

Institute for Sustainable Manufacturing

Brothers, Sheila C

From: Farrell III, Herman D
Sent: Monday, November 21, 2011 4:23 PM
To: Swanson, Hollie
Cc: Brothers, Sheila C
Subject: ISM Proposal -- Recommendation from SAOSC
Attachments: ISM responses to SOASC questions.docx

Dear Hollie Swanson:

The SAOSC met this morning to discuss the ISM proposal with Bob Gregory and Professor I.S. Jawahir. Last week they responded to our questions regarding the proposal. I have attached their written responses. In today's meeting members of the committee noted that the proposed transformation from the Center for Manufacturing to the Institute for Sustainable Manufacturing involves an internal college change and we expressed to Gregory and Jawahir, that if, in the future, the Institute for Sustainable Manufacturing expands to include educational units outside of the College of Engineering, such an expansion should be presented to the SAOSC, SC and US for further review. The members of the committee also took note of the written response to the committee's question regarding the "ISM Membership" funding mechanism (Appendix 3, page 19) and was assured by Gregory and Jawahir that any agreement involving such "ISM Membership" will be submitted for approval by the appropriate UK entities (ie, Office of Legal Counsel, Office for Commercialization & Economic Development).

Only 5 members of the committee were present at the meeting this morning, thus, no quorum. But we did all unanimously support the proposal. I sent around an email to the rest of the committee this morning and we have obtained a majority in support of the below recommendation:

After reviewing the proposal for the creation of the Institute for Sustainable Manufacturing, and after corresponding with and meeting with Bob Gregory and Professor I.S. Jawahir regarding the proposal, the Senate Academic Organization and Structure Committee hereby recommends to the University Senate support for the creation of the Institute for Sustainable Manufacturing in the College of Engineering. It is further recommended that the Senate Council review the written responses to questions presented by the SAOSC as a supplement to the initial ISM proposal.

Sincerely,

Herman Farrell
Chair, SAOSC

Brothers, Sheila C

From: Mary Watts [mwatts@engr.uky.edu]
Sent: Friday, December 09, 2011 8:48 AM
To: Swanson, Hollie; Brothers, Sheila C
Cc: Eric Grulke; I. S. Jawahir; Lester, Thomas W; Bob Gregory; Keith Rouch; Lynn Tilley
Subject: Faculty Vote Regarding the New Institute for Sustainable Manufacturing (ISM) in the College of Engineering

Following is the result of the electronic ballot conducted this week of College of Engineering Faculty on the issue of creating a new Institute for Sustainable Manufacturing (ISM) in the College of Engineering:

FAVOR: 76
OPPOSE: 13
ABSTAIN: 2

Faculty eligible to vote: 147

Mary

Mary Watts
Assistant to Dean Thomas Lester
College of Engineering
357 Ralph G. Anderson Building
University of Kentucky
Lexington, KY 40506-0503
mwatts@engr.uky.edu
(859) 257-4597 (phone)

Committee questions and ISM responses

- *What is the current status of the Center for Manufacturing? What is the history of the transition from the Center for Manufacturing to the proposed ISM?*

The Center is inactive, awaiting approval of ISM. "Inactive" means it has no budget and no personnel assigned. The Dean will follow procedures to recommend closure of the center, beginning with a proposal to Engineering faculty, once ISM is approved.

- *How will the proposed organizational structure for ISM compare/contrast to the organizational structure for the Center for Manufacturing?*

In many ways, the organizational structure is similar. As before, the Institute director reports to the dean of the college and the director is guided by an external advisory board. The ISM will also have a University Advisory Board composed of chairs of the three related departments (i.e. those contributing faculty FTE to ISM) to advise on academic/administrative issues that might arise re collaboration and provide a regular channel for communication between the chairs and ISM. The departments are Mechanical Engineering, Chemical and Materials Engineering and Electrical and Computer Engineering. The college's Associate Dean for Research is also a member of this board.

- *As noted in Footnote 1 on page 3 of the proposal, "ISM is a multidisciplinary research institute and is an "educational unit" within the meaning of UK GR-VII-A having as its primary mission instruction, research and service." UK GR-VII-A (7) states that, "a multidisciplinary research center or institute shall be administratively responsible to the Executive Vice President for Research unless specifically designated to another chief academic officer." Will the ISM be administratively responsible to the Executive Vice President for Research? Or another chief academic officer?*

ISM reports directly to the College of Engineering Dean.

- *UK GR-VII-A (7) also provides for a faculty advisory committee. Who will be on the faculty advisory committee for the ISM?*

We consider the University Advisory Board (see above) as performing this function. In addition, the ISM core faculty meets biweekly to discuss ISM business and associated faculty are welcome to attend these meetings.

- *Describe the level of faculty input (ie, voting rights) in the policy making process of the ISM.*

ISM policy will be decided by a majority vote of the core faculty.

- *How does the ISM proposal relate to other "sustainability" initiatives at the*

University of Kentucky?

ISM (which has an engineering/manufacturing focus) collaborates with the Faculty of the Environment (FotE) led by Dr. Paul Bertsch (which has a natural sciences/environmental focus) and ISM encourages individual research and education collaborations with other UK colleges, notably those currently with faculty in Gatton College, College of Design, and College of Education. Given the breadth of the issues involved with sustainability, which go well beyond engineering and the natural sciences, ISM research depends on multidisciplinary collaboration for its success.

- *How will these proposed changes affect the education/workload of students?*

The students primarily associated with ISM are research assistants to the various ISM faculty and have the same workload as any other research assistant in engineering; the impact on their education is beneficial in that students learning from their ISM mentors while performing research are gaining valuable experience in multidisciplinary collaboration and a broader perspective on their own discipline as part of a larger effort to tackle sustainability issues.

- *Are there letters in support of this proposal from within the university (faculty, department chairs, Deans, etc.) as well as from supporters outside the university (i.e., industry/government in Kentucky, US, etc.)?*

The Dean of the College of Engineering indicated his support with his cover letter submitting the proposal. We have attached his letter and letters from the relevant department chairs.

- *The ISM proposal (on page 14) notes that a "QFD-based strategic business operational plan" will be available by June 30, 2011. Has the plan been created? If yes, please provide the SAOSC with a copy of the plan.*

The planning process is not yet complete. It was paused for the summer while we awaited senate review so as to benefit from any further clarification as to ISM's obligations that might emerge from the review process. If approved, ISM will be expected to supply such a strategic plan to the dean.

- *The ISM proposal (in Appendix 3, page 19) discusses the "Sustainment of the ISM" via "ISM membership" with "member firms providing cash support, in-kind contributions, equipment donations or direct-project sponsorship." Has this proposed funding mechanism been vetted by the appropriate UK entities (ie, Office of Legal Counsel, Office for Commercialization & Economic Development)?*

We would submit any such agreement for approval before pursuing it. We felt a sample supplied with the proposal would be useful at this stage for informational purposes without being in any way an official document or agreement.

Executive Summary

This proposal seeks to establish within the College of Engineering a new organization, developed out of the former Center for Manufacturing, to be called the ***Institute for Sustainable Manufacturing (ISM)***.

Established in 1986 by the Commonwealth of Kentucky as the Center for Robotics and Manufacturing Systems, the Center for Manufacturing was a unique multidisciplinary program that conducted manufacturing research, transferred manufacturing technology to industry, and supported educational efforts in manufacturing. As a result of a strategic effort by the University of Kentucky to move to the forefront of new technologies and workforce development for the future of manufacturing, the Center for Manufacturing will now be transformed into the proposed Institute for Sustainable Manufacturing (ISM).

The purpose of the ISM is to advance progress toward sustainability, both nationally and internationally, by focusing on manufacturing.

The goals of the proposed ISM are to:

- (a) actively pursue academic research (basic and applied) with the goal of producing new and innovative manufacturing technologies at product, process and systems levels,
- (b) develop, deploy and commercialize new and innovative technologies and manage innovation,
- (c) perform effective dissemination of new knowledge generated, and
- (d) coordinate with graduate and undergraduate educational programs offered by the College and individual departments.

The ISM, if established, would be unique, the only university-based institute worldwide to focus on sustainability from a manufacturing perspective. Because it would serve as a model for how cross-disciplinary and inter-disciplinary research can be brought to bear successfully on urgent 21st century problems, the ISM would help bring talented and adventurous students and younger faculty with relevant and unique expertise to University of Kentucky and would raise the university's profile for innovative approaches to R&D and technology transfer. Bringing faculty together from a number of different colleges, departments and centers will create synergies that can enable more ambitious and effective research projects in sustainable manufacturing, and the successful pursuit of large-scale cross-disciplinary funding. The ISM's primary research goals include some of the nation's most urgent R&D priorities, such as creation of energy efficiency and environmentally benign net zero technologies for products and processes, and mentoring of the next generation scientific and technical workforce for sustainable manufacturing.



March 30, 2011

Dr. Kumble Subbaswamy, Provost
University of Kentucky
Lexington, KY 40506

Office of the Dean
College of Engineering
351 Ralph G. Anderson Building
Lexington, KY 40506-0503

859 257-1687
859 257-8827
fax 859 323-4922

www.engr.uky.edu

Dear Dr. Subbaswamy:

I am requesting your approval for the creation of a new research institute in the College of Engineering entitled "Institute for Sustainable Manufacturing" (ISM). The proposed institute is the outgrowth of more than a decade of work by Professor I. Jawahir and his colleagues in this emerging area of great importance to industry in Kentucky and nationally. The Institute is also the successor to the Center for Manufacturing, for which I will be submitting a proposal for closure in the near future.

The ISM will serve as a leading international organization committed to the development and deployment of sustainable manufacturing technologies for products, processes and systems. Its work will lead to significantly improved manufacturing productivity, efficiency and quality through research, educational and outreach programs.

Although the proposed ISM is a new framework to support multidisciplinary collaborative work, progress in sustainable manufacturing research and development at the University of Kentucky began nearly ten years ago. Currently, funding for nine faculty lines in the College of Engineering is dedicated to ISM. Since the new institute is not an academic unit, the faculty appointments reside in three departments. In addition to the faculty members who are appointed to funded positions in manufacturing, another nine faculty members from the College of Engineering, Gatton College of Business and Economics, School of Architecture, and Department of Mathematics participate in institute activities.

