A Personal Perspective on Industry-Research Collaborations
…and What Makes Them Work (or Not)

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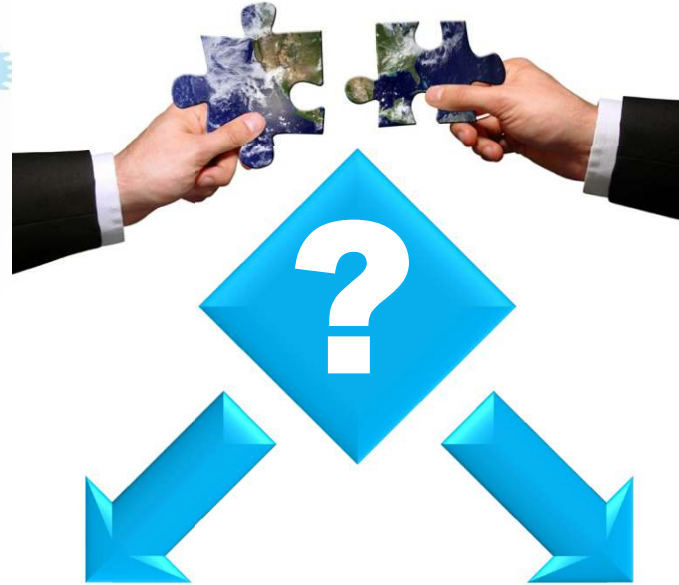selic@acm.org

Industry-Research Projects: Key Question

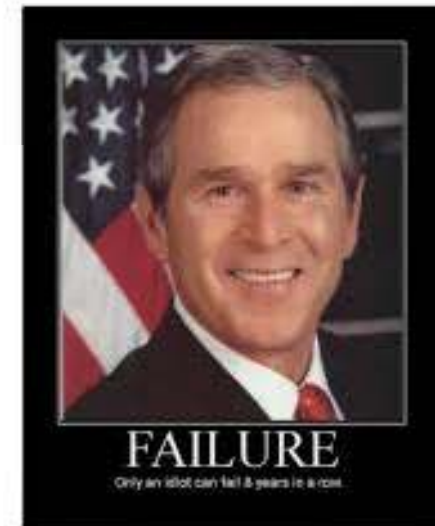**3.FUNDING AGENCY**

1.INDUSTRY

2.RESEARCH

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GREAT SUCCESS

Q: What makes an industry-research collaboration projects successful?

FAILURE
Only an idiot can fail 8 years in a row.

Who Am I to Talk About This?

- ◆ **Varied career but mostly in industry**
  - ▪ 40+ years in software engineering in private enterprises and research institutes
  - ▪ Some academic experience (teaching, course design, research: U. of Sydney, U of Toronto, Carleton U., INSA Lyon, U. of Ottawa)

- ◆ **Directly participated in and/or initiated over a dozen such projects in both North America and Europe**
  - ▪ Successful ones and those that were less so

- ◆ **Invited reviewer of numerous national and international research collaboration proposals**

- ◆ **Member of Board of Directors of several government-run research funding agencies**
  - ▪ Telecommunications Research Institute of Ontario (TRIO), Communications and Information Technology Ontario (CITO), Ontario Centres of Excellence (OCE)

- ◆ **Member of university Industrial Advisory Boards**
  - ▪ U. of Ottawa (SITE), Carleton U. (SCS)

THE RATIONALE BEHIND INDUSTRY-RESEARCH COLLABORATIONS

Motivations: Industrial Partner

- **Fixing specific point problems not obviously solvable by current practices and/or technologies**
  - Typically short-term projects (1-3 years)
- **General improvements in _productivity_ and/or product _quality_ ("_making better things in a better way_")**
  - Longer-term relationships (multiple related point projects)
  - Often involve a greater "vision" of future technical direction
- **Identifying new technical/product opportunities**
- **Knowledge transfer: Gaining a systematic and comprehensive understanding of the problem and solution spaces**
- **Access to government funding and/or potential tax breaks**
- **PR: Demonstrating technical leadership**
- **Access to potential highly-qualified hires (from research)**

