of an informal survey of design programs that I conducted as part of Rensselaer Polytechnic Institute's ongoing curricular project "Engineering and Society: The Art of Design." The primary objective of the survey was to identify interdisciplinary design curricula that have a significant social and engineering orientation.

In the diagram, region *a* (Engineering) is traditionally the domain of engineering design; region *b* (the Arts), of fashion design, graphic design, and often industrial design; region *c* (Humanities and Social Sciences), of "design" in the form of utopian studies, future studies, and peace studies. The main challenge of this project has been to attempt to identify existing college-level design curricula that occupy — or appear to be drawn toward — the "sweet spot" where the three domains coincide.

One of the most difficult aspects of this survey has been to comb through competing ideas of what constitutes a "social orientation" in design curricula. In their 1994 survey of engineering design programs, Levinger and Shea note that "integration of social and technical has become somewhat of a catch phrase in program and project descriptions," with the term "social" taking on numerous denotations and connotations.^[1] The definition of "social orientation" I attempted to employ during the survey has features drawn from Levinger and Shea's discussion. These features include:

- Awareness that genuine social orientation — and genuine interdisciplinarity — do not merely cross boundaries between engineering sub-disciplines but span the boundaries between engineering and the social sciences and humanities, directly challenging traditional notions of a clear divide between the social and the technical.
- Awareness that genuine social orientation does not merely focus on socially relevant topics in the design classroom/studio but demonstrates an understanding that technologies — and technological design — are themselves value-laden sociopolitical phenomena.
- Awareness that genuine social orientation does not merely allow social considerations to constitute the *context* of design projects but actively integrates social considerations into the *design process* itself.

I did not apply these features as filters. Had I done so, few programs would have qualified as having a significant "social orientation." Instead, I allowed them to function rather like the optical properties of a lens. They colored what I saw; heightened some aspects of the programs and softened others; established a focal plane. I identify these "optical properties" here not because they delineate a specific methodological stance but because they may help the reader understand my ideological

orientation and the trajectory of my analysis.

In North America, 37 institutions grant degrees in design, 4 in engineering design, 33 in industrial design, and nearly 400 in engineering. [2] I have examined the curricula of a relative handful of these. I identified the programs I would examine by: consulting the *College Blue Book*[3] (focusing primarily on institutions that have both design programs and engineering programs); doing web searches (using keywords such as interdisciplinary, design, engineering, education, and social); and obtaining referrals from individuals involved in the Rensselaer curriculum project, individuals in the identified programs, and individuals who participated in an interdisciplinary-design curriculum workshop at Rensselaer. My main focus was on industrial design and engineering design at the undergraduate level in North America.

I gathered program information by examining institutional web pages, catalogs, and promotional materials and, in some cases, through e-mail exchanges and phone conversations. Most of my assessments are based primarily or exclusively on program descriptions, mission statements, course titles, and/or course descriptions. In a few cases, I also examined selected course syllabi.

While my primary goal has been to identify programs in or near the “sweet spot,” I have also attempted to classify the other programs I have examined. In a number of instances, I have identified specific courses (or course sequences) of interest in institutions that have no design or engineering programs or that have design or engineering programs that otherwise are not of interest.

The survey has been informal, noncomprehensive, and relatively impressionistic. It is my hope that, despite these limitations, it will help focus future design-curriculum research.

Overview of Programs and Courses

In the tables below and the program notes that follow, notations in square brackets indicate my assessment of each school's/program's/course's position in the diagram. For example, “[b]” designates a position within the Arts region of the diagram, while “[b>>e]” designates movement from the Arts region into the region where Arts overlaps with Humanities & Social Sciences. Those that appear to be situated within or arguably tending toward the “sweet spot” [g] I have labeled as “of particular interest.” Those that I do not count as having any significant claim to the sweet spot but that arguably have some purchase on the other overlap areas — [d], [e], and [c] — I have flagged as “of moderate interest.”

