



Semiconductor
Research Corporation

PIONEERS IN
COLLABORATIVE
RESEARCH®



2010 SRC Operations Plan

Restricted Distribution: Contains SRC Confidential Material

Table of Contents

2010 SRC Operations Plan

Section I

Introduction	4
---------------------------	---

Section II

GRC Operations Plans

GRC Overview.....	6
Integrated Circuits and Systems Sciences (ICSS).....	9
Computer-Aided Design and Test Sciences (CADTS).....	12
Device Sciences (DS).....	15
Interconnect and Packaging Sciences (IPS).....	18
Nanomanufacturing Sciences (NMS)	21
Cross-Disciplinary Research (CSR).....	25

Section III

Other SRC Programs and Initiatives

Focus Center Research Program	28
Nanoelectronics Research Initiative.....	31
SRC Education Alliance	35
Bioelectronics.....	37
Energy	39
NINE	41

Section IV

SRC Supporting Operations

Value Infrastructure Management.....	44
Student Programs	45
Contracts and Intellectual Property	47

NOTE: A glossary of SRC acronyms can be referenced at <http://www.src.org/member/about/glossary.asp>.

Section I

Introduction

INTRODUCTION

The Semiconductor Research Corporation (SRC) comprises a growing number of research entities, each with its own set of members and organizational structure. The original program of research, launched in 1982, is today's Global Research Collaboration (GRC). The Focus Center Research Program (FCRP) and Nanoelectronics Research Initiative (NRI) were established in 1998 and 2004, respectively. More recently, the SRC Board of Directors approved the formation of Topical Research Collaborations (TRCs), typically around application-specific research and potentially involving new companies from relevant industry sectors. In addition to these research programs, the SRC Education Alliance is a private foundation of SRC focused on science and engineering education more broadly in support of SRC's research and education goals.

This document serves a number of purposes. It ensures that all SRC program directors engage annually in planning and coordination of their programs within the context of the current SRC Strategic Plan and the ITRS. It also is the means by which SRC communicates its operations plan to the ETAB and the SRC Board so that those bodies are able to perform their guidance and oversight functions.

This document provides the detailed 2010 operations plan for GRC research programs. It includes for each of the science areas operational priorities and milestones for the coming year, as well as brief summaries of technical research and milestones, a list of planned events, and the estimated 2010 budget. It also provides operational plans for FCRP, NRI, the Education Alliance, and the TRCs that are in place or under development (NINE, Energy, and Bioelectronics) and for SRC support groups (Value Infrastructure Management, Student Programs, and Contracts & Intellectual Property).

Section II

GRC Operations Plans

GRC OVERVIEW

GRC MISSION

The SRC GRC's mission is to provide for innovative, strategic research guided by the ITRS and conducted in universities worldwide. GRC provides for a global forum for collaboration among all segments of the semiconductor industry, universities and government agencies. GRC is an advocate to various government and other funding agencies for support of university semiconductor research. GRC management provides a comprehensive Value Proposition that focuses on maximizing member value.

OPERATIONAL PRIORITIES FOR 2010

The technical and operational priorities for GRC are summarized here. For a more complete listings, see the body of the text of this document.

- Continue support of SRC/NSF Multicore Design and Architecture initiative
- Continue support of TxACE with new and existing analog/mixed-signal/RF tool projects
- Continue to address Board and ETAB priorities in proposal selection and solicitation:
 - Memory
 - Functional Diversification – Applications
 - Analog and Mixed Signal Design and Technology
 - Homogeneous/Heterogeneous Multicore Architectures
 - Coping with Variability/Reliability Issues
 - Design and Technology Solutions for Thermal/Power
- Seek additional strategic leverage on research programs with NSF, DARPA, CDADIC, and other agencies
- Address the concerns of core funding balance between NCRC and classical CMOS research.
- Explore NSF cooperation on cyber-physical systems
- Determine path for supporting systems research within framework of ad hoc CADTS/ICSS/IPS committee initiated at 2009 Summer Study
- Continue successful activities to enhance academic design infrastructure (MOSIS Fabrication Initiative, PDK development and design contests) with constrained resources
- Maintain collaboration with the University of (?) Glasgow and SEMATECH to ensure continued support for NCRC.
- Maintain New York and Georgia matching funding in light of significant GRC budget reductions and state budget uncertainties.
- Develop plans to insure continued uniform annual portfolio turnover for both the BEP and PKG thrusts in light of dynamic budget allocations.
- Increase science area emphasis on targeted applications of nanoengineered materials, low variability materials and processes, design for manufacturing, and nano-characterization.

BUDGET SUMMARY

The projected GRC budget is decreasing over 13 percent in 2010 compared to 2009, with implications for all of the science areas. Within each science area, some thrusts are affected more than others. Where operational issues arise as a result of the budget cuts, they are addressed at the science area level later in this section. While some adjustments in the programs have been necessary as a result of the budget reduction, overall the program remains strong.

The table below shows the originally approved 2009 budget and the proposed 2010 budget that was recommended by the ETAB and approved by the SRC Board in November 2009. There is also a column showing the 2009 budget that the Board requested GRC to target in March 2009 in response to lower than expected 2009 fees due to dramatically lower revenues for 2008. Spending for 2009 was reduced substantially in the second half of the year and we were able to meet the revised target.

SUMMARY OF GRC BY SCIENCE AREA

Science Area		2009 Planned (M)	2009 Revised (M)	2010 proposed budget (M)
CADTS		\$3.66	\$3.47	\$3.34
ICSS		3.66	3.47	3.51
DS		3.38	3.20	2.97
IPS		3.02	2.85	2.65
NMS (including ESH)		2.74	2.58	2.30
CSR		0.50	0.47	0.05
RCP + RI		5.98	5.12	5.09
Total Core		16.95	16.05	14.82
Total (with RCP)		22.93	21.17	19.91
Leverage	Collaborative	20.92		24.0
	Influenced	26.63		26.0
	Direct	1.00		1.00
Total		71.48		70.91

In 2009 the ETAB and the VCTAB requested that the RCP money allocated to each company be available to support travel to reviews. This would be used in cases where there would not be attendance at a research review by that company with out using these funds. This has been put in affect and will be available in 2010, GRC is also committed to and will continue to supply remote access to reviews for those members who cannot attend in person.

Science Area: Integrated Circuits and Systems
Director: David C. Yeh

MISSION

To conduct research in advanced integrated circuits and systems design that will

- Exploit advances in IC technology while overcoming associated barriers and challenging conventional notions of the circuits and systems design space
- Develop a circuits and systems research portfolio that will provide exceptional value to our MCs – with a focus on design-based performance gains
- Facilitate the training of highly-skilled graduates to help fill design engineering needs of MCs

In the circuit design space, the emphasis will be on advances for robust high-performance low-power digital logic and memory, analog, RF, and mixed-signal designs. In the integrated system design space, the emphasis will be on advances that enable robust and power efficient designs for both high performance and embedded systems comprised of silicon and software for diverse applications.

SUMMARY OF KEY OPERATIONAL CHANGES/ CHALLENGES

- Continue support for TxACE with new work emphasizing energy efficiency and healthcare applications
- Maintain portfolio value and balance in the face of budget challenges
- Explore NSF cooperation on cyber-physical systems and cross-layer resilience in conjunction with CADTS
- Determine path for supporting systems within framework of ad hoc CADTS/ICSS/IPS committee initiated at 2009 Summer Study
- Continue successful initiative to enhance academic design infrastructure (MOSIS Fabrication Initiative, PDK development, design contests, workshops, system design) with constrained resources

ONGOING KEY OPERATIONAL PRIORITIES

- Continue support of SRC/NSF Multicore Chip Design and Architecture initiative
- Continue support of TxACE with new analog/mixed-signal/RF design projects
- Continue to address Board and ETAB priorities in proposal selection and solicitation:
 - Functional Diversification – Applications
 - Analog and Mixed Signal Design and Technology
 - Homogeneous/Heterogeneous Multicore Architectures
 - Coping with Variability/Reliability Issues
 - Design and Technology solutions for Thermal/Power
 - Memory
- Work with the SACC to continue to seek ways for better engagement with designers and more delivered value
- Seek additional strategic leverage on research programs with NSF, DARPA, CDADIC, and other agencies
- Continue synergy with design work funded through the FCRP program which includes appropriate research transfers, collaborations, and forum participation. This includes

MuSyC, GSRC and C2S2 centers including one update presentation at the ICSS SACC meeting in February from C2S2.

