A Future for Software Engineering?

Leon J. Osterweil
University of Massachusetts
Amherst, MA, USA

23 May 2007

How to Project the Future?

- Extrapolate (?)
  - Current Velocity
    - Where are we coming from?
  - Current Position
    - Where are we now?
  - Future Position
    - Where will we be?
  - Unless forces change…..
- But, will the forces change?
  - Forces that be imposed upon us
  - Forces that we might impose upon ourselves

The NATO Conferences

- The dawn of history for Software Engineering
- Enunciation of a set of problems and issues
  - 1968 in Garmisch
  - 1969 in Rome
- Set the initial trajectory for our discipline

Some problems posed there

- Can system software be written in a high-level language?
- What is nature of design? How to fit it into development?
- How should software be tested?
- What to do about problems of scale?
- What is Software Quality? And how to achieve it?
- What processes can deliver high quality products
- How can/should we do component-based development?

Some problems posed there

- Can system software be written in a high-level language?
- What is nature of design? How to fit it into development?
- How should software be tested?
- What to do about problems of scale?
- What is Software Quality? And how to achieve it?
- What processes can deliver high quality products
- How can/should we do component-based development?

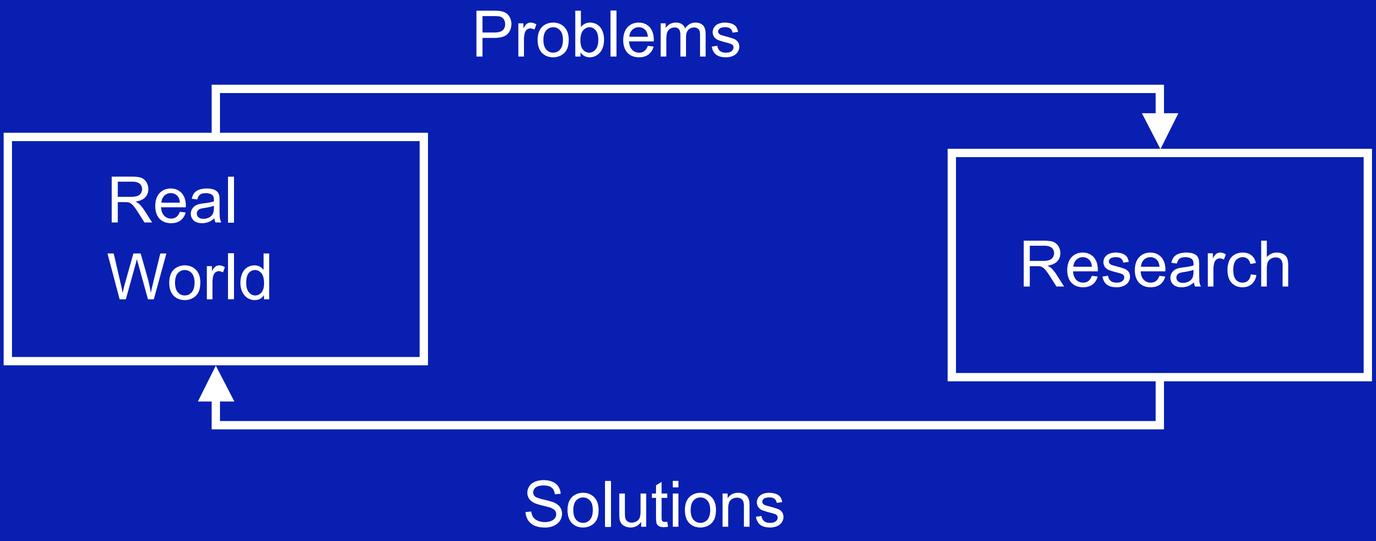
Most are still before us

Some problems posed there

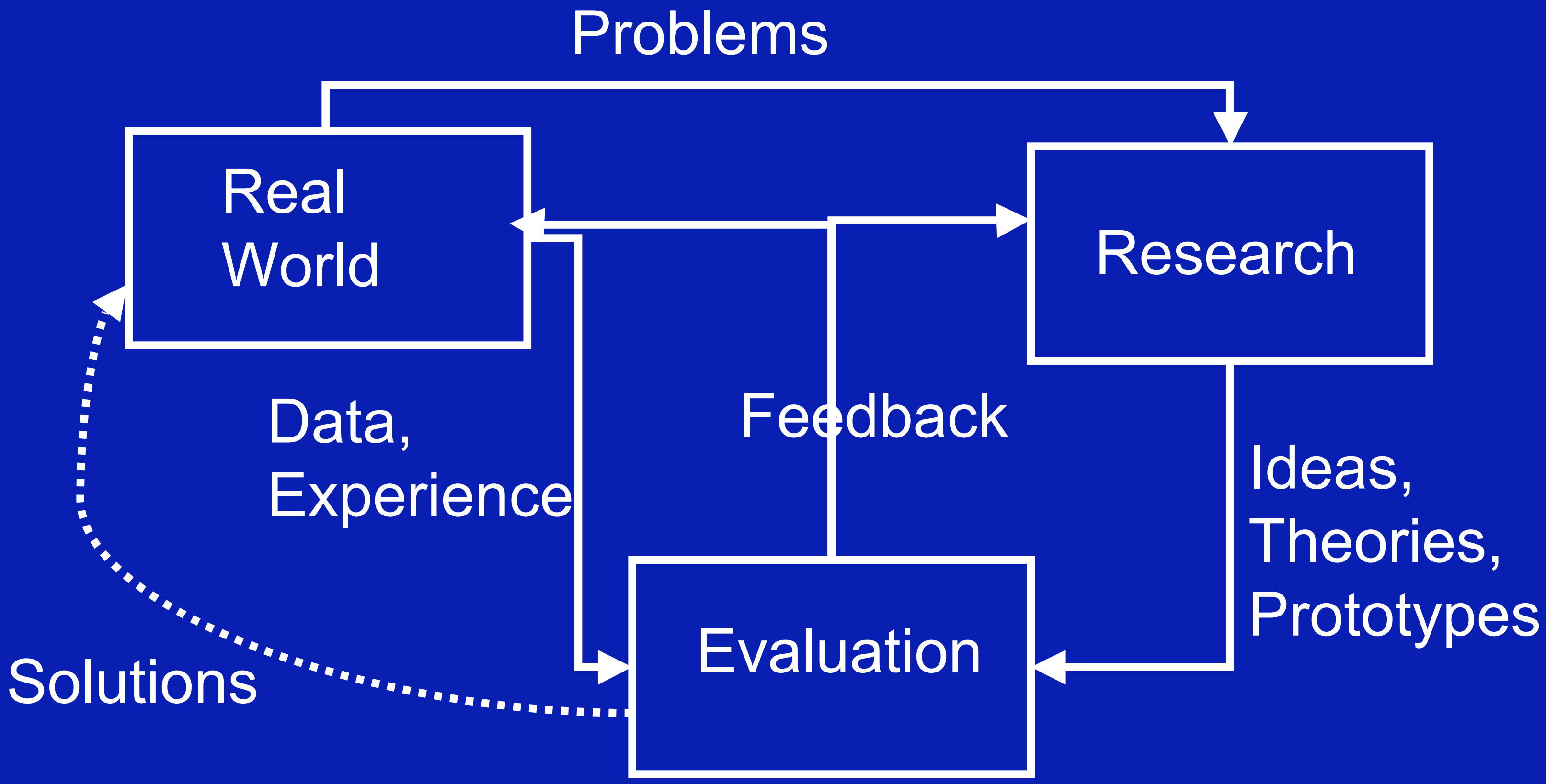
- Can system software be written in a high-level language?
- What is nature of design? How to fit it into development?
- How should software be tested?
- What to do about problems of scale?
- What is Software Quality? And how to achieve it?
- What processes can deliver high quality products
- How can/should we do component-based development?

Most are still before us. Is that bad?

How have we been functioning?

