

**Welcome To The 63rd
HPC User Forum Meeting
University of Oxford
September 29-30, 2016**



Welcome

Wes Armour Oxford e-Research Centre University of Oxford



UNIVERSITY OF
OXFORD



Welcome

Rupak Biswas
NASA Ames Research Center
Vice Chair, HPC User Forum



HPC User Forum Mission

To improve the health of the high performance computing industry through open discussions, information-sharing and initiatives involving HPC users in industry, government and academia along with HPC vendors and other interested parties

HPC User Forum Steering Committee

- Paul Muzio, City University of New York (Chair)
- Rupak Biswas, NASA Ames (Vice Chair)
- Earl Joseph, IDC (Executive Director)
- Swamy Akasapu, General Motors
- Vijay Agarwala, Penn State University
- Alex Akkerman, Ford Motor Company
- C. Scot Atkins, Industry Expert: Advanced Analytics/Dense Supercomputing
- Doug Ball, HPC expert (formerly Boeing)
- Jeff Broughton, NERSC/Lawrence Berkeley National Lab
- Paul Buerger, Avetec
- Simon Burbidge, Imperial College London
- Chris Catherasoo, Caltech
- Clayton Chandler, Credit Suisse/New York
- Jack Collins, National Cancer Institute
- Steve Conway, IDC Research Vice President
- Steve Finn, Emagine IT
- Merle Giles, NSCA/University of Illinois
- Keith Gray, British Petroleum
- Sharan Kalwani, Fermilab
- Arno Kolster, PayPal
- Doug Kothe, Oak Ridge National Laboratory
- Jysoo Lee, King Abdullah University of Science and Technology (KAUST)
- David Martin, Argonne National Laboratory
- Ryan Quick, PayPal
- Stephane Requena, GENCI
- Michael Resch, HLRS, University of Stuttgart
- Vince Scarafino, Industry Expert
- Suzy Tichenor, Oak Ridge National Laboratory

STEERING COMMITTEE MEMBERS HERE TODAY...

Simon Burbidge, Imperial College London

Jack Collins, National Cancer Institute (U.S.)

Steve Conway, IDC

Steve Finn, Emagine IT

Arno Kolster, PayPal

The IDC HPC User Forum: 63 Meetings Worldwide Since 2000

Amsterdam, Netherlands (SARA)

Annecy, France

Bangalore, India (Indian Institute of Technology)

Beijing, China (Chinese Academy of Sciences)

Bologna, Italy (CINECA)

Bristol, UK

Bruyères-le-Châtel, France (Teratec)

Canberra, Australia

Geneva, Switzerland (CERN)

Kobe, Japan (RIKEN)

Lausanne, Switzerland (EPFL)

London, UK (Imperial College)

Manchester, UK (Manchester University)

Melbourne, Australia

Munich, Germany (LRZ)

New Delhi, India (Indian Institute of Science)

Oxford, UK (University of Oxford)

Paris, France (GENCI)

Seoul, Korea (National Institute of Supercomputing & Networking)

Stuttgart, Germany (HLRS)

Warsaw, Poland (University of Warsaw)

Yokohama, Japan (Earth Simulator Center)

Zurich, Switzerland (ETH Zurich)

United States (many locations)

Future HPC User Forum Meetings

2017 Meetings:

- February 28/March 1, HLRS, Stuttgart, Germany
- April 17-19, Santa Fe, New Mexico
- September 5-7, Milwaukee, Wisconsin

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EXCELLENCE AWARDS**

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FUTURE MEETINGS

FORUM ATTENDEES



Lawrence Livermore
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IDC Research Vice President

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Welcome

Steve Conway, IDC
Steering Committee, HPC User Forum



Agenda: Thursday, September 29

- 12:00** Lunch
- 13:00** Welcome/Introductions
 - **Wes Armour, University of Oxford**
 - **Rupak Biswas (Vice Chair, HPC User Forum) and Steve Conway (IDC)**
- 13:15** HPC at the University of Oxford and the e-Research Centre: **Steve Young**
- 13:45** HPC at Imperial College London: **Simon Burbidge**
- 14:15** Update on HPC and Industry: **Steve Conway (IDC)**
- 14:30** High Performance Data Analytics at PayPal: **Arno Kolster**
- 15:00** HPC and Large Scale Membrane Simulations for Biomedicine, **Mark Sansom (University of Oxford)**
- 15:30** Networking Break
- 15:45** HPC Vendor Update: **SUSE**
- 16:00** Big Data in Cancer Research, **Jack Collins (National Cancer Institute)**
- 16:30** ARM Update, **David Brash**
- 16:45** After-Meeting Socializing