Programs of Particular Interest

Carleton	Industrial Design	[b>>e or f>>g]
Carnegie Mellon	Human Computer Interaction	[a>>d or f>>g]
Georgia Tech	Industrial Design	[g]
Royal College of Art	(various)	[b>>e or f>>g]

Stanford	Product Design	[g]
Syracuse	Industrial Design	[b>>e or f>>g]
U. of Maryland	Gemstone	[d or d>>g]
Worcester Polytech	IQP and MQP	[a>>d or f>>g]

Courses of Particular Interest

Colo. School of Mines	EPICS	[a>>d or f>>g]
Cornell	M&AE 400/401	[a>>d or a>>g]
COMM 639	[c>>e or d>>g]	
MIT	(various)	[a>>d or a>>g]
Santa Clara	Comm 193	[a>>d or f>>g]

Programs and Courses of Moderate Interest

Calif. Arts & Crafts	Industrial Design	[b>>e]
Carnegie Mellon	Industrial Design	[b>>e]
Evergreen State	interdisciplinary design	[b>>e]
Howard	300-101	[a or a>>d]
North Carolina State	Industrial Design	[b>>e]
R.I. School of Design	Industrial Design	[b or b>>e]
RIT	Industrial Design	[b or f]
San Jose State	Industrial Design	[b or b>>e]
U. of Art Helsinki	(various)	[b or b>>e]
U. of Maryland	ENES 100	[a>>d]

Programs and Courses of Moderate Interest (cont'd.)

U. of Michigan	various join degrees	[f or d]
	Exploratory Design Lab.	[f]
U. of Waterloo	Systems Design Engineering	[a>>d]
Virginia Tech	Industrial Design	[b or e]

Programs and Courses of Little Interest

Fashion Inst. of Tech.	(various)	[b]
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Parsons	Product Design	[b]
Penn State	ED&G 100	[a]
Pratt Institute	Industrial Design	[b]
U. of Calif. Berkeley	Visual Design	[b]
U. of Michigan	Industrial Design	[b]

Notes on Programs

California College of Arts & Crafts

Oakland, Calif. <no web page>

Industrial Design

The Industrial Design (ID) program is in the School of Design and appears to have little, if any, engineering content. Several courses push in the direction of H&SS, however: Materials and Manufacturing Processes 3; Industrial Design 4; Design and Culture. [b>>e]

Carleton University

Ottawa, Ontario <<http://www.carleton.ca>>

Industrial Design

Carleton is one of the few North American schools whose ID program is within an engineering program. The curriculum has significant engineering/technical content. According to one professor, the program also exhibits a “humanistic approach.”^[4] The program’s literature emphasizes ID as an activity that “tends to embrace all aspects of the human environment ... conditioned by industrial production”; it speaks of the need to “develop a design activity that contributes to the regulating of growth processes, the conservation of resources and the protection of the environment.”^[5] Two courses are of particular interest for their social content: Industrial Design Analysis (85.101), which emphasizes environmental conservation and values analysis^[6]; and Contextual Nature of Products (85.352), which examines the social and cultural context of the industrial product. ^[7] [b>>e or f>>g]

Carnegie Mellon University

Pittsburgh, Pa. <<http://www.cmu.edu>>

Human Computer Interaction Institute

Industrial Design

The Human Computer Interaction Institute offers an MS degree in human-computer interaction that requires courses in computer science, design, and behavioral and social sciences.[8] The program “is highly interdisciplinary, with instructors from Computer Science, Design, Psychology, Social and Decision Sciences, and Business Administration.”[9] “The objective of the ... program is to prepare students to participate in the design and implementation of software systems that can be used easily, effectively and enjoyably.”[10]

The Design program, including Industrial Design, is in the College of Fine Arts. The descriptions of several courses in the design curriculum make explicit reference to social considerations. These include Human Experience in Design (51-171), Introduction to Design Thinking (51-172), Design History I and II (51-271 and -272), How People Work With Things: Advanced Human Factors (51-342), and Contemporary Design (51-372). The descriptions of the design studio courses, however, make no such references. Courses with social content may be intended to serve, as the description of Design History II indicates, “as a resource” for work in the design studio. It appears there is little, if any, engineering content in the ID curriculum.[11]