Motivations: Funding Agencies

- ◆ **Typically government agencies**
  - ▪ Vast majority of funding dedicated to industrially-oriented research => _seeking industrial impact_

- ◆ **Economic benefits gained from advanced technologies and methods**
  - ▪ E.g.: new jobs, spinoffs

- ◆ **Ensuring local industry remains competitive**

- ◆ **Training of highly-qualified personnel**
  - ◆ PhD, MSc, postdoc

Motivations: Research Partner

- **Increasing potential for _funding_**

  - i.e., making funders happy

- **Solving _challenging problems_ and advancing the state of the art**

- **Boosting institutional/personal _scientific reputation_**

- **Making an _impact_ on industry/society**

  - Research results used in practice

- **_Patents_**

- **Training of _highly-qualified personnel_**

  - And access to them as potential future hires

Types of Research Institutions

Types of Research Institutions

- ◆ **Corporate research groups**
  - ▪ Internally funded (e.g., IBM, Microsoft, Google)
  - ▪ Often disconnected – culturally and technically – from corporate mainstream ("ivory tower" syndrome)
  - ▪ No IP issues, but, tend to be expensive and difficult to control

- ◆ **Academia**
  - ▪ Primarily motivated by publication record; less by impact
  - ▪ Not easily (re)directed to customer problem

- ◆ **Research institutes**
  - ▪ Typically externally (usually government) funded
  - ▪ Evaluated based on publication record *and industrial impact*
  - ▪ Tend to be more customer (i.e., partner) driven

ON THE EFFECTIVENESS OF INDUSTRY-RESEARCH COLLABORATION PROJECTS

Q: What Constitutes Success?

FUNDING AGENCY

INDUSTRY

RESEARCH

9REA7 SUCCESS

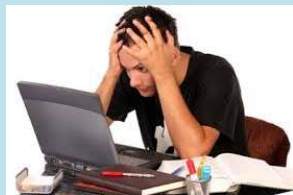A: Only if the expectations of <u>all parties</u> are adequately met

The Key Ingredients to Project Success

INDUSTRY

- Problem
- Domain expertise
- Resources
- Ideas
- Project funding
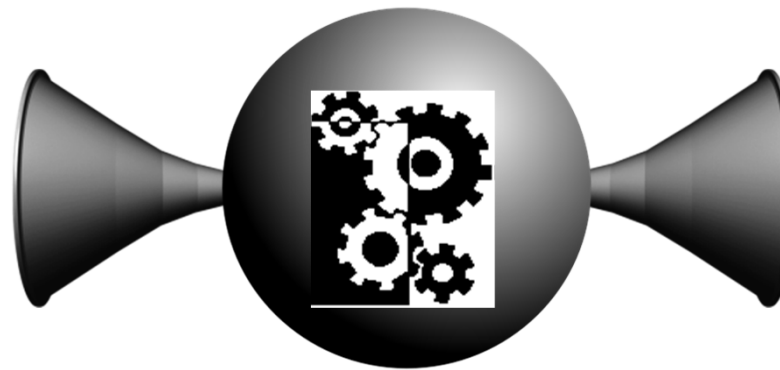
RESEARCH

- Resources
- Ideas
- Proofs of concept
- Expertise

FUNDING AGENCY

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PROJECT

GREAT SUCCESS

No surprise: A "critical mass" of each key ingredient is required for the project to succeed
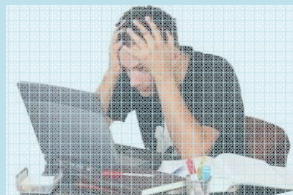
Key Ingredient: The Project Team

INDUSTRY

- Problem
- Domain expertise
- Resources
- Ideas
- Project funding

RESEARCH

- Resources
- Ideas
- Proofs of concept
- Expertise

- **A partnership of equals**
  - "Arm's length" arrangements rarely work out
  - Equally significant but *complementary* roles (no partner has monopoly on good ideas)
  - Shared problem and solution
  - Majority of effort by research partner
  - But, continuous and pro-active engagement by industry partner is crucial