- Coordinate with CADTS, DS, IPS, NMS, and CSR for possible crosscutting topics using such techniques as joint events, forums, and project funding
- Continue electronic participation by members in planning reviews, Technology Transfer e-Workshops and Kickoff meetings
- ETAB targets for 2010: 49% Circuits, 51% Systems

OPERATIONAL MILESTONES AND CHECKPOINTS FOR 2010

- Q1 Solicitation for new work in both circuits and systems thrusts for funding starts in August 2010 and early 2011
- Q1 ICSS SACC meeting at ISSCC
- Q2 Select abstracts, session chairs/judges for TECHCON
- Q3 ICSS SACC e-meeting
- Q4 Complete thrust reviews and include poster displays for students near graduation if pragmatic; examine NSF projects of interest for possible invitation to reviews; examine CSR projects of interest for possible invitation to reviews
- Q4 Complete a minimum of five Technology Transfer e-Workshops and Kickoffs in circuit and system design
- Q4 Review and renew highly leveraged CDADIC program
- Q4 Plan schedule for needs document revisions in 2011 for 2012 solicitations

ONGOING KEY TECHNICAL RESEARCH FOR 2010 AND RELATIONSHIP TO THE SRC 2010-2014 STRATEGIC PLAN

- Analog, mixed-signal, RF, and high-speed I/O design advances in partnership with TxACE
- Higher emphasis on system-level design, including software for multi-core architectures
- Continued emphasis on robust/resilient design
- Continued emphasis on low power design
- New work in emerging architectures, algorithms, and applications

TECHNICAL MILESTONES FOR 2010

- Jan Report on the impact of various FinFET parameters on the performance and power of logic and interconnect (1602.001, Jha, Princeton)
- Mar Report on the development of a token-based congestion management scheme (1793.001, Jha, Princeton)
- Mar Report on the circuits for fine-grain multi-core dynamic clock frequency operation utilizing digitally programmable local oscillators (1598.001, Baas, UC/Davis)
- Mar Report on the evaluation of impact of correlations on the performance of synthesized logic (1600.001, Nikolic, UC/Berkeley)
- Mar Report specifying (i) targeted workloads including fault-tolerance and performance requirements, (ii) metrics for reliability in terms of applicable safety standards, (iii) taxonomy of design options to be considered (2042.001, Skadron, Virginia)
- Apr Report on the design of on-chip HCI monitor (1805.001, Kim, Minnesota)

- Jul Report on reconfigurable power amplifier and its performance (1836.008/009/010, O, UT/Dallas)
- Jul Report on the analysis of sensor characteristics that will result from projected specs from CMOS developers (1836.048, De Lucia, The Ohio State University)
- Sep Report on the initial design of extensions to OpenMP API for Embedded systems (2043.001/002, Chapman, University of Houston)
- Nov Report on the revised circuit design, including physical design & tapeout for the final architecture (1836.022, Harjani, Minnesota)
- Dec Report on the set up for measuring oscillator output from 180-300 GHz (1836.035, Banerjee, UT/Dallas)

SIGNIFICANT EVENTS SCHEDULED FOR 2010

- April 27-29 Integrated System Design review at CMU
- Sept 13-14 TECHCON
- Oct Circuits Design review at UT/Dallas (tentative)
- Oct TxACE review at UT/Dallas (tentative)

RESOURCES (\$K)

ICSS		2009 Planned	2009 Actual	2010 ETAB Thrust Guidance	2010 Planned
Core		\$3,660	\$3,470	\$3,510	\$3,510
Circuits (core)		\$1,871	\$1,757	\$1,720	\$1,736
Systems (core)		\$1,877	\$1,744	\$1,790	\$1,758
RCP			\$1,403		\$1,320
Leveraged	Collaborative (CDADIC, NSF, Univ. match)		\$2,832		\$2,191
	Influenced		\$4,379		\$2,792

Science Area: Computer-Aided Design and Test Sciences
Director: William H. Joyner, Jr.

MISSION

Promote diverse university research to strengthen member leadership in computer-aided design and test through tools and techniques that reduce cost and time-to-market (through productivity and correctness improvements), take full advantage of technology advances (through linkages to manufacturing), and enable high value design (given power and other constraints), through highly qualified graduate students who can fill design positions in member companies, and through strategic partnerships that leverage other funding sources. Address design capability and productivity by identifying needs and opportunities, supporting productive university research tasks, making available leading-edge tools and results, and exposing students to member challenges.

SUMMARY OF KEY OPERATIONAL CHANGES/ CHALLENGES

- Maintain portfolio value and balance in the face of budget challenges
- Explore NSF cooperation on cyber-physical and cross-layer resilience in conjunction with ICSS
- Determine path for supporting systems within framework of ad hoc CADTS/ICSS/IPS committee initiated at 2009 Summer Study
- Determine path and mechanism to support 3D design research in response to 2009 Summer Study.
- Take advantage of new ETAB travel policy to increase review attendance
- Continue successful initiative to enhance academic design infrastructure (MOSIS Fabrication Initiative, PDK development, design contests, workshops) with constrained resources

ONGOING KEY OPERATIONAL PRIORITIES

- Continue support of SRC/NSF Multicore Design and Architecture initiative
- Continue support of TxACE with new and existing analog/mixed-signal/RF tool projects
- Develop SACC plan based on member input and move portfolio toward these goals. With SACC, consider how CADTS can address strategic imperatives by shaping research portfolio to provide critical mass research in targeted areas
- Develop new directions and new needs documents identifying shared member challenges and opportunities in Test and LPD in preparation for 2010 and 2011 solicitations (which will use new project selection method)
- Continue to address Board and ETAB priorities in proposal selection and solicitation:
 - Memory
 - Functional Diversification – Applications
 - Analog and Mixed Signal Design and Technology
 - Homogeneous/Heterogeneous Multicore Architectures
 - Coping with Variability/Reliability Issues
 - Design and Technology solutions for Thermal/Power

- Continue synergy with GSRC, C2S2, and new MuSyC Focus Centers through shared vision and differentiated operations, appropriate research transfers, forum participation, representation from Focus Centers at CADTS SACC meetings, and attendance at Focus Center reviews
- Continue interaction with other science areas, including follow-up from 2009 memory forum
- Investigate, plan and conduct one forum with other GRC science areas and other SRC entities
- Seek additional sources of leveraged funding from NSF, CDADIC, DARPA, and other agencies to augment member funds
- Encourage member customization program funding in CADTS and incorporate into core program operations
- Continue electronic participation by members in planning, reviews, Technology Transfer e-Workshops and Kickoff meetings
- ETAB targets for 2010: 43% LPD, 27% Test, 30% Verification

OPERATIONAL MILESTONES AND CHECKPOINTS FOR 2010

- Q1 Solicit Test white papers
- Q2 Select student abstracts and member session chairs and judges for TECHCON
- Q2 CADTS SACC meeting at DAC
- Q4 CADTS SACC e-meeting
- Q4 Complete thrust area reviews and include poster displays for students near graduation (see dates below)
- Q4 Complete a minimum of 5 Technology Transfer e-Workshops in CAD and Test
- Q4 Complete new needs document in Logic and Physical Design in preparation for 2011 solicitation

ONGOING KEY TECHNICAL RESEARCH FOR 2010 AND RELATIONSHIP TO THE SRC 2010-2014 STRATEGIC PLAN

- Continued research in multi-core design tools and use of multi-core platforms for CAD in conjunction with joint NSF solicitation
- Continued analog design, test, and verification tools advances in partnership with TxACE analog center at UTD
- Research in system-level and high-level design tools and 3D as part of 2009 ETAB Summer Study initiative
- Continued work in design tools aware of variability and manufacturing issues
- Continued work in tools for power reduction
- Explore NSF cooperation on cyber-physical systems and cross-layer resilience

TECHNICAL MILESTONES FOR 2010

- Jan Silicon results of delay tests controlling supply noise, power dissipation and temperature rise (1618.002, Walker, Texas A&M)
- Mar Prototype tools for generating test patterns for power-management structures for multicore chips (1992.001, Chakrabarty, Duke)
- May First-pass Architecture Evaluator, including transaction-level floorplanning and analysis environment, library of SRAM models, and tutorial (1824.001, Davis/Franzon, NC State)

- Jun Interconnect network planner for NoC structure in a multicore system (1819.001, Sapatnekar/Zhai, Minnesota)
- Jul Transient thermal modeling algorithms for multicore processors: software package in Matlab and documentation (1991.001, Tan, UC/Riverside)
- Jul Preliminary algorithms and software for RTL design optimization for size and speed (1813.001, Malik, Princeton)
- Jul Integrated verification engine, with interfaces to high-level tools, based on synergistic gate-level and high-level transformations (1875.001, Brayton/Mishchenko, UC/Berkeley)
- Aug Report and software on how to improve performance with concurrent simulation and evaluate with benchmark designs (1853.001, Cheng, UC/Santa Barbara)
- Sep Release validated power modeling infrastructure for MP-SOC architectures (1814.001, Brooks/Wei, Harvard)

SIGNIFICANT EVENTS SCHEDULED FOR 2010 UPDATE

- Apr 13-15 Verification Review at University of Texas at Austin (tentative)
- May 19-20 Test and Testability Review at Georgia Tech (tentative)
- Sep 13-14 TECHCON
- Oct 19-21 Logic and Physical Design Review at University of Michigan (tentative)

RESOURCES (\$K)

CADTS		2009 Planned	2009 Actual	2010 ETAB Thrust Guidance	2010 Planned
Core		\$3,661	\$3,663	\$3,340	\$3,340
LPD (core)		\$1,798	\$1,734	\$1,436	\$1,433
Test (core)		\$978	\$ 940	\$ 902	\$ 883
Verification (core)		\$883	\$ 989	\$1,002	\$1,024
RCP			\$ 888		\$ 900
Leveraged	Collaborative		\$ 698		\$1,164
	Influenced		\$ 2,032		\$1,166

Science Area: Device Sciences
Director: Kwok Ng

MISSION

Device Sciences (DS) acquires scientific knowledge and innovation in all aspects (design, process technology, modeling, characterization, and reliability) of semiconductor devices, through sponsoring university research worldwide and meanwhile training highly skilled graduates, to enable member companies to successful commercialization of differentiating semiconductor products.