Colorado School of Mines

Golden, Colo. <<http://www.mines.edu>>

EPICS

Levinger and Shea note that the Engineering Practices Introductory Course Sequence (EPICS) program “contain[s] some of the distinctive elements of the Rensselaer proposal,” including “attention to social and political contexts of design and engineering.”[12] According to one faculty member: “[CSM] been doing design with a strong societal component from the freshmen to the senior level ... for over a decade. In fact many of us feel that a true design experience is not obtained without that component.” In the EPICS program, projects not only involve technical research but “require students to consider non-technical constraints (economic, ethical, political, societal)”[13] A principal means by which the program maintains its “societal component” is that it takes design problems “directly from industry or government industries.”[14]

Cornell University

Ithaca, New York <<http://www.cornell.edu>>

Engineering in a Social Context (M&AE 400/401)

Interactive Multimedia (Comm 639)

Two courses are of interest. The first is a Mechanical and Aerospace Engineering course entitled Components and Systems: Engineering in a Social Context (M&AE 400/401). It “addresses, at a technical level, broader questions than are normally posed in the traditional engineering or physics curriculum.” Through an examination of cases such as nuclear power

and the Strategic Defense Initiative, the course “investigate[s] interactions between the scientific, technical, political, economic, and social forces that are involved in the development of engineering systems.”^[15] Students combine technical analyses with social analyses. This is a three-credit course, but some students take an additional design credit, producing an additional report that the instructor describes as “a technical assessment.”^[16] [a>>d or a>>g]

The second course is a Department of Communication course entitled Interactive Multimedia: Design and Research Issues (COMM 639). It provides an “overview of multimedia technologies” such as CD-ROM. Recently one section of the course has explored ideological issues involved in technological design.^[17] [c>>e or d>>g]

Evergreen State College

Olympia, Wash. <<http://www.evergreen.edu>>

interdisciplinary design

The school’s innovative curriculum focuses heavily on interdisciplinary learning. According to the catalog, “Each Evergreen program is designed around a theme or question, and each draws on many traditional academic disciplines to explore this central question.”^[18] A program consists of two to five faculty members and 40 to 100 students working (“primarily full time”) for one or more quarters.^[19] Many Evergreen programs involve study in three or more disciplines, and all require some cross-disciplinary work.^[20] Evergreen has no engineering, engineering design, or industrial design programs. Design apparently emerges primarily in the context of multimedia, film and video.^[21] [b>>e]

Fashion Institute of Technology

New York City <<http://www.apparel.net/fit>>

various design programs

Primarily apparel design and so forth. No industrial design program no engineering content, and little evidence of social orientation.^[22] [b]

Georgia Tech

Atlanta, Ga. <<http://www.gatech.edu>>

Industrial Design

The Industrial Design program is in the College of Architecture but appears to have significant engineering/technical content. The program description indicates that an industrial designer “must be part artist, part entrepreneur, and part engineer. ... While giving form to the efforts of industry, the designer is at the same time a consumer advocate, providing the humanizing link between technology and the consumer.”^[23] “The challenge [of] industrial design ... is to

maintain human priorities in an increasingly complex and competitive technological world.”[24] It is not clear, however, how this mission translates into design projects. Surprisingly, courses in humanities and social sciences are justified as necessary “for educational enrichment.”[25] [g]

Howard University

Washington, D.C. <<http://www.howard.edu>>

Introduction to Engineering Design (300-101)

Levinger and Shea indicate that the first-year engineering design class “takes a social problem as an opportunity to develop technological fixes.”[26] In Introduction to Engineering Design (300-101), the major project for Fall 1996 was design of small-scale solar vehicle. Mini-design projects in recent years have been portable shelters for homeless people, personal safety project for the elderly, portable water purification systems, and recycling systems for the university’s wastestream. Mini-design projects for 1996-97, on the theme of energy, are systems to propel water through a drinking straw and to prevent fluorescent tubes from breaking when dropped. All faculty members involved in the course are engineers, and the course syllabus does not explicitly mention a social orientation. [27] The engineering program is a member of the Engineering Coalition of Schools for Excellence in Education and Leadership (ECSEL). [a or a>>d]

