ENGINEERING OUR FUTURE

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THERE'S REASON TO BE HOPEFUL

“He who can, does. He who cannot, teaches.”

–George Bernard Shaw

AT MAC, WE ASK

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Should engineers and educators lag technology and society?

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Should engineers anticipate advances and prepare to create a beneficial future?

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How should engineering education evolve?

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Should engineers anticipate advances and prepare to create a beneficial future? YES

How should engineering education evolve?

THAT'S THE MILLION DOLLAR QUESTION

UNIVERSITIES LEAD THE WAY IN INNOVATION — BOTH IN THE CLASSROOM AND THROUGH RESEARCH:
WE DON'T REINFORCE SHAW'S FAMOUS DICTUM

GLOBAL NEEDS

Over 2002 and 2003, Professor Richard E. Smalley, 1996 Nobel Laureate for Chemistry, *developed a list of the Top Ten Problems Facing Humanity over the next 50 Years*

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- Food

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- Environment

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U.S. NAE GRAND CHALLENGES

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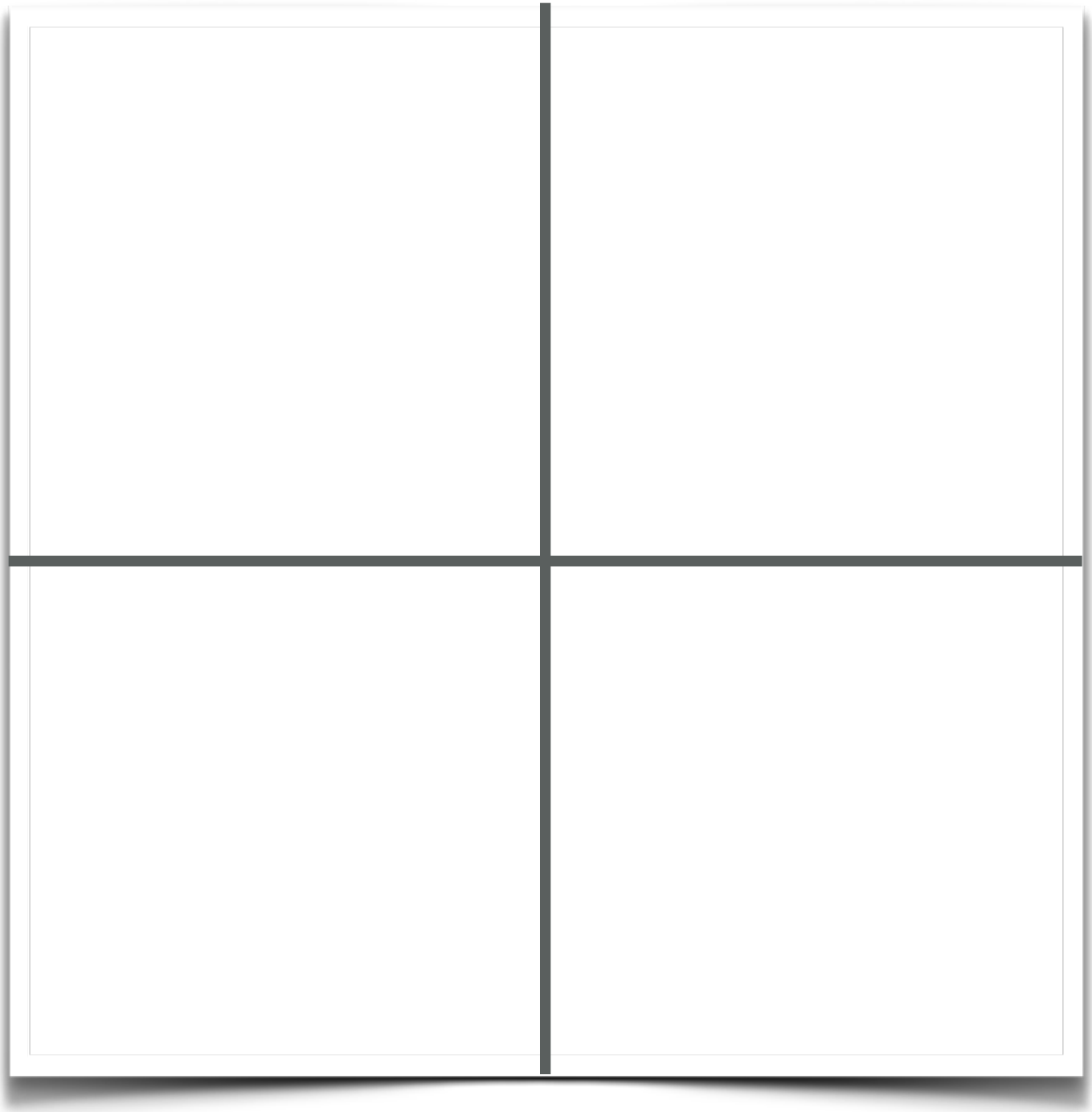
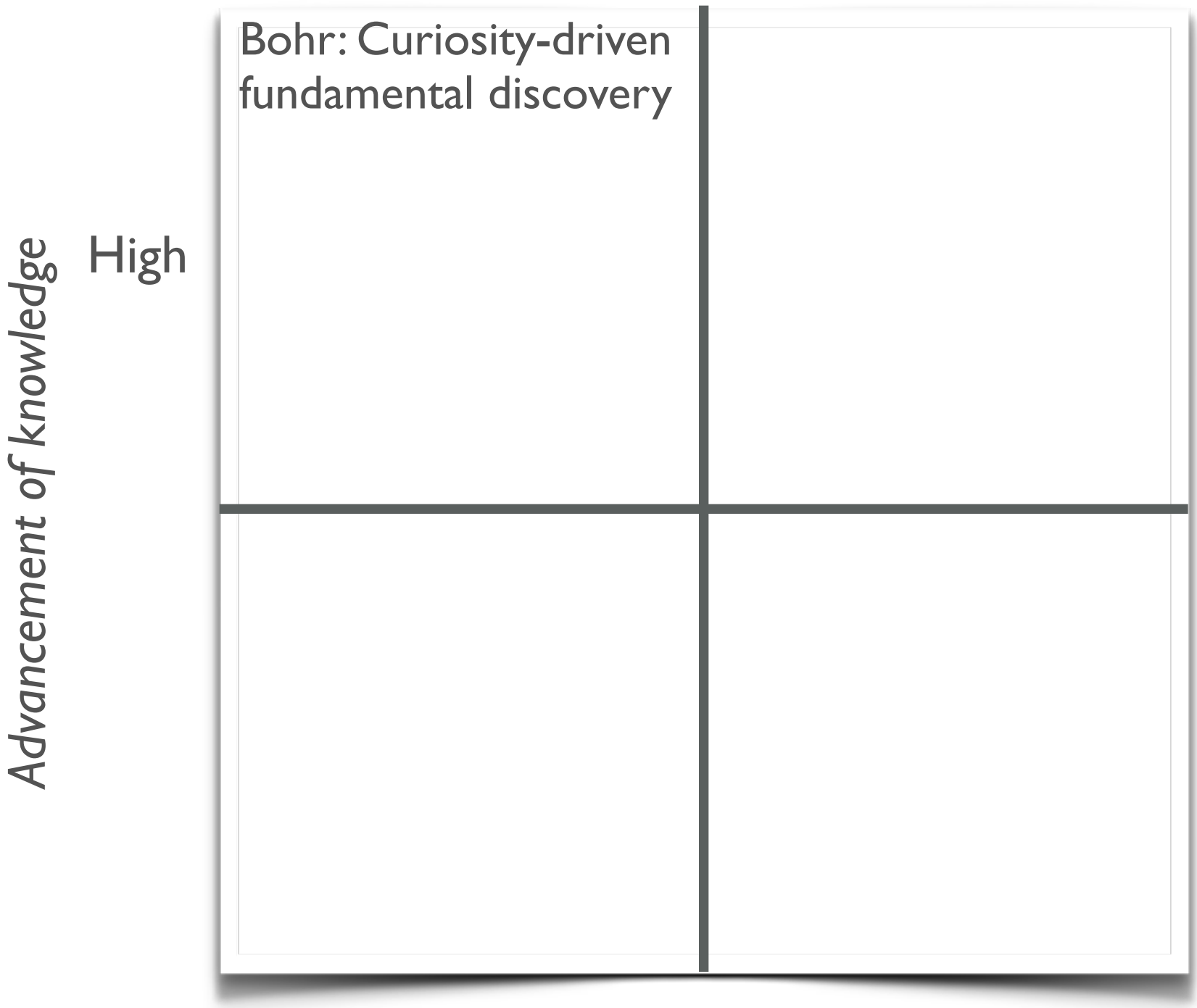
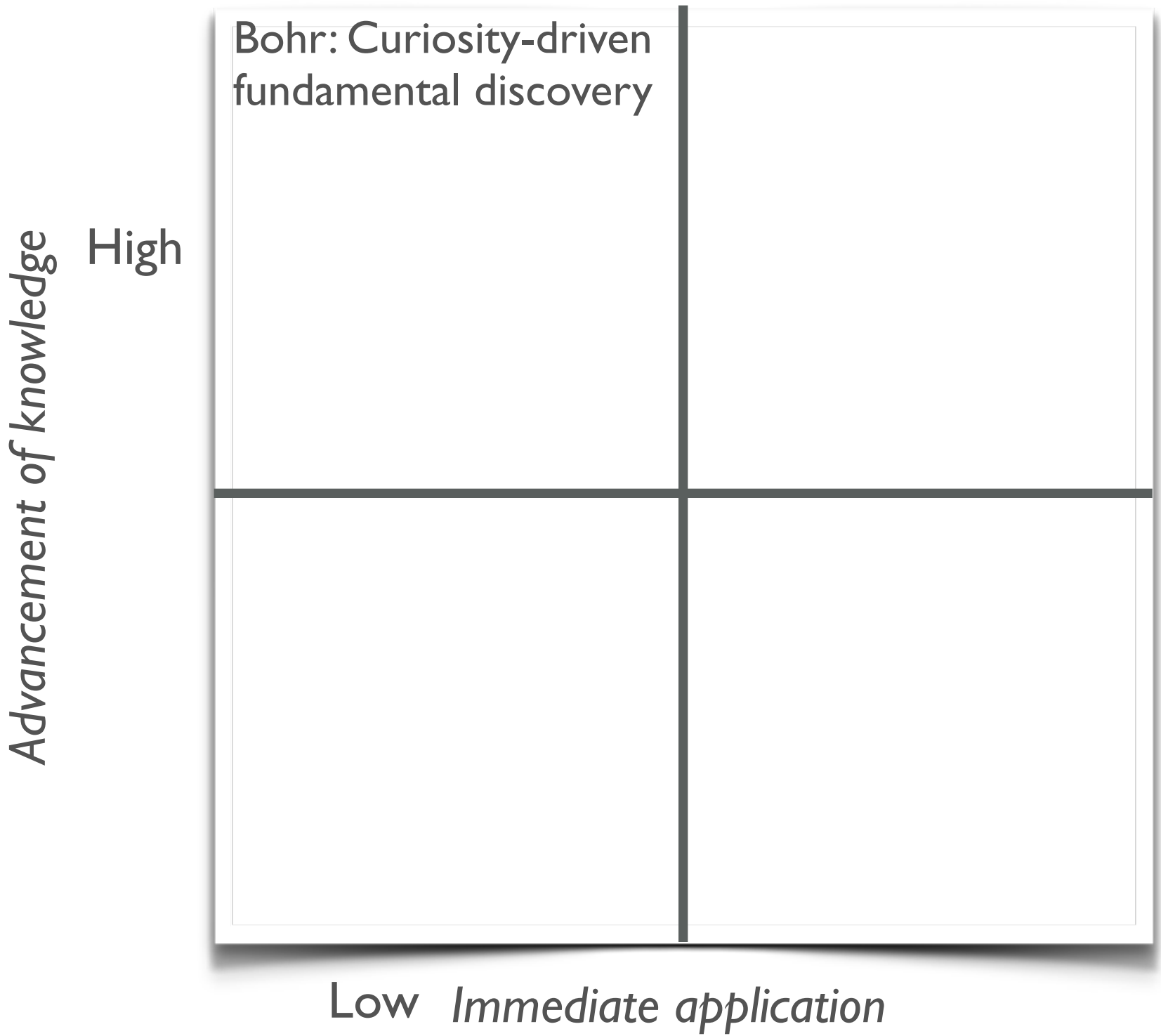
14. Engineer the tools of scientific discovery

