

Business innovation
and IT trends
If you just follow,
you will never lead



Executive summary

Many emerging technologies promise a transformational and disruptive effect on the business. To provide more insight in the actual use of technology trends, Deloitte and CIO Magazine organized a national technology trends survey. This report summarizes the results and presents our point of view on technology trends and innovation.

Key findings

1. The survey underpins the **three main areas of business-IT innovation: Mobile, Cloud and Data**. As the adoption rates of individual trends show companies are, however, still working on getting the basics right.
2. Mobile computing has revolutionised information technology and has introduced us to the post pc era. In just a few years smartphones and tablets have found widespread use in businesses. Companies are still working on integrating mobile devices in their IT landscape. The top-3 mobile trends in this respect are 'Bring Your Own Device', 'Mobile device management' and 'Mobile/back-end integration'. **Most companies have only just started to leverage the potential of mobile technology to mobilise business processes.**
3. Cloud is the megatrend with the highest impact on the application ecosystem and most companies are transitioning to a mix of on-premise and cloud solutions. Already 45% of all companies have an operational SaaS solution in place and another 22% is contemplating to implement SaaS. Nevertheless, only 14% have some form of cloud integration and therefore most SaaS solutions are stand alone. **We expect SaaS to become the de facto standard in multiple functional areas within 18 months. Fully integrated cloud applications is expected to become the norm.** Security and trust extend beyond the boundaries of the own organisation and require a new mindset.
4. Data is becoming companies' main strategic asset. Increasingly, **the competitive advantage will be in data-driven decision making. However, so far only 17% of the organisations actually use advanced analytics.**
5. CIOs are confronted with a plethora of new technologies and a seemingly chaotic supply of trends. The survey supports our view that individual trends can and should be categorized in five themes or megatrends:
 - Hyper connection (mobile)
 - Hybrid application eco systems (cloud)
 - From data to insight (data)
 - User experience
 - Industrialisation of the data centre
6. Adoption of trends in the user experience theme, like 'location aware services', 'augmented reality' and 'gamification', is lower than we expected. However, innovation will come from solutions that combine the power of new form factors and rich context information.
7. One remarkable result of the survey is how the CIOs assess the business impact of new technologies. They regard these trends as an improvement (57%) rather than being transformational (5%). This raises the question 'how transformational are technology trends anyway?' We all know silver bullets to be illusory, but many emerging technology trends nevertheless have the potential of a transformational and disruptive effect on the business. **A successful CIO combines technical expertise with imaginative power to spot the strategic use of IT and to lead this to its full potential.**
8. In the view of Deloitte, radical innovation is rarely realised by a single new technology; instead, it requires a smart combination of multiple trends and technologies. **A true Chief Innovation Officer should develop an innovation strategy per theme and even across themes.**
9. New technologies raise new issues for the CIO. We asked CIOs to describe their biggest technology trend challenges/dilemmas. **Security and compliance stands out as the absolute winner.** It was mentioned twice as much as the runner up on the list: integration of new technologies in the existing (legacy) landscape.

Background: Innovation and the CIO agenda

Information technology is evolving rapidly and CIOs are confronted with large numbers of new technologies and trends. A quick survey of ten random Gartner hype cycles results in a total of 522 trends, 379 of which are distinct (after de-duplication). Since the Gartner hype cycle master list contains 103 different hype cycles, the total number of trends far exceeds 1,000. Clearly, such abundance of trends makes it very difficult for CIOs to maintain a helicopter view – distinguishing the real promising trends and to thoroughly comprehend them. Nevertheless, they provide plenty of opportunity for innovation.

Information technology is more than just new technologies and trends. There, too, is a large core of technologies that have reached maturity after decades of development. Together they form the domain of information technology that has become a *sine qua non* for companies. Indispensable for critical business processes but no longer distinctive. The device here is *operational effectiveness*: executing similar activities in a superior way compared to competitors. The domain's two catchwords in this are process streamlining and complexity reduction in technology landscapes. The pursuit of operational effectiveness is continuous, because the best practice is constantly being improved.

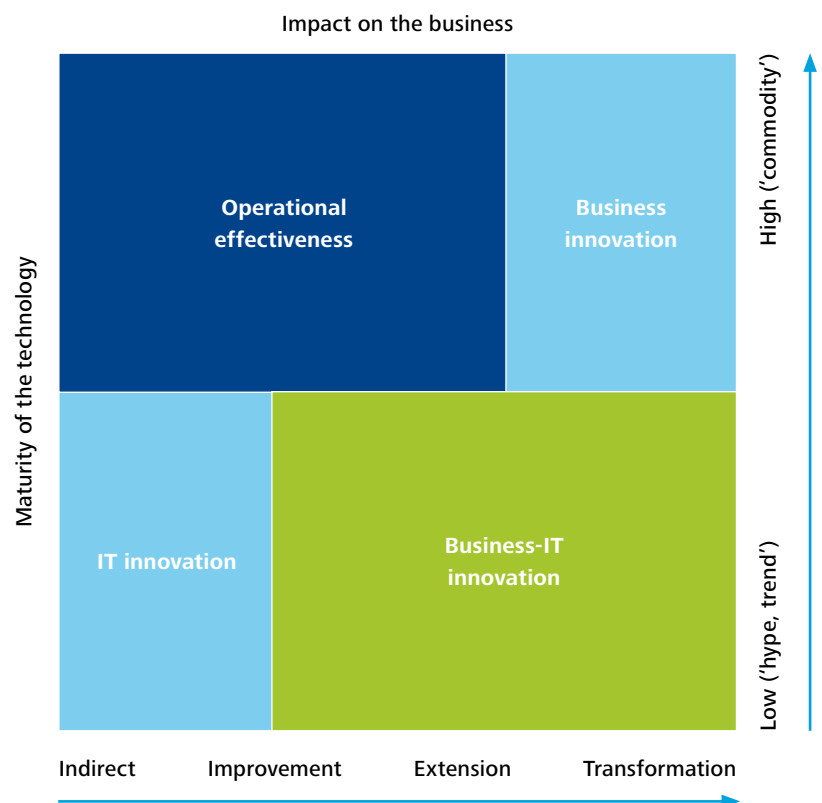
In contrast to operational effectiveness, *innovation* aims at distinctive activities. It creates a unique strategic position for organisations vis-à-vis their competitors. According to Michael Porter, operational effectiveness and innovation are the two elements that determine success. Both are necessary but they work in different ways. Operational effectiveness is the driver for profitability in the short term, whereas innovation drives sustainability of the company's position.

In our view, the CIOs' have four different domains on their agenda, each with its own principles and rules of play. Successful CIOs follow a differentiated strategy to cover each of the four domains. Besides operational effectiveness, we distinguish three types of innovation:

- **Pure IT innovation** applies new technologies in a way that does not impact the business directly. This type of innovation increases the efficiency of IT assets and fits in the adage 'do more with less'. Most of these innovations, like server and storage virtualisation, are located in the data centre. The role of CIOs is to make the right investments in the right time.

“Operational effectiveness and innovation are the two elements that determine success. Both are necessary but they work in different ways.”

- **Pure business innovation** uses existing information technology as enabler for an innovative business concept. These innovations require information technology, but not as a driver for the innovation. Even though CIOs will not lead pure business innovations, their expertise can be of great value if they enjoy their companies' trust.
- **Business-IT innovations** realise a leap in business as well as in technology. It uses new technologies in smart ways to reach a distinctive business position. The classic example of the previous decade is the use of web technology as a new channel to customers, or as the basis for new products.



Cohesion and connection between technology trends

The plethora of new technologies and trends means individual companies will never be able to explore each and every one of them. Choices have to be made. But how to do this, if confronted with a seemingly chaotic supply of trends? Deloitte feels all trends are part of larger themes or megatrends and individual trends can only properly be understood in that context. Our advice to CIOs is to develop a strategy per theme instead of

a strategy for some individual trends. Such approach would make the innovation agenda more consistent. Deloitte distinguishes five themes. They each have examples of impactful trends, as shown in the figure below. The colours correspond to the maturity phases according Gartner: dark blue for 'mature mainstream', light blue for 'early mainstream', light green for 'adolescent' and dark green for 'emerging'.