Massachusetts Institute of Technology

Cambridge, Mass. <<http://www.mit.edu>>

Product Development in the Manufacturing Firm (15.783J)

Structure of Engineering Revolutions (STS.185)

Engineering Systems, Economics, and Management (1.141J)

Integrated Studies Program

Several engineering-related courses are of interest. Product Development in the Manufacturing Firm (15.783J), combines engineering, industrial design, and management, with the ID component taught by faculty from the Rhode Island School of Design.[28] The Structure of Engineering Revolutions (STS.185), aims to help students “understand funding, politics, technology, and social context for historically significant developmental projects.”[29] Engineering Systems, Economics, and Management (1.141J), explores “procedures for successfully designing complex technical systems that must perform well in a social context.”[30] Also of interest is the School of Engineering’s Integrated Studies Program. Directed by an anthropologist, it “focuses on technology and its role in society. Specific technologies ranging from food production, weaving, and blacksmithing to the design of clocks, internal combustion engines, and communications systems are examined in the contexts of a variety of cultures.”[31] MIT is a member of ECSEL. [a>>d or a>>g]

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North Carolina State University

Raleigh, N.C. <<http://www.ncsu.edu>>

Industrial Design

The Industrial Design program, which is within the Design and Technology Department and the School of Design, has a strong humanities and social sciences bent. The school's goal is "preparing the designers who, in the broadest sense, shape the world." The technological environment has "a powerful impact on how humans function as a society," so "good design ... requires attention and sensitivity to social, economic, political and behavioral issues." The ID curriculum has little engineering content. [b>>e]

Parsons School of Design

New York City <<http://www.parson.edu>>

Product Design

The Product Design program emphasizes teaching students "to conceive attractive and functional consumer products that meet specialized needs and make intelligent, responsible use of available materials."^[32] The curriculum appears to have little social orientation and no engineering orientation.^[33] [b]

Pennsylvania State University

<<http://www.psu.edu>>

Introduction to Engineering Design (ED&G 100)

Levinger and Shea indicate there is a "social aspects" component in the introductory engineering-design course.^[34] But the current syllabus of the course — Introduction to Engineering Design (ED&G 100) gives no indication of a social orientation.^[35] [a]

The engineering program offers minors in Science, Technology, and Society and in Peace and Conflict Studies.^[36] It is a member of ECSEL.

Pratt Institute

New York, New York <<http://www.pratt.edu>>

Industrial Design

The Industrial Design program, in the School of Art & Design, is committed to "beautiful forms and products."^[37] The curriculum gives little evidence of social/interdisciplinary content or of

engineering content. [b]

Rhode Island School of Design

Providence, R.I. <<http://www.risd.edu>>

Industrial Design

The goal of the Industrial Design program is to “identify and resolve design problems ... innovatively and with sensitivity to the social, physical, and ecological environment.”^[38] The course titles and faculty roster do not suggest significant engineering content.^[39] [b or b>>e]

Rochester Institute of Technology

Rochester, New York <<http://www.rit.edu>>

Industrial Design

The Industrial Design program is in the Department of Industrial & Interior Design, School of Art and Design, College of Imaging Arts and Sciences. The course descriptions do not suggest a social orientation, and the engineering content does not appear to be extensive.^[40] [b or f]

Royal College of Art

London <<http://www.rca.ac.uk>>

Computer-Related Design

Industrial Design

Industrial Design Engineering

Within the School of Design for Industry, there appear to be strong social and technical/engineering orientations in three graduate programs (a.k.a., “courses”): Computer-Related Design “is as much about people as it is about technology”; issues addressed include “How does technology affect culture — and vice versa?” Industrial Design emphasizes design as a multidisciplinary process, “a rich and complex activity drawing from and addressing a wide range of concerns, cultural, social, philosophical, political, and anthropological.” Industrial Design Engineering “emphasizes the development of social ... sensibilities”; students write a thesis in which they “may consider in detail the broader ethical, social and cultural issues of a chosen area of design interest.”^[41] [b>>e or f>>g]

