ICT TRENDS 2020

Main Trends for Information and Communication Technologies (ICT)
and their Implications for
e-LEADERSHIP SKILLS

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Commission

*The opinions expressed in this study are those of the authors
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EXECUTIVE SUMMARY

Main Goals

This report was produced by IDC for the European Commission in the context of a service contract on the promotion of e-leadership skills in Europe with a focus on SMEs. The main targets groups are composed of high tech and high growth SMEs (start-ups, gazelles etc.), which need ICT and e-leadership skills to enhance their competitiveness and innovation potential to be successful in the 21st century.

The report highlights the main ICT trends expected to affect the demand of ICT and e-leadership skills in the next decade, and the evolution of the mix of skills requested by European enterprises, including SMEs.

There is broad agreement that the ICT world is in the midst of a new wave of innovation characterised by the confluence of social, mobile and cloud technologies, the rise of Big Data and the new kinds of analytics needed to create value in this environment.

This vision is the common background of the future technology trends presented by IDC, Accenture, AT Kearney, IBM and the McKinsey Global institute in their most recent reports on innovation up to 2020. In this context, it is important to analyse and qualify the specific demand for skills driven by the emerging technologies.

Definition of e-Leadership Skills

Within the context of this report, we define e-leadership skills as follows:

"e-Leadership skills enable people with strong ICT skills to lead qualified staff from different disciplines towards identifying and designing business models and exploiting key innovation opportunities, making best use of developments in ICT and delivering value to their organisations"

Source: empirica and INSEAD eLab, 2014

E-leadership skills comprise a body of knowledge and set of competences, which an individual in the 21st century economy requires to initiate and achieve innovation utilising ICT including:

- Lead interdisciplinary staff
- Innovate strategic business and operating models
- Exploit new ICT / digital trends
- Envision and drive change for business performance
- Influence stakeholders across boundaries (functional, geographical)

To this, we must add a combination of market / business skills and in-depth ICT skills (e-skills) enabling implementation and delivery capabilities. The necessary skills can be analysed through the **European e-Competence Framework** (e-CF).

Approach to the Analysis of the Impact of Main ICT Trends

In order to assess the impact of technology trends on skills, we have further articulated the previous definition of e-leadership skills as follows:

- **Strategic management skills** focused on the general management skills relevant for IT and business affecting the evolution of the CIO's role;
- **Hybrid market-IT skills** focused on the combination of IT and business skills in order to better exploit IT for business goals;
- **Industry-specific skills** focused on the understanding and exploitation of IT for business goals in a specific sector, with specific knowledge of the industry and its requirements.

This is complemented by the analysis of technology innovation impacts on ICT practitioner skills, grouped as follows:

- Infrastructure including: information systems outsourcing, network and desktop outsourcing, network consulting and integration services, hosted infrastructure services, hardware deploy and support, and system integration contracts where the main purpose is implementation of hardware or network solutions;
- Applications including custom application development, application management, hosted application management, software deploy and support, and system integration contracts for implementation of application solutions;
- General including IT and business consulting engagement, and IT education and training services, and IT management skills that are not specifically attached to applications or infrastructure, including enterprise architects, vendor management skills, data scientists and the emerging role of "chief digital officer".

Identification and selection of main technology trends

In order to identify and select the most important trends and their impacts, we have carried out a comparative analysis of main sources, including IDC Predictions, IBM Global Technology Outlook 2013, MGI report on disruptive technologies, Accenture Technology Vision 2014. Each one of these sources builds upon cumulative desk and market research on the most important innovation trends.

The selection of the most important trends was based on the following criteria:

- They are disruptive technologies, according to the definition provided by McKinsey, that is they are still rapidly advancing, they have a broad potential scope of impact, may affect significant economic value, and they can dramatically change the status quo of the market;
- Their development is profoundly changing the mix of skills requested in the new ICT environment, driving demand for new specialized skills to design, develop and deploy new digital services, decreasing demand for operational and practical e-skills, particularly in user industries, and stimulating an overarching demand for e-leadership skills, in order to exploit the new technologies for business growth.
- These characteristics are documented by at least two separate sources.

Table 1 Identification of Main Trends Based on Main Sources

Main Trends	IDC	McKinsey Global Institute (MGI)	IBM Research GTO	Accenture Technology Vision	IT 2020 AT Kearney
Mobility	***	***	***	***	***
Cloud Computing	***	***	***	***	***
Big Data analytics	***	***	Focus on Multimedia Analytics	***	***
Social Media Technologies	***	***	***	***	***
Internet of Things	***	***	***	***	***
Customer Experience IT	***			***	***
IT Security	***			***	
Convergence of Main trends	Third IT Platform	Automation of knowledge work	Focus on: Scalable Services Ecosystems Software Defined Environments Contextual Computing	Every business is a digital business – digital transformation	Build the skills necessary for meshing business needs with IT requirements

Legend: *** = high relevance. Source: IDC 2014 based on quoted sources

All the main sources agree in identifying the following technologies as the most important trends affecting the ICT market and the socio-economic system in the next ten years:

- **Mobility**: The incredibly rapid penetration of mobile devices and technologies in the market and the broad phenomenon of leveraging mobile solutions in the business environment;
- **Cloud computing**: the disruptive delivery model of software and ICT services, based on flexible and on-demand business models;
- **Big data analytics**: a new generation of technologies and architectures, designed to economically extract value from very large volumes of a wide variety of data, by enabling high velocity capture, discovery, and/or analysis;
- **Social media technologies:** the use of social media within and outside the enterprise, implementing social marketing techniques and facilitating collaboration and knowledge sharing;
- **Internet of Things** (IoT): A dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual "things" have identities, physical attributes, and virtual

personalities, use intelligent interfaces, and are seamlessly integrated into the information network.

In addition, the following trends have been selected for their impact on market dynamics and the demand of skills

- **Customer Experience IT** (CXIT) refers to the IT-related investments required to manage and optimise the customer's (or a citizen's) experience with an organisation. This is a new concept reflecting the increasing convergence of innovative IT (mobile, social technologies, cloud, Big Data, Internet of Things (IoT)) into applications and services centred on the customer experience, implemented through investments made by business managers other than CIOs.
- **IT security:** given the increasing dependency of European organizations on ICT systems, and the growing complexity of connected environments, there is strong demand for and diffusion of software and tools to ensure systems security at all levels.

Finally, all these studies underline the relevance of the convergence of these new technologies and their cumulative effect on the market.

Impacts on the demand of ICT practitioner skills

In 2014, the further growth of the main disruptive ICT trends highlights their convergence in a new emerging paradigm of use of IT for business strategies.

By looking across the analysis of the demand of e-skills for each main trend, we notice several common elements. In summary, these are the main considerations:

- High-level ICT practitioner skills are in increasing demand, but this is coupled with lower demand for traditional technical skills, particularly in the infrastructure and traditional IT management area.
- A revival of hardware innovation (driven by hyperscale data centres, storage, and all the new devices connected to the IoT) stimulates demand for highly specific hardware-related and systems management skills particularly in the ICT industry.
- The demand for highly specialized resources tends to move from the ICT users to the ICT vendors, while the profiles required by ICT users become more business-oriented and project-oriented, with a strong focus on the design of new services and apps, and the ability to outsource/ rely on standardized platforms and services;
- The applications skills area is the most dynamic, naturally so given the emergence of the so-called "apps economy". This builds on software skills but with very innovative demands, including the capability to manage a flexible and never-ending apps process.
- The emergence of highly integrated, automated and scalable infrastructures is driving new demand for standardization and interoperability skills (within the ICT industry) and capability to understand, select and manage standards and interoperability (within the ICT user industry).

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Table 2 Summary of Main Demand Trends of ICT Practitioners Skills

	ICT Industry		ICT User Industries	
	Increased Demand	**Reduced Demand**	**Increased Demand**	**Reduced Demand**
Infrastructure	Design, development and management of data centres and cloud services Integration of fixed-mobile systems (BYOD management) Data protection/ Privacy protection/ new IT security challenges Systems management skills for highly integrated, automated and scalable infrastructures (IoT) Design and management of end-to-end protection of emerging smart networks and cyber infrastructures	Operational skills to manage and maintain corporate IT systems Maintenance and support of legacy systems (PCs, desktops...)	Selection, configuration, combination, orchestration of cloud services, either public, private or hybrid Integration of fixed-mobile systems (BYOD management) Systems management skills for highly integrated, automated and scalable infrastructures (IoT) Data protection/ Privacy protection/ new IT security challenges Implementation and management of end-to-end protection of emerging smart networks and cyber infrastructures	Operational skills to manage and maintain corporate IT systems Maintenance and support of legacy systems (PCs, desktops...)
Application	Development and implementation of apps/ services based on mobility/cloud/Big Data/ Social Media/ IoT Business data analytics, Data scientists, Big Data skills Apps, web, IT service development for customer-centred design and deployment (CXIT)	Maintenance of legacy applications	Development and implementation of apps/ services based on mobility/cloud/Big Data/ Social Media/ IoT + industry knowledge Business data analytics, Data scientists , Big Data skills Apps, web, IT service development for customer-centred design and deployment (CXIT)	Maintenance of legacy applications
General	Skills to design and implement sophisticated identity and access management solutions Skills on standardisation/ IT regulation/ interoperability developments Ownership of skills certification	Traditional IT management skills focused on proprietary systems and custom developments	IT asset management and governance expertise Implementation of sophisticated identity and access management solutions Skills on standardisation/ IT regulation/ interoperability developments Ownership of skills certification	Traditional IT security skills by public cloud users Traditional IT management skills focused on proprietary systems and custom developments
R&D	Sophisticated R&D and development skills (especially for interoperability and standardization challenges)	None evident	Sophisticated R&D and development skills, focused on industry needs	None evident

Impact on the Demand of e-Leadership skills

In summary, the emerging demand for e-leadership skills is driven by the digital transformation process of enterprises and by the cumulative impact of main technology innovation trends. In our view, e-leadership skills can be articulated in three main strands, complementary to each other: general management skills, hybrid business-IT skills, and industry specific skills.

