

Strategic
Computing and Communications
Technology

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Research support

by
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Summary

- Classification of research
- The changing industrial research
- Market failure mechanisms in research
- Case for government support of research

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References

- *Funding a Revolution: Government Support for Computing Research* (NRC/CSTB, 1999)
- Donald E. Stokes, *Pasteur's Quadrant: Basic Science and Technological Innovation*, Brookings Institution Press, 1997

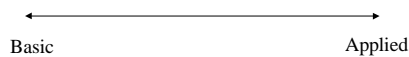
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Vannevar Bush

- Organized the research science community to contribute to WW II
- Defined the post-war scientific policy in his report *Science, the Endless Frontier*
- To this day, his influence persists, but the compact based on the Cold War is collapsing

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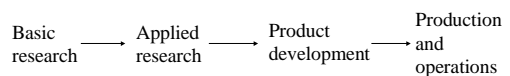
1-D model of research



- Research that is more basic is less applied and vice versa
- Dates to the Greeks, and to Francis Bacon
- Vannevar Bush: “applied research invariably drives out pure” and therefore basic research must be completely isolated from considerations of use

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Dynamic linear model for technology transfer



- Basic research: embarks on the unknown, enlarging the realm of the possible
- Applied research (or exploratory development): elaboration and application of the known
- Development: adaptation of research findings into products
- Each stage depends on the preceding

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Changes in industrial research

- With increasing competitiveness, research has changed radically
- Two interpretations:
 - Basic research has largely been abandoned
 - The linear model has been junked in favor of a superior model (in terms of corporate performance measures)

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Example: IBM research

- “Industry Solutions Laboratories” bring a stream of customers to interact with researchers
- “E-Commerce Institute” seeks to
 - seek interdisciplinary research between business, social sciences and technology
 - expand and leverage outside research activities

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Pasteur’s Quadrant

| | | Considerations of use? | |
|--------------------------------------|-----|------------------------|--------------------|
| | | No | Yes |
| Quest for fundamental understanding? | Yes | Bohr’s quadrant | Pasteur’s quadrant |
| | No | | Edison’s quadrant |

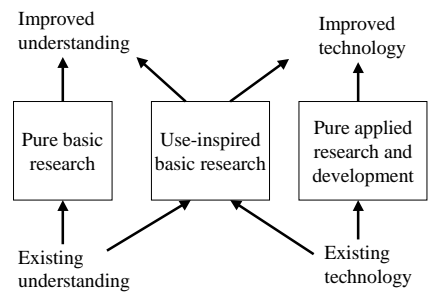
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Relationship to intellectual property

| | | Outcome a patent? | |
|----------------------------------|-----|-------------------|--------------------|
| | | No | Yes |
| Outcome a scholarly publication? | Yes | Bohr’s quadrant | Pasteur’s quadrant |
| | No | | Edison’s quadrant |

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Revised dynamic model



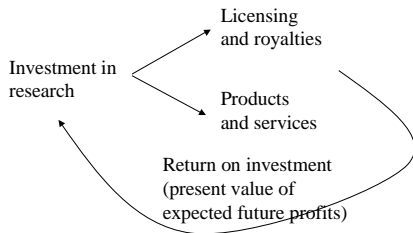
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Examples to discuss

- Transistor and integrated circuit
- Packet switching and Internet
- Graphical user interface
- Object-oriented programming
- Internet auction

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ROI criterion for research



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Some problems with ROI

- Discounts profits far in future
 - Patents run out in 17-20 years anyway
- Discounts high risk or uncertain payoffs
- Ignores return to others
 - Public good
 - Future generations

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Market failure mechanisms

- Market-supported research under invests in research
 - with a long-delayed payoff
 - with uncertain outcome
 - seeking fundamental understanding
- First two shortcomings can be addressed by sharing costs and risks of “pre-competitive” research in consortia

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Pure public good

- Easy appropriation
 - Difficult to put to use without revealing ideas or at least possibilities
- Nonrival in use
 - Using an idea doesn’t preclude others from using it
- Value of a pure public good is much greater to society as a whole than party that created it
 - Free riders benefit from lower costs
 - Patents are public and allow others to seek other means to the same end

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Government sponsored research

- Seek understanding
- Take long time horizon in expected outcomes
- Take high risk
 - Portfolio of projects with hope of some payoffs
- Maximizes benefit of free exploitation and future generations
- University research contributes to education

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Tire tracks



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