San Jose State University

San Jose, Calif. <<http://www.sjsu.edu>>

Industrial Design

The ID program is in the School of Art and Design. “[The] curriculum in design, theory, and skill classes [is] supported by courses in technology, business, science, art, and humanities.”^[42] [b or b>>e]

Santa Clara University

Santa Clara, Calif. <<http://www.scu.edu>>

Computer Design Workshop

In Computer Design Workshop (Comm 193), which is cross-listed in the Studio Art and Mechanical Engineering programs, students work in teams to “explore solutions to social

problems.”[43] It appears the course may use this focus on real-world problems not to explore the social context of the design process but as a tool for teaching the use of graphics hardware and software.[44] [a>>d or f>>g]

Stanford University

Stanford, Calif. <<http://www.stanford.edu>>

Product Design

The Product Design program is in the Design Division, School of Engineering; it is offered jointly with the Art Department. The Design Division combines “an emphasis on creativity, technology and design methodology ... with a concern for human values and the needs of society.”[45] The Product Design curriculum has a clear social orientation. Students are required to take a course in the Technology in Society curriculum and another Human Values in Design (Mechanical Engineering 115A; catalog, p. 136).[46] It is not clear to what extent the social orientation is carried over into the design project courses (Mechanical Engineering 116A, 116B, 116C). [g]

Syracuse University

Syracuse, New York

<<http://www.syracuse.edu>>

Industrial Design

The Industrial Design program is in the Department of Design, School of Art & Design, College of Visual and Performing Arts. The ID program is noted for “focusing on social and environmental responsibility.” [47] According to one professor, the program “view[s] designers as change agents or people that can and will be able to influence industry and/or society. We also understand the traditional role of design and the current job market So it’s a balance between ideals and practical needs.” [48] A course entitled Industrial Design: Product Humanics (IND 372) is geared to “Analyzing and defining human needs and developing simple products that serve them.” A Computer-Aided Design (CAD) course (IND 475/675) focuses, in part, on the “Impact of CAD on ... society.” Other course descriptions refer to societal and environmental needs. One course is devoted to the philosophy and ethics of design. [49] It isn’t clear how this social orientation plays out in project courses such as Industrial Design: Thesis (IND 574). There appears to be a small to moderate amount of engineering/technical content. [b>>e or f>>g]

University of Art and Design Helsinki

Helsinki, Finland

<<http://www.uiah.fi>>

numerous design programs

The university has a diverse array of design programs, including an ID program within the Faculty of Product and Strategic Design. Little, if any, engineering content is evident, but there apparently is considerable interdisciplinarity and some attention to social considerations. [50] [b or b>>e]

University of California at Berkeley

Berkeley, Calif.

<<http://www.berkeley.edu>>

Visual Design

Berkeley’s M.A. in Design is in Visual Design. [b] The university also has a College of Environmental Design, which I have not investigated.

University of Maryland at College Park

College Park, Md.

<<http://www.umd.edu>>

Gemstone Program

Introduction to Engineering Design (ENES 100)

The Gemstone Program, in the Institute for Systems Research, “spans disciplines and seeks solutions to the most compelling problems of our time” — “problems associated with technological change.”[51] the program gives students from across the university an opportunity to carry out multi-year research projects. The program is new, and the first projects now being defined. Design will probably be a component of all projects and a major component of some. A project now being developed focuses on information security and warfare and may include a software-design component, for example. At the faculty’s urging, virtually all Gemstone students take Introduction to Engineering Design (ENES 100), regardless of whether they are engineers. Gemstone exposes engineering students to social issues, but its primary goal is to provide all students experience working in teams with people from other disciplines.[52] This approach is more multidisciplinary rather than interdisciplinary, for within a team students address target issue from the perspectives of their respective undergraduate majors. For example, it is up to students from the humanities and social sciences to place the team’s topic in a historical perspective and to assess the societal impact of proposed solutions.[53] [d or d>>g]