DS consists of six thrusts whose names are indicated in the Resources table.

SUMMARY OF KEY OPERATIONAL CHANGES/CHALLENGES

- After creating new thrust in 2009, DS has now 6 thrusts, the most among 5 science areas. Three thrusts (Compact Modeling, Memory, Modeling and Simulation) are near critical funding level for a solicitation (~\$500K). DCMOS (\$90K) is way below that level. NCRC is also at sub-critical level (ETAB allocation \$760K) as a “Center”.
- ETAB allocations of funds among different thrusts are quite different from on-going commitment. In this year of reduced budget, some thrusts receive increased ETAB allocation, which put extra burden on other thrusts to bear the overall budget cut.
- Final budget might require cutting Memory and NCRC renewal funding by ~13%. It will be carried out by granting no-cost-extension when renewals come up (in July/Aug.).

ONGOING KEY OPERATIONAL PRIORITIES

- Redistribution of ETAB’s funding allocation among different thrusts to maintain and balance the overall DS priority, as well as minimizing hardship to students and PIs.
- Address the concerns of core funding balance between NCRC and classical CMOS research.
- Ensure the success of NCRC, and its collaboration with Glasgow and SEMATECH.
- Ensure the success and satisfaction of Custom programs. (DS has large Custom proportion.)
- Ensure synergy, maximize transfer, and avoid overlap between DS and FCRP, in particular MSD and FENA.
- Participate in ITRS development, in particular in the PIDS chapter. Align DS strategy to the Roadmap.

OPERATIONAL MILESTONES AND CHECKPOINTS FOR 2010

- Q1 Finalize NCRC and Memory budget, to decide whether no-cost-extension is needed before renewal.
- Q2 Check point for Glasgow and SEMATECH collaboration with NCRC.
- Q2 TECHCON: Selection of papers, judges, and chairs.
- Q4 Decision on NCRC Phase-III extension (starting 7/1/11).
- Q4 Decision on DCMOS solicitation depending on 2011 budget.
- Q4 Finish 6 Tech-Transfer E-Workshops for the year, one per thrust.

ONGOING KEY TECHNICAL RESEARCH FOR 2010 AND RELATIONSHIP TO THE SRC 2010-2014 STRATEGIC PLAN

- MOSFET development on III-V channel material based on Si infrastructure (NCRC), in collaboration with Glasgow and SEMATECH.
- Si-based advanced MOSFET structures: High-K/metal-gate gate stack, strain enhancement, S/D optimization, FinFET structures, reliability and variability.
- Analog devices for mixed-signal and functional diversification: RF power devices, passives, etc.
- Novel nonvolatile memory devices and embedded DRAM.
- Computationally efficient transport simulation including quantum effects, and process simulation including strain effects.
- Compact modeling for advanced digital and analog devices.

TECHNICAL MILESTONES FOR 2010

- Jan Report on the progress towards the design, fabrication and demonstration of a functional 4Kbit spin-torque MRAM memory circuit. (1432.001/Buhrman/Cornell)
- May Develop a physically based predictive model of NBTI and PBTI found in high-K systems. (1626.001/Lenahan/Penn State)
- Jun Report on generating first data on HRTEM study of switched oxide nanowire PCRAM. (1999.001/Ignatiev/U Houston)
- Jul Report giving process details on gate-last, spin-on-glass, and regrowth process flow of InGaAs MOSFET (1437.006/Rodwell/UC Santa Barbara)
- Sep Reliability analysis of the most promising gate stack. (1606.001/Mahapatra/IIT Bombay)
- Oct Report on the exploration of methodology to determine the chemical identity of the defects in high-k dielectrics. (1665.001/Williams/U Utah)
- Oct Report on the final device/process optimization for power MOSFET and concept review. (1667.001/Baccarani/U Bologna)
- Nov Report on the experimental data (time, frequency domain), analyses for dc, ac, 1/f noise and RTS characteristics of LDMOS, and other power MOSFETs as available, with different fabrication process parameters. (1959.001/Celik-Butler/UT Arlington)
- Dec Report on the ballistic model for quantum transport in 2D and application to double-gate FETs, nanowires and graphene sheets. (1869.001/Fischetti, U Mass)
- Dec Report on the device fabrication of SOI with new BOX layers and reliability test. (1960/Kim/UT Dallas)
- Dec Report on the new insights and understanding into thermoelectric and self-heating effects in nanoscale transistors and possibly novel devices designed for TE cooling or power generation. (1871.001/Lundstrom/Purdue)

SIGNIFICANT EVENTS SCHEDULED FOR 2010

- On-site annual and web-based quarterly project reviews:
 - March 30-31 NCRC--UC Santa Barbara, CA
 - April 27-29 DCMOS and Memory--UC Berkeley, CA

- July NCRC Quarterly E-Review
- August 17-18 DSMS and CM--UT Austin, TX
- October AMS-- UT Austin, TX (associate with TxACE)
- November NCRC Quarterly E-Review
- May 5-6 FCRP MSD annual review: MIT, MA.

RESOURCES (\$K)

Device Sciences		2009 Planned	2009 Actual	2010 ETAB Thrust Guidance	2010 Planned
Core		\$3,380	\$3,082	\$2,970	\$3,037
Digital CMOS Technologies (DCMOS)		\$1,100	\$1,360	\$90	\$55
Non-Classical CMOS Research (NCR)				\$760	\$964
Analog & Mixed-Signal Devices (AMS)		\$770	\$392	\$920	\$630
Memory Technologies (NT)		\$540	\$441	\$400	\$475
Modeling and Simulation (DSMS)		\$540	\$481	\$400	\$500
Compact Modeling (CM)		\$430	\$408	\$400	\$413
RCP			\$1,500		\$1,350
Leveraged	Collaborative		\$1,224		\$1,000
	Influenced		\$6,254		\$5,500

Science Area: Interconnect and Packaging Sciences
Director: Scott List

MISSION

To create and explore advanced evolutionary and revolutionary technologies for connecting elemental devices (transistors, capacitors, nanodevices, etc) to each other and to the macro world targeting the 16nm technology node and beyond;

To facilitate strong bridges and foster new ideas between the packaging and interconnect communities and develop closer ties to the system and design communities;

To enable the development of talented students in the areas of interconnect and packaging sciences through sponsored innovative university research.

SUMMARY OF KEY OPERATIONAL CHANGES / CHALLENGES

- Maintain New York and Georgia matching funding in light of significant core budget reductions and state budget instabilities.
- Identify more stable/higher value matching funds for an interconnect center in 2011.
- Generate combined BEP, PKG, interface and design needs document for new 2011 starts.
- Determine path for supporting systems within framework of ad hoc CADTS/ICSS/IPS committee initiated at 2009 Summer Study
- Expand the Topical Teleconference program to include both BEP and PKG tasks.
- Facilitate collaborations between NIST and IPS researchers to explore advanced metrologies.

ONGOING KEY OPERATIONAL PRIORITIES

- Facilitate continued funding in the interface area.
- Insure portfolio rationalization with the new IFC portfolio.
- Insure alignment with ITRS Interconnect and Assembly challenges.
- Evaluate new strategies for supplying university researchers with industrially relevant samples including the use of specially designed reticles and processes in CNSE.
- Increase interaction and potential joint funding with ICSS beyond the current multi-core initiative.
- Schedule at least eight e-Workshops in 2010.
- Evaluate the effectiveness of the Topical Teleconferences and decide whether or not to continue them.

OPERATIONAL MILESTONES AND CHECKPOINTS FOR 2010

- Q1 Resolve funding requirements to insure the continued matching state funding with reduced core budgets.
- Q1 Formulate new focus areas for 2010 needs document.
- Q2 Evaluate effectiveness of Topical Teleconferences and provide feedback to chairs.
- Q2 Generate joint BEP/PKG needs documents with ICSS inputs for 2011 funding starts.
- Q2 Facilitate at least one joint paper between PIs and NIST metrology researchers.

- Q2 Issue 2011 call for proposals with BEP and PKG funding and ICSS inputs.
- Q3 Insure IPS / IFC / NRI portfolio rationalization on interconnect and packaging research prior to the IFC review.
- Q4 Obtain feedback on IPS strengths and areas for improvement.
- Q4 Schedule at least eight e-Workshops in 2010

ONGOING KEY TECHNICAL RESEARCH FOR 2010 AND RELATIONSHIP TO THE SRC 2010-2014 STRATEGIC PLAN

- Continue driving Cu/low k scaling and thermal solutions for the 16 nm node and beyond.
- Demonstrate successful sub-3nm conductive, conformal and “electroplatable” barrier/seed layers.
- Develop a fundamental understanding of the relationships between dielectric etch, damage and reliability.
- Explore experimental and theoretical limits of interconnect reliability.
- Explore approaches for direct plating on barriers.
- Explore experimental and theoretical limits of package reliability including bump metallurgy, chip-package interactions and high temperature reliability.
- Initiate packaging tasks on chip in board and radical low cost packaging solutions.
- Explore 3D technologies including bonding, through silicon vias and design.
- Provide experimental database to help validate various die, package and board high frequency electromagnetic simulators.
- Explore both advanced thermal metrology and cooling solutions.

