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Technology Predictions

TMT Trends 2008

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There are dedicated TMT member firm practices in 45 countries and centers of excellence in the Americas, EMEA and Asia Pacific. DTT's member firms serve nearly 90 percent of the TMT companies in the Fortune Global 500. Clients of Deloitte's member firms' TMT practices include some of the world's top software companies, computer manufacturers, wireless operators, satellite broadcasters, advertising agencies and semiconductor foundries – as well as leaders in publishing, telecommunications and peripheral equipment manufacturing.

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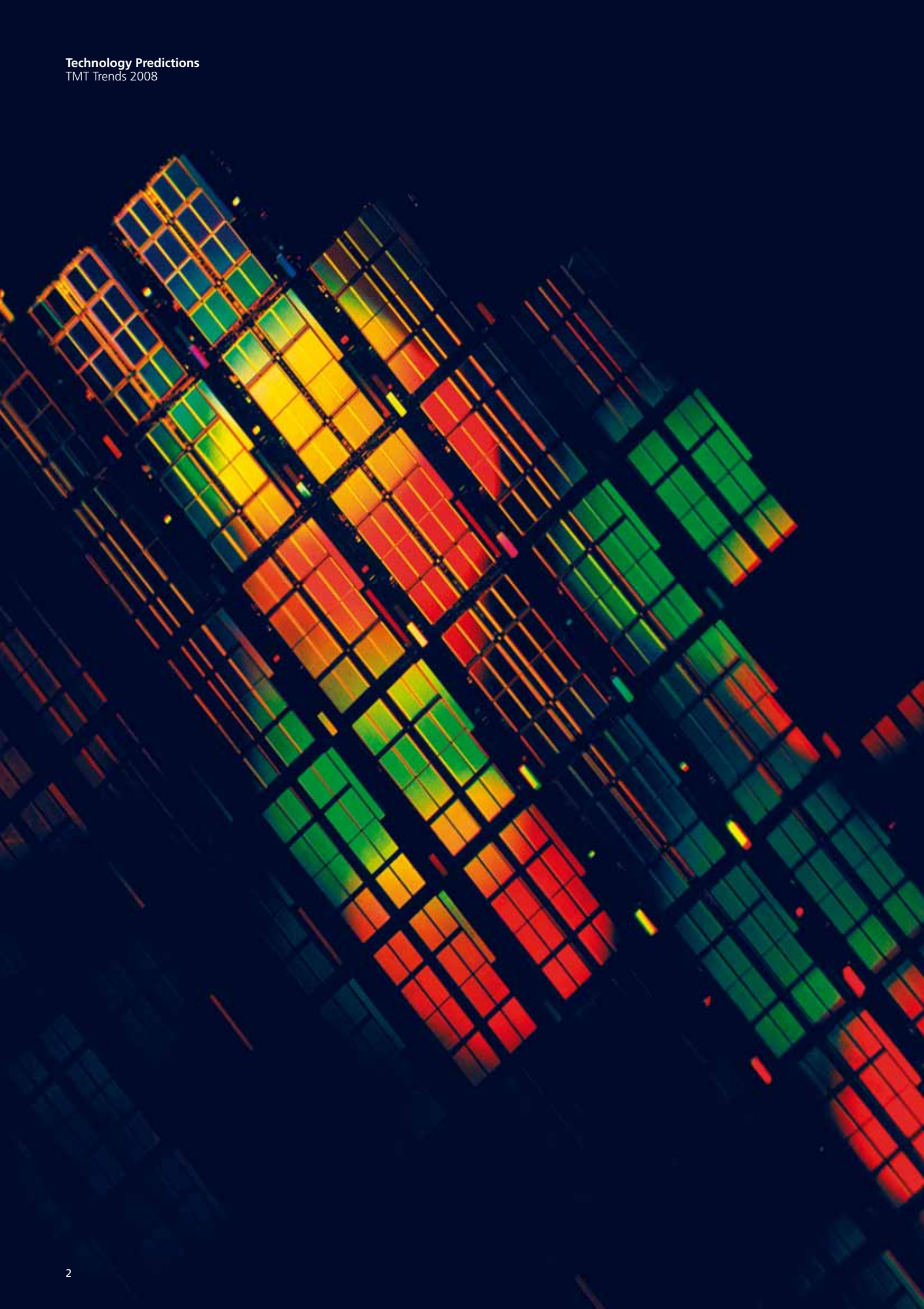


Foreword

Welcome to the 2008 edition of the DTT Global TMT Industry Group's **Technology Predictions**.

As predicted in last year's Technology report, the environment has become increasingly important to all of the activities of technology companies, from the greenness of products and services through to the sustainability of production processes. The user interface has also taken center stage, in all parts of the technology sector. Storage, and its cost, became a sensitive issue, with research suggesting that the volume of data created during the year would approach the total amount of storage available[1]. Biometric technologies continued to make progress, and were included in a growing range of products, from laptops to smart phones. Free offers in the technology sector continued to represent a double-edged sword, and in some markets, free services such as VoIP began to struggle. Carousel fraud continued to frustrate law enforcement agencies and technology companies alike, as gray markets continued to thrive. New combinations of existing technologies made a strong show, as suggested. Social networking continued to provide strong growth, and technology companies played their part in trying to monetize such services. Parasitic power systems made steady progress, though mostly on the margins of the sector. And the bionic human has marched – and run – steadily forward.

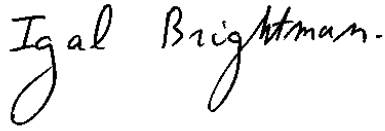
The outlook for the technology sector in 2008 is similarly varied. In this year's Predictions: virtualization of the enterprise working environment is likely to make steady gains, although companies are likely to question its panacea status. A greater skills shortage may emerge, sometimes as a result of erstwhile legacy technologies being viewed as the future. LED technology may start to supersede the incandescent lightbulb. The image of nanotechnology may be enhanced through a growing awareness of its ability to better the environment. The ability to be anonymous on the Internet may decline as users, traders and regulators call for more widespread authentication of users' identities. Earning revenues from PCs may become less about selling equipment and more about selling services, particularly for data protection. Privacy may become a key selling point for many online businesses. XBRL, a new reporting language for corporations may well become increasingly widespread. A digital divide separating advanced digital users and their own data may deepen, due to incompatible standards. And finally, all the while, man's most precious resource – water – is likely to become ever more scarce.

I am often asked how the DTT TMT Global Industry Group's Predictions differ from the many similarly titled reports produced by other organizations. I believe Predictions has a unique combination of objectives and methodology.

The Predictions series has been designed to provide a diverse selection of views and thoughts that challenge, inform and engage industry leaders and executives. It neither aims, nor claims to be a comprehensive forecast of every anticipated event. Its aim is to provide a point of view, but by the very nature of predictions, the outcome may differ from what was originally expected.

The inherent unpredictability of the global technology sector can be mitigated by having a robust methodology that synthesizes multiple sources of information and a wide body of opinions that require thorough peer reviews. The 2008 series of Predictions has drawn on internal and external inputs from conversations with member firm clients, contributions from DTT member firms' 6,000 partners and managers specializing in TMT, and discussions with industry analysts. As last year, Predictions for the technology sector has been able to draw upon the insight gleaned from a series of 20 interviews with leading executives from around the world on the key industry theme of digitization. These interviews have been published in a book, **Digital Dilemmas**, available online (www.deloitte.com/tmt).

I hope the result of our endeavors provides you with plenty of food for thought for the year ahead. On behalf of DTT's Global TMT Industry Group, may I take this opportunity to wish you all the best for an enjoyable 2008.