In Introduction to Engineering Design (ENES 100), part of the university’s ECSEL curriculum, projects have tended to be green rather than high-tech. In recent years, for example, students did wind-power projects and developed hand-powered water pumps for use in the Third World; in 1996-97, they developed solar desalination technology.[54] [a>>d]

University of Michigan

<<http://www.umich.edu>>

Industrial Design

joint degree in Industrial Design and Mechanical Engineering

Exploratory Design Laboratory

Joint Program in Liberal Arts and Engineering

The Industrial Design program is in the School of Art and Design, with little indication of significant engineering or social content.[55] [b]

There is a joint degree in Industrial Design and Mechanical Engineering, but with no indication that social perspectives are incorporated.[56] [f]

An Exploratory Design Laboratory involves cooperation between Computer/Electrical Engineering, Aerospace Engineering, Mechanical Engineering, Industrial Operations Engineering, and Industrial Design. It is not clear that the lab has any social orientation.[57] [f]

In addition, there is a Joint Program in Liberal Arts and Engineering.[58] Presumably this could translate into a design experience for some students. [d?]

University of Waterloo

Waterloo, Ont. <<http://www.uwaterloo.ca>>

Systems Design Engineering

The Systems Design Engineering (SYDE) program “represents a rational response to increasingly complex situations in modern technological society, involving not only technical, but also environmental, socio-economic and political factors.” The character of this social orientation appears quite narrow, however. The program’s mission statement suggests that social perspectives are gained through study of “human systems, social and environmental systems ... and other systems topics.” The program’s workshop course titles and descriptions give little indication of human/society orientation. Conflict Analysis (SYDE 533; taught by the chair of the undergrad program) focuses not on the social acceptability of technological projects but on their social/political feasibility. A list of “seven stages to the design process” that apparently is one of the primary focal points of Introduction to Systems Design Engineering (SYDE 161) makes no explicit mention of social issues. [59] Some social content may be present in the program’s seminar courses, whose descriptions are not available. [a>>d]

Virginia Polytechnic Institute

Blacksburg, Va. <<http://www.vt.edu>>

Industrial Design

The ID program, approximately two years old, is in the College of Architecture and Urban Studies and is quite architecture-oriented. It focuses extensively on low-cost housing such as mobile homes and emphasizes ways in which the benefits of industrial production can be achieved without sacrificing quality.[60] The course descriptions reflect little, if any, social orientation or engineering content.[61] [b or e]

Worcester Polytechnic Institute

Worcester, Mass.

<<http://www.wpi.edu>>

Interactive Qualifying Project

Major Qualifying Project

All WPI students are required to do an Interactive Qualifying Project (IQP). The IQP “challenges students to identify, investigate, and report on a self-selected topic examining how science or technology interacts with societal structures and values. The objective of the IQP is to enable WPI graduates to understand, as citizens and as professionals, how their careers will affect the larger society of which they are part.” The project “emphasizes the development of an understanding of the concepts and analytical techniques of the social sciences.”^[62] The WPI catalog lists five broad IQP themes: (1) technological literacy and public understanding of science; (2) reception of scientific and technical innovations by affected communities and technical professions; (3) impact of equity issues related to gender, race, ethnicity or social class; (4) reforms in science or engineering education; (5) processes of technology transfer and product innovation.^[63] Among scores of IQPs listed in the catalog, the word “design” appears in the title of only two: “Cognitive style shifts in the ‘Helios’ R&D team as it moves to the design phase of the product development cycle” and “An injury investigation of quadriplegia resulting from an automatic shoulder seatbelt: Design failure or negligent in use” [sic].^[64] According to the Project Program administrator, another required project, the Major Qualifying Project (MQP), although more technical, typically involves a sensitivity to social concerns.^[65] For many students, especially engineering students, MQPs involve capstone design activity.^[66] [a>>d or f>>g]