TECHNICAL MILESTONES FOR 2010

- Jan Report on the evaluation of 50+ surfaces as copper migration barriers using the flexible MLD process. (1292.040, Bent, Stanford)
- Jan Report on the Cu/barrier selectivity, planarization performance, results of polishing patterned wafers and initial studies on low-k films. (1774, Babu, Clarkson)
- Jan Report on the mechanisms of leakage, TDDB and the role of traps and interfaces in a wide variety of LKD films, interface sand structures including thickness dependence (1292.041, Heinz, Columbia)
- Feb Report on the investigation of solder microstructure refinement and intermetallic thickness in SAC and SAC-Ce alloys. (1292.068, Chawla, ASU)
- Mar Report on the effects of synthesis additives on the zeolites' mechanical properties, pore size distributions and electrical properties. (1576, Yan, UC Riverside)
- Apr Report on the data on copper solubility, copper ion lifetime and trap density as a function of temperature, applied field and surface O/OH content for porous SiCOH. (1292.033, Plawsky, RPI)
- Apr Report and software for 3-D subcritical fatigue crack propagation simulation on bimaterial interfaces. (1830, Nied, Lehigh)
- Aug Report on the profiling of both the lateral and vertical conductivities as function of depth, using variable grating period, of novel thermal interface materials. Extraction methodology for boundary resistances and internal resistance non-homogeneities. (1640, Goodson, Stanford)
- Sep Report on how to accelerate 3-D interconnect full-wave solver for large number of complex vertical paths on the board or package. (1634, Tsang, U Washington)
- Sep Report with TSV detailed process recipes and thermal cycling reliability data. (1883.006, Sitaraman, GA Tech)

- Nov Report on how to characterize signal integrity of high speed I/O stacked chip and 3-D package/interconnect systems. (1292.028, Eisenstadt, U Florida)
- Dec Report on built-in current sensors describing design and simulation results on interconnect current density measurement circuit with adequate range and resolution. (2003, Geiger, Iowa State)

SIGNIFICANT SPECIAL EVENTS SCHEDULED FOR 2010

- Feb Renew CAIST and IPC research centers.
- Apr CAIST Workshop, NY
- Apr Validate Strategic Plan with SACC, BEP TAB and PKG TAB.
- May Generate needs document for 2009 IPS solicitation.
- May NIST meeting to develop structure for continued collaborations
- Jun Release IPS call for proposals
- Jun Packaging review and TAB planning meeting, Atlanta, GA
- Jul IPS Call for proposals
- Oct BEP review and TAB planning meeting, NY
- Oct Validate Ops Plan with BEP and PKG TABs.
- Oct Final IPS proposal selections

RESOURCES (\$K)

Interconnect & Packaging Sciences		2009 Planned	2009 Actual	2010 ETAB Thrust Guidance	2010 Planned¹
Core		\$3,014	\$2,980	\$2,650	\$2,650
BEP (core)		\$1,425	\$1,470	\$1,050	\$1,186
PKG (core)		\$1,589	\$1,510	\$1,600	\$1,464
RCP		\$1,670	\$1,134	\$1,008	\$1,008
Leveraged	Collaborative	\$4,040	\$4,040	\$4,040	\$3,995
	Influenced	\$2,324	\$2,324	\$2,324	\$2,324

¹ Changes reflect updated SACC funding distribution and NYS + UNT collaborative funding reduction of \$45k from 2009.

Science Area: Nanomanufacturing Sciences Research
Director: Daniel J. C. Herr, Ph.D.

MISSION

The Nanomanufacturing Sciences (NMS) mission is to develop novel, sustainable, high performance, low variability, and centered materials, processes, and nano-characterization methods that enable affordable nanofabrication, scaling extensibility, and enhanced functional density and diversification of charge based technologies.

SUMMARY OF KEY OPERATIONAL CHANGES/ CHALLENGES

Projected changes to align with the current NMS Strategic Plan:

- Status/Changes:
 - Positioned the Patterning thrust to explore extensible patterning options and projected resolution, line edge roughness, and throughput requirements
 - This portfolio emphasizes aligned NGL and directed self-assembly projects,
 - Secured NEM TTAB leadership
 - Refined the metrology research needs assessment and gap analysis
 - Increased visibility of Metrology research through the use of Webinars
 - Secured \$1M GRC commitment and SEMATECH/ISMI support for the CEBSM.
 - Placed the Factory Systems Thrust on probation, with one funded task remaining;
- Challenges:
 - Manage a projected ~\$500K Patterning thrust budget reduction in 2010.
 - Increase the PAT thrust's emphasis on reducing variability, dimensional control, DFM, and emerging patterning materials for digital and analog applications;
 - Launch a stand-alone NEM thrust; deferred due to fiscal constraints.
 - Develop a path to support NEM research that enables synthesis and integration, materials by design, and options for functional diversification and 3D systems.
 - Increase engagement between the Metrology Cross-cut TAB and other TTABs;
 - Address cross-science area metrology gaps; deferred due to fiscal constraints.
 - Sustain current levels of leveraged support, i.e. for the ESH CEBSM;
 - Secure additional leverage to address critical ESH, PAT, NEM, and MET gaps.
 - Manage the smooth sun-setting of the Factory Systems thrust in 2010.

Projected impact of the ETAB's 2010 budget projections:

- Deferred consideration of new patterning projects to 2011 or beyond, including new research that targets reduced variability;
- Applied the Patterning thrust research priorities to guide portfolio reductions and scope alignment, i.e. emphasized variability, LER, resolution, throughput, cost, and extensible nanomanufacturing challenges in Next Generation Lithography and Directed Self-Assembly; Terminated prematurely one or more TTAB/SACC identified continuing projects. GRC sponsored research at UW-Madison will continue with significantly reduced funding and one less task, which jeopardizes the University's status of this Center.
- NEM and MET remain under the PAT thrust umbrella, due to fiscal constraints.
 - Continued the Metrology webinar series, but deferred NEM and MET new starts.
- Secured \$1M of GRC support for the ESH Center for Environmentally Benign Semiconductor Manufacturing and sustained support for the scope of the current portfolio.
 - Reach closure on joint GRC-ISMI CEBSM funding plans

ONGOING KEY OPERATIONAL PRIORITIES

- ETAB Targets for 2010: 44% ESH, 34% PAT/MET, 21% NEM, and 1% FAC.
- Increase the emphasis on low variability materials and processes, high impact nanoengineered materials, design for manufacturing, and nano-characterization, which reflect the following research priorities: 1) Centered, low variability, and extensible fabrication technologies; 2) New cost curves for nanoelectronics fabrication; 3) Functional diversification; and 4) Sustainable nanoelectronics fabrication.
- Coordinate with other GRC Science Areas/FCRP/NRI/TRC to manage complementary and cross-cutting research initiatives and avoid duplication of effort, especially for metrology, materials by design, and low variability design for manufacturing.
- Continue e-participation by members in planning meetings, reviews, workshops, etc.

OPERATIONAL MILESTONES AND CHECKPOINTS FOR 2010

- Host quarterly NMS SACC meetings and two MET cross-cut TTAB meetings, and link PAT, NEM, and ESH TTAB meetings to corresponding reviews.
- Q2 Manage the projected NMS budget reduction with minimal impact on continuing students and high potential impact research projects.
- Q2 Ensure coordination with other science areas/entities, i.e. FCRP, NRI, and TRC.
- Q2 Select student abstracts, session chairs, and judges for TECHCON 2010.
- Q4 Develop a strategic domestic or global government initiative, with high impact potential to address scaling, functional diversification, and/or ESH research gaps.
- Q4 Continue coordination with relevant FCRP, NRI, and TRC programs, identify potential transition projects, and include FCRP Directors as ex-officio SACC members.
- Q1 Rescope the Patterning Thrust portfolio to comprehend a ~\$500K shortfall;
- Q1 Secure and deploy support, at current levels, for the jointly funded SRC/ISMI SEMATECH research Center on Environmentally Benign Semiconductor Manufacturing.
- Q1 Refine PAT/NEM/MET gaps/priorities to maximize impact, value, and leverage potential; This includes 3D system related material and process research.
- Q1 Sunset the Factory Systems Thrust.
- Q2 Launch a 2010 directed self-assembly innovation challenge that leverages member company support in nano-device/circuit design, fabrication, and integration.
- Q4 Ensure good visibility of ESH results across relevant GRC thrusts.
- Q4 Continue to communicate breakthrough metrology results across science areas.

ONGOING KEY TECHNICAL RESEARCH FOR 2010 AND RELATIONSHIP TO THE SRC 2010-2014 STRATEGIC PLAN

- The alignment of NMS' strategic plan and corresponding PAT, NEM, ESH, and MET research portfolios with ETAB Priorities remains unchanged.
 - The ESH thrust remains focused on: 1) Sustainable, high performance materials and processes and 2) the ESH impact of new and nanomaterials;
 - The Patterning thrust: 1) Explores NGL and directed self-assembly as potential options for extensible patterning, with reduced variability, and 2) addresses critical materials and characterization challenges.

- The NEM thrust continues under the PAT umbrella and emphasizes: 1) Emerging research materials that enable continued scaling and 2) electronically useful materials and processes that enable functional diversification and 3D systems;
- Cross-cutting Metrology research will be scoped per each science area's priorities.

