The Impact Project:
Tracing the Source of Software Engineering Technology to its Origins

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26 October 2001

Where Does Software Technology Come From?

- Who should get the credit?
  - What credit should they get?
- How to award credit?
  - What measures?
  - How to determine them?
- Does this really matter?
  - To whom?
  - For what reasons?

Credit is due to:

- Commercializers
- Researchers
- Tech Transfer agents
- Early adopters
- Scientific and Technical Communities
- Students with new degrees
- New Hires
- ETC.

What are the natures of their contributions?
How to value them?

Contributions Differ

- Initial conceptualization of idea
- Evangelism
- Prototype demonstration
- Public promulgation
- Nurturing by community activities
- Indoctrination and training (students)
- Product commercialization

How to Evaluate These?

- Qualitatively
- Quantitatively
- Different perceptions by different parties
- Difficulties in assessing contributions

Facile answers are misleading

- It comes from:
  - Sun, Microsoft, IBM, Rational, the web,
- Yes, but!
  - Where did they get it from? And how?
- It comes from Dr. X's research
  - Published a seminal paper
- Yes, but!
  - Someone else cleaned it up, crafted code
- It was "in the air"
  - How did it get there? Who nurtured it?

Why should we care? (as users, beneficiaries)

- Some technology isn't great
  - Why are we stuck with it?
  - Why isn't it better?
- Some technology seems useful
  - How can we get more of same?
  - How can we speed its appearance?
  - Are there institutions that need to be
    - Strengthened
    - Demolished

Why Should We Care? (As Researchers)

- Altruistic reasons
  - More effective tech transfer
  - Better technologies in use
- More self-serving reasons
  - Self-image
  - Academic status
  - Positive Attitude
  - Funding prospects

Software Engineering Myths

- Software engineering research has had minimal impact on practice
- Software engineering research results have effected minimal increases in productivity
- Software engineering research has been a poor investment, giving little return
- Industry leads, research follows
  - (Industry cleans up; research sweeps up)

(Some myths are false, some are not)

Software Engineering Facts

(Some “facts” are false, some are not)

- Theory:
  - Software engineering research problems are hard, fundamental, and enduring
  - The research community has an increasingly strong grip on these problems
- Practice:
  - Software practice has achieved orders of magnitude productivity increases
  - Research results have driven much of this

More “Facts”

- We don’t know what the truth really is
- We are not really sure how to decide what “the truth” really is
- We really need to find out…….

The Impact Project: Tracing the Source(s) of Technology to its Origins

- Focus is on Software Technology
- Start with technologies in widespread use
- Trace back to how they came into widespread use
- Document and analyze
  - What facilitates/inhibits technology flow?
  - How to make more good things happen more easily and more often

Impact Project Structure

- Software community volunteer effort
- Modest sponsorship by:
  – ACM Sigsoft, US NSF, IEE, Japan
- Collection of reports on key areas
- Appearing 2002 onwards

Selected Report Topics

- Configuration Management
- Reviews and Walkthroughs
- Design Methods and Tools
- Programming Environments
- Modern Programming Languages
- Cost and Economic Modeling
- Testing and Evaluation
- ….. And more…..

Project Products

- Set of reports
  - Organized around subject areas
  - Range of sizes
    - Full (25-30 pages?): journal quality
    - Condensed (3-5 pages?): magazine style
    - Popular press (?): Scientific American?
    - Abstracts (one pager, one paragraph)
- Briefing materials
  - For all occasions

Project Organization

- Steering Group:
  - L. Osterweil, J. Kramer, C. Ghezzi, A. Wolf
- Subject Area-Based Author Groups
  - 12-20 Subject areas
  - 8-10 Authors per subject area
  - 1 or 2 CoLead Authors per subject area
  - Inclusive, open to broad community participation
- Panel of Distinguished Reviewers

Status Report on Software Configuration Management Study

Alexander L. Wolf

Department of Computer Science

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Team

- Lead Authors
  - Jacky Estublier, U. Grenoble/IMAG (Adele)
  - David Leblang, retired (Clear Case, DSEE)
- Contributing Members
  - G. Clemm, Rational (Clear Case, Odin)
  - R. Conradi, U. Trondheim (EPOS)
  - A. van der Hoek, UCI (NUCM)
  - W. Tichy, U. Karlsruhe (RCS)
  - D. Wiborg-Weber, Continuus (CCM)

What is SCM?

