Worldwide HPC
Market Update and Trends
23rd Daresbury Machine Evaluation Workshop
27-28 November 2012

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IDC
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Why Is HPC Market Growth Important?

- Market is more attractive to vendors
- More vendor choices
- More competition for users’ business
- Vendors invest more in R&D
- More innovation, better HPC tools
Why Is HPC Becoming So Important To Nations?

- HPC has been firmly linked to economic competitiveness as well as scientific advances

- In one worldwide IDC study, 97% of companies that had adopted supercomputing said they could no longer compete or survive without it.

- Worldwide political leaders increasingly recognize this trend:
  - In his 2006 State of the Union address, U.S. President George W. Bush promised to trim the federal budget, yet urged more money for supercomputing
  - In 2009, Russian President Dmitry Medvedev warned that without more investment in supercomputer technology, “Russian products will not be competitive or of interest to potential buyers.”
• Rep. Chung Doo-un of South Korea’s Grand National Party (2010): “If Korea is to survive in this increasingly competitive world, it must not neglect nurturing the supercomputer industry, which has emerged as a new growth driver in advanced countries.”
  • The Korean National Assembly then called for the creation of a national five-year plan for advancing HPC

• In his 2011 State of the Union address, President Obama noted China's rapid progress in HPC and pointed to U.S. achievements.

• In February 2012, the European Commission announced that it has adopted a plan to double spending on HPC to €1.2 billion, with much of that money aimed at the installation of additional petascale supercomputer systems.
### Table 45

<table>
<thead>
<tr>
<th>Country</th>
<th>GDP (1)</th>
<th>Average Supercomputer Sales Over Last Five Years (2)</th>
<th>Supercomputers As A Percentage Of GDP</th>
<th>Average 5 year HPC Spending</th>
<th>HPC As A Percentage Of GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>14,270,000</td>
<td>1,276,057</td>
<td>0.0039%</td>
<td>4,464,817</td>
<td>0.0313%</td>
</tr>
<tr>
<td>Japan</td>
<td>5,049,000</td>
<td>278,385</td>
<td>0.0055%</td>
<td>651,126</td>
<td>0.0129%</td>
</tr>
<tr>
<td>China</td>
<td>4,758,000</td>
<td>67,836</td>
<td>0.0014%</td>
<td>278,480</td>
<td>0.0059%</td>
</tr>
<tr>
<td>Germany</td>
<td>3,235,000</td>
<td>203,245</td>
<td>0.0063%</td>
<td>761,309</td>
<td>0.0235%</td>
</tr>
<tr>
<td>France</td>
<td>2,635,000</td>
<td>142,209</td>
<td>0.0054%</td>
<td>517,170</td>
<td>0.0196%</td>
</tr>
<tr>
<td>U.K.</td>
<td>2,198,000</td>
<td>129,384</td>
<td>0.0059%</td>
<td>478,353</td>
<td>0.0218%</td>
</tr>
<tr>
<td>Italy</td>
<td>2,090,000</td>
<td>76,751</td>
<td>0.0037%</td>
<td>338,661</td>
<td>0.0162%</td>
</tr>
<tr>
<td>Spain</td>
<td>1,466,000</td>
<td>37,690</td>
<td>0.0026%</td>
<td>138,984</td>
<td>0.0095%</td>
</tr>
<tr>
<td>Russia</td>
<td>1,255,000</td>
<td>30,371</td>
<td>0.0024%</td>
<td>75,720</td>
<td>0.0060%</td>
</tr>
<tr>
<td>India</td>
<td>1,243,000</td>
<td>19,627</td>
<td>0.0016%</td>
<td>74,780</td>
<td>0.0060%</td>
</tr>
<tr>
<td>Australia</td>
<td>920,000</td>
<td>55,411</td>
<td>0.0050%</td>
<td>238,900</td>
<td>0.0260%</td>
</tr>
<tr>
<td>Korea</td>
<td>800,300</td>
<td>59,305</td>
<td>0.0074%</td>
<td>284,705</td>
<td>0.0356%</td>
</tr>
<tr>
<td>Switzerland</td>
<td>484,100</td>
<td>24,144</td>
<td>0.0050%</td>
<td>94,481</td>
<td>0.0195%</td>
</tr>
<tr>
<td>Sweden</td>
<td>397,700</td>
<td>21,314</td>
<td>0.0054%</td>
<td>75,043</td>
<td>0.0189%</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>208,800</td>
<td>15,491</td>
<td>0.0074%</td>
<td>67,547</td>
<td>0.0324%</td>
</tr>
</tbody>
</table>
Top Trends in HPC