TECHNICAL MILESTONES FOR 2010

ESH:

- Dec 31 425.029/Ober/Cornell: Preparation of new "Sweet" PAG Gen 3 material.
- Feb 28 425.025/Chen/GIT: Catalogue sc nanomaterial physicochemical measurement.
- Mar 10 425.035/Tropsha/UNC: High-throughput cellular-based toxicity assays
- Apr 30 425.032/Philiposian/UAz: Die-level model, with pad-micro-structure and slurry.
- Dec 31 425.023/Ratner/UWA: Phase 2 NP properties relevant to toxicity assessment

PAT/NEM/MET:

- Mar 31 1779.01/Galvanauskas/ UMI: Enhanced tools for power scalable EUV generation
- May 31 1677.001/Ober/Cornell: LER tunable hybrid resists
- Jun 30 1884.001/Nealey/UWI: DSA induced feature density multiplication
- Dec 31 1672.001/Watkins/UMA: Improved LER via designed PAG segregation/retention
- Dec 31 1675.001/Schmidt/UBayreuth: PAG placement optimization for optimal LER
- Dec 31 1672.001/Subramanian/UCB: Printed electronics using inorganic nanoparticles
- Dec 31 1763.002/Bokor/UCB: Integration of 1st generation inkjet printing system
- Dec 31 1777.001/Bockrath/CalTech: Demonstration of a top-gated graphene device
- Dec 31 1676.001/Shinada/Waseda: Dopant atom position impact on electrical properties

SIGNIFICANT SPECIAL EVENTS SCHEDULED FOR 2010

- Feb 17-19, 2010 GRC/ISMI ESH CEBSM Review [at UAz-Tucson]
- May 19-20, 2010 PAT/NEM Review [at UW-Madison]
- Aug 16-17, 2010 PAT/NEM Review [at UC-Berkeley]
- Nov 9-10, 2010 PAT/NEM Review [at UMA-Amherst]
- Oct 6, 2010 Factory Project E-Review
- Metrology Cross Science Area Webinars (5): Feb 3, Mar 10, April 14, Aug 25, & Sep 22
- Sep 13-14, 2010 TECHCON
- Other NMS and ERM related meetings and workshops, as warranted

RESOURCES (\$K)

Nanomanufacturing Sciences	2009 Plan	2009 Actual	2010 ETAB Guidance	2010 Plan
Core	\$2,740	2,590		\$2,300
PAT/ MET (core)	\$1,270		\$770	\$860
NEM (core)	\$440		\$490	\$420
ESH (core) * [* Reflects \$1M of SEMATECH directed support]	\$1,000		\$1,000 + [\$1,000*]	\$1,000 + [\$1,000*]
FAC (core)	\$30		\$30	\$30

Nanomanufacturing Sciences	2009 Plan	2009 Actual	2010 ETAB Guidance	2010 Plan
RCP [[#] Proportional to science area budget reduction]	\$470			~\$390
Leveraged Support - Collaborative Totals:	\$11,750			~\$11,750
Influenced Totals:	\$11,640			~\$11,640

Science Area: Cross-Disciplinary Semiconductor Research
Director: Victor Zhirnov

MISSION

One of SRC's missions is to provide a strategic vision for the possible scenarios of both technologies and their applications in the longer term (e.g. 15 years from now). As a part of this effort, SRC launches exploratory research targeting long-term applications through CSR. CSR is a seed grant program to encourage out-of-the-box proposals to address technology and application challenges in semiconductor research. Successful proposals are funded at the level of \$40K on a gift basis for one year. Also, SRC conducts Fundamental Studies and associated Forums to provide an input to develop and implement CSR solicitations. The intent is that some of these funded projects will ultimately be continued through Science Area, Focus Center or Topical Research Consortia funding.

SUMMARY OF KEY OPERATIONAL CHANGES/ CHALLENGES

- Due to budget constraints, there will be no 2010 CSR solicitation. Fundamental studies will continue to be conducted

ONGOING KEY OPERATIONAL PRIORITIES

- Bioelectronics
- Semiconductor/Energy technology convergence
- Prospective Chip Architectures for low power

OPERATIONAL MILESTONES AND CHECKPOINTS FOR 2010

- 1Q10 Identify fundamental studies topics for 2010
- 2Q10 Launch fundamental studies
- 3Q10 Support bioelectronics TRC: work with A-STAR (Singapore) to determine their interest
- 4Q10 Complete fundamental studies

ONGOING KEY TECHNICAL RESEARCH FOR 2009 AND RELATIONSHIP TO THE SRC 2010-2014 STRATEGIC PLAN

- Materials that support novel devices
- Enabling design for ultra-high-speed devices
- Cyber-physical systems design
- Integrated on-chip energy sources: batteries and supercapacitors

TECHNICAL MILESTONES FOR 2010

- 1Q SRC/NSF/A-STAR Memory Forum Report complete
- 2Q ITRS ERD memory evaluation workshop
- 3Q Book on Nano-morphic Systems for Bioelectronics
- 4Q Support Special Issue of Proc. IEEE on nanoelectronics

SIGNIFICANT EVENTS SCHEDULED FOR 2010

- 2Q ITRS ERD memory evaluation workshop
- 2Q SRC Forum on PV Energy research needs (anticipated)
- 3Q SRC Forum on Low Power Electronics (anticipated)
- 3Q TECHCON (Sep 13–14)

RESOURCES (\$K)

CSR		2009 Planned	2009 Actual	2010 ETAB Thrust Guidance	2010 Planned
Core		500	500		50
RCP					
Leveraged	Collaborative (NSF matching of CSR)		396		
	Influenced (NSF Forum support)		66		

Section III

Other SRC Programs and Initiatives

Program Entity: Focus Center Research Program
Director: Betsy Weitzman

MISSION

- Long-term innovative research, utilizing breakthrough approaches, resulting in paradigm shifts, multiple options
- U.S.-based university research guided strategically by industry & government but managed by the university community
- Multi-university, multi-disciplinary, collaborative research highly leveraged with both industry and U.S. Department of Defense funding through DARPA
- Research focused on carrying CMOS to its ultimate limits while developing “hooks” to solutions beyond CMOS
- Access to highly trained university graduate students

DESCRIPTION

In order to pursue the FCRP mission, MARCO partners with the Defense Advanced Research Project Agency (DARPA) to ensure that funding from DARPA is contractually secured to support the FCRP university researchers. By agreement with DARPA, MARCO executes financial awards to the University Centers to conduct their research efforts. These awards include contributions from the semiconductor and defense industry sponsors to the Program. In 2009, DARPA fully matched the industry contributions to the FCRP, providing excellent leverage for the industry sponsors. The FCRP was fully re-competed in 2009, resulting in the creation of a new Center for Multi-Scale Systems Research, bringing the number of Focus Research Centers to six. These Centers will collectively support approx. 220 professors and 550 graduate students across 35 universities in 17 states. Each Center has a unique research focus, while the breadth of research across the six Centers addresses the full hierarchy of technology show-stoppers.

The resultant new set of Focus Research Centers, launched on November 1, 2009, is as follows:

- Multi-Scale Systems Research Center: Focuses on high-level systems design addressing distributed sense and control systems, large-scale and small-scale information technologies and applications.
- Gigascale Systems Research Center: Focuses on platform architectures, concurrent systems programming, platform viability, resilient systems and alternative computation models.
- Center for Circuit & Systems Solutions: Focuses on circuit/module infrastructure, enterprise systems, portable electronics, functional diversity and emerging circuits for post-CMOS.
- Interconnect Focus Center: Focuses on nanoscale electrical & optical interconnects; energy delivery and thermal management; wireless connectivity; and modeling, analysis and assessment of new connectivity solutions.
- Materials, Structures and Devices: Focuses on integration of new materials enabling CMOS extension; carbon-based devices; novel embedded memory; functional diversification; theory, modeling and simulation of new devices.

- Functional Engineered Nano-Architectonics: Focuses on novel materials and processes which enable fabrication of nanoscale devices and interconnects.

KEY STRATEGIES

- Continue aggressive recruitment activities to expand the FCRP through incremental industry funding.
 - The principle focus will on the defense industry community, along with systems applications and fabless companies.
- Support the Centers as they begin Phase V through consensus-based guidance from the FCRP Science Advisory Board (SAB).
- Coordinate with NRI, not only to ensure that the Programs remain synergistic, but to coordinate strategic planning in anticipation of the next phases of each research entity, with timing synchronized to 2012.

SUMMARY OF KEY CHANGES / CHALLENGES FOR 2010

- New MuSyC (Multi-scale Systems Center) Center added for Phase V to help attract new higher level systems sponsors including defense contractors
- Leadership changes in two Centers (GSRC and C2S2) - new Center directors
- Phase V plans call for more cross center coordination via cross-cut thrusts – monitor and facilitate
- Ensuring that funding availability from both DARPA and the industry sponsors to support Year One of FCRP Phase V will be a key challenge as the industry slowly emerges from the protracted economic downturn.
- Sponsor retention and recruitment of new industry members will also be extremely challenging for the same reason.