I am attaching a document in which the mission, objectives, and funding of the institute are outlined in detail. I am not requesting additional funding from the University to support the creation of the institute. This proposal has been approved by the faculty in the College of Engineering. By copy of this letter, I am routing this proposal concurrently to Dr. Hollie Swanson, Senate Chair.

Sincerely,

A handwritten signature in black ink, appearing to read "Thomas W. Lester". The signature is fluid and cursive, written over a white background.

Thomas W. Lester
Dean

Attachment

Cc Dr. Grulke
Dr. Jawahir
Dr. Swanson



UNIVERSITY OF KENTUCKY

**Department of Chemical and
Materials Engineering**

*177 Anderson Hall
Lexington, KY 40506-0046
(859) 257-5507
kalika@enr.uky.edu*

April 26, 2010

TO: University Senate Council

RE: Proposal to Establish the Institute for Sustainable Manufacturing

I am pleased to support the proposal to establish the Institute for Sustainable Manufacturing in the College of Engineering. The Institute will facilitate essential interdisciplinary research in an area of great importance to both the Commonwealth of Kentucky and the nation. Further, I anticipate that there will be numerous opportunities for productive research interactions involving faculty in the Department of Chemical and Materials Engineering that will be strengthened by the resources and facilities of the Institute.

Sincerely,

Doug Kalika

Douglass S. Kalika, Professor and Chair
Department of Chemical and Materials Engineering



UNIVERSITY OF KENTUCKY

Department of Mechanical Engineering

151 Ralph G. Anderson Building
Lexington, KY 40506-0503
Office: (859) 257-2662
Fax: (859) 257-3304
www.engr.uky.edu/me

College of Engineering
Ralph G. Anderson Building
Lexington, KY 40506

Subject: Letter of Support

To Whom It May Concern:

On behalf of the Department of Mechanical Engineering, I would like to add my endorsement to the proposal to establish the Institute for Sustainable Manufacturing (ISM) in the College of Engineering. I see the benefits of such an Institute in fostering interdisciplinary research in the college and with other University of Kentucky colleges. I believe our department's involvement in the Institute will be of mutual benefit.

Involvement of Mechanical Engineering faculty in ISM will be documented through use of the DOE Form and research interaction will be coordinated through the internal approval form. Faculty hiring in the area of manufacturing will be done with input from ISM faculty to ensure both units are well served.

Sincerely,

L. Scott Stephens, Ph.D., P.E.
Chair and Engineering Alumni Professor



College of Engineering
Department of Electrical and
Computer Engineering
453 E. Paul Anderson Tower
Lexington, KY 40506-0040
859 257-8042
fax 859 257-3092
www.engr.uky.edu

April 28, 2011

Dear Dr. Jawahir,

I endorse the proposal to establish the Institute for Sustainable Manufacturing (ISM) in the College of Engineering. I see the benefits of such an Institute in fostering interdisciplinary research in the college and with other University of Kentucky colleges. I believe our department's involvement in the Institute will be of mutual benefit.

Sincerely,

A handwritten signature in black ink that reads "Larry Holloway". The signature is fluid and cursive, with a long horizontal flourish extending to the right.

Larry Holloway
Professor and Chair, Department of Electrical and Computer Engineering
TVA Endowed Professor of Electrical Engineering
Director, Power and Energy Institute of Kentucky (PEIK)

**Proposal to Create the
Institute for Sustainable Manufacturing (ISM),
in the College of Engineering, University of Kentucky**

Presented to:

Faculty of the College of Engineering
University of Kentucky
Lexington, KY 40506

By

Sustainable Manufacturing Core Group
College of Engineering
University of Kentucky

March 2011

I. Introduction

This proposal seeks to establish within the College of Engineering a transformed organization to be called the ***Institute for Sustainable Manufacturing (ISM)***.¹

Established in 1986 by the Commonwealth of Kentucky as the Center for Robotics and Manufacturing Systems, the Center for Manufacturing was a unique multidisciplinary program that conducted manufacturing research, transferred manufacturing technology to industry, and supported educational efforts in manufacturing. As a result of a strategic effort by UK to move to the forefront of new technologies and workforce development for the future of manufacturing, the Center for Manufacturing, it is proposed, will be transformed into the proposed Institute for Sustainable Manufacturing (ISM).

The purpose of the ISM is to advance progress toward sustainability both nationally and internationally by focusing on manufacturing.

Specifically, in strategic areas of sustainable manufacturing, the ISM will

- conduct academic research² (basic and applied),
- invent and commercialize innovative products and processes and technologies,
- transfer knowledge to industry through extension/outreach, and
- coordinate with graduate and undergraduate educational programs offered by the College and individual departments.

A. Sustainable Manufacturing Defined

The term “Sustainable manufacturing” is defined as ***the creation of manufactured products that use processes that minimize negative environmental impacts, conserve energy and natural resources, are safe for employees, communities, and consumers and are economically sound*** (U.S. Department of Commerce, 2009). That is, sustainable manufacturing refers to a manufacturing sector that is not only compatible with a sustainable society, but also a sector that plays a key role in developing the technologies so vital to attaining such a society.

¹ ISM is a multidisciplinary research institute and is an “educational unit” within the meaning of UK GR-VII-A having as its primary mission instruction, research and service. Instruction here refers to “research instruction” --see ***Addenda***, p. 15. ISM’s director will be a faculty member. DOE assigned to ISM from core faculty funded research (a metric to be tracked annually) will total the equivalent of 1 FTE or more.

² As used in this proposal, the term research should be understood as academic research which inherently involves the mentoring and supervision of graduate students, visiting scholars and post-doctoral researchers as well as “research instruction.” “Coordinate with graduate ...educational programs ” should be understood in this context. See ***Addenda*** p. 15 for our proposed definition of “research instruction.”

The well-respected National Council for Advanced Manufacturing (NACFAM) states that currently the term “sustainable manufacturing” is used somewhat confusingly to emphasize different parts of the entire project. For NACFAM, “Sustainable manufacturing” means both the manufacturing of products, that are designed to be used in a sustainable fashion and to the sustainable manufacturing of all products. The former emphasis includes ***manufacturing of renewable energy, energy efficiency, green building, and other “green” & social equity-related products***, and the latter emphasizes the ***sustainable manufacturing of all products, taking into account the full sustainability/total life-cycle*** issues related to the products manufactured (NACFAM, 2009).

Thus, in the broad sense, **sustainable manufacturing addresses sustainable products, sustainable manufacturing processes and systems.**

B. Why Sustainable Manufacturing as Focus?

1. Broad reach and importance

Manufacturing is a key focus for ISM because the myriad activities involved in designing, making and distributing products touch on so many basic aspects of the transition to sustainability - the balance and harmony between ***economic, societal and environmental well-being*** – such as use of natural resources, wealth creation, environmental impact, energy-efficiency, living standards, health, safety, etc.

2. Need for rapid development & deployment of new energy-efficient and environmentally benign technologies for products and processes

Manufacturing will also be a key player in addressing critical and urgent national and international issues on the way to attaining sustainability. For example, a recent report from the National Academy of Sciences on “America’s Energy Future” speaks of the need for the U.S to obtain substantial energy-efficiency improvements, new sources of energy and reductions in greenhouse gas emissions “through the accelerated deployment of existing and emerging energy-supply and end-use technologies.” Thus, while other collateral R&D efforts can tackle necessary steps such as the development of renewable energy resources, ISM’s contribution to a viable energy future is to help create an advanced manufacturing sector that designs, makes and distributes (deploys) such technologies as rapidly, cheaply and efficiently as possible. Another example showing ISM’s focus on manufacturing is in line with current national priorities: The Hollings Manufacturing Extension Partnership (a program created and supported by Congress) in FY 2010 will focus on 1) increasing manufacturers’ adoption and application of renewable energy technologies and the development of new products, and 2) supporting energy-efficient production and reducing manufacturers’ environmental impact and related costs by promoting the development of new, environmentally-focused materials, products and processes.

C. Unique Features of the ISM

One unique feature of the ISM is that it will be designed to facilitate and support **cross-disciplinarity** (work across disciplinary boundaries), and even **inter-disciplinarity** (work

that results in the creation of new hybrid disciplines). Because attaining sustainability requires a better understanding of how complex human, natural and technological systems interact, the questions raised cannot be confined within the boundaries of traditional academic disciplines. Thus effective R&D will necessarily involve crossdisciplinary research teams in which professionals in natural sciences, social sciences and humanities work in collaboration. That is, ISM's R&D will not only bring engineering expertise to tackle product design, materials, manufacturing processes and systems, but also ISM R&D must also include expertise from ***business and economics, psychology, sociology, public policy, the natural sciences and other aspects of the broader economic, environmental and societal issues***. From this collaboration new hybrid disciplines and methodologies for products and processes will emerge.

The possibilities below represent a sampling of the potential collaborative research needed to understand the complex web of interactions between natural and man-made systems:

- Modeling the use of natural resources in sustainable products and processes
- Analysis of interaction between living systems and man-made systems
- Exploring technological and behavioral issues in sustainable products and processes
- Understanding the forces that determine human consumption of resources
- Studying life-cycles issues in the use of energy, materials and resources that reflect how human activities define, perturb, or limit materials/resource use flow and supply, nutrient distribution, biodiversity, and ecosystems
- Contributing to economic incentives and governmental policies for developing and deploying sustainable manufacturing technologies.

Another distinct feature to be noted is that the ***focus on sustainable manufacturing*** is unique. It sets the ISM apart from all existing centers or institutes devoted to sustainability issues. This niche has evolved from the patient groundwork over the last five years by the sustainable manufacturing research group within the College of Engineering.