Hyper connection

- Being connected is the norm for all information processing equipment
- Any time, any place, any device is the new paradigm
- Information technology blends with consumer electronics and other technologies
- Hyper connectivity redefines interaction between people, organisations and objects

mature mainstream	3G	Mobile devices	Unified communication			
early mainstream	Enterprise apps and app stores	Mobile device management	Video telepresence	Mobile / back-end integration	Bring Your Own Device	Cloud data synchronisation
adolescent	Online channel optimisation	Consumerisation	Radio frequency identification	Social media engagement	Mass collaboration/ crowdsourcing	
emerging	4G, LTE	Near field communication	The Internet of things	'Social' consumer electronics		

Hybrid application ecosystems

- Mature standard software solutions provide much more functionality than needed and reach the level of 'good is good enough'
- The application ecosystem blends cloud solutions, on-premise packaged applications and custom made business services
- Security and trust are extended beyond the enterprise

mature mainstream	Service oriented architecture	Web oriented architecture				
early mainstream	Business process management	Software as a Service (SaaS)	Composite applications	Mobile app developm. platforms		
adolescent	Cloud/On-premise integration	Federated identity	Business rule management	Complex event processing		
emerging	Cloud security standards	Cloud enterprise systems	Platform as a Service (PaaS)	Community clouds	Public web API	Hybrid cloud computing

From data to insight

- After commoditisation of hardware and software, data is the main strategic asset of enterprises
- Rich data is the norm: text, audio, video and sensor data
- An exponential increase in data volumes and the computing power to process it
- The competitive advantage will be in data-based decision making

mature mainstream	Enterprise content management	Master data management	Business intelligence/ Dashboards	Data mining			
early mainstream	Advanced analytics on enterprise data	Advanced data visualisation	In-memory analytics	Predictive analytics	Business activity monitoring	Real time analytics	Column-store DBMS
adolescent	Social analytics	Semantic Web (RDF, OWL)	Text analytics	Open data			
emerging	Audio / video analytics	Enterprise metadata management	Collaborative decision making	Big data			

User experience

- New form factors redefine the way people interact with information systems
- End users expect to enjoy simple, elegant and innovative products
- Man-machine interfaces reach the maturity level of transparency. Technology blends into daily life, users are only conscious of it when it is not available

mature mainstream	Smartphones	Rich internet applications	Media tablets				
early mainstream	HTML5	Location aware services	Multi touch displays				
adolescent	Speech recognition	Augmented reality	Electronic paper	Gesture control			
emerging	Context enriched services	3D printing / scanners	Virtual assistants	Gamification	Natural language interaction	Wearable computers	Automatic content recognition

Industrialisation of the data centre

- The data centre becomes a high-tech industrialised environment
- Location of data centres becomes a strategic choice, based on availability of power, cooling and access to internet
- Increasingly, data centre capacity is concentrated in large scale multi-tenant data centres to benefit from economies of scale

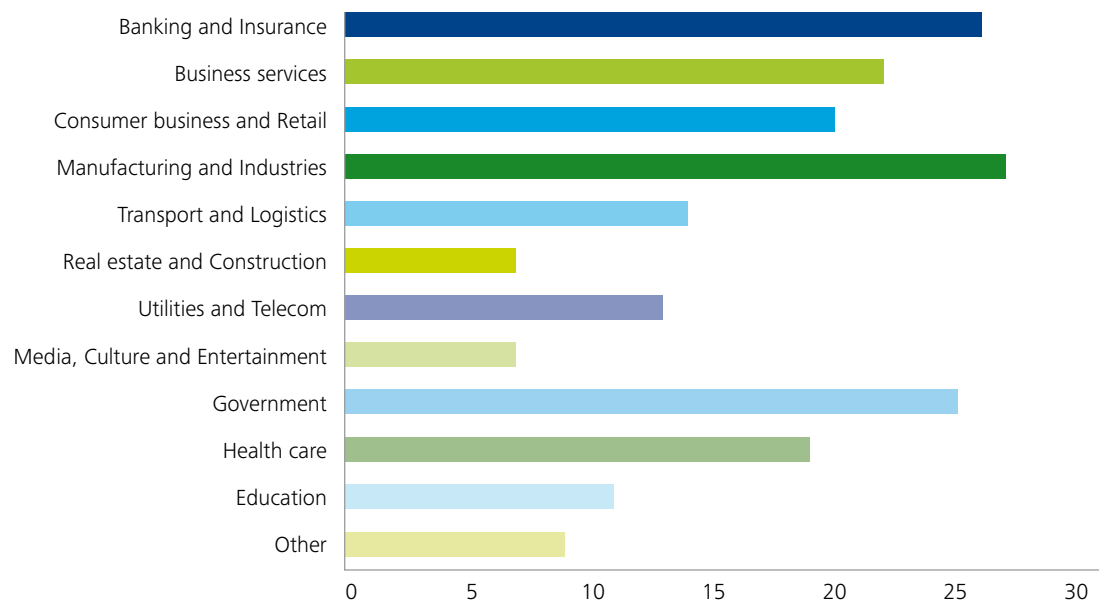
mature mainstream	Multi-core processors	Blade servers	Storage area networks						
early mainstream	Economization & Green IT	Server virtualisation	Storage virtualisation						
adolescent	Infrastructure as a Service (IaaS)	Virtual desktop	Private cloud	Provisioning automation	Skinless server	In-memory storage	High density (>100 kW) racks	Appliances	Extreme low energy servers
emerging	Cloud-based grid computing	Fabric-based computing	Data centre infra. management	'Open source' data centre design					

About the survey

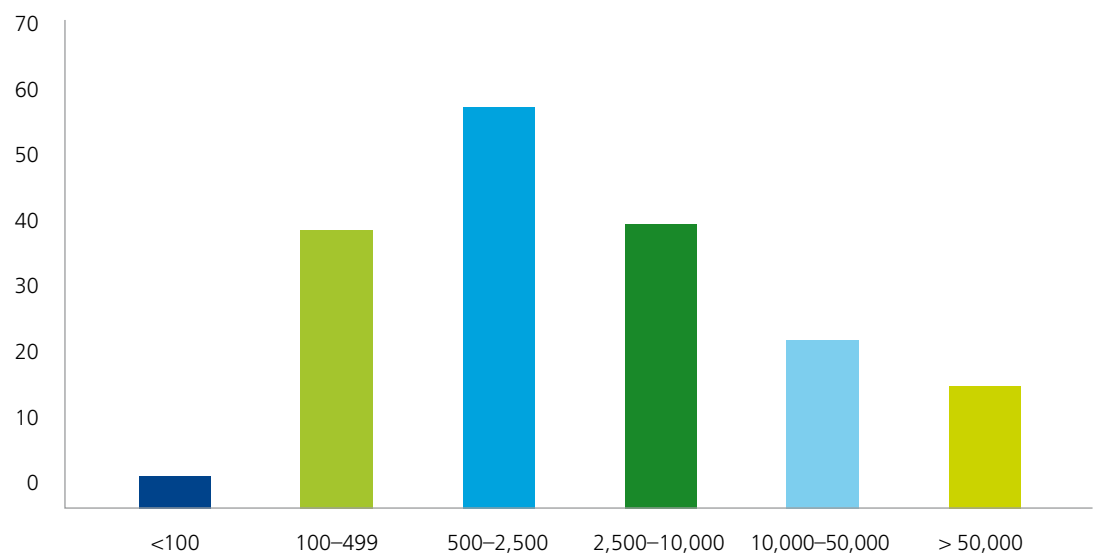
To provide more insight in the use of technology trends, Deloitte and CIO Magazine organized a national technology trends survey in October 2012. A total of 210 Dutch CIOs and IT managers participated in the online survey.

The survey focused on technology trends with high impact on the business, i.e. the first four themes shown on page 6 and 7. Furthermore, the survey only included trends with a maturity stage of 'early mainstream', 'adolescent' or 'emerging'. This resulted in a total of fifty-six technology trends in the survey.

A total of 210 Dutch CIOs and IT managers participated in the online survey. The distribution of respondents over industries is shown in the figure below.



