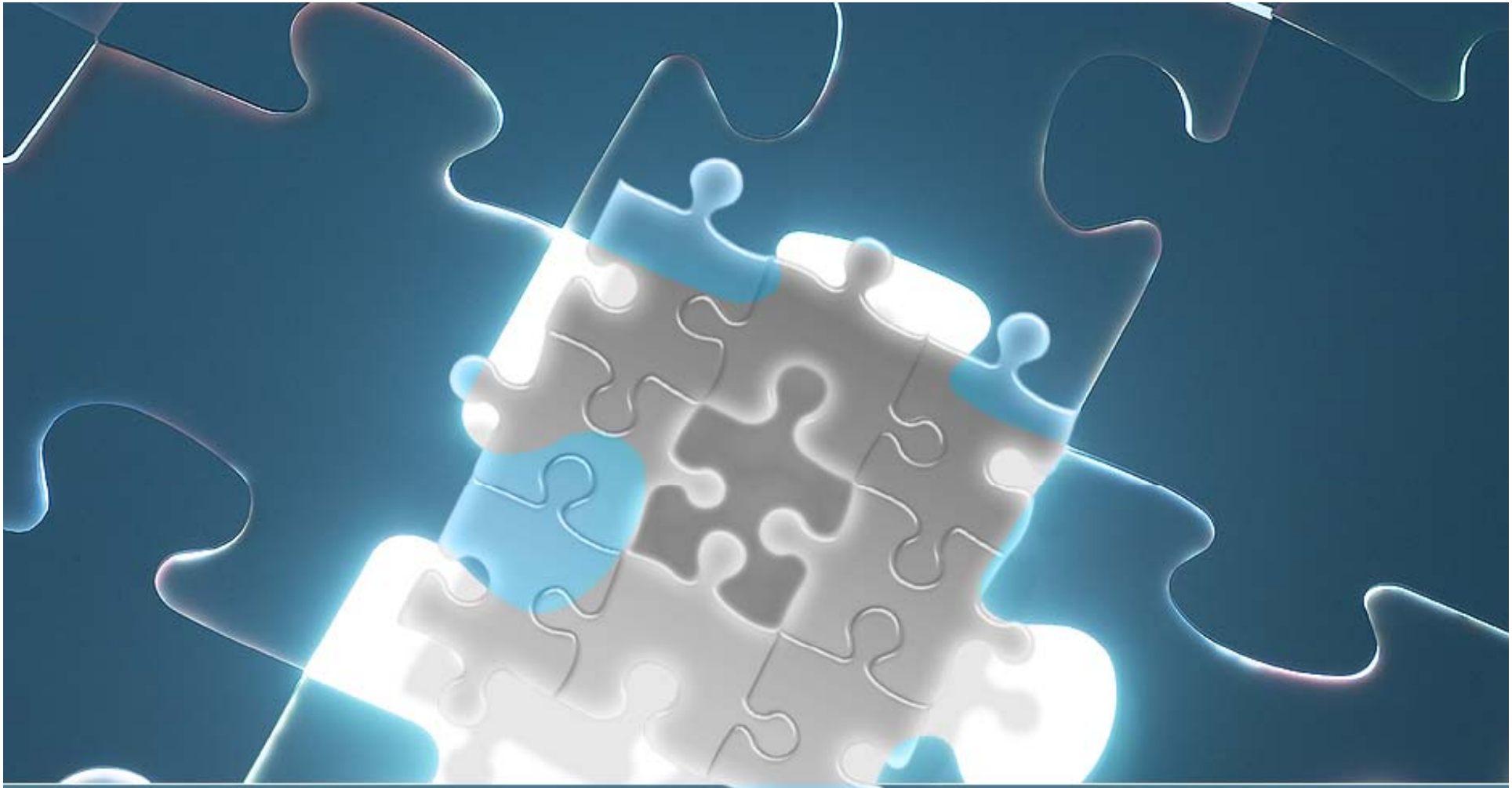

University-Industry-Government Partnerships
A Canadian Perspective

Hausi A. Müller, University of Victoria

Objectives

- The role of NSERC's funding models
  - National Sciences and Engineering Research Council
- The role of industrial research centers
  - IBM CAS, CA Labs, SAP Business Objects ARC
- The role of CEAB Accredited SE degree programs
  - Canadian Engineering Accreditation Board
- CSER as a case study
  - Consortium for Software Engineering Research

It's all about Highly Qualified Personnel (HQP)