D. Advantages & Benefits of an ISM

The ISM will help address many of the strategic goals of the University of Kentucky, such as increasing collaborations among academic and support units and helping support interdisciplinary studies and inter-professional training. Indeed, ISM's mission and goals explicitly support UK's Strategic Plan Goals One and Two, given the recognition by industry and governments around the world of the need for more sustainable approaches to manufacturing. For example, Sustainability is becoming a "hot topic" in several National Science Foundation engineering and engineering education areas, including most recently Partnership for International Research & Education (PIRE). More sustainable approaches will demand new technologies to enable more sustainable manufacturing and thus will drive innovation. Research in sustainable manufacturing is of benefit to Kentucky companies and Kentucky economic development as well, and may help shift the state away from the outmoded strategy of attracting industry by means of low labor costs, low energy costs and tax incentives. UK's Strategic Plan Goals Three and Four are addressed through research projects to develop graduate students through research participation and to attract underrepresented groups (standard College of Engineering practice ISM will

support). ISM will also support Goal Five directly through professional development offerings and through outreach, such as the Sustainable Manufacturing Forum held on UK campus and attracting representatives from both industry and academia nationally and internationally; the 3rd annual forum is now being planned for fall 2011.

Because it would serve as a model for ***cross-disciplinary and inter-disciplinary research***, the ISM would help bring talented and adventurous students and younger faculty, with relevant and unique expertise, to the University of Kentucky and would raise the university's profile for innovative approaches to R&D. Bringing faculty together from a number of different colleges and departments at the University of Kentucky will create synergies that can enable more effective research projects and the successful pursuit of large-scale cross-disciplinary funding in some of the nation's most urgent R&D priority areas such as energy-efficient and environmentally benign products and processes.

E. Vision

The Institute for Sustainable Manufacturing (ISM) will serve as a leading international organization committed to the development and deployment of sustainable manufacturing technologies for products, processes and systems for significantly enhancing manufacturing productivity, efficiency and quality through its highly effective research and outreach aimed at developing new technology for next generation manufacturing.

F. Mission

The mission of the Institute for Sustainable Manufacturing (ISM) is to actively pursue academic research (basic and applied) with the goal of producing new and innovative manufacturing technologies at product, process and systems levels, engaging in technology transfer/deployment and industry outreach for effective dissemination of the new knowledge generated, and coordinate with relevant educational programs offered by the College and individual departments.

II. Focus Areas in Detail

A. Research

1. Research Areas

The research focus of the ISM will include, but not limited to, the following areas:

- ***Sustainable materials*** (energy-efficient material design for manufacture: molecular, microstructural and metallurgical transformation of materials; self-healing materials and memory alloys)
- ***Sustainable product development*** (energy-efficient products; sustainability metrics for products; 6R-based product design for sustainability)
- ***Sustainable manufacturing processes*** (energy-efficient, environmentally benign manufacturing process development – toxic-free, hazardless, safe and secure)

technologies; minimal use of metal working fluids and chemicals; tribological interface science; coatings; surface and sub-surface integrity studies)

- ***Sustainable manufacturing systems*** (metrics for sustainability performance at enterprise levels, ontology for interoperability of sustainable supply chains; sustainable quality systems; energy-efficient supply chain operations and manufacturing systems)
- ***Society, public policy and regulatory issues in sustainable manufacturing*** (Societal Impact studies; legislative and administrative issues; policy implementation; product and process liability; ethics)
- ***Economic analysis of sustainable products and processes*** (marketing strategies and business economics for sustainable products and processes)

2. Research Teams

Each of these areas will include several assigned faculty (including the originally allocated faculty from the former Center for Manufacturing, and affiliate faculty³ (those drawn from other collaborating academic and research units); researchers (postdoctoral and staff researchers); graduate students; undergraduate students (research trainees); and limited technical staff. In the initial phase of the ISM, technical support for research involving experimental work and student training will be provided by allocated technical staff from the former Center for Manufacturing, and new funding brought in by ISM will enable hiring additional technical staff, as needed.

3. Support for the M.S.M.S.E. To Change

From its inception in 1992, the Master's program in Manufacturing Systems Engineering (MSMSE) has been operated by two organizations. The program was housed administratively in the College of Engineering rather than in an engineering department because of its highly multidisciplinary nature. At the same time, the Center for Manufacturing [formerly the Center for Robotics and Manufacturing Systems] assumed responsibility to coordinate the program, provide staff and graduate student support and oversee day-to-day operations. Faculty associated with ISM can continue to conduct MFS courses but ISM as a unit will not be involved in administration or awarding of degrees.

Faculty associated with ISM would also continue to provide mentoring for students in the Boeing Fellowship in Sustainable Systems, a recently established program which provides support for graduate study in inter-disciplinary and trans-disciplinary areas of sustainable manufacturing that integrate a lean manufacturing approach with sustainability principles.

³ For purposes of this proposal, assigned faculty are defined as faculty some of whose DOE is attributable to the Institute. Affiliate faculty are those whose DOE does not accrue to the Institute but who maintain involvement through collaboration in research and other Institute functions.

Information on the existing MSMSE program's courses, faculty and requirements can be found at <http://www.mfg.uky.edu/ms/>

B. Technology Transfer/Innovation Management

ISM will develop a solid platform for new technology deployment and dissemination in industry and for generating additional revenues for the ISM through commercialization activities of its inventions from patents and copyrighted software. Three specific avenues are proposed:

1. Product and Process Innovation

Developing new and innovative technologies for products and processes and promoting the application of these technologies.

2. Industry/University Consortia Development and Hosting of Conferences

In selected research focus areas, industry – university consortia will be established, and seminars/forums/workshops/conferences will be organized at national and international levels. The ISM faculty and staff recently organized and hosted its 2nd International Forum on Sustainable Manufacturing, held at the Young Library Auditorium on September 17, 2010. This annual event attracted over 100 participants with about 40% of the participants from industry. It is expected to continue with this new Forum series.

Note another effective means of dissemination and outreach: the ISM's proposed director, I.S. Jawahir, is editor-in-chief of International Journal of Sustainable Manufacturing.

3. Product and Process Commercialization

Technical assistance for developing technology transition and commercialization plans – development of intellectual property on inventions and assistance in licensing to industry

4. Professional Development Programs

The ISM proposes to begin its outreach by exploring possibilities for providing non-credit extension/outreach in the form of workshops and short courses accessible to and relevant for industry professionals. These courses will serve as a venue for dissemination of ISM research and a means to develop industry research collaborations. ISM will be able to draw on the extensive experience in offering such courses by the lean manufacturing program, currently housed with Institute of Research for Technology Development (IR4TD).

UK Collaborations

In addition to dissemination as part of their professional activities, ISM faculty are at work in developing collaborations with other UK units outside the College of Engineering. For example, ISM has been an active participant in the current activities of the Tracy Farmer Institute for Sustainability and the Environment, and recently played a major role in organizing and hosting of the university-wide Sustainability Showcase event on September 22-23 which included selection of recipients for the “Corporate Sustainability” award for two companies (one large company and a small/medium company) committed to sustainability practices in KY and the region.

E. Faculty and Staff

Table 1 below shows a list of committed core and affiliate faculty and staff for the proposed ISM, including 11 core faculty (including two vacant positions), 10 affiliate faculty, 6 senior staff (1 technical staff, one administrative/business officer and four part-time staff). ISM is currently in discussions for developing collaborative programs with the Martin School of Public Policy and Administration and the College of Law at the University of Kentucky.

ISM technical staff will provide laboratory management and equipment maintenance for core and associate ISM faculty, as well as technical support and logistics for all institute activities including audiovisual and videoconferencing activities.

Table 1: Current Faculty (Core and Affiliate), staff and their major areas of expertise

Faculty	Department, College, or Center	Core ISM Faculty	Affiliate Faculty	Area of Expertise Related to Sustainable Manufacturing
F. Badurdeen	ME	√		Sustainable supply chains
J. Balk	CME		√	Materials, micro/nanostuctures
Y.T. Cheng	CME	√		Nanostructured materials
O. W, Dillon, Jr.	ME	√		Manufacturing process mechanics
T. Goldsby	Coll. of B & E		√	Supply chain management
E. Grulke	CME		√	Sustainable materials, emissions
L. Holloway	EE	√		Manufacturing system modeling
S. Ellis	Coll. of B & E		√	Supply chain management
I.S. Jawahir	ME	√		Sustainable machining processes
H. Karaca	ME		√	SM alloys, self-healing materials
A.T. Male	ME	√		Materials science and engineering
J. Parker	ME		√	Society and public policy
N. Puckett	Coll. of Arch.		√	Sustainable design & architecture
D. Puleo	CBiomedE		√	Sustainable biomedical implants
K. Rouch	ME	√		Product design and FE modeling
J. Seay	Paducah (Eng)		√	Biofuels, green eng., CAD
D. Sekulic	ME	√		Manufacturing energy modeling

S. Stephens	ME		√	MEMS, tribology in metal working
Y. Zhang	EE	√		Intelligent control systems
*R. Alloo (P/T)	CoE			Industry liaison, IP issues, admin.
*B. Gregory (P/T)	CoE			Technical writing, documentation
C. Arvin	ISM			Lab mgmt., technical support
H.M. Adkins	ISM			Administrative/business support
**R. Anderson (P/T)	EE			Technical writing, documentation
***S. Woolery (P/T)	CoE			Website development

* Senior staff who will work with the ISM faculty and provide administrative support

** Technical staff who will work with the ISM faculty, and will provide technical support

*** College marketing staff who provide marketing and website development support

III. The ISM Five Years Out

Financially, the goal for the ISM is to become self-sustaining as a result of achieving excellence in its research, extension, and outreach missions.