Conclusions and Reflections

- The social/technical synthesis often touted in design program descriptions is often less than meets the eye. Schools’ promotional literature often suggests programs are located within the overlap regions (*d*, *e*, *f*), but the curricula often fail to bear out this claim. On one hand, design programs, including ID programs, often (perhaps usually) do not have significant engineering content. At the same time, “social” elements often hailed in engineering program literature frequently boil down to an emphasis on teamwork and intra-engineering “interdisciplinarity.” These are no substitutes for what I have rather brazenly termed “genuine social orientation.”
- Although claims for a synthesis of technical and social are common, none of the programs I examined promotes itself explicitly as being located within the region I have called the sweet spot (*g*). The Royal College of Art probably comes closest.
- The most interesting programs identified here deserve more detailed study, including examination and analysis of course syllabi. A major unresolved issue regarding the programs that I have suggested lie in or approach the sweet spot (*g*) is just what sort of overall curricular balance they achieve between the various major regions (*a*, *b*, and *c*). The emphases of these programs vary enormously, and only detailed study will reveal the character of the synthesis they achieve.

Another major issue that remains unresolved, in most cases, is whether programs that lie in or approach the sweet spot do so *within their design project courses* (rather than, e.g., by segregating design projects from courses intended to provide the “social context” of design) and, if so, how.

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- [1] David Levinger and Elizabeth Shea, “Appendix A: Survey of other engineering design programs,” in Frances Bronet, Deborah Kaminski, and John Schumacher, “Engineering and society: The art of design,” pp. 25-31, original NEH Proposal, 1994.
- [2] *College Blue Book*, 24th ed., New York: MacMillan, 1993.
- [3] Ibid.
- [4] Jacques Giard, personal communication, 10/28/96.
- [5] <http://www.id.carleton.ca>; 9/96.
- [6] Ibid.
- [7] 85.352, The Contextual Nature of Products, Course Outline, Fall 1996.
- [8] Dan Olson, personal communication, 4/11/97.
- [9] <http://www.cs.cmu.edu/~hccii/masters/masters.html>; 4/97.
- [10] Ibid.
- [11] http://www.cmu.edu/cgi-bin/ft_http/DB=/registrar/db/fulltext; 5/97. It appears that a multidisciplinary course offered c. 1993 that included significant engineering content (99-600, The Design, Manufacturing and Marketing of new Products) may no longer be offered.
- [12] Levinger and Shea, 1994.
- [13] <http://www.mines.edu/publications/bulletin/bulletin95/undergrad/epics.html>; 5/97.
- [14] Mike Pavelich, personal communication, 11/22/96.
- [15] <http://www.cornell.edu/Academic/Courses96/csen/en593.html>; 5/97.
- [16] Zellman Warhaft, personal communication, 5/22/97.
- [17] Julian Kilker, personal communication, 5/25/97. See Kilker, “Ideologies of Design: The Artifacts of Politics,” draft for use in COMM 439/639, July 1996 (available at <http://www.img.cornell.edu/439/kilker.html#abstract>). A revised version is: Kilker, “Technology design: A collaboration among multiple social identities,” unpublished ms., Dept. of Communication, Cornell University, March 1997 (Kilker’s e-mail: jak8@cornell.edu).
- [18] *The Evergreen State College 1996-97 Catalog*, CollegeSource (CD ROM), Career Guidance Foundation, 1996, p. 7 (page numbers may not correspond to those in printed catalog).
- [19] Ibid., p. 11.
- [20] Ibid., p. 12.
- [21] Ibid., pp. 54, 55.
- [22] “LookBook,” Fashion Institute of Technology, no date.
- [23] Georgia Institute of Technology, General Catalog 1996-97, p. 60.
- [24] <http://www.gatech.edu>; 9/96.

[25] Ibid.

[26] Levinger and Shea, 1994.

[27] <http://www.cldc.howard.edu/~introeng>; 5/97.

[28] See *Collaborative Product Development: Interdisciplinary Education*, Report on Corporate Design Foundation Conference, 1993. I have not confirmed that this course is still offered.

[29] <http://registrar.mit.edu@0002136.4035>; 5/97.

