**The National Academies'
Board on Science, Technology, and Economic Policy (STEP)
and
Committee on Science, Technology, and Law (CSTL)**

University Management of Intellectual Property:

Lessons from a Generation of Experience, Research, and Dialogue

**Louis Masi
Director, IBM Global University Programs
July 1st, 2008**

Agenda

1. Signs of the times – IP practices strain becomes more public

2. Game changers identified and / or confirmed
    *   The University - IT Industry Collaborative Research Spectrum – since that 'one size fit' flatters no one, a portfolio of solutions must be navigated
    *   Industry IP differences exist - and if ignored, reduce collaboration
    *   The value of Open Innovation in the IT Industry – Let go to grow!

3. Steps of progress – successful proof points
    *   Open Collaboration Principles – December 2005
    *   Open Collaborative Research Program – December 2006
    *   Free Participant Use Principles – June 2007

4. What's next – University & Industry Innovation Forum (July 2008)
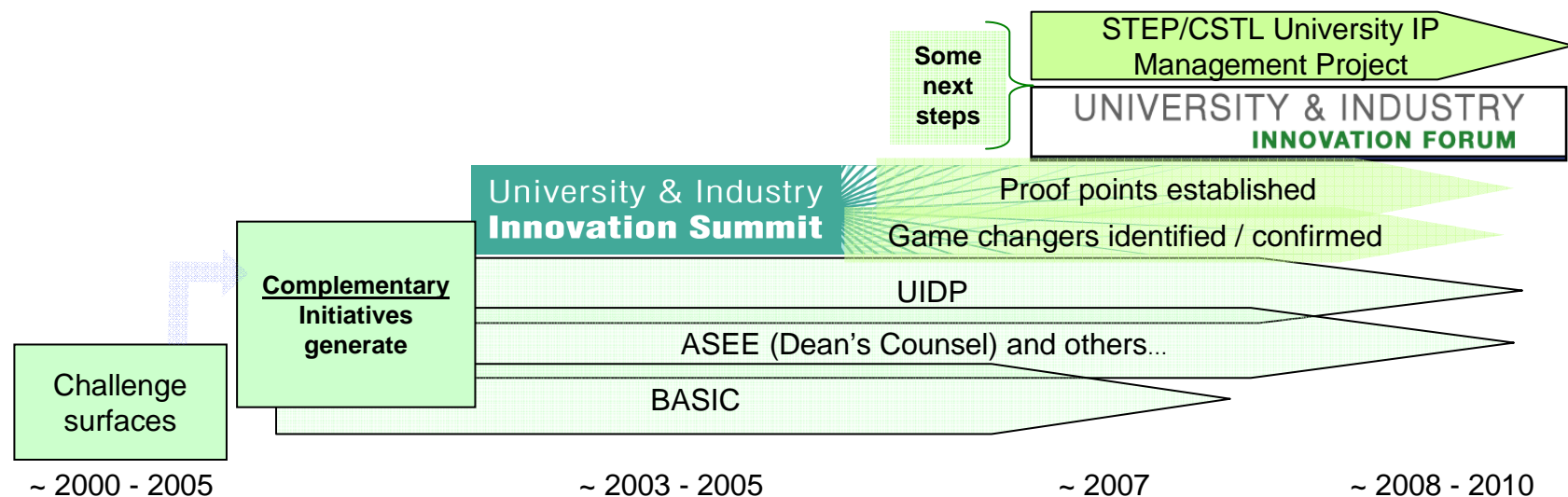
Signs of the times - IP practices strain becomes more public

THE WALL STREET JOURNAL. ONLINE

December 21, 2004

College Try

Columbia's Pursuit
Of Patent Riches
Angers Companies

As University Seeks to Extend
A $600 Million Bonanza,
Biotechs Refuse to Pay Up
Debate Over Academic Values

US universities emulate private sector IP practices.

The Boston Globe

November 9, 2005

Harvard woos firms to fund research

Universities seek additional revenue streams from companies, IP income, etc.

FORTUNE

GOVERNMENT

The Law of Unintended Consequences

Twenty-five years ago a law know as Bayh-Dole spawned the biotech industry. It made lots of university scientists fabulously rich. It was also supposed to usher in a new era of innovation. So why are medical miracles in such short supply?
Wednesday, September 7, 2005
By Clifton Leaf

Is there a need for varying licensing practices for different industries.

nature DRIFTING APART

The technology trap
The widely admired US system for transferring ideas from the labs to the marketplace is showing signs of distress.

Vol 437 | 13 October 2005

US university-industry relations are strained. Are other countries heading in the same direction?

Economist.com

SURVEY: PATENTS AND TECHNOLOGY

An open secret

Oct 20th 2005

Sharing intellectual property can be more profitable than keeping it to yourself

Why is this important to the IT industry? To create new markets in which to compete.

