Advanced research projects between Intel and top universities - initiatives, motivations, results, implementations



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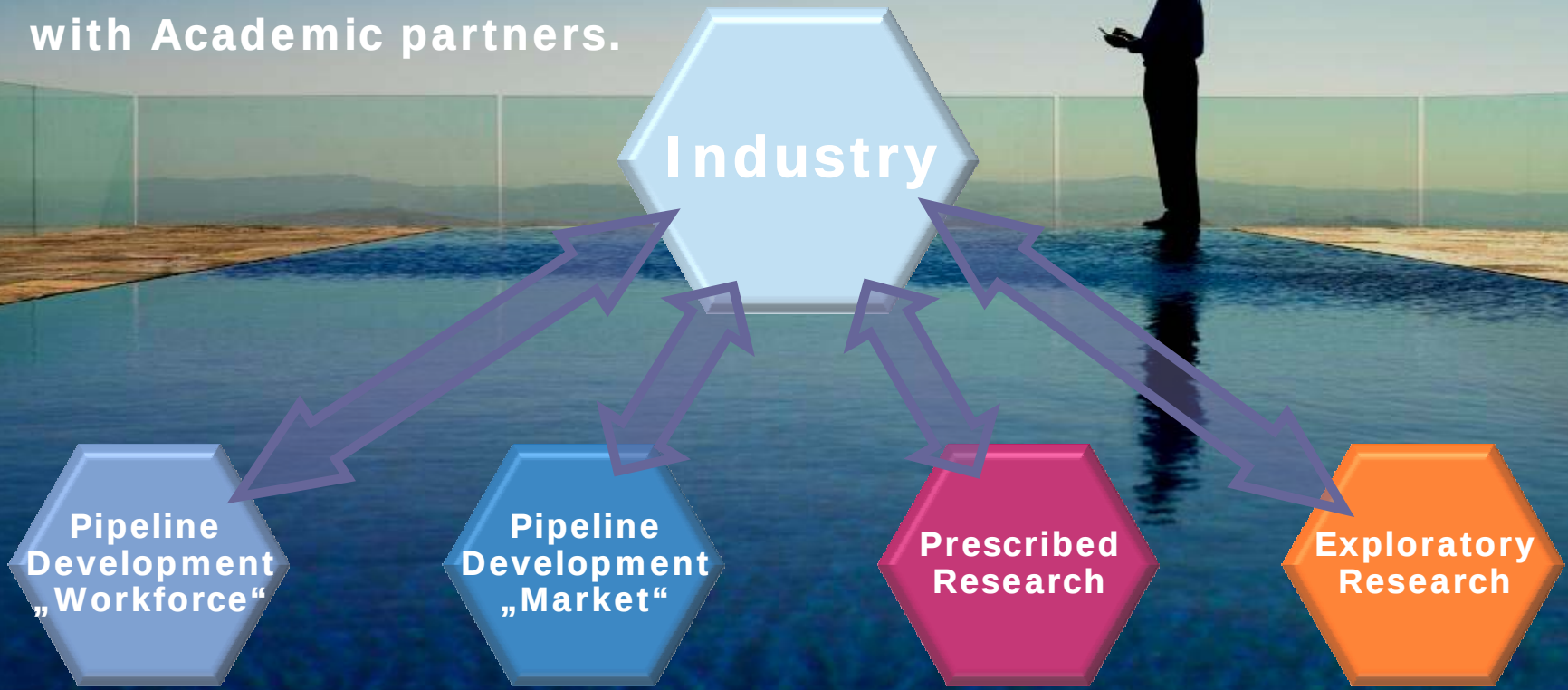
Working with Academic Partners – Global Academic Networking

Before we address HOW industry collaborates with Academic Partners we first need to address WHY industry collaborates with Academic partners.



Pipeline Development “Workforce”

- Pipeline Development of a Workforce means developing a continuous flow of graduates with the disciplines (ex.: Chemistry, Physics, Computer Science…) and levels required (BSc, MSc, PhD) to fullfil the hiring needs of the industry partner.

- This requires a close collaboration and understanding of the requirements of industry but also of the limitations academia has.

- This can result in a very close relationship in curricula development, MSc and PhD thesis as well as internships.

Pipeline Development “Market”

Pipeline Development „Market“

- Pipeline Development of a „Market“ means developing a continuous flow of graduates with the disciplines (ex.: Chemistry, Physics, Computer Science…) and levels required (BSc, MSc, PhD) to fullfil the hiring AND DEVELOPMENT needs of the MARKET.

- In some cases talent for and in the market needs to be developed before new technology can be deployed. (ex.: Wireless)

- This requires a close collaboration and understanding of the requirements of the MARKET‘s present and future needs.