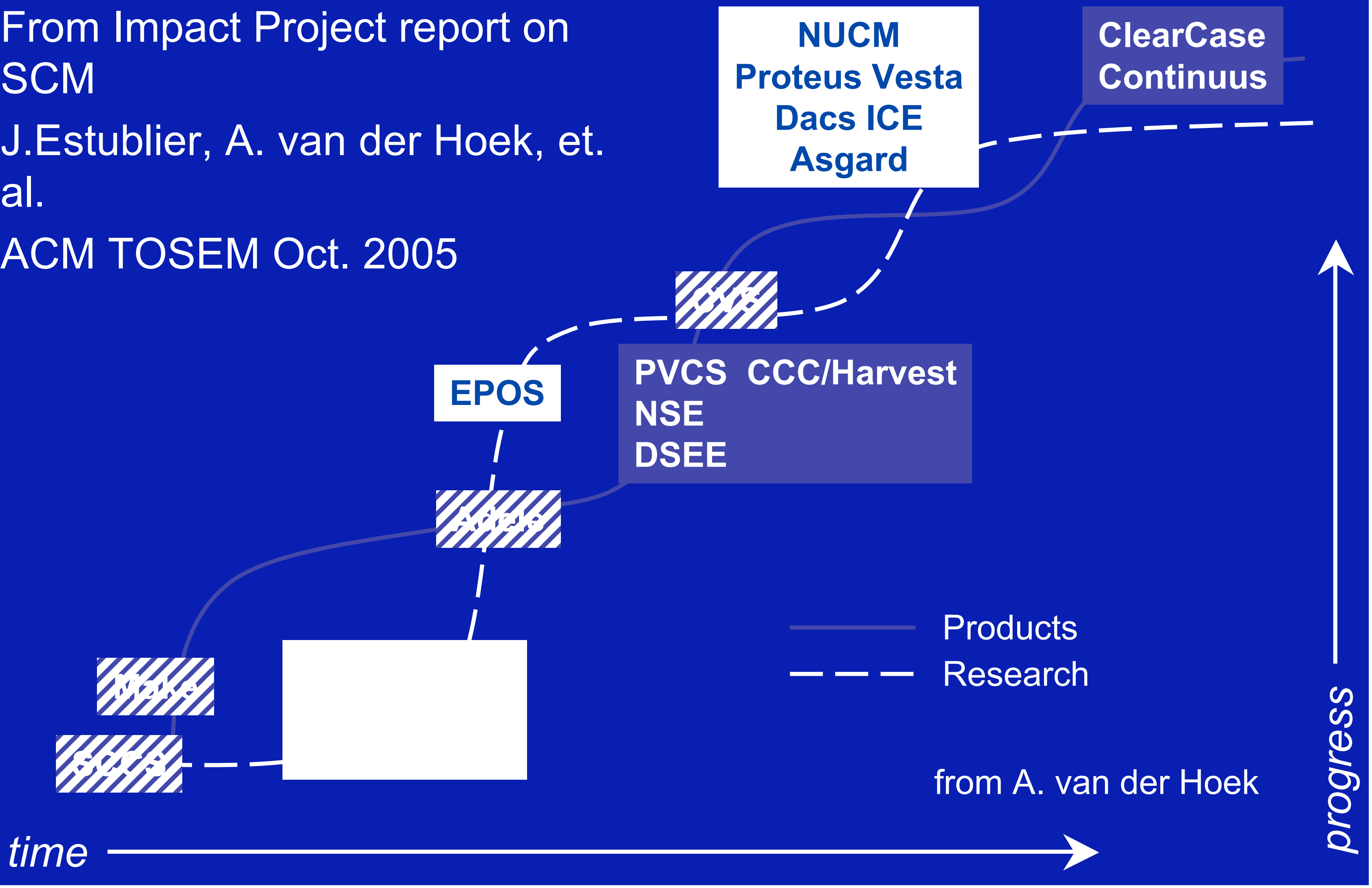


Maybe more like--



Actually maybe even more like…..

- From Impact Project report on SCM
- J.Estublier, A. van der Hoek, et. al.
- ACM TOSEM Oct. 2005



Present Position of Software Engineering

- Strong and Positive
  - Strong impact on the world
  - By a broad and powerful community
- Should be a source of pride
  - More than we seem to feel
    - Especially in the research community
  - More on this problem soon….