Table 3 Summary of Main Demand Trends of e-Leadership Skills

	Emerging Demand	Implications for High tech, high growth SMEs
General Management	Strategic management of business and contractual relationships with IT suppliers - partners - subcontractors – clients over extended value chain/ digital ecosystems In-depth understanding of IT offshoring/ outsourcing issues and cost-benefits balance to make informed choices Strategic Management of interaction between CIOs and business line managers	Strategic management of the role of the company in the digital ecosystem with specific attention to SMEs vulnerabilities (insufficient IPR protection, for example) Ability to outsource/delegate necessary IT services and make appropriate buy/train decisions of necessary skills
Hybrid Business/ IT	Strategic management of company information and data flows, including design and development of "data supply chains" to leverage company's data and partners' data and make them usable Combination of business analytics skills with industry-specific skills and understanding of IoT issues Strategic management of data protection/privacy issues	Similar demand, since customer expectations will be similar "Native" digital companies (e.g. web entrepreneurs) may have innate e-leadership skills in this area Challenge to source/ maintain scarce specialist skills, particularly data analytics and data scientists skills
Industry Specific	In-depth understanding of industry-specific business development opportunities driven by IT innovation Combination of business analytics skills with industry-specific skills and understanding of IT innovation implications for business processes Ability to use IT for customer-centred apps and services (CXIT) within specific industry	Similar demand, since customer expectations will be similar Risk of missing e-leadership skills necessary for competitive advantage; relative relevance linked to business model

The main drivers of demand are the following:

- With the diffusion of cloud, Internet of Things and Experience Customer IT the enterprise perimeter is no longer clearly defined. Therefore, the e-leader must have strategic management skills of business, technical, operational and contractual relationships with IT suppliers, partners, clients over extended value chain/ digital ecosystems, as well as with other business line managers in their organization. The key word is strategic management: the e-leader action must build on a strategic vision of the business evolution and transformation.
- The demand for hybrid business/IT skills is driven by the need to exploit IT for business growth opportunities, including in particular the ability to grow and nurture an apps system, to build a "data

supply chain" with the organization's data flows, and to manage in the appropriate way data and privacy protection issues.

- The demand for industry-specific e-leadership skills is focused on the in-depth understanding of sectorial business development opportunities driven by IT innovation, particularly for customer-centred IT systems and processes.

Looking closely at the implications for high-tech and high-growth, SMEs the following considerations emerge:

- High-tech and high-growth SMEs will have similar e-leadership skills needs than large enterprises, because customer expectations and requirements will be similar, but at a different scale level and with different viewpoints. For example, they will also need to manage relationships in the digital value chain, but from the point of view of a junior partner.
- Depending on their size and business model they may not need a CIO: the e-leaderships skills may be those of the entrepreneur himself. Actually, "native" digital enterprises (web entrepreneurs) may have "innate" e-leadership skills and leapfrog other companies with a creative use of IT innovation. Nevertheless, they still may not have the full range of e-leadership skills needed.
- SMEs will face harsher choices in terms of sourcing their needed e-leadership skills: should they buy, hire or train existing employees? Given their limited resources, they will have to be careful and invest well in the priority skills most functional to their business model.

1. OVERVIEW OF MAIN ICT TRENDS

1.1. Identification and selection of Trends

The focus of this report is to highlight the main ICT trends, which will affect the demand for e-skills and specifically e-leadership skills in the next decade, particularly the evolution of the range of skills requested by emerging innovation for SMEs. There is broad agreement that the ICT world is in the midst of a new wave of innovation characterised by the confluence of social, mobile and cloud technologies, the rise of Big Data and the new kinds of analytics needed to create value in this environment. This vision is the common background of the future technology trends presented by IDC, Accenture, IBM, AT Kearney and the McKinsey Global institute in their most recent reports on innovation up to 2020. In this context, it is not sufficient to identify a generic demand for e-skills, it is important to analyse and qualify the specific demand for skills driven by the emerging technologies.

1.1.1. Main sources

In order to identify and select the most important trends and their impacts, we have carried out a comparative analysis of the following public sources:

- **Accenture** Technology Vision, 2014
- **AT Kearney**: "IT 2020: Preparing for the Future", 2013
- **McKinsey Global Institute**: "Disruptive Technologies ", 2013
- **IBM** Global Technology Outlook, 2013
- **IDC** Predictions, 2014

Each one of these sources builds upon cumulative desk and market research on the most important innovation trends. We will review briefly their visions and then present a comparative analysis of their main results, from the point of view of the impact on the evolution of the demand for e-skills and e-leadership skills. In addition, we have taken into account two recent studies about the potential impact of ICTs on employment and the labour market, which had a strong impact on the debate on this issue. They are:

- **The Future of Employment**: How Susceptible are Jobs to Computerisation?
  By Carl Benedikt Frey and Michael A. Osborne, Oxford University, 2013
- **The Second Machine Age**: Work, Progress, and Prosperity in a Time of Brilliant Technologies by Eric Brynjolfsson and Andrew McAfee, MIT, 2014

1.1.2. Definition and Concept of e-Leadership Skills

Within the context of this report, we define e-leadership skills as follows:

"e-Leadership skills enable people with strong ICT skills to lead qualified staff from different disciplines towards identifying and designing business models and exploiting key innovation opportunities, making best use of developments in ICT and delivering value to their organisations"

Source: empirica and INSEAD eLab, 2014

This definition builds upon a four layers conceptual model developed by empirica articulated as follows.

Figure 1 e-Leaderships Skills Definition: Conceptual framework

Layer 1: **Starting point / initial framework**	European e-skills Forum definition of the term 'e-skills' using three different categories with the last one called 'e-business skills' which got converted into 'e-leadership skills'. E-leadership skills include in particular the capabilities needed: • to exploit opportunities provided by ICT, notably the Internet; • to ensure more efficient and effective performance of different types of organisation; • to identify, explore and take advantage of possibilities for new ways of conducting business/administrative and organisational processes; and/or • to establish new businesses.
Layer 2: **Skills areas explication**	E-Leadership skills enable people with very strong ICT skills to lead qualified staff from different disciplines towards identifying and designing business models and exploiting key innovation opportunities, making best use of developments in ICT and delivering value to their organisations. e-Leadership skills comprise a body of knowledge and set of competences which an individual in the modern economy requires to initiate and achieve innovation utilising ICT • Lead inter-disciplinary staff • Innovate strategic business and operating models • Exploit new ICT / digital trends • Envision and drive change for business performance • Influence stakeholders across boundaries (functional, geographical)
Layer 3: **Skills enumeration; division of the concept into component skills**	An e-Leadership skilled individual will have significant combinations of skills from areas A and E and some others of the European e-Competence Framework, but also business and organisation skills outside the e-CF. E-CF skills include e.g. (non-exhaustive) • A.1. IS and Business Strategy Alignment • A.2. Service Level Management • A.3. Business Plan Development • A.4. Product/ Service Planning • A.5. Architecture Design • A.7. Technology Trend Monitoring • A.8. Sustainable Development • A.9. Innovating • D.1. Information Security Strategy Development • D.2. ICT Quality Strategy Development • D.10. Information and Knowledge Management • D.11. Needs Identification • E.1. Forecast Development • E.2. Project and Portfolio Management • E.3. Risk Management • E.4. Relationship Management • E.5. Process Improvement • E.6. ICT Quality Management • E.7. Business Change Management • E.8. Information Security Management • E.9. IS Governance • + Extensions & further specifications formulated as actual learning outcomes
Layer 4: **Concrete configurations of sets of skills into profiles, based on use cases or requirement profiling**	e-Leadership skills as the universe e-Leadership skills Curriculum Profiles: • Business and Enterprise Architecture • Innovation and Transformation through ICT • Information Security Governance • *(Work in progress)* • ... • *IT Business Impact for the SME CEO* • *Business mindset for the SME CIO* • *Innovation and Transformation through ICT for SME consultants* • ...