Agenda: Friday, September 30

8:15 Light breakfast/coffee/tea

9:00 Welcome/Logistics/IDC HPC Market Update, Steve Conway

HPC AND SCIENCE

9:15 HPC at the University of Cambridge: Sean McGuire

9:45 HPC at NASA: Rupak Biswas

10:15 Networking Break

HPC INDUSTRIAL COLLABORATIONS

10:30 University of Edinburgh/EPCC, Mark Parsons

11:00 The U.S. National Strategic Computing Initiative, Bob Sorensen (IDC)

11:30 HPC and the Square Kilometre Array, Wes Armour (University of Oxford)

THE HPC WORKFORCE CHALLENGE

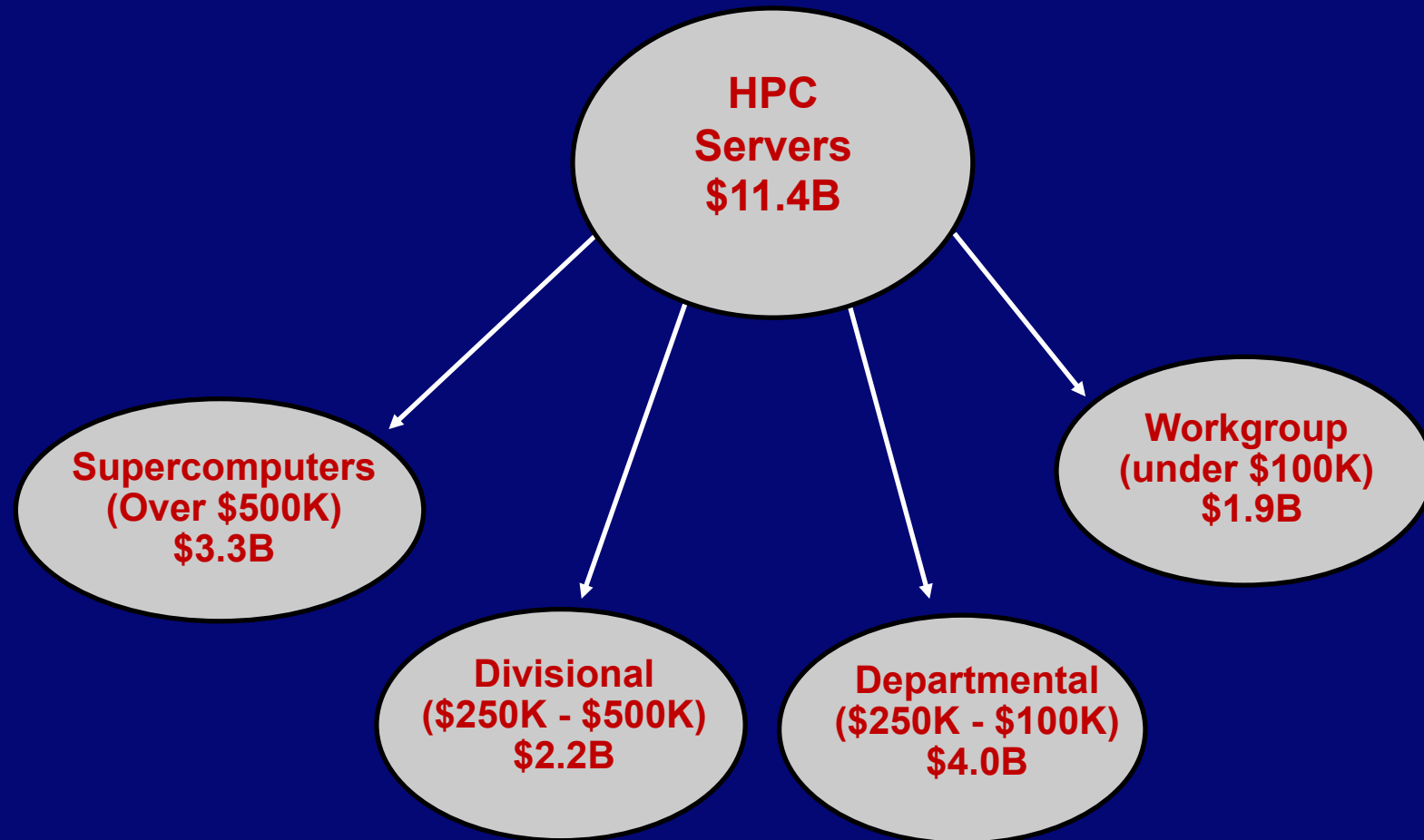
12:00 The HPC Workforce Challenge: Steve Finn, Emagine IT and Steve Conway, IDC