The global HPC market began growing again in 2010
- 2010 grew by 10%, to reach $9.5 billion (£6 billion)
- 2011 grew by 8.4% to reach $10.3 billion (£6.4 billion)
- HPC revenue for first half of 2012 was $4.9B (£3.1 billion)
- Q3 2012 may be the largest quarter ever in HPC
- We are forecasting ~7% growth (CAGR) over the next 5 years

Major challenges for datacenters
- Power, cooling, real estate, system management
- Storage and data management continue to grow in importance

Software hurdles continue to grow
GPUs/accelerators are seeing real traction in the market
The worldwide petascale race is gaining momentum
### 2011 HPC WW Market Results: By Competitive Segments ($000)

**Supercomputers: 27% of 2008 market → 42% of 2011 market**

<table>
<thead>
<tr>
<th></th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>CAGR '10/'11</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supercomputer</strong></td>
<td>2,686,128</td>
<td>3,342,073</td>
<td>3,475,577</td>
<td>4,361,336</td>
<td>25.5%</td>
</tr>
<tr>
<td><strong>Divisional</strong></td>
<td>1,395,817</td>
<td>1,078,575</td>
<td>1,268,735</td>
<td>1,245,541</td>
<td>-1.8%</td>
</tr>
<tr>
<td><strong>Departmental</strong></td>
<td>3,167,096</td>
<td>2,783,518</td>
<td>3,279,219</td>
<td>3,480,676</td>
<td>6.1%</td>
</tr>
<tr>
<td><strong>Workgroup</strong></td>
<td>2,522,809</td>
<td>1,409,979</td>
<td>1,474,792</td>
<td>1,212,505</td>
<td>-17.8%</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td>9,771,849</td>
<td>8,614,145</td>
<td>9,498,323</td>
<td>10,300,058</td>
<td>8.4%</td>
</tr>
</tbody>
</table>

- **Supercomputer:** >$500,000 (>£315,000)
- **Divisional:** $250,000-$299,000 (£157,000-£314,000)
- **Departmental:** $100,000-$249,000 (£63,000-£156,000)
- **Workgroup:** <$100,000 (<£63,000)
<table>
<thead>
<tr>
<th>Mfr</th>
<th>2010</th>
<th>2011</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM</td>
<td>2,819,087</td>
<td>3,362,098</td>
<td>29.7%</td>
<td>32.6%</td>
</tr>
<tr>
<td>HP</td>
<td>3,017,555</td>
<td>3,307,427</td>
<td>31.8%</td>
<td>32.1%</td>
</tr>
<tr>
<td>Dell</td>
<td>1,462,995</td>
<td>1,493,289</td>
<td>15.4%</td>
<td>14.5%</td>
</tr>
<tr>
<td>Cray</td>
<td>273,225</td>
<td>155,620</td>
<td>2.9%</td>
<td>1.5%</td>
</tr>
<tr>
<td>SGI</td>
<td>258,959</td>
<td>225,741</td>
<td>2.7%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Sun</td>
<td>178,227</td>
<td>75,630</td>
<td>1.9%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Fujitsu</td>
<td>134,596</td>
<td>120,351</td>
<td>1.4%</td>
<td>1.2%</td>
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<tr>
<td>NEC</td>
<td>102,429</td>
<td>84,141</td>
<td>1.1%</td>
<td>0.8%</td>
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<tr>
<td>Appro</td>
<td>109,665</td>
<td>135,360</td>
<td>1.2%</td>
<td>1.3%</td>
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<tr>
<td>Hitachi</td>
<td>59,257</td>
<td>62,802</td>
<td>0.6%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Dawning</td>
<td>63,469</td>
<td>102,923</td>
<td>0.7%</td>
<td>1.0%</td>
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<tr>
<td>Bull</td>
<td>106,112</td>
<td>327,536</td>
<td>1.1%</td>
<td>3.2%</td>
</tr>
<tr>
<td>Other</td>
<td>912,747</td>
<td>847,140</td>
<td>9.6%</td>
<td>8.2%</td>
</tr>
<tr>
<td>Grand Total</td>
<td>9,498,323</td>
<td>10,300,058</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
HPC Forecasts And Growth Areas
New HPC Forecasts

• 2011 was a very strong year and we are projecting 7% yearly growth to 2016
• 2016 should exceed $14 billion (£8.7 billion)
# New HPC Forecasts: By Verticals