Prescribed Research

Prescribed Research

To discuss the Research aspects we first need to understand Innovation models:

- **Closed Innovation**
- **Open Innovation**

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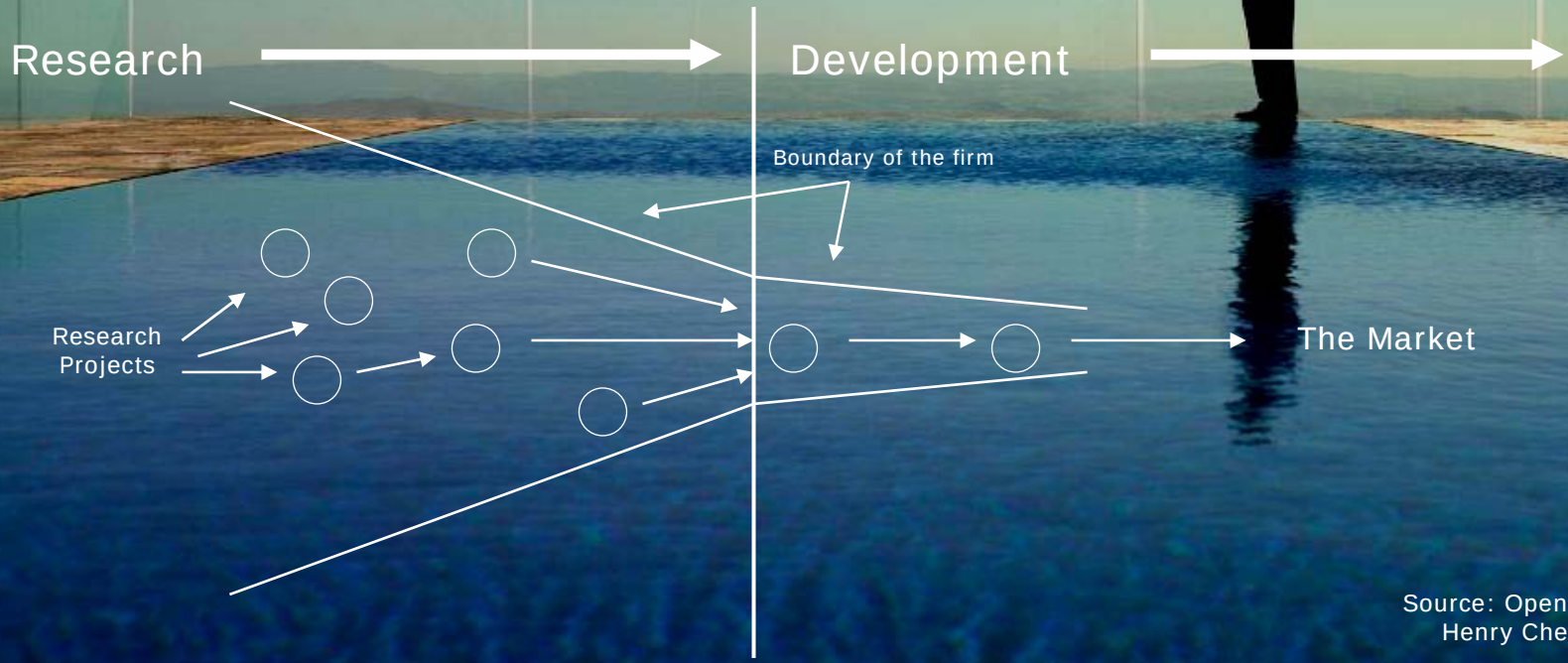
Open Innovation

Obviously, talking about Open Innovation, there must be something like „Closed Innovation“.

So lets first cover the **„Closed Innovation Paradigm“**



Source: Open Innovation
Henry Chesbrough

Open Innovation

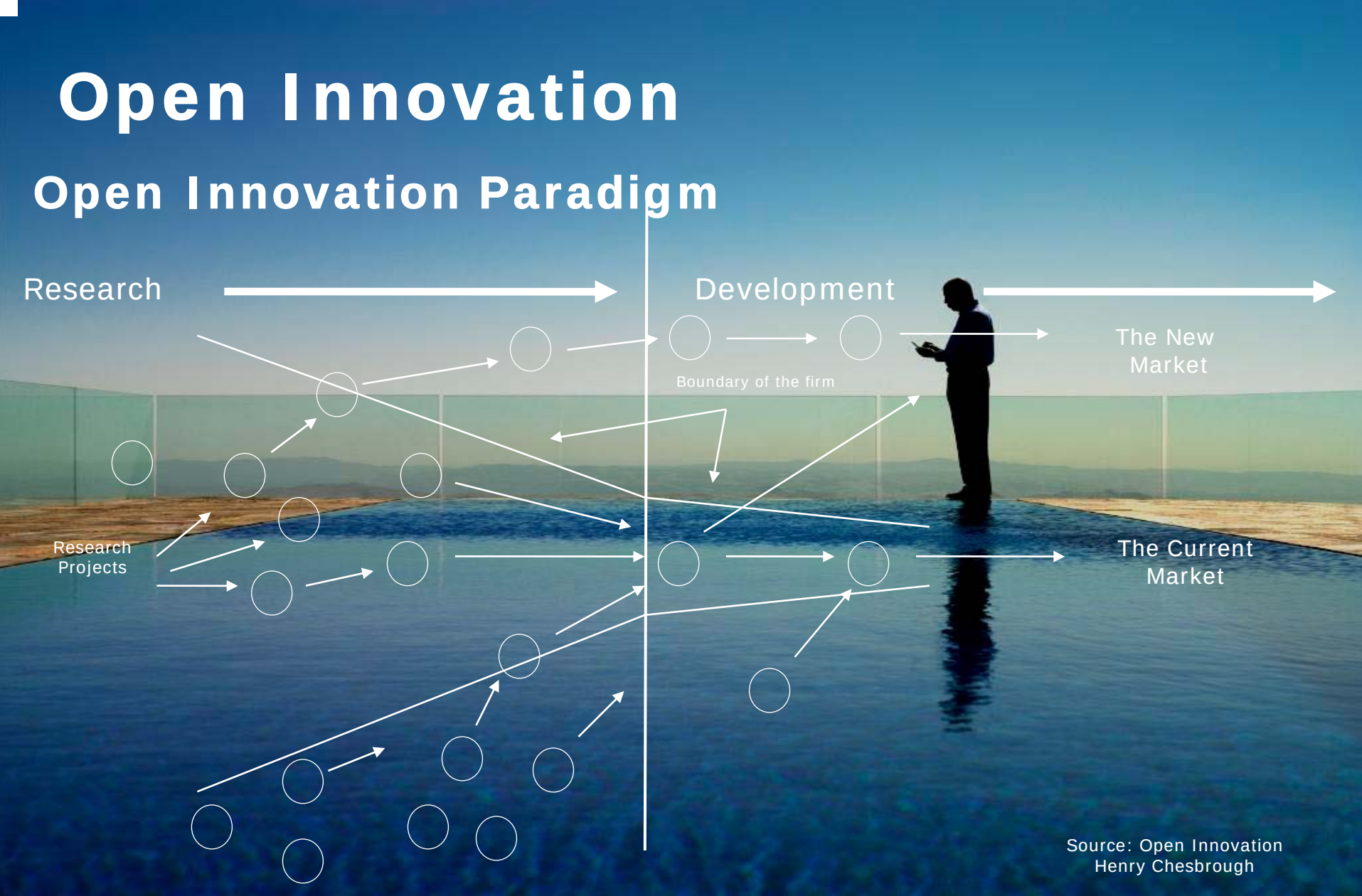
Assumptions of Closed Innovation:

- We should hire the best and brightest people, so that the smartest people in the industry work for us.
- In order to bring new products and services to the market, we must discover and develop them ourselves.
- If we discover it ourselves, we will get to market first
- The company that gets an innovation to market first will usually win.
- If we lead the industry in making investments in R&D, we will discover the best and the most ideas and will come to lead the market as well.
- We should control our intellectual property, so that our competitors don‘t profit from our ideas.

Source: Open Innovation
Henry Chesbrough

Open Innovation

Open Innovation Paradigm



Open Innovation

Assumptions of Open Innovation:

- Not all the smart people work for us. We need to work with smart people inside and outside of our company.
- External R&D can create significant value; internal R&D is needed to claim some portion of the value.
- We don‘t have to originate the research to profit from it.
- Building a better business model is better than getting to market first.
- If we make best use of internal and external ideas, we will win.
- We should profit from other‘s use of our IP, and we should buy other‘s IP whenever it advances our own business model.

Source: Open Innovation
Henry Chesbrough

Open Innovation (Intro)

Comparison: Closed / Open Innovation:

•Examples of Industries: nuclear reactors, mainframe computers	•Examples of Industries: PCs, movies
•Largely internal ideas	•Many external ideas
•Low Labor mobility	•High Labor mobility
•Little VC	•Active VC
•Few, weak start-ups	•Numerous start-ups
•Universities unimportant	•Universities very important

Source: Open Innovation
Henry Chesbrough

Prescribed Research

Prescribed Research

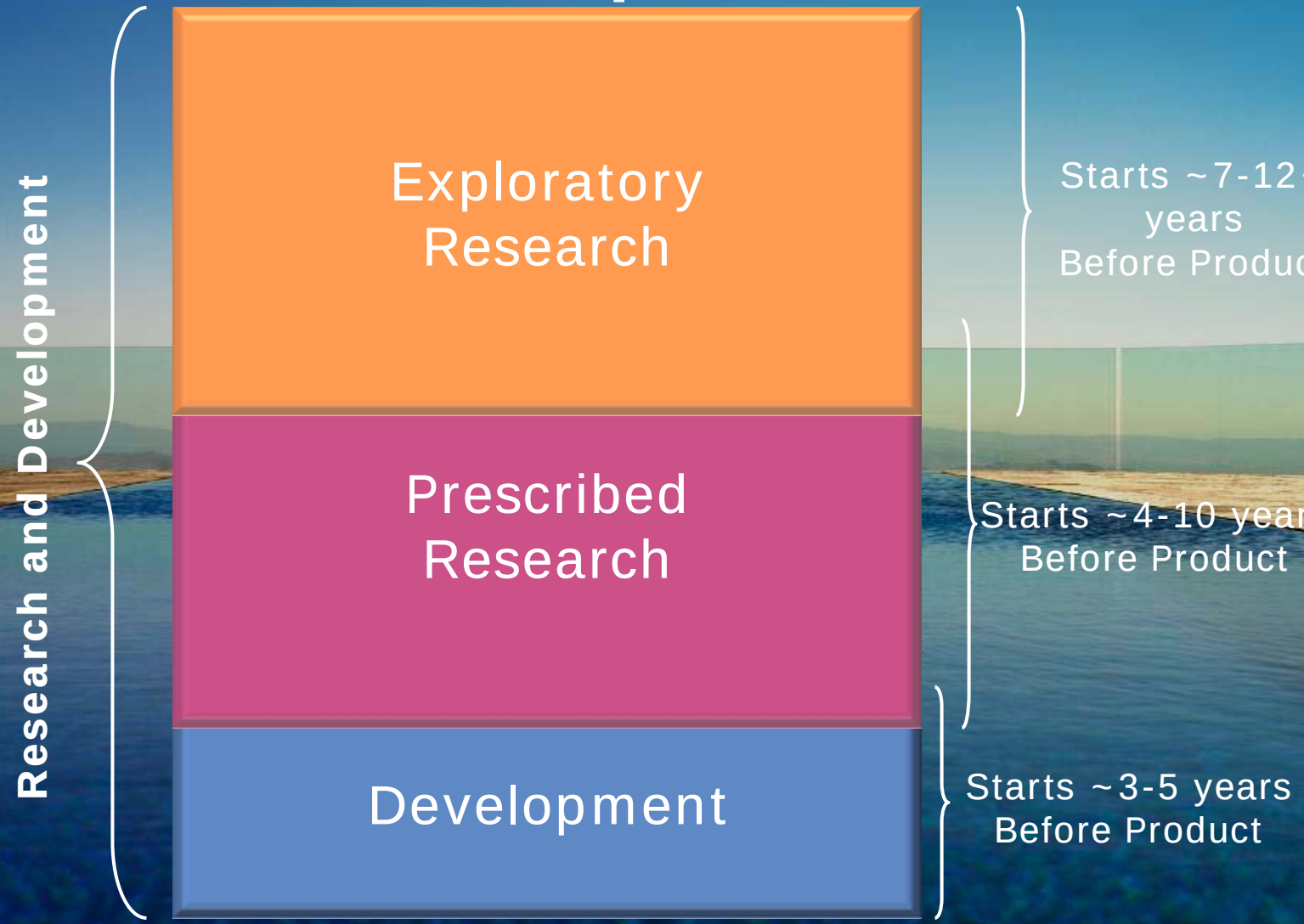
- Prescribed Research is in a way contracted research.
- The motivation to „prescribe“ research on certain issues can be manyfold.
- The most common reasons are resource constraints or lack of expertise or both.
- Lets envision we are travelling at 200 km/h in dense fog.
- We see several shadows ahead, but we cannot focus on all of them at the same time, but we need to recognise if any of those will have impact and for which of them we need to take what action.
- We would then prescribe research to academia very focussed on each of those shadows to understand their impact.