12:30 Meeting Ends

IDC HPC Market Update



The Worldwide HPC Server Market: \$11.4 Billion in 2015



HPC Server Market: By Industry/Applications (\$000)

WW HPC Revenue by Applications	
	2015
Bio-Sciences	1,090,722
CAE	1,299,380
Chemical Engineering	187,851
DCC & Distribution	704,950
Economics/Financial	614,503
EDA / IT / ISV	807,199
Geosciences	838,157
Mechanical Design	61,079
Defense	1,140,544
Government Lab	1,986,865
University/Academic	2,043,357
Weather	493,773
Other	94,903
Total Revenue	11,363,283

HPC Revenues: By Vendor (\$000)

Mftr	2015 Revenues	Shares
HPE/HP	4,083,397	35.9%
Dell	1,801,821	15.9%
Lenovo	1,585,618	14.0%
Cray	583,933	5.1%
IBM	461,087	4.1%
SGI	296,350	2.6%
Sugon (Dawning)	282,230	2.5%
Fujitsu	158,145	1.4%
NEC	209,282	1.8%
Bull Atos	96,475	0.8%
Other	1,804,945	15.9%
Total	11,363,283	100.0%

HPC Market Forecasts



HPC Forecasts (\$ Millions)

- Forecasting a 7.7% yearly growth from 2015 to 2019
- 2019 should exceed \$15 billion

	2015	2019	CAGR (15-19)
Supercomputer	\$3,284	\$4,829	10.1%
Divisional	\$2,212	\$2,278	0.7%
Departmental	\$3,994	\$5,747	9.5%
Workgroup	\$1,874	\$2,616	8.7%
Total	\$11,363	\$15,262	7.7%

The Broader HPC Market (\$ Millions)

	2015	2019	CAGR (15-19)
Server	11,363	15,262	7.7%
Storage	4,729	6,762	9.4%
Middleware	1,277	1,727	7.8%
Applications	3,857	5,196	7.7%
Service	1,895	2,456	6.7%
Total	23,121	31,403	8.0%
Source: IDC 2016			

Worldwide Study for U.S. DOE:
Returns on Investment (ROI)
and
Returns on Research (ROR)
Related to HPC



Rationale for Study

Absent the Cold War and with major economies still hurting, science and national security are necessary but no longer sufficient reasons for government investments in leadership-class supercomputers (esp. \$\$\$ exascale systems).

- Leadership-class supercomputers can cost up to \$500 million (vs. \$30 million ca. 1990).
- Need for additional argument: economic competitiveness (“to out-compute is to out-compete”)
- Need for scientific and industrial/economic ROI to be quantified, no longer just assumed.

Grant References

The authors thank DOE for its insights and guidance on and funding of this grant-based research project

- This study is based upon work funded by the U.S. Department of Energy Office of Science, Office of Advanced Scientific Computing Research, and the National Nuclear Security Administration, under award number DE-SC0012576.