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Executive summary

Virtualization was one of the most talked about technologies of 2007. In 2008, enterprises may ask more probing questions about the limits, as well as the potential, of virtualization, possibly leading to a more measured deployment of the technology. This should benefit companies and suppliers alike. Principal questions that IT departments might ask concern the timing, robustness of security and cost of ownership. While virtualization is still likely to be the future for many parts of a company's IT environment, a cautious, longer term view may replace the haste of the recent past. Companies may also ask themselves how will it change the way we work; how will we manage it; which business objectives would virtualization address and which problems could it solve? Full cost-benefit analyses should even consider factors such as the potential impacts of virtualization on tax planning.

Just 10 years ago, the consensus was that the mainframe was doomed to extinction. Yet, over the past few years mainframes have been going from strength to strength. In 2008, this trend seems set to continue. The installed base of mainframes is rising at about 5 percent a year. Every day in 2008, mainframes are expected to process more than 30 billion transactions, representing 70 percent of the world's business data. While the mainframe has proven to be resilient, the workforce appears not to be. In 2008, while the importance of mainframes may rise, the number of staff skilled in their maintenance and development may fall. What used to be regarded as legacy may then, as has happened with mainframe computers, become viewed as the way of the future. Enterprises, as well as the industry that supplies them, should review their long-term talent requirements regularly. There are several potential approaches for dealing with talent scarcity. One would be to migrate applications away from a platform with a skills pool that appears to be poor. But this is not always feasible. A second approach would be to train staff. A third approach could to be to make the underlying technology easier to use.

The conventional, highly inefficient, incandescent light bulb may finally start to be superseded by the white LED in 2008. The conventional light bulb represents as much as 25 percent of a typical household's yearly power bill. The luminous efficiency (the ratio of light output to power input) of the traditional light bulb is, at best, 2.6 percent. Current LEDs boast a luminous efficiency of up to 10 percent; next generation models offer up to 22 percent. In 2008, the LED should become commercially viable and its challenges with regard to intensity and color should have been resolved. Given that the LED is a semiconductor technology, it should benefit from Moore's Law, with manufacturing costs expected to decline by 50 percent every 18 months. The semiconductor industry should improve its LED technology, especially since it is one of the few high-growth areas in the sector at present. Governments should consider subsidizing LED purchases with rebates or tax deductions.

The public image of nanotechnology has recently become tainted, despite mass market use of nanotechnology-enabled products. People are concerned about the possible malign consequences of the release, accidental or otherwise, of engineered nanoparticles into the environment. Along with the growing distrust of nanotechnology there has been a steady rise in concern over the environment; nanotechnology could have an important role to play in healing, rather than harming the planet. Therefore in 2008, the public's demonization of nanotechnology could be reversed, and a green-tinged halo could replace its horns. Nanotechnology is already being used to address several environmental issues: generating clean power, reducing existing power consumption, providing drinkable water, cleaning contaminated land, reducing harmful emissions and enabling long-life portable power. While the industry should explain where nanotechnology has made a positive difference, it should be wary of succumbing to hype or overpromising. The sector should always bear in mind that, as with any emerging technology, adoption is always going to be an economic decision, whether for private consumers or for businesses.

It is often argued that one of the great benefits of the Web is anonymity. Contributions to the Internet, whether in the form of blogs, comments on products, video uploads, dialog within chat rooms and contributions to online encyclopedias, can all be made under aliases. In some respects this could be viewed as an extension of freedom of speech. But anonymity can give rise to abuses. In 2008, there is likely to be an increasing clamor, from regulators, users and online traders, for the Internet to require people to provide authenticated identity every time they make any transaction. A move to online authentication, while initially being regarded as an affront to liberty by some, could ultimately be good for business and for users. For example, bolstering consumer confidence in e-commerce, online auctions, Internet chatrooms and other transactional websites should help sustain growth, suppressing fears about the growing volumes of online fraud and other malign behavior. The industry should, however, bear in mind that full authenticity is unlikely; as in the real world, those who really want to remain anonymous are likely to be able to do so.

Since the launch of the first PC, the volume of and, more critically, the value of data stored on computers has grown exponentially. Credit card information, address books, clients' business plans and paid-for MP3 tracks may all be kept on the same computer. One way of measuring the value of data is in terms of the replacement cost. But the price paid, in terms of inconvenience, time and loss of credibility in dealing with the aftermath of lost data, may be even greater. As a result, some consumers can end up spending more on protecting their data than on the underlying device. This trend may extend beyond the PC to other devices, from MP3 players to mobile phones, from DVRs to external hard drives. Computer manufacturers, which face falling margins as a result of declining average selling prices, may need to launch a set of complementary services, including data protection.

In 2008, resistance may grow to the volume and depth of information that websites capture about consumers' online behavior. While most use of behavioral data is likely to be innocuous, this perception does not always tie in with fact. A few negative headlines about the abuse of individuals' data may be sufficient for Web users to demand that tracking be moderated or stopped altogether. If the depth of consumer knowledge becomes regarded any more negatively, some websites may differentiate on the basis of privacy. Getting the balance right may prove difficult during 2008, not least because government regulation in some territories may force some websites to move in the opposite direction. Online companies should educate users in online privacy, in a clear manner that neither trivializes nor exaggerates the way in which data is used. Surfers should then be given the autonomy to select the level of privacy that they would prefer. However, users should also be aware that one of the benefits of losing some anonymity is low-cost, or even free, online services. Laws concerning online privacy should be updated, and ideally standardized across regions, if not globally. The online world should also be careful not to over-react to demands for privacy. Companies should be careful to distinguish between the clamor of a vocal minority and the genuine concerns of a more passive majority.

The technology and financial services sectors have already bestowed a generous collection of acronyms on the world. But in 2008, a further acronym, XBRL may become as well known as HTML or GAAP. XBRL, or eXtensible Business Reporting Language, provides a standardized approach to tagging the financial information contained in company reports. XBRL makes the analysis of financial data far easier, as the process is more readily automated. Governments and their financial authorities are likely to push for XBRL's adoption because of the potential benefits in terms of productivity and efficiency. For companies, the biggest benefit may come from creating a more accessible pool of financial data that can be analyzed using standard business intelligence techniques. For investors, the major benefit of having machine readable accounts would be quicker analysis. Governments considering or planning to implement XBRL reporting should think about the changes this might imply in terms of their standard processes.

One of the fundamental benefits of digitization is the conversion of data into zeros and ones. But not all zeros and ones, it would seem, are equal. We may not even be able to access all the data that we own. Some data storage formats used just 10 years ago are now effectively obsolete. A further legacy issue relates to operating systems and computing platforms. This digital divide is most vexing when the existence of multiple standards for a particular type of file limits the utility of current computing systems. X-ray images are now commonly captured, stored and distributed digitally. However viewing software has not been standardized at all. The technology sector may have to take a more pragmatic approach in establishing, agreeing and maintaining long-term data storage formats. While the owner of a de facto standard is likely to gain economically, other players may also want to balance the downside of not owning the standard with the benefits of having similar standards for everything.

The human race seems to have a peculiar talent for making previously abundant resources scarce. This is especially the case with water. In 2008, it is estimated that more than one billion people will lack access to clean water. More than double that number lack access to sanitation. The lack of the most important form of liquid in the world is therefore a fundamental issue, and one that the technology sector can play a major role in addressing, in 2008 and beyond. The potential value in the opportunity appears to be as significant as the problem. The investment shortfall for the global water industry may be more than $1 trillion over the next 20 years. In 2008, technology companies should look at how their products and solutions can add to existing supply, as well as reduce current usage. While this should make good business sense, it is also of profound social importance. Technology could also be used to improve management of the existing supply in myriad ways. One of the biggest challenges – and opportunities – is reducing water leakage. Another powerful application of technology could be to model the impact of subsidies for industries such as farming, or the draining of wetlands. Technology could also be part of the solution in developing less wasteful approaches to hydrating crops.

