



BNY MELLON

Executive Summary

If you embrace the ideas of Austrian economist Joseph Schumpeter, then you know that creative destruction can be a powerful force. Nowhere is its impact as evident as in the Technology sector, where change is a constant and innovation is clearly rewarded.

Today, we are witnessing a renewed emergence of the creative destruction cycle within Technology. As the focus shifts away from desktops and servers toward the new paradigms of mobility and cloud computing, we see significant Darwinian conflict within Technology, with the most promising winners having the strongest innovation records and the most likely losers being unable or unwilling to react.

In this paper, we will discuss three important emerging themes consistent with this shift and related dislocation: mobility, cloud computing and data analytics. Common to all of these themes are two key underpinnings. First, consumers and enterprises are seeking to increase productivity economically. Second, the pace of innovation is accelerating as trends take hold and create efficiencies and opportunities, ultimately challenging market leaders to retain their dominance.

“Creative Destruction is the essential fact about capitalism. It is what capitalism consists in and what every capitalist concern has got to live in.”

– Joseph Schumpeter, circa 1942¹

The Explosion of Mobile Devices is Permanently Changing Computing

Mobility is perhaps one of the most disruptive forces we see in Technology today. We believe the world has moved into the Post-PC Era, largely because of consumers’ affinity for, and growing dependence on, their smartphones and tablets. In 2011, smartphones outsold personal computers for the first time on record according to the analysis firm Canalys, and we expect sales of Apple iPads™ to reach 60 million units in 2012 — a mere three years after the device’s debut. In fact by the end of 2012, the number of mobile-connected devices will

A Renewed Emergence of Creative Destruction in Technology

By

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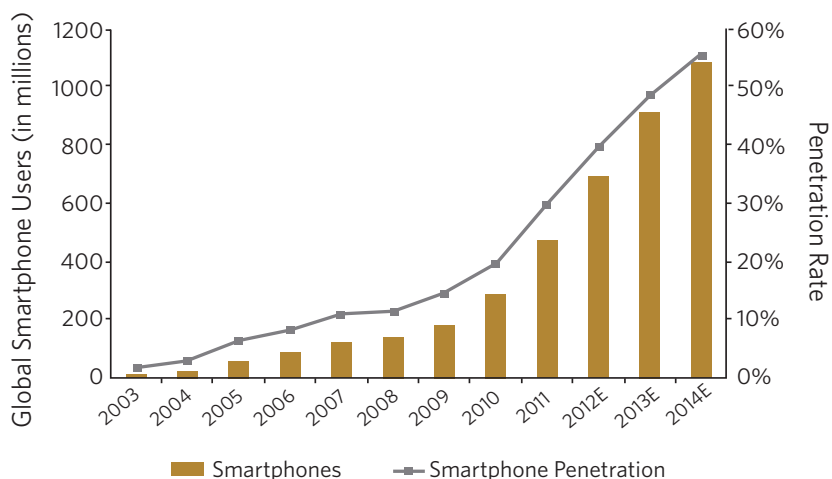
¹ Schumpeter, Joseph A. “Creative Destruction.” From *Capitalism, Socialism and Democracy* (New York: Harper, 1975) [orig. pub. 1942], pp. 82-85.

To support this explosive growth of smartphones and tablets, business models that are innovative, opportunistic and disruptive are being created at a rapid pace.

exceed the number of people on Earth.² In stark contrast, we expect anemic PC growth, which is likely to slow dramatically to only about 2% this year. Naturally, this shift in device preference and related divergent growth rates should have huge implications for the sector.

To support this explosive growth of smartphones and tablets, business models that are innovative, opportunistic and disruptive are being created at a rapid pace. Users are relying on their smartphones and tablets for functions that their PCs used to provide, such as all forms of written communication, as well as services that PCs cannot provide, such as those that are location-based. This shift in usage is not only creating new opportunities for mobile-facing business models, but also increasing challenges for PC-browser-based business models. According to Gartner, smartphone users still represent the minority of mobile subscribers in the world, but as the number of users grows, the disruption and opportunities presented by mobility will only accelerate.

Exhibit 1 - Global Smartphone Market Penetration Is Expected to Remain Strong



Source: Gartner, Barclays Capital Estimates, as of August 2012. E denotes full-year estimations.