<table>
<thead>
<tr>
<th>Vertical</th>
<th>2010</th>
<th>2011</th>
<th>2016</th>
<th>CAGR (11-16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bio-Sciences</td>
<td>$1,240,127</td>
<td>$1,251,665</td>
<td>$1,722,588</td>
<td>6.6%</td>
</tr>
<tr>
<td>CAE</td>
<td>$1,013,233</td>
<td>$1,095,398</td>
<td>$1,714,457</td>
<td>9.4%</td>
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<tr>
<td>Chemical Engineering</td>
<td>$193,759</td>
<td>$192,789</td>
<td>$251,392</td>
<td>5.5%</td>
</tr>
<tr>
<td>DCC &amp; Distribution</td>
<td>$519,549</td>
<td>$569,026</td>
<td>$868,925</td>
<td>8.8%</td>
</tr>
<tr>
<td>Economics/Financial</td>
<td>$253,607</td>
<td>$279,294</td>
<td>$472,015</td>
<td>11.1%</td>
</tr>
<tr>
<td>EDA / IT / ISV</td>
<td>$594,187</td>
<td>$662,674</td>
<td>$1,009,535</td>
<td>8.8%</td>
</tr>
<tr>
<td>Geosciences</td>
<td>$579,355</td>
<td>$653,859</td>
<td>$906,900</td>
<td>6.8%</td>
</tr>
<tr>
<td>Mech Design and Drafting</td>
<td>$75,316</td>
<td>$63,102</td>
<td>$79,128</td>
<td>4.6%</td>
</tr>
<tr>
<td>Defense</td>
<td>$919,558</td>
<td>$1,004,632</td>
<td>$1,380,750</td>
<td>6.6%</td>
</tr>
<tr>
<td>Government Lab</td>
<td>$1,467,110</td>
<td>$2,078,029</td>
<td>$2,714,603</td>
<td>5.5%</td>
</tr>
<tr>
<td>University/Academic</td>
<td>$1,762,777</td>
<td>$1,900,883</td>
<td>$2,526,773</td>
<td>5.9%</td>
</tr>
<tr>
<td>Weather</td>
<td>$388,735</td>
<td>$453,999</td>
<td>$601,585</td>
<td>5.8%</td>
</tr>
<tr>
<td>Other</td>
<td>$108,912</td>
<td>$94,708</td>
<td>$137,736</td>
<td>7.8%</td>
</tr>
<tr>
<td>Total Revenue</td>
<td>$9,116,225</td>
<td>$10,300,058</td>
<td>$14,386,387</td>
<td>6.9%</td>
</tr>
</tbody>
</table>

*Source IDC, April, 2012*
The HPC Market
Beyond
The Servers
### The Broader HPC Market Growth to 2016

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Server</td>
<td>10,300</td>
<td>11,031</td>
<td>11,910</td>
<td>12,778</td>
<td>13,839</td>
<td>14,621</td>
<td>7.3%</td>
</tr>
<tr>
<td>Storage</td>
<td>3,664</td>
<td>3,992</td>
<td>4,350</td>
<td>4,739</td>
<td>5,163</td>
<td>5,625</td>
<td>8.9%</td>
</tr>
<tr>
<td>Middleware</td>
<td>1,147</td>
<td>1,233</td>
<td>1,326</td>
<td>1,426</td>
<td>1,534</td>
<td>1,650</td>
<td>7.5%</td>
</tr>
<tr>
<td>Applications</td>
<td>3,370</td>
<td>3,618</td>
<td>3,884</td>
<td>4,169</td>
<td>4,475</td>
<td>4,804</td>
<td>7.3%</td>
</tr>
<tr>
<td>Service</td>
<td>1,801</td>
<td>1,924</td>
<td>2,056</td>
<td>2,197</td>
<td>2,348</td>
<td>2,509</td>
<td>6.9%</td>
</tr>
<tr>
<td>Total</td>
<td>20,282</td>
<td>21,799</td>
<td>23,526</td>
<td>25,310</td>
<td>27,359</td>
<td>29,209</td>
<td>7.6%</td>
</tr>
</tbody>
</table>

Source: IDC 2012

**£18.2 billion**
Countries With Large HPC Systems & Budgets
During the worst recession year, 2009, supercomputers selling for over $3 million (£1.9 million) grew 65%.

The EU just announced an increase in HPC funding by € 600 million.

Spending for supercomputers selling for $500,000+ (£375,000+) grew 24% in 2011, creating $4.4 billion (£2.7 billion) in sales.