- Managing a repository of components
  - Version Control; Product Models; Composition and Selection
- Helping engineers in their usual activities
  - Building (derived object control); Work Space Control
- Controlling and supporting the process
  - Change Control; Cooperative Work; Process Support

SCM Is in Wide Use

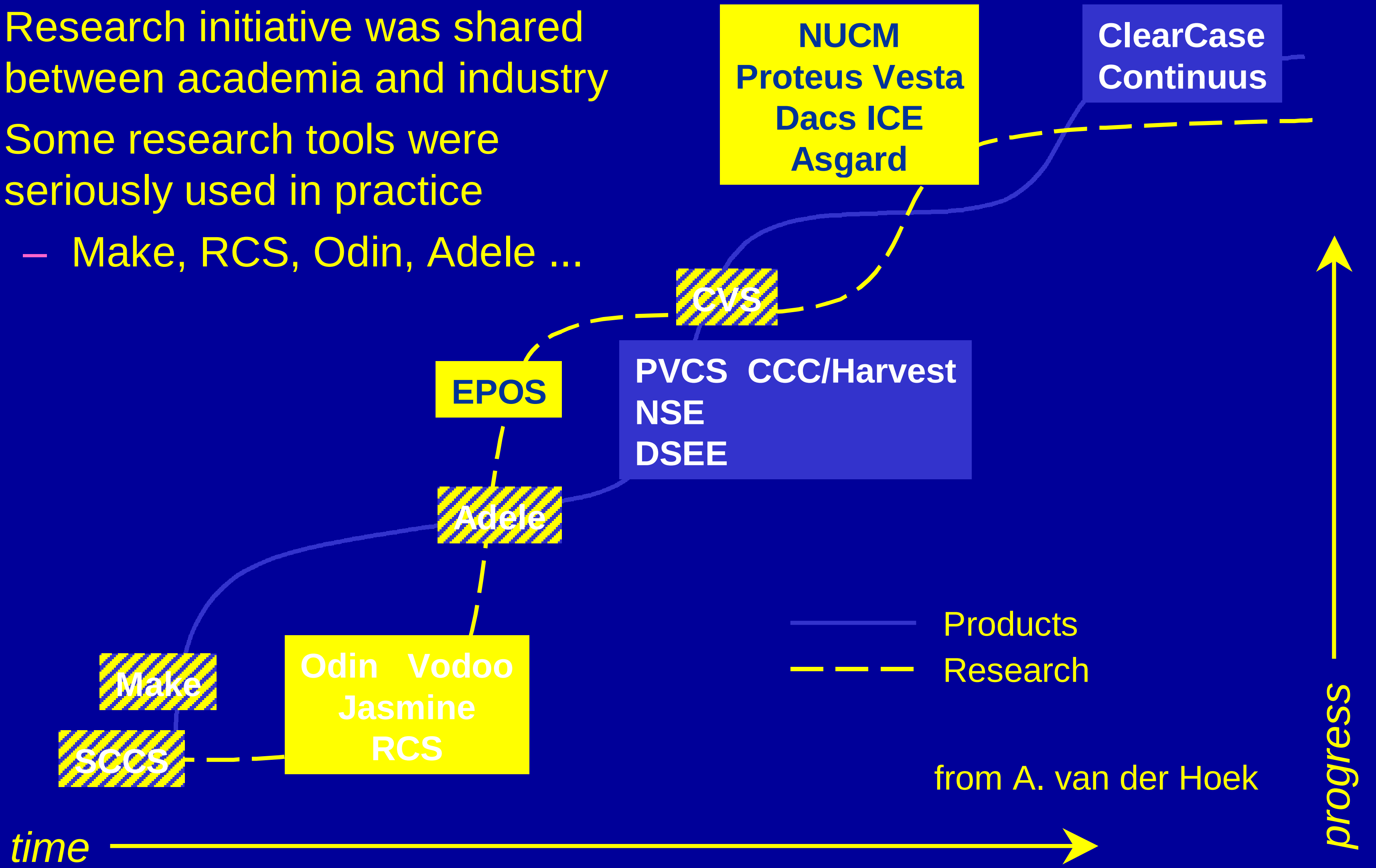
- Ovum estimates:
  - $1B (1998), $2B (2000), $3.3B (2002)
  - 25% mainframe;15%-20% workstations; 5%-10% PC
- Gartner estimates:
  - $6B (2003)