Moreover, significant indirect opportunities are associated with this trend. One such example centers on how the proliferation of these devices is straining network and data-center infrastructure. By 2015, mobile data traffic is expected to be 2,600% greater than 2010 levels.³

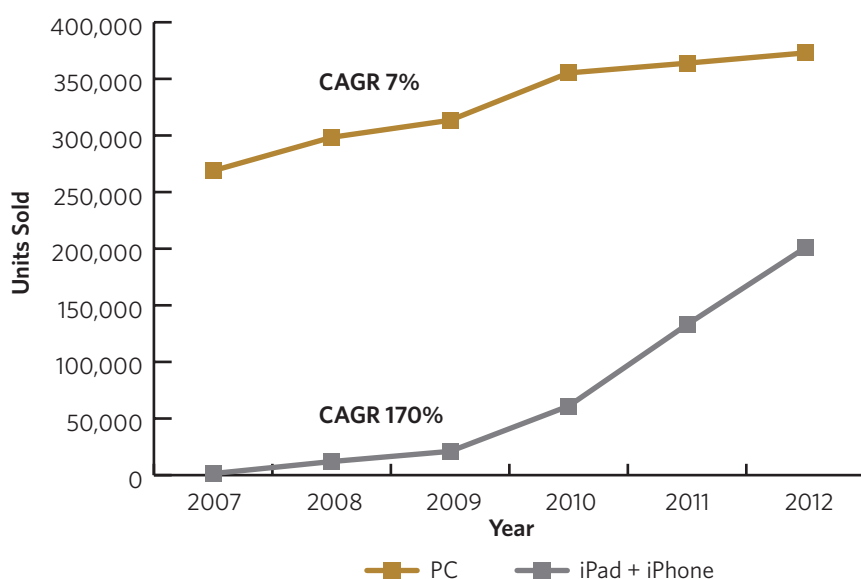
² "Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2011-2016." Cisco Systems, Inc., Feb. 14, 2012.

³ Press release, "Cisco Visual Networking Index Forecast Projects 26-Fold Growth in Global Mobile Data Traffic from 2010 to 2015," Cisco Systems, Inc., Feb. 1, 2011.

Still in the early stages of adoption, virtualization is an enabling technology that is paving the way for holistic cloud computing.

Conversely, slowing PC growth is proving to be a huge challenge for industry titans, such as Dell and Hewlett-Packard. Although part of the growth slowdown may be attributable to the October launch of Windows 8™, as enterprises and consumers defer purchases of new PCs until then, the secular slowdown is undeniable. It is forcing original equipment manufacturers, or OEMs, to pursue a survival strategy of either high prices and lower sales or lower prices and smaller margins.

Exhibit 2 - Mobile Device Growth Rates Are Far Exceeding Those of PC Growth Rates



Source: The Boston Company Core Research Technology Team with regard to publicly available iPhone and iPad data, and Gartner with regard to PC data. All data as of year-end 2011, with full-year 2012 estimates provided by Core Research Technology Team.

Cloud Computing Has Reached a Tipping Point

Still in the early stages of adoption, virtualization is an enabling technology that is paving the way for holistic cloud computing. The pace of commercial advancement has begun to accelerate as the overall ecosystem reaches a key inflection point, resulting in increased momentum for a multitude of new businesses, including those specializing in the segments listed here.

- **Enterprise Virtualization:** A key trend involves the virtualization of more mission-critical applications and development of management capabilities. The server market is approximately 50% penetrated, but management tool penetration appears to be very low, and the need for these products is escalating to manage the virtual infrastructure.

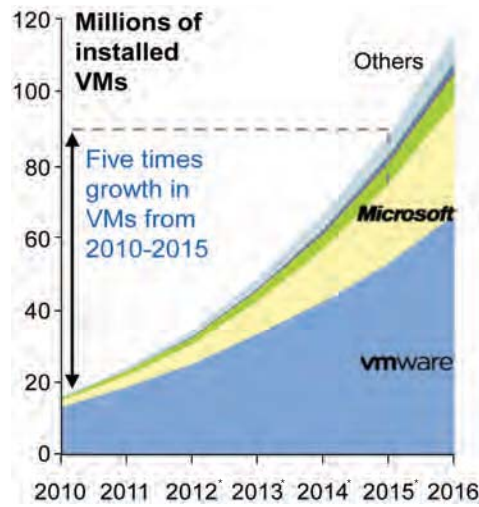
This on-demand, cloud-based delivery model allows an enterprise to effectively outsource the necessary infrastructure to a host-provider, thereby significantly reducing costs while having more accessibility to necessary applications regardless of location or device.