The respondents' number of employees shows a balanced distribution over the categories.



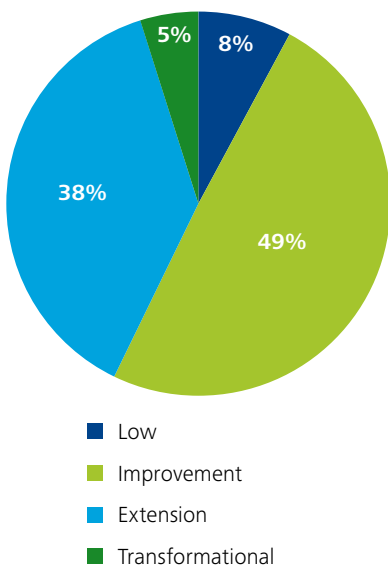
General results

Business value characterised as 'improvement' rather than 'transformational'

Many emerging technology trends promise a transformational and disruptive effect on the business. We all know silver bullets to be illusory, but the question still is 'how transformational are technology trends anyway?' The survey asked CIOs to rate the potential business value of each trend on the following scale:

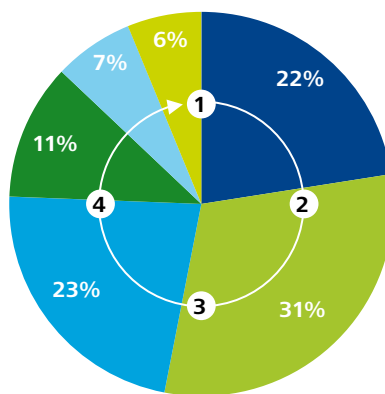
- **Low:** no or little effect on the business.
- **Improvement:** business processes do not change significantly but can be executed faster, cheaper and with less effort.
- **Extension:** the business is extended with new products/services, new customer groups or new channels to customers. The business model itself, though, does not change.
- **Transformation:** the business model changes.

When preparing the survey, we limited our choice to those trends rated by Gartner as 'transformational' or 'high' in terms of 'benefit rating'. Still, the aggregated results of all 57 trends in the survey show 57% of the data points to characterise the business value as 'low' or 'improvement'. Only 5% of the data points characterised business value as 'transformational'. Clearly, disruptive effects of technology trends are quite scarce. While one explanation considers technology trends to not be tremendously transformational after all, another explanation attributes transformational potential to trends but feels uncovering them is not obvious. We will address this question in the conclusions at the end of this report.



A long way from research to full business value

On average, companies reported active involvement in ten technology trends. For each technology trend a company is actively involved in, the survey inquired about the adoption phase. In general, 53% of all data points corresponded to a pre-operational phase (researching, experimenting) and 47% to an operational phase (with different levels of value realisation). Of all data points in the operational categories, 48% is in the first category that corresponds to less than 25% of potential business value realisation. Apparently, realising business value takes time after the technology trend has become operational.



- Researching/Investigating
- Experimenting/Piloting
- Operational, <25% business value
- Operational, <50% business value
- Operational, <75% business value
- Operational, full business value

Another way to look at these adoption phases is to relate them to the different roles of CIOs in the innovation process:

1. At the start of the innovation process, CIOs play the role of trend watchers to distinguish real promising trends from hypes.
2. In a next phase, CIOs are involved in defining a business case and convincing management.
3. After funding has been arranged, the next hurdle is to incorporate the new technology in the existing IT landscape. This represents the engineering phase, where CIOs play the role of architects.
4. When the new technology becomes operational, only a small part of potential business value is reached at that moment. The challenge for business executives and CIOs is to join efforts and establish the full business benefits.

Security is the biggest challenge

We asked CIOs to describe their biggest technology trend challenges/dilemmas. The question was formulated as a free-text, open question to avoid pointing the CIOs in a certain direction. Analyses of the

answers revealed eight well-defined categories, shown in the figure below. 'Security and compliance' stands out as the absolute winner. It was mentioned twice as much as the runner up on the list: integration of new technologies in the existing (legacy) landscape.



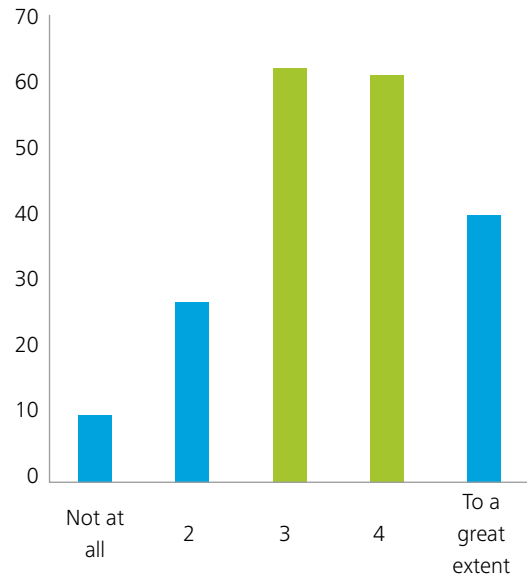
The high score for security and compliance is easily explained by the most popular trends: mobile and cloud. Both have the inevitable consequence of company data becoming available beyond the company network. The security dilemma is more complex than the mere question as to whether the appropriate

security measures are in place. The survey showed the real dilemma to be the choice between open and free versus closed and controlled or—in other words—between security and privacy versus transparency and user experience.



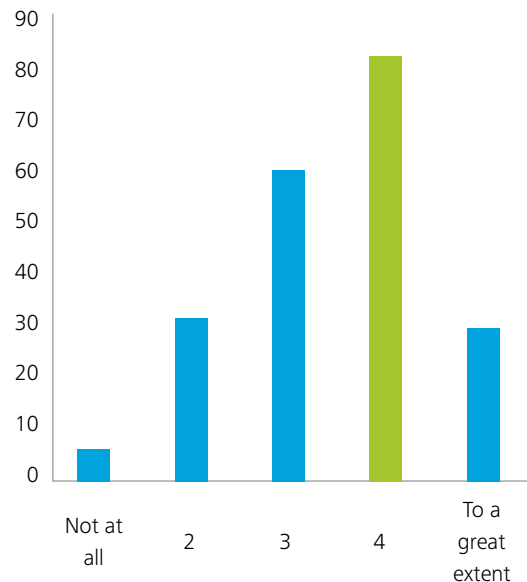
Innovation with trends is on the agenda, but not at the top of it

When asked to rate the statement 'innovation with technology trends is high on my agenda' on a scale from 1 to 5, most CIOs choose 3 or 4. When we relate this result to the four domains of the CIOs' agendas as illustrated in figure 1, we find evidence that most CIOs are still working on achieving operational excellence in the upper left quadrant. Innovation is certainly on the agenda, but the top position on that agenda is for other topics.



The CIOs play an important role in initiating innovations

Although the adage is that the business should be in the lead, the survey shows CIOs to still play an important role in initiating technology enabled innovations, although they do not have the monopoly. On a scale from 1 to 5, most CIOs answer the question 'IT enables most technology enabled innovations' with a 4. Our conclusion is that initiation of technology enabled innovations requires different types of expertise, both from CIOs and from business executives. It depends on the nature of the trend whether the balance tilts to CIOs or to the business.