Indicators of progress toward such a goal will include

- Growth in faculty (new hires as core ISM faculty and affiliate faculty)
- Growth in postdoctoral fellows and graduate students⁴
- Growth in collaborative cross-disciplinary research proposal awards
- Growth in extramural funding from government and industry (see Figure 1)
- Growth in invention disclosures and utility patents
- Growth in income from IP licensing
- Growth in SBIR/STTR awards
- Faculty recognition (awards and indications of their value from peers and professional/academic societies)
- ISM recognition as in the forefront of new developments in sustainable manufacturing through important publications, including books, journals, etc., in the field

⁴ *There is no provision for post-doctoral students to hold primary appointments in ISM; post-doctoral researchers like visiting scholars will be supported by their home institution. Graduate students and post-doctoral scholars will be recruited by faculty for their research; visiting scholars will request such status and ISM, home department and host faculty will develop a plan for the visit .*

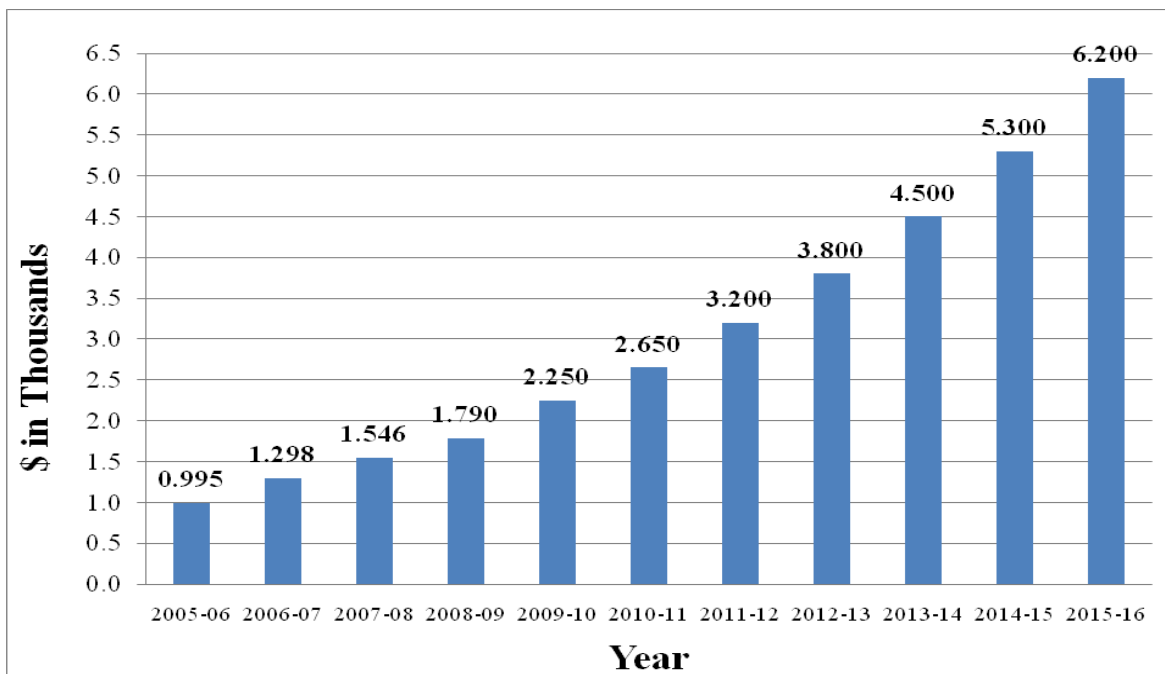


Figure 1: Past and projected extramural funding in sustainable manufacturing

Figure 1 (above) shows the funding levels during the last five years and the projected growth in extramural funding. As seen, the ISM is expected to bring in over \$6M per year by 2015-16. The funding projection includes distributed and total annual funding by the ISM faculty from federal and state agencies, foundations, industry groups and private donations including endowments. Income from research consortia and from licensing of IP and copyrighted software is also included in this projection. It is expected that UK will continue to support the current faculty and staff salaries, with a very high possibility of using the extramural funding generated by the ISM for creating new research faculty lines, postdoctoral research and staff positions, etc., in addition to graduate and undergraduate RA support for various research activities within the ISM. It is also worth noting that the current funding for AY2010-11 has already exceeded the projections.

IV. Administration/Management and the Proposed Organizational Structure

A. Relationship to Other Units

One key to a healthy advanced manufacturing sector is effective R&D conducted in collaboration with industry; thus, the model used by the former Center for Manufacturing - working to translate industry needs into university R&D projects -- remains one pillar of the ISM's approach. ISM will actively seek partnerships on and off campus.

To ensure good working relationships⁵, especially with ISM core faculty's home departments, ISM is obtaining letters of cooperation from chairs of units whose faculty are

⁵ ISM does not propose to grant degrees or certificates (undergraduate, graduate, post-doctoral). ISM faculty will serve on graduate committees as appropriate and provide advice

ISM core faculty (primarily ME, CME and ECE) approving the relationship, agreeing to share a portion of DOE⁶ and to work together on hiring faculty whose expertise would serve the department and ISM needs as well. Note that to replace recently departed core faculty (Khraisheh and Li) two new faculty will be hired; ISM will engage with the chairs of the respective departments (ME and ECE) to collaborate on hiring candidates of benefit to both the department and the institute.

To ensure its working relationships remain healthy, ISM plans to review progress annually (probably more often at first) as a self-evaluation and this review of measureables and metrics will be joined with an annual review of relationships with co-operating units (departments, other centers) to ensure that issues like resources, DOE allocations, student support, faculty hiring and so forth are being addressed satisfactorily and to adjust these areas as needed. The university advisory committee will be asked to assist and advise here.

ISM's planning approach has been to identify key stakeholders, identify what they value that could be provided by ISM activity, identify ways to measure the successful production of those values and then prepare operational plans for action to achieve those values. In such plans, we clearly identify the specific activities that ISM members will conduct and what their expected outcome(s) will be. These give us both interim targets for appropriate metrics to establish a "trajectory" for achieving the long term goal(s) as well as a "process" for periodic review of progress and adjustment of action plans to address deviation from those trajectories.

B. Approach

It is proposed to develop and structure the ISM as an integral unit of the College of Engineering at the University of Kentucky with close ties with all engineering departments, centers and interactions with several other academic departments, centers and institutes from other colleges in the university.

The ISM director will be appointed by the Dean of the College of Engineering using procedures in the ARs (or the appointment method for other unit/center directors).

The ISM, in its initial phase, will draw all of the nine faculty (F. Badurdeen, Y.T. Cheng, L. Holloway, M. Khraisheh (position recently vacated), I.S. Jawahir, J. Li (position recently vacated), A.T. Male, D.P. Sekulic, Y. Zhang) whose positions were created from the original

as students develop their educational and research plan with their committee. ISM faculty conducting research will supervise and evaluate the graduate students, visiting scholars and post-doctoral researchers participating in these ISM research projects according to the policies and procedures of the faculty member's home department. In cases where the research project involves faculty from several departments, the policies and procedures of the department in which the student is a degree candidate will take precedence.

⁶ DOE from ISM core faculty will total 1 FTE equivalent or more; this metric will be tracked and reviewed annually as a key measure of ISM viability.

funding allocated to the former Center for Manufacturing, and a few selected staff from this Center to form the core group to develop its strategic plan and to expand its activities in the strategic direction. Appendix 1 shows the expanded list of proposed faculty and staff of the ISM who have been identified for this initial phase of ISM development. This list includes the core ISM faculty and the Affiliate ISM faculty.

Laboratories currently used by these faculty and staff for research and extension activities will continue to remain as a part of the core facilities and the infrastructure of the proposed ISM. Appendix 2 shows the list of these laboratories.

It is proposed to partially utilize the technical and administrative staff of the former Center for Manufacturing in the initial phase of the ISM, and it is projected that within 12 months, the ISM will have several of these staff positions filled.

C. Proposed Organizational Structure

The proposed organizational structure of the ISM will include five functional units. Figure 2 (below) shows the proposed administrative and organizational structure of the ISM covering these five major sections.

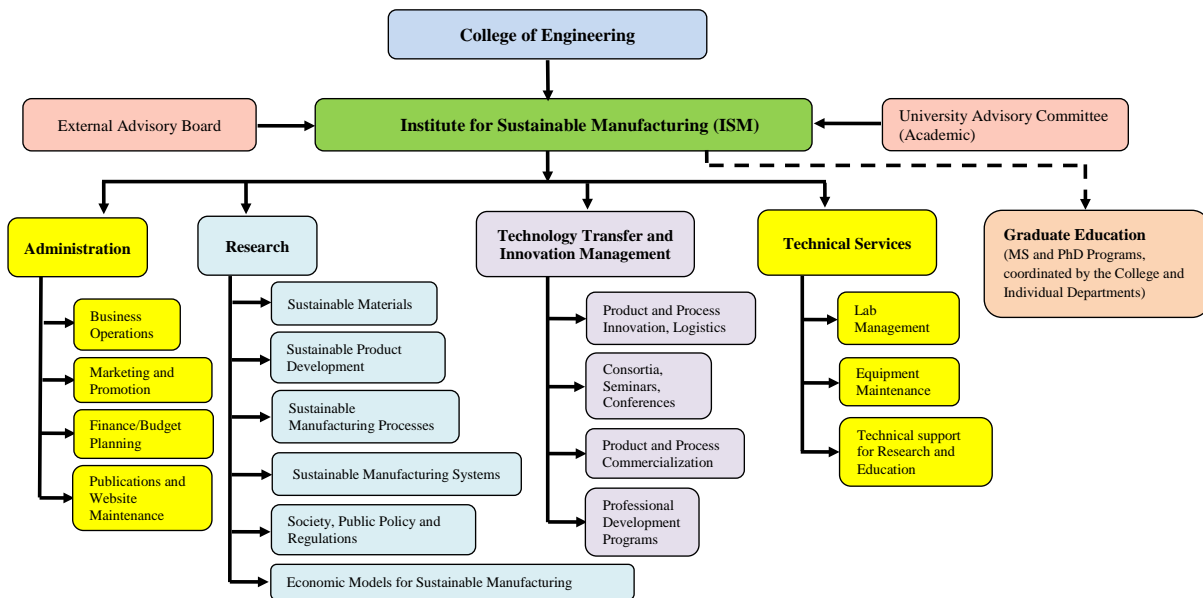


Figure 2: The proposed organizational structure of the ISM

The administrative/managerial services to be offered by the ISM to core and associate faculty will include the following major activities:

- Finance/budget planning, and management of all projects
- Marketing and promotion of all institute activities
- Publications and website maintenance

In the initial phase of the ISM, it is proposed to rely on current expertise available from staff drawn from the former Center for Manufacturing on a part-time basis. Within the first 12

months of operation, the ISM is expected to have its own full-time workforce for the above proposed activities.

C. Location including Laboratories and Office Space

The ISM will be housed within the CRMS building. The current lab and office spaces of the ISM faculty and staff will constitute its initial location and the proposed new faculty and staff will be housed within the former Center for Manufacturing's space. The ISM will continue to seek additional space for its faculty and staff as it expands. Appendices 1 and 2 show the list of ISM faculty and staff and their current lab facilities.