- **Desktop Virtualization:** With a base of corporate PCs estimated to exceed 685 million units by 2011,⁴ we believe current penetration rates of only the mid-single digits could accrue benefits to vendors for years to come. Technological enhancements, including lower-cost storage and faster network speeds, have generally created an acceptable return on investment to IT departments.
- **Software-Defined Networking:** This newer technology creates efficiencies in networking infrastructure through automation and central management. Recent acquisitions of startup ventures by industry bellwethers are helping to legitimize and ultimately shape the landscape of this budding market.
- **Software-as-a-Service:** This technology is another business model that thrives solely on the benefits created by virtualization. This on-demand, cloud-based delivery model allows an enterprise to effectively outsource the necessary infrastructure to a host-provider, thereby significantly reducing costs while having more accessibility to necessary applications regardless of location or device.
- **Social Enterprise:** Similar to familiar consumer products such as Facebook, social enterprise focuses on breaking down communication barriers among employees and enabling real-time sharing and collaboration. We believe this could become a significant market, as companies look not only to create efficiencies within their own organizations, but also to plug into external resources, such as Twitter and LinkedIn, to enhance customer reach, talent management and many other capabilities that benefit the operational aspects of running a business.

Of course, inherent to creative destruction are both winners and losers. The area most disadvantaged by the aforementioned innovation and evolution is the entire client server environment, which can be expected to see continued business-model pressure.

⁴ Goldman Sachs Global Investment EMERGING TECHNOLOGY RESEARCH Technology area: Virtualization, May 22, 2008.

Exhibit 3 - Server Virtualization Is Expected to Increase Fivefold by 2015



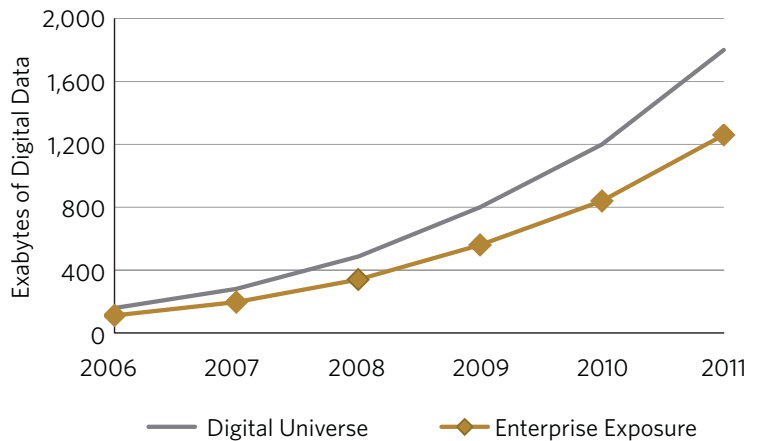
Source: Gartner, as of June 2012. VM stands for 'virtual machine.'

* Denotes full-year estimations. The companies listed above should not be considered recommendations to buy or sell a particular security.

Analytics Present "Big Data" Opportunities

Corporations have been creating, managing and storing data for decades, but advances in technology have increased the complexity and importance of execution. As seen in Exhibit 4, the amount of data generated at the corporate level has grown by more than 60% annually over the past five years, given the use of online connectivity, mobility and other cloud-based technologies that are layered atop traditional data-creation sources. This evolution has spawned a number of opportunities for infrastructure providers (a trend we believe is still very much intact), and organizations are now beginning to look to extract value from all the different data sources, both internal and external, in an effort to run their businesses more efficiently.

Exhibit 4 - Enterprise Data Volumes Have Expanded at a 60% + Compound Annual Growth Rate Between 2006-2011



Source: IDC; Morgan Stanley Research, September 4, 2012.

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Although the infrastructure layer tends to be the less exciting part of the Big Data evolution, it is arguably the most necessary piece because it creates the foundation for some of the more compelling components that are in earlier stages of deployment. Areas such as data integration, management, quality, and data warehousing are near-term beneficiaries. Once the infrastructure is developed, an enterprise can access real-time, rich data that enable effective and agile decision-making. Here are some examples of these real-time practices:

- Retailers are improving the accuracy and timeliness of their forecasting.
- Department stores are test-piloting sales strategies at selected locations and using their findings to influence strategies at other locations.
- Grocery stores are analyzing the contents of customers' carts to refine deals taking place that very same day.
- Municipalities are studying traffic flows to adjust construction timing.

Conclusion

Creative destruction is inducing game-changing innovation and related dislocation. With the pace of development and adoption accelerating and the differential between winners and losers intensifying, Technology is an exciting space right now. We expect to see continued and significant return dispersion in the sector as creative destruction translates to divergent individual company fundamentals and stock prices. Consequently, we believe the alpha opportunities in Technology investing are robust railroads that move raw materials and long-haul shipments and suppliers to those industries.

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