LET'S BACK UP A LITTLE BIT



Bohr: Curiosity-driven fundamental discovery


Bohr: Curiosity-driven fundamental discovery
High
Advancement of knowledge


Bohr: Curiosity-driven fundamental discovery
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Low
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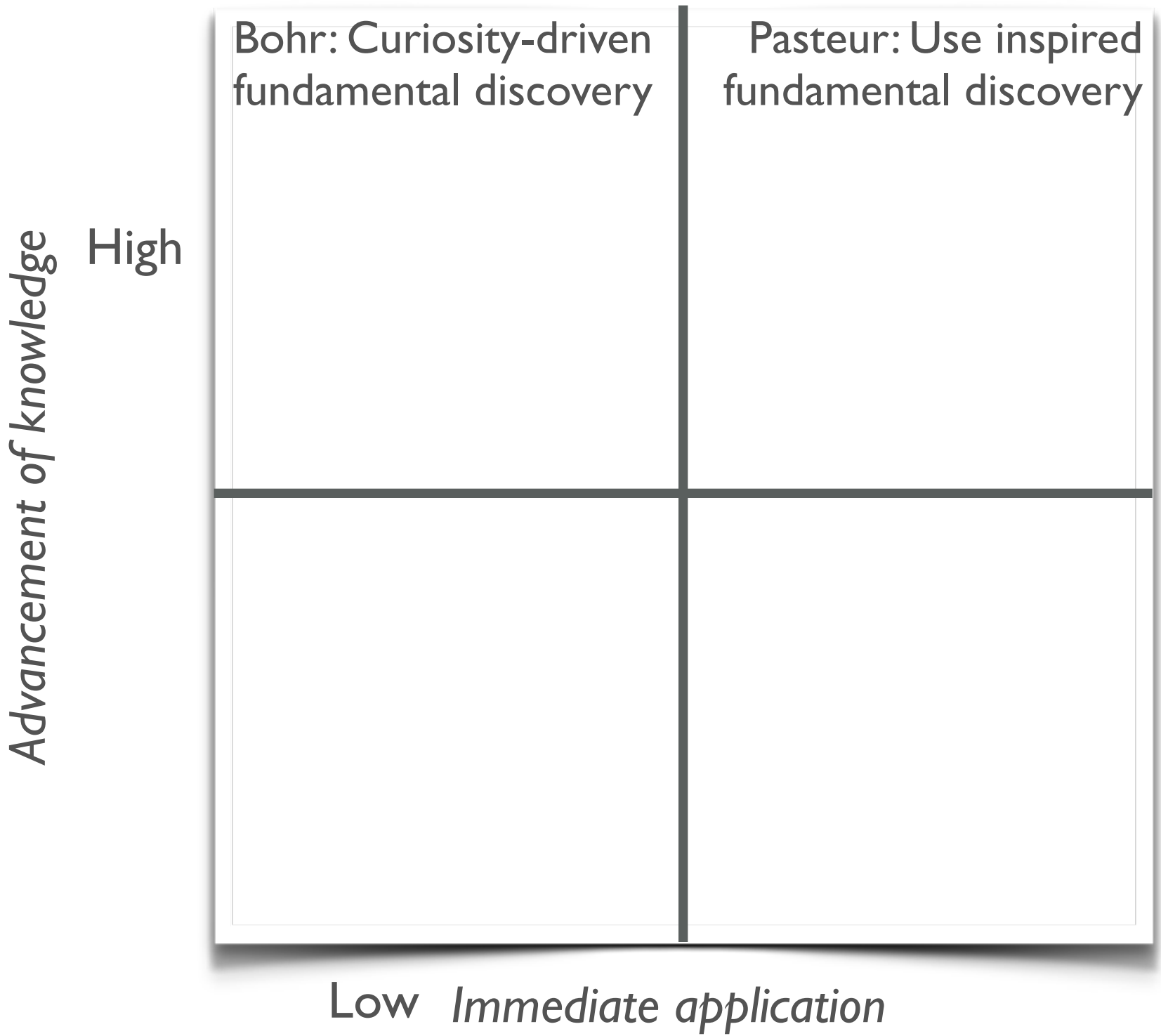
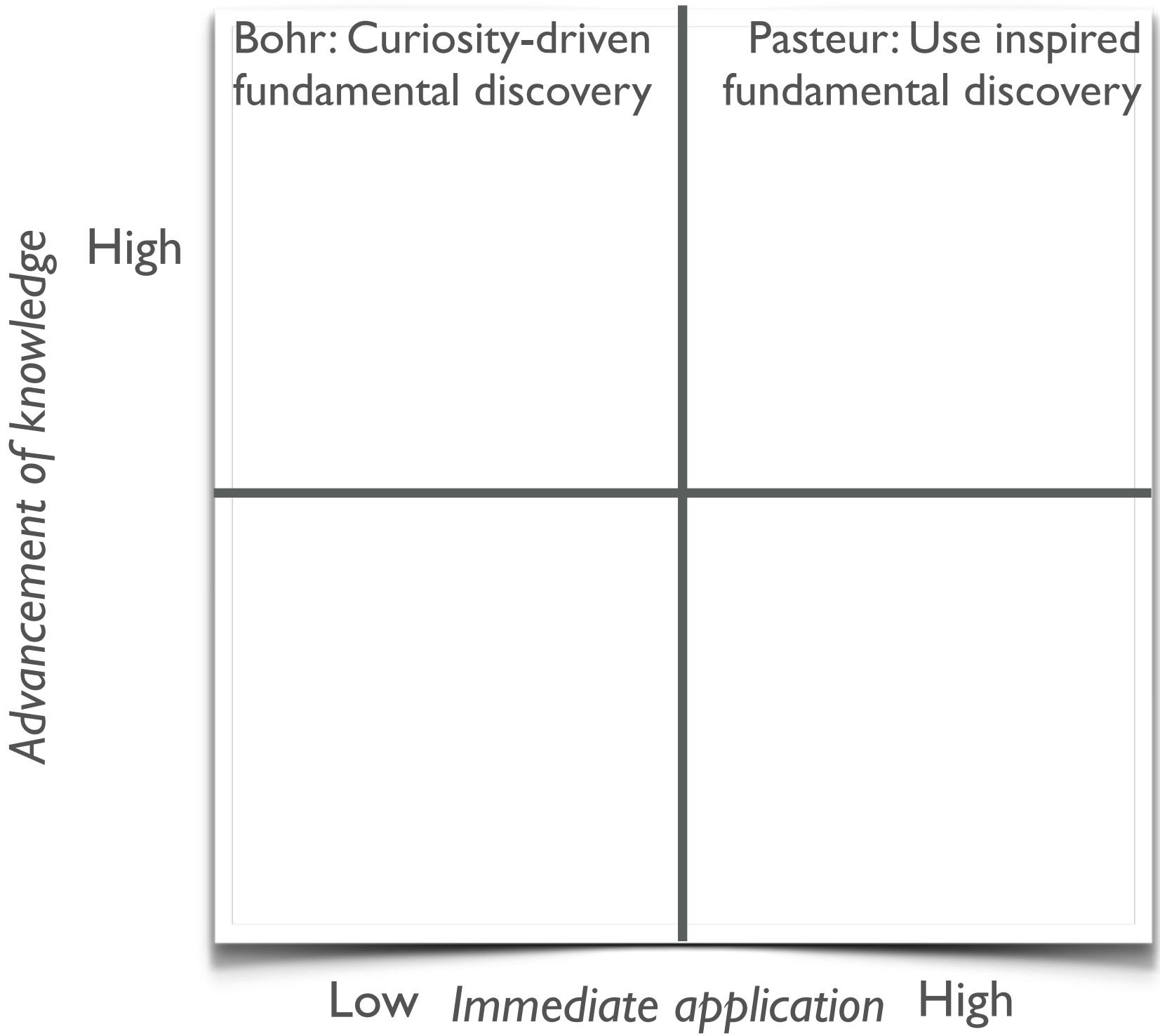