Game changers identified and / or confirmed

University & Industry Innovation Summit

1. The University - IT Industry Collaborative Research Spectrum – since that 'one size fit' flatters no one, a portfolio of solutions must be navigated

2. Industry IP differences exist - and if ignored, reduce collaboration

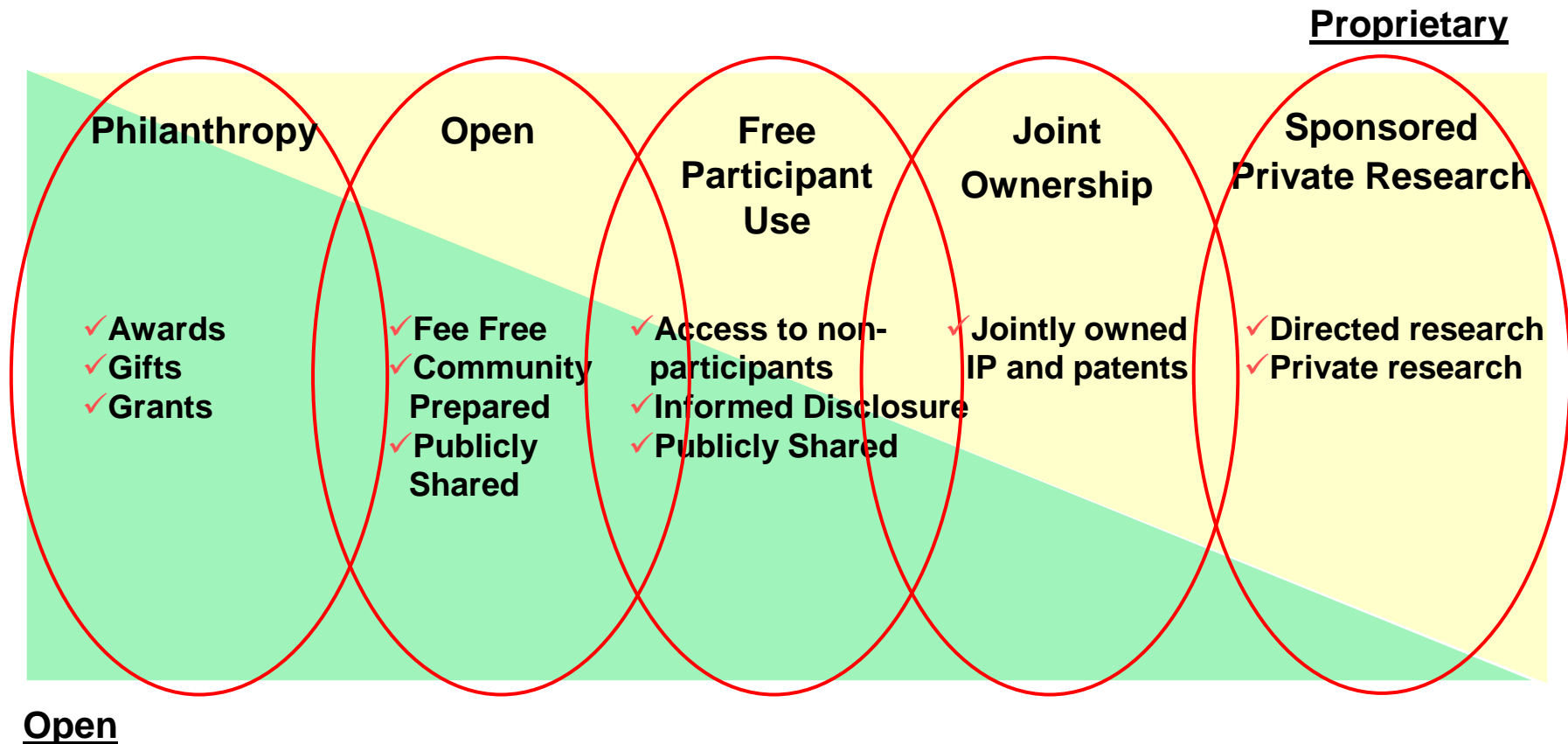3. The value of Open Innovation in the IT Industry – let go to grow!

Washington D.C., August 2005

Summit Objectives:

- Promote collaborative innovation between industry and universities throughout computer science, its applications, IT software, and the IT services disciplines
- Remove barriers and support collaborative research improvements
- Shorten the time from intent to joint development of IT knowledge and software

IBM

The University - IT Industry Collaborative Research Spectrum – since that 'one size fit' flatters no one, a portfolio of solutions must be continually navigated

Proprietary

Philanthropy

✓Awards
✓Gifts
✓Grants

Open

✓Fee Free
✓Community Prepared
✓Publicly Shared

Free Participant Use

✓Access to non-participants
✓Informed Disclosure
✓Publicly Shared

Joint Ownership

✓Jointly owned IP and patents

Sponsored Private Research

✓Directed research
✓Private research

Open

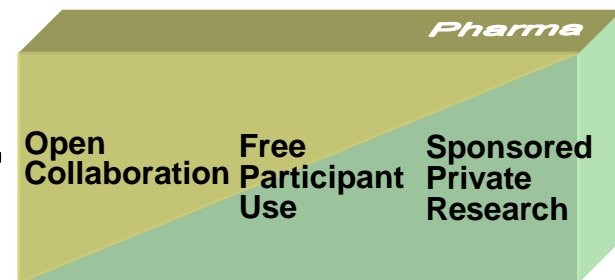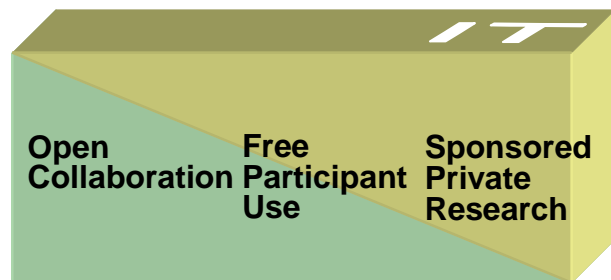# The need for industry specific university IP practices

Different industry business models and characteristics sometimes require different university IP practices

