Deutsche Bank
Markets Research

North America United States **TMT** IT Hardware and Supply Chain	Industry # Tech hardware and supply chain	Date 8 December 2014 ## Special Report

Ten themes to watch in 2015

DB top picks supported by ten themes to watch in 2015
The technology hardware and supply chain group has seen significant changes over the past few years, and we expect these trends to continue into 2015. In this report, we explore 10 key themes that we expect to be the most relevant to our coverage group in 2015, including the changes in the traditional hardware markets, the growth in the Internet of Things, which is driving the Big Data Analytics and artificial intelligence markets, and emerging growth in segments like wearables, phablets and 3D printing. For 2015, we would focus on investments in names well positioned to benefit from these trends, with our top picks being APH, HPQ, SSYS, STX, and WDC.

Structural changes in the hardware market pressuring traditional IT vendors
The IT hardware market has seen significant structural changes in recent years, and we expect these to continue to pressure IT hardware vendors in 2015. The growth in the public cloud and the increasing dominance of hyperscale vendors, like Amazon and Google, suggest the traditional server and storage markets will see more limited growth in the next few years. The storage market in particular is just beginning to evolve, with virtualization, hyper-converged infrastructure, and the increasing use of NAND flash all creating alternative architectures to traditional storage. In general, we remain cautious on the traditional IT hardware vendors, preferring to focus on names with company-specific catalysts and low valuations, including HPQ and EMC.

Big Data, artificial intelligence and the IoT to drive data and sensor growth
The growing number of connected devices which are collecting data that needs to be processed and analyzed is creating new market opportunities. IT hardware companies like IBM, HPQ and EMC are working on solutions to address these markets, but these companies are generally viewed as a few steps behind some of the pure-play software vendors. In our view, the best way to benefit from growth in these areas is through investments in HDD companies STX and WDC, who will benefit from the growth in data, which is ultimately stored on an HDD. We also expect connector companies to benefit from the growth in the Internet of Things (IoT) through increased connector growth and the inclusion of sensors in these new devices and we prefer APH.

Emerging growth segments: wearables, phablets and 3D printing
On the consumer side, wearables and phablets are interesting growth trends, with AAPL having the most exposure here, although these segments are unlikely to be large enough to move the needle for the company. EMS companies with capabilities in these areas could also see some benefit. 3D printing is in its early stages of adoption in the industrial markets, and we expect this market to continue to grow in the 30% range over the next few years as the technology is more widely adopted. For exposure to growth in the 3D printing market, we would invest in SSYS.

Valuation and risk
These evolving trends create risks and opportunities for the companies under our coverage universe. Please see our detail company-specific valuation and risks starting on page 28.

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Top picks

Amphenol (APH.N),USD53.72	Buy
Hewlett-Packard (HPQ.N),USD39.55	Buy
Seagate Technology (STX.O),USD66.40	Buy
Stratasys (SSYS.OQ),USD93.25	Buy
Western Digital (WDC.OQ),USD105.07	Buy

Source: Deutsche Bank

Companies Featured

Apple Inc. (AAPL.OQ),USD115.00	Hold
Amphenol (APH.N),USD53.72	Buy
Arrow Electronics (ARW.N),USD59.43	Hold
Avnet (AVT.N),USD44.77	Hold
Benchmark Electronics (BHE.N),USD24.41	Hold
CDW Corporation (CDW.OQ),USD34.36	Buy
Celestica (CLS.N),USD10.93	Hold
3D Systems Corp. (DDD.N),USD33.85	Hold
EMC Corporation (EMC.N),USD30.33	Buy
Flextronics (FLEX.OQ),USD11.29	Hold
Fabrinet (FN.N),USD17.86	Hold
Hewlett-Packard (HPQ.N),USD39.55	Buy
IBM (IBM.N),USD163.27	Hold
Jabil Circuit (JBL.N),USD20.71	Hold
NetApp, Inc. (NTAP.OQ),USD43.40	Hold
Plexus (PLXS.OQ),USD39.91	Hold
Sanmina (SANM.OQ),USD25.06	Hold
Stratasys (SSYS.OQ),USD93.25	Buy
Seagate Technology (STX.O),USD66.40	Buy
TE Connectivity (TEL.N),USD65.00	Hold
Violin Memory (VMEM.N),USD5.08	Hold
Western Digital (WDC.OQ),USD105.07	Buy
ExOne (XONE.OQ),USD20.28	Hold

Source: Deutsche Bank

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Ten themes for 2015

The technology hardware and supply chain group has seen significant changes over the past few years, and we expect these trends to continue into 2015. In the following pages, we explore 10 key themes that we expect to be the most relevant to our coverage group in 2015. We've grouped these themes into three broad categories: (1) the structural changes in IT hardware, (2) Big Data, artificial intelligence and the IoT, and (3) emerging growth segments. For 2015, we would focus on investments in names well positioned to benefit from these trends, with our top picks being APH, HPQ, SSYS, STX, and WDC.

Structural changes in IT hardware

Growth in new technology and IT solutions are contributing to a fundamental, structural shift in a continually changing IT hardware market. These changes have been pressuring traditional hardware suppliers, and we expect these traditional server and storage markets to see lower-than-historical growth over the next few years driven by these structural shifts. Growth in public cloud, in particular, is poised to cannibalize traditional IT. While public cloud currently represents only about 10% of total IT hardware spending, public cloud solutions are more efficient than standalone data centers, and thus require a lower level of investment in new hardware, a negative trend for IT hardware providers.

In addition, the growth of large-scale public cloud providers, also known as hyperscale providers, is poised to cut out the traditional IT hardware suppliers, as many of these hyperscale vendors are using ODMs to build custom-designed systems and are not buying traditional server and storage systems. In a similar vein, the traditional storage market is just beginning to be challenged by a number of evolutions in storage architectures, including the increasing use of NAND flash, virtualization, and the hyper-converged model.

An emerging technology being employed by a small number of firms is container technology, which is an alternative to virtual machines (VMs). Containers offer improved utilization at a lower cost compared to current VMs, and longer term has the potential to unseat legacy virtualization technology.

As a result of these changes in the traditional IT hardware market, we remain cautious on companies with a heavy reliance on traditional IT infrastructure solutions, including IBM and NetApp. Instead, we would focus investments on names with company-specific catalysts and names that are undervalued, including Hewlett-Packard and EMC.

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Big Data, artificial intelligence and the Internet of Things

The next-generation trends of Big Data, artificial intelligence (AI), and the Internet of Things (IoT) are steadily gaining traction and we are seeing a great deal of overlap among these three spaces. We believe that companies that position themselves to take advantage of these growth trends have the potential to reap significant benefits. According to a recent Gartner report, Big Data and Big Data Analytics are gaining traction, with 73% of organizations planning to invest in Big Data over the next 24 months. While we believe the

pure-play software providers are the most likely beneficiaries of growth in this market, within our coverage group, we view IBM, Hewlett-Packard and EMC as well positioned.

Artificial intelligence (AI) is also rapidly gaining traction as a potential technology to be used in a variety of fields. While still a small market, the AI space is interrelated with Big Data Analytics and machine learning. A large number of corporations are experimenting with AI to enable new market opportunities, which makes it a significant market to watch over the next few years.

The Internet of Things (IoT) is an increasingly relevant market for technology companies, as increased connectivity from IoT devices produces a large amount of data that is being sent and received, creating increased demand for Big Data Analytics as well as smarter computers. We believe the growth trends in Big Data, as well as AI and the IoT are the most positive for hard disk drive companies, with our top picks being Seagate and Western Digital, as this data is eventually stored on a hard disk drive. In addition, IoT devices require connectors and sensors, which is a positive growth driver for connector companies, and our favorite name for exposure to the growth in IoT devices is Amphenol.

We believe the growth trends in Big Data, as well as AI and the IoT are the most positive for hard disk drive companies Seagate and Western Digital. We also see IoT growth as a positive for connector company Amphenol.

Emerging growth segments

Three new areas of growth, which we expect to become increasingly relevant in 2015, are wearables, phablets, and 3D printing. Wearables are poised for more significant growth in 2015, with the introduction of new devices from a number of new and established companies. We expect the Apple Watch, which should be introduced in early 2015, to serve as a major catalyst for widespread adoption and growth in the wearables market which IDC expects to grow at a CAGR of 78% over the next five years.

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The convergence of the mobile devices market is another trend set to impact many different subcategories within hardware. Notebook PC growth has slowed, and tablet growth is now slowing, as an increasing number of consumers opt for smaller devices with increased functionality. In addition, the difference between these devices is beginning to blur, as exemplified by the growth in phablets, which are smartphones with screen sizes of 5.0" or more. Among larger mobile devices, phablets are expected see the most significant growth over the next few years, with phablets already representing nearly 40% of smartphone shipments in 2014. Samsung is leading the phablet market today, but Apple's introduction of the iPhone 6 Plus positions Apple to regain some of its lost share in the smartphone market.

Growth in the 3D printing market, also known as additive manufacturing, has accelerated in the past 3 years, to a CAGR of 32%. The technology is still in the process of being adopted in industrial manufacturing, and is set to continue to be adopted due to the advantages of smaller lot sizes, increased part complexity, lower materials usage, and reduced inventory needs. Looking to benefit from the growth in this market, Hewlett-Packard recently introduced a platform to address this segment called Multi Jet Fusion (MJF), which will be available in 2016. We expect growth in 3D printing to continue to be robust and we view Stratasys as well positioned in this segment.

We expect growth in 3D printing to continue to be robust and we view Stratasys as well positioned to benefit from this growth.

Structural changes in the IT hardware market

Theme 1: Growth in public cloud cannibalizes traditional IT

Defining the cloud

Cloud in simple terms is software and infrastructure which is accessible over the internet. There are many forms of cloud infrastructure and services, but the market can be defined into two broad categories: public and private clouds. Public clouds are the most visible; these are services and solutions that are delivered over the internet to multiple people, with examples being Amazon Web Services (AWS) or Microsoft's Azure. Private clouds cover many different models, but the difference from public clouds is that content on a private cloud is not openly shared and is only available to one organization. An example of a private cloud is a company's internal databases that might hold customer data or employee information.

How big is the public cloud and how fast is it growing?

IDC estimates that cloud services, which includes Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) will be a $56.6B market in 2014. As a percentage of total IT spending, cloud services are still small, representing roughly 10% of the total $563B in expected IT spending on enterprise hardware and software in 2014. However, cloud services are growing rapidly as customers realize the benefits of moving internal resources to the cloud. IDC estimates that SaaS will grow at a CAGR of 20% from 2013 to 2018, while IaaS is expected to grow 31% and PaaS is expected to grow 27%. In total, cloud services are expected to grow at a CAGR of 23%, as seen in Figure 1. This compares to expected enterprise hardware and software growth which is expected to increase at a more modest 6% during the same period.

Figure 1: Expected growth in cloud services, 2012-2018E
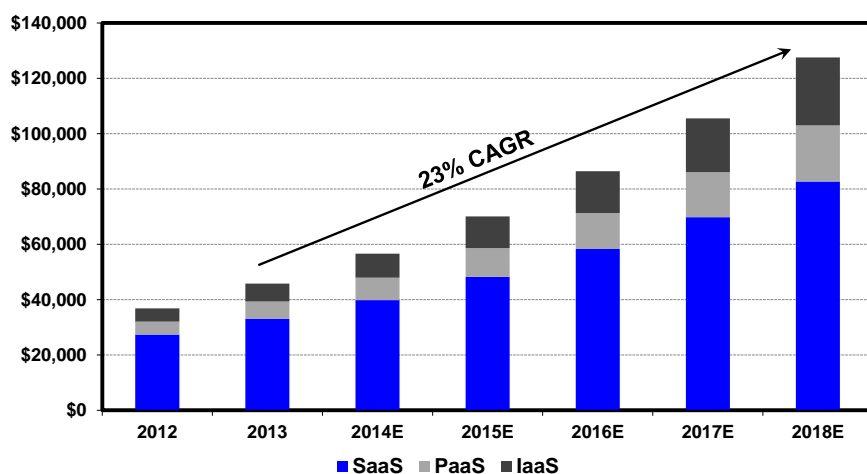
Source: IDC

Why is the public cloud important in 2015?