Bohr: Curiosity-driven fundamental discovery
Pasteur: Use inspired fundamental discovery
High
Advancement of knowledge
Low
Immediate application


Bohr: Curiosity-driven fundamental discovery
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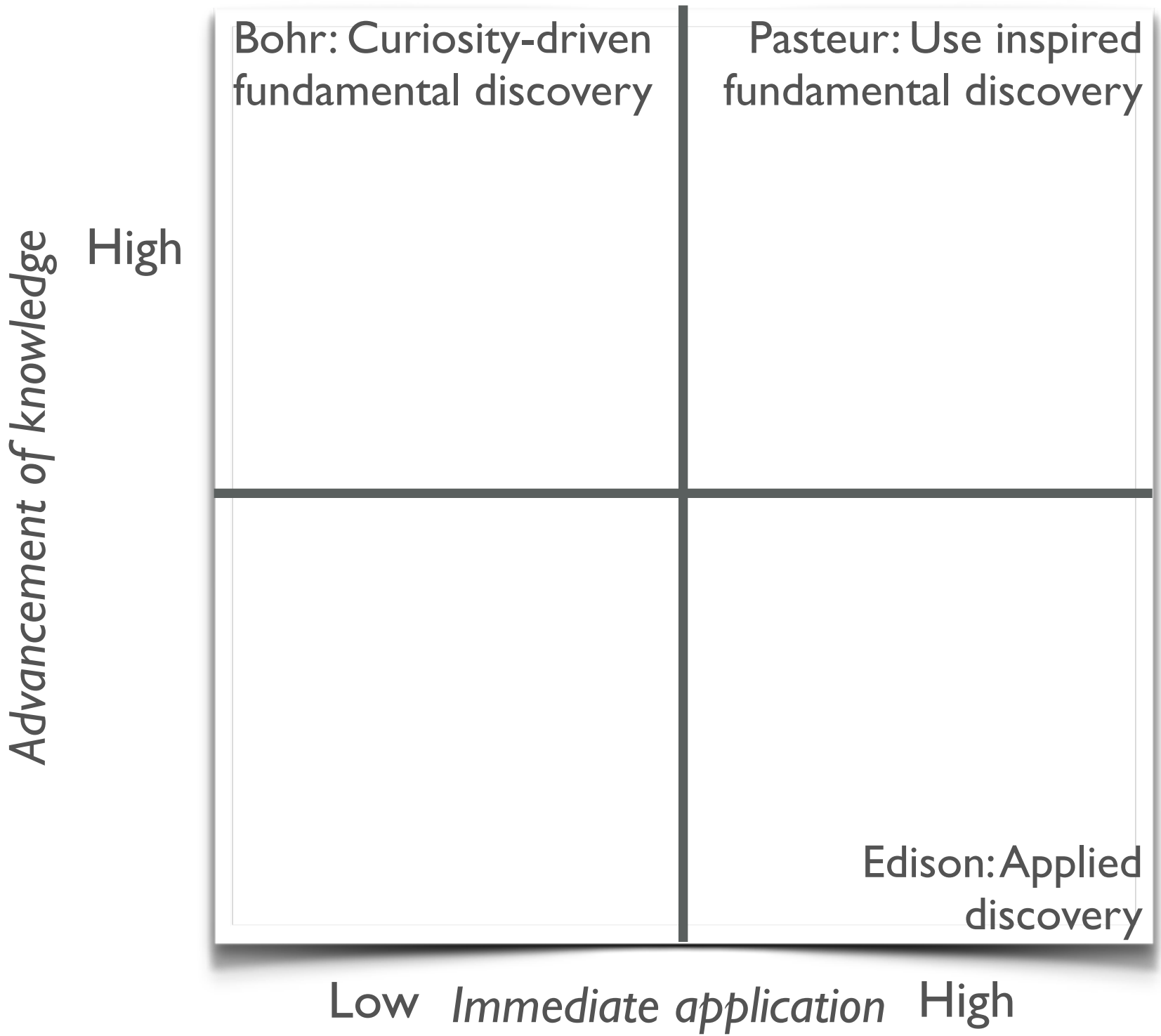
Bohr: Curiosity-driven fundamental discovery
Pasteur: Use inspired fundamental discovery
Edison: Applied discovery