D. Proposed Industry-University Consortium Plan

The ISM will be actively seeking to establish industry-university consortia in selected areas of research. Appendix 3 shows a summary of this plan.

E. Business and Operational Plan for ISM

The ISM core group (faculty and staff) are currently engaged in developing a QFD-based strategic business operational plan for the ISM. This plan will be available by June 30, 2011.

Addenda

Addendum to pp. 3, 5, 7, 12 (chart ref. to “graduate education”)

For purposes of this proposal, we would define “research instruction” as “providing professional education to graduate students and postdoctoral scholars (including visiting scholars) in a form that arises largely from participation in and collaboration with faculty research—in other words, experiential learning on novel research problems. Thus, RI is in addition to and distinct from the degree granting education which is provided through formal course work. RI thus has more the quality of apprenticeship and of situated learning because it is not determined in advance as in a syllabus but tends to be drawn from particular research task/program, i.e., providing a participant whatever learning is needed to complete the task at hand (which could involve theoretical study, experimental work in a laboratory or a field work (data collection) needed to turn data into publishable research. This activity always includes faculty-provided feedback on the performance of that work. RI will thus tend to be one-on-one and specific to the work at hand. However this does not preclude RI also being offered to groups of students in the form of a seminar series or workshops covering various aspects of research work and the professional career, such as, for example, providing guidance on scholarly publication and the making of successful research proposals.”

Addendum to page 7

Because of its multidisciplinary structure, ISM offers a unique kind of research instruction to graduate students and visiting scholars participating in ISM research projects. ISM RI will involve:

- (i) Faculty guided individualized instruction for graduate students, postdoctoral scholars (including visiting scholars)
- (ii) Seminars, workshops and/or short non-degree granting courses in multidisciplinary research practice and communication. These seminars would be offered by ISM core and affiliate faculty and on occasion by visiting faculty from other institutions. Students would be given credit for participation in the seminar or workshop, and for leading such workshops or seminars themselves, if practicable and useful.
- (iii) Supporting the degree granting units (Departments) in guiding graduate students through advising if fellowships/scholarships that involve multidisciplinary work are established. This advising will be facilitated through ad hoc advising committees that include core faculty of ISM and degree granting institutions selected advisors and thesis committee members (such as the BOEING Fellowship currently in effect).

Appendix 1: List of Faculty and Staff for the Proposed ISM

Institute Faculty:

(a) ISM Faculty:

F. Badurdeen, Y.T. Cheng, O.W. Dillon, Jr., L. Holloway, I.S. Jawahir, A.T. Male, K.E. Rouch, D. Sekulic, Y. Zhang + 2 New Faculty to be hired in AY2010-11

(b) ISM Affiliate Faculty:

T. Goldsby, E. Grulke, S. Ellis, H. Karaca, J. Balk, J. Parker, N. Puckett, D. Puleo, J. Seay (Paducah), L.S. Stephens

ISM Staff:

C. Arvin
R. Heather-Michele Adkins
R. Alloo (Part-time)
R. Anderson (40%)
R. Gregory (33%)
S. Woolery (20%)

Appendix 2: List of Laboratories for the Proposed ISM
(includes current labs and Graduate Student Offices (GSO))

Laboratory	Faculty/ Office (Space in Sq. ft.)	Lab Number	Space (Sq. Ft)
Sustainable Machining Laboratory	I.S. Jawahir/414C (217)	009	2,820
GSO		9B	138
GSO		4140	213
GSO		413	137
		523	460
Materials Processing Laboratory	Vacant (Formerly of M. Khraisheh)/414H (200)	517	471
Metallography Lab	A.T. Male/ 4141N (200)	012	1,014
GSO		12A	143
		511	471
Welding Research Laboratory	Y. Zhang/414P (225)	119	1,424
GSO		115	130
GSO		117	82
GSO		119A	53
		409	94
Brazing Research Laboratory	D. Sekulic/4141F (200)	510	898
GSO		509	466
Production Systems Laboratory +	L. Holloway	414G	216
Product Development Laboratory	L. Holloway	419	785
		419A	169
Manufacturing Systems Simulation Lab	L. Holloway	414Q	223
Manufacturing Systems and Supply Chain Laboratory	F. Badurdeen/414L (200)	414K	216
Nanomechanics Research Laboratory	Y.T. Cheng	Not assigned	Not assigned
Undergraduate Manufacturing Lab	A.T. Male + All Faculty	215D	633
		215E	609
		215F	117

Appendix 3: Sample Industry-University Consortium Plan

Active participation by business and industry partners will support the ISM's primary research thrust areas by providing direction on technical barriers to sustainability, by offering internships to engineering students, by helping design virtual spin-offs that will explore commercialization of ISM discoveries, by providing feedback on curricula for innovation management and sustainability engineering courses, by providing appropriate platforms for conducting research in the actual manufacturing context and by providing the opportunity for the ISM affiliated researchers to conduct validation of their findings in multiple settings.

Facilitation. The Institute for Sustainable Manufacturing (ISM) will be the principal facilitator for industry-ISM partnerships, technology transfer and extension. It is envisioned that the former Center for Manufacturing will be transitioned to focus on sustainable manufacturing as a unifying theme and will merge all of its activities with the ISM in the future. Through this synergistic arrangement, and with suitable ISM staff allocation, the ISM can potentially leverage well-established industry relationships that bring over 100 individual companies into the ISM's research, extension and outreach activities each year, yielding well over 200 industry projects and over 1000 industry participants in extension offerings annually, providing over \$2 million per year in external revenue.

Sustainment of the ISM. Demonstrating the abilities and value of the ISM research through existing industry partnerships will attract partners to ISM membership, with member firms providing cash support, in-kind contributions, equipment donations or direct-project sponsorship. The fee structure would accommodate small, medium and large firms at different annual levels: \$10,000; \$25,000; \$50,000. The membership agreement would be developed early in the establishment of the ISM through cooperation with potential industry partners, College of Engineering expertise and existing University support systems. Potential benefits to the ISM members could include technical assistance, technical support in product and process innovation, new technology development and deployment, assistance in training and professional development of company employees, pooling of resources for solving medium and long range problems and/or high risk pre-competitive research. Other benefits will be explored to make affiliation and membership in the ISM attractive to a wide variety of industry partners.

An Industrial Advisory Board for the ISM will be formed to advise on the overall direction of the research program, provide direct industry access for internships and research projects, assist in transferring technology within member firms, advise on improvements to increase value of ISM membership and attract industry partners to membership. The Industrial Advisory Board will be composed of a representative from each large (greater than 500 employees) firm in the consortium and of members from small and medium sized firms selected to maintain appropriate balance.

Innovation. The proposed ISM will be actively involved in translational research with small firms to commercialize product and process innovation for sustainability. Faculty will be encouraged and supported in ways to create such firms and existing state and local entrepreneurship programs will be tapped for help in locating and funding small firms

willing to participate in sustainability research and internship programs for innovation. For example, The Kentucky Science and Engineering Foundation (KSEF), which identifies innovative small firms and helps provide seed funding for product and process innovation in manufacturing and other fields, will be solicited to join the ISM's advisory board to help identify small firms and facilitate partnerships. KSEF, which operates under the aegis of the Kentucky Council on Postsecondary Education (CPE) and the Kentucky Department of Commercialization and Innovation (DCI), is ideally placed to assist in developing internship programs. So also are the Kentucky network of ICCs (Innovation Commercialization Centers) and SBDCs (Small Business Development Centers), housed at UK and in several other regions of the state. Lastly, UK's technology incubator, the Advanced Science and Technology Commercialization Center (ASTeCC), will collaborate in ISM multidisciplinary research, technology transfer, and new business startups. ASTeCC is a combination faculty research facility and commercialization center that promotes collaborative research and commercial development of discoveries made by research faculty, staff and students. In this way, a culture of discovery and innovation will develop symbiotic relationships among the ISM researchers, small innovative firms, and larger industrial and practitioner partners.

Technology Transfer. In addition to overall technology transfer facilitation through the Center for Manufacturing, the ISM can also draw on help from UK centers such as the Center for Aluminum Technology (CAT), which coordinates research efforts with the aluminum industry. Considering the energy intensive nature of aluminum processing and manufacture, and the increasing utilization of aluminum, this center will provide valuable access to an existing set of industry members and synergies. The Center for Applied Energy Research (CAER), which conducts research into energy efficiency and alternate energy sources, will serve as a channel for technology transfer to existing and emerging energy producers and manufacturers of energy production processes. The Institute of Research for Technology Development (IR4TD), founded by a \$1 million endowment from Toyota Motor Corporation and a matching \$1 million from the Commonwealth of Kentucky, focuses on the development of breakthrough technologies for the automotive and other durable goods manufacturing industries; this institute engages with industrial partners for rapid deployment of new technologies into manufacturing and will serve as another important channel for transfer of the discoveries and developments of the proposed ISM. The Sloan Center for a Sustainable Aluminum Industry focuses on areas such as recycling and supply chain development which are relevant to the proposed ISM's research. Sloan Center Partners include major companies such as ARCO, Aleris, Century Aluminum and Logan Aluminum. The ISM will also actively seek to support development of manufacturing technologies for next generation energy storage devices by close collaboration with the recently announced National Center for Battery Manufacturing Research, a collaboration of Argonne National Laboratory, University of Kentucky and University of Louisville to be located near the University of Kentucky campus.