[30] *Massachusetts Institute of Technology 1996-97 Bulletin*, CollegeSource (CD ROM), Career Guidance Foundation, 1996, p. 128 (page numbers may not correspond to those in printed catalog).

[31] Ibid., p. 131.

[32] *Parsons Catalog & Portfolio 1996-97*, p. 67.

[33] Ibid., p. 68.

[34] Levinger and Shea, 1994, p. 29.

[35] Introduction to Engineering Design ED&G 100, Section 1, Spring 1997.

[36] <http://www.engr.psu.edu/www/ug/#Majors>; 5/97.

[37] *Pratt Undergraduate Bulletin 1996-1997*, p. 132.

[38] *Rhode Island School of Design 96-97*, p. 59.

[39] I have been unable to obtain course descriptions (which are not provided in the catalog).

[40] *Rochester Institution [sic] of Technology 1996-97 Bulletin*, CollegeSource (CD ROM), Career Guidance Foundation, 1996, pp. 83-85, 217-218 (page numbers may not correspond to those in printed catalog).

[41] *Royal College of Art Postgraduate Art and Design Prospectus 1997/98*. I have been unable to obtain descriptions of specific lectures, seminars, workshops, projects.

[42] <http://www.sjsu.edu>; 9/96. I have not reviewed the curriculum.

[43] <http://www.scu.edu/SCU/Courses/Descriptions/comm193.des>; 9/96.

[44] Computer Design Workshop, Art/Comm/ME 193, syllabus, winter 1990-91. I have been unable to obtain a more recent syllabus.

[45] "General Information," Design Division, Mechanical Engineering at Stanford, 1994.

[46] *Stanford University 1996-97 Bulletin*, CollegeSource (CD ROM), Career Guidance Foundation, 1996, pp. 135-37, 255-56, 260 (page numbers may not correspond to those in printed catalog).

[47] <http://vpa.syr.edu/SCHOOLS/SOAD/DESIGN/indesgnt.html>; 4/97.

[48] Donald Carr, personal communication, 5/29/97.

[49] *Syracuse University Bulletin 1996-97: Undergraduate Course Catalog*, CollegeSource (CD ROM), Career Guidance Foundation, 1996, pp. 174, 180-81 (page numbers may not correspond to those in printed catalog).

[50] <http://www.uiah.fi>; 9/96.

[51] <http://asdg-99.umd.edu/CPSP218t/t05/gemstone.htm>; 9/96.

[52] Tom Fuja, personal communication, 5/27/97.

[53] <http://asdg-99.umd.edu/CPSP218t/t05/teams.htm>; 9/96.

[54] Tom Regan, personal communication, 5/22/97.

[55] <http://www.umich.edu/~webteam/soad/undergraduate/areas/areahome.html>; 4/97.

[56] <http://www.umich.edu/~webteam/soad/undergraduate/ughome.html>; 4/97.

[57] “The Exploratory Design Laboratory,” University of Michigan, in *Collaborative Product Development: Interdisciplinary Education*, Report on Corporate Design Foundation Conference, 1993.

[58] *University of Michigan College of Literature, Science, and the Arts 1996-97 Bulletin*, CollegeSource (CD ROM), Career Guidance Foundation, 1996, pp. 26-27 (page numbers may not correspond to those in printed catalog).

[59] <http://sail.uwaterloo.ca:80/~sydewww>; 4/97.

[60] Bill Green, personal communication, 5/21/97.

[61] *Virginia Polytechnic Institute Catalog 1996-97*, CollegeSource (CD ROM), Career Guidance Foundation, 1996, pp. 73-74, 76-77 (page numbers may not correspond to those in printed catalog).

[62] *Worcester Polytechnic Institute 1996-97 Catalog*, CollegeSource (CD ROM), Career Guidance Foundation, 1996, p. 32 (page numbers may not correspond to those in printed catalog).

[63] *Ibid.*, p. 36.

[64] *Ibid.*, p. 37.

[65] C. J. Kornick, personal communication, 11/15/96.

[66] *Worcester Polytechnic Institute 1996-97 Catalog*, p. 31.