Getting value from virtualization

Virtualization, a form of software first used in the 1960s, was one of the most talked about technologies of 2007. It has been lauded as a technology that offers a compelling combination of benefits. Virtualization is claimed to deliver cost savings, better security[2], more efficient use of resources[3], better disaster recovery[4] and lower power consumption[5].

By the beginning of 2008, every Fortune 100 company and 80 percent of the Fortune 1000 companies had already deployed virtualization in some parts of their businesses[6].

In 2008, enterprises considering deploying or extending virtualization may ask more probing questions about its limits, as well as its potential. This could lead to a more measured deployment of the technology, which should benefit companies and suppliers alike. The outlook for virtualization looks positive, with one industry analyst forecasting that 50 percent of all servers would be virtual by 2010[7].

A principal question that IT departments might ask concerns timing. While 2007 was characterized by a rush to evaluate or deploy virtualization, in 2008 companies may be more cautious. They may invest more effort in determining which aspects of their IT environment should be virtualized and when. Some companies may find that virtualization is not suitable for all applications. Machines deployed to run Internet services, which require in-built redundancy to handle peak loads, may not work within a virtualization environment[8].

Corporate databases, particularly those not based on mainframes, may also be unsuitable, as they are already using up most of their available capacity. In addition, a spate of new product announcements expected in 2008 may also encourage IT departments to wait and see how upcoming products compare with current ranges before committing to a deployment.

A key area that enterprises may scrutinize this year is the robustness of virtualization's security. Questions may be asked about the software's intrinsic security. A continuation into 2008 of the issuing of patches to address vulnerabilities could cause concern. There may also be concern that conventional safety approaches, such as IP-based security tools may not work because virtual machine communications within a server may not enter the physical network[9]. Security specialists may identify even more vulnerabilities. One company claimed that malware could escape onto an operating system[10].

Enterprises may take a closer look at the true cost of ownership of their virtualization environment. While the technology can deliver savings in some areas, it may cause other costs to rise, such as for software licenses and new infrastructure management software. Furthermore, wherever virtualization is deployed in an ad-hoc manner[11], a company may find it challenging to have an accurate record of exactly how many servers it has. Attempts to audit virtual and secure server estates can be complicated by the many-to-one ratio of virtual to physical servers[12].

Thus in 2008, while virtualization is still likely to be the future for many parts of a company's IT environment, a cautious, longer term view may replace the haste of the recent past.

Bottom line
Virtualization is most likely to remain a significant technology, delivering a range of benefits to enterprises in 2008. But its impact, positive and negative, is likely to vary by company.

The bottom line is that each company has to ask itself key questions such as: how would it affect costs; how would it change the way we work; how will we manage it; which business objectives would virtualization address, and which problems would it solve? Companies should avoid the trap of deploying the technology simply to follow the crowd.

The assessment of costs should include an evaluation of the total cost of ownership, and particular attention should be paid to issues such as software licenses. While virtualization is generally expected to lower cost, lack of diligence in understanding how current software providers' licenses would work in a virtualization context could lead to a nasty shock in the shape of an unexpectedly high bill. IT departments need to consider just how large deployments need to be. If deploying in a live environment, the deployment needs to be large enough to balance out the resulting costs, such as support, and the development and implementation of new processes.

Companies should also consider how virtualization could improve internal processes. For example, the technology may enable internal cross-charging by processor, RAM utilization and disk space. It may also make cost management easier and clearer.

Enterprises should ensure all systems and processes to manage virtual machine implementation are in place prior to rolling out the technology. Processes should include a policy for decommissioning virtual servers. Just because virtual servers cannot be seen does not mean that they do not exist, or indeed, run up costs.

Companies should look at all possible benefits from the technology. This would even include looking into areas such as how virtualization could help with tax planning. One possible area would be the ability to move server-based intellectual property between tax jurisdictions more quickly. While relocating digital intellectual property between countries or states to obtain lower tax rates is possible without virtualization, the technology could save a company time because it wouldn't have to commission new servers in the new location.

Finally, companies should take a long-term view. While virtualization is a decades-old technology, it still lacks maturity in some environments. In 2007, the industry is likely to see further consolidation as key players purchase companies with complementary technologies. This activity, and the continuing maturation of the technologies, should lead to significant advances in virtualization for the foreseeable future. An organization's decisions regarding the how, what and when of implementing virtualization could be critical.

How to manage talent when legacy becomes the future

Just 10 years ago, the consensus was that the mainframe was doomed to extinction, rendered obsolete by the growth in popularity of client servers and distributed computing models[13]. Massive contractions in the size of deployments in companies around the world had suggested that the age of 'big iron' would soon be over.

Yet, over the past few years mainframes have been going from strength to strength. In 2008, this trend seems set to continue. The installed base of mainframes is rising at about 5 percent a year[14]. Furthermore, mainframes' use of power, measured by watts per transaction, is lower than any other type of server, making it both environmentally friendly and cost efficient. By comparison, the power consumption of servers, per $1,000 of acquisition cost, rose from 8 watts to 109 watts between 2000 and 2006. It is forecast to rise to 417 watts by 2009[15].

Every day in 2008, mainframes are expected to process over 30 billion transactions, representing 70 percent of the world's business data[16]. Mainframe capacity for the largest mainframe vendor, IBM, has grown steadily from under 3.5 million MIPS in 2000 to 11.1 million MIPS in early 2007.

Traditional industries are not alone in consolidating their mainframe assets. A Brazilian new media company is using a mainframe as the basis of a massive multiplayer online game[17]. One of the attractions of the mainframe appears to be its robustness. According to vendors, the average mainframe breaks down every 38 years or 456 months[18]. This compares with just 18 months for competing technologies[19].

While the mainframe has proven to be remarkably resilient, the workforce, it appears, has not. In 2008, while the importance of mainframes may rise, the number of staff skilled in maintenance and development of mainframes may fall.

A key mainframe-related skill is the ability to work with COBOL, a language invented in the 1950s, when many COBOL programmers started training. Over the past few years, the number of staff capable of maintaining mainframes appears to have contracted. Younger programmers entering the workforce are more likely to be trained in Java and .net. In 2008, over half of all IT workers with mainframe experience are expected to be over 50[20].

At the same time as the fall in the pool of COBOL programmers, the volume of COBOL code has risen. A survey of IT managers found that almost three-fifths of respondents polled were developing new, strategic COBOL-based applications[21], with a focus on vital back-end financial systems[22].

Bottom line
It can be hard to judge the lifetime of a particular technology. What used to be regarded as legacy can, as has happened with mainframe computers, become viewed as the way of the future. Enterprises, as well as the industry that supplies them, should review their long-term talent requirements regularly.

There are several potential approaches for dealing with a scarcity of talent. One would be to migrate applications away from a platform with a skills pool that appears to be poor. But this is not always feasible. In the case of mainframes, migration could be time consuming and expensive[23]. Such a project would probably require the recruitment of a highly paid team of programmers with knowledge of COBOL as well as current programming languages. Using lower cost, inexperienced staff would likely be a false economy. And the full benefits of such a migration may only be realized in the mid-term, making the business case for such a move challenging to argue.