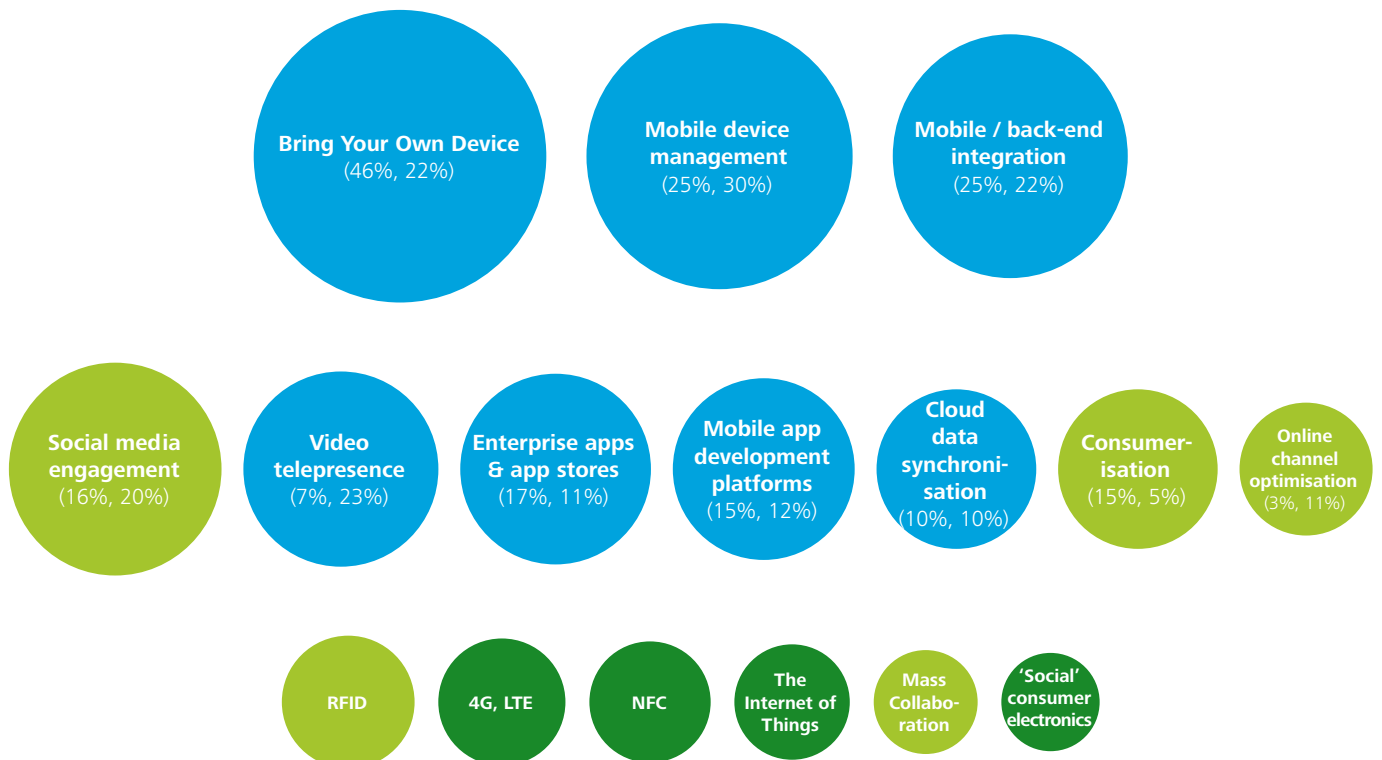
Results for 'Hyper connection'

Background

About a decade ago, mobile devices and wireless networks brought a revolution to information technology. Whereas applications had always been bound to the desk top, they now became mobile in an 'any time, any place' type of way. In only a couple of years 'being connected' became the norm. Various sensors like camera, GPS, and gyroscope enabled innovative services on mobile devices. The instant-on, always-connected nature of smartphones and tablets redefined interaction between people, organisations and objects. The availability of low cost communication technology made it possible to integrate it in all kinds of consumer electronics. As a result, we have witnessed the first phase of information technology and consumer electronics blending completely. We summarise the future of all this in the term 'hyper connection'.

Survey results

The ideal of hyper connection has not yet been reached, as the survey reveals. Most companies are still working on the basics. The figure shows the trends in this theme. The size of each circle corresponds to the percentage of companies is actively involved in this trend. The colour corresponds to the maturity phase according Gartner: light blue for 'early mainstream', light green for 'adolescent' and dark green for 'emerging'. Each trend has two percentages. The first percentage corresponds to the number of companies researching this trend or experimenting with it. The second percentage corresponds to the number of companies using the technology operationally.



The top three: getting the basics right

Our 2011 technology trends survey showed 'smartphones and tablets' to be the number one trend in that year. Only one year later, most companies already use these devices. The top three mobile trends of 2012 show most companies are still working on getting the basics right.

The number one trend of the survey is **Bring Your Own Device (BYOD)**, a strategy that allows users to select and purchase their own mobile devices from which they can use enterprise applications and data. A major driver for BYOD is **Consumerisation**; the trend of innovations starting in consumer technology and companies taking advantage of these innovations by embracing them for enterprise use. The increasing use of cloud solutions that only require an Internet connection makes a BYOD strategy even more feasible. Most companies introduce BYOD to achieve higher employee satisfaction and higher productivity. That said, realisation of BYOD is not easy and requires adoption of other new technologies, like multiplatform mobile application development and HTML5. Security and compliance is the greatest challenge: how do you control data security on unmanaged devices. The survey shows 22.5% of all companies to use BYOD operationally and 46.5% are examining it.

Remarkably, the survey shows BYOD to score highest on adoption rate among all trends but lowest on transformational impact on the business model. Apparently, BYOD is something most companies regard as part of 'getting the basics right'.

A typical consequence of the introduction of mobile devices is **Mobile device management**: the use of software tools to manage policies and configuration management for mobile devices across multiple OS platforms. Its goal is to manage security, privacy and compliance in a heterogeneous mobile environment. This is also one of the trends necessary for 'getting the basics right'. The survey shows that 30.5% of the companies have mobile device management in place and 25.5% are experimenting with it. In our view, mobile device management will become a self-evident part of the IT-basics for most companies.

Another consequence of mobile devices is **Mobile/back-end integration**: full integration of mobile apps with back-office applications (ERP, CRM), including appropriate security measures. According to the survey, 22% of all companies have mobile/back-end integration in operational use and 25.5% are examining it. Since the adoption rate of enterprise specific apps is significantly lower (11.5%), the majority of mobile integration must be realised with off the shelf mobile apps.

Trends with adoption rates between 40% and 25%

Social media engagement is the active use of social media (i.e. beyond monitoring) to engage with (potential) customers. A typical example is the web care team of an airline using Facebook and Twitter to respond to customer questions and problems. Successful adoption of this trend requires much more than a mere active response to social media platforms. It requires a culture that is able to react vigorously and swiftly and it requires the organisation to simultaneously be active in social marketing, sales and services. Furthermore, since people use social media 24 hours a day, social media teams need to make themselves available 24/7 too. The survey shows social media engagement to be operational at 20.5% of the companies, while another 16% of the companies are examining it. There are significant differences per industry: Education (50%) and Government (50%) versus Real estate (0%). Among all trends in this theme, social media engagement has one of the highest scores for transformational impact on the business model.

“Social media engagement requires a culture that is able to react vigorously and swiftly and an organisation that is simultaneously active in social marketing, sales and service.”

Video telepresence uses video communication to give the impression of being in another location. A popular type of use is for video conferencing involves life size images of participants. This requires expensive equipment to be installed in special video conferencing rooms, while at the other end of the spectrum innovative types of video telepresence use standard cameras and microphones in mobile devices. The survey shows 23.5% of all companies to have video telepresence in place and 7.5% are examining it.

Enterprise specific apps and app stores, either for internal use or as a channel to customers, are operational at 11.5% of the companies and 17% of the companies are experimenting with it. Given the popularity of mobile devices and apps, the adoption rate is low. We expect to see a similar pattern as in the adoption of the Internet as a new channel. It starts with a small number of companies experimenting with apps and app stores. Gradually, apps will become self-evident to the point where everyone expects an organisation to have an app store offering a wide variety of apps that provides automation for simple functional tasks. The real challenge in the use of apps is to take advantage of all possibilities of the mobile platform and the sensors with which they are equipped.

“We are heading to the point where everyone expects an organisation to have an app store offering a wide variety of apps that provides automation for simple functional tasks.”

Closely related are **Mobile app development platforms**; software tools to manage the entire life cycle of mobile apps (develop to deploy). Cross-platform support is one of the key features of MADP. The adoption rates of 12% (operational) and 15% (examining) are almost identical to the ones of enterprise apps and app stores.

The use of mobile apps and social media as new channels to customers immediately generates the need for **Online Channel Optimization** (or Omni Channel Optimization). This is an approach to optimize user experience across communication channels (e.g. website, email, social media and mobile apps). The essence is to actively use the context in which each individual interaction takes place and understand the individual's preferences and needs. The survey shows 11% of all companies to have Online Channel Optimization in place, while 3% are examining it. One noticeable survey result is that CIOs rank this trend highest on transformational business impact.