Exploratory Research

Exploratory Research

- Using the same anology of driving 200 km/h in fog, this time we have slightly different scenario and objectives.
- We see nothing through the fog. Our vision is limited.
- We are though paranoia of knowing if the road is blocked (i.e. a deadend) and need to take an exit.
- Or there is a leg of the road which requires to slow to 30 km/h to still make the curve before accelerating again.
- For this type of research you need „scouts“ who are miles ahead of you and help you to take the right decisions and actions.
- For this we would engage scouts from academia with specific knowledge in areas we are heading for.

Research and Development



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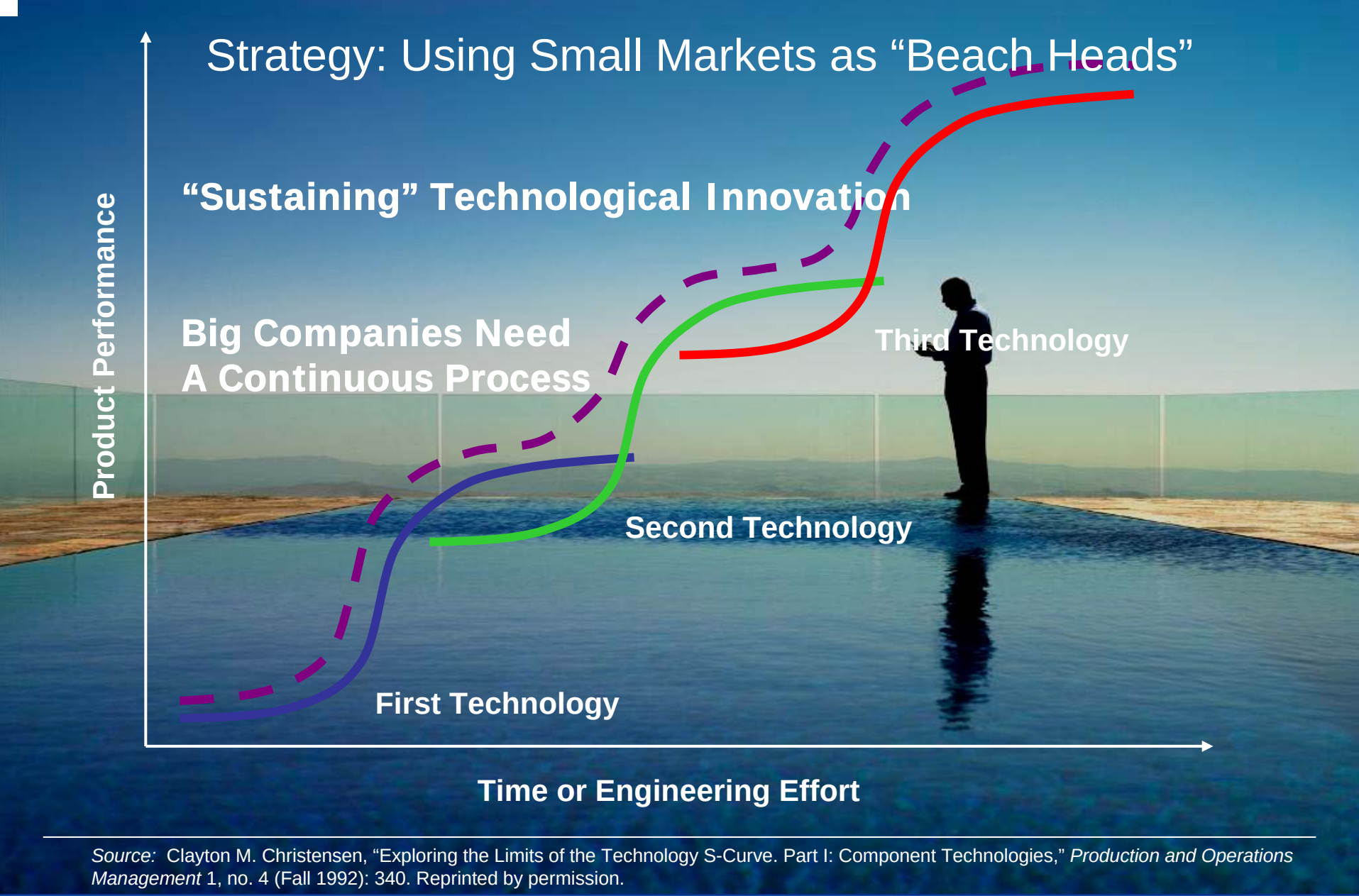
More reasons WHY:

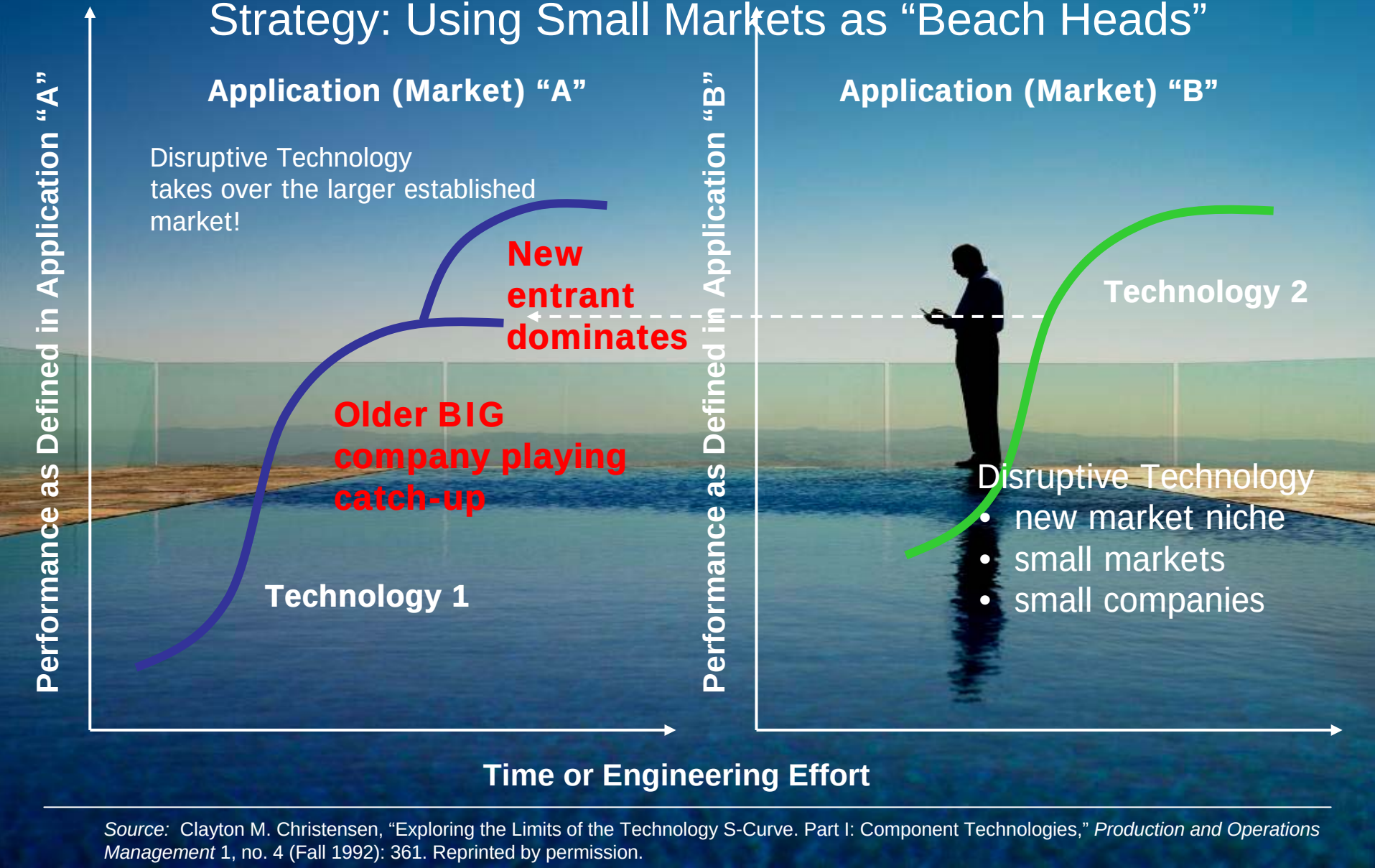
Sustaining Technological Innovation.

Strategy: Using Small Markets as "Beach Heads"



Source: Clayton M. Christensen, "Exploring the Limits of the Technology S-Curve. Part I: Component Technologies," *Production and Operations Management* 1, no. 4 (Fall 1992): 340. Reprinted by permission.

Strategy: Using Small Markets as “Beach Heads”



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Working with Academic Partners – Global Academic Networking

We have spoken now a lot about WHY industry collaborates with academia.