The Criticality of Industry Engagement

◆ **A *must-have* ingredient**

  ▪ Clear statement of expectations (i.e., success criteria)

  ▪ Ensuring that research focuses on the right problems

  ▪ Joint development of proposed solution

  ▪ Minimal IP hurdles; clear NDA arrangements necessary

  ▪ Continuous and direct engagement of key experts throughout the project (ideas, domain expertise, evaluation, feedback)

  ▪ Full follow-through on declared time commitments

◆ **Despite the best of intentions, this is often the most problematic aspect of the collaboration**

  ▪ Particularly if industry partner is a commercial enterprise

  ▪ Much more pronounced in larger commercial enterprises (vs. SMEs and government institutions)

The Research vs Short-Term Profit Conundrum

♦ **Commercial enterprises, especially publically-traded ones, face strong market pressures to meet <u>quarterly</u> market projections**

- Primary focus on short-term results

- Most and best resources dedicated to production

- It is difficult to "prove" the value of research

- Manager's dilemma: *"Do I sacrifice my project (and my bonus) in favor of something that <u>might</u> may benefit the company in the future?"*
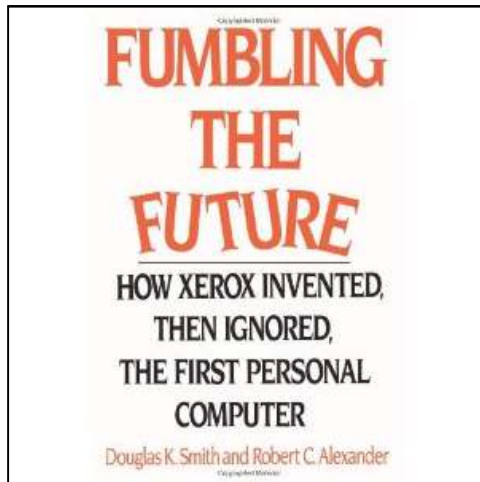
An Instructive Case Study

Current Market Capitalization: ~$13B
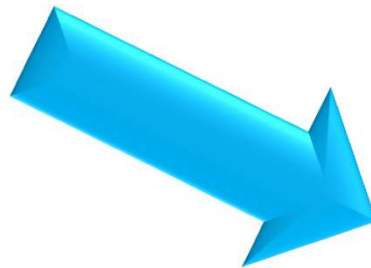
**Current Market Capitalization: ~$470B**

Overcoming Corporate Impedance

- ◆ **Skunkwork" strategies are rarely adequate**
  - ▪ Forgiveness vs. permission approach
  - ▪ Possible "foot-in-door" strategy, but, easily detected and intercepted

- ◆ **Need <u>strong internal champions</u> who:**
  - ▪ Understand and believe in the need for the research (<u>*vision*</u>)
  - ▪ Have <u>*necessary corporate leverage*</u> to commit and protect resources allocated to research from inevitable corporate pressure
  - ▪ Are persistent in their vision
  - ▪ Follow project progress and are keen to see the results

- ◆ **More difficult to achieve in larger enterprises due to greater dilution of managerial responsibilities**

Increasing the Likelihood of Success

◆ **Important for project team to _demonstrate value early and consistently_**

  ▪ Establish clear _objectives_ and corresponding _measurement criteria_

  ▪ Build _working prototypes_ as early as possible and evolve throughout the duration of the project

  ▪ _Managed_ agile (e.g., scrum-like) process:

    • As much as possible, maintain a regular cycle (e.g., "sprint")

    • Continuously _record and measure_ results and compare against objectives

    • Identify potential improvements and any necessary changes of focus

    • Discuss results and opportunities with potential user base to solicit feedback, maintain interest, and establish a sense of "ownership" of the problem and the solution within the enterprise