The number of very large supercomputers, those selling for $50 million (~£30 million) or more, is growing at a high rate.
Countries That are Growing The Most

- These countries will have multiple $100 million-plus computers, and potentially $1 billion a year in HPC purchases within five years:
  - US
  - China
  - Germany

- These countries will also LIKELY have multiple $100 million-plus computers, and potentially $1 billion a year in HPC purchases within five years:
  - France
  - Japan

- And these will have at least one $50 to $100 million supercomputer within five years:
  - Russia
  - UK
  - South Korea, Australia, Spain, Switzerland, and others
The overall HPC market was hit hard by the recession, and has now largely recovered.

The worldwide supercomputer segment went into a major growth cycle from 2008 to 2011.
• The US HPC market was hit hard by the recession, and still hasn’t fully recovered

• The US supercomputer segment grew, but at a lower rate
The China HPC market wasn’t impacted by the recession, and is well under way to reach $1 billion in 5 years.

The China supercomputer segment grew the most heavily since 2007.
The Japan HPC market was hit hard by the recession.

The Japan supercomputer segment is very up and down (Riken will make 2012 very large).
• The German HPC market wasn’t hit as much by the recession
• It reached $1 billion in 2011
• The German supercomputer segment is growing well
How Europe Is Changing Its HPC Focus
Europe declined from 34.4% WW share in 2007, to 24.8% in 2009

### Table 6

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>CAGR (05–09)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total WW Revenue</td>
<td>2,160,829</td>
<td>1,925,165</td>
<td>2,011,793</td>
<td>2,014,596</td>
<td>2,527,058</td>
<td>4.0%</td>
</tr>
<tr>
<td>North America Revenue</td>
<td>1,043,865</td>
<td>903,948</td>
<td>932,183</td>
<td>1,031,201</td>
<td>1,291,493</td>
<td>5.5%</td>
</tr>
<tr>
<td>Europe Revenue</td>
<td>614,307</td>
<td>582,989</td>
<td>692,038</td>
<td>592,535</td>
<td>627,732</td>
<td>0.5%</td>
</tr>
<tr>
<td>** Percent of WW</td>
<td>28.4%</td>
<td>30.3%</td>
<td>34.4%</td>
<td>29.4%</td>
<td>24.8%</td>
<td></td>
</tr>
<tr>
<td>Asia/Pac Revenue</td>
<td>249,244</td>
<td>204,639</td>
<td>228,972</td>
<td>219,970</td>
<td>226,608</td>
<td>-2.4%</td>
</tr>
<tr>
<td>Japan Revenue</td>
<td>231,745</td>
<td>206,965</td>
<td>122,733</td>
<td>137,872</td>
<td>348,448</td>
<td>10.7%</td>
</tr>
<tr>
<td>Rest of World Revenue</td>
<td>2,669</td>
<td>8,594</td>
<td>14,464</td>
<td>14,692</td>
<td>13,362</td>
<td>49.6%</td>
</tr>
</tbody>
</table>

Source: IDC, 2010
# Investments Required And Scenarios

## TABLE 4

**Alternative HPC Funding Scenarios: Yearly Funding ADDITIONS By Year Five**

*(Millions of euros added per year)*

<table>
<thead>
<tr>
<th></th>
<th>Full Leadership Funding Level</th>
<th>Funding To Reach Major Goals Level</th>
<th>Partial Funding Level</th>
<th>Minimal Increase Funding Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPC System Funding Increases</td>
<td>250</td>
<td>210</td>
<td>120</td>
<td>50</td>
</tr>
<tr>
<td>HPC Development Test-beds (H/W)</td>
<td>50</td>
<td>40</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>HPC Development Test-beds (People)</td>
<td>75</td>
<td>60</td>
<td>35</td>
<td>0</td>
</tr>
<tr>
<td>Exascale Software Development</td>
<td>150</td>
<td>125</td>
<td>55</td>
<td>25</td>
</tr>
<tr>
<td>Scientific Talent Magnet Program</td>
<td>75</td>
<td>60</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total Yearly Funding Increase</strong></td>
<td><strong>600</strong></td>
<td><strong>495</strong></td>
<td><strong>260</strong></td>
<td><strong>75</strong></td>
</tr>
</tbody>
</table>

Note: These figures include HPC funding paid by the EU, by member nations and contributions by vendors.

Source: IDC, 2010
President Dmitry Medvedev warned that:

- Without more investment in supercomputer technology, “Russian products will not be competitive or of interest to potential buyers.”