Advancement of knowledge
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Immediate application
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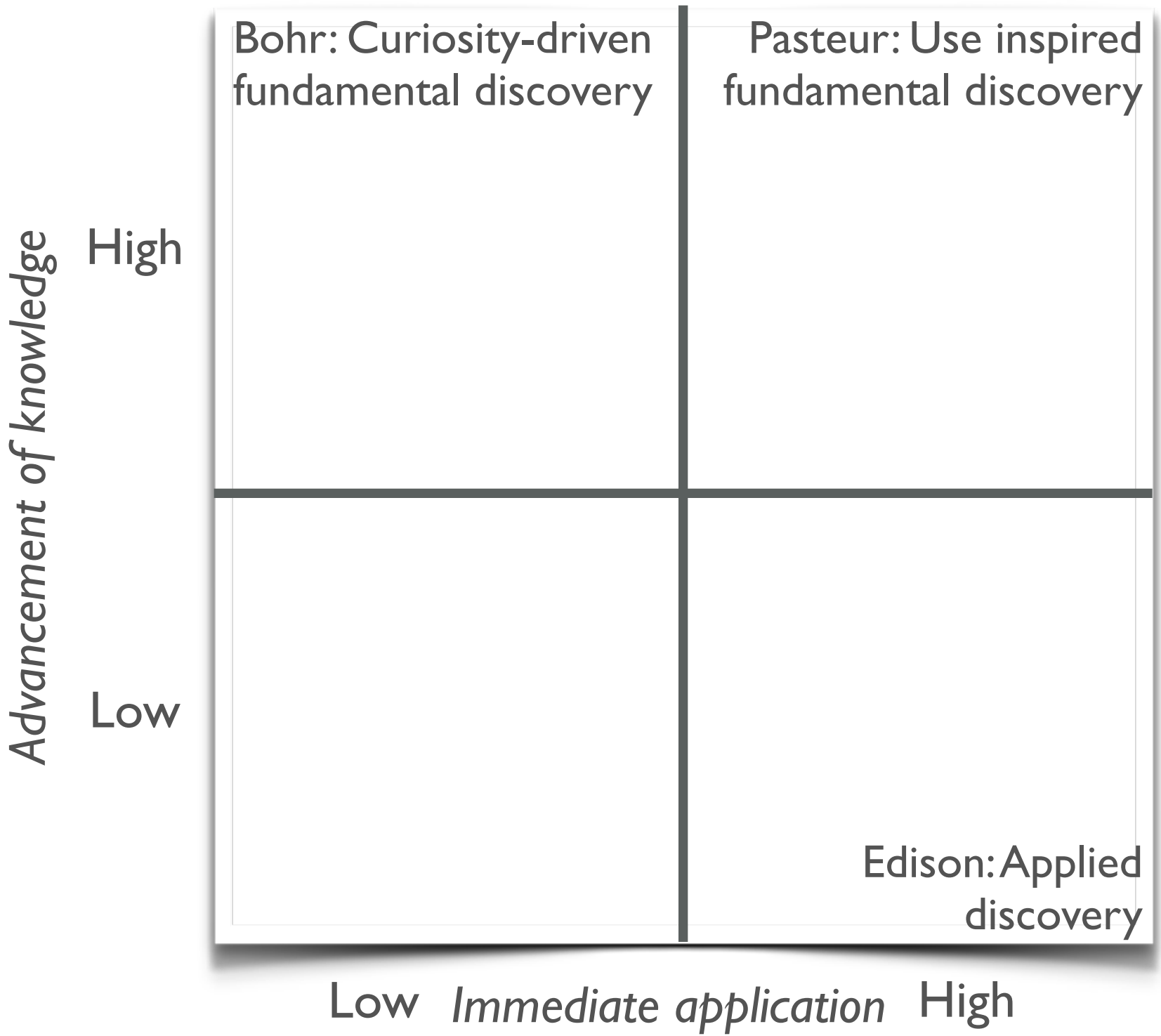
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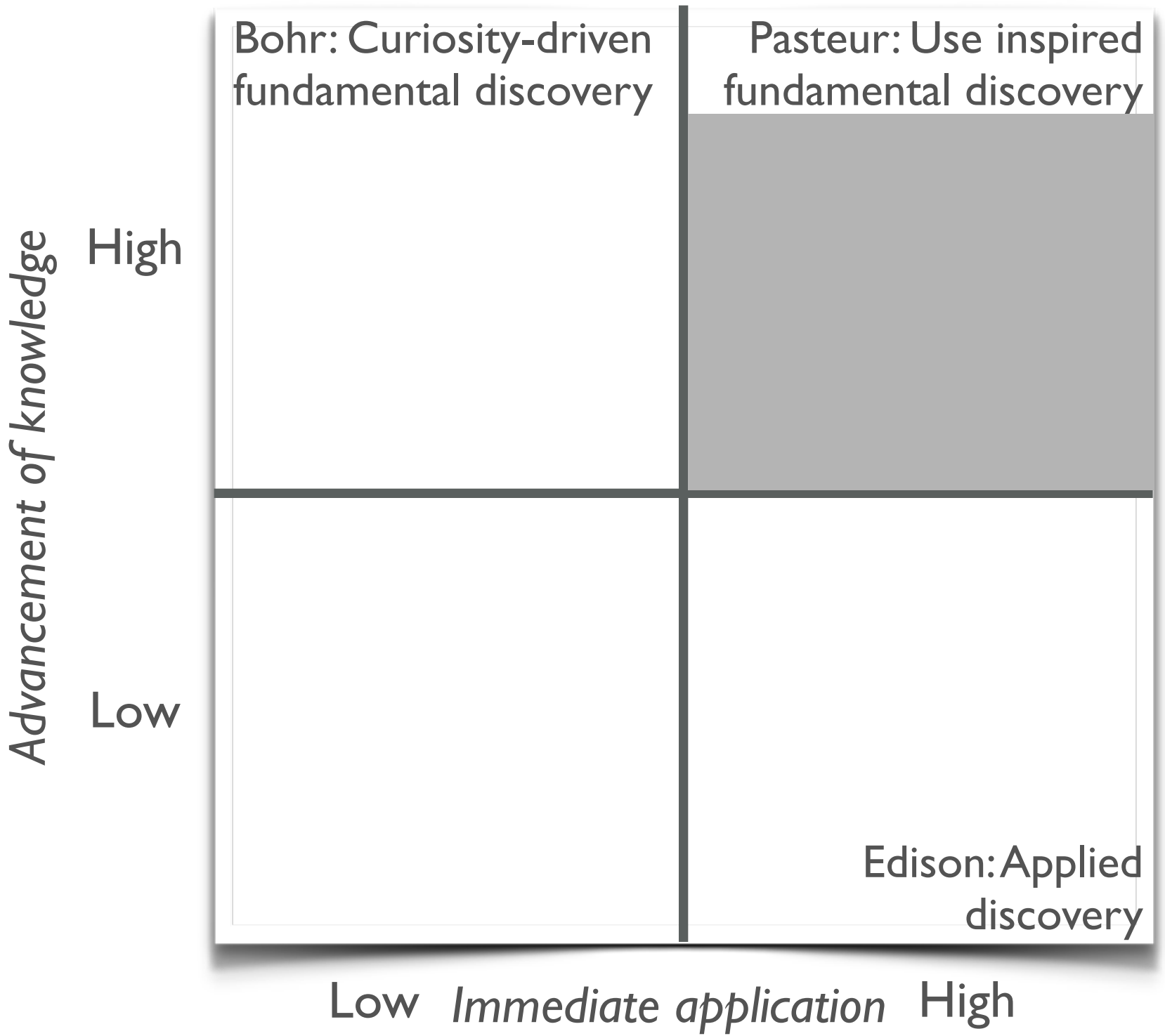
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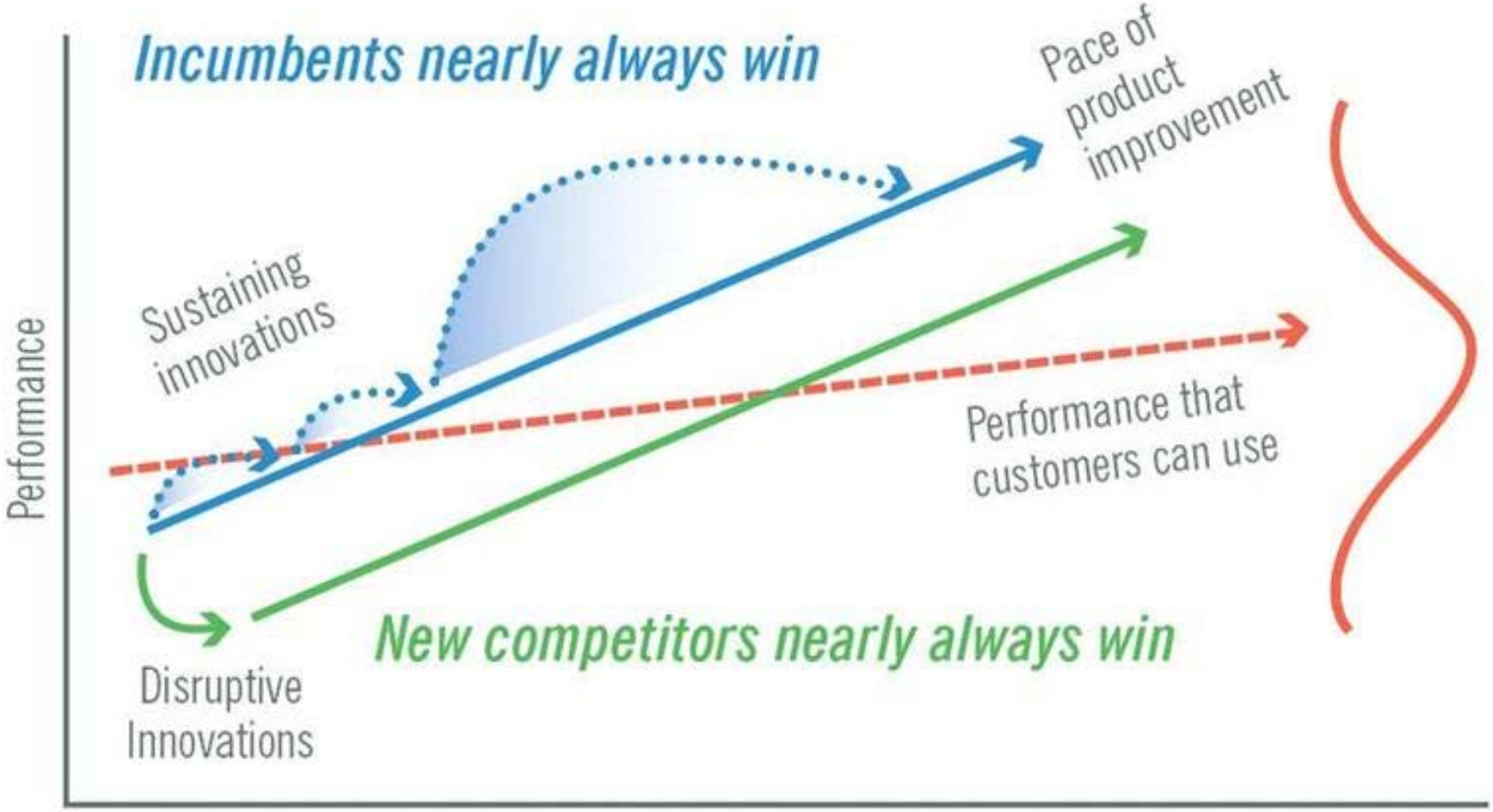
WHAT DOES USEFUL MEAN?