A second approach would be to train staff. This is happening with COBOL. Some companies are pairing together new recruits and experienced COBOL programmers to accelerate the transfer of knowledge. Companies could even recruit recent retirees on part-time, short-term contracts, to assist with training. One supplier, IBM, is in the middle of a five-year initiative aimed at training more than 20,000 people in mainframe administration[24] . Companies should note that it may not be enough just to train in a new language; there also needs to be instruction in the discipline of programming in a robust, error-free way.

A third approach could to be to make the underlying technology easier to use. One vendor is investing $100 million to make mainframe management easier[25].

What used to be regarded as legacy can, as has happened with mainframe computers, become viewed as the way of the future.

Let there be light emitting diodes

How many years does it take to change a light bulb? About 130 years and counting in the case of the incandescent light bulb, a technology which has long been recognized as an imperfect approach to shedding light. But in 2008 the conventional light bulb may finally start to be superseded by a viable replacement: the white LED.

Incandescent bulbs provide light via passing current into a fragile filament that ruptures with the slightest shock – sometimes even just the impact of being turned on is sufficient to break it. This filament is housed within an equally fragile glass tube. And while the aim of the bulb is to illuminate, the chief output of the bulb – more than 90 percent – is actually heat. The bulb is so effective at generating heat that a single bulb has been the sole heat source for more than 16 million toy ovens!

The luminous efficiency (the ratio of light output to power input) of the incandescent light bulb is, at best, 2.6 percent[26]. The halogen bulb, a derivative of the incandescent bulb with a sealed gas enclosure for the filament, is only slightly more efficient. The only less efficient form of lighting than the standard incandescent bulb is the candle, whose luminous efficiency is a meager 0.04 percent.

Given the inefficiency of incandescent bulbs, it is not surprising that they represent a major chunk – as much as 25 percent – of a typical household's yearly power bill[27]. The global lighting bill in the developed world adds up to $138 billion per year.

Since the first incandescent light bulb was introduced, some competing technologies have emerged. But none has managed to offer a sufficient combination of low cost, power consumption, size and lighting up time to challenge incandescent in a significant way.

In recent years, CFL bulbs have grown in popularity. Initially CFL bulbs were a niche market as the technology was relatively expensive, the bulbs were bulkier and it could take several seconds for the bulbs to turn on fully. CFL technology can be over three times more efficient than incandescent bulbs, offering luminous efficiency of up to 8.8 percent[28]. Demand for CFL bulbs may grow in some regions over the next few years if the incandescent light bulb is banned[29].

Another competing technology that has been developing in the background is the LED, whose advantages are multiple. It is far more efficient. Current LEDs boast a luminous efficiency of up to 10 percent[30]; next generation models offer up to 22 percent[31 32 33 34]. That is more than 10 times better than incandescent bulbs and three times better than CFL. LED bulbs offer superior longevity, of up to 50,000 hours, equivalent to 17 years with an average eight hours light per day. This is 50 times better than incandescent and five times better than CFL.

For years, however, LEDs have been uncompetitive on other lighting metrics. They were not bright enough, they didn't emit the right colors, and they cost too much. LEDs had limited successes: some traffic lights, a few high-end vehicles and consumer devices.

But in 2008, LED should become commercially viable. LED's issues with intensity and color appear to have been resolved[35]. A recent breakthrough offers an entirely new approach for making white light LEDs[36]. While the upfront cost of an LED is high, its long life makes the total cost of ownership more than competitive[37]. An LED bulb and holder may cost up to $50, but energy and replacement cost savings, per bulb, over a 20-year period add up to about $265[38].

Not only does longer life help reduce the overall lifecycle costs, many light sources are in difficult or dangerous to replace locations, such as high ceilings.

While the initial price of an LED bulb may still frighten off the mass market in 2008, manufacturing costs are continuing to decline. As the LED is a semiconductor technology, it should benefit from Moore's Law, with manufacturing costs expected to decline by 50 percent every 18 months[39]. Conversely, nothing much has changed in the way incandescent bulbs have been manufactured in the last 50 years; the cost certainly has not fallen. But the energy costs associated with them are not going down – they are rising.

The first widespread use of LEDs was in digital watches. Owners of these timepieces probably associate LEDs with the color red. In the medium term, it is likely that the most common application for LEDs will be to give off white light, but their true hue may really be green.

Bottom line
LED lighting manufacturers should ensure that they communicate their positive environmental credentials. As well as offering low power consumption, the sector should also promote its other characteristics, such as clean manufacture and disposal. The average CFL contains about 20 milligrams of mercury, which is toxic. The United States' annual consumption of all fluorescent bulbs would produce enough mercury to contaminate 20 million acres of water if not recycled or otherwise properly disposed of[40]. Making these points could make a stronger case for subsidies, which are currently provided to some renewable energies, such as solar and wind.

The semiconductor industry should improve its LED technology, especially since it is one of the few high-growth areas in the sector at present.

Governments should consider subsidizing LED purchases with rebates or tax deductions. Adoption of LED lighting and its resulting reduction in power consumption could lessen the need to build further power plants.

Finally, architects could let their imaginations run riot in creating lighting in inaccessible locations. With a 17-year life span, they should not worry about the challenge of changing an LED bulb.

From zero to green hero: the renaissance of nanotechnology

The public image of nanotechnology – the manipulation of matter at the atomic or molecular scale – has recently become tainted. This is despite mass market use of nanotechnology-enabled products, from smoother sun cream to portable MP3 players and faster processors[41].

The impact of nanotechnology on new or improved products and services has already been significant and its potential remains considerable. Matter behaves in fundamentally different ways on the nanometer scale. Previously inert materials can be transformed into catalysts; solids can become liquids, even at room temperature; insulators can become conductors. According to advocates, nanotechnology could even be the basis for the next industrial revolution[42].

Despite, or perhaps because of, the potential of nanotechnology, it has scared the public more than it has thrilled them. People are concerned about the possible malign consequences of the release, accidental or otherwise, of engineered nanoparticles into the environment. They are also uncertain about the fate and toxicity of nanoparticles and how they behave[43]. The insurance industry has debated whether some nanotechnology risks can be covered as not all the potential negative impacts are known or can be quantified at this time[44].

One influential commentator has labeled nanotechnology as "gray goo"; it also has been suggested that it could be more threatening than nuclear power[45]. On a personal level, there have been concerns about the long-term impact of nanotechnology based anti-wrinkle creams[46]. In addition, some nano particles have been found to be carcinogenic[47]. It is the subject of several official inquiries around the world and has even driven the plot of a bestselling novel[48].

Along with the growing distrust of nanotechnology there has been a steady rise in concern over the environment. And it is becoming increasingly apparent that nanotechnology could have an important role to play in healing, rather than harming the planet[49]. Therefore in 2008, the public's demonization of nanotechnology could be reversed, and a green-tinged halo could replace its horns.

Nanotechnology is already being used to address several environmental issues: generating clean power, reducing existing power consumption, providing drinkable water, cleaning contaminated land, reducing harmful emissions and enabling long-life portable power.

Nanotechnology could allow the manufacture of solar panels based on plastics instead of silicon.

