Could IBM Become the Nokia of Supercomputers?

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Supercomputing is being squeezed by new cloud computing competitors and more expensive component suppliers. How will the likes of IBM adapt to this hostile environment?

Two weeks ago, the tech media was abuzz with news of the z13, IBM's newest "mainframe" supercomputer". Geared for processing 2.5 billion mobile transactions a day, the z13 is the most powerful piece of hardware out there for enabling mobile payments and analysing customer data in real time. It was five years in the making, costing US$1 billion in development and is built on 500 patents. Such a machine reminds us that IBM still has the strength to create powerful hardware. But the company's earnings just one week later also remind us of IBM's yo-yo-like fortunes in the supercomputing business.

Last April, Cray Inc., a smaller rival of IBM in the supercomputing industry, won a US$70 million bid for supplying the U.S. National Energy Research

Scientific Computing Center (NERSC) with their **next supercomputer**. The computer is likely to become one of the world's fastest when it is delivered in 2016. Tenders this large only happen a few times a year and attract the entire supercomputing industry.

2014 turned out to be a good year for Cray. On June 25th, it also won a US$54 million supercomputer contract with the Korean Meteorological Administration (KMA), which will be the computer that **prepares future South Korean weather forecasts**. July 10 followed with an even more important announcement from Cray: it had been **awarded a US$174 million contract** by the National Nuclear Security Administration to run computations for managing the US nuclear arsenal. And on October 29 Cray announced it had won a contract with the British Meteorological Office to build a £97 million supercomputer.

How is it possible that IBM lost such prestigious and important contracts in the supercomputing market to Cray, a company that has only one hundredth of IBM's **US$6.2 billion annual R&D budget**? Is the company that brought computers to the world no longer able to build the fastest machines?

Cray: From David to Goliath – twice

Competitors have eaten IBM's lunch before. Control Data Corporation (CDC), IBM's much smaller competitor, built a machine in the 1960s that was ten times faster than anything else on the market and was a huge success, selling in total for over US$800 million dollars. Seymour Cray was the chief designer of the new "supercomputer" machine and was a firm believer in the power of small, innovative teams.

IBM went on the offensive and by the end of 2006, 47 percent of **the world's 500 fastest computers** were IBM machines. Cray Inc., the company Seymour Cray founded after his success at CDC, had seen its share of the top systems dwindle from over 60 percent in the 1980s to just 3 percent in 2006.

Yet, by 2014 IBM's share of the top 500 list had dropped by fifty percent to only 33 percent while Cray had made a comeback at IBM's expense, claiming 10 percent of the top 500 systems. Furthermore, IBM had not yet made an announcement regarding a **successor to its popular Blue Gene platform**, which had powered their lead for the past 15 years. What explained this change of fortune?

The Supercomputer Supply Chain

IBM's surprising retreat is partly explained by the fundamental changes that are sweeping through the supercomputing supply chain. While there are thousands of components in a supercomputer, processors (CPUs, accelerators and GPUs) generally account for about 80 percent of the cost of a system according to International Data Corporation (IDC), a research firm. 95 percent of the processors used in supercomputers today are of the "x86" family, which is produced by Intel and AMD, with Intel being the dominant player. Smaller processor makers produce the remaining 5 percent. For example, IBM makes its own POWER series of processors, which are used in some of its highest-end supercomputing systems.

The trend in recent years has been for processor makers to divest their factories and rely on specialist producers. AMD, for example, spun off its factories in 2009 and is now a "fabless" chipmaker. Pure-play semiconductor foundries have to a large extent overtaken processor manufacturing, leaving the chipmakers to focus on chip design. The semiconductor makers are mostly Asian players; the most significant is Taiwan Semiconductor Manufacturing Company (TSMC).

Figure 1 provides the estimated EBIT shares for 2003. This shows the system vendors (such as IBM, HP) capturing 32 percent of chain profits, much less than their 55 percent share of revenues. In contrast, the estimated 2003 share of profits of the processor makers and the semiconductor manufacturers stood at 34 percent for both, much higher than their respective shares of revenues of 27 percent and 18 percent.

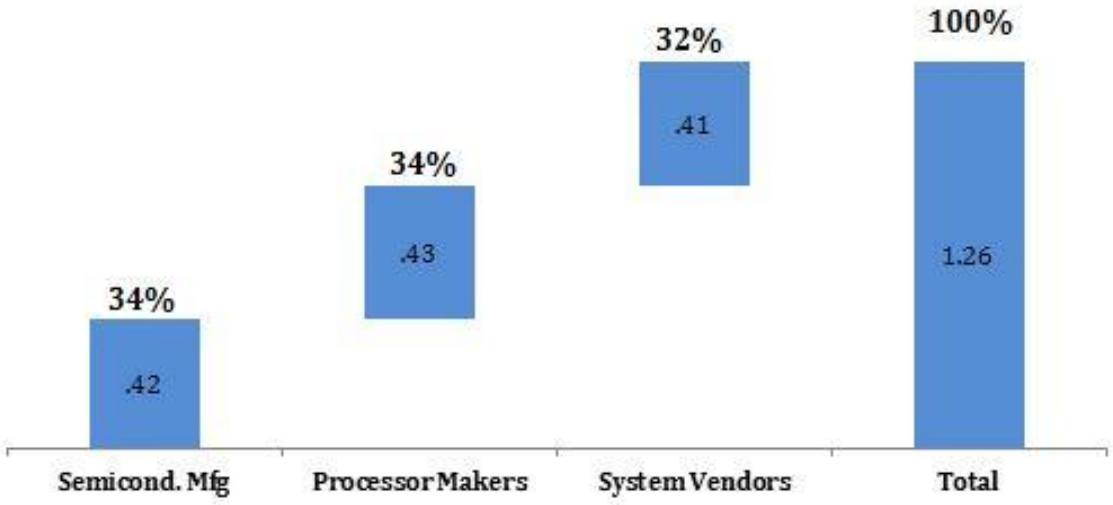

Figure 1. Distribution of EBIT among semiconductor manufacturers, processor makers and system vendors in the supercomputer supply chain, 2003, bn. USD