1.2. Approach to the Analysis of Impacts

For the sake of this study, we have aggregated the main typologies of e-skills and e-leadership skills in the following main groups.

Table 4 Main ICT Practitioner skills

Infrastructure:	Information Systems Outsourcing
	Network and Desktop Outsourcing
	Network Consulting and Integration Services
	Hosted Infrastructure Services
	Hardware Deploy and Support and System Integration contracts where the main purpose is implementation of hardware or network solutions
Applications:	Custom Application Development
	Application Management
	Hosted Application Management
	Software Deploy and Support
	and System Integration contracts where the main purpose is implementation of application solutions;
General:	Pure IT and business consulting engagements
	IT education and training services
	IT management skills that are not specifically attached to applications or infrastructure
	Enterprise architects
	Vendor management skills
	Data scientists and the emerging role of "chief digital officer"

Source: IDC 2014

We have classified e-Leadership skills as follows:

- **Strategic Management skills** focused on the general management skills relevant for IT and business affecting the evolution of the CIO's role;
- **Hybrid market-IT skills** focused on the combination of IT and business skills in order to better exploit IT for business goals;
- **Industry-specific skills** focused on the understanding and exploitation of IT for business goals in a specific sector, with specific knowledge of the industry and its requirements.

The following table shows how this definition can be mapped out onto the **European e-Competence Framework** (e-CF).

Table 5 Definition of e-Leadership Skills

Strategic Management skills	Lead inter-disciplinary staff
	Innovate strategic business and operating models
	Exploit new ICT / digital trends
	Envision and drive change for business performance
	Influence stakeholders across boundaries (functional, geographical)
Hybrid market-ICT skills	A.1. IS and Business Strategy Alignment A.2. Service Level Management A.3. Business Plan Development A.4. Product/ Service Planning A.5. Architecture Design A.7. Technology Trend Monitoring A.8. Sustainable Development A.9. Innovating
	D.1. Information Security Strategy Development D.2. ICT Quality Strategy Development D.10. Information and Knowledge Management D.11. Needs Identification
	E.1. Forecast Development E.2. Project and Portfolio Management E.3. Risk Management E.4. Relationship Management E.5. Process Improvement E.6. ICT Quality Management E.7. Business Change Management E.8. Information Security Management E.9. IS Governance
Industry specific skills	As above, but focused on the specific sector needs A.1. IS and Business Strategy Alignment A.2. Service Level Management A.3. Business Plan Development A.4. Product/ Service Planning A.5. Architecture Design A.7. Technology Trend Monitoring A.8. Sustainable Development A.9. Innovating

Source: IDC 2014

1.3. Structure of the Report

The report is structured as follows:

- Chapter 1 provides an overview of the main technology trends and the reasons why they have been selected;
- Chapters 2 to 8 present a description of each trend and the main impacts on the demand for ICT and e-leadership skills as well as the implications for SMEs
- Chapter 9 draws final considerations summarizing the main factors driving increased or reduced demand for skills.

1.4. Accenture: Six Digital Transformation Trends

Accenture vision is focused on the concept that "every business is a digital business". The Technology Vision is published each year by the Accenture Technology Labs, the research and development (R&D) organization within Accenture. In 2014, the vision was developed through crowdsourcing and screening ideas and trends from over 850 technologists and analysts from the company's global workforce.

The focus was on identifying the main ways in which social, mobile, analytics, and cloud technologies are being woven into the next generation of business strategies across every industry. The selected trends reflect the way digital transformation is affecting companies and their identity (see Table 6).

In Accenture view, enterprises in order to remain competitive need to use new technologies in such a way to reshape their own organizations and modify their value proposition. For example, industrial companies are becoming customer service companies. Consumer products companies are becoming Internet companies. Energy companies are becoming information companies. Media and entertainment companies are becoming logistics companies. This is reshaping global value chains and the interaction between enterprises and their customers and partners.

From this perspective, Accenture's trends are very much about e-leadership skills, inasmuch as they reflect the changes in leadership and mindset needed to achieve the digital transformation enabled by technology innovation.

Each of the main changes reviewed by the "vision report" is calling for e-leadership by CIOs in cooperation with the other business leaders of the organization. For example, their view of the emerging apps economy (the business of applications) is framed as a fundamental change in the strategic choices of IT and business leaders, who must learn how to shape an apps environment characterised by constant evolution and agility (a "world where apps are in a constant "beta" stage, always evolving).

Accenture Technology Vision is mainly focused on large and midsized companies. It is clear, though, that its key messages are equally relevant for the innovative SMEs. Even trends such as the need to "harness hyperscale" and "architecture resilience", which are clearly developed thinking of the extended IT infrastructures of major enterprises, can be read as significant issues for the extended value chains in which high tech SMEs operate and collaborate. In other words, SMEs will face similar problems and must deal with them in partnership with other enterprises.

Table 6 The Six IT Trends Identified by Accenture

Technology	Description
Digital-Physical Blur – Extending Intelligence to the edge	The physical world is coming online as objects, devices, and machines acquire more digital intelligence. This is more than an "Internet of Things"; it is a new layer of connected intelligence that augments the actions of individuals, automates processes and incorporates digitally empowered machines into our lives, increasing our insight into and control over the tangible world.
From workforce to crowd source: the rise of the borderless enterprise	Cloud, social, and collaboration technologies now allow organizations to tap into vast pools of resources across the world, beyond the boundaries of the enterprise. Channelling these efforts to drive business goals is a challenge, but the opportunity is enormous: it can give every business access to an immense, agile workforce that is not only better suited to solving some of the problems that organizations struggle with today but in many cases will do it for free.
Data Supply Chain: Putting information into circulation	Data ecosystems are complex and littered with data silos, limiting the value that organizations can get out of their own data by making it difficult to access. To unlock that value, companies must start treating data more as a supply chain, enabling it to flow easily and usefully through the entire organization, and eventually throughout each company's ecosystem of partners too.
Harnessing Hyperscale	Accenture uses the term "Hyperscale" to describe the physical infrastructure of giant and distributed systems that support the data centres with the computing power to deal with vast volumes, variety, and velocity of data, but also the ability to scale computing tasks to achieve performance that is orders of magnitude better than the status quo.
Business of applications: software as a core competency	Mimicking the shift in the consumer world, organizations are rapidly moving from enterprise applications to apps. As large enterprises push for greater IT agility, there is a sharp shift toward simpler, more modular, and more custom apps. The implications are significant for IT leaders and business leaders alike: they must soon decide not just, who plays what application development role in their new digital organizations but also how to transform the nature of application development itself. In a traditional software world, deployment is the end of the development cycle. In the app world, deployment is just the first iteration.
Architecting resilience	CIOs and IT managers must adopt a new mindset to ensure that systems are dynamic, accessible, and continuous, not just designed to specifications, but designed for resilience under failure and attack.

Source: Accenture

1.5. McKinsey: Twelve Leading Disruptive Technologies

The McKinsey Global Institute (MGI)[1] reviewed a long list of over 100 technologies before selecting the 12 most relevant ones. According to MGI, the main criteria needed to identify truly disruptive technologies are the following:

- The technology is rapidly advancing or experiencing breakthroughs;
- The potential scope of impact is broad (as in the case of the IoT which will affect billions of devices and a huge range of vertical markets);
- Significant economic value could be affected (in terms of macroeconomic impacts: for example cloud technologies impact productivity of all enterprises);
- Economic impact is potentially disruptive (because the technologies have the impact to change dramatically the status quo, as for example smart grids can do in the energy sector).

The twelve technologies selected by MGI are presented in the table below. The first four concern directly ICTs and represent the most important potential impact on the demand for e-skills.

Table 7 Twelve Potentially Economically Disruptive Technologies

Technology	Description
Mobile Internet	Increasingly inexpensive and capable mobile computing devices and Internet connectivity
Automation of knowledge work	Intelligent software systems that can perform knowledge work tasks involving unstructured commands and subtle judgments
Internet of Things	The Internet of Things Networks of low-cost sensors and actuators for data collection, monitoring, decision making, and process optimization
Cloud Computing	Cloud technology Use of computer hardware and software resources delivered over a network or the Internet, often as a service
Advanced Robotics	Increasingly capable robots with enhanced senses, dexterity, and intelligence used to automate tasks or augment humans
3D printing	Additive manufacturing techniques to create objects by printing layers of material based on digital models
Autonomous and near-autonomous vehicles	Vehicles that can navigate and operate with reduced or no human intervention
Next-generation genomics	Fast, low-cost gene sequencing, advanced big data analytics, and synthetic biology ("writing" DNA) Energy storage Devices or systems that store energy for later use, in

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[1] Mc Kinsey Global Institute: "Disruptive technologies: Advances that will transform Life, Business, and the Global Economy", May 2013

Energy storage	Devices or systems that store energy for later use, including batteries
Advanced oil and gas exploration and recovery	Exploration and recovery techniques that make extraction of unconventional oil and gas economical
Renewable energy	Generation of electricity from renewable sources with reduced harmful climate impact
Advanced materials	Materials designed to have superior characteristics (e.g., strength, weight, conductivity) or functionality

Source: McKinsey Global Institute May 2013

1.6. IBM Global Technology Outlook

The IBM report[2] identifies four mega-trends of transformation of the economic system, addressing change in adoption and usage patterns of the last wave of IT technology innovation:

- **Growing Scale / Lower Barrier of Entry**: a massive expansion in the amount of structured and unstructured data, while the rise of easy-to-use and affordable programming interfaces is simultaneously lowering the barrier of entry for companies to create applications and services that derive value from this data;
- **Increasing Complexity / Yet More Consumable**: increasing complexity of data management and workloads, but mobile devices have made technology more consumable, creating user demand for interactive tools for visual analytics;
- **Fast Pace**: Change is coming faster than ever, with disruptive models for the development and consumption of technology emerging to penetrate global enterprise ecosystems;
- **Contextual Overload**: The explosive growth of data and data processing devices is causing information and contextual overload, which in turn drives demand for contextually aware and personalized services based on user views, desires, preferences and location, delivered just in time.

