Engineering and Technology Industry Council
Campus Investment Proposal
Biennium from July 1, 2009 to June 30, 2011

Campus:

Oregon Health & Science University: School of Science & Engineering (OGI)

Contact Name:

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Summary of Proposal:

Our programs integrate science and engineering to focus on major problems of human and environmental health. Investment from ETIC will allow us to:

- Complete the ramp-up process for nearly all of the ***five faculty members*** most recently hired with ETIC investment funds; and
- Hire ***one new faculty member*** in select research focus areas.

Together, these efforts will promote excellence in our programs, increase the number of graduate students serving as leaders in Oregon's bioscience[1] and biomedical engineering industries, and further the development of technologies to improve the health and well-being of Oregonians.

Vision Statement

We are committed to ***engineering a healthier world***, by:

- combining science and engineering to develop new solutions for human and environmental health problems;
- educating the next generation of bioscience and biomedical engineering leaders; and
- developing technologies today that will improve health and well-being tomorrow.

[1] We define bioscience broadly, as does the Oregon Bioscience Association, to include industries such as medical devices, pharmaceuticals, marine biotechnology, environmental information technology, nanobiotechnology, and bioengineering, for example.

Aspirational Peers

The table below lists aspirational peers for our two main programs, one focused on biomedical engineering and computer science and the other focused on environmental health. Neither program is easily comparable to others; both contain a center with an international reputation. Comparisons are difficult because of our focus on cutting-edge, interdisciplinary research areas; faculty members in both programs are international leaders in developing new fields of research. Highlights of the two centers include:

- ***Center for Spoken Language Understanding (CSLU).*** There is no similar center in Oregon, and only two comparable peers in the U.S. CSLU focuses both on advancing the science of speech and language technologies and on applying those technologies to complex human health problems. One of its major initiatives in recent years has been autism, for which it has successfully developed non-invasive software tools for early diagnosis, and assistive technologies for the elderly. Other applications of the same underlying algorithms the Center is actively working on include computational bioinformatics and computational medical informatics. The center has been extremely successful in attracting NIH funding, has spun off a start-up company (Biospeech), and is a recognized leader in its field.

- ***Center for Coastal Margin Observation & Prediction (CMOP).*** CMOP is Science & Technology Center (STC) funded by a ten-year, nearly $40M grant from the National Science Foundation. There are no other STCs in Oregon, only 17 in the U.S., and only one—CMOP—focused on the health of coastal margins. As an anchor center for our program in environmental and biomolecular systems, CMOP is developing ocean-based observatories that integrate physical, chemical, and biological data across entire ecosystems, from the microbial through the systemic scale.

Biomedical Engineering & Computer Science Program	**Johns Hopkins University** ***Whitaker Department of Biomedical Engineering***	**OHSU** ***Biomedical Engineering and Computer Science***
Founded	1962	2002
Ranking (NIH Funding)	18	33
# Core Faculty	23	20
# Grad. Students	130	36
# Undergrad. Students	100	0
# Research Focus Areas	8	4
$ NIH Grants ('05)	$5.4M	$1.8M (FY07)
$ Founding Support	Tens of millions (Whitaker Fdn.)	$4M (Murdock Trust), for BME

Environmental & Biomolecular Systems Program	Princeton University Center for Environmental Bioinorganic Chemistry	OHSU *Environmental & Biomolecular Systems*
Founded	1998	2003
Ranking (USNWR)	Unranked emerging field	Unranked emerging field
# Core Faculty	39 (spread over >12 institutions)	16
# Grad. Students	40 graduate studnets, 25 postdocs	34
# Undergrad. Students	50 (over 10 years)	0, except 12 summer interns
# Research Focus Areas	4	4
$ Federal Grants ('05)	Not available	$6.4M
$ Founding Support	$1.2M	-

Long-term Goals

The long-term goals of our engineering programs are closely aligned with our vision, and with the focus of the Engineering and Technology Industry Council. They include:

- ***Promoting excellence*** in programs that combine science and engineering to solve human and environmental health problems;
- ***Increasing the number of graduate students*** educated to serve as leaders in Oregon's biomedical engineering and bioscience industries; and
- ***Aligning research and education with industry*** in developing and commercializing new technologies to improve health and well being for all Oregonians.

Please also refer to the addendum to this proposal for further information about the engineering programs at Oregon Health & Science University. The addendum contains background about the 2001 merger of the School of Science & Engineering (OGI) with OHSU, explanatory information about educational goals for our science and engineering programs, and details about the coming transition of the school as a new engineering unit inside OHSU's School of Medicine.