Lets look into some examples HOW Intel collaborates with Academia.

Intel Research Model

Academia

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Business Units

Universities

Government/ Consortia

Research labs

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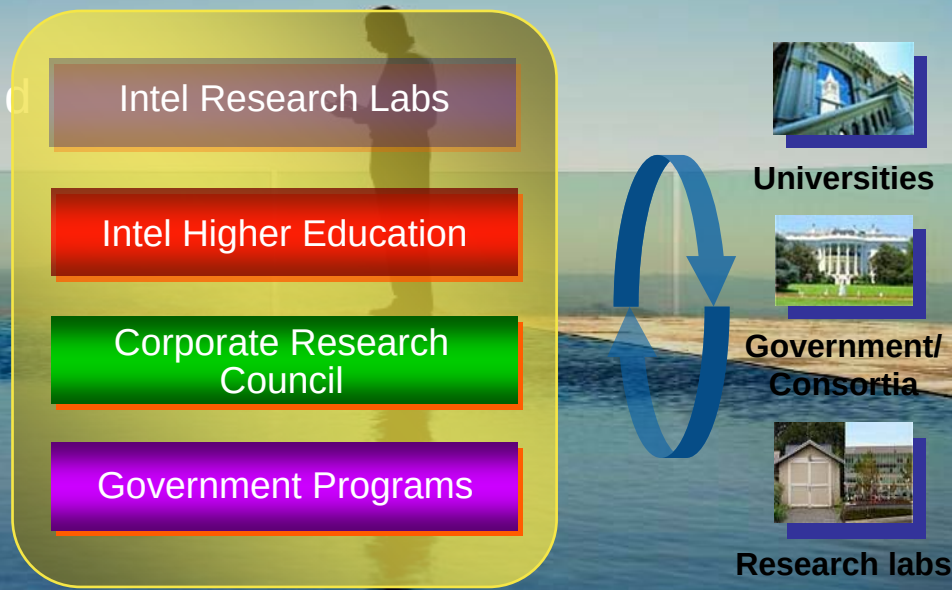
Microprocessor Technology Lab

Systems Technology Lab

Communications Technology Lab

Intel Research – A snapshot

- Exploratory Research and Deep University Collaboration
- Intel Research Labs around the world
- External Programs across Americas, EU, Asia, …
- Joint Prescribed Research (350+ Research Council grants)
- Strong University Relationships (150+ Lighthouse Universities in EMEA)
- Influencing and collaborating with Government on research



Working with Academic Partners – Global Academic Networking

We have spoken now a lot about WHY and HOW industry collaborates with academia.

Lets look into some examples WHERE Industry collaborates with Academia.

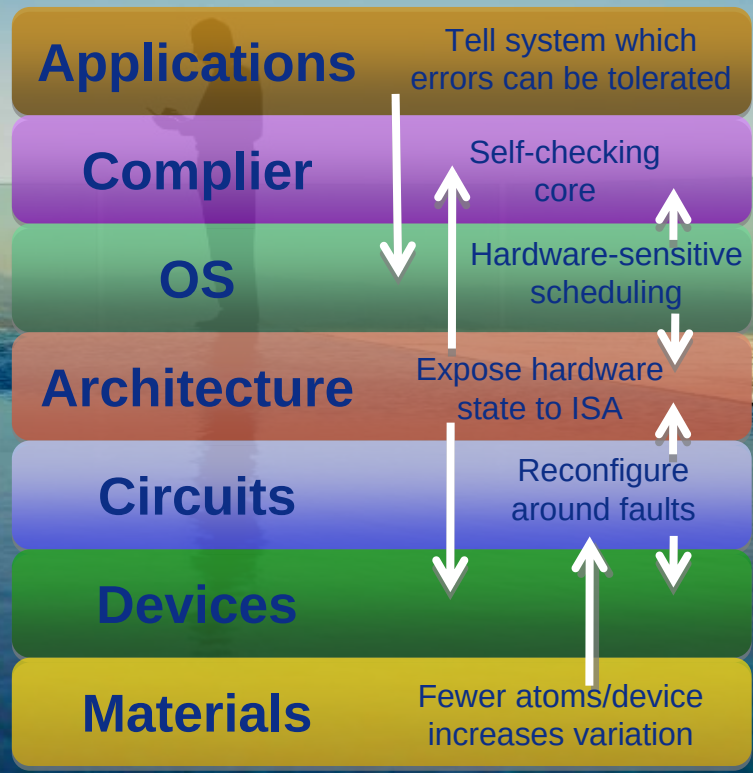
N+4 Systems and "Exascale"

Problem Statement

- Moore's law scaling may lead to increased inter- and intra-die variation and higher rates of transient and permanent errors
- Power consumption may limit the total active logic transistors

Research Activities

- Multi-level approaches to resilience that tolerate variation and errors at much lower overheads than existing approaches; communicate across stack => **Build robust systems**
- Radical approaches for power efficiency at circuit, power regulation, design/specialization, and reconfiguration => **Enable use of larger fraction of chip for active logic**