As companies move from traditional IT models to public cloud models, we expect the traditional hardware and software markets to be under pressure. As seen in Figure 2, the move from a traditional model to a public cloud model has positive and negative implications for hardware suppliers, but the negatives generally outweigh the positives. While public cloud providers do need to purchase hardware to support their own internal infrastructure, these models tend to be more efficient than traditional models, as they support multiple users. While it's still unclear how much more efficient cloud models are, the net effect is that less hardware is needed in public clouds to support the same number of users in a traditional enterprise datacenter model.

Figure 2: Cloud cannibalization of tradition IT model
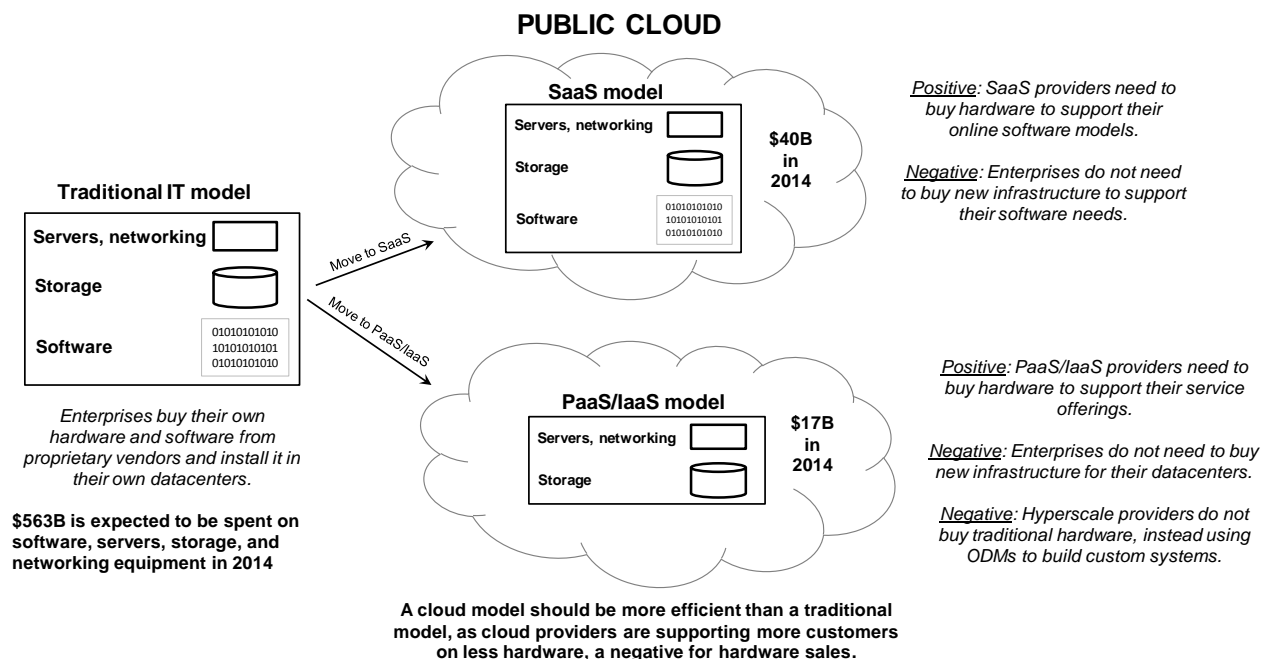
Source: Deutsche Bank, chart includes IDC market estimates

Another negative for traditional hardware vendors is that large cloud providers are building out their datacenters using custom-designed systems using off-the-shelf components that are built for them by ODMs. While the number of companies doing this today is small, it includes large-scale services providers like Amazon and Google, who are seeing rapid growth. This trend can be seen in the server market, where ODM sales have grown to represent 9% of total volume server sales.

The ODM segment of the volume server market also represents most of the growth in the overall server market. As seen in Figure 3, volume server sales increased 3% Y/Y in 2013, however, when excluding ODM sales which were up 57%, volume server sales were flat Y/Y. We expect this trend is also impacting storage and networking sales and partially explains the below-average growth rates in these segments. As cloud providers become a larger percentage of the market, we would expect ODM sales to continue to cannibalize and outpace traditional vendors.

Figure 3: Volume server sales and growth, with and without ODM sales
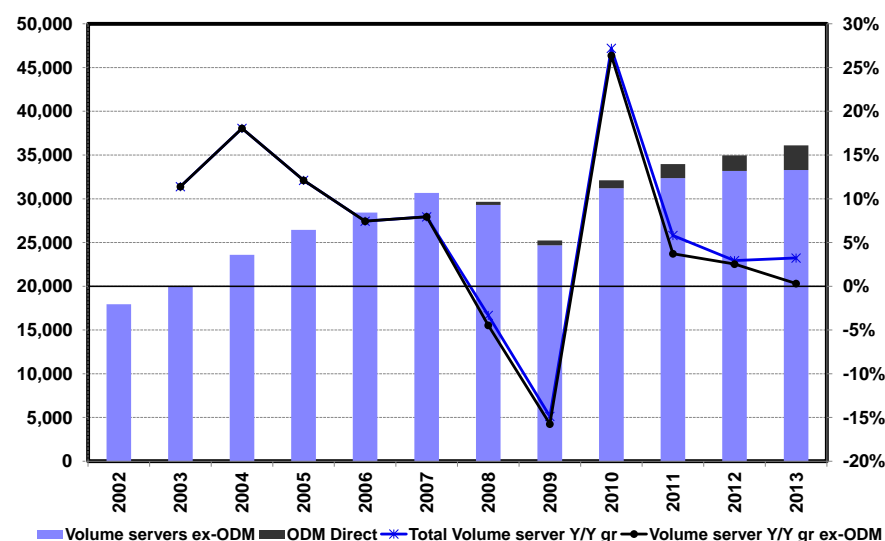
Source: IDC

While a few of the large cloud service providers build their own solutions, most service providers are buying servers and storage from traditional IT hardware vendors. We believe this segment of the market can be a growth opportunity for companies that are able to tailor cost-effective solutions to cloud providers' needs. In addition, not all solutions will be appropriate for cloud applications, and we expect that large enterprises will have at least some portion of their infrastructure in private clouds, which creates additional opportunities for hardware vendors to develop new solutions that are attractive to these customers.

Who are these trends relevant for?

The risk of cannibalization from the cloud has broad implications across our coverage group. Slower server and storage industry growth has been a negative for IT hardware companies like IBM, HP, EMC and NetApp. The shift from traditional software models to SaaS models has also been a negative for IBM's software business. Slower hardware sales are also a concern for IT distributor Arrow and Avnet, who derive 30-40% of their revenue from the sales of IT hardware. The manufacturing of servers, storage and networking gear is also a large percentage of sales for EMS companies and slower sales of hardware is a negative for contract manufacturers like Flextronics, Jabil, Sanmina, Celestica, Plexus, Benchmark and Fabrinet.

Theme 2: Growth in hyperscale players

What is hyperscale computing?

Hyperscale computing is a datacenter architecture that utilizes low-cost commodity hardware and virtualization technology to provision scalable and on-demand computing resources, aimed at reducing costs and increasing efficiency in datacenters. Hyperscaling in datacenters has thus far largely been adopted by large-scale cloud service providers like Amazon, Facebook and Microsoft, but gradually more traditional enterprises are realizing the benefits of this architecture and have started to implement them in their datacenters.

### How big is the hyperscale market and what are the growth expectations?

Capacity buildouts by large-scale cloud providers and increased adoption of hyperscaling by large enterprises is expected to result in robust hyperscale server shipments over the next few years. As seen in Figure 4, unit shipments are expected to grow at a robust CAGR of 16% from 2013 to 2018, while revenue is expected to increase at a 14% CAGR over the same period.

Figure 4: Hyperscale server shipments, 2013-2018E
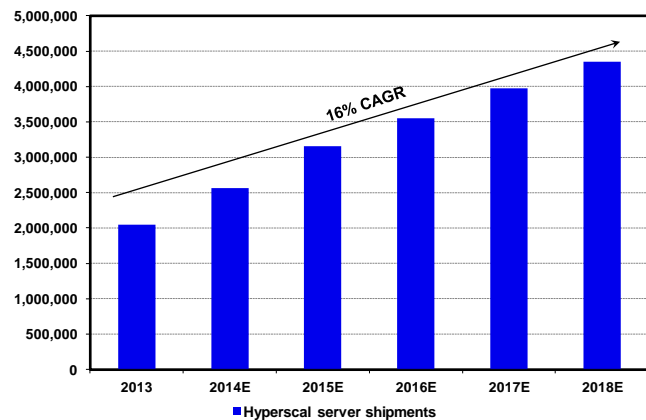
Source: IDC

Figure 5: Hyperscale share of total server revenue, 2013
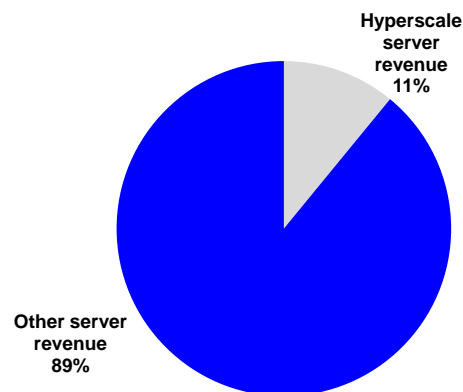
Source: IDC

As a result of this robust uptake, hyperscale server revenue is expected to gain a larger slice of overall server revenue share going forward. As seen in Figure 5, hyperscale servers accounted for 11% of all server spending in 2013, and IDC expects this proportion to increase to 20% in 2018.

Who's doing it?

Facebook's Open Compute Project (OCP), which was launched in April 2011, was a key enabler of the rapid growth of the hyperscale market and the advent of ODMs into the market. The increasing popularity of the OCP is having a sizable impact on traditional OEM businesses like Cisco, Dell, HP and IBM which sell datacenter equipment to enterprise customers. Since OCP primarily targets efficiency and cost in the datacenter, it is a very attractive infrastructure framework for customers with hyperscaling needs. In addition, systems can be tailored to a hyperscaler's specific workloads using off-the-shelf components, making the systems more cost effective when purchased in volume. Because these systems are customer tailored to a customer's needs and because hyperscalers are purchasing systems in large quantities, employing an ODM to build the systems makes sense, as hyperscalers avoid paying a profit margin to the traditional hardware vendors.

According to IDC, ODM vendors had 58% unit share of the hyperscale market share and 48% revenue share in 2013. This compares to only 13% unit share and 8% revenue share of the volume server market held by ODMs in 2013. While ODM's still have limited share in the overall server market, they dominate the hyperscale market, with nearly 50% of the sales in this segment going to ODM providers.

While ODMs are expected to continue gaining share in the hyperscale market, we believe traditional server vendors can also have a place in the market if they are able to offer lower cost solutions tailored to hyperscale customers. One example is HP's recent joint venture with Foxconn to create a line of

cloud-optimized servers and its hyperscale-focused 'Project Moonshot' line of servers. The joint venture should enable HP to provide a cost-competitive server offering capable of competing with other Asia-based server ODMs such as Quanta Computer. According to HP, Moonshot is up to 89% more energy efficient, takes up to 80% less space and costs 77% less than traditional servers, which translates into attractive total cost of ownership (TCO) attributes for customers building datacenters for social media, cloud, big data and mobile services.

Why is growth at hyperscalers relevant in 2015?

As the public cloud model continues to take share from traditional hardware models, hyperscale customer become a significant growth opportunity for hardware vendors if they are able to create compelling solutions for these customers. In 2015, we expect hyperscale architectures to continue to gain traction and drive the lion's share of growth in the server market.

Who are these trends relevant for?

We expect ODMs to consolidate their dominance in the hyperscale datacenter market, but traditional server vendors such as HP and other solution providers, including HDD companies Seagate and Western Digital, are well positioned to introduce compelling new offerings to address opportunities in this market. The volume server market is the most likely to be impacted by the shift to hyperscale models, with top vendors including HP, Dell and IBM (now Lenovo). As discussed in the public cloud section above, ODMs have represented an increasing portion of the growth in the volume server market. Both HP and IBM have lost share since 2010, while Dell's position has remained fairly stable. HP's and IBM's market share losses during this period coincide with the advent of hyperscale servers and the addition of Cisco to the market.