ONGOING KEY OPERATIONAL/TECHNICAL PROJECTS FOR 2010 AND RELATIONSHIP TO THE SRC 2010-2014 STRATEGIC PLAN

- Secure DARPA funding for Year 1, Phase V of the Focus Center Research Program
 - Initiate new three-year (annually renewable) Other Transactions Agreement with DARPA
 - Negotiate terms of the new OTA and execute the Agreement to secure funding for Year One, Phase V
- Successfully secure committed industry funding
- Recruit new FCRP sponsors from various industry segments
 - Particular focus on defense contractor, systems, and fabless companies
- Continue focus on retention of present sponsors: Increase Executive Visits to communicate new Phase V research offerings, specific program value
- Work with DARPA to consider implementation of program to reimburse industry assignees to Focus Centers, using overall Program funding
- Continue to coordinate with GRC, and NRI directors to monitor respective research portfolios to identify and control instances of potential overlap of research efforts as well as to identify opportunities for research transfers
 - Continue joint internal reviews of SRC-wide research portfolio to identify perceived areas of overlap which may require management going forward
 - Identify/coordinate/hold key topical workshop for GRC/FCRP/NRI participation (following earlier successful spintronics and graphene events)

- Identify/coordinate/hold SRC joint (GRC/FCRP/NRI) special topic forum
- Deliver timely payable milestone reports for release of DARPA funding
- Drive improved value delivery and extraction processes & tools for all sponsors
 - Encourage continuation of Center-initiated monthly e-Workshops, weekly e-Seminars (MSD), face-to-face inter- and intra-center workshops, etc. for both value delivery and extraction for sponsors, in addition to ongoing cross-center collaboration enhancement
 - Work with SRC IT to implement FCRP My Company webpage, incorporate identification/roles of FCRP “Associates”
- Continue to drive appropriate patent disclosure activity for value enhancement to the FCRP sponsors
- Work with the Focus Centers to increase early submissions of presentations / publications from all FCRP universities to FCRP web site for enhanced member value
- Continue to enhance sponsor visibility/access to FCRP students
 - Encourage high level participation of FCRP students in SRC TECHCON event, as well as through networking events held in conjunctions with Center Annual Reviews
- Continue to conduct annual FCRP sponsor surveys to gauge level of satisfaction with program
- Continue to focus on overall communications with FCRP sponsors to enhance Program awareness
 - Conduct at least three Governing Council meetings
 - Conduct bi-monthly meetings with full SAB participation
 - Conduct 1:1 monthly calls with SAB members
 - Send Quarterly Focus Center Highlights reports to all FCRP sponsors
 - Send monthly FCRP Newsletter to inform sponsors of upcoming events (sponsored by Focus Center or MARCO), featured pre-publications, notification of online Quarterly Focus Center Reports, etc.

OPERATIONAL MILESTONES AND CHECKPOINTS FOR 2010

- Payable Milestone Reports to DARPA (per OTA schedule throughout the year)
- Annual Focus Center Reviews per center schedules

SIGNIFICANT EVENTS SCHEDULED FOR 2010

- | | |
|-----------------|-----------------------------------------------|
| ● January 26-27 | FENA Center Annual Review, Los Angeles |
| ● May 5-6 | MSD Center Annual Review, MIT |
| ● Sep/Oct (tbd) | GSRC/MuSyC Centers Annual Review, UC Berkeley |
| ● October 4-6 | IFC/C2S2 Centers Annual Review, GaTech |

Program Entity: Nanoelectronics Research Initiative
Director: Jeffrey Welser

MISSION

NRI Mission: Demonstrate novel computing devices capable of replacing the CMOS FET as a logic switch in the 2020 timeframe.

- These devices should show significant advantage over ultimate FETs in power, performance, density, and/or cost to enable the semiconductor industry to extend the historical cost and performance trends for information technology.
- To meet these goals, NRI is focused primarily on research on devices utilizing new computational state variables beyond electronic charge. In addition, NRI is interested in new interconnect technologies and novel circuits and architectures, including non-equilibrium systems, for exploiting these devices, as well as improved nanoscale thermal management and novel materials and fabrication methods for these structures and circuits.
- Finally, it is desirable that these technologies be capable of integrating with CMOS, to allow exploitation of their potentially complementary functionality in heterogeneous systems and to enable a smooth transition to a new scaling path.

DESCRIPTION

In order to pursue its mission, the NRI is partnering with both federal agencies and state governments to sponsor research at U.S. universities, and is currently funding over 30 universities in 20 states. There are four main NRI multi-university centers, which are organized geographically, and a unique aspect of NRI is the large financial leverage for the industry funding coming from state governments. In addition to contributing millions of dollars in matching funds for research, the lead states in the four NRI centers have also invested hundreds of millions into new buildings and infrastructure to enable this next generation of research, including the New York Albany NanoTech Center, the California NanoSystems Institute, and the Notre Dame Innovation Park, as well as major support for recruiting and endowing new faculty for Nanoelectronics research in Texas. The National Institute of Standards and Technology (NIST) joined NRI in 2007, contributing funding directly to these four centers and participating as a full partner on the NRI technical and governing boards. There are also several joint projects between the NRI university PI's and the NIST labs, which leverage NIST's unique tools and capabilities.

While all of the centers are working on research aimed at finding a new logic switch, the focus of the programs at each center has its own specific character:

- Western Institute of Nanoelectronics (WIN), UCLA: Focuses solely on spintronics and related phenomena, including materials and device structures, for logic applications.
- Institute for Nanoelectronics Discovery and Exploration (INDEX): Focuses on a broad range of phenomena for logic, organized in centers of competency around excitonic, quantum-dot spin, magnetic, and graphene devices, with emphasis on fabrication and characterization.
- SouthWest Academy for Nanoelectronics (SWAN): Focuses on a large graphene program, which integrates projects on theory, material fabrication, device structures, and metrology, as well as work on magnetic materials, pseudospintronics, magnetic and multi-ferroic materials, and plasmonics.
- Midwest Institute for Nanoelectronics Discovery (MIND): Focuses on tunneling and non-equilibrium phenomena for energy efficient devices and architectures, as well as thermal phonon management.

In addition to the centers, NRI and the National Science Foundation (NSF) co-fund supplemental grants for NRI-related research at existing NSF nanoscience centers (Nanoscale Science and Engineering Centers (NSECs), Materials Research Science and Engineering Centers (MRSECs), and the Network for Computational Nanotechnology (NCN)). We are currently supporting 18 projects at 15 NSF centers, which range from advanced computer simulation of spin-based devices to measurements of non-equilibrium coherent transport in single-layer graphene sheets to directed self-assembly of quantum dot and wire structures for novel devices. The goal in making this joint investment is not only to complement the work going on in the NRI centers, but also to leverage the work in the NSF centers, with the NRI program gaining from the knowledge being created in the NSF center as a whole and the NSF centers gaining from the NRI industry involvement.

KEY STRATEGIES

- Position NRI to extend program in upcoming phases to narrow the search for the “next switch”
 - Phase 1 (present – YE2010): Complete benchmarking and define RFP for a two-year (“Phase 1.5”, 2011-2012) extension
 - Phase 1.5 (2011-2012): Same resources as Phase 1, narrowed onto a smaller set of device areas (~4-8). Insure extension focuses on collecting sufficient data on all aspects (materials through architecture) of the most promising device approaches, to provide a clear direction for Phase 2 to justify resource expansion
 - Phase 2 (Beyond 2012): Expand the effort / resources for prototyping proof-of-concept devices and circuits on the ~1-2 chosen devices
- Find partners (industry and government) to expand the resources of the program, particularly in preparation for Phase 2
- Coordinate with the FCRP, to insure the programs remain synergistic and to coordinate strategic directions, particularly in preparation for decisions on the next phases of each program in 2012

SUMMARY OF KEY CHANGES / CHALLENGES FOR 2010

- Complete the work to sign-on member companies for the NRI extension through 2012
- Primary technical focus: Making decisions on areas to pursue in extension through 2012
 - Benchmarking NRI research devices and concepts, including potential for general purpose and application-specific architectures
 - Consider opportunities for nearer-term impact of technologies as well
- Continue work on expanding Federal partnerships, with particular focus on partners for 2010 and beyond expansion
 - Continue NNI re-authorization efforts
 - Work on advancing the “Gov-Univ-Ind (GUI) Innovation Center” concept for NRI prototyping utilizing National lab facilities
 - Work with other SRC entities for integrated approach to DoD and other agencies for expanded partnerships

KEY TECHNICAL PRIORITIES FOR 2010 AND RELATIONSHIP TO THE SRC 2010-2014 STRATEGIC PLAN

- Complete benchmarking work on the NRI devices and architecture
- Identify most promising device areas (1-2 per NRI center) for focus in Phase 1.5 based on benchmarking
- Work with TPG to define new Phase 1.5 RFP for extending the NRI program through 2012
 - Consider the content of the new FCRP centers in the process
- Insure all centers have adequate vehicles for value delivery to sponsor companies:
 - Timely submission of publications and IP disclosures; semi-annual reports; and on-site annual reviews at all four NRI centers
 - Continuation of monthly NRI e-Workshop program