By 2013, the share of chain revenue for the systems vendors, processor makers and semiconductor manufacturers had barely changed (respectively 57 percent, 28 percent and 15 percent).Figure 2 however shows that the vendors' share of 2013 profits more than halved, to 15 percent. This dramatic drop was much to the benefit of the processor makers that saw their share increase from 34 percent to 45 percent of total chain profits, and the semiconductor makers whose share increased from 34 percent to 40 percent.

Figure 2. Distribution of EBIT among semiconductor manufacturers, processor makers and system vendors in the supercomputer supply chain, 2013, bn. USD.

The increasing share of total profits for the semiconductor manufacturers, such as TSMC, and processor makers, such as Intel and AMD, shows the rising importance of the processor in the supercomputer – as well as the pricing power of the handful of players. Similarly, the very significant drop in profits for the system vendors reflects their loss of power due to the commoditisation of that activity.

System vendors have thus been downgraded to assemblers and unless they discover new niche markets or expand into more lucrative parts of the

supercomputer supply chain, their future is looking less attractive.

The processor makers on the other hand are enjoying good times. While there is rivalry among the key players (Intel, AMD and NVIDIA), the reality is that there are very few companies that can design high-end processors.

To reshape or exit?

One can therefore expect the processor makers to continue to capture a very substantial part of the profit in the chain. One can also expect the semiconductor manufacturers to grow their share of profits, particularly the top players such as TSMC.

On the horizon, however, is a new disruptive element -- cloud providers. These include major companies such as Amazon, Google and Microsoft, which rent remote access to their supercomputing clouds that are typically built using commodity clusters. This gives anyone the ability to utilise supercomputing at a very low price, and without owning a physical machine. We expect the cloud computing providers to grow significantly as more and more sites prefer to use cloud services rather than set aside a physical premise for their supercomputing sites which can cost over 150 percent of the actual machine. In 2014, 23.5 percent of supercomputer users were using cloud services to complement their internal supercomputers, up from 13.8 percent in 2011 according to IDC.

How IBM is seeking to reshape supercomputing

As the system vendor business has become less hospitable – and less profitable – IBM may well be better off leaving the hardware market to Cray – that soon will have to deal with competition from lower-cost, system assemblers. In fact, in January of 2014, IBM **sold its server business to Asian manufacturer Lenovo** and has taken several steps to shift focus to the more lucrative parts of the supercomputing system supply chain. First, it has extended its software platform for managing supercomputing systems to the management of clusters. IBM’s management software, developed over decades while designing large-scale computers, used to be an important reason for buying a traditional IBM supercomputer. Clusters have typically been harder to manage since they use software and components built for lower-grade personal computers. However, with a broadening customer base that has less IT knowledge than before, system vendors have been put under pressure to provide comprehensive management software that makes it

easier to use the computational power, lowers maintenance costs and keeps supercomputer utilisation high.

Second, IBM has shifted from selling supercomputing “machines” to “solutions”. While building its services division over the past 20 years, IBM has gained expertise in nearly every conceivable domain that uses computing. The typical company that wants to utilise supercomputing thinks in terms of applications, not computers. Therefore, IBM has used its domain expertise to bundle software, hardware and technical consulting into ready-to-go solution packages for a wide range of supercomputing applications within domains such as biotechnology, financial services and energy. Smaller system vendors lack the knowledge to provide the complete solutions of IBM. For a customer, this means that buying a machine from a smaller vendor requires more IT expertise than buying a complete solution from IBM – and typically, lack of expertise is a big hurdle for adopting supercomputing.

Finally, IBM is trying to make sure that as its customers move to the cloud, they stick with IBM. A large gap in the offer of the major cloud providers is the lack of easily accessible domain-specific solutions. In June 2013, **IBM acquired SoftLayer**, a cloud computing provider. Since then, IBM has integrated cloud computing into its solutions packages. For example, in choosing a solution, a customer can (with IBM’s help) choose to own its own machine, go for a hybrid solution that uses both a customer-owned machine and IBM’s cloud, or exclusively utilise the cloud. IBM’s cloud also provides high-speed interconnects and increased security features, which are typically important to supercomputing customers but lacking from the bigger cloud providers. By making sure that IBM is the first cloud provider a transitioning supercomputer customer uses, the customer can also be locked into IBM’s cloud ecosystem.

Will IBM succeed in reshaping itself?

The changing fortunes and strategy of IBM in supercomputing demonstrate the significance of the challenge and the need to develop a new business model rather than tweak the strategy that worked well for them in the previous decade.

Disruption leading to resource obsolescence is one of the toughest challenges that a corporation can face as it undermines the very foundation of its long term-success. Examples of companies that could not overcome these challenges abound: Nokia, Research in Motion, Motorola, Kodak, DEC.

Any change in business model entails the significant risks of leaving behind established competences and of being too slow or unsuccessful in building the new competences. However, while computing power has become a commodity, significant IT expertise is still required to provide solutions to very complex problems and IBM is making a credible commitment to reconfigure its resource base to be competitive in the emerging (super)computing environment.

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