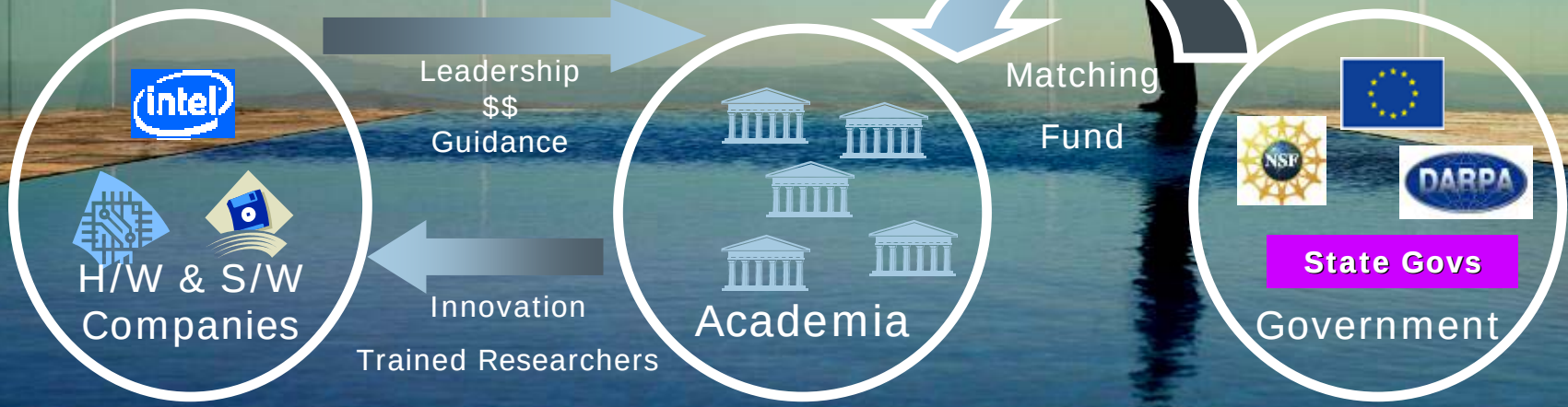
UPCRC: A Research Partnership

Intel + Microsoft

$20 Million over 5 years

Matching University Investments

- **University of Illinois: $8 mil match**
- **UC Berkeley: $7 mil match**



Objective: Breakthroughs in Parallel Programming

Making Parallel Computing Pervasive

Joint HW/SW R&D program to enable Intel products 3-7+ in future

Intel Tera-scale Research

Academic Research UPCRCs

Academic research seeking disruptive innovations 7-12+ years out

Enabling Parallel Computing

Software Products

Intel Higher Education

Community and Experimental Tools

Wide array of leading multi-core SW development tools & info available today

- TBB Open Sourced
- STM-Enabled Compiler on Whatif.intel.com
- Parallel Benchmarks at Princeton's PARSEC site

- Parallel Programming
  - 400+ Universities
  - 25,000+ students
  - 2008 Goal: Double this
- Intel® Academic Community
- Threading for Multi-core SW community
- Multi-core books

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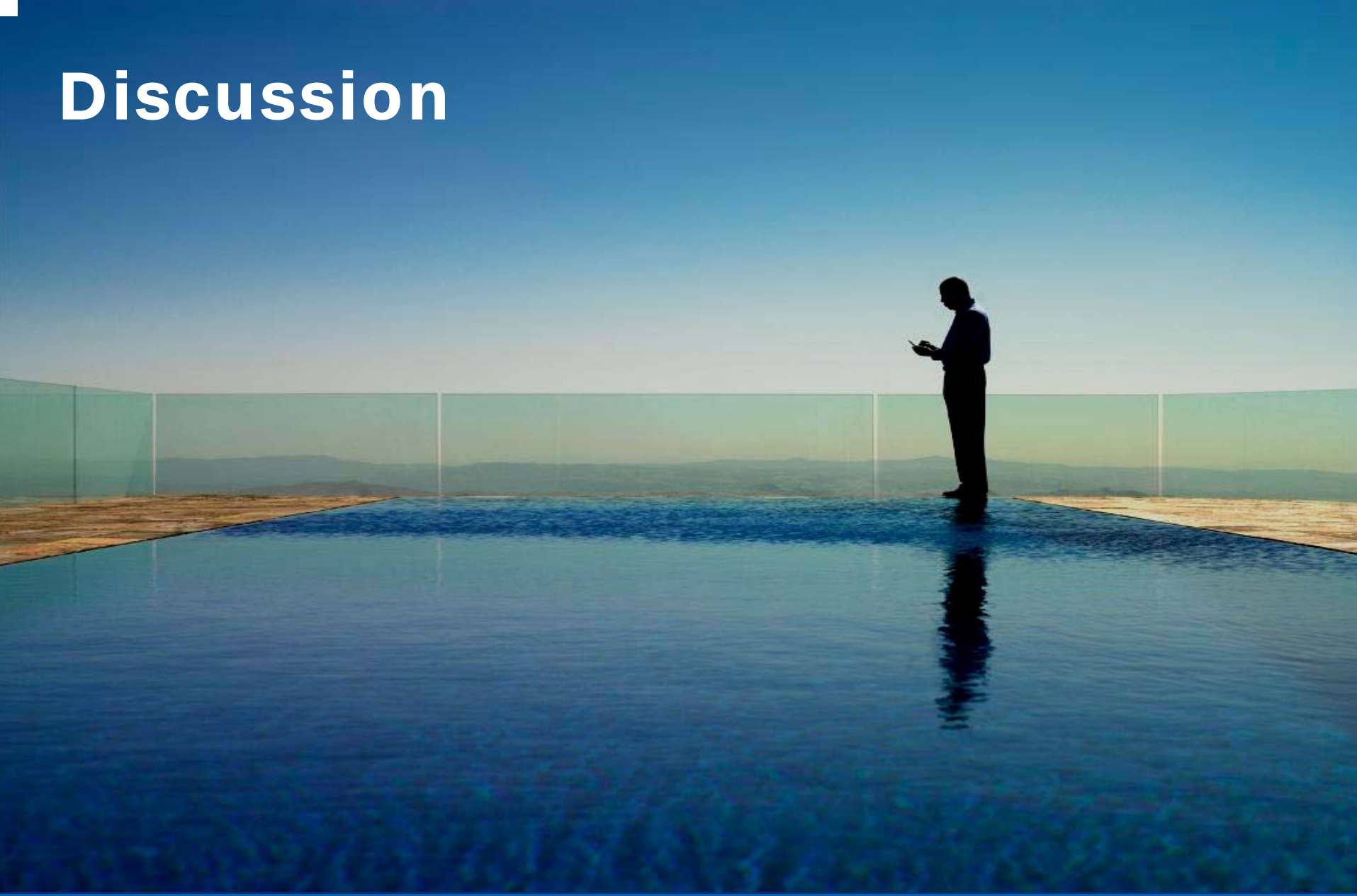
Cloud Computing