Information Technology

✓ Usually many patents from different IP owners per product

✓ No single patent is key enabler / of high strategic value

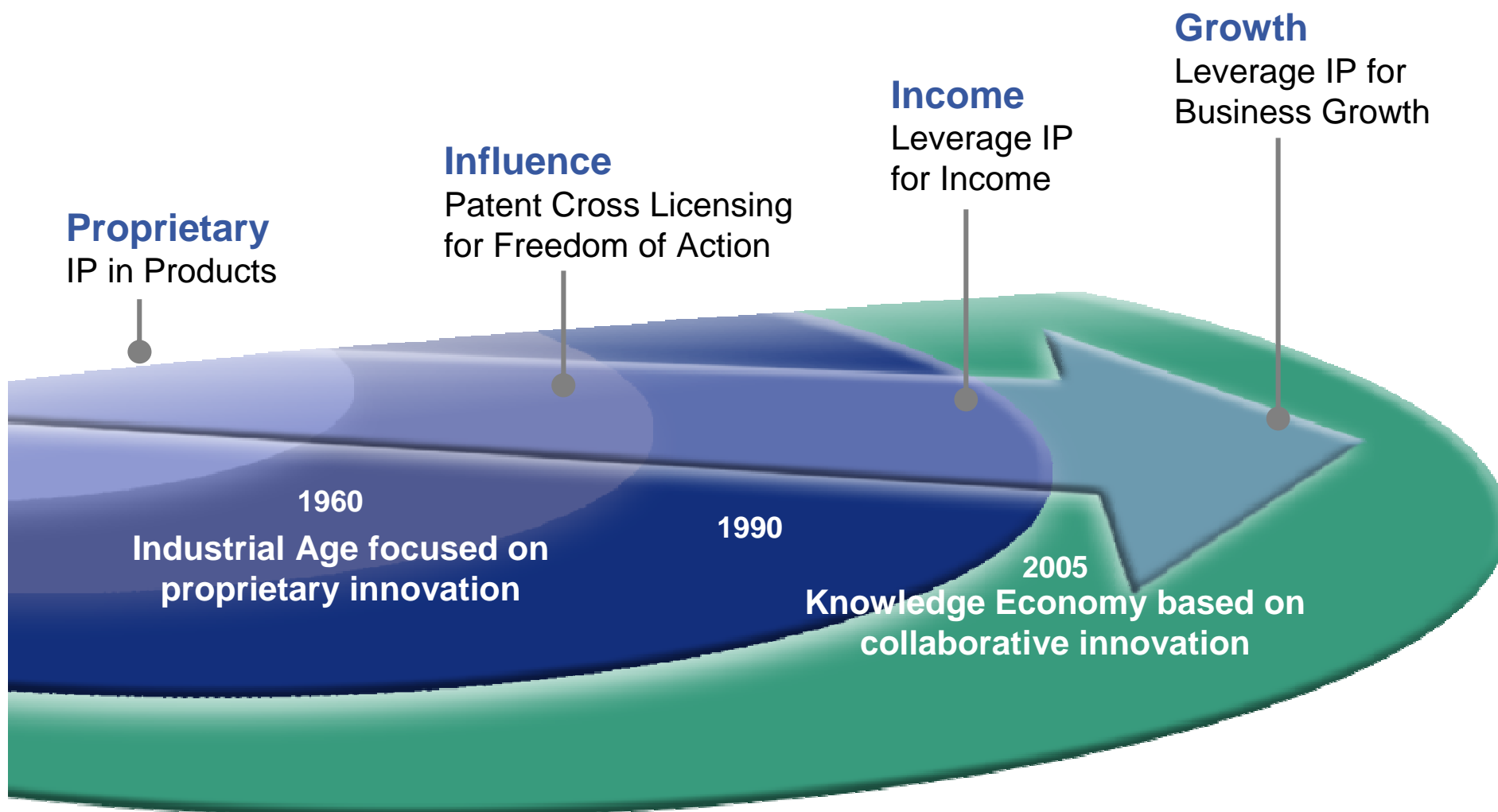✓ Cross-licensing between portfolios common due to the relative small value of each patent

Pharmaceuticals (recent model)

✓ Usually fewer patents per product

✓ Heavier reliance on IP-income from a few "blockbuster" drugs to drive return on research investment

✓ …

IT

Open Collaboration Free Participant Use Sponsored Private Research

Pharma

Open Collaboration Free Participant Use Sponsored Private Research

Bio tech. – are some components moving from right to left, e.g., to improve world hunger (fresh on demand), stopping the risk of Avian Flu, or check-mating other pandemics?