◆ **Don't be shy: _advertise early successes_ to management and colleagues**

The Importance of Working Prototypes
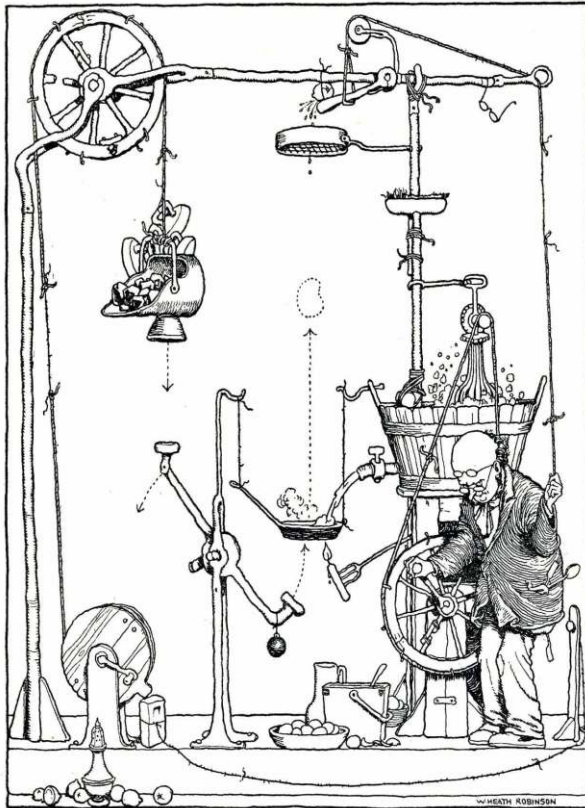
- ◆ Proof of concept
- ◆ Foster understanding and credibility: "Seeing is believing"
- ◆ Confidence and intuition boosters
- ◆ Useful for timely and agile feedback
- ◆ Guide for productized version
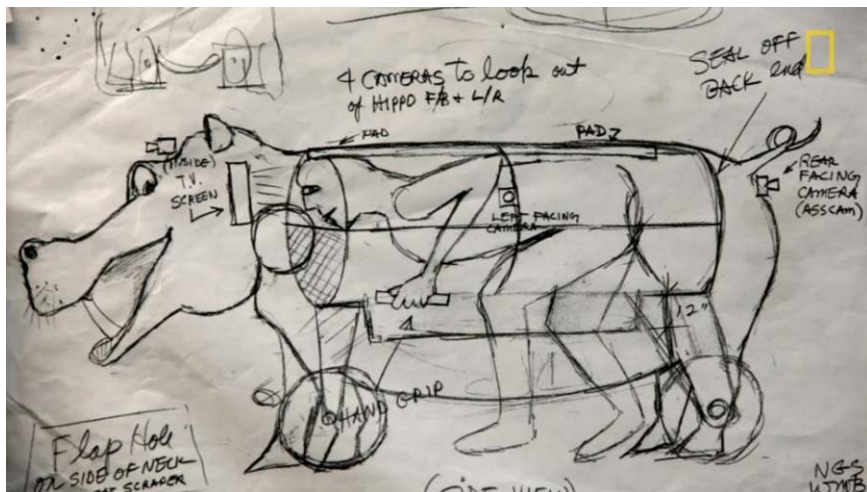
WARNING: do not confuse the prototype with a productized version

Productization

◆ **It is often inappropriate to evolve a working prototype into a product**

- Too many architecturally significant elements omitted during prototype development (e.g., usability, scalability, robustness, integration with other tools)

- Prototype is a learning tool; likely needs re-architecting

◆ **Who should do it?**

- Depends on the product, but…

- Productization typically requires significant time and resources and relies on skills that rarely qualify as "research"

⇒ Ideally, done by a specialized commercial enterprise (e.g., tool vendor, spinoff) in collaboration with the project team

Conclusions

- **The opportunities provided by industrially-oriented research collaborations are numerous and have great potential**

  - Especially if they are government funded

- **In my experience, not many collaborative research projects are truly successful**

  - Not readily admitted in public, but it is rare that key objectives of _all_ the participants are met

- **Primary causes:**

  - Unclear objectives

  - Insufficient engagement between partners (no team spirit)

  - Inadequate project management (irregular meetings, poor tracking of progress/results)

- **None of the above are fundamental and can be fixed**

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