Economic Impact thru HPC

HPC User Forum

RIKEN, Kobe Japan

July 2014

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NCSA Director, Private Sector Programs and Economic Impact

Innovation converts inventions and discovery into engineered products and services.

2014 HPC Breakthroughs

Consumer Products

Jet Engine Design

Genome Variant Analysis

Combustion

Computational Beating Heart

1 Billion Biomedical Atoms

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Industry-Induced Innovation

Product Life Cycle

Theoretical & Basic Research → **Prototyping & Development** → **Optimization & Robustification** → **Production & Commercialization**

PSP Mission: Help others Lower risk and Demonstrate ROI

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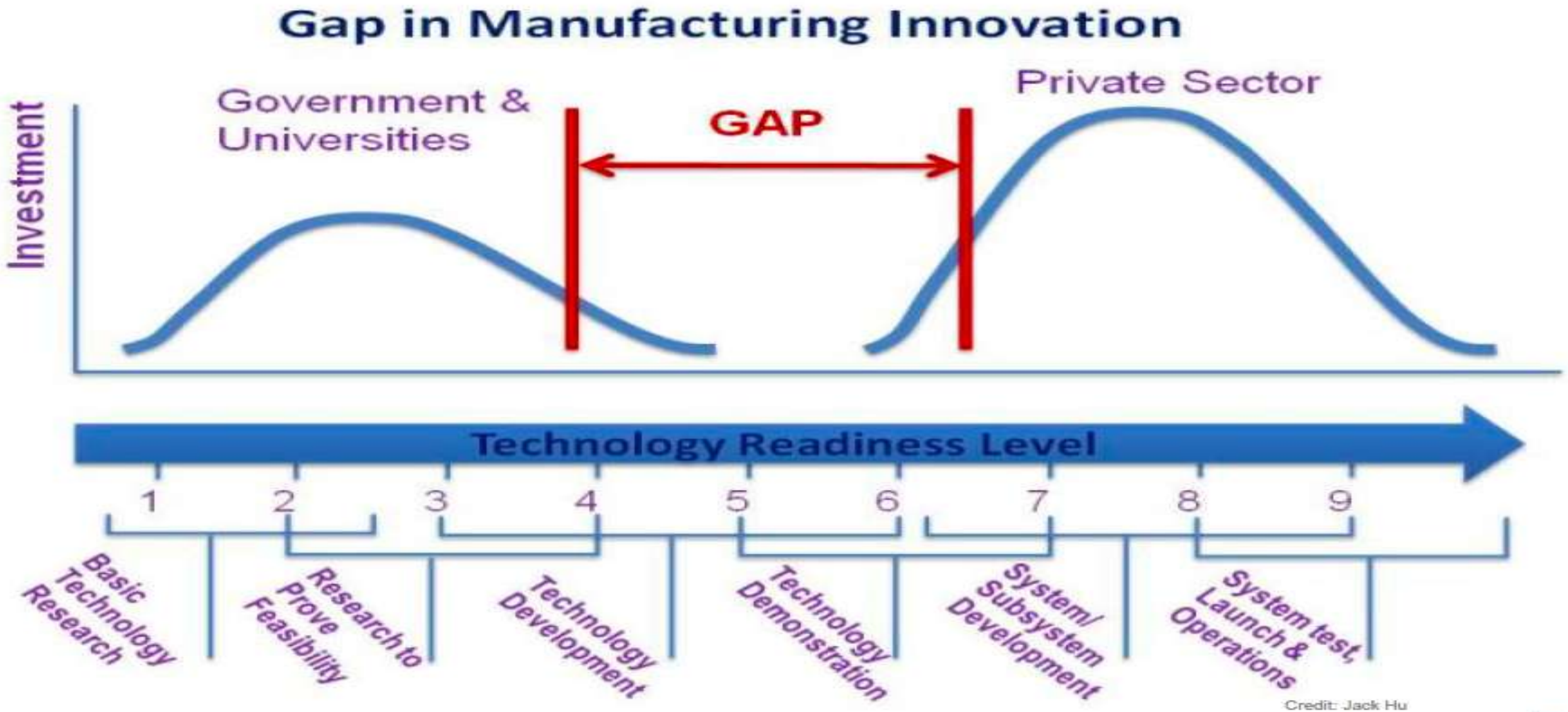
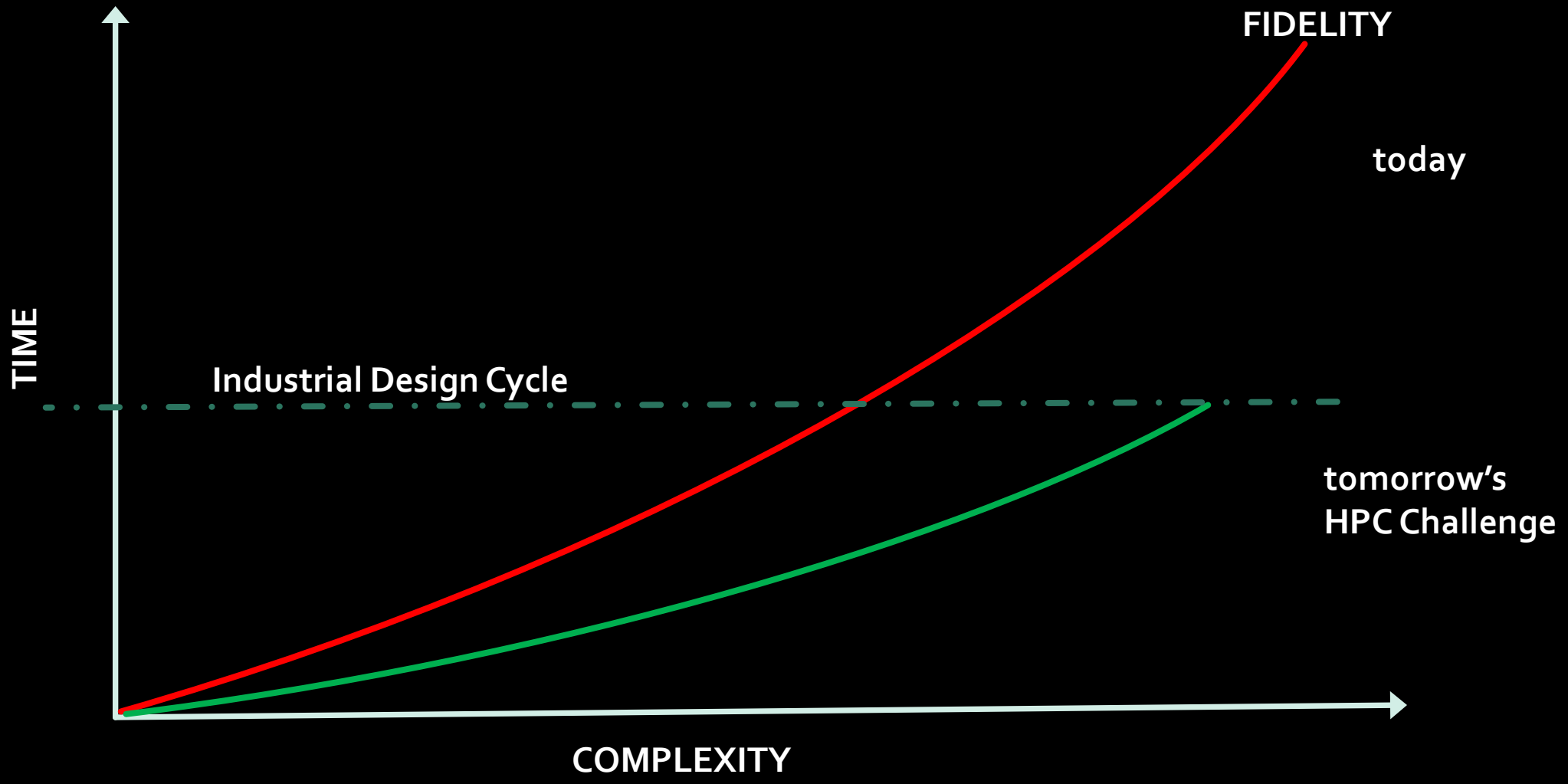
The Scale-up gap