Evolving IP strategies

Proprietary
IP in Products

Influence
Patent Cross Licensing
for Freedom of Action

Income
Leverage IP
for Income

Growth
Leverage IP for
Business Growth

1960
Industrial Age focused on proprietary innovation

1990

2005
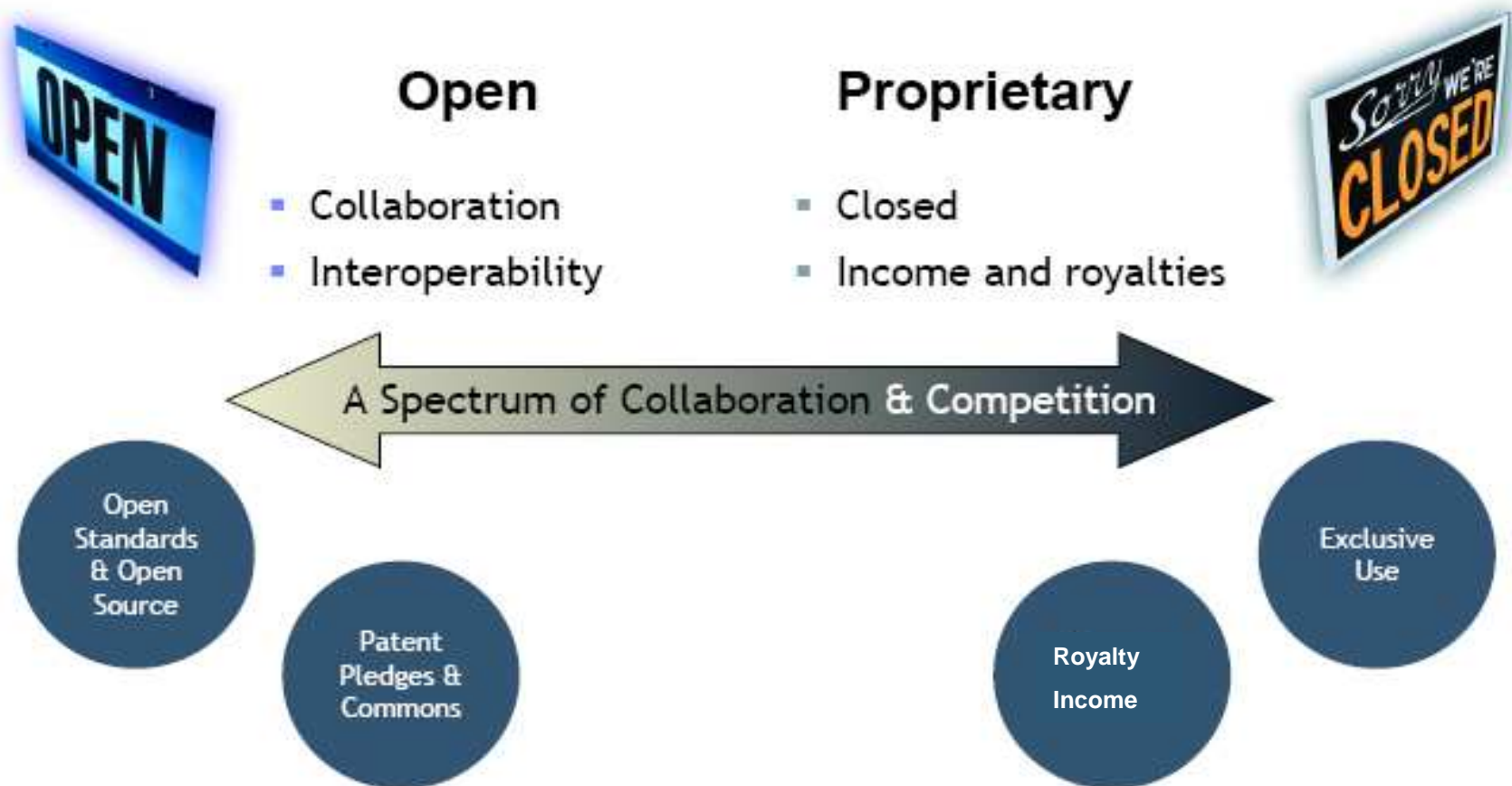**Knowledge Economy based on collaborative innovation**

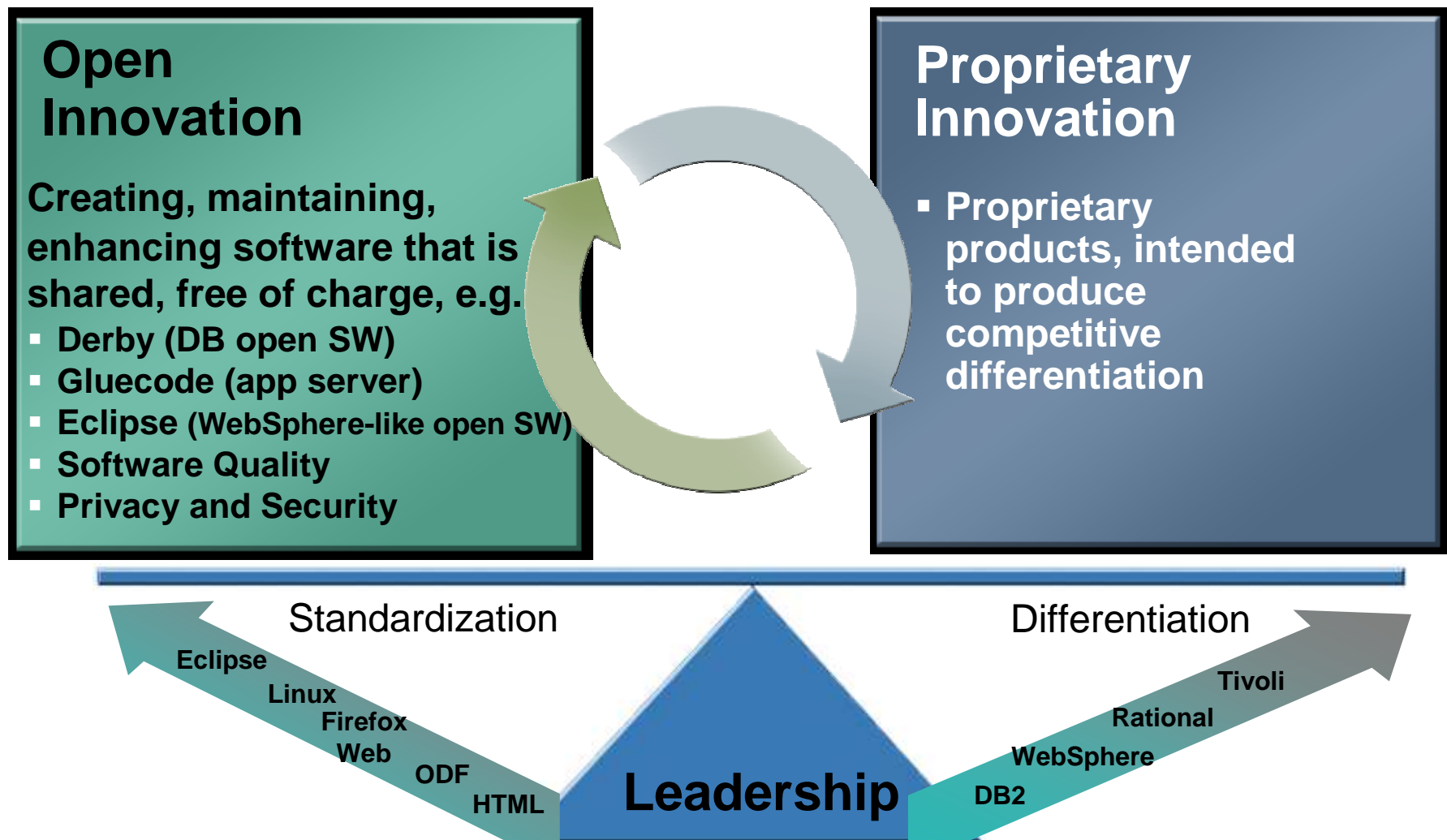# Cell Processor:
Collaborative innovation pays off