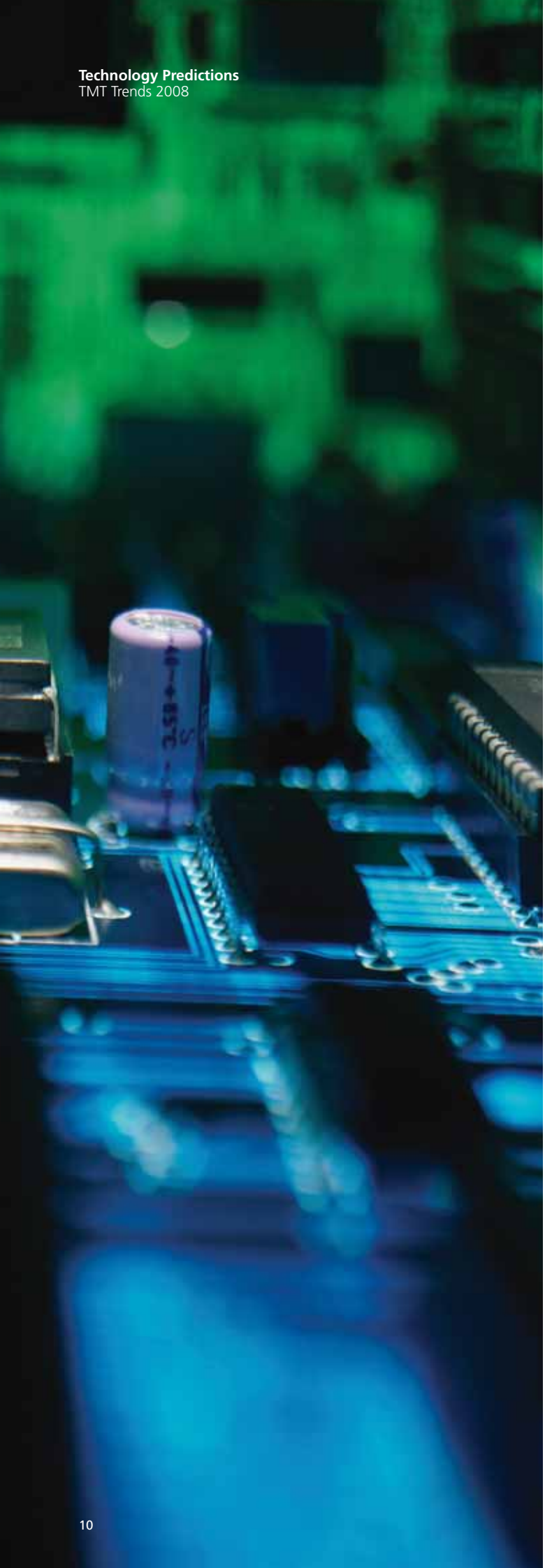
The combination of global population and economic growth generates an increasing need for energy. Carbon-based fuel reserves may be insufficient to meet demand, and, more worryingly, may have too great a negative impact on the global climate. So cleaner energies are required, one of the most appealing of which is solar power. But solar energy is not yet price competitive with oil, gas and nuclear energy, and costs up to $5 per watt. Nanotechnology could allow the manufacture of solar panels based on plastics instead of silicon[50]. This could lower production costs, allow a greater range of form factors, and more than halve the cost of solar power to just $2 per watt, which is far closer to 2007 prices for fossil-fuel-derived electricity[51].

Nanotechnology can also be used to conserve energy. As highlighted in 'Let there be light emitting diodes', lighting represents a significant share of domestic power consumption. The efficiency of traditional incandescent light bulbs is very low, with most power being converted into heat, rather than light. Nanotechnology could enable an alternative light source, LEDs. Presently most LEDs are based on crystals; nanotechnology may allow the use of thin films of polymers or organic modules that could improve electroluminescence efficiency fourfold[52].

As highlighted in 'The challenge and opportunity of water scarcity', another of the world's gravest concerns is water supply. One of the solutions to this problem is the conversion of salt water into drinkable water. Nanoscale membranes, based on carbon nanotubes, offer a dramatic improvement in productivity when compared to reverse osmosis, currently the most common form of desalination[53]. The nanotechnology approach requires less energy and fewer filter cleaning agents than the current approach[54 55] for an equivalent volume of drinking water[56].

Similarly, a major source of emissions is motor-vehicle exhaust. Nanotechnology catalytic converters could reduce the quantity of precious metals required to make a standard three-way converter, enhance the lifetime of the converter, increase efficiency and substantially reduce its cost[57 58].

Engineered nanoparticles are showing considerable promise as a means of cleaning up contaminated land and groundwater. Various industrial processes and pesticides create a class of pollutants called chlorinated hydrocarbons, some of which are known to suppress the human immune system and have been linked to cancer[59]. Trials in the United States, Canada, and Germany have indicated that nanoparticles are capable of binding to such pollutants very efficiently, enabling safe collection and separation. With one-third of the world's population obtaining their potable water from aquifers, the majority of which are polluted, nanotechnology could have a major impact by saving lives[60].



Billions of batteries, of all sizes, are manufactured every year, powering everything from toys to power tools. A large proportion of these are discarded once exhausted, which can cause the leakage of toxic residues. Nanotechnology is being used to develop an ultra long-life battery substitute based on reinvention of the capacitor, a centuries-old technology. Capacitors charge faster and last longer than conventional batteries; a nanotechnology-based ultra capacitor could recharge in seconds and provide power for many hours[61].

Public awareness of these issues and the environment in general, is growing daily, and as a result, its new public tagline may well start to shift nanotechnology from gray goo[62] to green good[63].

Bottom line
Like many scientifically advanced technologies, the main strength of nanotechnology is also a weakness. While nanotechnology holds enormous potential, public understanding of what the technology does is actually as minuscule as the atoms it manipulates.

Companies, research institutes and industry bodies should make a substantial, sustained effort to make nanotechnology more understandable to the layperson[64]. That should help the public feel less threatened by the technology. Part of the dialog should include direct and open responses to concerns about nanotechnology. As the size of the impact of nanoscale innovation grows, the list of concerns is likely to expand proportionately. If the industry does not provide evidence and explanations, scaremongers may fill in the gaps.

While the industry should explain where nanotechnology has made a positive difference, it should be wary of succumbing to hype or over promising. Any emerging sector is vulnerable to exaggerated and premature claims; nanotechnology industry bodies around the world should strive to keep such diversions to a minimum.

The sector should always bear in mind that, as with any emerging technology, adoption is always going to be an economic decision, whether for consumers or for business. Only once cost is competitive with existing approaches will nanotechnology become mass market.

Nanotechnology is being used to develop an ultra long-life battery substitute based on reinvention of the capacitor, a centuries-old technology.

From anonymity to authenticity

It is often argued that one of the great benefits of the Web is anonymity. Contributions to the Internet, whether in the form of blogs, comments on products, video uploads, dialog within chat rooms and contributions to online encyclopedias, can all be made under aliases.

In some respects this could be viewed as an extension of freedom of speech. Not only can users say what they want and upload what they wish, but they can do all of this without revealing who they are. As a result, disappointed tourists could provide negative views of their experiences without fear of retribution from the travel agency, or employees could offer honest feedback on their workplace to prospective co-workers, without fear of censure.

Such freedoms can be seen as a force for good. But they also, unfortunately, permit a growing variety and alarming volume of abuses. In 2008, there is likely to be an increasing clamor, from regulators, users and online traders, for the Internet to require people to provide authenticated identity every time they make any transaction via the Web.

Many sites allow anonymous contributions. Pedophiles have abused this characteristic in chat rooms, posing as young children or teenagers to gain the confidence of potential victims[65]. Online photo sites appear to be increasingly targeted by pedophiles, with such sites representing more than 10 percent of all URLs reported to law enforcement and other hotlines in the United Kingdom in 2006[66].

Anonymity also creates wider potential for libel against individuals or corporations. Libelous comments published on the Internet have the potential to reach a global audience within hours. It could be argued that the anonymity of contributors to blogs and encyclopedias may encourage some libelers, as the chances of being identified have so far appeared to be slim. One court ruled that an ISP did not have to reveal the identity of a blogger who had been accused of libeling a local official[67]. One former journalist found it impossible to track down the identity of the individual who had falsified elements of his biography on an online encyclopedia[68].