Most of the storage needs in the hyperscale datacenters are met by traditional nearline HDDs, which are capacity-optimized drives used in enterprise datacenters. However, due to surging demand from hyperscale customers, both Seagate and Western Digital have introduced customized HDDs that are specifically aimed at the hyperscale market. These drives are workload-limited nearline drives, in the sense that they are performance limited low-cost drives with high-capacity points, suitable for hyperscaling needs. As hyperscale customers continue to grow, they will need additional high-capacity HDDs, which is a positive for HDD manufacturers Seagate and Western Digital.

Theme 3: Container technology

What is container technology?

Container technology is an emerging alternative to virtual machines (VMs) which runs as an application within the operating system and has the benefit of greater efficiency and portability. This software runs directly on the hardware node with several isolated guests or "containers" (i.e., software programs) able to easily move from computer to computer. Transportability is an important benefit for software development in various cloud architectures, which makes containers attractive for these markets. Containers also provide 10x better server utilization than current VMs, therefore they have the potential to provide a significant cost advantage.

What are the growth expectations for containers?

VMware estimates that the virtual compute and management market was a $18B market in 2014, which is expected to grow in the mid-teens over the next few years. It remains unclear how much and how quickly container technology will be able to cannibalize this market since market adoption is still nascent. However, container technology may have the potential to disrupt current VM environments which offer densities of 8-10 instances per server. According to IDC, containers could offer a minimum uplift of ten times that amount, suggesting container densities may allow for 80-100 applications per server which translates into a compelling economic benefit. In addition, container technology is 2-6x faster than current virtual machines. Figure 6 highlights the key benefits of containers relative to hypervisors.

Figure 6: Comparing container technology and hypervisors

	Containers	Hypervisors
Average density per server	Hundreds, potentially more.	Ten.
Overhead	Low. Based on a single shared OS kernel, which reduces the memory consumed and need for context switching from one OS instance to another; lighter- weight deployment overhead overall and maximizes potential density.	Higher. Each VM has its own full OS image, which consumes system resources such as memory, disk, and network. Modern hypervisors create small amounts of overhead, in the order of single-digit percentages, but still have higher overhead than containers.
Security	Good, but not as high as hypervisors. Compromise of the host OS is likely to compromise all containers.	High. Each VM has a fully independent OS and shares only the physical hardware with other guest VMs.
Hardware agnostic	Yes. Runs on multiple hardware environments without modification - bare metal, VMs, OpenStack, and public IaaS.	No. Needs to be modified to run on different hardware environments.
Portability	Creates consistent and portable environment for development, test and delivery. Portability is good across other servers with the same host OS that are configured to support containers. No portability to other OS or hypervisor environment without attaching a host OS.	Less portable between on-premise and off-premise cloud environments, although VM converters are available to bridge various hypervisor environments.
Isolation	Content, resource, and network is isolated between the containers, but all containers are sharing one host OS, which makes the host OS a single point of failure.	Type 1 hypervisors offer full tenant isolation, and each VM functions as a separate server. Hypervisor is a single point of failure, but due to the thin nature of the hypervisor, this has rarely been a problem. Type 2 hypervisors are hosted by the domain 0 OS and are affected from the same single-point-of-failure issue as containers.
Operating system	The guest OS (container) has to be the same as the host OS. It has to use a VM to run on Windows or other OSs. Versions may differ, but backward compatibility is likely to be limited.	VMs can run different guest OSs (Windows, Linux, Unix, and others) regardless of what the host OS may be; no backward version compatibility issues (for operating systems released in the past 5–10 years).

Source: Deutsche Bank, IDC

Who's building and using containers?

Docker is a private firm which built the open-source platform for building, shipping and running distributed applications. The Docker platform has been used by multiple webscale companies such as Baidu, Cambridge Healthcare, eBay, Gilt, Groupon, Spotify and Yandex, which report datacenter efficiency improvements of 10x, with development-build-test cycle times having been compressed from weeks to minutes. IBM recently announced a strategic partnership with container software technology developer Docker, under which IBM will enable enterprises to run Docker technologies on IBM Cloud. In addition, Google recently announced a product that allows software developers to run Dockers containers on Google servers, thereby making it easier for developers to deploy containerized applications on the Google

Compute Engine. Red Hat, a leader in open-source software, also offers Linux container technology, including OpenShift and Red Hat Enterprise Linux, using technologies such as Control Groups, Resource Management and SE Linux.

### Why is container technology important in 2015 and who is it relevant for?

Container technology is in its nascent phase, but is gaining traction especially with cloud providers. While container technology is unlikely to be a significant threat to virtualization in 2015, lower term, greater adoption of container technology may pressure vendors in the virtualization market. In addition, the potential to extract greater hardware efficiency could act as an additional headwind to IT hardware providers such as Dell, HP, and IBM.

Theme 4: The changing storage landscape

What is happening?

The traditional storage market is being challenged by a number of evolving technologies including virtualization, software-defined storage, and new storage architectures. The traditional storage model is based on separate storage arrays which are networked in a data center and use a large number of HDDs with some DRAM memory to increase performance. This model is changing, as a handful of new entrants are introducing all-flash or hybrid arrays, while other companies are introducing new architectures that are more similar to hyperscale and cloud models. Virtualization solutions through software are also beginning to be rolled out by smaller companies as well as large companies like VMware and EMC.

Figure 7: Networked storage revenue (SAN and NAS)
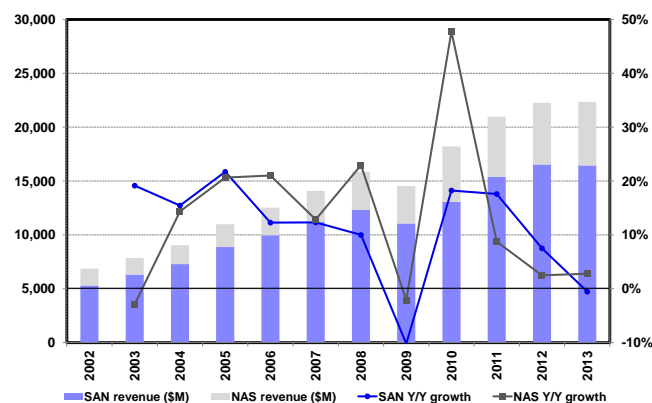
Source: IDC

Figure 8: Terabyte Y/Y growth is slowing
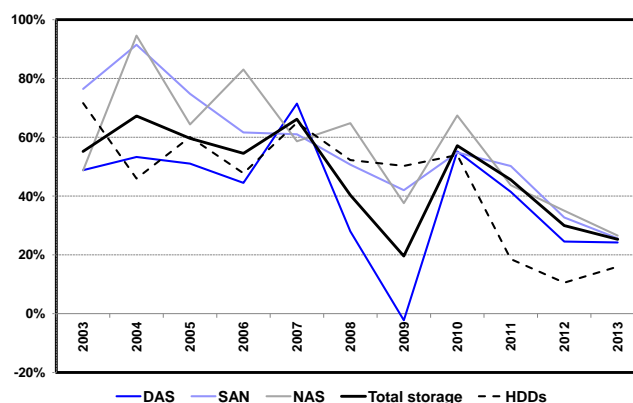
Source: IDC

What has the impact been on the storage market?

The networked storage market, which includes SAN and NAS storage arrays, was a $22B market in 2013. The market has grown at a CAGR of 11% since 2002, but due to the increasing competition from new technologies, storage revenue was flat in 2013, as seen in Figure 7. Capacity growth, as measured in terabytes (TBs) also has slowed, as seen in Figure 8, with typical growth in the 50-60% range now falling to 25-30% in the past two years.

The traditional storage model continues to evolve, with the industry moving in a few different directions. As seen in Figure 9, we believe these evolutions can be broadly lumped into three categories. Below we discuss each of these evolutions in more detail.

- **Evolution 1**: Hybrid and All-flash arrays – New architectures are being built utilizing some NAND along with HDDs or all flash for storage arrays in order to increase storage performance.

- **Evolution 2**: Virtualization and software-defined storage – Virtualization and software are enabling storage arrays to be managed as one pool of storage, with automatic load balancing and thin provisioning.

- **Evolution 3**: Hyper-converged model – Integrated systems with compute, storage and networking, which is interconnected and easy to scale out. Systems are similar to hyperscale cloud provider architectures.

Figure 9: Evolution of storage
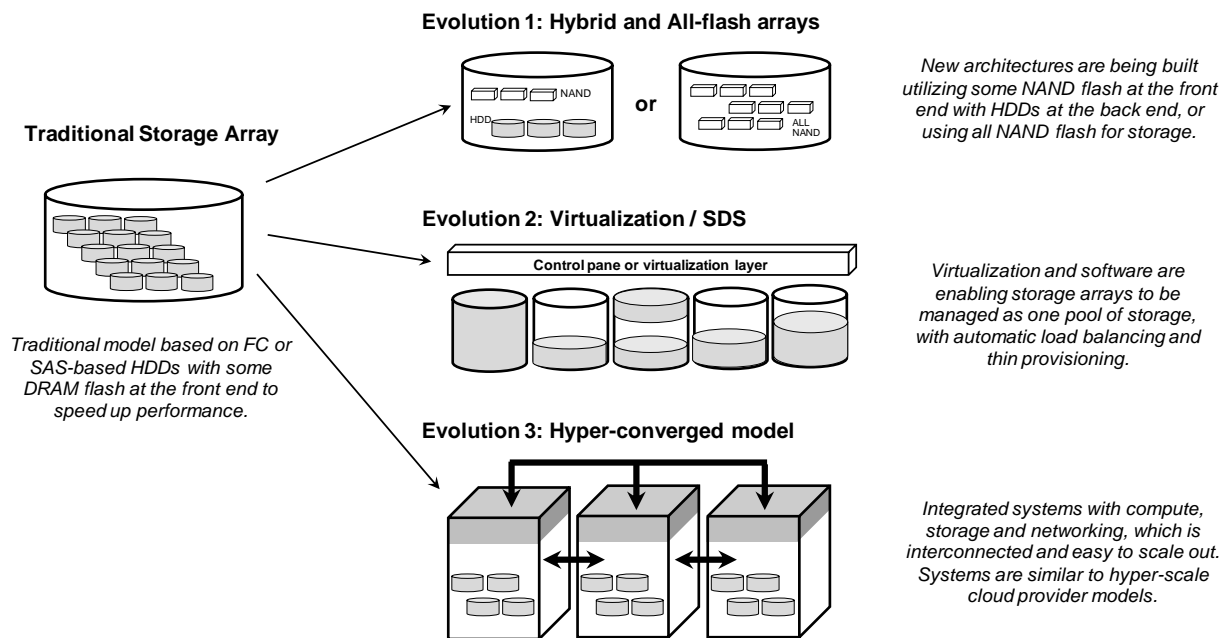
Source: Deutsche Bank

Evolution 1: New storage architectures utilizing NAND

Traditional storage arrays are based on HDD storage, with some DRAM flash in the front end to help speed up the system. As an example, EMC's VMAX3 family of storage arrays scales up to 4PB of usable HDD storage, with up to 2,048GB of DRAM cache per engine (i.e., CPU core). However, with the decline in the cost of NAND flash memory, an increasing number of storage companies are introducing systems that utilize flash for some part of the array's storage capacity or use all-flash storage instead of HDDs. These systems promise to speed up the performance of the storage array, and enable increased functionality driven by faster throughput. EMC and NetApp both offer hybrid systems that utilize HDDs as well as NAND flash. In addition, EMC has an all-flash system called XtremIO, and the company recently purchase all-flash array company DSSD. NetApp offers a line of all-flash arrays for its FAS 8000 line of products, as well as an all-flash EF550 line and its FlashRay system, both for high-performance applications. HP and IBM also have hybrid and all-flash products.

In addition to the traditional vendors, new storage start-ups are entering the storage industry using hybrid or all-flash solutions that take advantage of the

speed benefits of NAND flash. Nimble Storage offers hybrid storage arrays that utilize its proprietary Cache Accelerated Sequential Layout (CASL) architecture to utilize a small amount of flash to significantly speed up the performance of higher-capacity HDDs. Nimble claims these systems can reduce an enterprise's data footprint by 30-75% with sub-millisecond latencies. Another new entrant, Tegile is building hybrid and all-flash storage arrays using its proprietary IntelliFlash operating system, which Tegile claims enables the performance of flash at the price of disk, with up to 10 to 1 data reduction. Pure Storage is an example of an emerging all-flash array provider. The company claims that its FlashArray products can deliver up to 3 times the performance advantage of real-world environments in a smaller footprint. Violin Memory also offers a number of all-flash storage arrays including its Concerto 7000 and its 6000 Flash Array, which the company claims has 10-20 times the running speed for applications using 67% less electrical and 80% less cooling requirements.