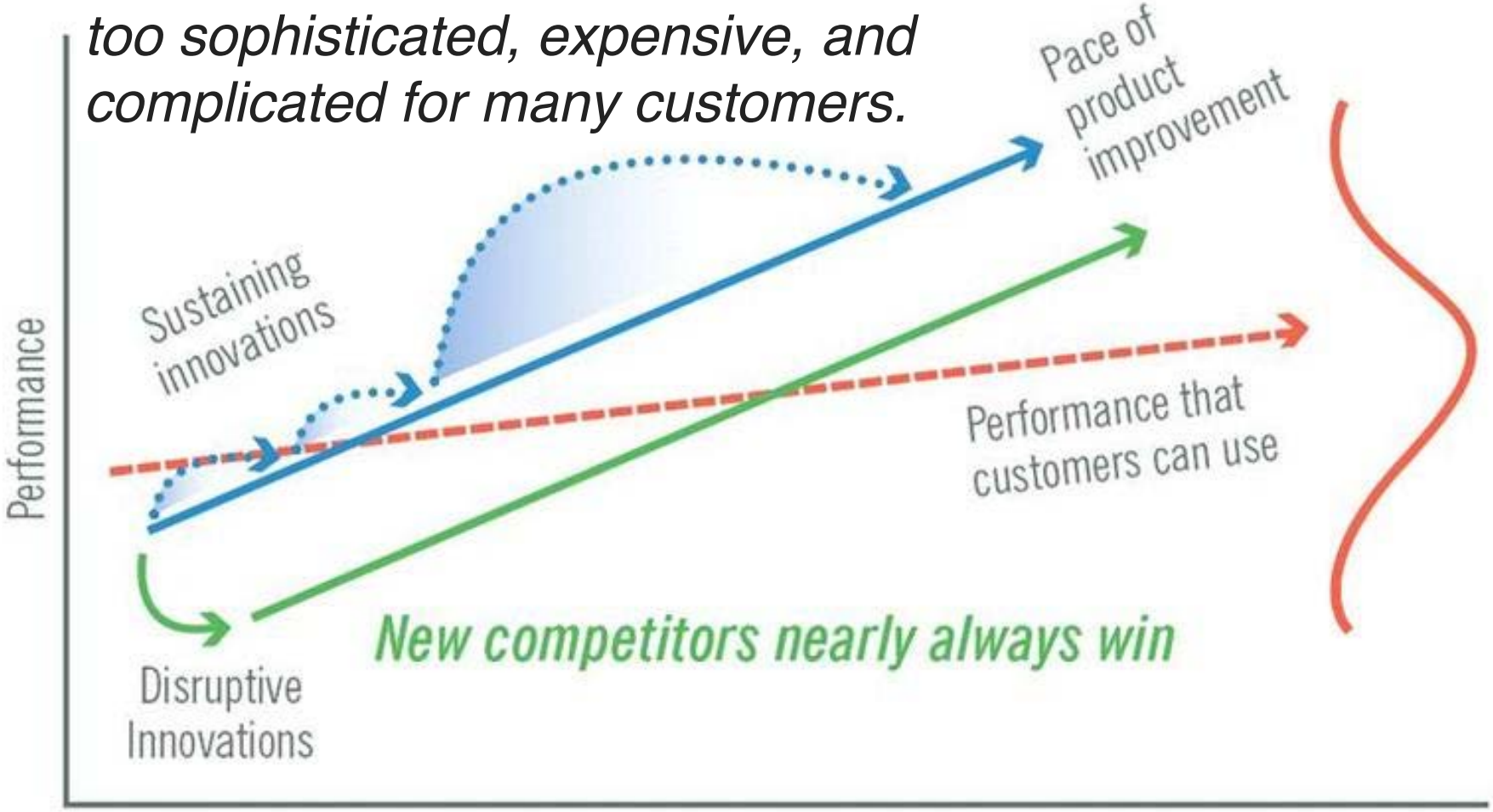
DISRUPTIVE INNOVATION



Source: Clayton Christensen, *The Innovators Solution*

DISRUPTIVE INNOVATION

Innovations produce stuff that is too sophisticated, expensive, and complicated for many customers.