My Background

- **UVic**
  - At UVic since 1986
  - Founding Director of Bachelor of Software Engineering program 2003-07
  - SE program Accreditation 2007
  - Over 50 graduate students supervised
- **Industry-University Collaboration**
  - Over 20 years experience
  - IBM, SEI, CA, NRC, Business Objects, klocwork, Nortel, ...
- **IBM CAS**
  - Sabbatical Toronto Lab 92/93
  - Worked with CAS ever since
  - 2006 IBM CAS Toronto Faculty Fellow of the Year Award
- **NSERC**
  - CRD Grants since 1993
  - Served on NSERC committees Discovery, Equipment (Chair), Strategic (Chair), ACUIG (Advisory Committee for University Industry Grants)
- **CSER**
  - 1996 CSER—Consortium for Software Engineering Research was founded
  - Chair of CSER Technical Steering Committee for the past 10 years
  - 2000 NSERC Leo Derikx Synergy Award for CSER
  - 2006 CSER Outstanding Leadership Award

Motivation from work at ABB before Grad School

NSERC

National Sciences and Engineering Research Council

- Discovery Grants
  - Every researcher; success rate (SR): 80%; international review in 2008
- Strategic Grants
  - Only industrial in-kind required; SR: 15-30%
- Collaborative Research & Development Grants (CRD)
  - Industrial cash & in-kind required; up to 2:1 matching; SR: 75-85%
- Industrial Research Chairs
  - Industrial cash & in-kind required; 1:1 matching; SR: 75-85%
- Networks of Centers for Excellence (NCE)
- Mini NCEs (e.g., CSER)
- Business-led NCEs (new initiative)
  - Industrial cash & in-kind required; up to 2:1 matching; SR: 75-85%
- Incubation grants

NSF of Canada

Software Engineering Degree Programs

- Industry demands Engineering SE degrees
- Canada has a high concentration of accredited SE programs
  - Calgary, Carleton, Concordia, Lakehead, McGill, McMaster, New Brunswick, Ottawa, Victoria, Waterloo, Western Ontario
- Programs are typically offered as joint programs between CS and ECE
- Many more SE options and specializations in CS

Success in numbers: ICSE 2008 in Leipzig had 80 participants from Canada; 268 from Germany; 209 from USA

Grand Challenge for CS

- Teach engineering design and trade-off analysis with cost and quality criteria
  - Teaches many transferable and qualitative skills
  - Will apply 30 years down the road
  - Produces generalists with analytical reasoning skills
  - More fun because you see how things work together
  - Instills self-confidence and passionate leadership

Experience in Collaborating with Industry

- What is the value it brings to my institution?
  - Funding for graduate students
  - Access to architecture and development experts
  - Access to industrial problems, methods and tools
  - Testbeds & scenarios for evaluation
  - Consulting opportunities for PIs; 12 month-salaries in Canada
- How did it come about?
  - Industrial and academic partners recognizing the value
  - Government: NSERC NCSe
  - Industry: IBM CAS, CA Labs, SAP Business Objects ARC, GM, MS
  - University: encouraged more and more
  - Personal: Spent 1992/93 at IBM Toronto CAS
- What is unique about it?
  - NSERC funding model: Strategic, CRD grants
  - NCEs, CSER
  - Engineering SE degree programs
  - Coop programs

Experience in Collaborating with Industry

- What aspects of collaboration does your collaboration cover?
  - It's all about HQP
  - More well rounded CS education—covers engineering aspects
  - PhD students are introduced to industrial partnerships
  - Bidirectional relationships: industry ⇐⇒ university
- How do we handle IP created by collaboration?
  - Depending on university: owned by university or by researcher
  - CAS agreement, CA agreement, GM agreement, ARC agreement
  - Ideally one agreement that works for all (e.g., CSER)
- How does it relate to financial support from public funds?
  - Every industrial $ is matched by NSERC at least 1:1 up to 2:1
  - NSERC is directly involved

It's all about Highly Qualified Personnel (HQP)

CSER

Consortium for Software Engineering Research

- Mandate and model
- Funding model
- Organization and synergy
- Benefits and success stories
- Lessons learned

CSER Mandate

- CSER helps Canada to capitalize on its strengths in the software industry and contributes to the growth in the software and information technology sectors of the Canadian economy through research, technology development and education
- The initial mandate included research and education—now just research
- CSER research focuses on processes, methods, techniques and tools for creating, maintaining, and evolving software products and applications.