While the majority of storage arrays are still HDD based, the demand for NAND-based systems is growing. Hybrid solutions with sophisticated software that can manage the placement of data on flash or HDD continue to gain traction in the market, as these systems claim to offer higher performance at the same price as traditional HDD-based arrays. All flash-arrays are gaining traction for high-performance workloads where performance is the most important criteria. We expect these new storage architectures to continue to gain traction, with NAND flash continuing to be adopted in data centers.

Evolution 2: Server virtualization sets the model for changes in storage

Server virtualization was introduced by VMware in 1998 and had a profound impact on the server market. Over the past nine years, the server market has not grown, with server revenue peaking in 2007 and then seeing mostly steady declines, as virtualization of workloads increased. The composition of the server market has also changed, with commodity volume servers now representing more than 70% of server revenue, versus only 40% in 2002. Server virtualization allowed enterprises to better utilize their unused processing power on servers, which reduced IT budgets and severed the link between workload needs and new server purchases.

This virtualization trend is now set to impact the storage market. With enterprises seeing better utilization of their server assets, CIOs are now looking to better utilize their storage. Storage capacity growth has historically grown in line with data growth, which averaged 50-60% historically (see Figure 8). However, enterprises are under pressure to reduce their budgets, and can no longer support 50-60% data growth. As a result, CIOs are looking to new solutions that better utilize storage assets, similar to what they were able to achieve with server virtualization. The introduction of server virtualization also changed the traditional direct link between a server and its storage, with multiple virtual servers, also known as virtual machines (VM), now putting more pressure on storage arrays, which are in some cases now becoming the bottle neck.

Storage virtualization is the process of abstracting storage from its physical hardware. Traditional storage architectures typically involve manually managing storage as discrete physical devices. Storage administrators have to manually address paths, connections, and provisioning between servers and storage arrays. This includes repurposing LUNs and volumes, and the difficult process of altering the control path if the data path is changed. Storage

virtualization simplifies storage management by providing administrators the ability to view multiple physical storage arrays as a single unit. Virtualization also allows lower storage capacity needs due to improved utilization, which can be accomplished through methods such as thin provisioning, a storage method that optimizes physical disk space by allocating data only when it is being used. Storage virtualization also allows for automatic and dynamic (on-demand) provisioning of data, usually governed by policy-based service level agreements (SLAs). This results in greater ease in scalability, as customers no longer have to manage physical arrays in order to increase or decrease storage needs.

Given the performance benefits and cost savings from storage virtualization, both old and new companies have begun to offer software storage solutions. VMware currently offers Virtual SAN (VSAN), a storage virtualization product that is embedded with their vSphere kernel. EMC's ScaleIO is similar to VSAN, but is largely used for more heterogeneous storage environments. EMC's ViPR Software-Defined Storage can be leveraged through ScaleIO. The ViPR platform provides a centralized tool to automate storage and provisioning, with EMC claiming that ViPR reduces the time to provision storage by 63%. Hitachi Data Systems (HDS) created a Storage Virtualization Operating System (SVOS) to support their Virtual Storage Platform G1000, a software-defined storage solution. HP has its StoreVirtual Storage solution, and their 3PAR division is known for popularizing thin provisioning. Emerging companies are also entering the market. Actifio, a copy data management provider, attempts to virtualize the four core functions of copy, store, move, and restore into a single storage platform, called Actifio CDS, creating one "golden" copy of an enterprise's data.

Evolution 3: The cloud and hyper-converged model
A hyper-converged IT infrastructure offers many advantages compared to a traditional hardware model. Instead of having separate silos for compute, network, and storage, a hyper-converged model combines all three groups under one umbrella. The hyper-converged architecture is software-defined and allows for easier IT maintenance and management. While a converged infrastructure closely integrates compute, networking and storage, a hyper-converged model is constructed by modular systems, which leads to easier scalability. To scale-out in a hyper-converged environment, customers simply need to increase the number of modular systems. Major players offering hyper-converged infrastructure include VMware, Nutanix, and SimpliVity.

With their foray into storage, VMware introduced EVO:RAIL, a hyper-converged infrastructure for their Software-Defined Data Center (SDDC) solution that combines compute, server, networking, and storage (VSAN). The EVO:RAIL engine is responsible for deployment, configuration, and management of the SDDC, and leverages vSphere with VSAN, allowing quick setup with QEPs (Qualified EVO:RAIL Partners) such as Supermicro, HP, IBM, Dell, and Cisco.

Emerging storage provider Nutanix offers a hyper-converged infrastructure service that combines the compute tier and the storage tier into one integrated appliance. Through their Cloud Connect hybrid cloud product, Nutanix is able to decouple storage from computing in a hyper-converged infrastructure. Customers are then able to manipulate data needs without necessarily increasing compute power. Nutanix claims that using their Virtual Computing

Platform can increase the effective storage capacity of a system by up to 4x, while reducing TCO by up to 2x when compared to competitors.

SimpliVity provides a globally-federated hyper-converged solution in the form of products called OmniCube and OmniStack. These products are connected together to form a single hyper-converged infrastructure. SimpliVity's Software-Defined Data Center (SDDC) is a cloud architecture that provides cloud integration for easy data transfer to and from the public cloud, and can be integrated with OmniCube to form a hyper-converged infrastructure solution. SimpliVity touts OmniCube as offering up to 3x TCO savings versus traditional storage.

Why are these changes important in 2015?

In our view, storage is one of the main segments that will see significant changes over the next few years driven by the evolutions of storage architectures. These changes were starting to take hold in 2014, but we expect 2015 will be a more significant year for the evolution of storage. With corporate budgets expected to be higher in 2015, enterprises will need to determine what they will spend their storage dollars on, and which direction they want to take their storage infrastructure.

Who are they relevant for?

The large storage vendors will see the most significant impact from the changes in storage. At this point, top storage providers like EMC, NetApp, IBM, HP and Hitachi have solutions that address the shift to using more NAND and most have introduced solutions that somewhat address virtualization and software-defined solutions. For legacy storage vendors, the question will remain whether their solutions solve the problems enough, or if they will see competitive pressures from smaller, emerging storage vendors with new solutions. At this point, the larger storage vendors have not yet embraced the hyper-converged model, leaving room for emerging companies to gain share.

Big Data, AI, and the Internet of Things

Theme 5: Big Data and Big Data Analytics

What is Big Data?

The terms Big Data and Big Data Analytics are often used interchangeably, but they differ in one fundamental way. Big Data describes the processes used to collect and store large amounts of data. A data set is generally considered big when traditional relational databases or statistical programs become difficult to work with on existing hardware platforms. When this happens, new techniques must be used which are based on distributing the processing of the data set across hundreds or thousands of servers. Examples of these data sets can include shopping patterns collected by customer loyalty cards or location information collected from iPhones. Big Data Analytics is the process of collecting <u>value</u> from that data.

Market size and growth expectations for the Big Data market

IDC estimates that the combined Big Data and Business Analytics market was a $115B market in 2013, with Big Data representing 11% of the total, while Business Analytics represented 89% of the total. As seen in Figure 10, the combined market is expected to grow at a CAGR of 13% over the next 5 years, reaching $214B by 2018. The Business Analytics market is expected to grow at a CAGR of 11% during this period to a $173B market by 2018, largely driven by growth in services and software to support Business Analytics, while the hardware to support that growth is only expected to see modest growth.

Figure 10: Big Data & Business Analytics ($B), 2011-18E
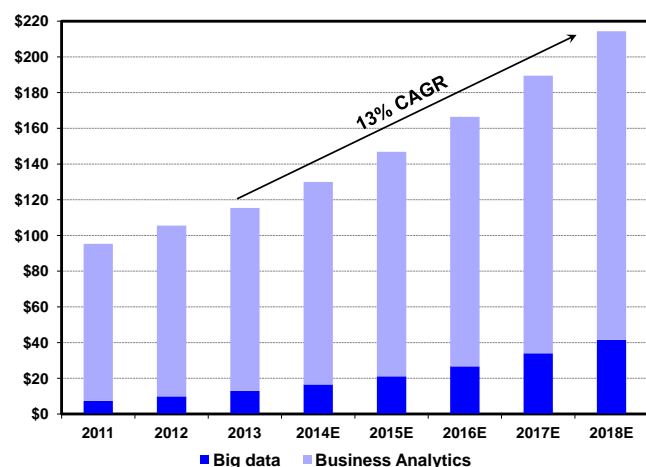
Source: IDC

Figure 11: Big Data market by segment ($B), 2011-18E
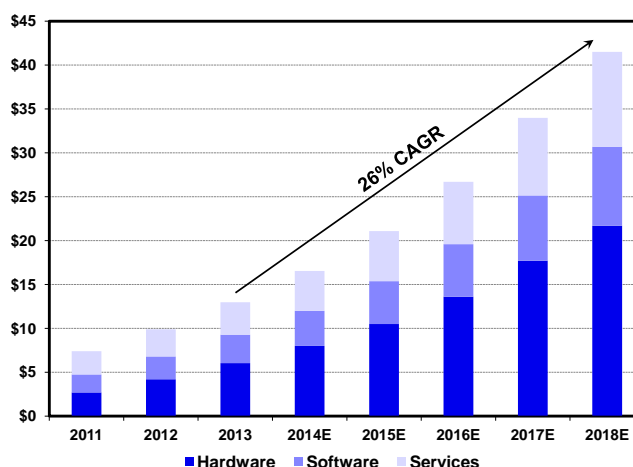
Source: IDC

The Big Data market is a smaller market than analytics and was a $13B market in 2013. As seen in Figure 11, the Big Data market is expected to grow at a CAGR of 26% over the next 5 years, driven largely by growth in hardware to support Big Data. Servers and storage to hold Big Data are expected to see growth of 28-29% during this period, with this growth significantly helped by

cloud infrastructure which is expected to grow 41% over the next few years. Growth in Big Data is being driven by increased use of social media, the digital market place, the proliferation of mobile devices, and the growth in the Internet of Things (IoT).

Who are the big players in Big Data?

The Business Analytics market is driven primarily by software and services, with software representing 37% of the market in 2013, and services representing 44%. According to IDC, the top software providers of Business Analytics include Oracle, SAP, IBM and Microsoft, who combined represent more than 50% of the market. In the Big Data Analytics market, the open-source software Hadoop is also a crucial building block as it is technically capable of storing and processing enormous data volumes by breaking the data set into smaller chunks and processing the data in a distributed fashion (i.e., parallel vs. serial processing). In addition, Hadoop is cost effective because it uses x86 hardware and open-source software (vs. a proprietary stack).

IBM is the third largest Business Analytics software provider, with 12% share of the market in 2013, according to IDC. IBM is leveraging its strong position in Business Analytics to positioning itself for the Big Data market opportunity. IBM's DataWorks is a cloud-based data refinery service integrated with Twitter. In addition, IBM's Analytics for Hadoop is an open-source project which uses distributed processing of large data sets across commodity servers in order to extract business intelligence in real time. Watson Analytics is a cognitive compute engine that can ingest wide swaths of data and quickly determine relevant facts, patterns and relationships.

HP has also moved to expand its Big Data offerings through various acquisitions including Autonomy and Vertica. In order to monetize this opportunity, HP has developed a specific Big Data platform named HAVEn, which is an acronym for Hadoop, Autonomy, Vertica, Enterprise security and nApps. HAVEn uses Hadoop to catalog enormous volumes of data, processing and indexing it with Autonomy's IDOL search platform which is capable of processing both structured and unstructured data. In addition, Vertica is a massively scalable database platform which is custom built for real-time analytics and petabyte-sized data sets. Enterprise security is based on ArcSight software which provides real-time collection and analysis of logs and security events across a variety of devices. Examples of HAVEn solutions include capacity planning, targeted advertising, cyber security, sentiment analysis using social media and operational analytics.