SCM Impact Study Plan

- Examine characteristics/features of leading products in SCM market
- Assume that products used in practice
- Trace characteristics/features back to research ideas and prototypes
- Try to establish arguments for/against influence of research on practice (via products)

Complex Interplay between Research and Commercialization

- Research initiative was shared between academia and industry
- Some research tools were seriously used in practice
  - Make, RCS, Odin, Adele ...



Other Factors As Well

- Role of Community Nurturing
  - Product architects present at nearly all SCM workshops (1988-2001)
  - Cagan, Clemm, Dart, Leblang, Wiborg-Weber
- Movement of key people precipitated progress

Impact of Software Engineering Research on Modern Programming Languages

A work in progress

Barbara G. Ryder and Mary Lou Soffa

Approach

- Focus on languages currently in widespread use: e.g., Java, C++, Ada, Perl
- Find origins of, and influences on, essential features of these languages

Challenges

- PL and SE have a complex, close, synergistic relationship
- Hyp 1: SE research impacted PL design
- Hyp 2: PL impacted SE research and practice
- SE(PL) research also influenced SE(PL)
  - Parnas on modularity -> OO design
  - Simula 67 -> C++,Java

Modularity and Information Hiding

- Roots of OO languages – (modules, objects, inheritance, dynamic method binding) – Simula 67
- Parnas (1972) was one of the first to recognize value of modularity (code + data)
- Parnas first to come up with notion of information hiding (1972)
- Refined notion of encapsulation appeared in CLU in 1977

Exceptions

- Introduction of exceptions - ON conditions in PL/I in early 1970's
- J. Gannon, J.J. Horning (CACM 1975) explore issues in PL design for reliability
- J.Goodenough (CACM 1975) defines exception conditions and proposes PL features for handling
- Mesa, Mitchell et al (1979) and Ada, J. Ichbiah et al. (Ada Rationale 1979)
- CLU, B. Liskov, A. Snyder (IEEE-TSE 1979) offers clean definition of handling

Some Broader Lessons

- Vendors tend to see value (impact) in
  - algorithms (e.g., differencing)
  - pieces of reusable code (e.g., RCS)
- But not in
  - concepts (e.g., hierarchical workspaces)
  - architectures (peer-to-peer repositories)
  - Which are often seen as "engineering common sense"
  - "Research had very little influence …"
  - "We do not sell ideas, but tools. We (re)invented everything we needed…"

More Lessons

- Researchers tend to see impact in
  – Precedence
  – Concepts
  – Prototypes
- But tend to devalue importance of
  – Efficiency
  – Usability
  – Reliability
  – seeing them as "engineering common sense"
  – "We invented almost everything …"
  – "Tools are only an engineering issue …"

Still More Lessons

- **Both are right, both are wrong**
- **A good idea is had more than once**
- **Vendors have disincentives for distributing credit for ideas**
- **Researchers have incentives for claiming credit for ideas**
- **Research and productization both require *engineered creativity***

Final Observations

- Cultural chasms between research and commercialization
  - Probably deeper than either realizes
- Each needs the other more than it realizes
  - Causes more damage than realized
- Archeology is hard
  - But very timely now
  - Can get contentious
- History is hard too
  - Especially for non-historians

"Those who refuse to study history are doomed to relive it"

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"History teaches us that History teaches us nothing"