Appendix 4: Bios of Key ISM Faculty

Fazleena Badurdeen

Department of Mechanical Engineering and Center for Manufacturing
414L CRMS Building, University of Kentucky, Lexington, KY 40506
Phone: (859) 323-3252, E-mail: badurdeen@engr.uky.edu, Fax: (859) 257-1071

EDUCATION

Ohio University, Athens, OH	Integrated Engineering	Ph.D. 2005
Ohio University, Athens, OH	Industrial Engineering	MS 2002
Postgraduate Institute of Management, Sri Lanka	Business Administration	MBA 2000
University of Peradeniya, Sri Lanka	Engineering	B.Sc. 1995

APPOINTMENTS

2005 - present	Assistant Professor, Department of Mechanical Engineering and Center for Manufacturing, University of Kentucky, KY
Spring 2002/Winter, Fall 2003	Instructor, Department of Industrial and Manufacturing Systems Engineering, Ohio University, Athens, OH
Summers 2001 - 2004	Graduate Research Assistant, Human Factors and Ergonomics Laboratory, Ohio Research Institute for Transportation and the Environment, Ohio University, Athens, OH
2004 - 2005	Graduate Research Assistant, Department of Industrial and Manufacturing Systems Engineering, Ohio University, Athens, OH
1998-1999	Visiting Lecturer, Department of Science, University of Peradeniya, Sri Lanka
1997 - 2000	Lecturer, Department of Production Engineering, University of Peradeniya, Sri Lanka

PUBLICATIONS (*five most closely related*)

- **F. Badurdeen**, T.J. Goldsby, D. Iyengar and I.S. Jawahir, Transforming Supply Chains to Create Sustainable Value for All Stakeholders, in Sustainability Science and Engineering, I.S. Jawahir and S. Sikdar (eds.), Vol. I, In Press.
- **F. Badurdeen** and J.P. Liyanage, "Sustainable Value Co-creation through Mass Customization: A Framework", *International Journal of Sustainable Manufacturing*, In Press.
- Jayal, A.D., **F. Badurdeen** and I.S. Jawahir, "Sustainable Manufacturing: Modeling and Optimization Challenges at the Product, Process and System Levels", *CIRP J. Manufacturing Science and Technology*, Elsevier Publishers, Vol. 2(3), 2010, pp. 144-152.
- **F. Badurdeen**, T.J. Goldsby, D. Iyengar, H. Metta, S. Gupta, and I.S. Jawahir, Extending Total Lifecycle Thinking to Sustainable Supply Chains, *International Journal of Product Lifecycle Management*, Vol. 4(1-3), 2009, pp. 49-67.
- J.P. Liyanage, **F. Badurdeen** and Ratnayake, R.M.C., Industrial asset maintenance and sustainability performance: Economical, Environmental and Societal Implications, in Handbook on Maintenance Engineering and Management, Ben-Daya, M., Duffuaa, S.O. Raouf, A., Knezevic, J. and Ait-Kadi, D.(eds.), Springer Publishing, pp. 665-694.

CURRENT RESEARCH AREAS

Modeling and Optimization of Sustainable manufacturing systems and Sustainable Supply Chains; Metrics development for Sustainable Supply Chains.

INTERNATIONAL RESEARCH COLLABORATORS

Prof. Jayantha Liyanage (University of Stavanger, Norway)

GRADUATE STUDENTS: 8 MS

- **Graduated:** 1 PhD, 8 MS (Thesis) and 6 MS (Project) students
- **Current:** 3 PhD candidates and 6 MS students

RESEARCH FUNDING (2005-2010): Received \$439,007 funding as PI and, collaborated as Co-PI in projects that received research funding more than \$ 2 M.

Yang-Tse Cheng

F. Paul Anderson Tower, Room 179, Department of Chemical and Materials Engineering
University of Kentucky, Lexington, KY 40506-0046
Phone: 859-323-4191 E-mail: ycheng@engr.uky.edu Fax: 859-323-1929

EDUCATION

Caltech	PhD	1987	Applied Physics
Caltech	MS	1983	Applied Physics
Caltech	BS	1982	Physics/Mathematics

APPOINTMENTS

August 2008 – present: Professor of Materials Engineering, Dept. of Chemical and Materials Engineering, University of Kentucky, Lexington, KY
Feb. 1987 – July 2008: Senior Research Scientist (1987-1992), Staff Research Scientist (1992-2001), Senior Staff Research Scientist (2001-2004), GM Technical Fellow (2004-2006), Laboratory Group Manager, Engineered Surfaces and Tribology (1999-2003), Laboratory Group Manager, Engineered Surfaces and Functional Materials (2003-2006), GM R&D Center, Warren, MI

FIVE MOST CLOSELY RELATED RECENT PUBLICATIONS

(from a list of over 130 papers and 35 U.S. Patents)

- [1] J.M. Dasch, C.C. Ang, C.A. Wong, R.A. Waldo, D. Chester, **Y.-T. Cheng**, B.R. Powell, A.M. Weiner, and E. Konca, “The effect of free-machining elements on dry machining of B319 aluminum alloy,” J. Mater. Proc. Tech. 209, 4638 (2009).
- [2] **Y.-T. Cheng** and M. W. Verbrugge, “Evolution of stress within a spherical insertion electrode particle under potentiostatic and galvanostatic operation,” J. Power Sources 190, 453 (2009).
- [3] **Y.-T. Cheng** and F.Q. Yang, “Obtaining shear relaxation modulus and creep compliance of linear viscoelastic materials from instrumented indentation using axisymmetric indenters of power-law profiles, J. Materials Research 24, 3013 (2009).
- [4] **Y.-T. Cheng** and D. S. Grummon “Indentation in shape memory alloys,” in Micro and Nano Mechanical Testing of Materials and Devices, edited by Fuqian Yang and James C. M. Li, Springer 2008, pp.71-86.
- [5] Y.-L. Chen, T. A. Perry, **Y.-T. Cheng**, and A.M. Weiner, “Friction stir processing for surface properties,” US patent 7,225,969 (June 5, 2007).

SYNERGISTIC ACTIVITIES

- *Principal Editor*, Journal of Materials Research (2001-).
- *Co-Chairperson*, 2005 Materials Research Society Fall Meeting
- *Volume Organizer*, MRS Bulletin (2006-1008)
- Delivered more than 100 *invited presentations* at international conferences and university seminars

RESEARCH AREAS

Nano- and micro-meter scale properties of materials and their applications: nanoindentation modeling and measurements of mechanical properties; growth, structure, and properties of nanostructured materials (e.g., amorphous materials, nano-composites, epitaxial single crystals, single crystal nanowires); microscopic shape memory and superelastic effects; magnetorheological fluids; superhydrophobic and superhydrophilic surfaces; ion-solid interactions and ion beam modification of materials; automotive applications of new materials and processes, including electrical contacts, hydrogen sensors, metal hydride batteries, lithium batteries, fuel cells, high power-density engines and transmissions, and environmentally friendly machining processes.

INTERNATIONAL RESEARCH COLLABORATORS (past 48 months)

GM: M. W. Verbrugge, S. J. Harris, A. Timmons, X. Xiao, Y. Qi, T. Xie; Mich. State Univ: D.S. Grummon, X. Fei; Inst. of Mechanics (Beijing, China): C.-M. Cheng; UK: F.Q. Yang, C. Trinkle, H. E. Karaca, Z. Hilt, A. Dosier

GRADUATE STUDENTS AND SUMMER INTERNS SUPERVISED

W.Y. Ni, Y.J. Zhang, E. Konca, Y. Qi, Y. Li, M. Karmarkar, J. Yang, G. Auner, L. Loewenau (undergraduate), I. Hoffmann (undergraduate), N. Kishor (undergraduate, political science major), A. Carter (high school student)

RESEARCH FUNDING: Received \$1,102,105 funding as PI

Oscar W. Dillon, Jr.

Professor Emeritus
University of Kentucky

EDUCATION

Columbia University	D.Eng. Sc.	1959	Engineering Mechanics
Columbia University	MS	1955	Engineering Mechanics
University of Cincinnati	BS	1951	Aerospace Engineering

APPOINTMENTS

1997 – present:	Professor Emeritus, Mechanical Engineering, post retirement appointment (part- time) at the UK Center for Manufacturing, University of Kentucky
2001 – 2002:	Solid Mechanics Program Director, IPA assignment, NSF
1967 – 1997:	Professor, Engineering Mechanics Department, University of Kentucky
1993 – 1996:	Interim CMS Div. Director and Solid Mechanics Program Director, IPA assignment, NSF
1988 – 1990:	Solid Mechanics Program Director, IPA assignment, NSF
1967-72, 1984-89, 1990:	Dept. Chair, Engineering Mechanics Department, University of Kentucky
1965 – 1967:	Associate Professor, Engineering Mechanics Department, University of Kentucky
1963 – 1965:	Lecturer, Mechanical and Aerospace Department, Princeton University
1959 – 1963:	Assistant Professor, Johns Hopkins University

RESEARCH AREA

Thermoplastic effects in solids; connection between metallurgical effects and stress analysis; FEM of machining

AWARDS

- Outstanding Contribution to Research, ASEE (Southeastern Section), 1966.
- Several local teaching and research awards.
- 2007 ASME Applied Mechanics Division Award for a lifetime of research in thermal effects in solids.

FIVE MOST CLOSELY RELATED PUBLICATIONS (From approx. 100 in journal and conf. papers)

- [1] Umbrello, D., A.D. Jayal, **O.W. Dillon, Jr.**, and I.S. Jawahir, “Modeling of White and Dark Layer Formation in Hard Machining”, *J. Machining Science and Technology*, Vol. 14(1), 2010, pp. 128-147.
- [2] Pu, Z., **O.W. Dillon, Jr.**, I.S. Jawahir and D.A. Puleo, "Microstructural Changes of AZ31 Magnesium Alloys induced by Cryogenic Machining and its Influence on Corrosion Resistance in Simulated Body Fluid for Biomedical Applications", *Proceedings of the 2010 ASME International Manufacturing Science and Engineering Conference*, October 12-15, 2010, Erie, Pennsylvania, USA.
- [3] Jayal, A.D., D. Umbrello, **O.W. Dillon, Jr.**, and I.S. Jawahir, “An Investigation of the Effects of Cutting Conditions, Tool geometry and Workpiece Hardness on Surface Integrity in Orthogonal Machining of AISI 52100 Steel”, *Trans. NAMRI*, May 2010, Vol. 38, pp. 57-64.
- [4] Pu, Z., Puleo, D.A., **Dillon, O.W. Jr.** and Jawahir, I.S., Controlling the biodegradation rate of magnesium-based implants through surface nanocrystallization induced by cryogenic machining, *Proceeding of Magnesium Technology 2010, TMS Annual Meeting*. Seattle, WA. February 14-18, 2010.
- [5] M’Saoubi, R., J.C. Outeiro, H. Chandrasekaran, **O.W. Dillon, Jr.**, and I.S. Jawahir, “A Review of Surface Integrity in Machining and Its Impact on Functional Performance and Life of Machined Products”, *Int. J. Sustainable Manufacturing*, Vol. 1(1-2), 2008, pp. 203-136.