DOE Program Managers:

- Christine Chalk, 301-903-5152, christine.chalk@science.doe.gov, and Barbara J. Helland, 301-903-3127, barbara.helland@science.doe.gov, U.S. Department of Energy Office of Science, Germantown Building, 1000 Independence Avenue, S.W. Washington, D.C., 20585-1290, and Doug Wade in National Nuclear security Administration (NNSA).

Administrator/Contracting Officer:

- Warren Riley, 630-252-2485, warren.riley@ch.doe.gov, U.S. Department of Energy Office of Acquisition and Assistance, 9800 South Cass Avenue, Argonne, Illinois, 60439

IDC Reporting:

- Principal investigator: Earl C. Joseph, Ph.D., 612-812-5798, ejoseph@idc.com
- Senior technical project manager: John Daly, 508-935-4643, jdaly@idc.com



Background: Project Overview

A study that describes how HPC investments are related to improved economic success and increased scientific innovation

The study includes large scale data collection to populate two unique models:

1. A macroeconomic model which depicts how HPC investments result in economic advancements in the form of ROI, growth and jobs
2. Two Innovation Indexes that measures and compares innovation levels, based on the level of applying HPC computing resources towards scientific and technical advancement

Innovation Models Used

Two innovations indexes are used:

1. Based on the importance of the innovation
2. How broadly the innovations impact different organizations

The innovations are also sorted by the primary area:

- Better Products
- Major Scientific Breakthrough
- Cost Saving
- Created New Approach
- Discovered Something New
- Helped Society
- Helped Research Program

Sample Characteristics

Sample demographics:

- As of May 1st, 2016 we are at **329** case study examples of ROI and innovations:
 - **114** financial ROI examples
 - **215** innovation examples
- *We will soon release an update – now over 400 examples!*

Latest Findings: ROI from HPC is Very High

New results indicate high ROI returns resulting from investments in HPC

– On average, from the latest data:

- **\$673** in revenue per dollar of HPC invested
- **\$44** of profits/cost savings per dollar of HPC invested
- HPC investment per innovation = **\$3.9M**