- Continue monthly e-Newsletter, with announcements of key events and direct links to all new publications
- Expand exposure to NRI students at TECHCON and through TechConnect events at selected NRI reviews and/or combined with other appropriate events (e.g. FCRP reviews)
- Utilize industry assignee teams at the centers for:
 - Assignee topical research summaries on all the major NRI research programs
 - Working on the device and circuit component “benchmarks”
 - Organizing intra- and inter-center projects
 - Assisting centers in identifying potential IP and projects that could have a nearer-term impact on technology, for highlighting to sponsors or other SRC programs
- Continue and expand partnership with NIST, including:
 - Timely delivery of semi-annual technical and financial reports to NIST
 - Participation in NIST internal conferences and reviews, as appropriate
 - Expand joint work between NRI centers and NIST labs
- Continue and expand partnership with NSF, including:
 - Continuing the NRI-NSF joint projects program
 - Maintain strong ties between all NRI-NSF centers and industry liaison teams, including on-site visits for each center
- Continue to work with the SIA PPC in their efforts to secure maximum funding for key NRI partners, including NSF and NIST, and potentially finding new partners for NRI
 - Work with newly formed NRI Observers’ Committee for new partnerships
- Work with GRC, FCRP directors to refine management processes to minimize redundancy and/or overlap between similar research areas across these research entities
- Conduct annual member survey of NRI sponsors, to accurately gauge program satisfaction
- Conduct annual review of all NRI projects in 4Q10

OPERATIONAL MILESTONES AND CHECKPOINTS FOR 2010

- 6/10 and 12/10 Center Semi-annual Reports
- 4/10 and 10/10 Assignee Topical Summary Updates
- 4/10 and 10/10 NRI Semi-annual Technical & Financial Reports to NIST
- 3Q10 Onsite Reviews for WIN/INDEX/SWAN/MIND
- 4Q10 NRI Annual Review

SIGNIFICANT SPECIAL EVENTS SCHEDULED FOR 2010

- NRI e-Workshop Series:

○ January 26	○ July 27
○ February 23	○ August 31
○ March 30	○ September 28
○ April 27	○ November 9
○ May 25	○ December 7
○ June 29	○ Additional dates as needed
- NSF-NRI Liaison Team visits to NSF centers: Throughout year
- Technical Program Group Meetings: Monthly on first Wednesday
- Governing Council Meetings: Bi-monthly on second Wednesday

- Onsite Reviews – 3Q10:
 - INDEX – September 22-23
 - MIND – August 10-11
 - SWAN – September 15-16
 - WIN – October 7-8
- NRI Annual Review – October 26-28

Area: Education Alliance
Director: Celia Merzbacher

OVERVIEW AND CURRENT STATUS

The Education Alliance supports programs aimed at attracting and supporting a diversity of high quality students in science, technology, engineering, and mathematics (STEM) fields relevant to SRC. Such programs provide member companies with access to students who are potential interns, coops, and employees and can serve as points of contact/entry for new SRC members.

In 2009, the SRC Undergraduate Research Opportunities (URO) program was launched with support from the Intel Foundation. Ginny Wiggins is managing the program as part of the Student Programs. The URO program aims to increase the number, quality, and diversity of STEM graduates with advanced degrees and who are eligible to work in the United States. The program currently involves 14 universities and is managed locally by on-campus program managers. The program supports hands-on research by undergraduates and also provides activities and support to assist students in selecting and applying to graduate schools. SRC plans to double the URO program (to \$1.5 million) within 3 years. Additional sponsors are being recruited from entities with a passion/mission to improve STEM higher education, including other member and non-member companies, foundations, government agencies, and individuals. A consultant has been retained to assist in establishing and implementing a strategy and in recruiting suitable board members.

It remains a goal of the Education Alliance to increase support through philanthropic and other donations/grants/etc. aimed explicitly at education. To grow support among the pool of SRC alumni, an SRC Alumni Association is being formed. Efforts to launch an expansion of the Alliance have been slowed by the economic environment, which for the first time has caused a decline in giving. As a result, some of the milestones for 2009 have slipped into 2010.

VALUE PROPOSITION TO MEMBERS

The URO provides access to a pool of motivated undergraduates with research experience who are strong candidates for Graduate Fellowships and as members of SRC-funded research teams. More broadly, participation in the URO leverages member company investment in/giving for STEM education and provides access to more students, more faculty researchers, and more universities than they can realize individually.

SCOPE

Various programs aimed at student education and training relevant to SRC's mission, including graduate, undergraduate, and—as funding becomes available—K-12.

FUNDING GOAL

The goal is to double the URO to \$1.5 million by 2012.

MILESTONES AND CHECKPOINTS FOR 2010

Education Alliance

- Q2: Recruit Board of Directors
- Q2: Hire Executive Director
- Q3: First meeting of Board of Directors

URO

- Q1: Interim report and proposal for 2010-2011 academic year to Intel Foundation
- Q1: Faculty Resource Center available to SRC-funded faculty as recruiting tool for graduate candidates
- Q3: URO proposals accepted/renewed for 2010-11 academic year
- Q3: URO students participate in TECHCON 2010

Area: Bioelectronics TRC
Director: Celia Merzbacher & Dan Herr

OVERVIEW AND CURRENT STATUS

Interest has been expressed by a number of member companies in a potential Topical Research Collaboration (TRC) in the area of Bioelectronics. With funding from the National Institute for Standards and Technology, a roundtable in late 2008 brought together technical experts from industry, academia, and government to identify areas in which advances in semiconductor electronics could have a high impact on bio/medical research and application development. A report released in February 2009 based on input from the roundtable participants identified priority application areas and related research needs. Outreach to biomedical device companies has been ongoing in 2009. In addition, A*STAR, an agency of the Singapore government that funds research and education, has expressed interest. The next steps are to work with all interested parties at high levels to get support for a TRC effort and at the program director level to further refine research priorities.

VALUE PROPOSITION TO MEMBERS

The SRC Board of Directors has approved the development of TRCs in areas that are related to SRC's current research portfolio and that are focused on "functional diversification". Biomedical research and devices are enabled by advances in semiconductor technology. Conversely, progress in biology has the potential to impact the semiconductor industry, for example, through implementation of biomimetic processes. Biomedical applications are becoming an important aspect of a number of SRC member companies, creating an opportunity for a collaborative effort that addresses basic technological research problems and involves new member companies from the biomedical industry.

TECHNICAL SCOPE

The specific technical areas that will be the subject of future research are diverse and yet to be determined. The range of topics can be grouped as follows:

- *Ex vivo* systems (e.g., tools for characterization of physical and chemical properties of biological materials)
 - Research needs: Sensors, data management, power, wet/dry interface, micro/nano-fluidics
- *In vivo* systems (e.g. implantable devices; neural-electronics interface/communication)
 - Research needs: Sensors, signal processing, power, biocompatibility, reliability
- Imaging
 - Sensors, probe materials (e.g. quantum dots); architecture (Moore's Law for imaging systems?)

FUNDING LEVELS

Funding will depend on the final scope and level of interest/commitment by new and existing members and Federal agencies.

SIGNIFICANT SPECIAL EVENTS SCHEDULED FOR 2009 (IF APPLICABLE)

- TBD—two stakeholder gatherings are envisioned. One aimed at getting buy-in at high levels and one to prioritize research topics.

Area: Alternative Energy TRC
Director: Steve Hillenius & Bob Havemann

OVERVIEW AND CURRENT STATUS

Several SRC member companies have expressed interest in a Topical Research Collaboration (TRC) in the area of Alternative Energy. In response to this member interest, a legal entity—The Energy Research Corporation (TERC)—was formed to provide a business framework for the new consortium and recruiting of potential members was initiated. Discussions were also initiated with the DOE to explore opportunities for leveraged funding, and the DOE is currently considering financial support of a consortium approach to research and development that would enhance the competitiveness of the U.S. based photovoltaic (PV) industry. Ultimately, the energy TRC will comprise several multi-university Centers, each with its own research focus and area of expertise, but coordinated so as to leverage each other with complimentary programs. The initial Center will focus on modeling and simulation of photovoltaics, and will be established at Purdue University in order to leverage the existing infrastructure of the NSF-supported Network for Computational Nanotechnology (NCN). The new consortium is expected to launch by the end of November with Applied Materials and First Solar as the founding members. Numerous other companies have expressed strong interest in the new consortium, and recruiting new members is an ongoing focus.

VALUE PROPOSITION TO MEMBERS

The SRC Board of Directors has approved the development of TRCs in areas that are related to SRC's current research portfolio and that are focused on "functional diversification". Alternative energy approaches, ranging from photovoltaics and solar systems to smart grids and green servers, will be enabled by advances in semiconductor technology and provide significant opportunities for future growth of the semiconductor industry. Several SRC member companies are already actively involved in alternative energy research and development, and a collaborative effort that incorporates new member companies from the alternative energy arena would provide the synergism that will be required to solve the challenging technological problem of meeting future energy needs.

TECHNICAL SCOPE

While the ultimate goal of this TRC is to address a broad range of research needs in the area of alternative energy, the TRC will initially focus on solar-powered systems, starting with the modeling and simulation of technologies and energy production systems related to photovoltaics. Specific deliverables include:

- Simulation tools that support research, design, manufacturing and reliability of photovoltaic technologies and systems)
- A broad conceptual and computational framework capable of treating a wide range of photovoltaic materials, devices and systems
- Computational methods and algorithms and open-source software
- Relevantly educated graduates with the expertise and skills to transition these new methods into industry

FUNDING LEVELS

Funding will depend on the final scope and level of interest/commitment by new and existing members and Federal agencies.

SIGNIFICANT EVENTS SCHEDULED FOR 2010

- TBD—Forum on Photovoltaics: PV Market Drivers, PV Systems & Cell Technologies
- TBD—Workshop on PV research needs & technology requirements

Area: TRC on NINE
Director: Steven Hillenius and Chris Daverse

OVERVIEW AND CURRENT STATUS

The National Institute of Nano-Engineering (NINE) program is collaboration among industry participants, Sandia National Laboratories and the Department of Energy and engaging university students and researchers. SRC has formed a separate program entity called the National Institute for Nanoengineering Company (NINECO), which will be the contractual organization that manages the industry, DOE, and University contracts for the NINE program collaboration. Current industry participants include Intel, ExxonMobil, and Goodyear. First full meeting of provisional Governing Council was held November 12, 2009.