Some Impressive Numbers

- Millions of jobs worldwide
  - Many are very high paying
- Annual revenue in hundreds of billions USD
  - Trillions ?
- Conferences
  - ICSE, FSE/ESEC, and dozens more
- Journals
  - TSE, TOSEM, and dozens more
- Magazines
  - IEEE Software, and dozens more

Non Quantitative Measures

- A core competency in diverse disciplines
  - Telecommunications
  - Aerospace
  - Hardware
  - Automotive
  - Medical
  - ……
- Subject of major national initiatives
  - India, China, Germany, Ireland, ….
  - Counted on for wealth generation

Impact from Synergy between Research and Practice

- The Impact Project
  - Assessing the interplay between Software Engineering Research and Practice
- Numerous, well-documented examples
  - In TOSEM papers
  - And SEN preprints
- Come to the three sessions of the ICSE 2007 Impact Project Track

Extrapolating Forward

- Continue to be driven by problems arising in the real world
  - This has been a great success
- New forces from new problems that are growing in size, scope, and complexity
  - New disciplines, new problems, etc.
- A promising and tractable Future
  - But, A future that is driven by others
  - How do we feel about a future that is so reactive?

Do we have an agenda of our own?

And should we?

Other scientific communities derive strength from agendas driven by deep questions

- Physics
  - What is the nature of matter, energy, time?
  - What is the world made of?
- Biology
  - What is the nature of life?
  - Where did we come from?
- Astronomy
  - How did the universe begin/how will it end?

Other scientific communities derive strength from agendas driven by deep questions

- Physics
  - What is the nature of matter, energy, time?
  - What is the world made of?
- Biology
  - What is the nature of life?
  - Where did we come from?
- Astronomy
  - How did the universe begin/how will it end?

Note: None of these has much practical value

Deep questions followed long observation of practice

- Phenomena are observed
- Primitive practice is established
  - And nagging questions arise
- Leads to curiosity about deep questions
- Leads to deeper understandings
- Leads to more mature and effective practice

Deep questions followed long observation of practice

- Phenomena are observed
- Primitive practice is established
  - And nagging questions arise
- Leads to curiosity about deep questions
- Leads to deeper understandings
- Leads to more mature and effective practice

In disciplines such as:
Thermodynamics, Medicine, Electrical Engineering

Do we have analogous questions?

Can our curiosity about them help us in similar ways?

Shaping our agenda

- Our conferences focus on answers
- Should they also address deep questions?
- Should they encourage more curiosity about our problem domains?
- Do we need a different format for this?
- Do we need this at all?