T-Platforms has expanded into Europe and wants to enter the US market

Russia has its own TOP-50 rating: http://top50.supercomputers.ru/?page=rating

- The sixteenth edition of the list showed further growth performance of supercomputers → Linpack results for the six months rose from 1899 trillion operations per second to 2492 TFlop/s (31% growth)

- Total peak performance of the list was 4350 TFlop/s (3275 TFlop/s in the previous edition of the list) (33% growth)

- This list has 19 new systems (during the last six months)
<table>
<thead>
<tr>
<th>Site</th>
<th>Website</th>
<th>Site Location</th>
<th>Officials IDC Met With</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moscow State University - Research Computing Center</td>
<td><a href="http://srcc.msu.ru/nivc/index_engl.htm">http://srcc.msu.ru/nivc/index_engl.htm</a></td>
<td>Moscow, Russia</td>
<td>Prof. Alexander V. Tikhonravov (Director), Prof. Vladimir V. Voevodin (Deputy Director)</td>
</tr>
<tr>
<td>Moscow State University - Institute of Microbiology</td>
<td><a href="http://www.msu.ru/en/resources/msu-ws1.html#biol">http://www.msu.ru/en/resources/msu-ws1.html#biol</a></td>
<td>Moscow, Russia</td>
<td>Prof. Alexander Alexeyev</td>
</tr>
<tr>
<td>Tomsk State University</td>
<td><a href="http://www.tsu.ru/Website/TSU/coreen.nsf">http://www.tsu.ru/Website/TSU/coreen.nsf</a></td>
<td>Tomsk, Russia</td>
<td>Prof. Alexander V. Starchenko</td>
</tr>
<tr>
<td>Tyumen State University</td>
<td><a href="http://www.utmn.ru/english/">http://www.utmn.ru/english/</a></td>
<td>Tyumen, Russia</td>
<td>Prof. Filippov Vadim (Vice Rector for New Education and Information Technology)</td>
</tr>
<tr>
<td>N.I. Lobachevsky State University</td>
<td><a href="http://www.unn.ru/eng/">http://www.unn.ru/eng/</a></td>
<td>Nizhni Novgorod, Russia</td>
<td>Prof. Dmitry Shaposhnikov (Director, Faculty of Mathematics and Cybernetics)</td>
</tr>
<tr>
<td>Moscow Institute of Transport Engineers (railway industry)</td>
<td><a href="http://www.miit.ru/">http://www.miit.ru/</a></td>
<td>Moscow, Russia</td>
<td>Prof. Alexander B. Abramov (Senior Lecturer)</td>
</tr>
</tbody>
</table>
Interesting Charts From China:

From Their Public Presentations
At ISC In Germany And
Supercomputing In The US
17 PF Systems in Five Years

- With correct strategies, China wins the HPC Olympic Games, and HPC is really helping science and economy development of China.
- HPC real application still lag behind the US, Euro and Japan.
- On TianHe-1A, several applications can scale up to 80,000 cpu cores.
- The growth rate of China HPC Perf. Is the fastest.
- There will be at least 17 major petaflops supercomputing centers within 5 years.
Plans For Major Growth In HPC Budgets

Petascale Supercomputers@CAS+Beijing

- 1 PetaFlops supercomputer in 2012
  - Budget 250M RMB (£25 million)
  - For scientific computing
- 10 PetaFlops supercomputer in 2015
  - Collaboration with Beijing local government
  - Budget 1.2B RMB (£120 million)
  - For scientific computing and industry computing
HPC Demand Is Strong And Growing In China

Future Computing Capability Demand in SSC

Increase 2.3 times every year
Future Plans In China

Perspectives on Future Development

- 2012-2013: System with peak performance of 10 Pflops will appear
- 2011-2012: Total Linpack performance will reach 10PFlops
- 2014-2015: System with peak performance of 100 Pflops will appear
- 2013-2014: Total Linpack performance reach 100 PFlops
TH-1A Application Example: GPUs For Breaking Passwords

Case study (CPU+GPU)

- FreeBSD MD5 crypt cracker, Brute-force attack
  - Number of passwords checked on single node
    - Without GPU, 50Kilo/s, With GPU, 250Kilo/s
    - Whole system (186368 cores) lineal scalable
  - Number of passwords checked on Tianhe-1A
    - 1.8 Billion per second
Sunway Bluelight