Cloud Computing Testbed – Announced July 29, 2008

- ~5 site distributed testbed, each >1000-4000 cores, open to academic research community, dedicated to supporting the development of an open source stack
- Create a technology stack and research community to create the next 100 Google's and Amazon's

Reuters, Forbes, Financial times, BusinessWeek online, BBC, New York Times, Dow Jones Newswires, TechCrunch, CNET, EE Times, InformationWeek, ComputerWorld, Times UK, San Jose Mercury News, Bloomberg, … *July 2008*

Discussion



Backup

Open Innovation

Advantages of Closed Innovation:

- The logic of Closed Innovation created a virtuous circle.
- Companies invested in internal R&D, which led to many breakthrough discoveries.
- Those discoveries enabled those companies to bring new products and services to market.
- Because of those products they could realize more sales and higher margins, which enabled them to spend more in internal R&D, which led to further breakthroughs.
- And because the intellectual property (IP) that arises from this internal R&D is closely guarded, others could not exploit these ideas for their own profit.

Source: Open Innovation
Henry Chesbrough

Open Innovation

Origin of Closed Innovation Paradigm:

- First started in the German Chemical Industry in the 19th + 20th century with the creation of a central research Lab.
- Copied by Thomas Edison in a US version, developed and perfected a number of breakthroughs, and founded General Electric's famed laboratory.
- Bell Labs discovered amazing physical phenomena and harnessed its discoveries to create the transistor among its many important achievements.
- US government created an ad hoc central reseach Lab to conduct a crash project on nuclear fission, which led to the development of the A-Bomb
- The cold war kept some level of Closed Innovation going.

Source: Open Innovation
Henry Chesbrough

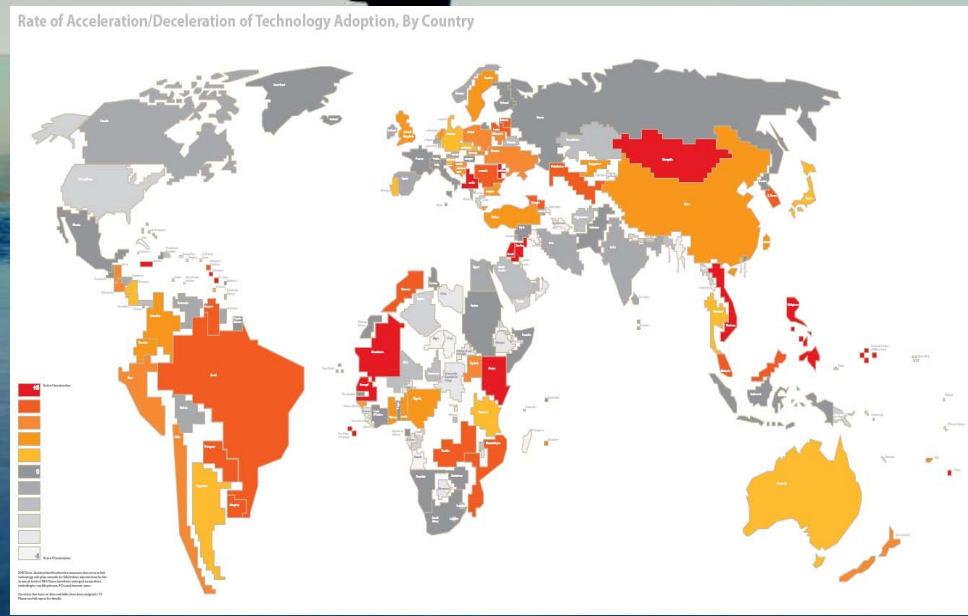
Technology Metabolism Index (TMI)

Problem Description

- Biggest 'emerging' markets have already emerged – no easy way of selecting smaller countries.
- By understanding if/when countries adopt technology at rates higher than predicted by economic development, we can understand, influence and accelerate technology adoption.

Research Activities

- Does even distribution of technology in a country accelerates adoption?
- How do national development strategies affect technology adoption?
- Active, agile nation-states have high TMI (e.g. social changes in Central Asia and Rwanda predict rapid technology adoption).



Relative to wealth, US is a poor adopter, differences exist amongst BRIC countries, many surprises amongst smaller ones.