Investment Description

Investments from funds secured through the Engineering and Technology Industry Council will be devoted to:

- Completing the ramp-up process for nearly all of the ***four faculty members*** most recently hired with ETIC funds, enabling them to rapidly begin producing Ph.D.-educated leaders who will make substantial contributions to Oregon's business community and intellectual property; and

- Hiring ***one new faculty member*** in a focus area where human health, high-tech, and software overlap, enabling core research clusters to reach the critical mass required to secure significant levels of external support.

➢ $1.2M: Phasing Out ETIC Support For 4 Recently Hired Faculty Members

$1.2M in investment funds will provide the final phase of support required to achieve self-sufficiency for nearly all of the five faculty members most recently hired with funds secured through ETIC (one or two may require some additional support).

ETIC funds have been leveraged to hire six faculty members: Brian Roark, Zak Shafran, Tania Vu, Deniz Erdogmus, Miguel Carriera-Perpiñan and, recently, Kemal Sönmez. One, Miguel Carriera-Perpiñan, was terminated for not meeting performance targets and Deniz Erdogmus took a position at another university, but retains a joint appointment with the BME division.

Supported by mentoring from senior faculty, they have secured (or are expected to secure, in the case of the most recent hire) significant and diversified funding. In addition, they have attracted strong Ph.D. candidates now in the pipeline. A final phase of ETIC investments would provide bridge for most of these junior faculty members to become self-funded and more productive in graduating Ph.D. and M.S. students.

Brief research profiles and notable achievements for these faculty members include:

Brian Roark

- ***Research Focus:*** Incremental parsing of text and speech; language modeling for automatic speech recognition; supervised and unsupervised learning of language and parsing models; probabilistic models of human language processing; computational bioinformatics and medical informatics.
- ***Notable Funding:*** Has obtained more than $1M in funding during his first three years, including grants on automated detection of Mild Cognitive Impairment and a five year, $500K National Science Foundation CAREER grant in support of research and education on improvements to the efficiency and accuracy of automated speech recognition algorithms and software.

Zak Shafran

- ***Research Focus:*** Speech and language processing; multilingual speech recognition; large vocabulary speech recognition; spoken term detection; spoken structural event detection; language recognition; speaker recognition; computational bioinformatics.
- ***Notable Funding:*** Three National Institute of Health-funded collaborations with Johns Hopkins University, including two on automated speech recognition and one on learning models for use in robot-assisted minimally invasive surgery.

Kemal Sönmez (new hire as of 2.1.08)

- ***Research Focus:*** Speech and speaker recognition, computational bioinformatics.
- ***Notable Funding*** (prior to moving to the School from SRI International**:** More than $10M from Department of Defense, NIH, and NSF on Prediction of Health and Disease Program, Biological Network Informatics, and speaker recognition.

Tania Vu

- ***Research Focus:*** Functionalized nanoparticle probes for cell-directed delivery, transport, and visualization. Engineered bioplatforms for studying molecular-scale interactions in the nervous system. Live cell stimulation and single-molecule imaging. Micro/Nanotherapies for the brain and retina.
- ***Notable Funding:*** $1.3M, four year Department of Defense grant to use quantum dots to identify receptor proteins involved in neural signaling of depression and therapeutic targets of antidepressants.

➢ $526K: Start-Up Support For One New Faculty Member

$526K in investment funds provided through ETIC will provide start-up support for one new faculty members in a strategically selected area of existing strength, where human and/or environmental health, high-tech, and software overlap. Areas of strength, and some current applications of research in those areas, include:

Area	Application
Advanced computational modeling	Broad-scale environmental modeling based on data from molecular to ecosystem scales; modeling thrombosis and hemostasis in primates
Advanced medical device software	Algorithms enabling real-time tracking of lung tumors during radio surgery
Biomedical optics and imaging	Photodynamic therapies for cancer, precise imaging of skin tumors, devices for imaging engineered tissues
Environmental information technologies	Marine-based sensor networks for forecasting tsunamis, pollution/contaminant spread, health impacts of anthropogenic activities
Marine biotechnology	Cancer-fighting compounds from marine sponges
Microbe-based environmental remediation	Cleaning up hazardous wastes, toxic sites
Molecular engineering	Engineering new anti-thrombotic proteins
Multi-modal inference technologies	Unobtrusive and continuous physiological and behavioral assessment for estimation of health and mental state
Nanoscale probe and sensor development	Probes for *in vivo* imaging, sensors for marine microbial as well as human cell-based measurements
Nanoparticle-based drug delivery	Quantum dots to target delivery to cells or modulate drug trafficking within cells
Nanoparticle-based environmental remediation	Nano-sized iron particles to remediate groundwater contaminated by carbon tetrachloride