These mega-trends design a new environment for the ICT market, where businesses and consumers must adapt to very different patterns of interaction with ICTs.

The specific trends identified by IBM are presented in the following table. Compared to the analysis of McKinsey, they focus on the systemic evolution of the use of IT, particularly of software and services. There are however important similarities: mobility ranks first in IBM's analysis as in McKinsey's.

The trends concerning services, software and multimedia are connected with cloud computing and big data innovation, representing a sophisticated and articulated perspective of the next steps likely to be driven by these technologies.

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[2]   IBM Research, Global Technology Outlook 2013

Table 8 Six Main Trends from IBM Global Technology Outlook

Technology	Description
Mobile First	Mobile First is about re-imagining businesses around constantly connected employees and customers, and creating new ways to deliver value to customers. Mobile First is accelerating the integration of cloud, social, and analytics in a way that requires companies to re-think how value is created within a larger ecosystem.
Scalable Services Ecosystems	Scalable Services Ecosystems describe open clusters of enterprises, including partners and value-added firms, where business functions are delivered as API-centric services, enabling businesses to co-create customer value with speed and agility. The confluence of social, mobile and cloud is fuelling the hyper-growth of a new business-as-a-service economy where enterprises externalize APIs to their business processes.
Software Defined Environments	Cloud computing as currently defined represents only the very early stage of a major revolution in how information technology systems are architected, developed, deployed and used. The last few years have seen the emergence of Software Defined Networks (SDN), Software Defined Storage (SDS) and Software Defined Compute (SDC).
Multimedia and visual analytics	Multimedia analytics is about computers making sense of images and videos, and being able to extract information and insights from those sources, whereas visual analytics is about humans using visual interfaces to consume and make sense of complex data and analytics.
Contextual Computing	Contextual computing accelerates the detection of complex patterns in both data and processes through four main activities: gathering, connecting, reasoning, adapting. In all four activities, systems continually learn from user behaviour and interaction patterns to enhance the context over time.
Personalized Education	The education industry is at the brink of an IT-enabled transformation. This transformation is driven by a demand for quality education that outstrips supply especially in the growth markets, misalignment between education and employment needs, and impatience with inefficiencies of education systems.

Source: IBM Research GTO 2013

1.7. AT Kearney: IT 2020: Preparing for the Future

AT Kearney "IT 2020", rather than a vision for the future, is a report based on a survey of more than 150 CIOs of large global enterprises and leading midsized companies and their views and expectations for the period up to 2020. The main considerations of the report are coherent with the expected changes outlined by the other main sources, particularly Accenture and IBM. They include:

- General agreement that the future will see a significant increase of IT requirements as IT becomes more and more important for the core business of enterprises (85% of respondents).
- Consensus that sales and customer driven applications will become the focus of IT investments, according to 61% of CIOs. This means for example the development of end-to-end social marketing suites connecting internal CRM with external social network data, to identify customer groups and access them via appropriate channels.
- CIOs expect innovation and customized development to be focused on front-end apps, but nearly 80% of CIOs expect

standard software to cover more than half of the required functionality.

- Most CIOs see IT strategy evolving towards a decentralization of value-driving IT functions (with business managers) accompanied by centralization and outsourcing of major parts of delivery.
- Most CIOs perceive an increasing strong collaboration between them and the other line managers – with CIOs rising to the board, as they become increasingly central to company's strategies.
- Finally, the IT budgets of organizations in sectors such as automotive, machinery and defence, consumer and retail will grow faster than the IT budgets of organizations in the sectors traditionally leading IT spending (telecom and media, financial services, utilities). This will reflect the digital transformation of organizations in these sectors.

1.8. IDC Vision: The Emergence of the Third IT Platform

In IDC vision, the ICT industry is in the midst of a "once every 20–25 years" shift to a new technology platform for growth and innovation (the Third IT Platform), expected to dominate the market by 2020 (Figure 2). This platform is characterised by the disruptive combination of the following technologies:

- The diffusion of **cloud computing**, a disruptive delivery model of IT software and services, based on flexible and on-demand business models;
- The incredibly rapid penetration of **mobile devices and technologies**, including mobile apps and M2M, machine to machine connectivity through billions of sensors (the Internet of things);
- The emergence of **Big Data** analytics, driven by the huge increase of data generated by mobile devices and the Internet;
- The diffusion of **social technologies**, migrating from the personal to the business environment will be affecting profoundly business and social interactions within enterprises and in supply chains.

In 2014, spending on mobile, cloud, Big Data, and social and related offerings will grow by 15% on the year before, drive 29% of IT spending, and drive 89% of IT spending growth.

According to IDC, by 2020, when the ICT industry will generate $5 trillion in spending worldwide (which is over $1.3 trillion more than it does today), about 40% of the industry's revenue and almost the totality of its growth will be driven by 3rd Platform technologies that today represent just 29% of IT spending[3].

This "Third IT Platform" will engage billions of users and generate millions of apps, sustaining a new intelligent economy. As shown in Figure 2, it represents also a change of scale in the size and depth of the ICT market, both in terms of the number of users, the number of connected devices, and the number of applications and services. This change of scale represents as well a change of paradigm.

Figure 2 The Third IT Platform for Growth

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[3]   IDC Predictions 2014: Battles for Dominance and Survival
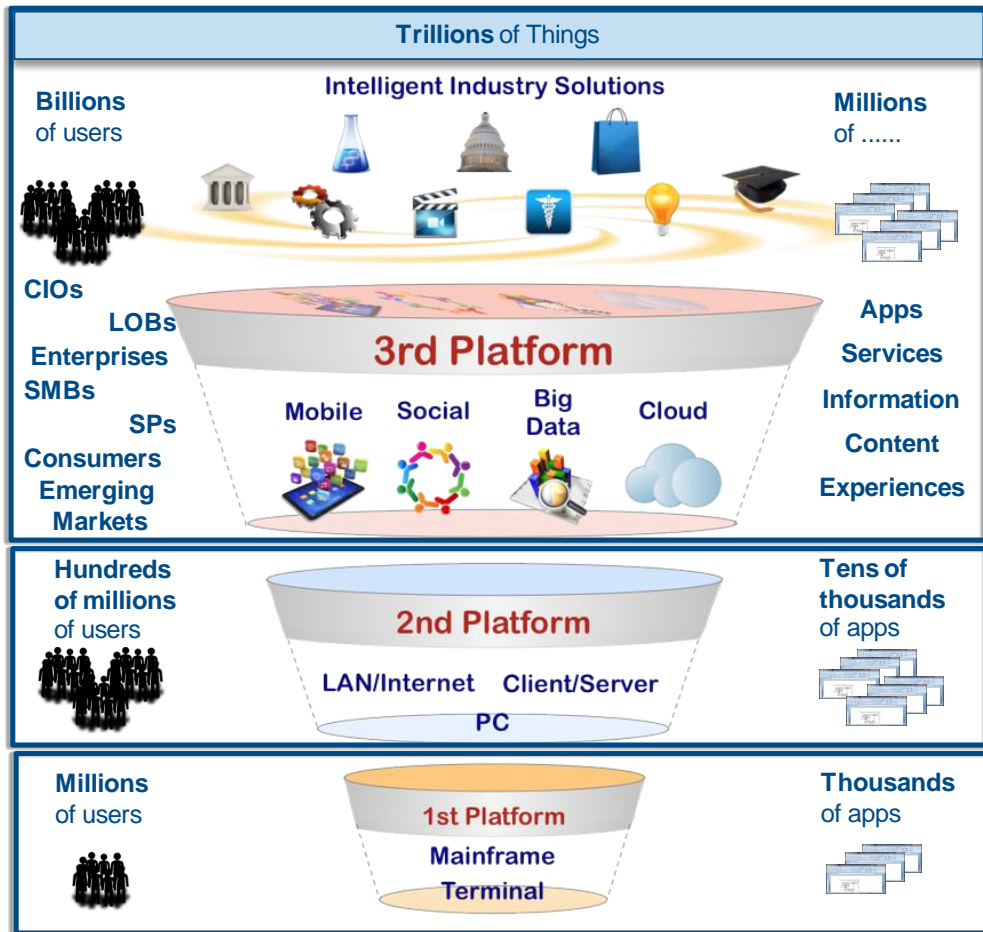
Source: IDC Predictions 2013

1.9. Selection of the Main Technology Trends

This excursus of the main sources of forecast of future trends shows a remarkable convergence, as shown in the table 9 below. Building on these considerations, we have selected the technology trends presented in Table 9 with the following criteria:

- They are disruptive technologies, according to the definition provided by McKinsey, that is they are still rapidly advancing, they have a broad potential scope of impact, may affect significant economic value, and they can dramatically change the status quo of the market;
- Their development is profoundly changing the mix of skills requested in the new IT environment, driving demand for new specialized skills to design, develop and deploy new digital services, decreasing demand for operational and practical e-skills particularly in user industries, and stimulating an overarching demand for e-leadership skills, in order to exploit the new technologies for business growth;
- These characteristics are documented by at least two separate sources.