Online auctions, with over 200 million users[69], have also been subject to exploitation, partly as a result of the anonymity permitted on some sites. In Japan, the National Police Agency (NPA) found that online auction and other cyber crimes involved computers, based in Internet cafes, whose users are not obliged to provide identification[70]. The NPA's response to this finding – to ask for all Internet café users to register and for submitted details to be verified – may be mirrored by equivalent organizations around the world in 2008. In the United States, the Federal Trade Commission has issued a recommendation to users of online auctions not to trade with any seller that cannot be identified[71].

Bottom line

A move to online authentication, while initially being regarded as an affront to liberty by some, could ultimately be good for business and for users. For example, bolstering consumer confidence in e-commerce, online auctions, Internet chatrooms and other transactional websites should help sustain growth, suppressing fears about the growing volumes of online fraud or other malign behavior[72].

Being the official authenticator of identity could become a full-time business in itself. User authentication in chat rooms or on social networking sites may increasingly be seen as a feature worth paying for, particularly by worried parents[73].

Access to verified user identity may improve the business models for some companies. Moving to a trusted authentication system could reduce the need for moderators in some chat rooms, social networks and online forums.

Regulators from around the world should establish common approaches to dealing with the dark side of anonymity, working alongside privacy protection groups, to ensure a fair balance between authenticity and freedom of expression is attained. Law-makers should agree regulations that protect both service providers and customers. Liability is likely to be a critical issue, because, for example, it remains unclear who is liable for defamatory material posted online – the individual posting the material or the owner of the site. It will be important to define clearly where each party's responsibilities begin and end.

The industry should also bear in mind that it is unlikely that full authenticity could ever be attained on the Internet. As in the real world, those who really want to remain anonymous are likely to be able to. A move to authenticity would be most effective at removing casual offenders.

Ultimately, one of the best tools for dealing with anonymity on the Web may be common sense. Free lunches are as fictional in Cyberspace as in the physical world. An email from an anonymous stranger offering millions of dollars simply in exchange for bank details and home address is likely to be just as much of a scam as a letter or phone call that makes the same claim – and should also be ignored[74].

The rising value of digital protection

The first Personal Computer was priced at $1,565, with the display and diskette drives offered as optional extras[75]. Since then the cost of a PC in some countries has fallen to zero, as long as the customer purchases a broadband contract[76]. Unsubsidized PCs are available for under $400[77].

Since the launch of the first PC, the volume of and, more critically, the value of data stored on PCs, has grown exponentially. Credit card information, address books, clients' business plans and paid-for MP3 tracks may all be kept on the same computer. One way of measuring the value of data is in terms of the replacement cost. But the price paid, in terms of inconvenience, time and loss of credibility in dealing with the aftermath of lost data, may be even greater, and some kinds of data may be irreplaceable.

This combination of the declining average selling price of PCs[78] and the increasing value of digital files stored on computers, has increased users' willingness to pay more to safeguard this data. As a result, some consumers can end up spending more on protecting their data than on the underlying device[79]. In 2008, some owners may spend more on virus protection, online backup and insurance over the lifetime of the computer, than they did on the initial outlay for the PC[80].

This trend may extend beyond the PC to other devices, from MP3 players to mobile phones, from DVRs to external hard drives. All hold different forms of valuable data.

Enterprises are already accustomed to spending on virus protection, intrusion detection and back-up services. However with the growing popularity of new technologies and communications tools among enterprises, new threats to data may emerge through seemingly innocuous routes such as corporate wikis, blogs, RFID tags and even text messages[81]. Furthermore, a rise in criminal activity targeting corporations has been forecast and may make new forms of defense necessary[82].

Companies also need to protect against the loss of portable computers, such as laptops, PDAs and high-end mobile phones, which can be more easily lost or stolen. Theft of portable devices has left some companies facing losses running into billions of dollars – far in excess of the value of the hardware[83]. Therefore, offering IT managers the ability to secure laptops, PDAs and mobile phones in a manner that makes data unreadable once they are hacked into or stolen, is likely to become a substantial opportunity[84]. Failing that, various forms of new software embedded in the BIOS allow for the recovery of stolen laptops[85].

The number of computers and other digital devices looks likely to grow by more than 10 percent in 2008. The cost, both financial and in terms of convenience, of lost or stolen data will probably be even greater, at up to 20 percent, according to one analyst[86]. In parallel, the amount of potentially valuable data stored is expected to grow rapidly. By 2010, the information added annually to the digital universe will have increased more than six-fold from 161 exabytes to one zettabyte (one followed by 21 zeroes)[87].

Keeping data safe from prying eyes and malicious code could become more valuable than manufacturing the hardware on which it resides.

Bottom line
Computer manufacturers that face falling margins as a result of declining average selling prices may need to launch a set of complementary services. Providing a suite of services designed to protect data would address customer demand and also provide a predictable cash flow. PC software providers should focus on the security aspects of their solutions, rather than slower growth applications.

Manufacturers lacking experience in service provision may wish to enter service via alliances or acquisitions. Companies should raise consumer awareness of the widespread risks associated with digital data, from identity theft through to surfing without a firewall. Education could protect all customers and stimulate demand.

Service providers should demonstrate the value of their offerings, particularly to the enterprise sector, where the business case for data protection and other services can be difficult to justify[88]. This is often because companies struggle to put a financial value on their data[89]. Helping companies to quantify the value of their bits and bytes will likely be a step in the right direction.

The flight to privacy

People usually regard it as a good thing when a supplier knows them well. If a maitre d' guides us to our usual table, a shop owner knows the names of our kids, or a bartender prepares our favorite drink before we have even sat down, this is generally regarded positively.

A good memory is also a useful skill for a successful merchant. But the computers that underpin online services have vastly superior recall. Not only do they know what people purchased last week, they can also recall everything they have ever purchased, what they paid for it, and even where they were when the transaction was made.

In 2008, resistance may grow to the volume and depth of information that websites are capturing about consumers' online behavior.

Many Internet users are probably aware that cookies, discrete information repositories residing on computers, keep a log of every site visited. Every time a website is accessed, the cookie is used by the browser to send a range of information, such as the user's IP address, the date and time of the request, the browser type and the browser language. But few surfers may be aware that until recently companies could hold on to such consumer data for decades[90].

This information is often used to deliver targeted advertising and marketing. On one social networking site, the purchase of movie tickets from a partner site can be communicated to the buyer's friends, who may then also turn up for the same screening[91].

While most use of behavioral data is likely to be innocuous, perception does not always tie in with fact. A few negative headlines about abuse of individuals' data may be sufficient for Web users to demand that tracking be moderated or stopped altogether, even to the point where tracking is denied by default.

Some of that resistance may come in the form of organized lobbies. In 2007, privacy groups challenged the legality of some information retention practices[92]. In the United States, the Center for Democracy and Technology, the Electronic Frontier Foundation and the Consumer Federation of America approached the Federal Trade Commission to ask for the creation of a 'do not track' list[93]. In Europe, the Article 29 Working Party, made up of national advisory bodies that provide input on privacy to the European Union, has asked for an explanation of search-engine data retention periods[94].

If the depth of consumer data collected becomes regarded any more negatively, some websites are likely to differentiate on the basis of privacy. One search engine has already launched a non-tracking version[95]. Sites may also be increasingly ranked by groups according to their privacy practices[96].

Getting the balance right may prove difficult during 2008, not least because government regulation in some territories may force some websites to move in the opposite direction. In 2007 for example, a judge ordered one search engine that had been accused of copyright infringement to begin logging user activity and to pass this data on to the plaintiff[97].