Four new projects were started this year:

- Responsive Nanocomposites
- Integration of Block-Copolymer with Nanoimprint Lithography
- Scalable Assembly of Patterned Ordered Functional Micelle Arrays
- Enabling Self-Powered Ferroelectric Nano-Sensors

VALUE PROPOSITION TO MEMBERS

The access to the Sandia's Microsystems and Engineering Sciences Applications (MESA) facilities, including research clean rooms, and Sandia's high performance computational research facilities would complement the GRC, FCRP and NRI programs. As envisioned, the NINE program will build upon the unique resources available at Sandia to address nano-engineering challenges of interest to industry and to Sandia. The program will develop a pipeline for a skilled workforce to help meet laboratory and industry personnel needs in the future.

SCOPE

Possible topics for research that have been suggested by the current set of interested industry advisors are:

- Nanoscale Modeling, Simulation, Code Validation
- Self-assembly and Surface Functionality
- Soft Nanomaterials, Nano-composites, and Interfaces
- Micro-Nano Sensors & Actuators for Use in Extreme Environ. & Process Control
- Characterization of Nanomaterials
- Nano-catalysis, Sunshine to Petrol
- Electronics and Optoelectronics of Nanowires, Nanotubes, & Patterned Material
- Nanoscale Electrochemistry for Energy and Energy Storage
- Nanocrystalline Bulk and Thin Film Materials: Experiment and Modeling
- Micro and Nano Photonics, Quantum Information Processing

FUNDING LEVELS

Approximately \$12M over three years \$4.7M DOE, \$6.6M Sandia, \$100k/year each industry participant

SIGNIFICANT EVENTS SCHEDULED FOR 2010

The NINE Program is seeking to launch one more project this year with its available funding and that the project is likely to be energy focused. We are actively soliciting new members.

Section IV

SRC Supporting Operations

Area: Value Infrastructure Management
Manager: Michael D. Connelly

MISSION

The mission of SRC's Value Infrastructure Management group is to enable SRC to optimally serve and collaborate within the full SRC community of sponsors, member company personnel, government participants, researchers, and students. By integrating SRC's Value Management, Student Programs and Information Systems efforts, SRC is able to establish efficient business processes, a robust and scalable technology infrastructure, and targeted value management and delivery mechanisms that identify, manage, promote and deliver research and programmatic information across all SRC programs and initiatives.

SUMMARY OF KEY CHANGES

- Integration of new capabilities & opportunities within the expanded architecture of SRC's soon-to-be-released Next Generation Website
- Increased focus on marketing and communication efforts integrating all media platforms
- A focus on improvements in the efficiency and effectiveness of Value Management operations
- Support of the new URO Program under the purview of the SRC Education Alliance

PRIORITIES FOR 2010 AND RELATIONSHIP TO THE SRC 2010-2014 STRATEGIC PLAN

- Final development, testing and deployment of SRC's Next Generation Website
- Communication and support initiatives to ensure a smooth transition to the new Website
- Participation in Value Chain TAB initiatives and direction
- Improvements and cost efficiencies in internal value management processes, products and support across all SRC program entities
- Integration of new and improved Web applications to facilitate online data collection and improvements in content awareness, personalization and delivery
- Continued support and coordination of Student Programs and SRC Education Alliance initiatives to facilitate program growth and expansion
- Promote the effectiveness and best practices of the GRC Liaison program
- Continued focus on utilization and effectiveness of e-Meeting technologies

- Enhance solicitation for the Technical Excellence Award to recognize researchers that have significantly enhanced productivity/competitiveness of the semiconductor industry
- Coordinate marketing and communication efforts to better leverage SRC's new Website

MILESTONES AND CHECKPOINTS FOR 2010

- 1Q10 Final development, beta testing and release of SRC's Next Generation Website
- 2Q10 Integration of new and improved Web applications within SRC's new Website
- 2Q10 Corporate Annual Report
- 3Q10 TECHCON 2010
- 3Q10 Member Satisfaction Survey

SIGNIFICANT EVENTS SCHEDULED FOR 2010

- Release of SRC's Next Generation Web site in 1Q2010
- TECHCON 2010

Area: Student Programs
Manager: Virginia Wiggins

MISSION

The mission for Student Programs is to work in a strategic partnership with all SRC entity members/sponsors, faculty and students to ensure the quality and flow of relevantly-educated students for internships and regular full-time hire by the various memberships.

SUMMARY OF KEY CHANGES

- Define a plan to facilitate cooperative management of student programs between the current SRC Student Programs and the SRC Education Alliance
- Implement and improve web functions relating to student information for Web NextGen, including providing all student information in one place on the SRC website.

PRIORITIES FOR 2010 AND RELATIONSHIP TO THE SRC 2010-2014 STRATEGIC PLAN

- Establish centralized and streamlined availability of student information across all SRC programs for ease of access by all member organizations (resumes, Graduate Student Directory, events, etc.) in the implementation of SRC's Next Generation Website
- Work with member organizations toward the hiring of a greater percentage of SRC graduates in the member organizations (PRTW/diversity issues, recruiting events, etc)
- Work toward a greater involvement of staffing organizations with SRC student programs
- Recognize excellent teachers within the SRC community through the 2010 Aristotle Award, including all entities in this process
- Explore options to move the Fellowship and Scholarship Programs to Alliance management and expand to all SRC entities
- Implement a marketing plan for SRC students and student programs within the memberships and the universities; reassess the student programs brochure
- Coordinate TECHCON 2010

MILESTONES AND CHECKPOINTS FOR 2010

- 1Q – Conclude the tenth Simon Karecki Award process.
- 2Q – Coordinate the 2010 Aristotle Award process
- 2Q – Award 2010-2011 Fellowships and Scholarships
- 3Q – Coordinate TECHCON 2010
- 3Q – Publish and distribute marketing material, e.g., student programs brochure
- 3Q - Move Fellowships and Scholarships to SRCEA management if appropriate
- 1-4Q – Continue to improve methods of gathering and disseminating student information, e.g., web (resume builder, etc) recruiting events, etc.
-

SIGNIFICANT EVENTS SCHEDULED FOR 2010

- Jan 26 Networking at FCRP FENA Review
- Apr 17 GRC TechConnect ICSS Systems Review, CMU
- May 5 Networking Event at FCRP MSD Review
- Sep 27 Networking Event at FCRP GSRC/MuSyC Reviews (tentative)
- Oct 5 Networking Event at FCRP IFC/C2S2 Reviews (tentative)
- Nov 9 GRC TechConnect NMS Patterning Rev, U. Mass (tentative)
- Sep 13-14 TECHCON 2010

Area: Contracts & Intellectual Properties
Manager: Michael C. Phillips

MISSION

To serve as the first line of counsel and legal support for SRC legal matters, including research contract administration, intellectual property asset management, globalization, inter-consortial relations, and legal and export compliance for SRC, GRC, FCRP, NRI, TRC's and EA.

The Contracts and Intellectual Property Department is charged with negotiating and executing over 292 sponsored research agreements, amendments and grants each year. Over 132 invention disclosures are processed, including technical evaluations from Research Operations. Patent applications are filed where potential Member benefit is identified. Ongoing prosecution is managed daily to obtain the maximum claim coverage.

SUMMARY OF KEY CHANGES

- Continue migrating universities to the revised Sponsored Research Agreement.
- Facilitate and educate end-users on blocking background intellectual property issues; enforce a unified approach to BIP for all sponsored research.
- Revise the IP Value Model to create an enhanced tool for evaluation of invention disclosures; further develop and involve the IP Advisory Board on filing decisions. Conduct informational sessions with Research Ops in the IP evaluation and decision process.
- Achieve linking of the TED database with contract/IP files.
- Restructure the departmental server drive to enhance document and storage capability.
- Continue implementing a paperless environment enhancing document control and costs.
- Maintain a rigorous review of IP invoices to identify cost savings relative to patent prosecution costs.

PRIORITIES FOR 2010 AND RELATIONSHIP TO THE SRC 2010-2014 STRATEGIC PLAN

- Maintain the high standards of support for the establishment and expansion of research programs, including research in export-controlled countries.
- Ensure export control procedures remain in compliance with the increasingly restrictive U.S. export control restrictions.
- Support the entry and assimilation of new U.S. and foreign SRC Member companies to include new government agencies, such as NIST and Sandia.
- Expand proactive involvement with universities, SRC personnel, and Members to reduce BIP on research projects.
- Continue enhancing the IP Filing decision and communicating processes.
- Continue the selection of patent law firms with policies, procedures, and fee structures favorable to SRC.

MILESTONES AND CHECKPOINTS FOR 2010

- Q2 Reevaluation of IP Advisory Board changes and effectiveness

- Q3 CIP at 75% paperless for prospective activities
- Q4 Targets for cost containment comparable to budget and budget trends

SIGNIFICANT SPECIAL EVENTS SCHEDULED FOR 2010

- Annual export control seminar.
- Periodic educational sessions with Contract Monitors to discuss IP issues and procedures.