Shaping our agenda

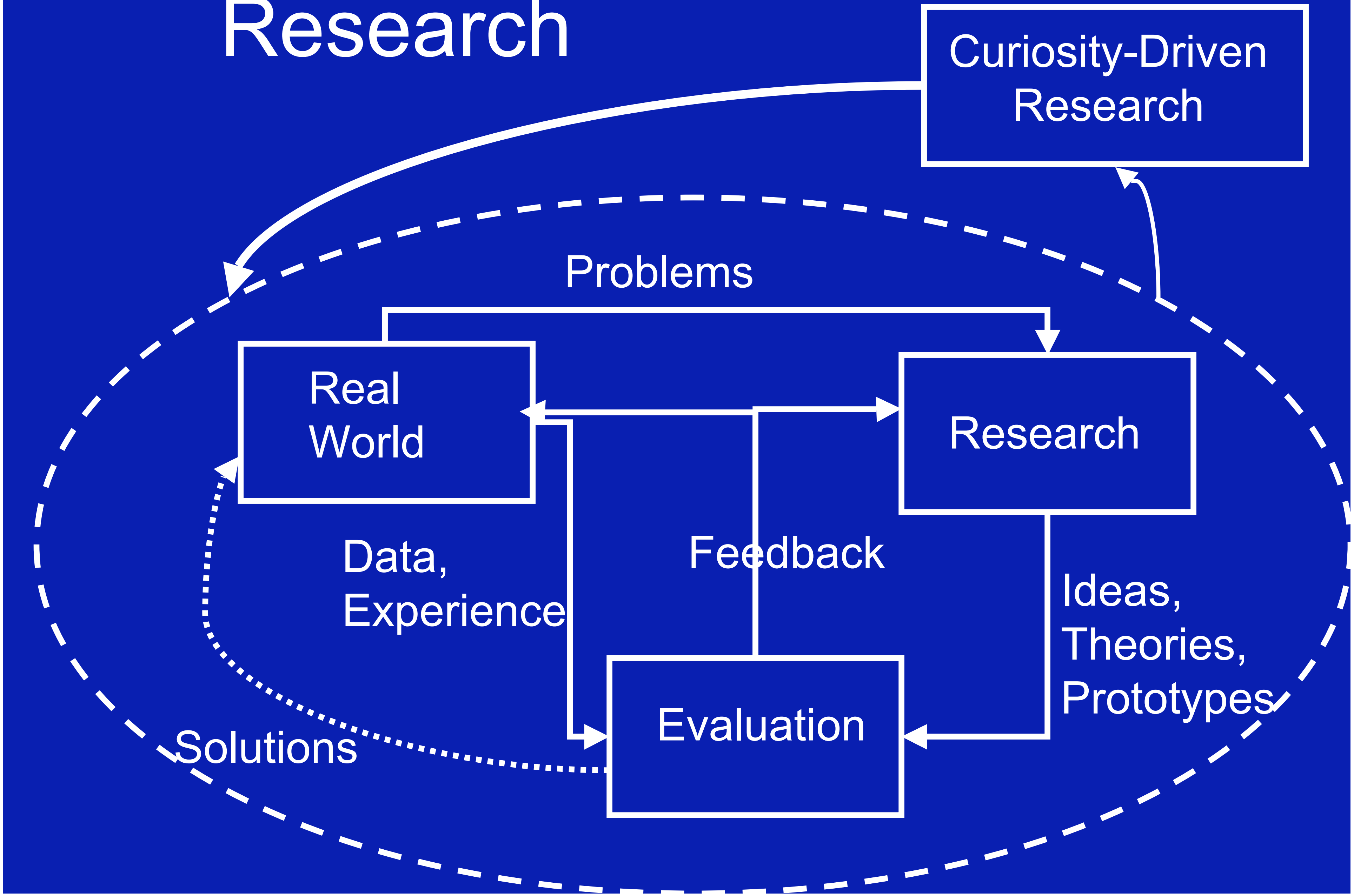
- Our conferences focus on answers
- Should they also address deep questions?
- Should they encourage more curiosity about our problem domains?
- Do we need a different format for this?
- Do we need this at all?

Maybe it is time for us to talk about all of this?

Grappling with Hard Problems Should Pique Curiosity

- It need not be embarrassing to be working on the same question for years, decades, even centuries
  - Physicists and biologists are proud to do this
- Having such problems can be an encouraging sign of the profundity of a discipline
- Software Engineering has such questions
  - Could we be proud and relieved?
  - Should we emphasize a focus on enunciating them and addressing them?

Curiosity-Driven Research



Well-articulated deep and enduring questions can help us

- Define what we are all about
- Set overall directions
- Maintain and build a sense of progress
- Explain and justify ourselves to others
  - Faculty colleagues
  - Industrial colleagues
  - Government funding sources

Deep, Curiosity-Driven Questions

- We have them
  - They have been there from the start
- Should we look for more of them?
  - Maybe we just have to acknowledge them?
- Should we talk about them?
  - In our best venues?
- Can they constitute a force that affects the future trajectory of our community?
- Should the community support this activity by
  - Seeking them?
  - Evaluating them?

Alan J. Perlis, in 1968

“…we recognize that a practical problem of considerable difficulty and importance has arisen: The successful design, production and maintenance of useful software systems.…The source of difficulty is…easy to identify, and yet its cure is hard to pinpoint.… Our problem has arisen from a change of scale.…we must assume that additional magnification of goal will take place without necessarily being preceded by the emergence of a satisfactory theory or.… tools. Not only must we know how to build special purpose systems, but how to combine them into larger ones.”