- National Engineering Center for Parallel Computer
- Developed for the National Supercomputing Center (Shandong), Jinan, China
- >Petaflops peak performance
- Infiniband QDR 40Gbps
- Multi-core Processor designed by China
- Will be released on HPC China 2011@Jinan
High Performance Data Analysis (HPDA)
HPDA = tasks involving sufficient data volumes and algorithmic complexity to require HPC resources
- Established (simulation) or newer (analytics) methods
- Structured data, unstructured data, or both
- Regular (e.g., Hadoop) or irregular (e.g., graph) patterns
- Government, industry, or academia
- Upward extensions of commercial business problems
- Accumulated results of iterative problem-solving methods (e.g., stochastic modeling, parametric modeling).
The Boundaries Between HPC Big Data and High-End Commercial Analytics Are Dissolving

- HPC vendors are targeting commercial markets
- Commercial vendors are seeing HPC requirements (SAS, SAP, Oracle, LexisNexis, et al.)
- Early crossover use cases:
  - Fraud/error detection
  - Genomics/proteomics
  - Personalized medicine
  - FSI
Fast growth from a small starting point

<table>
<thead>
<tr>
<th>TABLE 2</th>
<th>IDC Worldwide Data Intensive (Big Data) Focused HPC Server Revenues</th>
<th>($ Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2009</td>
<td>2010</td>
</tr>
<tr>
<td>WW HPC Server Sales</td>
<td>8,637</td>
<td>9,504</td>
</tr>
<tr>
<td>Big Data Workloads</td>
<td>535</td>
<td>603</td>
</tr>
<tr>
<td>Big Data in HPC Portion</td>
<td>6.2%</td>
<td>6.3%</td>
</tr>
</tbody>
</table>

Source: IDC 2012
USE CASES: HPDA
Detecting fraud in ‘real time’ as millions of transactions are processed between disparate systems at volume.

Finding suspicious patterns that we don’t even know exist in related data sets.

Ability to create and deploy new fraud models into event flows quickly and with minimal effort.

Provide environment for fraud modeling, analytics, visualization, M/R, dimensioning and further processing.
Problem: Need accurate automated phone quotes in 100ms

Solution: Each weekend, use HPC cluster to pre-calculate quotes for every American adult and household (60 hours)
Enter the patient’s history and symptomology.

While patient is still in the office, sift through 10 million archived patient records for relevant outcomes.

Provider considers the efficacies of various treatments for “similar” patients (but is not bound by the findings).

Ergo, this functions as a powerful decision-support tool.

Benefits: better outcomes + rein in costly outlier practices
Government Health Care Fraud & Other Apps

- Multi-year evaluation project using real-world problem.
- Big, separate databases for the big USG health care programs (Medicare, Medicaid, Veterans Affairs, Social Security, et al.)
- ORNL has won contract to evaluate various architectures for performing fraud detection and other apps
- Estimated fraud: $150B-$450B (<$1B caught today)
NCSA/NSF
Study Highlights
Goals Of The Study

- Document which HPC applications manufacturers are using today and their future needs
- Determine the scalability of these applications
  - And the underlying science that may be limiting the scalability
  - Identify the barriers preventing greater scalability
- Determine what methods the manufacturers are using, if any, to get past scalability limits
- Recommend areas where additional investments, training and/or research could improve the scalability and usability of applications
Research Methodology

• IDC conducted interviews, in person or by phone, with individuals from 30 organizations who were selected for their known deep understanding of the attributes of key software applications in their areas of activity
  • From a broad spectrum of industrial segments to be representative of the HPC-reliant industry as a whole
• IDC convened a focus group in conjunction with our HPC User Forum held in Richmond, Virginia
  • Invited participants included noted experts in multiple fields of computational science and engineering
  • They were also known to have a strong understanding of the relationships between their HPC applications and the science underpinning the applications
Respondent Profiles

30 organizations participated:

- 76.6% Industry
- 16.7% Government
- 6.7% Academia
Respondent Profiles

- Organizations ranged greatly in size, from 22 to 164,000 employees
- R&D investments among the responding organizations ranged from $515 million to a whopping $5 billion
  - As a percentage of revenues, R&D expenditures varied from 3% to 45% and averaged 18.2%
  - The responding companies invested about 6.5 times more, as a percent of their revenues, than did all U.S. companies as a group
Q: When asked if their existing applications will meet their requirements for the next five years:

- 38.9% said the underlying mathematical model/algorithm needs to be improved
- 31.2% said the underlying science needs to be improved
- 15.5% applications as now written would meet their requirements
- 14.5% said that a factor other than those cited above needs to be addressed
### Workforce Capability – Training is Greatly Needed

Three-quarters of the participants said their people can handle today's technologies but need retraining to handle next-generation systems.

What are the capabilities of your current workforce to implement changes that improve scalability and performance of applications using latest HPC hardware and software technologies?