Growing global competition in scaling-up



Manufacturing: Discovery Alone is Not Sufficient



Source: Rolls-Royce Shyam Neerarambam

Commercial Codes for Manufacturers

- COTS – Commercial Off-The-Shelf codes are central to all manufacturers
- 90% of these applications are used on PCs
- Little use on parallel file systems
- Pressing need to shorten design time and increase realism
- Access to supercomputing is barrier to use AND development
- COTS development @scale trickles down to everyday applications

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NCSA Private Sector Program

- 27 years of impact @scale
- Industry-Induced Science & Engineering
- High-Performance Computing & Data
- 3Ds: Development, Demonstration, Deployment
- ~60% of FORTUNE 100 manufacturers
- Accelerate faculty research
- Partnerships – Services - Consulting

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Manufacturing
Rolls-Royce
DOW
CAT
P&G
GE
JOHN DEERE
Technology
DELL
HDF
CRAY
allinea
intel
Adaptive COMPUTING
ILLINOIS ROCSTAR
Microsoft
Energy
bhpbilliton
bp
ExxonMobil Upstream Research
MAYO CLINIC
syngenta
THE DARK ENERGY SURVEY
WATERBORNE ENVIRONMENTAL, INC.
Bio, Chem & Other
PSP Partners, 2014 June

iFORGE

BLUE WATERS

SUSTAINED PETASCALE COMPUTING

U.S. Industrial Programs

- **NDEMC** – Midwest U.S. Pilot targeted at Small & Medium Manufacturers
  - OEM investors: John Deere, GE, P&G, Lockheed Martin
  - Federal CTO Aneesh Chopra: best bottom-up business model today
- **IML** (Illinois Manufacturing Lab)
  - Real access to advanced computing for 3D CAE design
  - Leverage experience from NDEMC
- **NNMI** (National Network for Manufacturing Innovation)
  - Fraunhofer model + supercomputing/analytics/data
  - **DMDII** (Digital Manufacturing and Design Innovation Institute)
- **XSEDE** – NSF funding for no-cost allocations

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DMDI Institute

To-Do

- Digital link between design and fab
- Virtual assembly and testing
- Connected factories and supply chain
- Advanced Analytics (AA)
- Intelligent Machines (IM)
- Advanced Manufacturing Enterprise (AME)

Benefits

- Increased performance & reliability
- Data integration drives quality
- Reduced barriers for SMMs

DMDI: Digital Manufacturing and Design Innovation

International Industrial Supercomputing Workshop

- **IISW** Founders: KiSTi (SK), HLRS (G), NCSA (USA)
- Past Attendees: Tokyo, Daejeon, Amsterdam, Stockholm, Stuttgart, Barcelona, Bologna, Paris, Edinburgh, Manchester, Dallas, Columbus, Livermore
- 5th Annual Workshop: Toyo University October 2-3, 2014, hosted by Hiroshi Kawai (Tokyo Science University-Suwa / ADVENTURE, Japan)
- 2015 book on Industrial Use of Supercomputing by Giles/Osseyran

Europe 2013 Projects

- EU PRACE 3IP Project
  - SME HPC Access Program in Europe (SHAPE)
- EU Fortisimo (Factories of the Future Resources, Technology, Infrastructure and Services for Simulation and Modeling) 2013-2016
  - Target: pay-per-use SMEs
  - Service Model: one-stop shop for HW, SW, expertise, tools, viz
  - Funding up to 250,000 Euro for collaborations of 3-4 organizations
- Italy Lombardy Region: SNAP! (Simulazione Numerica Avanzata per le PMI - Advanced Numerical Simulation for SMEs) Initiative for SMEs

South Korea - KiSTi

- 2007 government SMBA program for SMEs
- CAE tools on HPC
- KiSTi support for model building
- 337 SMEs served in 2013
- New product development reductions
  - Costs reduced 53.4%
  - Develop time reduced 52.4%