GRANTS AND CONTRACTS: Received significant funding from AFOSR, NASA, USAF, NSF-IPA Contracts, NSF Grant, NSF EPSCoR, etc.

RESEARCH COLLABORATORS

Prof. J.C. Outeiro (Portuguese Catholic University, Lisbon, Portugal), Prof. G. Poulachon (ENSAM, Cluny, France), Prof. Dr. R. M’Saoubi (Seco Tools, Sweden), Prof. D. Umbrello (University of Calabria, Calabria, Italy).

GRADUATE STUDENTS: Total of 20 MS graduates, 10 PhD graduates

Currently co-advising 5 PhD Students with Prof. I.S. Jawahir and Prof. D. Puleo

Lawrence E. Holloway

TVA Professor of Electrical and Computer Engineering, and
Chair, Department of Electrical and Computer Engineering
University of Kentucky
Lexington, Kentucky, KY40506
E-mail: holloway@engr.uky.edu

EDUCATION

Southern Methodist University, Dallas: **B.S.** in Electrical Engineering, magna cum laude, May 1987.
Minors in Math and Business.
Carnegie Mellon University, Pittsburgh: **M.S.** in Electrical and Computer Engineering, Oct. 1988.
Carnegie Mellon University, Pittsburgh: **Ph.D.** in Electrical and Computer Engineering: July 1991.

EMPLOYMENT (abbreviated)

University of Kentucky, Chair, Dept. of Electrical and Computer Engineering,
July 2007-present
University of Kentucky, Director, U.K. Center for Manufacturing, a center for manufacturing research,
teaching, and industrial extension. Sept.2002 to present. (Deputy Director 1999 to 2002)
University of Kentucky, Professor (formerly Assoc. Prof and Assist. Prof.). Aug. 1991 to present.
Joint faculty member in Center for Manufacturing and Department of Electrical and
Computer Engineering.
Rockwell Science Center, Thousand Oaks, California. June 93 to August 93, July 95
Developed methods for automated fault monitoring in automated mfg. systems.
National Instruments, Austin, Texas. June 87 to August 87.
Developed application software for Macintosh II circuit boards.
LTV Aerospace and Defense, Dallas, Texas. My 1983-June 1986. Co-op student.
Assignments included Avionics support, development of hardware and software.

RESEARCH AREAS

Systems, including: embedded systems, discrete event control systems; fault monitoring, detection, and
diagnosis; manufacturing systems including production control and manufacturing automation.

MAJOR RECENT PUBLICATIONS

“Detection of unmodeled anomalous behaviors via localized controllers for condition systems”; Ashley, J,
and Holloway, L.E.; *International Journal of Production Research*; (A Special Issue on
Computation Engineering in Systems Applications). Volume 46; Issue 19; pages 5289-5312; 2008.
“Design for Sustainability (DFS): New Challenges in Developing and Implementing a Curriculum for Next
Generation Design and Manufacturing Engineers,” Jawahir, I.S.; Rouch, K.E.; Dillon, O.W.; Holloway,
L.; Hall, A. *International Journal of Engineering Education*, Volume 23, Number 6, November 2007,
pp. 1053-1064(12)
“Applying Automated Control Synthesis Methods to Condition Systems Requiring State Observers”, L.E.
Holloway, J. Ashley, Y. Gong. *Control Engineering Practice*, volume 14:10 (2006), pp 1169-1181.
“Determining the right-hand vectors of an irredundant linear inequality system,” Ramprasad Potluri and L.
E. Holloway. *Operations Research Letters (Elsevier publishers)* vol.24 (2006), pp 373-381.

CURRENT RESEARCH FUNDING: Received \$3.4M funding as PI

I. S. Jawahir

414C, Center for Manufacturing, and Department of Mechanical Engineering
University of Kentucky, Lexington, KY 40506-0108.
Phone: 859-323-3239 E-mail: jawahir@engr.uky.edu Fax: 859-257-1071

EDUCATION

University of New South Wales, Sydney, Australia. PhD 1986 Manufacturing Engineering
P. F. University, Moscow, U.S.S.R. MS 1975 Mechanical/Manufacturing Engineering

APPOINTMENTS

July 2002 – present: James F. Hardymon Chair in Manufacturing Systems,
Department of Mechanical Engineering, University of Kentucky, Lexington, KY
July 1996 – present: Professor, Mechanical Engineering (Tenured), University of Kentucky, Lexington, KY
July 1990 – June 1996: Associate Professor, Mechanical Engineering, University of Kentucky, Lexington, KY
Sept. 1989 – June 1990: Manager, Carbide Product Design, Carboloy Inc., Warren, MI
July 1986 – Sept. 1989: Lecturer and Senior Lecturer, Dept of Mech. Eng, Univ. of Wollongong, Australia

FIVE MOST CLOSELY RELATED RECENT PUBLICATIONS

(from a list of over 230 papers and 4 U.S. Patents, including 94 refereed journal papers)

- [1] Pusavec, F., H. Hamdi, J. Kopac and **I.S. Jawahir**, “Surface Integrity in Cryogenic Machining of Nickel-based Alloy – Inconel 718”, *J. Materials Processing Technology*, Vol. 211, 2011, pp. 773-783.
- [2] Outeiro, J.C., J.C. Pina, O.W. Dillon, Jr., and **I.S. Jawahir**, “Size Effects and Surface Integrity in Machining and their Influence on Product Sustainability”, *Int. J. Sustainable Manufacturing*, Vol. 2(1), 2010, pp. 112-126.
- [3] Jayal, A.D., F. Badurdeen and **I.S. Jawahir**, “Sustainable Manufacturing: Modeling and Optimization Challenges at the Product, Process and System Levels”, *CIRP J. Mfg. Sci. & Tech.*, Vol. 2(3), 2010, pp. 144-152.
- [4] Badurdeen, F., T.J. Goldsby, D. Iyengar, H. Metta, S. Gupta, and **I.S. Jawahir**, “Extending Total Lifecycle Thinking to Sustainable Supply Chains”, *Int. J. Product Lifecycle Management*, Vol. 4(1-3), 2009, pp. 49-67.
- [5] Niranjali de Silva, **I.S. Jawahir**, O.W. Dillon, Jr and M. Russell, “A New Comprehensive Methodology for the Evaluation of Product Sustainability at the Design and Development Stage of Consumer Electronic Products”, *Int. J. Sustainable Manufacturing*, Vol. 1(3), 2009, pp. 251-264.

SYNERGISTIC ACTIVITIES

- **Technical Editor and Co-Founder**, Journal of Machining Science and Technology, Taylor & Francis Publishers, Philadelphia, PA, (1998 - to date).
- **Founding Editor-in-Chief**, International Journal of Product Design and Manufacture for Sustainability, Inderscience Publishers, United Kingdom, (2008 - to date).
- **Chairman**, ASME-BRTD Research Committee on “Sustainable Products and Processes” (2005-10).
- **Chairman**, CIRP International Working Group on “Surface Integrity and Functional Performance of Components”, CIRP, Paris, France (2008-11).
- **Founder**, CIRP Annual International Conference Series on Modeling of Machining Operations (1998). The 13th conference in this series will be held in Sintra, Portugal in May 2011.
- Delivered 24 **Keynote Papers** at international conferences, and 38 **Invited Presentations** in 25 countries.

CURRENT RESEARCH AREAS

Sustainable product design; Modeling and optimization of sustainable manufacturing processes: dry, near-dry and cryogenic machining; Metrics and metrology development for sustainable manufacturing.

INTERNATIONAL RESEARCH COLLABORATORS

Prof. D.K. Aspinwall (University of Birmingham, United Kingdom), Prof. E. Brinksmeier and Prof. F. Vollertsen (University of Bremen, Germany), Prof. M. Dassisti (Bari Polytechnic, Italy), Prof. J. Kopac (University of Ljubljana, Slovenia), Prof. J.C. Outeiro (Portuguese Catholic University, Portugal), Prof. G. Poulachon (ENSAM, Cluny, France), Prof. R. Teti (University of Naples, Italy), Dr. R. M'Saoubi (Seco Tools, Sweden), Prof. D. Umbrello (University of Calabria, Italy).

GRADUATE STUDENTS: 54 MS and 24 PhD Students (Current Graduate Students: 12 PhD candidates and 4 MS students; and PhD Graduates during the Last Twelve Years: 10)

POSTDOCTORAL RESEARCHERS SUPERVISED (1990-to date): 12

RESEARCH FUNDING (1990-10): As PI, received over \$10M in research funding from various funding agencies and industry groups. Also, collaborated as Co-PI with other colleagues in receiving over \$3M additional funding.