<table>
<thead>
<tr>
<th>Description</th>
<th>Percentage Of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workforce is capable of adequately handling the current generation technologies but need to be retrained for next generation systems</td>
<td>75.0%</td>
</tr>
<tr>
<td>Work force fully equipped to handle current technologies and are able to provide technology leadership for next generation systems</td>
<td>12.5%</td>
</tr>
<tr>
<td>Workforce is inadequate to handle the complexity of HPC and is a serious impediment to adopting advanced HPC simulation based engineering</td>
<td>12.5%</td>
</tr>
<tr>
<td>Workforce is capable of maintenance of current infrastructure but is inadequate to develop new solutions for current generation or future generation systems</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

Source: IDC, 2012
Desired Improvements in Applications

- Most of these near-term improvements fell into the following categories:
  - Higher-resolution meshes
  - Improved mathematical models and algorithms
  - Improvements to the underlying physics
  - Better methods for data integration and analysis

- 44.4% said that the current science has the potential to provide "a large amount of additional realism"

- In a majority of cases, the known science has advanced beyond the ability of industrial applications to exploit it fully

- Additional investments to advance the known science are needed to drive industrial innovation and competitiveness forward
Areas Needing Most Improvement

• Higher-scaling models and algorithms
• More training for personnel
• Advances in the underlying science (e.g., physics, radiation biology)
• Better-performing hardware systems
• Better interconnects/networking (bandwidth, latency)
• More attractive software licensing models
A New IDC Study: Creating An Economic Model For HPC and ROI, and for HPC and Innovation
A study that describes how increases in HPC investments can significantly improve the nation's economic success and increase its overall scientific innovation

The study includes creating two unique models:

1. A macroeconomic model which depicts the way HPC investments result in economic advancements in the form of ROI, growth and jobs
2. An "Innovation Index" that provides a means of measuring and comparing national innovation levels, based on the level of applying HPC computing resources towards scientific and technical advancement
Research Overview – Key Data and Metrics

1) Determine the time delay by the different sectors/categories (delay of investments → to returns)

2) Determine the type of return and size of return by year
   - Sales, profits, cost savings, employee growth, new companies/start-ups, innovation, etc.
   - For year 1, 2, 3, 4, ...

3) Determine the % of each sector that can actually use HPC
   - Must do some R&D today
   - Must use some computers in R&D today (could be desktop only)
   - Estimate the % of each sector that could use HPC and the size of each sector within a country = total potential

4) Estimate the typical R&D and other costs per HPC $ invested

5) Then calculate the results:
   - ROI per HPC/R&D dollar (overall and by sector)
   - Additional R&D investments required per HPC dollar
   - Total return for a country per HPC dollar, over time
   - Innovation increase per HPC dollar invested

6) In addition, estimate competitive responses, leading to how much is needed to keep ahead over time (or stay even)
   - Flow of HPC investments over time (vs. a single investment)
   - Likely competitive reactions (requiring an increased HPC investment)
Research Overview – An Example of the Parameters Needed

For Each Industry Sector: e.g. in Manufacturing

Companies That Don’t Conduct R&D

% That Conduct R&D

Don’t really Need HPC

Already Using Max HPC

% That Could Use More HPC

Companies That Don’t Conduct R&D
Research Overview: Potential Sectors To Be Explored

1) By major industry sectors (including government and academic)
2) By organization size
3) By country
4) Length of time doing R&D
5) Length of time using HPC or desktops/workstation
6) Type R&D or engineering or application area:
   - Regular R&D (more research focused)
   - Engineering or direct design
   - Other – e.g., movie design/rendering, finance, etc.
Based on organizations in each sector **ranking** innovations made within their sector:

- **Different indexes will be used to categorize the innovation areas:**
  - For new products and services
    - Major innovations
    - Incremental innovations
  - For scientific discovery & breakthroughs
    - Fundamental research, e.g. base scientific discoveries for advancing science
    - Applied science, e.g. to directly help society
Proposed Schedule: 9/1/12 to 6/1/13

1. October 2012 – finalize the plan, surveys and overall research approach
2. November 2012 – conduct a limited number of surveys to both see what can be collected and start testing the two models
3. December 2012 – refine the surveys and models as needed
   - Review the initial results with DOE
   - Refine as needed
4. January – March 2013 – conduct the broad data collection/surveys
5. April 2013 – populate the two models with data from both surveys and existing economic data elements
   - Review the results with DOE
   - Refine as needed
6. May 2013 – present and refine the models as required, and create the 3 funding scenarios
7. June 2013 – disseminate the results
The IDC HPC Innovation Award Program
We Are Collecting A Large Set Of HPC ROI Examples