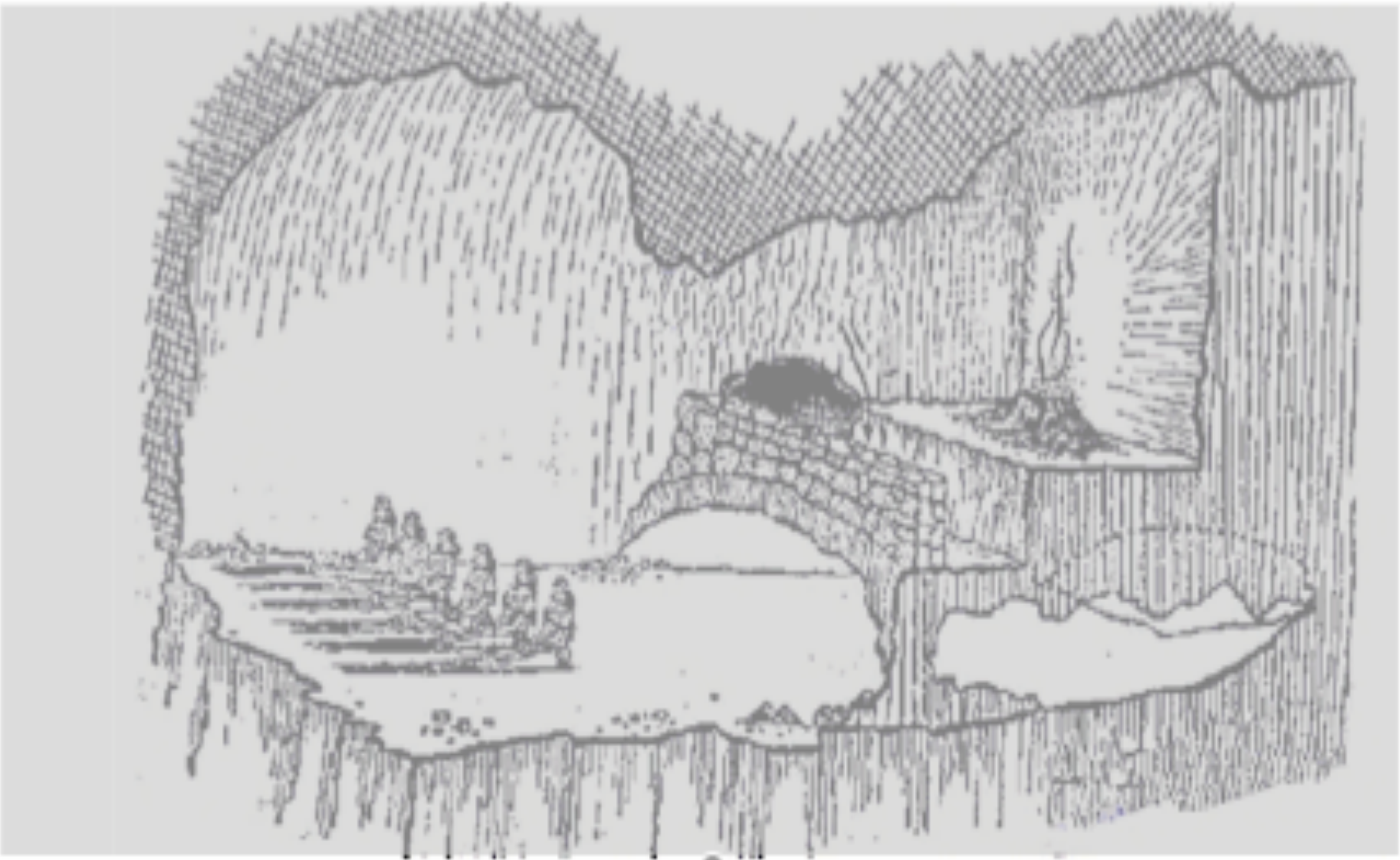
Other examples of Deep Questions?

What is Design?

- The noun
- The verb
- The US NSF Science of Design program is currently probing this.

What is the Relationship Between a Model and Reality?

- A representation of reality?
- What does that mean?
- Pondering that goes back (at least) to Plato
  - Allegory of the Cave



How to determine software quality?

- Or do we mean qualities?
- Which are they?
- Can we quantify them? How?
- Would help to know the nature of software

What is Execution?

What is software?

- Many negative characterizations
  - Not tangible, physical, sensable, etc.
- But few positive characterizations
- What are its properties, characteristics?
- Maybe understanding design, quality, modeling, execution will help?
- How can we engineer it without knowing its nature?

What is our Future?

- Should we be proactive in determining it?
- Should it be a balance between
  - Problems from real-world clients
  - Deep questions of our own formulation
- How can we nurture and foster discussion about this?

Should we be proactive in shaping

A Future for Software Engineering

?