- Five-year collaboration to revolutionize the digital experience

- Supercomputer on a chip – up to 50x performance improvement

- Technical specifications to open source and development communities

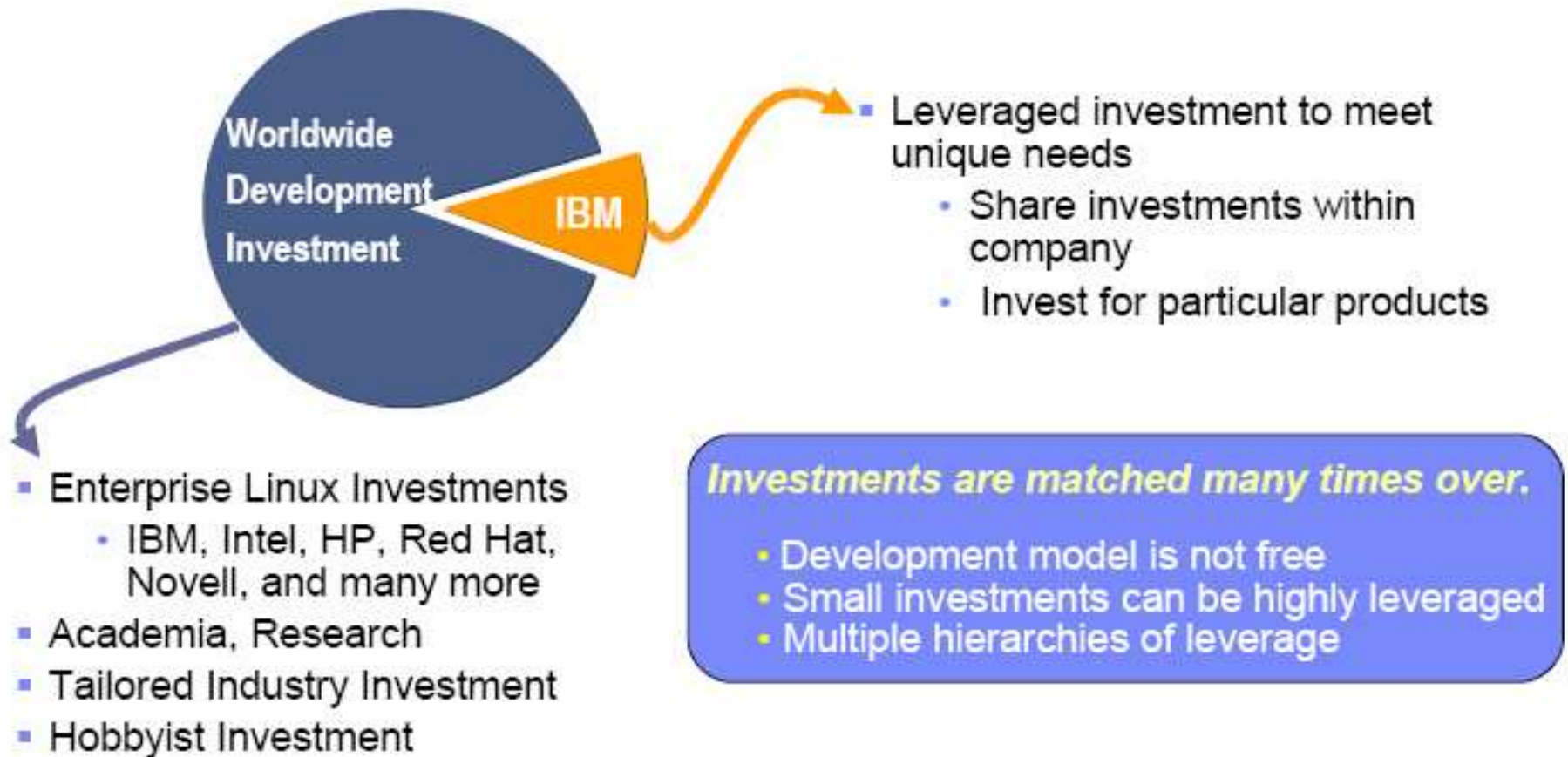# The intellectual property landscape

Open
- Collaboration
- Interoperability

Proprietary
- Closed
- Income and royalties

A Spectrum of Collaboration & Competition

Open Standards & Open Source

Patent Pledges & Commons

Royalty Income

Exclusive Use

21st-Century Innovation Model *A Shared Foundation*

Open Innovation

Creating, maintaining, enhancing software that is shared, free of charge, e.g.