• *Another outcome of this research is an expansive list of HPC success stories*

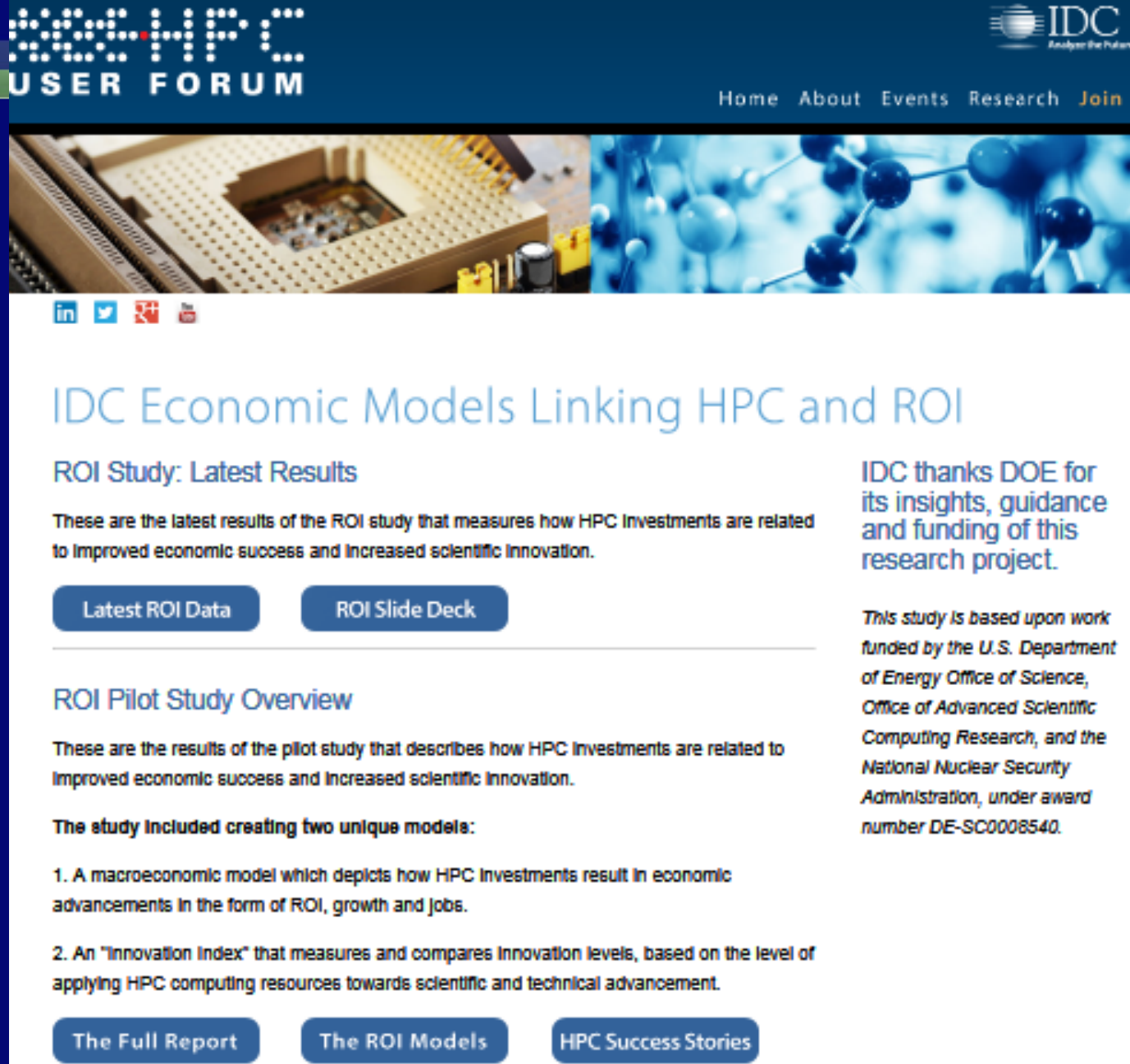
New Findings: Job Creation

Results continue to indicate very substantial job creation from investments in HPC:

- 2,756 jobs where created at 106 of these sites

Sector	Count of Employee Growth	Sum of Employee Growth	Count of Accomplishment Type
Academic	24	176	109
Government	8	53	28
Industry	74	2,527	192
Grand Total	106	2,756	329

Download Results: www.hpcuserforum.com/ROI



The screenshot shows the HPC User Forum website. At the top, there is a navigation bar with the forum's logo and the IDC logo. Below the navigation bar is a banner image featuring a close-up of a server rack on the left and a molecular model on the right. The main content area is titled "IDC Economic Models Linking HPC and ROI" and includes a sub-section for "ROI Study: Latest Results". This section contains a brief description of the study, two buttons for "Latest ROI Data" and "ROI Slide Deck", and a section for "ROI Pilot Study Overview" which lists two unique models created for the study. On the right side of the page, there is a testimonial from IDC thanking DOE for its support. At the bottom of the page, there are three buttons: "The Full Report", "The ROI Models", and "HPC Success Stories".

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IDC Economic Models Linking HPC and ROI

ROI Study: Latest Results

These are the latest results of the ROI study that measures how HPC Investments are related to improved economic success and increased scientific innovation.

[Latest ROI Data](#) [ROI Slide Deck](#)

ROI Pilot Study Overview

These are the results of the pilot study that describes how HPC Investments are related to improved economic success and increased scientific innovation.

The study included creating two unique models:

1. A macroeconomic model which depicts how HPC Investments result in economic advancements in the form of ROI, growth and jobs.
2. An "Innovation Index" that measures and compares Innovation levels, based on the level of applying HPC computing resources towards scientific and technical advancement.

[The Full Report](#) [The ROI Models](#) [HPC Success Stories](#)

IDC thanks DOE for its insights, guidance and funding of this research project.

This study is based upon work funded by the U.S. Department of Energy Office of Science, Office of Advanced Scientific Computing Research, and the National Nuclear Security Administration, under award number DE-SC0008540.

HPC USER FORUM

Questions?

Please email:
hpc@idc.com

Or check out:
www.hpcuserforum.com



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- February 28/March 1, HRLS, Stuttgart, Germany
- April 17 to 19, Santa Fe, New Mexico
- September 5 to 7, Milwaukee, Wisconsin

Thank You
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