In April 2013, EMC combined its Cloud and Big Data assets, including Greenplum, Cloud Foundry, Spring, Cetas, Pivotal Labs, GemFire, and products from the VMware vFabric Suite and placed them into a separate subsidiary run by Paul Maritz called Pivotal. The goal was to create a separately-run company that could focus specifically on the cloud and Big Data opportunity from a vendor-neutral perspective, similar to how the company positioned VMware within the virtualization market. EMC describes the Pivotal platform as comprising next-generation data fabrics, application fabrics, and a cloud-independent Platform as a Service (PaaS) designed to support cloud computing and Big and Fast Data Applications. EMC owns an 84% stake in Pivotal, which is split between EMC and its VMware subsidiary. GE also invested $105M in April 2013 and owns a 10% stake.

Why is it important in 2015 and who is it relevant for

A recent Gartner survey shows enterprise interest in Big Data is gaining traction with 73% of organizations polled stating that they have already invested in or plan to invest in Big Data over the next 24 months, which is up 10ppts Y/Y, suggesting organizations are beginning to move forward with Big Data investments. With the increasing digitization of products, growth in social media, and increased cloud adoption, we expect Big Data and Analytics to continue to be a growing market, as business try to extract value from this ever increasing data. In our view, the pure-play software companies are the most likely to benefit from these trends, however, within our group, we view IBM, HP and EMC as well positioned to benefit from the growth in Big Data applications, through hardware and software sales. We also expect the growth in Big Data to be a positive driver of growth for the HDD market as this data will largely be stored on HDDs, which is a positive for Seagate and Western Digital.

Theme 6: Artificial intelligence and machine learning

What is artificial intelligence and machine learning?

Artificial intelligence (AI) is described as the study and design of intelligent agents. These agents are systems that can perceive their environments and are able to take actions to maximize the chances of their success. John McCarthy coined the term artificial intelligence in 1955, defining it as the science and engineering of making intelligent machines. AI deals with reasoning, planning, learning, natural language processing, perception, and the ability to move. One of the early visible examples of AI was IBM's Deep Blue, the first chess-playing computer that was able to beat a reigning world champion in 1997. Other examples of real-world AI include robots, autonomously navigated vehicles, IBM's Jeopardy-winning Watson machine, the Kinect body-motion interface on the Xbox 360, and Apple's Siri program.

Machine learning is a subset of AI, and is described as a scientific discipline that deals with the construction and study of algorithms that can learn from data. Put more simply, machine learning is the study of giving computers the ability to learn without being explicitly programmed. Machine learning is similar to pattern recognition and data mining, all of which focus on looking for patterns, but in the case of machine learning, these patterns are used to help the machine learn and adapt in order to improve outcomes. Examples of machine learning being used in the real world include speech recognition, Google web searches, face recognition, spam filters, character recognition, weather prediction, and medical diagnosis. Deep learning is a subset of machine learning and is defined as a set of algorithms that attempt to model high-level abstractions in data by using non-linear models (also known as neural networks).

How big is the market and who are the big players?

It's hard to assess how large the AI market is today, however one estimate by research firm Research and Markets valued the AI market at $900M in 2013. However, this number seems low given Google's acquisition earlier this year of DeepMind Technologies which was reportedly purchased for more than $400M. Smart machines are one aspect of the AI market, and according to BCC research, smart machines were a $5.3B market in 2013, which is expected to grow at a CAGR of 20% through 2019. IDC estimates that the search and content analytics market was a $3.1B market in 2013, which is

expected to grow a 10.5% CAGR from 2014-2018. IDC notes that AI, machine learning, and cognitive computing are a subset of this market, but does not break out its share of the search and content analytics market.

Why is AI important in 2015?

While artificial intelligence and machine learning are not new concepts, three recent breakthroughs are driving significant advances in this area. These advances include cheap parallel computing, big data and better algorithms. AI development by large tech firms like Google, Facebook and IBM continues to accelerate, with quantitative analysis firm Quid estimating that AI has attracted more than $17B in investments since 2009. According to an article in Wired, in 2013 more than $2B was invested in 322 companies with AI-like technology. The article also states that over the past four years, private investment in AI has expanded 62% a year on average a rate that is expected to continue.

Companies like Google, Facebook, IBM, Microsoft, Amazon, and Apple are at the forefront of developments in AI and machine learning. In addition, Yahoo, Intel, Dropbox, LinkedIn, Pinterest, and Twitter have all purchased AI companies over the past two years.

Google Brain is the name of Google's deep learning project, one of the Google X projects. In 2012, the company the created of one of the largest neural networks for machine learning by connecting 16,000 computer processors that was able to self teach itself to recognize cats. In early 2014, Google purchased DeepMind Technologies, a British AI company that had created a neural network that learns how to play video games in a similar fashion to humans.

Microsoft is also investing and advancing AI. In July, Microsoft Research announced new advances with a deep learning system it calls Project Adam. The goal of the project is to enable software to visually recognize objects, something that is easy for humans to do, but difficult for machines. The system runs on Microsoft's Azure Machine Learning cloud platform and the company claims that Adam is able to beat the Google Brain in delivering on benchmarks. Microsoft's Azure Machine Learning cloud service combines artificial intelligence and data analysis to help companies' better extract value from the data they collect. The cloud-based predictive analytics solutions are templates and common workflows that can be used as is or enhanced with additional code. According to Bloomberg, the software is currently being used to predict fraud, analyze purchasing patterns to decide on future inventory, and to track weather patterns and electricity usage to save on energy costs.

IBM was an early innovator in AI with its Deep Blue chess-playing supercomputer. The company's current supercomputer is called Watson, and the technology is now not only able to learn, but is also able to reason. IBM has developed a number of programs based on Watson, including Watson Oncology, which provides medical diagnostics to parts of the world where modern medical technology is limited, as well as a commercial application which will be utilized in the management decisions for lung cancer treatment at New York's Memorial Sloan Kettering Cancer hospital. IBM also announced earlier this year a $100M project using Watson to help solve problems in Africa, including curbing the outbreak of deadly diseases like Ebola and tracking dust storms to assess their connection with airborne diseases like meningitis. So far, IBM has set aside over $1B for the Watson program, and the company believes it will perform well as an advisor in research-oriented industries like

pharmaceuticals or in industries with a large number of customers including retail and telecommunications.

IBM has also made progress in creating a processor that acts like a human brain. In August, the company introduced its latest SyNAPSE chip called TrueNorth, which consists of 1 million programmable neurons and 256 million programmable synapses, using 5.4 billion transistors across 4,096 individual neurosynaptic cores. Despite the high number of transistors, TrueNorth only uses 70 milliwatts of power, compared to 35 to 140 watts for today's PC and data center chips. According to IBM, the chip's neurons and synapses have the ability to drive common artificial intelligence (AI) tasks and will help solve a wide class of problems from vision, audition, and multi-sensory fusion.

Who is AI relevant for?

In the future, AI could be used to better train people in a number of professions, including doctors, pilots, and teachers. With the addition of Big Data, AI and machine learning are becoming increasingly more relevant in everyday applications. The large technology firms are already investing in AI and machine learning, as these technologies have the potential to enable significant new market opportunities. We believe AI will be increasingly relevant for companies like IBM and HP, and we expect HDD companies like Seagate and Western Digital to benefit through the increased growth in data to support these applications. Additionally, connector companies and EMS companies stand to benefit from new machines which are built using AI.

Theme 7: Internet of Things

What is the Internet of Things?

The Internet of Things (IoT) are devices that have internet connectivity, allowing them to send and receive data. These unique computing devices are expected to offer more advanced connectivity and communication beyond simple machine-to-machine connectivity. Devices currently in this category include internet-controlled home thermostats and wearable devices with internet connectivity, but also include machines with sensor equipment, bridges that communicate seismic loads, and weather equipment which communicates temperature and barometric pressure to a remote location. Smartphones, tablets, PCs and other IT hardware equipment are generally excluded from the IoT category.

How big is the market and what are the growth expectations?

Cisco estimates that connected devices today outnumber the world's population by 1.5 to 1.0. In revenue numbers, IDC estimates that the IoT market was $1.9T in 2013, with 9.1B IoT units installed at the end of the year. As seen in Figure 12, IDC expects the number of devices to grow at a CAGR of 17% from 2013 to 2020, increasing to 28B units. Revenue is expected to grow faster, as seen in Figure 13, with sales expected to increased at a CAGR of 20% during this period, rising to $7T by 2020.

Figure 12: Number of IoT devices, 2013-2020E
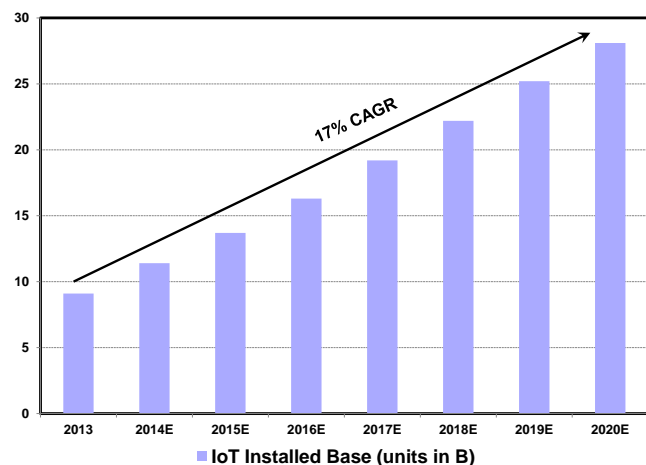
Source: IDC

Figure 13: IoT market revenue, 2013-2020E
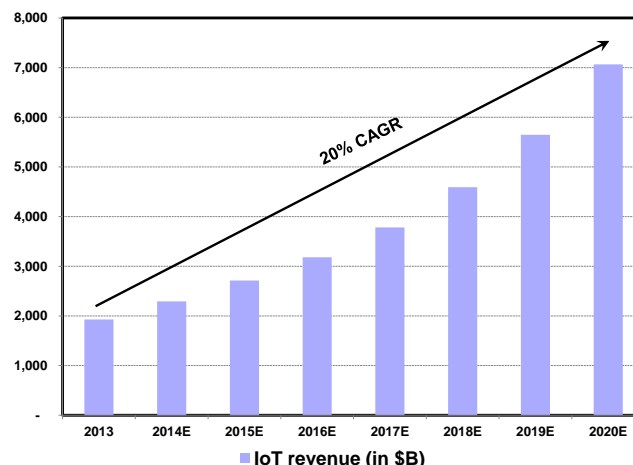
Source: IDC

Who's exposed to IoT and why is it important in 2015?

While most people think of Nest thermostats and wearables as IoT devices, the market has been expanding into industrial applications. As noted in the AI section above, smart machines were a $5.3B market in 2013, and these robots, smart manufacturing equipment, and industrial devices are all expected to have internet connectivity. Gartner sees automotive, LED lighting, and smart consumer devices driving growth for connected devices. Prime examples include Google's Nest (connected home devices) and Rio Tinto's driverless trucks (equipped with IoT technology to automatically navigate harsh terrains). GE recently announced that it expects to recognize $1.1B in revenue this year from its IoT software business. Companies such as Cisco now employ GE's big data software Predix in their networking devices and routers. Various companies across all industries have begun to use IoT devices in unexpected ways, and 2015 could be a breakout year in terms of device connectivity.

Who is IoT relevant for?

Within the technology supply chain, we believe the connector companies are the best positioned to benefit from the growth in the Internet of Things. Connectors will be an integral part of new digital devices, and both Amphenol and TE Connectivity are expending into the sensor business, another component which will be critical to the benefits of many connected devices. The IoT market also ties into the growth in Big Data and Big Data Analytics, as well as machine learning, areas that we expect to benefit companies with HP, IBM and EMC. In addition, with the explosion in data derived from IoT devices, we expect the HDD companies Seagate and Western Digital to benefit.

Emerging growth segments

Theme 8: Wearables

What are wearables?

Wearable Technology, commonly referred to as wearables, is defined as the integration of computing and wireless technologies with clothing, jewelry or other accessories worn on the body. These wearable computing devices are defined by IDC as complex and smart wearables, and can be broken down into three product categories: complex accessories (i.e., health and fitness trackers), smart accessories (i.e., smartwatches), and smart wearables (e.g., Google glass).

How big is the wearables market and what are the growth expectations?