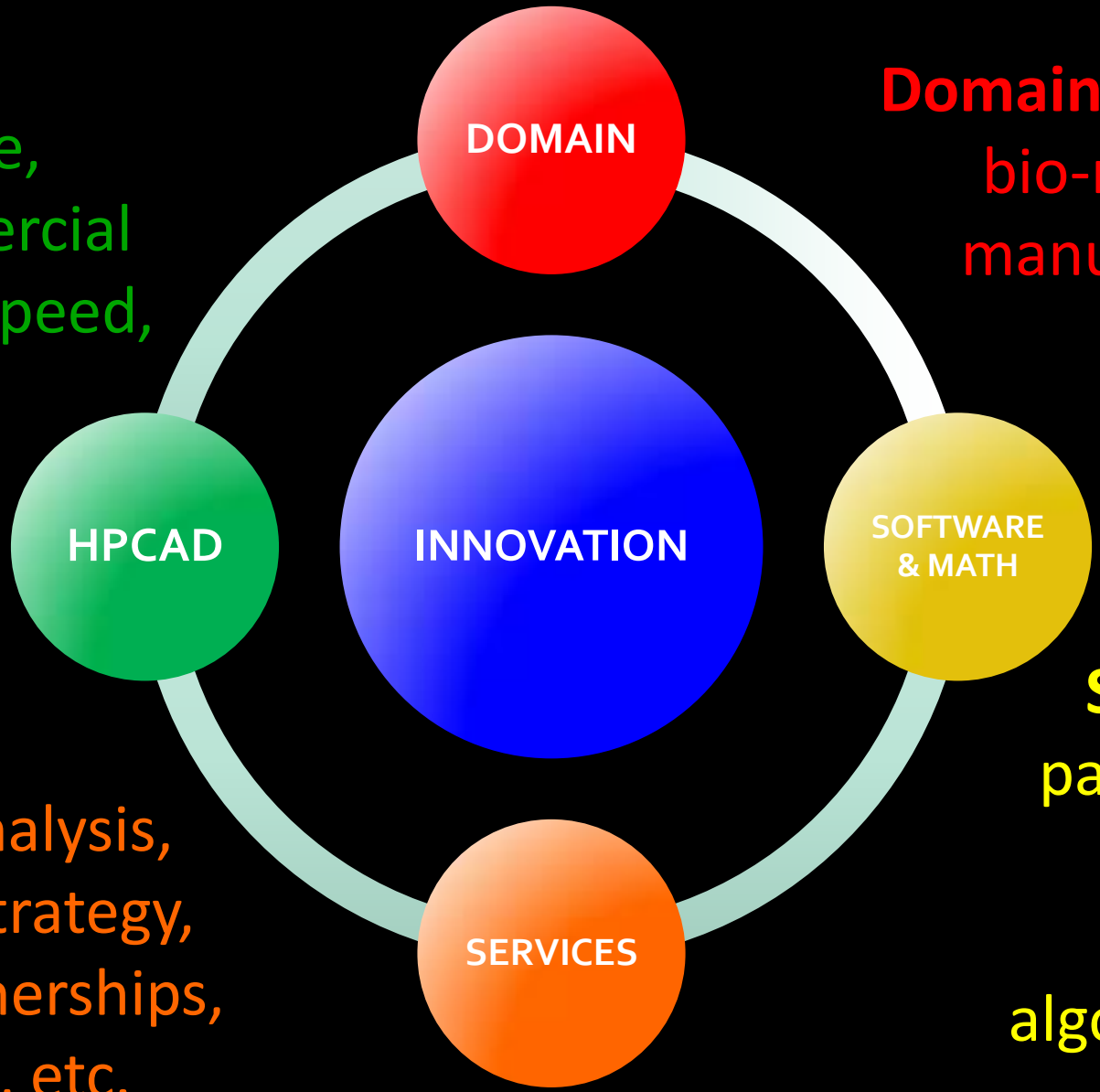
Innovation Occurs at the Intersections

1. **Relevant scale** – normal has already been done
2. **Multidisciplinary expertise** – single disciplines are more mature
3. **Collaboration** – no one can do the big stuff alone
4. **Open access** – resources for all innovators
5. **Business and technical** – ROI drives investment

4 Pillars of Innovation in a Digital World

HPC: performance, petascale, commercial codes, Big Data, speed, etc.

Domains: materials, fluids, bio-medical, genomics, manufacturing, seismic, etc.



Consulting: analysis, assessment, strategy, services, partnerships, value creation, etc.