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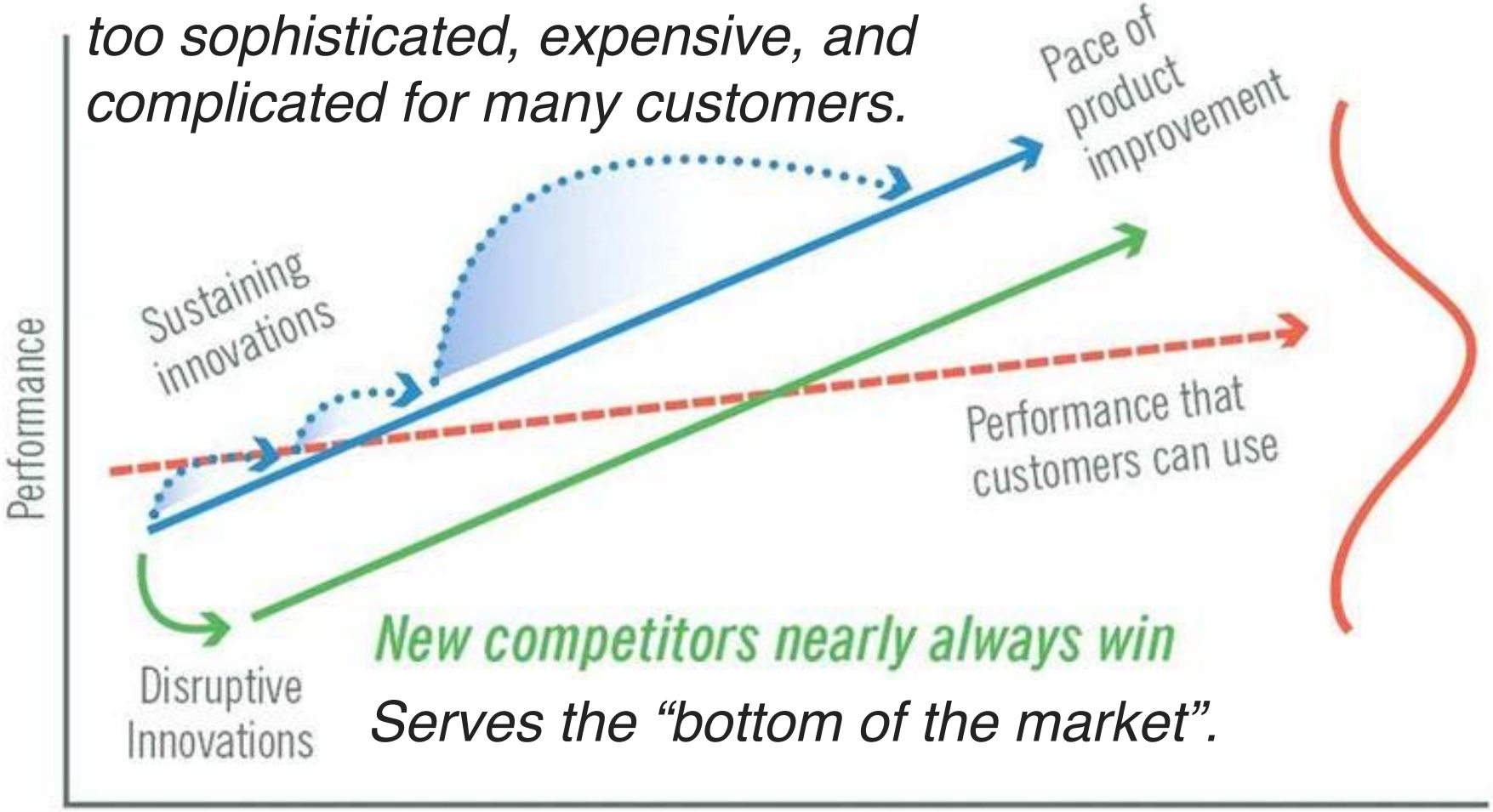


Serves the "bottom of the market".

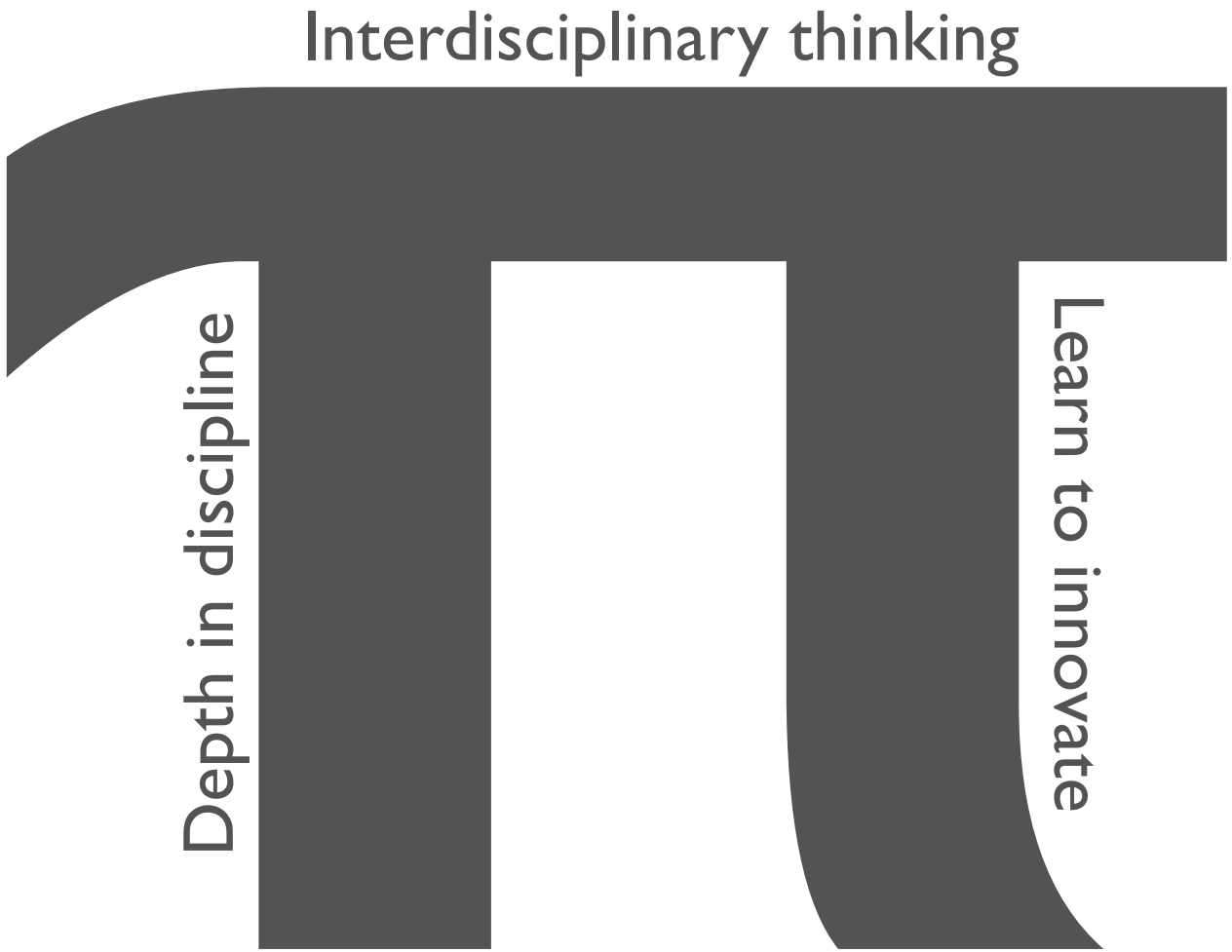
Source: Clayton Christensen, *The Innovators Solution*