The next chapters will discuss in details these trends and their impacts on the demand for skills.

All the main sources agree in identifying the following technologies as the most important trends affecting the ICT market and the socio-economic system in the next ten years:

- **Mobility and mobile apps**: The incredibly rapid penetration of mobile devices and technologies in the market and the broad phenomenon of leveraging mobile solutions in the business environment;
- **Cloud computing**: the disruptive delivery model of IT software and services, based on flexible and on-demand business models;
- **Big data analytics**: a new generation of technologies and architectures, designed to economically extract value from very large volumes of a wide variety of data, by enabling high velocity capture, discovery, and/or analysis;
- **Social Media technologies:** the use of social media within and outside the enterprise, implementing social marketing techniques and facilitating collaboration and knowledge sharing;
- **Internet of Things:** A dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual "things" have identities, physical attributes, and virtual personalities, use intelligent interfaces, and are seamlessly integrated into the information network.

We have also selected two more trends, emerging in different ways from several sources and particularly from Accenture and IDC visions:

- **Customer Experience IT (CXIT)** refers to the IT-related investments required to manage and optimise the customer's (or a citizen's) experience with an organisation. This is a new concept reflecting the increasing convergence of innovative IT (mobile, social technologies, cloud, Big Data, IoT) into applications and services centred on the customer experience, implemented through investments made by business managers other than CIOs.
- **IT security:** given the increasing dependency of European organizations on ICT systems, and the growing complexity of connected environments, there is strong demand for and diffusion of software and tools to insure IT systems security at all levels;

Finally, all these studies underline the relevance of the convergence of these new technologies and their cumulative effect on the market and on usage patterns, from different viewpoints as highlighted in Table 4.

The consequences of this convergence are a theme running through the analysis presented in each of the following chapters, and therefore it has not been analysed separately.

Table 9 Identification of Main Trends

Main Trends	IDC	McKinsey Global Institute (MGI)	IBM Research GTO	Accenture Technology Vision	IT 2020 AT Kearney
Mobility	***	***	***	***	***
Cloud Computing	***	***	***	***	***
Big Data analytics	***	***	Focus on Multimedia Analytics	***	***
Social Media Technologies	***	***	***	***	***
Internet of Things	***	***	***	***	***
Customer Experience IT	***			***	***
IT Security	***			***	
Convergence of Main trends	Third IT Platform	Automation of knowledge work	Focus on: Scalable Services Ecosystems Software Defined Environments Contextual Computing	Every business is a digital business – digital transformation	Build the skills necessary for meshing business needs with IT requirements

Legend: *** = high relevance according to the source

Source: IDC 2014 based on quoted sources

2. Mobility and Mobile Apps

2.1. Description of the Trend

The mobile revolution is becoming a challenge for organisations and CIOs as the demands on IT are ramping up quickly. This mobile revolution is not just about employees being able to use mobile devices (perhaps of their choice) for accessing data and information and being able to read email on mobile phones. Nor is it only about customers accessing a company's website on smartphones or tablets. Indeed, in its fullest extent, it is the opportunity to extend business processes ever closer to the point of transaction.

However, the rise of mobile devices means that mobile is becoming the primary design point for end-user access to the Internet. By 2016, the number of people accessing the Internet through PCs will shrink by 15 million as the number of mobile users increases by 91 million.

In addition, consumers tend more and more to bring their personal devices into the workplace (hence often termed Bring-Your-Own-Device or BYOD) and to use social technologies, for personal and work reasons. This is a trend called "consumerisation" that is the set of changes engendered by employees bringing technologies designed for the consumer world into the work environment.

Mobility developments (new devices, consumerisation, and mobile applications) are one of the key drivers of change recognised in the ICT industry and will remain so for the coming decade. Mobility is the "M" in what is sometimes in the IT industry called the SMAC Stack (the rest being S for Social, A for Analytics, and C for Cloud) and one of the four pillars of what IDC terms the 3rd Platform of IT, the remainder being social technologies, Big Data and Cloud.

2.1.1. Mobile Devices and Bring Your Own Device (BYOD)

Traditional desktop and laptop sales have been outpaced by the rise of tablet and mobile devices over the past couple of years and this development will continue. IDC estimates that smartphone and tablet sales will continue to dwarf slumping PC sales by 2.5 to 1.

Even prior to the inflection point when mobile devices outsold traditional devices, the focus of enterprises was already on the ability to be productive while mobile. This brings a significant shift within the market. The installed base of traditional desktop and laptop devices is still significant, but all the momentum and attention are diverting to new devices such as smartphones and tablets.

This brings a significant shift within the support ecosystems as it introduces new operating systems, new refresh rates, and the need for different skills as well as more vendors to an already complex equation. In brief, it makes the support environment more challenging — a price that has to be paid to have a more mobile workforce.

In addition to market changes on the device side, employee expectations have also transformed significantly in the past two to three years. Employees now expect to have 100% access regardless of whether they are at work, home, or travelling. Not only that, they also require this access to be relatively simple as the consensus is that their personal

devices are often far superior (and simpler) to those provided by their IT departments. Perhaps the best proof of this trend has been the rise of BYOD and application consumerisation within the past couple of years.

All these factors are putting pressure on the IT department and the CIO for several reasons:

- Mobility introduces a faster pace of change into the ICT infrastructure. Smartphones need to be refreshed (or are out of fashion) every 24 months at most, whilst traditional desktop devices are usually considered to have a 3-4 year life cycle. This change of pace requires an overhaul of existing processes in most IT departments, both in terms of change requests when new devices are introduced but also in terms of speed of roll-out.
- Mobility introduces the "multiple device" era. Smartphones and tablets are not "the" device of choice for most end users but one of the two or three devices from which they choose to work. This places pressures on IT in terms of the mobile application interfaces and design criteria that are needed (see more below) but also in terms of the extended number of devices that needs to be supported.
- In fact, mobility has significant consequences on for the IT support function: supporting different versions, operating systems, and security set-ups can be a nightmare for the IT department. Disaster recovery and compliance (data leakages) are also aspects of mobility, which CIOs must take into account.
- Bring Your Own Device (BYOD) is now common within the European market. Many consumers and employees alike prefer to use their personal devices of choice to access their corporate resources. This means that the efforts made to standardise the workplace area within the last 25 years have now "gone out of the window". Standardisation is no longer possible, and CIOs must focus instead on containment, flexibility and security.

Notwithstanding the spending on actual devices and the time and effort of internal IT staff, IDC estimates that Western European organisations will spend €3.8 billion in 2014 on seeking the help of external service providers to help design their mobile strategy, delivering a seamless wired and wireless experience and optimising network architectures, and implement, manage and support the mobility solution. The spending is expected to grow to €6.5 billion by 2017, representing a compound average annual growth rate (CAGR) of 15.3% over the period.

2.1.2. Mobile Application Development

The development of native apps for mobile devices (as opposed to mobile interfaces of enterprise-class applications) is growing strongly in Europe. According to a study by VisionMobile and Plum Consulting[4], in the EU28 in 2013, it was estimated that the European App Economy contributed:

- 794,000 jobs across the whole economy;
- 529,000 direct App Economy jobs, 60% of which are developers;
- 22% of the global production of app-related products and services;
- Revenues of more than €10 billion per annum.

However, these numbers are only set to grow strongly in the coming years, driven by three key elements:

- The growth in mobile and smart devices ownership is growing and will continue to do so in the next 5-10 years (see above);
- The growth in the capability and the diversity of apps, including the use of cloud as a delivery platform;
- The continued improvement of wireless connectivity, including 4G rollout. Around the corner, 5G is already on the cards with the UK and Germany agreeing to develop the new web spectrum that is 1,000 times faster than 4G. This will have significant impact, not only on end users' normal access to the Internet but also huge implications for the adoption of the Internet of Things.