Trends with low adoption rates (<10%)

Radio Frequency Identification (RFID) uses tags on physical objects to collect data (identity, status and location) from these objects via wireless networks. RFID is generally used for tracking and tracing of physical objects. The technology has been available for some years, but operational use is limited to 3% on average, with 5.5% of all companies examining it. However, we see significant peaks in certain industries: transport & logistics (50%), manufacturing (14%), real estate and construction (14%) and health care (10%). In the latter, RFID is used for tagging mobile equipment like infusion pumps, which saves many hours of searching for not returned equipment. RFID can also be used to increase patient safety by tagging units of blood with the identification of the patient it is meant for. Special software that processes RFID signals can then detect blood bags in the operating room that do not match the patient (who is also identified with an RFID tag).

Near field communication (NFC) is short range, contactless communication (10 cm) between a mobile device and a compatible reader. It can be used to replace all kinds of member cards, tickets, and keys. The possibility of two-way communication makes it highly suitable for personalized narrow-casting and for mobile payments. The technology is rather new and many mobile devices still lack NFC functionality.

Only 1% of the companies reported operational use of NFC and 6% are examining it. However, this trend also shows some significant peaks in industries: media, culture and entertainment (60%), transport and logistics (21%), professional services (10%) and financial institutions (8%). Our prediction for NFC is that we will see a widespread use as soon as NFC chips become common in mobile devices.

4G and LTE is about the use of 4G mobile networks for high-speed, low-latency communications that are not possible on 3G networks. 3% of all companies reported operational use and another 4.5% are examining it. In the Netherlands, 4G networks are only available in pilots. As with earlier technologies that increased bandwidth, our behaviour will swiftly adapt and the demand for bandwidth will soon match the supply again.

“The impact of ‘Social consumer electronics’ on everyday life will be huge.”

Finally, two trends with maturity phase ‘emerging’ are **Social consumer electronics** (also known as Connected Products) and **The Internet of Things**. The former is about consumer electronics (varying from cars to household equipment) interacting with the user through websites and social software. Currently, 1% of all companies report operational use of this trend and 3.5% are examining it. Although the adoption rate of this trend is still low, we expect this trend to have a big impact on daily life in the future.

The Internet of things is a similar approach, in which large amounts of physical objects are equipped with low-cost communication technology and a unique IP address to communicate and interact with their environment. The combination of intelligent sensors with wireless communication creates networks of ‘smart objects’. The new IPv6 standard allows an almost infinite number of IP addresses to be defined. In the future, the vast majority of all IP addresses in the world will belong to objects instead of persons. The survey shows 4.5% of all companies to already have operational experience with this trend, while 2% are examining it. Two industries with above average adoption are utilities and telecom (18%) and government (14%).



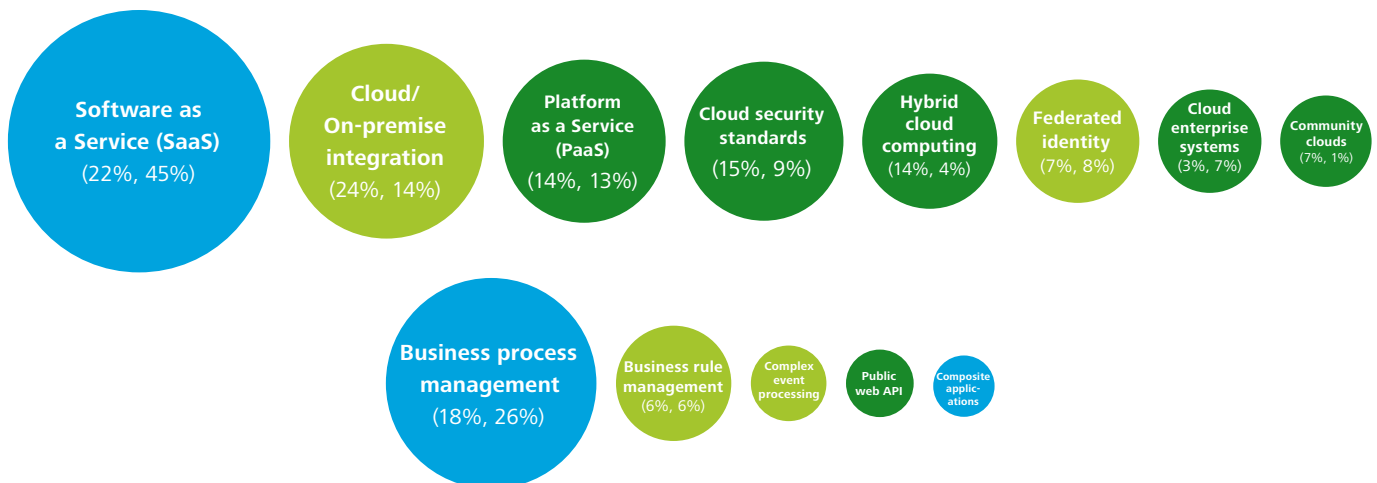
Results for ‘Hybrid application ecosystems’

Background

In the CIOs’ ideal world, the application landscape fits the needs of business processes entirely and is highly flexible and agile at the same time. Reality shows most CIOs to struggle with legacy systems that are far from ‘agile’. In the past decades new technologies, such as ERP and CRM systems in the nineties and web technology and service oriented architecture in the first decade of the new century, promised to bring the ideal closer. Although considerable steps have been made, CIOs are still pursuing this ideal.

Without a doubt, cloud technology is the trend with the highest impact on the application ecosystem. Most companies are transitioning from a full, on-premise application landscape to a mix of on-premise and cloud solutions. Integration between cloud solutions and on-premise applications, but also integration between cloud solutions mutually, brings new challenges for CIOs. Security and trust extend beyond the boundaries of the own organisation and require a new way of thinking.

Survey results



Cloud trends

The clear winner in this cluster is **Software as a Service (SaaS)**: application software provided as a web-application, used in a multi-tenant model and purchased on a pay-for-use basis. The survey shows 45.5% of the companies to have some form of SaaS operational and another 22% are examining it. By now, SaaS has entered mainstream technology. Our expectation for the next 18 months is that SaaS will become the de facto standard in functional areas like Office automation, CRM and HR, and will be adopted by virtually all organisations. Increasingly, companies will have the choice between a cloud solution that can be ready in days and an internal software implementation project that takes months. Many companies that have always taken those implementation projects for granted will now choose for SaaS solutions instead. The number of employees who only use cloud solutions (office automation and some enterprise applications) will increase significantly.

“Our expectation for the next 18 months is that SaaS will become the de facto standard in functional areas as Office automation, CRM and HR, and will be adopted by virtually all organisations.”

Although 45.5% of the companies use SaaS operationally, only 14% of the companies have **Cloud/on-premise integration** in place, for example for (master) data synchronisation and workflows spanning both SaaS and on-premise applications. This 14% implies that about three quarters of all operational SaaS solutions stand alone. Apparently, SaaS adoption typically starts with an application for which integration is not necessary. However, our expectation is that integration of cloud applications will become the norm instead of the exception. The percentage of companies examining or experimenting with cloud/on-premise integration (24%) supports this.

Another form of integration is cloud-cloud integration. We define **Hybrid cloud** as the use of multiple cloud solutions in an integrated and coordinated fashion, on aspects like data, process, compliance and security. The operational use of a hybrid cloud is in place at 4.5% of the companies and 14.5% are examining it.

Our conclusion is that most companies start with a stand-alone cloud solution. The next step is a cloud solution that is integrated with the on-premise landscape. Finally, as the number of cloud solutions increases, cloud-cloud integration complements the new hybrid application ecosystem. When we compare the number of companies examining cloud integration with the number that already have cloud integration in operational use, we see the first percentage is about twice as big as the second. This shows cloud integration to be an important theme on the CIOs' agendas for the next year. Not surprisingly, CIOs mention security as the most important challenge related to innovation with new technologies.