Bottom line
Possibly the most important action for online companies is to educate users in online privacy, in a clear manner that neither trivializes nor exaggerates the way in which data is used.

Surfers should then be given the autonomy – subject to local regulation – to select the level of privacy that they would prefer. However, users should also be aware that one of the benefits of losing some anonymity is low-cost, or even free, online services. Furthermore, there are drawbacks and inconveniences in not allowing certain facets of tracking, such as the possible need to re-enter preferences and other personal information.

Web users should be made aware that even seemingly innocuous activities, such as social networking, may be compromising. A date of birth and partial address details could be sufficient information to obtain a credit card fraudulently[98]. And a smart criminal could easily piece together important clues to passwords, such as the maiden name of someone's mother, simply by surfing.

Laws concerning online privacy should be updated, and ideally standardized across regions, if not globally[99]. In some cases this means revising legislation that is vague in both online and physical spheres. For example, the copyright for a photograph taken in the street is vested with the photographer. But it may breach the various laws concerning data protection, human rights and confidentiality[100].

The European Union Data Protection Directive of 1995 limited the use of information collected by Internet groups, but each member country has had some flexibility in how this directive should be applied. This disparity could become problematic when a service accessed in one country refers to data held in another[101], and may serve to confuse companies and their customers.

Different types of data attract varying treatment in the eyes of the law. So, while a warrant may be required to obtain an email, it may only require a simple request to obtain an individual's search inquiries[102].

The online world should also be careful not to over-react to demands for privacy. Companies should be careful to distinguish between the clamor of a vocal minority and the genuine concerns of a passive majority. They should also recognize that local cultural beliefs may have a strong influence on what is considered the right approach.

Consequently, actively researching consumers' preferences country-by-country, if necessary, may prove to be the most effective way of managing privacy concerns. Consumers' tolerance for advertising may vary by market, and by demography. This diligence may seem expensive, but could be cheaper than dealing with litigation, heavy-handed government regulation or public relations battles with lobbyists. It may also help companies to avoid costly tactical mistakes, such as serving up unwanted advertisements on social networking sites or even on mobile phones.

XBRL goes XL

The technology and financial services sectors have already bestowed a generous collection of acronyms on the world. But in 2008, a further acronym, XBRL may become as well known as HTML or GAAP.

XBRL, or eXtensible Business Reporting Language, provides a standardized approach to tagging the financial information contained in company reports. Each item of data, such as 'company net profit', is allocated a tag[103]. This makes the analysis of financial data for an individual company or across multiple companies far easier, as the process is more readily automated. Without XBRL, making a comparison between company reports can be laborious, requiring, at times, tedious, costly and error-prone manual re-entry of data.

In 2008, XBRL, which is part of the XML family, will be 10-years-old[104]. But in this year, the momentum behind this reporting language may be greater than ever, with governments, financial authorities, companies and investors all favoring its adoption.

One of the biggest drivers for XBRL in 2008 is likely to be the rising number of the world's largest economies that make, or plan to make, XBRL reporting mandatory.

At the beginning of 2008, listed companies in China were already providing data in machine readable XBRL format for quarterly, half-yearly and annual reports. In the second quarter of 2008, XBRL submissions for all public companies in Japan will become mandatory[105].

In the United States, by year-end 2007, at least 40 companies, with a combined turnover of $2 trillion, had already signed up for a pilot scheme for XBRL filing and mandatory filing appeared imminent: in November 2007 the US Securities and Exchange Commission (SEC) announced that it was preparing a proposal to make XBRL submission mandatory[106]. In South Korea, a voluntary XBRL filing scheme, launched in October 2007, had been taken up by 30 companies by the following month[107]. The UK Government has announced that it plans to make XBRL obligatory by 2011[108]. Two years ago, the first XBRL submission had already been made[109].

Governments and their financial authorities are likely to push for XBRL's adoption due to the potential benefits in terms of productivity and efficiency. For example, the technology could enable greater automation in all areas of tax including payroll taxes, corporate income tax, value added tax and customs duties. XBRL should enable greater transparency. The US SEC directly attributed its discovery of billions of dollars-worth of backdated share options to the conversion of existing submissions into machine readable files[110].

The format provides benefits for companies required to file in XBRL and for consumers. XBRL may lower companies' costs but the bigger benefit may come from creating a more accessible pool of financial data that can be analyzed using standard business intelligence techniques. This should reduce error, minimize tax claims and could allow value to be created through tax. Companies may even be able to present results in multiple standards[111].

For investors, the major benefit of having machine readable accounts would be quicker analysis. An investor evaluating mutual funds would be able to compare a fund's strategies, costs, risks and returns at the click of a button. Today, the investor would probably have to pore through each fund's individual reports.

Bottom line
Governments considering or planning to implement XBRL reporting should consider the changes this might imply in terms of their standard processes. For example, as XBRL may enable statutory accounts and tax returns to be submitted in the same format, the filing of statutory accounts and the corporation tax return, currently two discrete processes in some countries, may well converge.

Governments should also ask what data they really need to be submitted via XBRL: asking for everything currently provided in paper format as well as anything else that may additionally be required may result in the collection of some superfluous data sets. Governments should therefore consider starting with a thin set of requirements and add more later, if necessary.

The provision of data in XBRL should change the way that revenue authorities are able to analyze and review information. Governments should ensure they have the right skill sets, or adequate training plans, to enable staff to be able to exploit XBRL's functionality.

There are multiple implications of the move to XBRL for companies. Companies likely to be required to file in XBRL should make preparations as soon as possible, ensuring that all affected by the change, from the board down, are aware of some of the implications. The change should not be regarded as merely the addition of new software.

Firms should also consider whether XBRL reporting requirements go beyond the set of financial data currently collected.

XBRL may enable – and hasten – changes in invoicing of clients. Firms may become responsible for the classification and coding of items included in electronic invoices that then deliver tax data directly into a company's reporting system. This could enable a significant proportion of tax compliance to be completed at source, with minimal input from the customer.

The provision of data in XBRL should change the way that revenue authorities are able to analyze and review information.

A digital divide for the digerati

Mention the digital divide and most people would think of the growing gulf between the technology 'haves' and 'have nots' in terms of access to personal computers, broadband connections or mobile phones.

However, the digital divide that afflicts users of technology may become deeper than ever in 2008. This division affects people who own or need access to digital data, but are unable to access it. This divide is particularly frustrating as one of the fundamental benefits of digitization is the conversion of data into zeros and ones. But not all zeros and ones, it would seem, are equal.

Digital storage has undergone massive evolution over the last few decades. The floppy disk, the cassette tape and the zip drive have all come and gone. Yet their legacy remains, as reams of data, safely stored, but often largely inaccessible[112]. Data stored on 5.25-inch floppy disks is practically unreadable on today's PCs[113]. Access to an external floppy drive may not help, as the appropriate driver may be almost impossible to locate[114]. A further legacy issue relates to operating systems and computing platforms. The list of hardware already consigned to the scrapheap by the computer industry is long, from the original PC to the Commodore 64[115]. Reading data created on any of these systems requires the original hardware; unfortunately many people discarded this long ago[116].

However this digital divide is most vexing when the existence of multiple standards for a particular type of file limits the utility of current computing systems. The medical world provides a case in point.

X-ray images are now commonly captured, stored and distributed digitally. In theory this should accelerate analysis and improve the overall quality of care. However, while there is a standard file-format used in medical imaging, some vendors have variants on that single standard, and viewing software has not been standardized at all. This means that when a patient, seeking a second opinion, brings along a set of CDs containing the digitized x-rays of the area to be examined, a specialist may squander half an hour trying to work out how to see the images[117 118]. Some medical institutions find themselves struggling with many terabytes of data in several hundred different formats[119].