In addition, as part of the mobility wave, European organisations are eager to build applications that improve customer engagement and employee productivity. This clearly indicates a shift in the approach to mobility solutions, from control and security to a platform for business enablement.

In IDC's Western Europe Enterprise Mobility Survey (February 2014), results showed that one in five firms has at least launched its first mobile app, and an additional 19% are working on their first mobile app implementation (see Figure 3). The results also show a ramp up in the number of firms that are accelerating the pace of development (14%) with the second or third mobile application. Mobility is fast becoming the new normal; IDC research suggests that only 8% of organizations have no plans to evaluate a mobile strategy.

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[4] The European App Economy: Creating Jobs and Driving Growth, VisionMobile and Plum Consulting, September 2013

Figure 3 Western Europe Enterprise Mobile Application Maturity

Q. What best describes your organization`s stage of maturity regarding the development and or deployment of mobile applications (excluding email) (% of respondents)
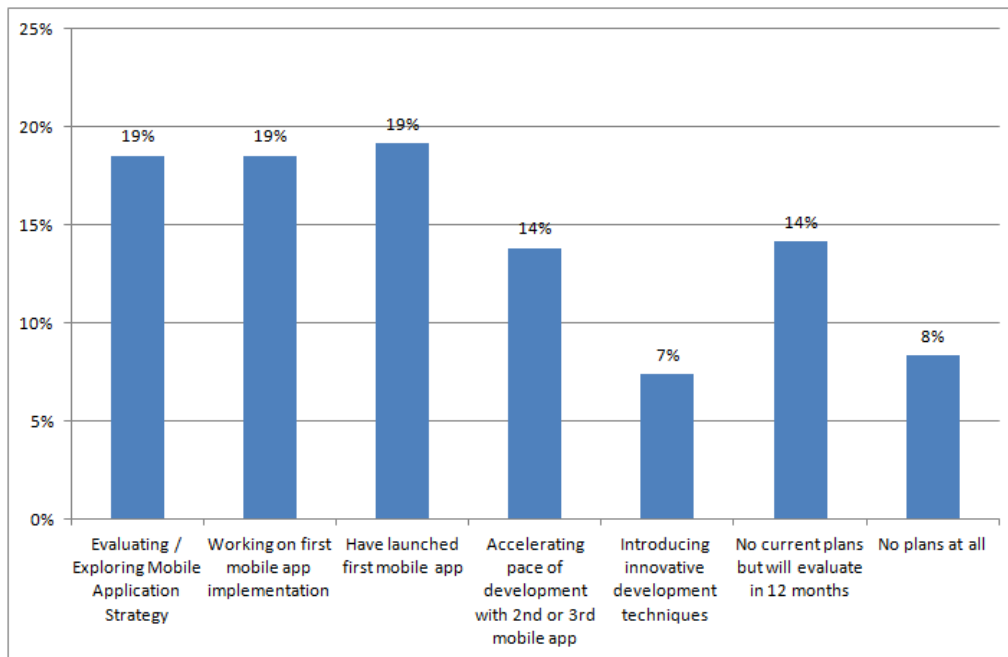
Source: IDC Enterprise Mobility Survey, February 2014 (N=933, enterprises over 10 employees)

Most organisations developing mobile apps are supporting multiple technology stacks, as they find that standardising mobile app development stacks is like herding cats. However, a recent IDC survey results indicate that two thirds of organisations are targeting a maximum of two operating systems, while over 40% of organisations plan to use web development/HTML5 tools. Organisations increasingly opt to choose Web application architecture to assist with issues of platform fragmentation and to allow leverage of existing developer resources. The "HTML5 in the enterprise" story is only just beginning, and this topic is expected to be a critical enterprise mobility theme in 2014 and beyond.

There is a clear shift in the types of mobile apps that are being built, from largely business to consumer apps to increased interest and development in business-to-business (B2B) and business to employee (B2E) mobile apps. A recent survey conducted by Appcelerator (in partnership with IDC) of over 6,000 of Appcelerator's mobile application developers showed the percentage of developers that planned to build B2B and B2E apps has increased to 42.7% in the second quarter of 2013 from 29.3% in the fourth quarter of 2010. As mobile penetrates the enterprise, driven by consumerisation, the demand for B2E and B2B mobile applications will continue to increase.

Today, there is no one-size-fits-all approach to mobile application development with many different technology approaches. However, IDC finds that there are certain horizontal trends that are ultimately driving the direction the market chooses over the next several years:

- **Multichannel development:** Increasingly, enterprises look toward taking a mobile-first approach toward development, but

this does not mean desktop does not matter anymore. Enterprises will need one platform on which to develop apps that run across any end-user endpoint. This would include mobile, desktop, and Internet of Things–type modules/devices.

- **Cloud-based platforms:** As European firms build holistic enterprise mobility strategies, most will not have the time, resources, or funds to evaluate, test, deploy, and manage a multitude of often duplicative, capex-based, behind-the-firewall point solutions for mobility management, security, and app development. The need for a simplified, common mobility architecture across security and management, app design and development, integration, content management, analytics, and reporting encourages firms to leverage software-as-a-service (SaaS) and cloud solutions for time-to-market advantages. A mobile cloud-based project allows companies to leverage more open technologies and budget on a per-user/ per-month basis. Such rollouts are typically built in a matter of weeks, which is critical in the current phase of development in which mobile application development is a means of competitive advantage.

- **Move toward open standards-based solutions:** In a rapidly moving space such as mobile, end-user enterprises are often very concerned about vendor lock in. Because of this uncertainty, companies increasingly seek standards based solutions that allow them a greater range of flexibility as the market evolves. Although companies may want to avoid tying themselves too much to any one vendor, the reality is that there are benefits to solutions that offer a consistent way to develop and deploy apps across many operating systems.

- **Integration to multiple data sources:** One of the most difficult parts of modern mobile application development is integration across the multiple back-end data sources to which a single client-side app must connect. The fact that the app must connect to back-end data sources behind a company firewall has posed enough of a challenge in the past, but now apps often have to connect to enterprise and consumer cloud services as well. Managing identity and APIs across all of these different data sources is a key source of complexity for mobile enterprise application development.

- **Focus on design:** In the new consumerised world, it is of utmost importance that mobile applications engage users. Doing so requires a laser focus on the user experience, or UX of the application. Designers, developers, line of business, and IT must be in a constant feedback loop of communication to deliver apps that drive return on investment.

- **Focus on Testing:** Mobile adoption, use of social media and the infinitely growing number of mobile applications has taken most companies (particularly European) by surprise. IDC finds that mobile application testing is one of the biggest unresolved challenges that organisations face, and that QA teams are playing catch up on formulating a mobile strategy and on testing mobile applications. IDC data suggests that approximately 75% of large organisations will be testing mobile applications in 2014, with 40% opting to use third party services.

2.1.3. Technology Adoption and Impact on Skills Needs

As mobility allows end users and customers to access information from anywhere, using new mobile specific application, life is becoming easier and more convenient. Conversely, from an IT management perspective, complexity has increased, which leads to new requirements in terms of skills (see Table 10 and Table 11 below).

- **Management** is more complex due to the multiplicity of platforms, OS (iOS, Windows, Android, etc.) and the faster pace of change. Support specialists will need to update their skills more regularly, and be able to work across different platforms. Alternatively, the IT function within enterprises will need to recruit more people to cover all technical requirements 24x7.
- **Application development skills** will shift towards mobility and mobile operating systems. Systems management skills will need to cross the gap between the traditional and mobile infrastructure, to ensure an end-to-end service.
- In addition, a higher number of skilled programmers and developers will be required to update, build and support the fast changing mobile application landscape.
- The mobility trend puts pressure on the IT departments to understand the business' demand for mobile interfaces, often driven by what the end-customer wants and how he/she interacts with the organisation. This requires hybrid skill sets that can bridge the gap between technology and business needs, i.e. e-leadership skills.

Table 10 Mobility Impact on e-Skills

	e-Skills		
	Infrastructure	**Application**	**General**
Increased demand	Mobile tech support skills + integration with traditional ones Enhanced security skills btw corporate and consumer environments Mobile network skills to optimise operations	Mobile apps development and testing skills	IT asset management and governance expertise
Decreased demand	Demand for traditional PC and desktop support skills	Demand for traditional IT apps and services support	

Source: IDC, 2014

Table 11 Mobility Impact on e-Leadership Skills

	e-Leadership Skills		
	Management	**Hybrid Business/IT**	**Industry-specific**
Emerging demand	Redesign of business and marketing strategies	Analysis and understanding of customer/business demand for mobile interfaces	Design of new products and services based on mobility

Source: IDC, 2014

2.1.4. Skills Implications for SMEs

Enterprise mobility is one of the key drivers for IT spending among SMEs. The fast growth of smartphones and tablets, the escalation of bring-your-own-device (BYOD), and the need to empower an increasingly mobile workforce affect also the SMEs.