Natural language processing	Automated summarization, data mining of clinical notes
Neurobehavioral diagnostic technologies	Non-invasive language-based technology for diagnosing autism, apraxia, stuttering, cognitive impairment
Neurobehavioral assistive technologies	Voice transformers for unintelligible speech
Neurobehavioral remediation technologies	Software to improve memory function in the elderly, computer-based therapies for children with autism
Neurophysiological assistive technologies	Real-time non-invasive brain activity sensing, for enhancing cognitive function
Pharmaceutical development	New therapies for treatment and prevention of thrombotic cardiovascular disease
Technologies for independent living	Context-aware medication prompting, automated health coaching, Living Lab for facilitating translational resource
Tissue engineering	New substitutes for blood vessels

Private Support

Core support for the engineering unit inside OHSU's School of Medicine will come from an existing quasi-endowment, funds for which were contributed largely by private donors, generating over $1M annually. This will be supplemented by industry contracts and grants from private foundations, largely for equipment, both of which our faculty members have been highly successful in attracting. For example, our faculty members currently average more than 8 percent of their annual support from industry contracts—higher than the 6 percent average at research universities—many with significant partners like Intel. The Department of Biomedical Engineering was founded with the largest grant ever awarded by the M.J. Murdock Charitable Trust.

Results and Benefits

Short-term

- ***Result:*** One or two new faculty members hired in strategically selected areas of existing strength, where human and/or environmental health, high-tech, and software overlap.

  Benefits: Anticipated benefits include:

  — Additional Ph.D. students will begin entering pipeline;
  — Building of critical mass in selected clusters will attract additional support; and
  — Alignment of clusters with ETIC and state priorities will generate positive industry synergies.

- ***Result:*** Most of the four faculty members most recently hired with ETIC support become fully ramped up in preparation for self-funding and normalized production of Ph.D. students; one recently hired faculty member partially ramped up.

  Benefits: Anticipated benefits include:

  — Most faculty members recently hired with ETIC funds become self-funded, requiring no further ETIC support;
  — Ph.D. student production will be maximized for all of these faculty members;
  — One new drug in clinical trials;
  — Launch of pilot clinic using technologies pioneered by engineering faculty; and
  — Ramp up of Technology for Independent Living / Smart House.

- ***Result:*** Full integration of an engineering unit into OHSU's School of Medicine.

  Benefits: Anticipated benefits include:

  — Expanded number of collaborations between engineering faculty and healthcare practitioners—*e.g.*, physicians, nurses, dentists, pharmacists;
  — Increased opportunities for area companies to establish joint research projects with OHSU, based on OGI's historically strong industry relationships and modeled after successes like Intel's Behavioral Assessment and Intervention Commons collaboration with our engineering faculty; and
  — Acceleration of interdisciplinary training opportunities for engineering Ph.D. and M.S. students, where engineering skills will be supplemented with real-world experience working in teams of healthcare professionals.

Results and Benefits

Medium-term

- The biomedical engineering and computer science program will be ranked in the top 25 nationally for funding received from NIH (as compared with biomedical engineering departments).
- The environmental and biomolecular systems program will be ranked in the top 35 (as compared with other environmental health programs focused on water) by *USN&WR*.
- Additional spin-offs in both program areas—environmental and biomolecular systems, and biomedical engineering and computer science.
- New technologies developed by our researchers will come to market, making certain kinds of healthcare procedures or diagnostics more accurate, more efficient, and more affordable for Oregonians.
- Spinoffs and tech transfer from our research will expand and benefit Oregon's emerging bioscience and biomedical engineering industry, and a close relationship with OHSU will enable traditional high-tech companies like Intel to begin focusing on healthcare.
- Management training in bioscience and healthcare will not only benefit OHSU's employees, but will provide our engineering graduates and other professionals in the region with the skills they need to lead others in the industry.

Future Plan & Resources

Future Plan

Our approach through 2011 and beyond will be to continue to build strength and flexibility in engineering programs based at OHSU. Our two major program areas, in environmental health and biomedical engineering and computer science, were selected to provide maximum opportunities for collaboration inside OHSU and beyond, and we will aggressively continue those efforts. We will seek out opportunities to develop centers of excellence like CMOP and CSLU, based on an evaluation of emerging research priorities at a national level and their potential synergy with our research focus areas.