We invite users to submit their examples at: www.hpcuserforum.com/innovationaward/
New HPC Innovation Award Program:
www.hpcuserforum.com/innovationaward/

Program Goals

- Showcase success stories involving HPC in science and industry
- Help other users better understand the benefits of adopting HPC and justify HPC investments, especially for SMBs
- Demonstrate the value of HPC to funding bodies
- Expand public support for increased HPC investments
- If you have one or more HPC success stories you would like to see recognized through our program, we encourage you to complete and submit this application form. Please submit a separate form for each success story that you want considered.

Program Objectives

While there are multiple benchmarks to measure the performance of technical computers, there currently isn’t an adequate methodology to evaluate the economic and scientific value HPC systems contribute. The HPC Innovation Excellence Award Program is designed to help close that gap.
HPC Award Program Goals

#1 Help to expand the use of HPC by **showing real ROI examples:**

1. Expand the “Missing Middle” – SMBs, SMEs, SMSs -- by providing examples of what can be done with HPC
2. Show mainstream and leading edge HPC success stories

#2 Create a large database of success stories across many industries/verticals/disciplines

- To help justify investments and show non-users ideas on how to adopt HPC in their environment
- Creating many examples for funding bodies and politicians to use and better understand the value of HPC to help grow public interest in expanding HPC investments
- For OEMs to demonstrate success stories using their products
We recognize these sites for their excellence in applying HPC to solve key business and scientific problems:

<table>
<thead>
<tr>
<th>Site</th>
<th>Person</th>
<th>Success Area</th>
<th>Org Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barcelona Supercomputing Center</td>
<td>Mariano Vazquez</td>
<td>Sci/Eng/ROI &amp; Society</td>
<td>Large</td>
</tr>
<tr>
<td>Computational Research</td>
<td>Kishore Nikam Medium</td>
<td>Bus Impact &amp; Eng</td>
<td></td>
</tr>
<tr>
<td>Laboratories</td>
<td>Anutosh Moitra</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cycle Computing / Schrodinger</td>
<td>Jason Stowe</td>
<td>Bus Impact &amp; Eng</td>
<td>Small</td>
</tr>
<tr>
<td>Intelligent Light</td>
<td>Roger Rintala</td>
<td>Sci/Eng/ROI</td>
<td>Small</td>
</tr>
<tr>
<td>PayPal</td>
<td>Arno Kolster, Large Ryan Quick</td>
<td>Bus Impact, ROI &amp; Eng</td>
<td></td>
</tr>
<tr>
<td>Ramgen Power Systems</td>
<td>Allan Grosvener</td>
<td>Bus Impact &amp; Eng</td>
<td>Medium</td>
</tr>
<tr>
<td>St. Vincent Institute of</td>
<td>Michael Parker</td>
<td>Sci/Eng/ROI &amp; Society</td>
<td>Large</td>
</tr>
</tbody>
</table>
In Summary
Why HPC Is Projected To Grow

1. **It has become a competitive weapon**
   - For companies, universities and governments
   - Global competitiveness is driving R&D and better product designs
   - Even small companies are using HPC to gain market share

2. **Governments view HPC leadership as critical**
   - For national pride, but more importantly for economic prosperity
   - It use to be 1 large supercomputer – now its multiple ones

3. **There are very critical HPC issues that need to be solved**
   - Global warming, alternative energy, safe NE, financial disaster modeling, healthcare, homeland security, …
   - And 3D movies and large scale games are fun

4. **At the same time, “live” science and “live” engineering costs have escalated**
   - And time-to-solution is months faster with simulations
But There are Still Major Customer Pain Points

Software is the #1 roadblock
- Better management software is needed
- Parallel software is lacking for most users
  - Many applications will need a major redesign

Clusters are still hard to use and manage
- System management & growing cluster complexity
- **Power, cooling and floor space are major issues**
- Third party software costs
- RAS is a growing issue
- Storage and data management are becoming new bottle necks
- Weak support for heterogeneous environment and accelerators

ROI is becoming a requirement, especially as system costs escalate
Upcoming Meetings/Events

HPC User Forum Meetings (www.hpcuserforum.com)

- April 29-May 1, 2013. Tucson, AZ. Loew’s Ventana Canyon
- September 7-9, 2013. Boston, MA. Fairmont Copley Plaza
- October 2013. Toyko, Japan and Seoul, South Korea