Digital data incompatibility is an issue that transcends almost all industries and sectors. Its impact is expected to grow along with growth in the volume of data. Two years ago, over 160 million terabytes of new digital data were created[120]. In two years, global data output is forecast to reach one zettabyte[121].

Yet despite this proliferation, access to data is continually hampered by incompatible standards. There are competing standards for high-definition DVD and digital music as well as programming languages.

Across the TMT industry, there has always been a tension between the desire of companies to own proprietary solutions, and the desire of individuals and corporations for established and robust standards.

In the realm of data storage, this tension is likely to become increasingly apparent during 2008, and dealing with it in a manner that satisfies the needs of both groups is likely to become a substantial challenge.

Bottom line
Analog storage media, from printed x-rays to paper patient records have a common reader: the human eye.

Digital storage cannot hope to replicate such ease of access, but it should strive to come as close as possible. This means that the technology sector may have to take a more pragmatic approach to establishing, agreeing and maintaining long-term data storage formats. This has been achieved in certain areas: the PDF format for documents can be read by just about every computer, including high-end mobile phones. While the owner of a de facto standard is likely to gain economically, other players may also want to balance not owning the standard against the benefit of having similar standards for everything, from address book entries, to emails and their attachments.

For corporate customers, the need for standard formats is becoming more urgent. Companies are being required to provide increasing volumes of historical data upon demand[122]. As a result, companies may be obliged to transfer years-worth of data into contemporary data formats and media that are expected to have a long lifespan.

Longevity should be measured in terms of the durability of the standard and also in the rate of physical decay. Although CDs and DVDs are widely used and have demonstrated excellent performance so far, it is more or less inevitable that they too will one day degrade or become obsolete[123].

Companies should consider outsourcing this task to specialist storage firms, which can manage the process of transition to current formats and take on the responsibility of periodic upgrading and transfer.

For consumers, advice on the lifetime of data formats is likely to be helpful, particularly as the typical consumer is expected to have over one terabyte of digital data by 2010[124]. However these data may be scattered across a wide range of devices and underlying formats, from movies stored on DVRs to contact details on a mobile phone's SIM card.

The consumer market may prove a boon for specialist digital storage companies, as the volume and value of personal data grows in line with the use of digital cameras, email, productivity tools and other applications. Indeed, the data backup and management service business may become as lucrative for the consumer segment as it has been in the enterprise market.

The challenges and opportunities of water scarcity

The human race seems to have a peculiar talent for making once abundant resources scarce. This is especially the case with water.

In 2008, it is estimated that more than one billion people will lack access to clean water. More than double that number lack access to sanitation[125]. The balance between supply and demand for water is likely to continue deteriorating in 2008.

Demand for water is expected to be driven by economic growth and population increases, trends which are common in emerging economies. India, for example, is home to 16 percent of the world's population but just 5 percent of its fresh water. India's demand for water is expected to exceed supply by 2020[126].

Climate change is exacerbating scarcity, causing a fall in fresh water reserves due to changing rainfall patterns[127] as well as shrinking glaciers[128].

Water shortages are worsening faster than had been expected just a few years ago. Scientists had forecast in 2000 that one in three of the world's population would face shortages by 2025. But that point had already been reached in 2006[129].

The long-term outlook for water supply is ominous. The World Bank's forecast for the Middle East and North Africa suggests a 50 percent fall in per capita supply by 2050[130]. Some major cities, such as Houston in the United States and Sydney in Australia, already consume more water than they replenish[131]. The World Wildlife Federation has forecast that in the Himalayas, the retreat of glaciers could reduce water flows in the summer months by up to two-thirds. In the Ganges area, this would cause a water shortage for 500 million people[132].

For consumers, in 2008 active water management may become as important as other environmental measures, such as carbon footprint reduction. Some major companies have already been lobbied because of their purportedly wasteful water policies[133]. As consumer awareness grows, pressure on corporations is also likely to grow.

Acute demand for water can provoke desperate responses. In recent years, water scarcity has already prompted several uprisings and even wars[134].

The lack of the most important form of liquid in the world is therefore a fundamental issue, and one that the technology sector can play a major role in addressing, in 2008 and beyond.

The potential value in the opportunity appears to be as significant as the problem. The investment shortfall for the global water industry may be more than $1 trillion over the next 20 years[135]. China plans to spend $125 billion on water projects in urban areas alone[136]. And while a few companies and funds have already started investing in water technology[137], there is likely to be room for plenty more.

Bottom line
In 2008, technology companies should look at how their products and solutions can add to existing supply, as well as reduce current usage. While this should make good business sense, it is also of profound social importance. Four children in the world die every minute from illnesses caused by lack of drinking water[138].

One way to increase supply is desalination, a process that converts vast supplies of salt water, mostly found in the sea, into drinkable water. There are two approaches to desalination: reverse osmosis and thermal desalination. However both are energy intensive. The former involves passing sea water through a filter at high pressure, which requires significant effort[139]. Thermal desalination is a relatively simple approach, involving heating water until it evaporates, to remove the salt.

Use of desalination, which already provides much of the drinking water in a number of countries, is likely to grow in 2008. Currently the world's total desalination capacity provides less than 1 percent of total freshwater needs[140]. Some countries already obtain the majority of their water through this process[141]. In 2008 new desalination plants are expected to be commissioned or completed around the world, including areas from China's coastal cities to Algeria[142].

While desalination addresses one problem, it creates another: its immense thirst for power. The process can require up to 10 megawatts of power to produce 100,000 liters of drinkable water[143], making desalinated water up to 10 times more expensive than harvested rain-water[144]. While this expense may be tolerated in the world's richer nations, it is of limited practical use in the developing world. As a result, more efficient desalination technologies and less expensive power sources will be required, and the technology industry could supply both[145 146].

Technology could also be used to improve management of the existing supply in myriad ways. One of the biggest challenges – and opportunities – is reducing water leakage. In the United Kingdom this has been estimated to be 4.5 billion liters per day, equivalent to a bathful for every one of the country's 60 million people[147]. Detecting and remedying such wastage could be one of the most effective ways of managing scarce supply.

Another powerful application of technology could be to model the impact of subsidies for industries such as farming, or the draining of wetlands[148]. Technology could also be part of the solution in developing less wasteful approaches to hydrating crops. Some scientists have argued that the amount of water required to grow food could be halved[149]. Technology can also be deployed in developing and growing plants that can serve as alternatives to fossil-based fuels, yet which consume little water[150].

Possibly the most important issue is the business model. In many respects, technology has reached a point where adequate supplies of safe drinking water can be generated, but not at a practical cost. Finding ways of making water supply affordable will likely be the biggest challenge of all.

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*All currency conversions correct on 5 December 2007 at 12.00 (**www.xe.com**).

Glossary of technical terms

BIOS	Basic Input-Output System
CD	Compact Disc
CFL	Compact Fluorescent (bulbs)
DVD	Digital Versatile Disc
DVR	Digital Video Recorder
GAAP	Generally Accepted Accounting Principles
HTML	Hypertext Markup Language
IP	Internet Protocol
ISP	Internet Service Provider
IT	Information Technology
LED	Light Emitting Diode
MIPS	Million Instructions Per Second
PDA	Personal Digital Assistant
RAM	Random Access Memory
RFID	Radio Frequency Identification
SIM	Subscriber Identity Module
URL	Uniform Resource Locator
VAT	Value Added Tax
XML	Extensible Markup Language

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