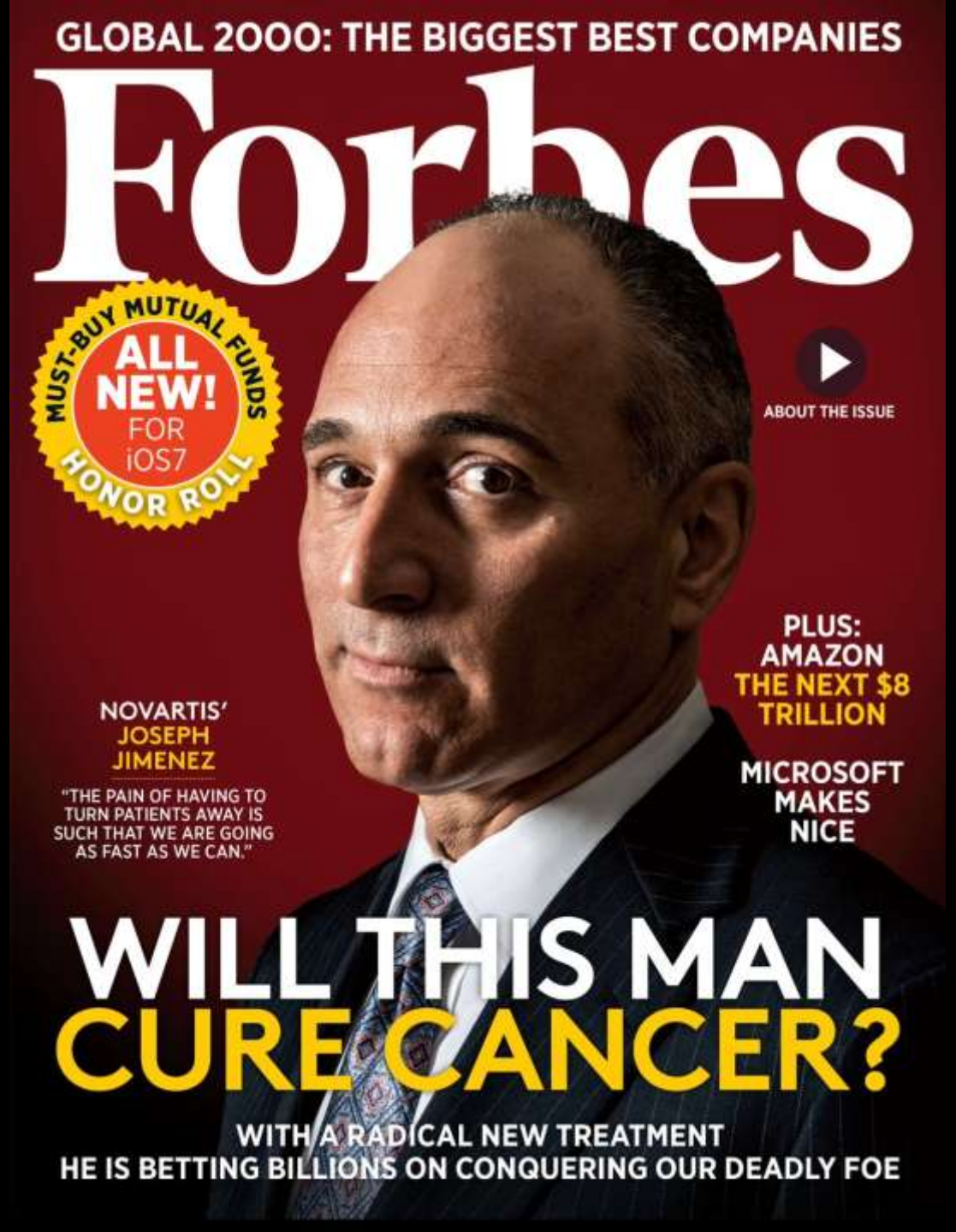
Software & Math: parallelization, code bottlenecks, multiphysics, algorithms, data, etc.

Plus: Speed Matters

Opportunities

- Multinational digital manufacturing supply chain
- Global manufacturing companies
- ISC EU/US announcements on software collaboration is promising
- Which TRLs are targeted?
- When does industry get involved?
- Opportunities beyond manufacturing

What would industry-induced innovation look like for curing cancer?



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