Keith E. Rouch

Professor of Mechanical Engineering
University of Kentucky, Lexington, KY 40506-0108

Phone: 859-218-0637

Fax: 859-257-3304

E-mail: rouch@engr.uky.edu

EDUCATION

Marquette University, Milwaukee, WI	PhD	1977	Electrical (Systems) Engineering
Purdue University, West Lafayette, IN	MS	1967	Agricultural Engineering
Purdue University, West Lafayette, IN	BS	1965	Agricultural Engineering

APPOINTMENTS

1997 – 2009:	Chair of Department of Mechanical Engineering, University of Kentucky, Lexington, KY.
1993 – present:	Professor of Mechanical Engineering, Lexington, KY.
1996 - 1996	Interim Director, Center for Robotics and Manuf. Systems, University of Kentucky.
1985 – 1993:	Associate Professor of Mechanical Engineering, Univ. of Kentucky, Lexington, KY.
1966 – 1985:	Allis-Chalmers Corporation, Milwaukee, WI (various,(including Technical Group Leader)

PROFESSIONAL AFFILIATIONS

Fellow of American Society of Mechanical Engineers
Registered Professional Engineer, Kentucky, 1992 to present (PE # 17403)
Registered Professional Engineer, Wisconsin, 1971 to present (E-12298)
Member, American Society of Engineering Education
Member, Society of Tribologists and Lubrication Engineers

Five Most Significant Recent Papers

- [1] Hamade, R.H., S.P. Manthri, F. Pusavec, K.A. Zacny, L.A. Taylor, O.W. Dillon, Jr., **K.E. Rouch** and I.S. Jawahir, “Compact Core Drilling in Basalt Rock using Rectangular PCD Tool Inserts: Wear Characteristics and Cutting Forces”, *J. Materials Processing Technology*, Vol. 210, 2010, pp. 1326-1339.
- [2] Hamade, R.H., S.P. Manthri, F. Pusavec, K.A. Zacny, L.A. Taylor, **K.E. Rouch**, O.W. Dillon, Jr., and I.S. Jawahir, “Developing a Methodology towards Sustainable PCD Compact Core Drilling on Planet Mars”, 2009 ASME-IMECE, Orlando, FL, November 2009.
- [3] Jawahir, I.S., **K.E. Rouch**, O.W. Dillon, Jr., L. Holloway and A. Hall, “Design for Sustainability (DFS): New Challenges in Developing and Implementing a Curriculum for Next Generation Design and Manufacturing Engineers”, *Int. J. Engineering Education*, Vol. 23(6), 2007, pp. 1053-1064. [1]
- [4] “Transitioning To a Two-Semester Capstone Design Sequence in Mechanical Engineering”, **Keith E. Rouch**, William E. Murphy, Vincent R. Capece, 2007 Capstone Design Conference, June 2007.
- [5] “Multi-University and Industrial Collaboration for Research-Oriented Capstone Experience”, Suzanne Weaver Smith, **Keith E. Rouch**, William T. Smith, Jamey D. Jacob, 2007 Capstone Design Conference, June 2007.

RECENT PATENTS (total of five)

Rouch, K.E., Tewani, S., Walcott, B., Massa, T., Stephenson, R.W., Stephens, S. (1992), Active Vibration Control Device, United States Patent 5,170,103, December 8, 1992. (also foreign patents applied for in Australia, Canada, Japan, South Korea, EPC [Germany, Great Britain, France, Italy, Sweden, and Belgium])

Ball, J.H., Sheth, P.N., and Rouch, K.E. (1986), Damped Dynamic Vibration Absorber, United States Patent 4,583,912.

Dusan P. Sekulic

414F CRMS Building, Department of Mechanical Engineering
University of Kentucky, Lexington, KY 40506-0108
Phone: 859-257-2972 E-mail: sekulicd@engr.uky.edu Fax: 859-257-1071

Professional Preparation

University of Novi Sad, Yugoslavia	Mechanical Engineering	B.Eng.	1972
University of Novi Sad, Yugoslavia	Physics	B.Sci.	1976
University of Belgrade, Yugoslavia	Mechanical Engineering	M.S.	1978
University of Belgrade, Yugoslavia	Mechanical Engineering	D.Sc.	1981

Appointments

2006 - Present	Full Professor (tenured), Department of Mechanical Engineering, U of Kentucky
2000 – 2006	Adjunct Professor, College of Engineering, UK, Lexington, Kentucky,
1997 - 2000	Senior Research Scientist, CRMS, College of Engineering, UK, Lexington, Kentucky
1996 - 1997	Visiting Professor, Department of Mechanical Engineering, UK, Lexington, Kentucky
1994 - 1996	Visiting Professor, Marquette University, Milwaukee, Wisconsin
1993 – 1995	Full Professor (tenured), University of Novi Sad, Yugoslavia
1993 – 1994	Visiting Research Professor, University of Tennessee, Knoxville
1988 – 1993	Associate Professor with tenure, University of Novi Sad, Yugoslavia
1989	Visiting Scholar, Massachusetts Institute of Technology, Cambridge, Massachusetts
1988 – 1989	Senior Fulbright Scholar, Duke University, Durham
1977 – 1987	Assistant professor and subsequently Docent, University of Novi Sad, Yugoslavia
1977	Visiting Researcher (DAAD), Technical University Munich, LATUM, Germany
1973 – 1977	Research Fellow, College of Engineering, University of Novi Sad, Yugoslavia

Publications: (total more than 150; SCI >400)

Books:

- R.K. Shah and D.P. Sekulic (2003) *Fundamentals of Heat Exchanger Design*, Wiley, Hoboken.
- B. Bakshi, T. Gutovski and D.P. Sekulic (2010) *Thermodynamics and the Destruction of Resources*, Cambridge University Press, Cambridge, UK.
- Shah, R.K. and Sekulic, D.P. (2010) *Fundamentals of Heat Exchanger Design*, *China Machine Press*, Beijing, 2010. ISBN 978-7-111-28881-7 (translated by Cheng Lin into Mandarin)
- Sekulic, D.P. (2011) *Advances in Brazing: Science, Technology and Applications*, *Woodhead Publ.*, Cambridge, UK. 2011. ISBN to be published (July 2011).
- Sekulic, D.P. (Editor) *Handbook of Heat Exchanger Design*, Vol. 2, Begell House, 2011 (to appear)

Articles (only the last ten months):

- D.P. Sekulic (2010) Wetting and Spreading of Liquid Metals Through open Micro Grooves and Surface Alterations, *Heat Transfer Engineering*, Hard Copy 2011, Vol. 32, Issues 7 & 8, pp. 1-11
- M. Chen, Yuanning, J., Sekulic, D.P., Zhao, H. (2010) Wetting Kinetics of SiC nanoparticle reinforced Sn-Pb eutectic solders, *China Welding*, Vol. 19, No. 3, pp. 16-20.
- D. Busbaber, W. Liu, and D.P. Sekulic, (2010) High Temperature Brazing of Mo/Mo-Re with a nano-composite Mo-Ni filler, *DVS Berichte*, Vol. 263, 2010, pp. 211-214

Synergistic Activities: Dr. Sekulic is a Fellow of ASME. Prof. Sekulic is the Director of Graduate Studies of the Manufacturing Systems Engineering program and a Consulting Professor at the Harbin Institute of Technology. Reviewer of: (i) more than 30 international technical journals, (ii) NSF, NSERC, AAAS, Royal Soc., USCRDF, and various other researches funding organization Review Panels, and (iii) member of multiple advisory boards of research journals.

Postdoctoral and Graduate Students: Dr. Hui Zhao, Dr. Gao Feng, Dr. Chunxu Pan, Dr. Philip Hadinata, Dr. Maoai Chen, Dr. Michael Krivelyev (Fulbright), Dr. Li Yulong (CIS), Dr. Wang Hongqin, S. Jayasankar, N. Dinesh, V.S. Boddapati, A. Renduchintala, N. Narayanaswamy, D. Busbaber, S. Sunramanian, L. Wen, Cheng Nien-Yu, Schwindell, Michael.

YuMing Zhang

Department of Electrical and Computer Engineering
University of Kentucky, Lexington, Kentucky 40506
Phone: 859-323-3262 E-mail: YMZhang@uky.edu Fax: 859-257-1071

EDUCATION:

- Ph.D., 1990, Harbin Institute of Technology (HIT), National Key Laboratory for Advanced Welding Production Technology (NKLAWPT), Harbin, China.
- M. S., 1984, HIT, Department of Control Engineering, Harbin, China.
- B. S. 1981, HIT, Department of Control Engineering, Harbin, China.

EMPLOYMENT:

University of Kentucky

- Department of Electrical and Computer Engineering: Professor-July 2005-present, Associate Professor-August 1998-June 2005
- Center for Robotics and Manufacturing Systems: Visiting Scholar-Feb. 1991-July 1998
Harbin Institute of Technology, Harbin, China
- NKLAWPT, HIT, Harbin, China
Associate Professor-December 1990-Feb 1991, Lecturer-Sept. 1998-Nov. 1990, Junior Lecturer- Sept. 1984-August 1986

HONORS AND AWARDS:

- American Welding Society (AWS), Fellow, 2009
- James R. Boyd Professor in Electrical Engineering (7/03-present)
- Adams Memorial Membership Award, American Welding Society, 2005.
- Best Poster Paper Prize, The 15th Triennial IFAC World Congress, The International Federation of Automatic Control (IFAC), July 2002
- The A. F. Davis Silver Medal Award for Machine Design, American Welding Society, 2011, 2009, 2001
- The Donald Julius Groen Prize, The Institution of Mechanical Engineers, United Kingdom, 1995

SYNERGISTIC ACTIVITIES:

- Lead Principal Reviewer, Welding Journal, since 2007
- Principal Reviewer, Welding Journal, since 2001
- Associate Editor, International Journal of Identification, Modelling and Control, since 2007
- Member of Editorial Board, International Journal of Science and Technology of Welding and Joining, 2010

FIVE SELECTED PUBLICATIONS:

- Z.Z. Wang and Y.M. Zhang, "Brightness based selection and edge detection based enhancement separation algorithm for low resolution metal transfer images," IEEE Transactions on Automation Science and Engineering, 6(1): 181-187, 2009.
- Kehai Li and Y.M Zhang, "Consumable Double-Electrode GMAW Part II: Monitoring, Modeling, and Control," Welding Journal, 87(2): 44s-50s, 2008.
- H.S. Song, Y.M. Zhang, "Three-dimensional Reconstruction of Specular Surface for Gas Tungsten Arc Weld Pool," Measurement Science & Technology, 18: 3751-3767, 2007.
- K.H. Li and Y.M. Zhang, "Metal transfer in double-electrode gas metal arc welding," ASME Journal of Manufacturing Science and Engineering, 129(6): 991-999, 2007.
- Y.M. Zhang and Y.C. Liu, "Control of dynamic keyhole process," Automatica, 43(5): 876-884, 2007.

PhD GRADUATED: 13

Joseph Istre, Yuchi Liu, Wei Lu, Ming Jing (A.Y.Male, Y.M Zhang), Brenton Losch, Gohar Saeed, Ge Wang (G. Huang, Y.M Zhang), Kehai Li, Kun Qian, Hongsheng Song, Zhenzhou Wang, Xiaodong Na (B.L. Walcott, Y.M Zhang), Xiaopei Liu, Xiangrong Li (Y,M Zhang, L. Holloway)

CURRENT RESEARCH AREAS: innovative welding processes; monitoring and control of welding processes; next generation welding machines.

SUMMARY: 115 Referred Journal Papers, 5 US Patents, 40 Scholars and Students, PI for 7 NSF Grants.