EXAMPLES OF DISRUPTION

Disruptor	*Disrupted*
Personal computers	Mainframe and mini computers
Mini mills	Integrated steel mills
Cellular phones	Fixed line telephony
Community colleges	Four-year universities
Discount retailers	Full-service department stores
Retail medical clinics	Traditional doctor's offices
Internet retailers	Bricks and mortar retailers

— Clayton Christensen

PI-SHAPED GRADUATES



WHAT'S A POSSIBLE EMERGING DISRUPTION?

INTERNET OF THINGS (*CISCO*)

- Twenty five billion devices connected to the Internet by 2015 and fifty billion by 2020 (*Cisco*).
    - Will drive $14.4 trillion in value for companies and industries worldwide in the next decade.

INTERNET OF THINGS (*INTEL*)

- Fifteen billion embedded devices connected to the Internet by 2015 (*Intel*).
    - Intelligent embedded devices will connect with larger computing systems, and to each other, without human intervention.

INTERNET OF THINGS (*ERICSSON*)

- By 2020
  - Three billion subscribers buying information 24/7 basis with 5-10 connected devices each.
  - 1.5 billion vehicles globally, not counting trams and railways.
  - 3 billion utility meters (electricity, water and gas).
  - Hundred billion processors shipped, capable of processing information and communicating.

INTERNET OF THINGS (*MCKINSEY GLOBAL INSTITUTE*)

- The largest impacts would be in health care and manufacturing.
    - Across health-care applications, economic impact of $1.1 trillion to $2.5 trillion per year by 2025.

WHAT'S THE HOLD UP?

INTERNET OF THINGS (*ARTHUR D. LITTLE*)

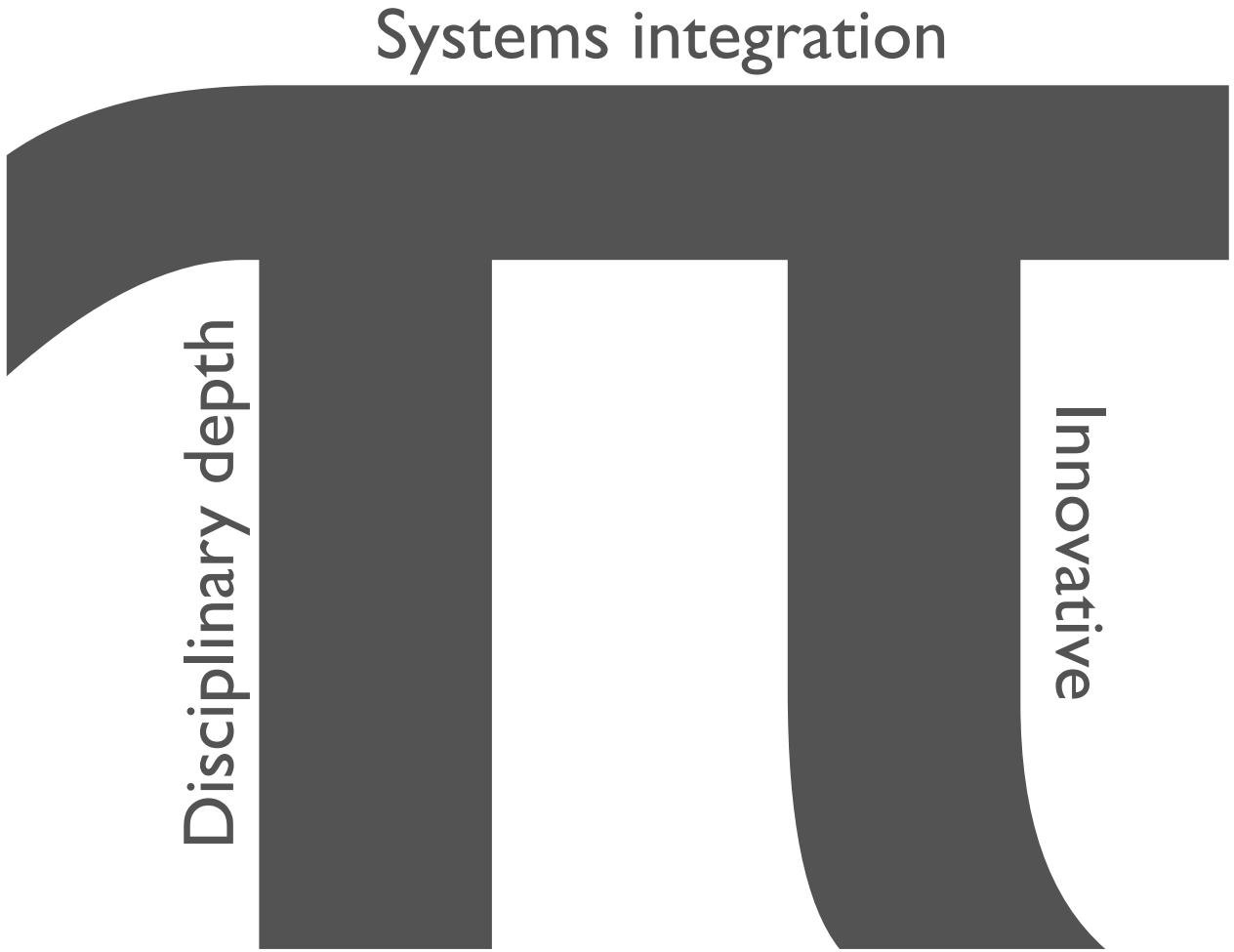
- The industry is scattered today.
  - Diverse types of hardware, software and service players populate fragmented value chain.
- For market to take off, innovative players must take the lead to spread easy-to-use and affordable smart solutions, just as Apple's iPhone revolutionized and built the smartphone market.

(SOME) GRAND CHALLENGES

1. Energy consumption.
2. Secure physical assets.
3. Configuration and connectivity.
4. Standardized interfaces.
5. Instrumentation and feedback.
6. Data security and privacy.
7. Governance, accountability, legislation and jurisdiction.

EDUCATE ENGINEERS TO ALSO BE INTEGRATORS WHO CONCEPTUALIZE SYSTEMS

PI-SHAPED EDUCATION



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