The wearables market is still in its early stages, but is expected to grow rapidly. In total, IDC estimated wearables shipments were 6.2M in 2013, with sales of $998M. IDC estimates 19.2M wearables will be sold in 2014, representing a 209.5% growth rate Y/Y. As seen in Figure 14, total shipments are expected to reach 112M units by 2018, growing at a CAGR of 78%. As seen in Figure 15, wearables sales are expected to reach $21B in 2018, growing at a CAGR of 83%. Smart accessories are expected to represent the largest percentage of wearables by 2018 with units expected to grow at a CAGR of 99% from 2013 to 2018.

Figure 14: Wearable shipments, 2013-2018E

Complex accessories (Fitness) Smart accessories (Watches) Smart wearables (Glass)
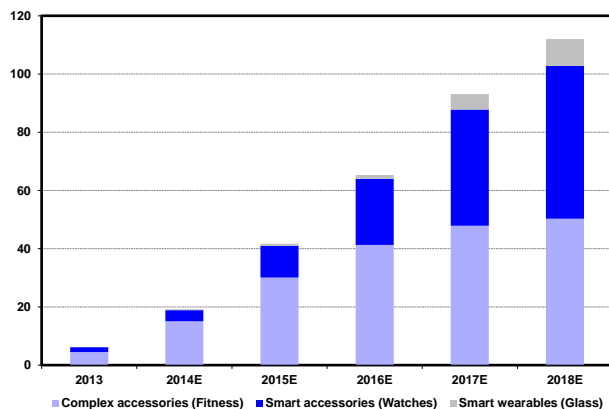
Source: IDC s

Figure 15: Wearable sales, 2013-2018E

Complex accessories (Fitness) Smart accessories (Watches) Smart wearables (Glass)
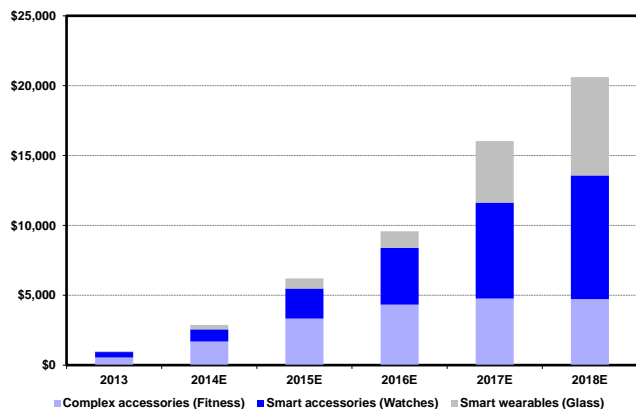
Source: IDC

Who's in the wearables market?

The dominant player in the complex accessories market is the startup Fitbit, which represented 68% of health and fitness tracker sales in 2013, according to NPD. Other competitors include Jawbone, Nike, Polar, and Garmin. Companies such as Microsoft and Intel have also recently introduced fitness tracking devices. The smartwatch market is generally comprised of smartphone companies, including Samsung, Motorola, LG, Sony, and starting in 2015, Apple.

Why are wearables important in 2015 and who is it relevant for?

The wearables market is expected to grow quickly, and we believe the introduction of the Apple Watch in early 2015 could serve as the catalyst for widespread adoption of wearables. The increasing momentum behind wearable technology is a positive trend for connector and EMS companies with wearable capabilities. In addition, protection of consumer data collected from wearables and privacy services could be a key growth driver for IT vendors such as IBM, EMC and HP. Apple is also poised to benefit directly from wearble growth through its Apple Watch.

Theme 9: Phablets and the convergence of mobile devices

What is happening?

With the invention of the tablet in 2007 and the increasing functionality and size of smartphones, internet connectivity has become more and more accessible to a larger number of people. In addition, the use cases for each of these devices is no longer clear cut, as functionality has increased across smaller mobile devices. First the notebook PC gained share from the desktop PC, as users opted for the increased mobility of notebooks over desktops. With the introduction of the tablet, additional use cases were created for mobile internet connectivity, driven by the tablet's smaller size and weight. As a result, some notebook applications moved to the tablet, as they did not need the full functionality of the notebook. Smartphones had already been addressing the most mobile applications, but as smartphones screen sizes grew larger, the differences between tablets and smartphones began to blur. A new subcategory of smartphones, known as phablets, has emerged. Phablets are smartphones with screen sizes of 5.0" and larger, with the larger screen sizes enabling increased functionality more similar to tablets.

Figure 16: Larger-format mobile device spectrum, 2010-2014E
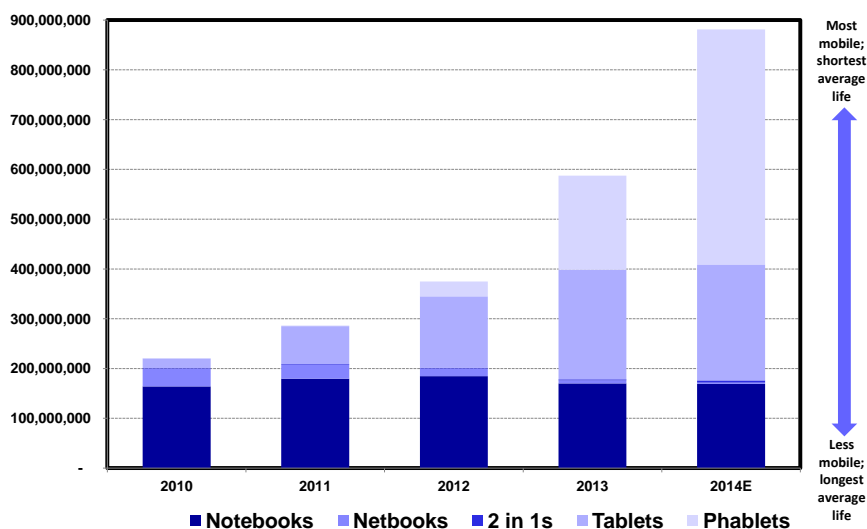
Source: IDC and Deutsche Bank estimates

How big is the mobile devices market?

As seen in Figure 16, when including all larger-format mobile devices, from notebook PCs to phablets, mobile device shipments are likely to reach nearly 900M units in 2014. Notebooks, netbooks and 2-in-1 devices (tablets that have an attached keyboard), will represent roughly 20% of these devices in 2014,

down significantly from 91% of the market in 2010, while tablets will represent roughly 25% of devices and phablets will represent more than 50% units. As seen in Figure 16, phablets will more than double in 2014, while tablets are expected to see more modest growth. In terms of unit shipments, phablets will be a larger market than tablets and notebooks combined, while tablet shipments will continue to out ship notebook PCs.

What are the growth expectations?

Smaller devices have seen more rapid growth in recent years as users have opted for smaller, more portable devices that have most of the functionality needed. Unit growth for these smaller devices is also expected to be helped by a faster replacement cycle. Notebook replacement cycles have elongated to more than 4 years, while smartphone devices have an average life closer to 2 years, meaning that unit shipment levels should be higher regardless of the installed base.

Between the three types of devices (i.e., notebooks, tablets and phablets), phablets are expected to see the most significant growth over the next few years, as more users opt for connectivity and good functionality in a smaller but large-enough form factor. IDC expects phablets to increase roughly 2.5x in 2014 and continue to see robust growth, increasing to 1.3B units by 2018, a 47% CAGR. Tablets are also expected to grow, but growth rates have slowed considerably, driven by longer replacement cycles and some cannibalization by phablets. Tablet unit growth is expected to slow to 6% in 2014, and IDC expects unit growth to be in the 5-9% range through 2018, well below the 52% growth experienced in 2013. Notebooks are expected to decline modestly over the next 5 years, with units expected to decline 5% in 2014 and then fall modestly, declining at a CAGR of 1% through 2018.

Why is this trend important in 2015?

Phablet growth exploded in 2014 with phablets estimated to represent nearly 40% of smartphone shipments this year. Phablets are also expected to out ship tablets and notebooks units combined making it the largest of the larger-format mobile device segment by far. In 2015, this growth is expected to continue, with all of the growth in the smartphone market coming from 5.0"- and-higher screen size phones. These larger phones are putting pressure on growth in the tablet market, and by extension, the notebook market, as the lines between these devices get blurred.

Samsung introduced the phablet category in 2011 with the Galaxy Note, but driven by the demand for larger phones, numerous other companies have since introduced models with screen sizes above 5.0", and we expect the category to be a key driver of smartphone growth for suppliers in 2015. LG introduced the G3 5.5" phone in May and Sony recently introduced the Xperia X3 with a 5.2" display in September. Xiaomi, China's fastest growing smartphone maker, also recently introduced the Redmi Note in August. Apple's announcement of the iPhone 6 Plus adds another significant entry into the phablet market.

Since 2012, Samsung and Apple have been the leading smartphone vendors, and the companies continue to control about 40% of the smartphone market. However, as seen in Figure 17, both companies have been losing share to newer vendors like Xiaomi, Lenovo and Huawei. Samsung is the largest phablet vendor with 35% market share, but new entrants, including the iPhone

the industry has increased revenue at a CAGR of 32% over the past 3 years, as the benefits of AM have begun to be realized. According to Wohlers, the industrial additive manufacturing market was a $3B market in 2013, while the consumer market (i.e., machines priced at less than $5,000) was an $88M market.

Figure 18: Industrial 3D printing sales, 1990-2013
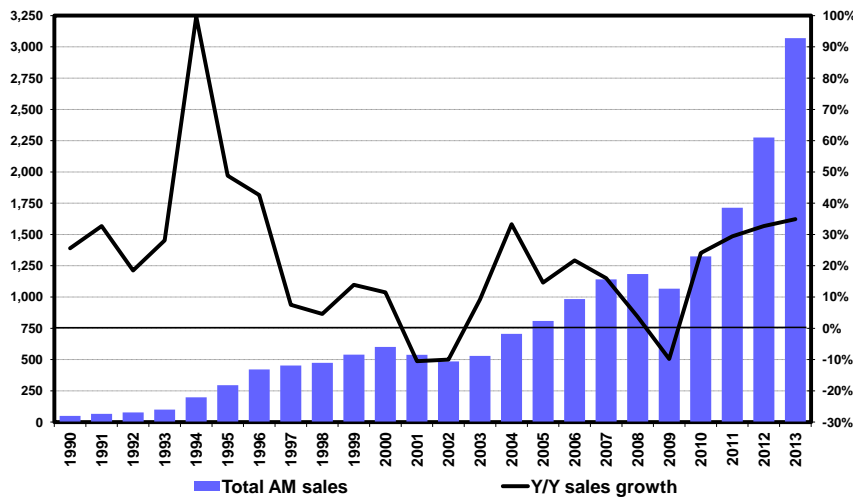
Source: Wohlers

Why is 3D printing important in 2015?

Growth in the 3D printing market is expected to continue to be robust, as an increasing number of industries adopt 3D printing in their manufacturing process. While 3D printing is reasonably well penetrated in the prototyping market, the production of final products still largely uses traditional manufacturing processes. The benefits of 3D printing are just beginning to be realized in a number of different markets. These benefits include, smaller lot sizes, increased complexity of parts, lower material usage, lower weight per part, reductions in inventory, and more rapid go to market. In addition, additive manufacturing processes have improved substantially since 1988, including faster build times, smoother surface finishes, and an increased number of materials. As a result of these benefits, we would expect the 3D printing market to continue to see robust growth over the next five to ten years as the technology is more largely adopted as part of the manufacturing process.

Who's doing 3D printing?

The additive manufacturing market encompasses seven different processes, using multiple materials. As seen in Figure 19, material extrusion (a.k.a. FDM) represents the largest number of installed systems for 3D printing, followed by photopolymerization (e.g., stereolithography) and material jetting. The largest manufacturers of 3D printing machines today are Stratasys and 3D Systems.

The most recent entrant in the 3D printing market is Hewlett-Packard, which announced a technology platform it calls Multi Jet Fusion (MJF) technology in October. HP claims its MJF technology will be faster (10x faster, 350M drops per second), less expensive (no details) and higher quality (21 microns) than current 3D printing technologies. The company expects to introduce 3D printers in 2016, with some select customers receiving beta versions in 2015.