CSER Model

- Industry-driven
- Pre-competitive research
- Several research groups working on the same or similar problems semi-competitively with the same company or different companies
- Mini Centre of Excellence

Without IBM CAS, there would be no CSER

CSER Community

- Industrial partners
  - CA Inc. (formerly Computer Associates), IBM Toronto, IBM Ottawa, IBM Victoria, Nortel, Mitel, Bell Canada, Sun, OTI (now IBM), Rational (now IBM), Klocwork Solutions, RIM, SAP Business Objects, SMEs in Calgary, Ottawa and Victoria
- Universities
  - Alberta, Calgary, École Polytechnique de Montréal, École de technologie supérieure, Manitoba, Ottawa, Queen's, Toronto, York, UBC, Victoria, Waterloo, Western
- Government
  - NSERC, NRC, SEI

Approximately 70-90 people attend the semi-annual CSER Meetings

CSER Funding Model

- Evolved over time (1996 – present)
- Phase I (Years 1-6)
  - 10 projects funded by NSERC as one large project
  - NSERC CAP (Cooperative Activities program) Grant for Administrative Support
  - Significant admin support from NRC staff
- Phase II (Years 7-9)
  - A set of NSERC CRD projects
  - NSERC CAP (Cooperative Activities program) Grant for Administrative Support
  - Some admin support from NRC staff
- Phase III (Years 10-present)
  - A set of NSERC CRD projects
  - Some admin support from NRC staff
  - Charging conference fees at semi-annual CSER meetings

Accountability requirements increase every year

NSERC CRD Grants

- Initial project funding model
  - $50K (or more) industrial cash
  - $200K in-kind contribution from industry
  - $100K NSERC contribution—2:1
- Current funding model
  - $50K (or more) industrial cash
  - $50-100K in-kind contribution from industry
  - $50-75K NSERC contribution—1.5:1

Get NSERC Officers involved from Day 1

Role of Industrial Members

- Pivotal role
- Cash and in-kind contributions
- Provide research topics, problems and directions
- Industrial staff monitor and participate in the research activities
- Many co-authored papers between academics and industrial participants
- Strong involvement of management and technical staff
- Availability of developers, processes, industrial environments, tools and source code

CSER is industry-driven

Synergy among University, Industry and Government Participants

- Just as NCEs, CSER has been very successful in bringing together researchers that would not have formed relationships otherwise
- Working together on common case studies has produced solutions that are envied in the international research community

2000 NSERC Leo Derikx Synergy Award

Benefits

- CSER is highly regarded and recognized in the international SE research community
- Creation of synergy between multi-company and multi-university research à la NSERC Networks of Centres for Excellence (NCE)
- Much smaller than a typical NCE; PIs, students and industrial participants all know each other
- Being able to attack several aspects of a problem in parallel
- Working together on common problems brings out better solutions

Multi-university multi-project, multi company synergy

Benefits

- Because CSER research focuses on the processes, by which products are built and supported, and not necessarily on the products themselves, companies can collaborate on this kind of research not just in the pre-competitive stage, but even while the products are being marketed.
- Method and process improvement make companies more competitive through higher productivity, reduced time-to-market, better quality, more accurate prediction for planning, reduced unit costs, and longer life times.

Lessons Learned

- 12 years and counting ... is a very long time for a valuable and fragile research organization to survive
- Building and consolidating an organization of dissimilar and competing members requires
  - Significant time and energy
  - Deep understanding of the forces at work
  - Staying power and patience

CSER is fragile and requires a lot of nurturing

Lessons Learned
Graduate Students or HQP

- 40-70 students at any one time in CSER
- Over 500 grad students in total so far
- CSER encourages students to fully participate by sharing their ideas, knowledge and expertise
- Get multiple perspectives from CSER PIs
- Move from within CSER from MSc to PhD
- CSER PhD students become CSER PIs
- Excellent mentoring for young PIs

Central to the organization

Lessons Learned
Trust and Openness

- Building trust and understanding among the participants of CSER was a necessary but slow process
- Trust is not developed between Company A and University Y, but between an *individual at* Company A and an *individual at* University Y
- Appreciate each other's agendas

Building trust is an incremental process

Lessons Learned
Leadership of Key Individuals

- The success of CSER stems directly from the involvement of its participants
- Without the leadership shown by key individuals among the participants (academia and industry), who continually drive the organization, the necessary interaction and trust would not have been achieved

Lessons Learned Management Effort

- Research Director and Chair of the Technical Steering Committee invest enormous time and energy
- Very difficult to raise funds for an Operations Manager beyond initial years
- Current funding models cannot accommodate long term projects

Easily underestimated

Lessons Learned
Regular Meetings

- The semi-annual meetings of CSER PIs, their students and industrial partners are the foundation of CSER
- Played a significant role in the consolidation of the Consortium
- Expose all members to problems faced by the participants; multiple perspectives
- Alliances are formed and solutions emerge
- PhD students establish many connections they can exploit later on as PIs

Final Thoughts

- Turn over in industry is much faster than in academia; continuity is critical
- Need a good mix of catalysts and pure researchers
- Academic folks you recruit first for such a consortium may stick around for 20 years ☺
- Loyalty should be highly regarded, appreciated and rewarded because academics who commit to a company take a major risk for their career

Catalysts are the key to success