“Fully integrated cloud applications will become the norm instead of the exception.”

A different kind of cloud technology is **Platform as a Service** (PaaS). This is a set of application infrastructure and middleware in a cloud environment that enables users to develop applications and services. An advantage of PaaS is that new development environments can be made available within the hour, which might otherwise take weeks or months if this is arranged on-premise. Various PaaS providers are available on the market and they each have their own technology stack, which creates a vendor lock-in. Already 13% of all companies report using PaaS operationally and 14% are examining it.

Cloud security

The use of cloud solutions creates new security questions. The trend **Cloud security standards** aims at a standardized set of security requirements and a formal evaluation by a third party to assess the security and continuity risk of cloud services. This eliminates bilateral discussion and agreements between cloud provider and user. Such standards are complementary to ISAE3402 reports and address aspects specific to cloud solutions. According to the survey 9% of all companies use such standards in some form already and another 15.5% are examining it. As the share of cloud solutions in the application landscape increases, cloud security will become an even bigger concern for CIOs than today (where security and compliance is already the biggest challenge).

Seamless integration of SaaS solutions in the on-premise application landscape encompasses the aspect of authentication. **Federated identity** is an approach to use identities across autonomous security domains. Usually by one security domain “trusting” identities belonging to another domain. This allows users to access systems in another security domain seamlessly, without redundant user administration. The survey shows 8.5% of the companies to use this trend operationally and 7% are examining it.

Specific cloud solutions

A **Community cloud** is a cloud computing environment for a specific group of organisations (e.g. governmental or educational). This brings the benefits of cloud computing to the group and limits complexity, because group members have similar requirements for issues such as security, compliance and availability. Of the entire population, 1.5% of companies use a community cloud and 7% are researching it. However, some industries show an adoption rate (examining as well as operational) that significantly exceeds the 8.5% average: education (64%), professional services (23%) and health care (16%).

The most popular cloud solutions have well delimited functionality and limited integration with other applications. **Cloud enterprise systems** is the trend to use SaaS solutions for enterprise systems such as ERP. This is currently only feasible for smaller companies for which an out-of-the-box solution suits the needs. The survey shows 7% of all companies to use a cloud enterprise system and 3.5% are examining it. Due to the multi-tenant character of SaaS solutions and the limited options for customisation follow from this, we expect adoption of cloud enterprise systems to increase slowly.

Architectural trends for flexibility and agility

The search for flexibility and agility has given rise to new architectural concepts and technologies. Cloud computing is one of them, but not the only one. In 2005, Service Oriented Architecture (SOA) emerged as a trend. Seven years later, SOA has been accepted as mainstream although companies are still struggling to realise the potential benefits. Today, companies combine SOA with other architectural trends to fully unleash the potential.

One of the older trends is **Business Process Management (BPM)**: software tools for designing, orchestrating and monitoring business processes among applications and users. The increasing use of SaaS solutions adds a whole new dimension to BPM. The survey shows 26% of all companies to use BPM operationally and 18% of all companies are still examining it. In our view, the use of BPM suites is extended to a wider range of integration issues. An example we mentioned earlier is cloud/on-premise integration. Another example regards the trend where companies opt for an ERP backbone implemented as standard as possible, complemented by custom made services for that is highly company specific or changes frequently.

The discipline of software development has a history of isolating specific types of logic into standardised components. **Business rule management** is one of the latest examples. This approach defines, maintains and executes business rules in a separate system (BRMS), which is called by business applications. This approach enables the consistent use of business rules over all applications and increases the company's agility to modify business rules. BRM is actively being used by 6.5% of the companies and being examined by another 6.5%. Compared with the total of 13%, the survey shows significant peaks for government (32%), utilities and telecommunications (30%) and financial institutions (23%). This supports the premise of BRM providing most value in business environments with complex and frequently changing regulations.

Another example of an approach to isolate logic from custom made systems into standard components is **Complex event processing (CEP)**. The essence of this approach is to combine data about events into higher level 'complex events' that trigger real-time actions and decisions. The trend is part of the broader trend of event-based architecture. The survey shows 2% of all companies to use CEP in an operational form, while 3.5% are examining it.

Finally, **Composite applications** is an approach to develop an application as an orchestration of already existing solutions (web services, programs, data), creating functionality which the leveraged solutions fail to deliver on their own. Such applications can leverage a **Public Web API**: web-oriented API's to expose application functionality or data to the world. Companies use Public Web API's to be easily incorporated in third party websites or mobile apps. Composite applications and Public Web API's are a niche technology: operational use is limited to 1% and 2.5% respectively, and about the same number of companies are examining them.

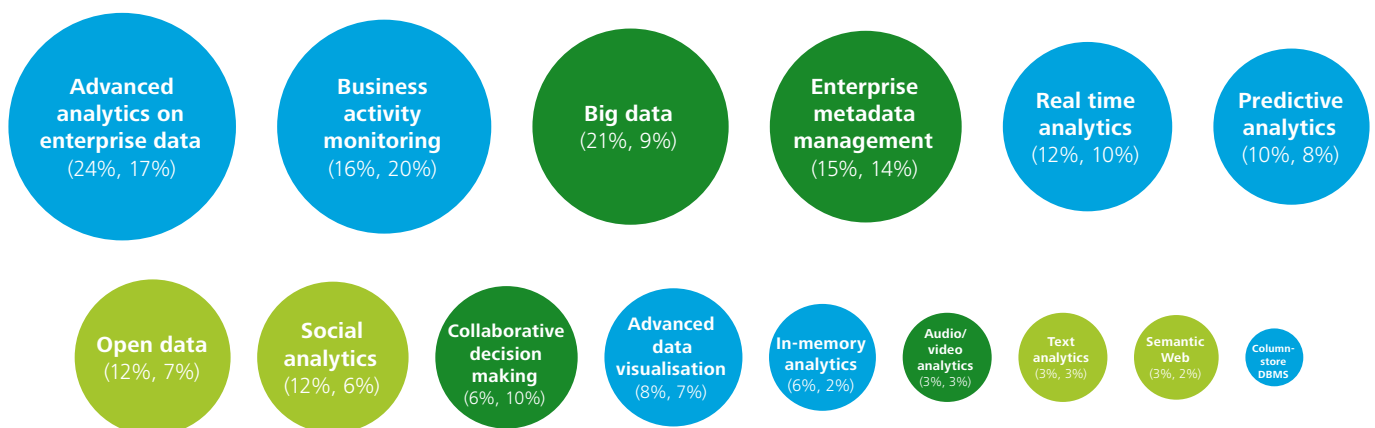
Results for 'From data to insight'

Background

After commoditisation of hardware and software, data is becoming companies' main strategic asset. The competitive advantage will be in data-based decision making. The progressing digitalization of business processes has caused an exponential increase in the data volumes. ERP and CRM systems capture hundreds of thousands records with detailed transaction data of core business processes. Web shops and online portals generate a wealth of information about customer behaviour and preferences. Many companies experience an information overload or, in other words, a filter failure. Apart from the increase in data volume,

we also see new types of data emerge in the business domain. All kinds of sensors in physical devices like energy meters generate a continuous stream of data available for analysis. In hospitals, new generations of scanning equipment generate high density digital images. Research is being done on computer based analysis of such medical images. In the public security sector, large numbers of cameras create audio and video streams that must be analysed for exceptions. Finally, in line with the increase in data volume we see an exponential increase in computing power and a decrease in costs of in-memory storage. Considering the combination of all these factors, we can say the age of data analytics has arrived.

Survey results



From looking behind to looking ahead

Two major developments characterise the data analytics domain. The first is a shift from common reporting to the use of advanced statistical techniques to translate data into insight. The second trend in analytics is a shift from looking back to looking ahead. Typical analytics on enterprise data is like looking in the rear-view mirror: it clarifies what lies behind. Although this provides useful insights, no possibilities are open to change things. Applying data analytics and decision making techniques on real-time data is already a big change that creates many opportunities. An even bigger step is using predictive analytics to forecast the effect of business decisions.