Mobile solutions hold strong potential to European SMEs. Just as with large enterprises, customers (and employees) will also expect to access applications and interface with SME via mobile devices. For SMEs with legacy installations, they may need to hire skills in-house or use external service providers to develop and implement these mobile application front-ends.

This will require enhanced IT and business skills to understand the mobile environment, but also new security and governance policies as well as integration capabilities (to fully enable and leverage "mobile business processes").

Further, SMEs that do not have access to the e-leadership skills needed to react quickly in terms of addressing new customer requirements may find themselves at a competitive disadvantage. Last, but not least, mobility represents a huge opportunity for mobile application developers of all sizes, including one man companies and/or SME start-ups.

3. Cloud Computing

3.1. Description of the Trend

Cloud computing is rapidly gaining widespread adoption throughout enterprises of all sizes. The main promise of cloud computing is that it reduces IT costs while increasing flexibility. There are different types of cloud computing:

- Hosted public cloud (all public cloud is hosted)
- Hosted private cloud
- On-premises private cloud

The hosted public and private cloud services comprise of three main types of service:

- Software-as-a-service or SaaS (includes applications, such as CRM, and infrastructure software, such as security software). The vast majority of SaaS services are public cloud services, in other words offered as a shared service to anyone with the means to pay.
- Platform-as-a-service or PaaS provides a range of services for building and running applications. PaaS is usually a public cloud service.
- Infrastructure-as-a-service or IaaS (servers and storage). IaaS is widely available as public and private cloud services, the latter meaning that the vendors use dedicated, and often isolated resources to supply the service to each customer.

The third type of cloud computing - on-premises or in-house private cloud is where an enterprise's IT system is built using the same or similar architecture to hosted public or private cloud systems, but it is used to provide a shared service only to users within the enterprise.

Organisations of all sizes, including SMEs, are attracted to the cloud promises of increased flexibility, speed and reduced cost. Yet many have concerns with the public cloud model. They are worried about security when they do not know where data is located and who could potentially have access, they worry about service performance and availability, and they find it hard to budget the variable cost. These are key reasons for the rise of private cloud, which has the same key characteristics as the public cloud, but in a restricted, either dedicated or at least firewalled environment. Of course, the restrictions come with a cost of lower flexibility and higher price, but the pooling of internal resources, automation of provisioning and self-service are often sufficient to justify a migration to a private cloud for workloads that for one or another reason are not fit for public cloud.

In addition, while uptake of public cloud is stronger than the uptake of private cloud, hosted private cloud is the fastest growing cloud model in Europe. On-premises clouds are popular mainly with clients who already have spare datacentre capacity or a large IT organisation that want to have the tight control of the operation of the physical infrastructure. While on-premises clouds were more popular in the early cloud years (2010-12) and less so in 2013-2014, and IDC expects that the future will see most interest in private cloud. Private cloud is typically a cloud at the infrastructure level, where clients will implement traditionally licensed

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application or custom developed applications. However, there is an increasing interest in using a platform for integration of the application to the infrastructure also in the private environment, though this is not a strong trend yet.

So, how mature are European organisations in their cloud adoption? IDC has identified five stages of cloud maturity, explained briefly below:

- Stage 1: Ad Hoc - beginning the exploration process to increase their awareness of cloud technology options, key considerations, and cloud's contribution toward IT efficiency.
- Stage 2: Opportunistic - experimenting with more standardized offerings and developing short-term improvements regarding access to IT resources via cloud.
- Stage 3: Repeatable - enabling more agile access to IT resources through standardization, identifying cloud best practices, and increasing governance.
- Stage 4: Managed - expanding the boundaries of how and why they use cloud.
- Stage 5: Optimized - driving business innovation through seamless access to IT resources from internal and external service providers and making informed decisions based on the true cost and value of those services.

It should be noticed that not all cloud user companies would necessarily complete the maturity journey to the last stage. For example, some of the more traditional SMEs may never progress beyond the opportunistic stage, while high tech SMEs will jump ahead to the optimized stage, and start-up may even be born with a cloud-only infrastructure.

According to IDC European CloudTrack survey of 304 European organisations conducted in October 2013, 97% of European organizations are currently in the process of either educating themselves about the cloud model, evaluating cloud services for specific workloads, planning the implementation of a private or public cloud service or actually implementing a private or public cloud infrastructure or service.

The survey also shows that there are two waves of cloud adoption. Organisations that started about five years ago - being early adopters of cloud services - have now reached the final two stages of managed (26% of respondents) and optimized (12% of respondents). The second wave of companies has only started 1-2 years ago and is still at the ad hoc (13% or respondents) and opportunistic (22% of respondents) stages as shown in Figure 4.

However, more than one in ten of European respondents have not even started their cloud journey or are only just getting into it, which would be the late adoption segment of the market.

Comparing that view with European organisations' expectation for their own cloud maturity 24 month from now, it becomes apparent that many organisations will have moved along the maturity curve. As expected, there will be fewer organisations on the early stages of cloud maturity (too soon to tell, ad hoc and opportunistic), while more than double the number of organizations expect to be at the optimized stage of cloud maturity.

Previously, IDC estimated that progress through the stages of cloud maturity could take an average of 4-5 years. The advances in technology

like the availability of converged infrastructure for cloud deployments, better automation and orchestration tools, as well as best practices may enable organizations to accelerate the maturity process to some extent, perhaps even a year less or so. However, organizational change takes time and this is a barrier against compressing the maturity process further.

Figure 4 Cloud Maturity of European Organizations

Q. Which statement best describes your organization current Cloud strategy and your desired Cloud strategy 24 months from today?
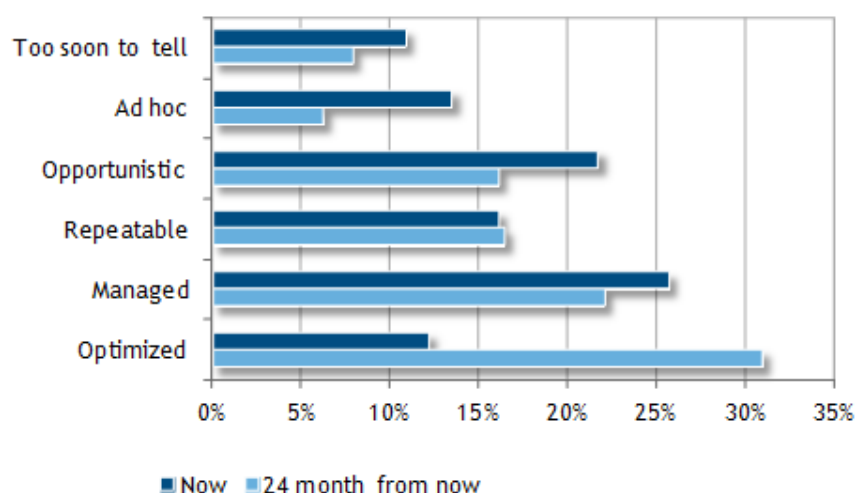
Source: IDC, 2014

3.2. Technology Adoption and the Impact on Skills

As shown above, European organisations are standing at a turning point in cloud adoption. Much of the activity has been ad hoc to test the waters but they are now moving to a strategic approach, where cloud is the chosen model for future IT delivery. The consequences of this shift are substantial:

- Organisations start to think of larger scale migrations of their existing environments, including business critical applications. This drives a strong focus on architecture. A cloud strategy is different from other architectures in that it is less prescriptive for all the parts, instead it will have an architecture as the underlying principle for how and where applications should be implemented, and how they should interact.
- The growing adoption puts integration in focus. In the ad hoc period, integration was of little interest, but with IT for complex processes going to cloud, integration between applications and data management becomes important. Large organisations are aware of that and starting to address these issues – and so are vendors. SMEs are typically slightly behind in adoption and still take an ad hoc approach but will need to consider the integration.
- Private cloud is substantially more complex than public cloud, and whereas technical skills requirements are limited for public cloud, they will be needed to a higher degree for the private cloud.
- Hybrid clouds are the emerging model for cloud adoption – starting as a mix of public and private cloud, leading to a wish to move workloads between the different types, for instance to

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develop and test in a public environment, but operate in a private environment, or to run stable production loads in a private environment for the sake of a better business case, but using the ability to "burst" into public cloud for extraordinarily high usage, provisioning public cloud resources for the surplus capacity requirements. As technologies mature, this will become an attractive model, but it will require an underlying architecture and integration model to keep control over data, performance and cost.

- There is a growing interest in hybrid solutions, such as disaster recovery, where a private environment is backed up to the public cloud and in case of disaster recovered to a public cloud quickly while the private environment is rebuilt.

All of this means that organisations need to change their skills base to be able to take advantage of the cost, flexibility, and other benefits that can be derived from cloud services. Increasingly the IT skills required are not those of "keeping the lights on" or building new IT systems, but learning how to best select, configure and combine a wide range of cloud services, either with the "legacy" on-premises systems or a wide range of other cloud services. This requires not just a different skill set but also a different mindset from dealing with in-house IT. It also requires a degree of flexibility – often being able to define what is needed from a service, then identify and re-use existing capabilities within the services to fulfil these needs.