Resources Required

It is anticipated that all faculty members will be supported beyond their ramp-up period by a combination of grants, tuition, and the core salary provided to them by the engineering unit's quasi endowment. Further requests to ETIC will be focused on:

- ***Additional phase of faculty support.*** At a 5-year rate for achieving faculty sustainability, it is anticipated that an additional phase of ETIC investment support, of at least $900K, will be required for the faculty hired at the end of the '07-'09 biennium and during the '09-'11 biennium.
- ***Replacement faculty support.*** It is anticipated that ETIC support, of approximately $1.8M, for up to three additional replacement faculty members will be requested.
- ***Support for physical infrastructure.*** As the School of Science & Engineering begins to move inside the School of Medicine, support for physical infrastructure, of approximately $500K, will be requested to assist faculty in establishing optimally configured lab and workspaces.
- ***Complementary support for M.S. program maturation.*** Additional ETIC support may be requested to assist in the further elaboration of M.S. programs designed to interface with emerging needs in regional bioscience and biomedical engineering industry clusters.

Proposed Investment and Private Support Forecast ($M)

	2009-2011 Biennium
Sources of funds	
Base budget for ETIC-related programs – all sources except ETIC allocation & private support	$ 37,071,400
Proposed allocation from ETIC budget ($M) (3)	$ 1,726,000
Expected private support ($M) (4)	$ 5,000,000
Total ($M)	$ 43,797,400
Personnel supported (FTE) (5)	
Existing faculty (1), (8)	4.0
New faculty(2)	1.0
Existing staff (1)	2.0
New staff(2)	1.0
Total	9.0
New positions created (6)	
Faculty (2)	1.0
Staff (2)	1.0
Total	2.0
Uses of ETIC funds in line 3	
New facilities	$ -
Improvements to facilities (7)	$ 75,000
Laboratory equipment (7)	$ 100,000
Other equipment (7)	$ 25,000
Other one-time expenses	$ 200,000
Existing faculty salaries & benefits (1)	$ 600,000
New faculty salaries & benefits (2)	$ 400,000
Existing staff salaries & benefits (1)	$ 150,000
New staff salaries & benefits (2)	$ 51,000
Services & supplies	$ 75,000
Other	$ 50,000
Total (8)	$ 1,726,000

Notes

(1) Hired through June 2009 that will be supported by ETIC funds during 2009-11.

(2) To be hired with ETIC funds during 2009-2011 biennium.

(3) Includes Certificates of Participation to be issued during 2009-2011 biennium.

(4) Consistent with ETIC Private Support Policy dated 1-23-02.

(5) FTE expressed as percent of full time over 2 years of biennium.

(6) FTE on an ongoing basis.

(7) Includes improvements and equipment to be purchased with ETIC funds and any Certificates of Participation to be issued during the biennium.

(8) ETIC funds have been leveraged to secure 20% of support for these faculty positions from other sources.

Metrics Forecast (for programs/departments receiving ETIC funding):

	Actuals (1)		Projected (2)		
	AY 99	**AY07**	**AY11**	**AY13**	**AY20**
Undergraduate student credit hours	NA	NA	NA	NA	NA
Graduate student credit hours	9479	4177	2000	2500	3800
Graduation rate, 6-year (3)	87%	71%	75%	80%	80%
Bachelor's degrees granted	NA	NA	NA	NA	NA
Master's degrees granted (4)	103	78	15	18	25
PhD degrees granted	9	9	10	12	15
Women graduating (5)	29%	16%	20%	25%	35%
Minorities graduating (6)	21%	24%	23%	25%	25%
Externally-funded research expenditures (7)	15,883,154	14,631,047	15,000,000	16,000,000	18,800,000
Invention disclosures	NA	20	20	23	28
License/options	NA	NA	NA	NA	NA
License income received	NA	NA	NA	NA	NA
Spin-off Companies	NA	2	1	1	2
National ranking of <Biomedical & Computer Science Program> (8)	NA	33	31	30	28
National ranking of <Enviromental & Biomolecular Systems Program> (9)	NA	38	35	33	30
Notes/instructions.					
(1) Actuals for 12-month period ending in June of the year shown.					
(2) Forecast for the 12-month period ending in June of the year shown.					
(3) Percentage of students who started ETIC-related program six years earlier who have completed					
(4) Projected master's degrees granted *after* AY07 reflect low assumptions based on current undetermined disposition of Management program.					
(5) From engineering, computer science, and other programs directly benefiting from ETIC funding,					
(6) Racial and ethnic minorities who are US citizens or permanent residents, stated percent of US					
(7) Total external dollars spent by ETIC-related departments towards research during academic year.					
(8) According to NIH funding.					
(9) According to *U.S. News & World Report* rankings.					