The biggest trend in this cluster is **Advanced analytics on enterprise data**: applying statistical techniques on complex data sets to find patterns and correlations between variables. Typical examples are outlier detection, clustering, pattern recognition and link analysis. The survey shows 17.5% of all companies to use these techniques, which is much lower compared to the percentage of companies with business intelligence and reporting in place. However, since 24% of all companies are examining advanced analytics, this technique's adoption rate will soon rise.

Advanced analytics is supplemented with **Advanced data visualisation**: visualisation techniques extending beyond traditional graphs and charts and with interactive features. It combines information technology, psychology, graphic design and art. The approach builds on human qualities like pattern recognition and interpretation of colour, brightness, size and motion. With 7.5% operational use and 8% of all companies examining it, these new techniques are already getting a wider audience.

When we shift our focus to real-time data, **Business activity monitoring** is the largest trend in that area. It involves monitoring real-time business process data. The goal is to provide real-time insight into critical performance indicators to make better informed decisions and address issues swiftly. The concept is used by 20.5% of all companies operationally, while another 16% are experimenting with it.

One step beyond monitoring is **Real time decisioning**: applying decision making capabilities to real-time data. This technique encompasses the selection of an optimal, real-time follow-up action out of several alternatives. The survey shows 10.5% of all companies to have real-time decisioning capabilities in operational use and 12.5% are examining it.

The increasing insight generated by advanced analytics and the shift towards real-time availability of these insights has large consequences for organisations. Many companies have come to realise that generating insight and presenting this on dashboards is one thing, but using this cleverly is something quite different. In general, successful data driven companies requires responsiveness and agility. A company can measure the effect of a web campaign in real-time, but if the marketing department is executing annual plans a flexible response is difficult.

“The age of data analytics has arrived. The competitive advantage will be in data-based decision making.”

The other end of the analytics spectrum is **Predictive analytics**: applying statistical models to historical data to try and predict the future outcome of various potential actions. The results are used in decision making processes to select the optimal course of action. The essence of the technique is capturing the statistical relationships between a variety of explanatory variables and the predicted variables in a model. The basic assumption is that this estimated model is valid for the future. It is therefore very difficult to predict the outcome of disruptive measures. The survey shows 8.5% of all companies to use predictive analytics in an operational form and 10.5% are examining it.

The use of statistical models and predictive analysis is not the only approach for data-based decision making. Another approach is the use of software tools that help knowledge workers to make better collaborative decisions. These tools support brainstorming and option evaluation (with decision support tools) and agreeing on a course of action. We call this trend **Collaborative decision making**. It is used by 10% of all companies in operational form and 6.5% are examining it.

Analytics on other types of data

Analytics is not limited to structured data from ERP or CRM systems but can be applied to various types of data. **Social analytics** is an umbrella term for the analyses of human interactions through social software such as email and social media. A typical example is **Social network analytics**: this reveals networks between people by analysing traces of person-to-person communication (e.g., email, chat and voice). Clearly, this form of analytics is often subject to privacy regulations. Another example is **Sentiment analysis**: the analysis of text posted on forums, blogs and social networks to reveal sentiments about companies or products. The survey shows 6% of all companies to use social analytics in operational processes and 12.5% are experimenting with it.

An often used technique in social analytics, but also for other purposes, is **Text analytics**. It derives valuable information from text sources by using techniques that combine linguistic knowledge with statistical techniques (word frequencies, adjacency of words). These techniques are used for finding key content, reveal sentiments and identify what are the particular cases of a specific issue. According to the survey results, 3.5% of all companies use text analytics in an operational form and another 3% are researching it.

Audio/video analytics extract insights from audio of video streams, which are used to classify cases or trigger alerts. The survey shows 3.5% of all companies to have it in place and 3% are examining it.

A whole new category of data is **Big data**. The survey defines this as data too large to be processed by traditional database management and analysis tools. Instead, big data requires a distributed approach with parallel software running on large numbers of servers. Apart from volume, other characteristics of big data are: velocity (rapidly changing) and variety (heterogeneous content). Surprisingly, the survey shows 30% of all companies to be involved in big data, either in an operational form (9%) or they are examining it (21%). This raises the question as to how companies interpret the term 'big data'.

Alternative approaches to data storage

Traditionally, enterprise data is stored in relational databases on disk. This is challenged by some trends like **In-memory analytics**: analytics on data residing in random access memory (RAM) entirely. It is characterised by very fast response times, allowing a much more interactive use. Furthermore, in-memory analytics reduces or eliminates the need for building pre-calculated cubes. Currently, 2.5% of all companies use it for operational purposes and 6.5% are experimenting with it.

A trend also related to data storage is **Column-store DBMS**. A column-store DBMS indexes each column of a table and stores these indexes as opposed to storing row-oriented data. Tables are stored as separate columns and data is compressed on column-by-column basis. This is really a niche technology with 1% operational use and 1.5% research.

A very different approach comes from the **Semantic web** initiative, an umbrella term for technologies aimed at a machine-readable Web. One of the cornerstones is the Resource Description Framework (RDF): this defines data as a graph of machine-readable triples (object, predicate, subject). The database in which triples are stored is called a triple store, which is one example of what is called NoSQL databases. Triples are defined by the Web Ontology Language (OWL) in ontologies and knowledge models. These trends are used by 2.5% of all companies and 3% are experimenting with them.

Miscellaneous trends

Open data is machine-readable digital data, freely available for everyone to use and republish. The objectives of the 'open data' movement are similar to movements like 'open source'. Major open data initiatives are taken by governments to boost economic growth, for example in the UK (data.gov.uk) and the Netherlands (data.overheid.nl). The idea is for companies to improve the quality of their existing services and look for opportunities to develop new services. The trend is not, however, limited to 'open' government data. Businesses, too, will open up their data to innovate the way they compete. By releasing parts of their data, companies expect to ignite the creativity of the crowd, to ultimately generate new revenues. This represents a paradigm shift compared to the current practice of keeping all data proprietary. The survey shows 7% of all companies to use or supply some form of open data and 12.5% are examining it.

Enterprise metadata management is the discipline of defining metadata about information assets in the company. Typical metadata include purpose, creator, applicable standards, date and time of creation, source, and reliability. Metadata management is a supporting technology for many other initiatives like master data management and service oriented architecture. Currently, 14% of all companies have some form of operational metadata management in place and 15% are examining it.

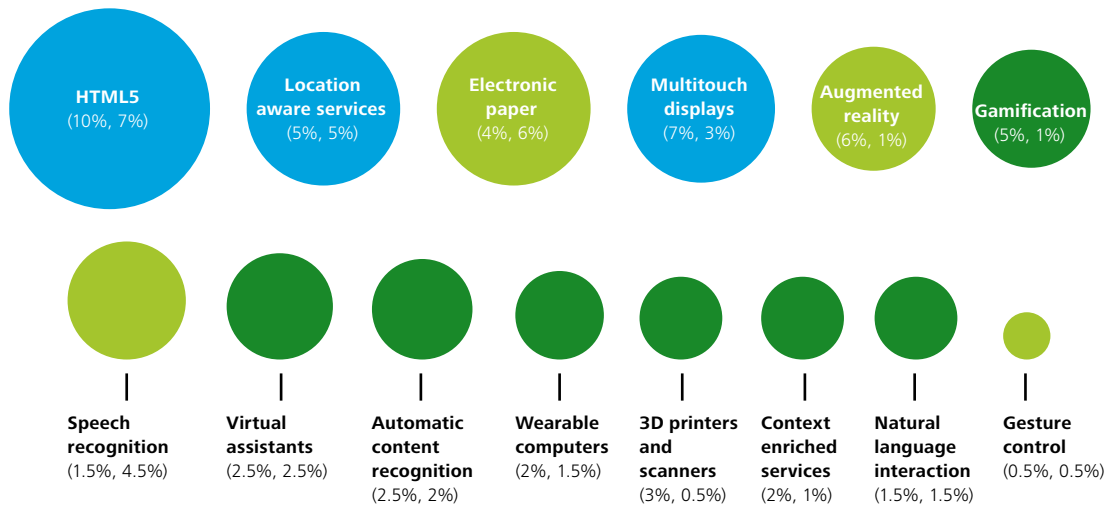
Results for ‘User experience’

Background

Since the rise of graphical user interfaces in the early eighties, user interaction was based on a keyboard and mouse combination for a long time. Emerging new form factors, like smartphones and tablets, have redefined the way people interact with information systems over the past decade. These new innovative

user interfaces set a new standard and because of that, end users expect to enjoy simple, elegant and innovative products. Human-computer interfacing is reaching the maturity level of transparency: technology blends into daily life and users are only aware of it when it is not available.