- **Derby (DB open SW)**
- **Gluecode (app server)**
- **Eclipse (WebSphere-like open SW)**
- **Software Quality**
- **Privacy and Security**

Proprietary Innovation

- **Proprietary products, intended to produce competitive differentiation**

Standardization

Eclipse
Linux
Firefox
Web
ODF
HTML

Differentiation

Tivoli
Rational
WebSphere
DB2

Leadership

The sum of community innovations with the Linux operating system far exceed what any single vendor could create

Worldwide Development Investment

IBM

- Leveraged investment to meet unique needs
  - Share investments within company
  - Invest for particular products

- Enterprise Linux Investments
  - IBM, Intel, HP, Red Hat, Novell, and many more
- Academia, Research
- Tailored Industry Investment
- Hobbyist Investment

Investments are matched many times over.

- Development model is not free
- Small investments can be highly leveraged
- Multiple hierarchies of leverage

Steps of progress – successful proof points

University & Industry Innovation Summit

1. Open Collaboration Principles – December 2005

2. Open Collaborative Research Program – December 2006

3. Free Participant Use Principles – June 2007

Washington D.C., August 2005

Summit Objectives:

- Promote collaborative innovation between industry and universities throughout computer science, its applications, IT software, and the IT services disciplines
- Remove barriers and support collaborative research improvements
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University & Industry
Innovation Summit

Sponsored by Ewing Marion Kauffman Foundation and International Business Machines Corporation®

Open Collaboration Principles – Purpose

✓ *Fee Free*
✓ *Community Prepared*
✓ *Publicly Shared*

This "Free Public Commons" model represents just one type of formal collaboration that can be used when appropriate.

It will co-exist with other models, such as sponsored research, consortia and other types of university/industry collaborations, where the results are intended to be publicly disseminated.

August & December 2005

IBM's Open Collaborative Research Program

- **Multi-year**, so that faculty can take on new students and obligations

- **Collaborative**, allowing IBM and university participants to forge deep relationships

- **Open**, providing maximum opportunity for others to build on the results

- **Challenging**, research requiring considerable innovation

IBM

IBM's Open Collaborative Projects

Topics	Universities
Software Quality	UC Berkeley, Rutgers
Clinical Decision Support	Columbia, Georgia Tech
Mathematical Optimization	CMU, UC Davis
Privacy & Security Policy Management	CMU, Purdue, Imperial (UK)
Accessibility	Dundee (UK), Miami
New Gen Hospital	Technion (ME)
Globally Distributed Service Chains	Indian School of Business (AP)
Multi-core Software Exploitation	CMU, Rice, SUNY Oswego, UT Austin
Additional topics currently under negotiations	University collaborations worldwide

See below.

Open Collaborative Research Program Success

- **More than 20 Scientific Publications**

IPCO 2008
The 13th Conference on Integer Programming and Combinatorial Optimization

ACM/IEEE International Conference on Software Engineering (ICSE)

acm

siam ACM-SIAM Symposium on Discrete Algorithms — Association for Computing Machinery

VLDB 2007

OOPSLA

- **12+ Open Source Contributions**

COIN|OR

eclipse

WALA — T. J. WATSON LIBRARIES FOR ANALYSIS

- **Talent Pipeline / Recruiting**
  - PhD pipeline
  - On-site faculty development
  - Research Staff Member hiring

- **Improved Collaborations**
  - New partnerships
  - Improved efficiency

Free Participant Use Principles

University & Industry
Innovation Summit

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✓ *Free Participant Use*
✓ *Access for Non-participants*
✓ *Informed Participant Disclosure*
✓ *Publicly Shared*

- Provides another option for discussing collaboration goals between universities and industry and tests alignment of research interests

- Does not dictate when the principles should be used – that is to be determined by the researchers during their discussions

Announced June 2007

What's Next – the University & Industry Innovation Forum (July 2008)

◆Create a collaborative community that address impediments to collaborative research models by developing specific (micro) solutions to remove barriers for the IT industry to quickly engage in collaborative research with academia.

◆Celebrate best practices and successful models that enable more effective negotiations between universities and industry