Figure 19: Cumulative 3D printer shipments by company and AM technology (2003-2013)
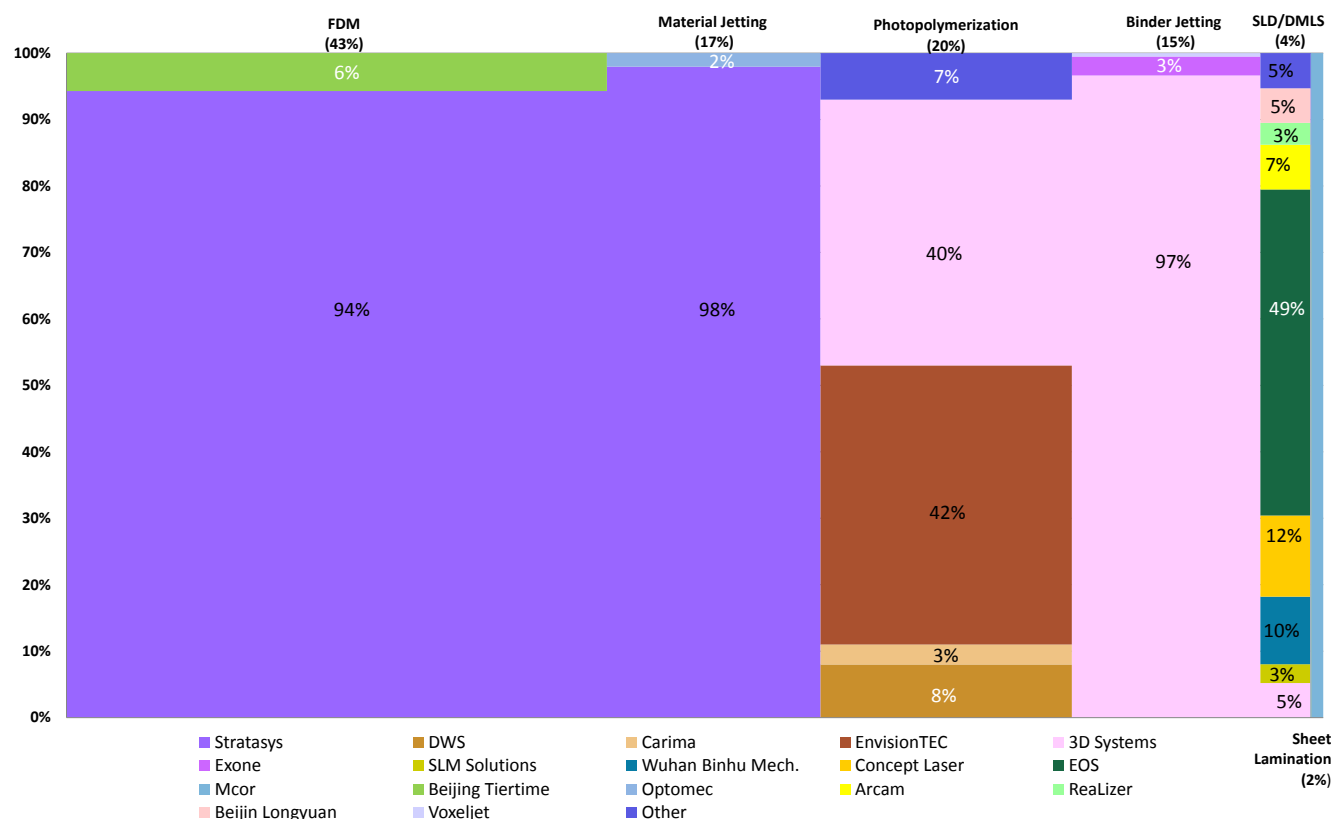
Source: Deutsche Bank estimates and Wohlers

Who is 3D printing relevant for?

The 3D printing market is expected to grow at a CAGR of 30% for the foreseeable future, and we view HP's entry as another significant positive for the development of the 3D printing industry. There is still plenty of opportunity for other 3D printing companies to benefit, and we view Stratasys and 3D Systems as well positioned to continue to see growth.

Company specific valuation and risks

Valuation

3D Systems

With the significant growth expected in the 3D printing space, we view sales ratios coupled with DCF as the best way to value 3D printing stocks. Our price target for 3D Systems is based on the shares trading at 5x our EV to FY-15E sales, which is in line with other high-growth software and internet companies. Our price target is also supported by our DCF analysis.

Apple

Apple has traded at an average forward P/E of 13x since 2010 with a range of 9x to 20x. We believe shares should trade in line with historical multiples and, because of its large market cap, should trade roughly in line with the market. Our price target is based on shares trading at 13x our FY-15E EPS.

Amphenol

Amphenol has historically traded at a premium to the markets with a forward P/E multiple in the range of 18x to 23x in the post-bubble period. Due to its faster-than-industry growth and solid execution, we expect the shares to continue to trade at a premium. Our price target is based on 21x our FY-15 EPS estimate. With the shares trading below these levels, we rate Amphenol a Buy.

Arrow

We expect Arrow's shares to move along with the overall market, as spending on electronic components and computer products is highly dependent on overall IT spending. We also believe post-dot.com multiples are the most appropriate way to value Arrow's shares. Since 2004, Arrow has traded at an average forward P/E of 11x. With most technology shares trading below historical valuations, we believe modestly lower multiples are reasonable at this time. As such, our price target is based on 10x our FY-15 EPS estimate. With shares trading near these levels, we rate Arrow a Hold.

Avnet

We expect Avnet's shares to trade with the overall market, as spending on electronic components and computer products is highly dependent on overall IT spending. We also believe post-dot.com multiples are the most appropriate way to value Avnet's shares. Since 2004, Avnet has traded at an average forward P/E of 11x. With most technology shares trading below historical valuations, we believe modestly lower multiples are reasonable at this time. As such, our price target is based on 10x our CY-15 EPS estimate. With shares trading near these levels, we rate Avnet a Hold.

Benchmark

In general, EMS stocks have historically traded at similar P/E ratios, and we believe earnings coupled with a review of balance sheet and return metrics is the best way to value EMS stocks. Since 2004, EMS company P/Es have averaged 13x, largely in line with market multiples, with a range of roughly 3x-20x. We believe an 8-15x multiple is more appropriate for EMS shares at this

time, with smaller EMS companies trading at the high end of that range due to faster revenue growth and higher operating margins. Our price target is based on Benchmark trading at 14x our FY-15 EPS estimate, which is in line with peers. With the shares currently trading near these levels, we rate Benchmark a Hold.

CDW

We expect CDW's shares to trade with trends in IT spending. In addition, we expect the shares to trade at similar multiples to IT hardware companies and value-added distributors. Our price target is based on CDW trading at 14x our FY-15E EPS including stock options, which is at a modest premium to multiples for value-added distributors (10x) due to the company's higher operating margins. With shares trading below these levels, we rate CDW a Buy.

Celestica

In general, EMS stocks have historically traded at similar P/E ratios, and we believe earnings coupled with a review of balance sheet and return metrics is the best way to value EMS stocks. Since 2004, EMS company P/Es have averaged 13x, largely in line with market multiples, with a range of roughly 3x-20x. We believe an 8-15x multiple is more appropriate for EMS shares at this time. Our price target is based on Celestica trading at 13x our FY-15E EPS, including options, which is in line with similar market cap peers. With the shares currently trading near these levels, we rate Celestica a Hold.

EMC

EMC has historically traded at an average forward P/E of 19x and a median forward P/E for 17x. We believe the company should trade at its historical average multiple, and modestly above market multiples due to its higher growth rates. Our price target is based on shares trading at 17x our FY-15E EPS including options. With shares trading below these levels, we rate EMC a Buy.

ExOne

With the significant growth expected in the 3D printing space, we view sales ratios as the best way to value 3D printing stocks. Our price target for ExOne assumes the shares trade at 5x our EV to FY-15E sales, which is at a discount to other high-growth software and internet companies, which we view as appropriate given the company's inconsistent sales performance.

Fabrinet

In general, EMS stocks have historically traded at similar P/E ratios, and we believe earnings coupled with a review of balance sheet and return metrics is the best way to value EMS stocks. Since 2004, EMS company P/Es have averaged 13x, largely in line with market multiples, with a range of roughly 3x-20x. We believe an 8-15x multiple is more appropriate for EMS shares at this time, with smaller EMS companies trading at the high end of that range due to faster revenue growth and higher operating margins. Our price target is based on Fabrinet trading at 13x our FY-15 EPS estimate including options, which is in line with peers. With the shares currently trading near these levels, we rate Fabrinet a Hold.

Flextronics

In general, EMS stocks have historically traded at similar P/E ratios, and we believe earnings coupled with a review of balance sheet and return metrics is

the best way to value EMS stocks. Since 2004, EMS company P/Es have averaged 13x, largely in line with market multiples, with a range of roughly 3x-20x. We believe an 8-15x multiple is more appropriate for EMS shares at this time. Our price target is based on Flextronics trading at 12x our CY-15 EPS estimate, including options. With Flextronics' shares currently trading near these levels, we rate Flextronics a Hold.

Hewlett-Packard

Hewlett-Packard has historically traded at an average forward P/E of 11x, although recent troubles and slower growth have driven P/Es below the company's historical average over the past 4 years. With the company now executing on its turnaround strategy, we believe the shares should trade in line with historical averages. We also believe the company's two business segments should trade more in line with peers, which suggests an 11x P/E multiple for the HP Inc. business and an 11x P/E multiple for the Hewlett-Packard Enterprise business. Our price target is based on shares trading at 11x our FY-15E EPS. With shares trading below these levels, we rate HPQ a Buy.

IBM

IBM has historically traded at an average forward P/E of 11x. We believe the company should trade modestly lower than historical averages and more in line with peer HP who has a similar revenue growth outlook. Our price target is based on shares trading at 10x our FY-16E EPS. With shares trading near these levels, we rate IBM a Hold.

Jabil Circuit

In general, EMS stocks have historically traded at similar P/E ratios, and we believe earnings coupled with a review of balance sheet and return metrics is the best way to evaluate EMS stocks. Since 2004, EMS company P/Es have averaged 13x, largely in line with market multiples, with a range of roughly 3x-20x. We expect EMS companies to trade below this historical multiple due the higher volatility of EMS shares and EMS companies' more limited visibility on demand. As such, we believe an 8-14x multiple is more appropriate for EMS shares at this time. Our price target is based on Jabil trading at 12x our FY-16 EPS estimates, including options. With the shares currently trading near these levels and in line with peers, we rate Jabil a Hold.

NetApp

NetApp has historically traded at an average forward P/E of 23x. We believe the company should trade lower than historical averages due to our expectation that the company will see only single-digit growth over the next few years, well below past growth trends. Our price target is based on shares trading at 15x our FY-16E EPS including stock option expense. With shares trading near these levels, we rate NetApp a Hold.

Plexus

In general, EMS stocks have historically traded at similar P/E ratios, and we believe earnings coupled with a review of balance sheet and return metrics is the best way to evaluate EMS stocks. Since 2004, small-cap EMS company P/Es have averaged 14x, largely in line with market multiples, with a range of roughly 3x-20x. We believe an 8-15x multiple is more appropriate for EMS shares at this time, with smaller EMS companies trading at the high end of that range due to faster revenue growth and higher operating margins. Our price target on Plexus is based on 14x our FY-15 EPS estimate.

Sanmina

In general, EMS stocks have historically traded at similar P/E ratios, and we believe earnings coupled with a review of balance sheet and return metrics is the best way to value EMS stocks. Since 2004, EMS company P/Es have averaged 13x, largely in line with market multiples, with a range of roughly 3x-20x. We believe an 8-15x multiple is more appropriate for EMS shares at this time. Our price target is based on Sanmina trading at 12x our FY-15 EPS estimate, including options. With the shares currently trading near these levels, we rate Sanmina a Hold.

Stratasys

With the significant growth expected in the 3D printing space, we view sales ratios coupled with DCF as the best way to value 3D printing stocks. Our price target for Stratasys is based on the shares trading at 6x our EV to FY-15E sales, which is in line with other high-growth software and internet companies. Our price target is also supported by our DCF analysis.

Seagate

HDD stocks are highly correlated, historically trading in a P/E range of 4x-20x, with a median forward P/E of 10x. Our price target for Seagate is based on 14x our FY-15 non-GAAP EPS estimate, which is higher than historical multiples driven by the positive benefit of industry consolidation. With shares currently trading below our price target, we rate Seagate a Buy.

TE Connectivity

TE Connectivity has historically traded at a 14x forward P/E multiple with a post-bubble range of 7x to 19x. We believe the shares should trade in line with historical ranges. Our price target is based on the company trading at 15x our FY-15 EPS estimate.