Survey results



HTML5

HTML5 is the new standard for device independent Rich Internet Applications (RIA) that provides a highly intuitive and interactive user experience. This is achieved by a combination of drag-and-drop, interactive graphics, complex animations and streaming audio and video. Web pages respond very fast to user actions since much of the logic is executed client side instead of server side. The two way connection between RIA and server allows push concepts in which the server initiates an action on the webpage. Finally, HTML5 applications run in every browser on any operating system. Although the standardisation process by W3C is not yet entirely complete, browsers already support HTML5. The survey shows HTML5 to be in operational use at 7.5% of the companies and examined by 10.5%. We expect HTML5 to become the industry standard for RIA user interfaces.

Rich services

The availability of all kinds of sensors in mobile devices (e.g. camera and GPS) facilitates new types of services that actively use these sensors.

“Innovation will come from solutions that combine the power of new form factors and rich context information.”

Location aware services are mobile applications that use information about the geographical location of a device to provide location-aware functionality. The survey shows 5.5% of all companies to use this technique in an operational form and 5.5% are examining it. The trend scores high on the transformational impact on the business and companies will use it for new types of services. However, these new types of services require more than just the use of the technique alone. Genuine innovation will spring from the companies’ imaginative power .

Context-enriched services are applications and services that combine information about the user with all kinds of situational information to offer context-aware experiences. It includes proactively pushing content to the user to suggest products or actions that may be attractive to the user in a particular situation. According to Gartner, this technology is less mature than location-aware services. The survey supports this: adoption rates are 1% for operational use and 2% for the research phase.

Automatic Content Recognition is the ability of a mobile application to identify content within its proximity based on a sample (audio/video fragment, image of a physical object) and through matching that sample with an online repository of all existing content. A typical example is an app from a web shop that uses the camera to identify the product it has in sight, after which it can be ordered with one touch on the screen. Adoption is still limited, with 2% of operational use and 2.5% of all companies examining it.

New concepts

Gamification is the use of game design techniques in non-game business contexts, for example by using points, achievement levels and leader boards. The concept is used to stimulate people to higher levels of engagement or to motivate people to perform tasks they would otherwise consider boring. Currently, 1.5% of all companies apply the concept operationally and 5% are examining it.

Human computer interaction

Speech recognition is the automatic interpretation of human speech, e.g., for routing of call centre calls, user interface control or text entry. It is used by 4.5% of all companies for operational use and 1.5% of all companies are examining it.

Gesture control is the interaction with a computer system through recognized movements of the human body and without physical contact. The technique has become popular in consumer games, and is slowly being disseminated in business environments. Adoption is still limited to 0.5% operational use and 0.5% research.

Augmented reality is real-time visualisation of real world objects augmented with computer generated virtual enhancements (text, graphics, audio). The objective is to enhance the interaction of the user with his environment. The technology can be used on smartphones with camera and GPS, but we also see dedicated devices like the Google Augmented Reality glasses emerge. The survey shows 1% of all companies to use augmented reality for operational purposes and 6% are experimenting with it.

Virtual assistants are computer generated virtual characters that simulate a conversation with the user (either with text or voice). It has a visual appearance that adapts to the context of the conversation. The survey shows 2.5% of all companies to already use it and 2.5% are examining it.

Natural language interaction is a way of interacting with an application by asking or answering questions in plain language, after which the application responds in a meaningful way. The survey shows 1.5% of all companies to use it in an operational form and 1.5% of all companies are examining it.

New devices

Multi touch displays is the use of multi touch functionality for new and innovative user interfaces and new products. The survey shows 3% of all companies to use it operationally and 7% are experimenting with it.

Electronic paper is a display technology that does not require a backlight and can be viewed under normal illumination conditions. Driven by 'the Internet of things', large numbers of low-cost, low-power displays will become necessary. The technique is used by 6.5% of all companies in an operational form and 4.5% are researching it.

3D printers are devices to create a 3D physical object from a digital model (printing) or create a digital model from an existing 3D object (*scanners*). These devices are in operational use by 0.5% of all companies and 3% are examining them.

Wearable computers are computer devices and interfaces designed to be worn on the body, e.g. wrist-mounted screens or head-mounted displays. The survey shows 1.5% of all companies to use wearable computers and 2% are examining it.

Our interpretation of the results

Conclusions

The survey underpins the three main areas of business-IT innovation: Mobile, Cloud and Data. Adoption rates of individual trends show companies to still work on the basics. It will take years for companies to fully exploit the potential of all current trends and new technologies.

One remarkable result of the survey is how the CIOs assess the business impact of technology. They regard these trends as an improvement (57%) rather than being transformational (5%). The conclusion is that, even with the latest technology, radical innovation is difficult to realise. We have three explanations for this.

1. First, disruptive change requires much more than just the use of one new technology. Trends will generally have to be used in combination with other trends to lay the foundation for transformation, but even such a foundation is insufficient. Real business-IT transformation also requires the business model to change: skill sets and processes, products and services, customers and customer relationship.

“The conclusion is that, even with the latest technology, radical innovation is difficult to realise. Transformational potential, however, still exists. The CIO will face the challenge of identifying this and realise its full business value.”

2. The second explanation has to do with four subsequent stages in the adoption of new technologies: substitution, innovation, transformation and transparency. Experience shows it takes time to go through these stages. The first stage is always *substitution*. The new technology is applied to existing products and processes, where only a limited number of variables are changed. The goal: using the new technology to optimise an already existing situation. The next stage is *innovation*: using the new technology to create change at the micro and meso level, but still well within the existing boundaries of the macro level. The boundaries of existing paradigms are searched and stretched, but no real paradigm shift occurs. In the next stage we see *transformation*: entire institutions are changed and the innovation now reaches the macro level. Paradigms that have long existed are now replaced by others. The new situation is entirely based on the potential of the new technologies and entire industries or chains are changing as a result. The last stage of a new technology is *transparency*: people experience the technology as self-evident. They do not struggle with the technology, but simply use it, almost without thinking about it. The technology has disappeared from the user's conscious mind. Users only become conscious of it when it fails, like with electricity or a telephone. When we apply this theory to the survey results, we conclude that part of the non-disruptive nature of trends can be explained by still being in the substitution or early innovation stage.
3. Finally, we explain the limited transformational effect as a result of not spending the time and resources required to fully exploit the potential of new technologies. While this may be the result of a deliberate choice to focus on Operational effectiveness, in most cases it will be the result of an IT operation requiring too much management attention and resources. It is the responsibility of the CIO to streamline the operation to make time and resources available for business-IT innovation based on the strategic use of technology trends.

Expectations for next year

Our expectation for next year is that Mobile, Cloud and Data remain the three major themes. Regarding Mobile, companies' attention will gradually shift from 'getting the basics right' to innovative solutions on mobile platforms. Security and Mobile/back-end integration become even more important than today. In Cloud computing, the maturity of SaaS solutions will further increase. Our expectation for the next 18 months is for SaaS to become the de facto standard in functional areas like Office automation, CRM and HR, and will be adopted by virtually all organisations. Although SaaS adoption started with stand-alone solutions, our expectation is that integrated cloud applications will become the norm. Finally, the importance of Data as a strategic asset will increase, as companies have only taken the first steps in uncovering the full potential of their data. The main challenges will be in asking the right questions and in the intelligent use of analytics results.

Follow-up

The Deloitte and CIO Magazine Technology Trends survey will be executed each year. In 2013, we plan to pay additional attention to the factors contributing to a successful cycle from initial research to full business value realisation. Furthermore, we will increasingly focus on the business impact of major technology trends: what kind of improvement and which extensions to the business are established? Our ambition is to help CIOs with an overview of technology trends and ideas for business-IT innovation.

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