◆Positively influence competitiveness, innovation and collaboration worldwide

◆Continue to support complementary initiatives addressing university-industry research collaboration such as UIDP, ASEE, AUTM, etc.
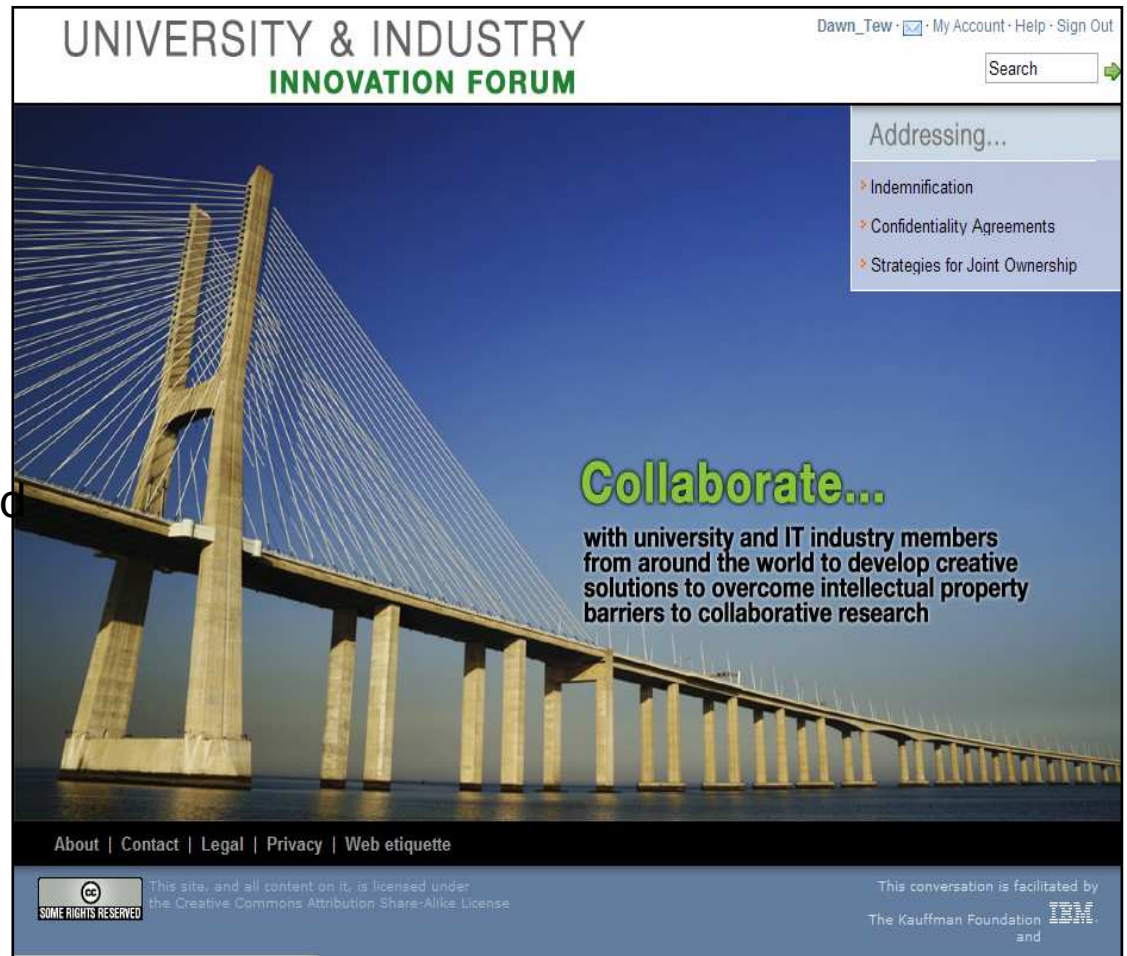
Initial Forum Topics to Address (should include both strategic & tactical opportunities)

◆ Strategies for Joint ownership (TBD)
  ● Is joint ownership of IP desirable, or a burden?
  ● How should joint owners 'share' in obtaining protection?
  ● What are best practices for exploiting jointly owned IP?

◆ Indemnification (Ga Tech, IBM)
  ● Should this team focus on IP indemnification only – or all indemnification issues?
  ● Under what conditions is it appropriate for one party to indemnify the other? What is the justification?
  ● What expenses should be included in indemnity?
  ● Should indemnity be capped or uncapped?

◆ Confidentiality agreements (UT Austin, RPI)
  ● Does the community think that these would be beneficial?
  ● Do confidentiality agreements slow down the pace of research?
  ● What are the more difficult problems with confidentiality agreements?

◆ Additional topics will be identified by the Summit team

Features of the Forum

◆ Site licensed with Creative Commons
  ● Discussions freely available

◆ Members have access to all discussion threads real-time
  ● Member profiles provide transparency
  ● Ability to share best practices, lessons learned, published works, to support discussions

◆ Ability to crosslink forum capabilities to other technologies
  ● Upload presentations, link web sites, attach pod casts, video casts, blogs and create RSS feeds

Take away thoughts - summary

1. One size does not fit all – no universal solution, different strokes for different folks

2. Only a portfolio of solutions will improve our circumstance

3. Emulation can be dangerous

4. Industry differences do matter

5. Let go to grow – open standards, open source, open innovation (see 21st Century Innovation mode)

6. How valuable is one IT patent – the collaboration / business idea could be much more important

7. Progress remains slow – better understanding and continued vigilance needed by all (throughout the university ecosystem)

8. Some universities & IT Co's (and pockets within) still operate under old business paradigms…while inefficiency remains (see Evolving IP Strategies)

9. There is plenty to do and room for improvements, leading by example and more pervasive acceptance

10. Globalization necessitates that we pick up the pace

For more information about IBM's Open Collaboration Research Program visit:

www.ibm.com/university/collaborativeresearch

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Backup Slides

Success: Scientific publications – 20+ accepted

- "Ditto: Automatic Incrementalization of Data Structure Invariant Checks", AJ Shankar, Rastislav Bodik, ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI'07), San Diego, CA, June 2007
- "Sketching Stencils", Armando Solar-Lezama, Gilad Arnold, Liviu Tancau, Rastislav Bodik, Vijay Saraswat (IBM) and Sanjit Seshia, ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI'07), San Diego, CA, June 2007
- "Thin Slicing", Manu Sridharan, Stephen Fink (IBM), and Rastislav Bodik, ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI'07), San Diego, CA, June 2007
- "A Hardware Memory Race Recorder for Deterministic Replay", Min Xu, Rastislav Bodik, and Mark D. Hill, IEEE Micro Special Issue: Micro's Top Picks from Microarchitecture Conferences, January-February 2007
- "Combinatorial Sketching for Finite Programs", Armando Solar-Lezama, Liviu Tancau, Rastislav Bodik, Vijay Saraswat (IBM) and Sanjit Seshia, 12th International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS 2006), San Jose, CA, October 2006
- "A Regulated Transitive Reduction for Longer Memory Race Recording", Min Xu, Rastislav Bodik and Mark D. Hill, 12th International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS 2006), San Jose, CA, October 2006
- "Refinement-Based Context-Sensitive Points-To Analysis for Java", Manu Sridharan and Rastislav Bodik, ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI'06), Ottawa, Canada, June 2006
- "Blended Analysis for Performance Understanding of Framework-based Applications", Bruno Dufour, Barbara Ryder, Gary Sevitsky, International Symposium on Software Testing and Analysis (ISSTA), July 2007
- "Heuristic Ranking of Java Program Edits for Fault Localization", Xiaoxia Ren and Barbara Ryder, International Symposium on Software Testing and Analysis (ISSTA'07), July 2007.
- "Crisp - A Fault Localization Tool for Java Programs", Ophelia Chesley, Xiaoxia Ren, Barbara G. Ryder, and Frank Tip, a selected demo at ICSE 2007, abstract in International Conference on Software Engineering, May 2007.
- Reeder, R., Karat, C., Karat, J., & Brodie, C. (2007) Usability challenges in security and privacy policy-authoring interfaces. INTERACT 2007, Springer Lecture Notes in Computer Science 4663, p 141-153.
- Qun Ni, Dan Lin, Elisa Bertino, Jorge Lobo: Conditional Privacy-Aware Role Based Access Control. ESORICS 2007: 72-89
- Dan Lin, Prathima Rao, Elisa Bertino, Jorge Lobo: An approach to evaluate policy similarity. SACMAT 2007: 1-10
- Qun Ni, Alberto Trombetta, Elisa Bertino, Jorge Lobo: Privacy-aware role based access control. SACMAT 2007: 41-50
- Qihua Wang, Ting Yu, Ninghui Li, Jorge Lobo, Elisa Bertino, Keith Irwin, Ji-Won Byun: On the Correctness Criteria of Fine-Grained Access Control in Relational Databases. VLDB 2007: 555-566
- Dan Lin, Prathima Rao, Elisa Bertino, Jorge Lobo, Ninghui Li: EXAM - a Comprehensive Environment for the Analysis of Access Control Policies. Submitted to IEEE Trans Software Engineering
- "An Open Source Software for non-convex MINLP", Belotti, Biegler, Bonami, Grossman, Lee, Margot, Waechter. 2nd International Conference on Continuous Optimization + 7th Modeling and Optimization: Theory and Applications
- "An Exact Solution Approach for Portfolio Optimization Problems Using Stochastic and Integer Constraints", Pierre Bonami and Miguel Lejeune, submitted to Operations Research
- "Expressing Combinatorial Optimization Problems by Systems of Polynomial Equations and the Nullstellensatz", Jesus de Loera, Jon Lee, Susan Margulies, Shmuel Onn, submitted to Combinatorics, Probability and Computing
- "Combinatorial Optimization Via Polynomial Equations and the Nullstellensatz", Jesus de Loera, Jon Lee, Susan Margulies, Shmuel Onn, submitted to ACM-SIAM Symposium on Discrete Optimization
- "Automatic Administration of the Get Up and Go Test", Dounia Berrada, Mario Romero, Gregory Abowd, Marion Blount, John Davis, 1st ACM SIGMOBILE International Workshop on Systems and Networking Support for Healthcare and Assisted Living Environments

Success: Open Source Contributions – 12 and counting

- Context-Sensitive Points-to Analysis: A highly-efficient refinement algorithm for demand-driven points-to analysis (paper). Implemented in WALA. http://www.cs.berkeley.edu/~manu_s/points-to/
- JavaSketch: A second generation of the Prospector synthesizer (paper) for search and generation of Java API client code. http://javasketch.sourceforge.net/
- Thin slicing: an implementation of the thin slicing algorithm (paper) is included in WALA. No user interface yet but suitable for slicing experiments. Implemented by Stephen Fink (IBM). Release in progress.
- Ditto: An incrementalizer of data structure invariant checks for Java (paper). http://ditto-java.sourceforge.net/
- SKETCH: A sketch-based synthesizer (paper, paper). http://sketch.cs.berkeley.edu/wiki/index.php/Main_Page
- Prospector (web): A web version of the Java API synthesizer.
- Prospector: Eclipse plug-in with the first generation of the Prospector. A simple user interface but less control over the synthesis. http://snobol.cs.berkeley.edu/prospector/index.jsp
- String Type Discovery: Discovering string subtypes by mining a corpus of client code. A research prototype. http://www.cs.berkeley.edu/~mandelin/typeDiscovery/
- "Remote Testing" Eclipse Plug-in A plug-in for displaying results of testing a student assignment on a server against a reference solution. Displays errors and coverage. Used in our compiler courses. http://inst.cs.berkeley.edu/~cs164/fa04/Pages/software.html#_Remote_Testing_Plugin:
- Chianti, a prototype change impact tool for Java that works as an Eclipse plug-in, released on the web in executable form in July 2007 http://prolangs.rutgers.edu/projects/chianti/index.php
- Elude, a blended escape analysis tool based on WALA has been built, and is being re-engineered with the goal of eventual public release.
- Global Optimization (Couenne=Convex Over/Under ENvelopes for Nonlinear Estimation) https://projects.coin-or.org/Bonmin/wiki/BonCouenne