Violin Memory

Our price target is based on Violin trading at 5x our FY-16E sales estimates, which is in line with other high-growth flash systems peers.

Western Digital

HDD stocks are highly correlated, historically trading in a P/E range of 4x-20x, with a median forward P/E of 10x. Our price target for Western Digital is based on 14x our FY-15 non-GAAP EPS estimate, which is higher than historical multiples driven by the positive benefit of industry consolidation. With shares currently trading below our price target, we rate Western Digital a Buy.

Risks

Company-specific positive risks to our Hold rating on 3D Systems include a marked acceleration in organic growth and improving margins. Negative risks include slower growth in the 3D printing market, an inability to integrate acquisitions, commoditization of printers and materials, and an unsuccessful roll out of new products that does not drive higher materials sales over time.

Company-specific positive risks to Apple include stronger-than-expected smartphone sales and share gains, significantly higher margins, and a significant new product introduction. Negative risks include slower smartphone sales, market share losses in smartphones, and declines in Macs or iPad.

Company-specific risks to our Buy rating on Amphenol include higher commodity costs that the company is not able to pass on to customers, an inability to integrate acquisitions, and slower spending in the military end market.

Company-specific upside risk to our Hold rating on Arrow include significantly improved demand which could drive EPS leverage, and a shift of business to higher-margin US and European markets. Downside risks include a negative correction in the semis market, weakness in industrial spending, a decline in Europe, an increased mix of revenue from Asia, and the inability to realize benefits from the company's recent acquisitions.

Company-specific upside risks to our Hold rating on Avnet include significantly improved demand which could drive EPS leverage, and a shift of business to higher-margin US and European markets. Downside risks include a negative correction in the semis market, weakness in industrial spending, a deceleration in business in Europe, and a significantly higher mix of revenue from Asia.

Company-specific positive risks to our Hold rating on Benchmark include increased business due to competitive deal wins, better business trends with top customers, and improvements in IT spending. Negative risks include the loss of a top customer, and a higher mix of low-margin compute business.

Company-specific risks to our Buy rating on CDW include a slowdown in overall US IT spending and deterioration in macro economic conditions, which could translate into slower growth and profitability. Specific downside risks to our Buy rating include the threat of direct sales from vendor partners, the loss of key accounts or strategic vendors, and high leverage / debt levels.

Company-specific risks to our Hold rating on Celestica include significant new program wins and faster-than-expected growth in its higher-margin Diversified segment. Downside risks include failure to deliver on recent cost cutting plans, negative sales growth, inability to fully ramp new programs to forecasts, and loss of a top 10 customer (IBM and Cisco).

Company-specific risks to our Buy rating on EMC include: lack of growth in emerging segments, the virtualization of storage, a publicly-traded subsidiary (VMware) and the competitive threat from emerging flash storage vendors.

Company-specific positive risks to our Hold rating on ExOne include higher machine sales and improved profitability. Negative risks expectations for high growth rates, more limited product offerings, and a large shareholder.

Company-specific positive risks to our Hold rating on Fabrinet include an improvement in optical demand, and new program wins in the optical and the laser and sensor markets. Negative risks include high customer concentration, further consolidation of top customers, high exposure to the optical components market, and limited geographic manufacturing footprint (Thailand).

Company-specific positive risks to our Hold rating on Flextronics include an improvement in the networking and telecom end markets, improved profitability in components, and better-than-expected revenue from the Google/Motorola Mobility (MMI) business. Negative risks include the loss of a

top 10 customer, an inability to win new programs, inability to realize revenue from the Google/MMI deal and a slowdown in technology spending.

Company-specific risks to our Buy rating on Hewlett-Packard include an inability to deliver on restructuring plans, lack of growth in its enterprise segments, the risk from businesses moving to the cloud, and the inability to split into two separate companies.

Company-specific positive risks to our Hold rating on IBM include: improved revenue growth, large acquisitions, and improved results in the hardware business. Negative risks include: the inability to deliver on growth initiatives, inability to integrate acquisitions, and the inability to deliver on profitability targets.

Company-specific positive risks to our Hold rating on Jabil include improved margins in the Electronics Manufacturing (EMS) segment and significant deal wins with new customers. Negative risks to our Hold rating include weaker demand trends in mobility and the loss of a top customer (Cisco, Apple).

Company-specific positive risks to our Hold rating on NetApp include: a return to revenue growth, significantly higher margins, and an acquisition of the company. Negative risks include: lack of product growth, cloud adoption by medium-sized businesses, and further public sector weakness.

Company-specific positive risks to our Hold rating on Plexus include an improving networking market, faster cost improvements, and significant new deal wins. Negative risks include the loss of a top customer, deteriorating end markets, and increased competition.

Company-specific negative risks to our Hold rating on Sanmina include continued market share losses in the IMS segment which are not offset but growth in the CPS business, a decline in gross margins due to cost pressures, and an inability to win new business. Positive risks include, increased profitability in the components and enclosure businesses, improvement in demand from the telecom and networking end markets, and increased business due to competitive deal wins.

Company-specific risks to our Buy rating on Stratasys include slower growth in the 3D printing market, an inability to integrate acquisitions, commoditization of printers and materials, and political/geographic risk due to some of its business being located in Israel.

Company-specific negative risks to our Buy rating on Seagate include weaker demand for HDDs, more severe aggressive pricing, considerable cannibalization by SSDs, an inability to maintain margins in current ranges, and an inability to procure components.

Company-specific positive risks to our Hold rating on TE Connectivity include a better-than-expect automotive market, substantial margin improvements in the Network and Consumer Solutions segments, and higher cost savings from recent restructuring actions. Downside risks include higher commodity costs, slower global automotive spending, and sustained market weakness in Network and Consumer solutions.

Company-specific risks to our Hold rating on Violin include Violin's ability to adjust its cash burn rate (either up or down) relating to its investment in sales force expansion and R&D. Additional downside risk includes the fact that Violin competes in a very competitive market against large and established data storage providers such as EMC, NetApp, IBM and HP.

Company-specific negative risks to our Buy rating on Western Digital include weaker demand for HDDs, more severe aggressive pricing, considerable cannibalization by SSDs, an inability to maintain margins in current ranges, and an inability to procure components.

Appendix: definitions

- **3D Printing - Three Dimensional Printing** - Fabrication of objects through the deposition of a material using a print head, nozzle or other printer technology. Also known as Additive Manufacturing.

- **AI - Artificial Intelligence** - the study and design of intelligent agents. These agents are systems that can perceive their environment and are able to take actions to maximize the chances of their success.

- **AM - Additive Manufacturing** - Process of joining materials to make three-dimensional objects from CAD files, usually layer upon layer. Used interchangeably with the term 3D printing.

- **AWS - Amazon Web Services** - In 2006, Amazon Web Services (AWS) began offering IT infrastructure services to businesses in the form of web services, now commonly known as cloud computing.

- **ASP - Average Selling Price** - The price at which a certain class of goods or services is typically sold. ASP is affected by the type of product and the product life cycle.

- **CAGR** - Compound annual growth rate

- **CASL - Cache Accelerated Sequential Layout** - Nimble Storage's proprietary storage architecture.

- **CIO** - Chief Investment Officer

- **CPU - Central processing unit** – the "brains" of a computer that carries out compute instructions.

- **DAS – Direct-attached storage** – external storage that is connected to a server though a direct connection. Can also include internal storage inside of a server enclosure.

- **DRAM** - Dynamic random-access memory – memory module used in PC computers, servers and storage arrays which stores data in cells containing capacitors and transistors. DRAM is volatile, meaning it must be powered on to hold its memory. When powered off, the memory is lost.

- **EMS** - Electronic manufacturing services – a company that utilizes its large manufacturing economies of scale to provide low-cost manufacturing to customers.

- **HDD - Hard disk drive** – a traditional storage device with mechanical parts, including a spinning disk and a read/write head.

- **IaaS - Infrastructure as a Service** - is a cloud computing model where computing resources are made available to customers on-demand by service providers. The service has also been more simply defined as a "virtual" datacenter.

- **IoT - Internet of Things** - everyday devices that have internet connectivity, allowing them to send and receive data.

- **IT - Information Technology** - is a segment of the market that includes computers, telecommunications equipment, servers, storage arrays and numerous other hardware devices, combined with the software and services that are provided to support this hardware.

- **LUN - Logical Unit Number** - used to identify a logical unit, a device addressed by a SCSI or SAN protocol.

- **MJF - Multi Jet Fusion** - a term used by HP to describe its 3D printing technology.

- **NAND - Flash memory** - non-volatile solid state memory (stands for "Not And").

- **NAS – Network-attached storage** – networked storage that is placed directly on the network without being connected to a server. NAS devices are comprised of a thin server, a simplified operating system optimized for serving up data files, and storage. A NAS device differs from DAS or SAN in that it provides file-level access to data, while DAS and SANs provide block-level access.

- **OCP - Facebook's Open Compute Project** - Specifications and design documents for the custom-built servers, racks, and other equipment used in Facebook's data centers.

- **ODM - Original Design Manufacturer** - An ODM manufactures products from its own designs, which are eventually branded by another firm for sale. Typically, the ODM determines what products to build and usually owns the rights to the intellectual property that goes into making the product.

- **OS - Operating System** - is the system interface that resides on a computer or server. Examples include Microsoft Windows and Apple's Mac OS for personal computers, and Windows XP, Linux and UNIX for servers.

- **PaaS - Platform as a Service** - is a service model where the provider offers application, data and content development and deployment capabilities bundled as a full-stack solution which is delivered over the internet.

- **PC** - Personal Computer

- **QEP** - Qualified EVO:RAIL Partners

- **SaaS - Software as a Service** - is a distribution model where software applications are hosted on a cloud vendor's infrastructure and are made available to users on-demand over the internet.

- **SAN - Storage area network** – a dedicated network that provides access to consolidated data storage to enhance storage devices accessible to servers. A SAN typically has its own network of storage devices that are generally not accessible through the local area network by other devices. SANs are typically networked using a Fibre Channel interface, although new SANs have been developed based on Internet Protocol (IP).

- **SAS - Serial attached SCSI** - a technology used to transfer data to and from HDDs.

- **SCSI - Small Computer Storage Interface** - used to attach peripherals devices such as HDDs to PCs or servers.

- **SDDC - Software-Defined Data Center** - data center where infrastructure is virtualized and delivered as a service.

- **SDS - Software-defined storage** - is storage infrastructure that is managed and automated by intelligent software to better utilize the disparate storage resources in a datacenter in order to better manage and control storage growth.

- **SLA - Service Level Agreement** - agreement between two or more parties, where one is the customer and the others are service providers

- **SVOS - Storage Virtualization Operating System** - Hitachi's storage virtualization software

- **TB – Terabyte** - one trillion bytes. A measure of storage capacity on a hard drive or storage array.

- **TCO - Total cost of ownership** – a comprehensive assessment of IT costs over time. TCO includes the initial purchase of infrastructure to support IT needs as well as ongoing expenses related to downtime, training, maintenance, licensing fees, and power costs to support IT infrastructure.

- **VM - Virtual Machine** – an emulation of a particular computer system. Server virtualization is the implementation of multiple server VMs on top of a hypervisor that is run on one physical machine or server.

- **VSAN - Virtual SAN** - VMware's storage virtualization product.

Appendix 1

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Buy: Based on a current 12- month view of total share-holder return (TSR = percentage change in share price from current price to projected target price plus pro-jected dividend yield) , we recommend that investors buy the stock.

Sell: Based on a current 12-month view of total share-holder return, we recommend that investors sell the stock

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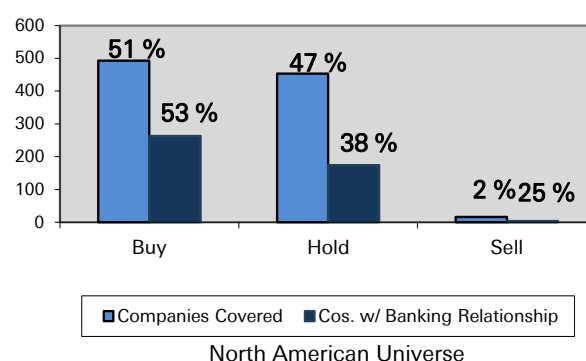
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