Table 12 Cloud Impact on e-Skills

	e-Skills		
	Infrastructure	**Application**	**General**
Increased demand	Cloud technology skills requirements considerable for private cloud: at infrastructure, application, and management and integration levels	Security management skills	Selection, configuration, combination, orchestration of cloud services, either public, private or hybrid
Decreased demand	Operational skills for corporate IT systems	Demand for security skills may decrease for public cloud users	
	Demand for maintenance of infrastructures, applications		

Source: IDC, 2014

Table 13 Cloud Impact on e-Leadership Skills

	e-Leadership Skills		
	Management	**Hybrid Business/IT**	**Industry-specific**
Emerging demand	Management of relationship with cloud providers/ contracts/ SLA Strategic management of data protection/ privacy issues in cloud environment	Analysis and understanding of cloud potential to meet new customer/business needs Management of interaction with business line managers	Design of new products and services based on cloud + mobile, big data, social...

Source: IDC, 2014

A very interesting point around cloud, which will only be answered over time, is the degree to which work force will be substituted by software in automated implementations. This will have a substantial impact on which skills a user organisation will need. At the moment technical skills requirements are considerable for a private cloud environment – at infrastructure, application, and management and integration levels – but as software companies increasingly launch software that automate many of the tasks, deep technical knowledge will not be needed. Technical understanding will only be needed for the company's specific configuration and/or adaptations and combinations, requirements that many will look for external skills to cover, which is one of the reasons for the choice of hosted solutions.

As even private clouds become automated the most important skills will be to understand the technology to a sufficient degree to make it effective for the business, i.e. understand the potential for change of business processes and client interactions offered by cloud in combination with the other Third IT Platform technologies of mobile, social and big data.

The most critical concern towards public cloud today is security. However, this is expected to change. Firstly, technologies will improve and better solutions to the issue will become available in a few years' time. Secondly, users will become accustomed to the cloud and develop a more realistic view. This will drive an increasing shift from private cloud solutions towards shared clouds – virtual private cloud or public cloud. Over time, this will mean that growth in private clouds will lessen, but within IDC's five-year forecast period, there will be more migration from non-cloud to private cloud, than from private cloud to public cloud, and continued growth in private cloud is expected over the next five years.

3.3. Skills Implications for SMEs

SMEs have the potential to benefit greatly from public cloud, but they also have some significant skills challenges. The skills they require include:

- Identifying the organisation's needs and selecting the appropriate services to adopt. There is a lot of hype in the cloud services market, and SMEs need to have the skills to evaluate the best service for the business. Often the employees themselves play a strong role in this process, but there still needs to be input from

the IT discipline to ensure compatibility with any existing systems or services and the actual requirements.

- Configuring the services to the organisation's needs. While some cloud services are very simple and need little or no configuration, others require configuration to make them fit the organisation's needs. Often the best people to do this are "power users" or administrators of the service, with assistance and guidance from IT staff. Another issue is that applications may often require the transformation and upload of data from any legacy systems that they replace. These are areas where IT skills are required, as well as a good understanding of the business and how it works.
- Administering, monitoring and dealing with changes in the cloud services that are used. Although the vendor does most of the work, there are still some aspects that the user organisation has to take care of, in particular administering the users and ensuring that any integration to other systems is maintained. On the latter point, public cloud applications tend to evolve over time, adding new functionality that may or may not be useful to a particular customer, and occasionally removing or re-designing existing functionality, which may require some work-around. Ideally, the latter should be minimized by the user organisation's IT staff and user-administrators keeping themselves familiar with the cloud vendor's roadmap.
- For most SMEs, public cloud represents a higher degree of security than what they have today, simply because the cloud providers deal with security in a professional, continuous fashion and has a lot at stake. Consequently, while SMEs may currently to some degree shy away from public cloud services because of security concerns, over time it is expected they will indeed turn to cloud to improve security. This will decrease the security skills that they need in-house.

4. Big Data

4.1. Description of the Trend

Big Data is a broad and multi-faceted topic. Big Data technologies describe a new generation of technologies and architectures designed to economically extract value from very large volumes of a wide variety of data by enabling high-velocity capture, discovery, and/or analysis.

When using this established model of the four Vs (Volume, Variety, Velocity, and Value) to describe Big Data, the challenges for data capture and data storage become apparent:

- **Volume:** One of the aspects of Big Data is clearly large volumes of data. Organisations today are not only capturing the traditional structured data from their transactional systems, semi-structured data from their email and file sharing systems, but also machine-generated data, sensor generated data, traffic from social media streams, which are all high velocity and high volume data sources. The volumes of data generated by machines (airplanes, cars, production systems, GPS connected devices etc.) are significantly higher than the volume of traditional transactional data. Organisations need to decide if they want to store all the information that flows through their organisation, or if they want to analyse it on the fly and only store the results of the analysis. They also need to understand the regulatory frameworks that govern the new data types and the correlating retention periods.
- **Variety**: Organisations are adding new data sources to the mix of data. These new data sources raise new questions about which data to keep, which data to delete after use, and what is the regulatory framework that governs them. Information management and information governance are required to answer these questions.
- **Velocity**: This relates to capturing data at high speed and making it available for real-time analysis. Doing this makes Big Data processes expensive.
- **Value**: The value function of the Big Data model points towards the balancing of cost versus value of information. Organisations need to be sharp on their information governance and management processes and need to determine if their Big Data store is business critical

4.1.1. Capturing and Storing Big Data

Big Data refocuses companies on the old topic of information lifecycle management. Storing all the data might not be an option, as many organisations are running out of datacentre space and cannot just add new storage arrays to solve the problem. Technologies like dynamic storage tiering, data deduplication and archiving come to bear to contain data growth at least to some extent. However, even the use of these technologies will not be enough to store the large volumes of data in a cost efficient fashion. IT vendors like HP are currently developing the next generation storage technologies like memrista that can store significantly more data at better energy efficiency.

Big Data re-invigorates the importance of proper information management and governance processes, as the data landscape is getting far more complex, and much harder to manage due to its large size. Intelligent decisions need to be made about which data to keep and which data to delete. These processes can be supported by software that can understand the content of the data (files, emails etc.) and take automated decisions about retention requirements and deletion.

If data needs to be captured at high speed and made available for real-time analysis, high performance storage systems are required to achieve the speed of capture and speed of analytics. One of the promises of Big Data technologies is that they are more affordable than traditional storage and analytics systems. Consequently, organisations need to balance their need for high performance with cost considerations and use open source technologies that enable capture and ingestion at high speed with lower cost storage technologies.

4.1.2. Big Data Analytics

In one sense, Big Data Analytics is an evolution of business analytics, as it has been known under various names for over two decades. However, from a technology perspective, Big Data comprises a set of genuinely new technologies (e.g., Hadoop, highly scalable databases, advanced data visualization tools, and high-performance search engines) and a convergence of more mature technologies (e.g., event-driven processing, business intelligence or BI, and data mining). One thing is certain from two decades of experience with business analytics — to embrace fully Big Data, organizations need to be dedicated and determined to embrace a more information-led culture. While Big Data Analytics is becoming mainstream in North America, but Europe has lagged until now.

There are three main reasons for this:

- European organisations and their data sets are generally smaller, so organisations expect to see fewer benefits and less economy of scale from Big Data. In essence, this means that creating the business case for the significant investments needed for Big Data can be harder to justify.
- Big Data is still a relatively new area and at this point the lack of skills development around the new technologies is a potential barrier to adoption
- The economic climate has made organisations more cautious when looking at new investment areas like Big Data. Organisations are cautiously evaluating business cases and potential return on investment. As mentioned above, for many the business case for Big Data is harder to justify.

However, activities are starting to pick up, driven by the increase in information and awareness of best practices coming from North American markets, the rapidly evolving enterprise versions of open source frameworks like Hadoop and Cassandra beyond the very early stages, and adoption in highly advanced segments with a high-profile presence in Europe such as online gaming. Vendors including Cloudera, Hortonworks, and MapR are entering the European market, and this factor should be reflected in broader adoption of Hadoop.

## 4.2. Technology Adoption and its Impact on Skills

Big Data is still not embraced by European organizations at large (see figure 5). According to IDC's European Vertical Market Survey in October 2013, only 23% of European organisations said they have adopted Big Data.

However, considering that Big Data is a relatively new concept, this is quite a high adoption rate. The same survey shows that another 7% of respondents are expecting to adopt Big Data in the next 24 months.

Nevertheless, almost half of European organisations have no plans for adoption at this point underlining firstly the uncertainty of business case justification and secondly that adoption is still concentrated on in larger enterprises and verticals such as telecom/media, banking, and oil and gas, where business analytics technologies have been widely adopted in the past.

A gap between early and late adopters as well as between large enterprises and SMBs will continue to exist in the short to medium term.

Figure 5 Big Data Adoption in Europe
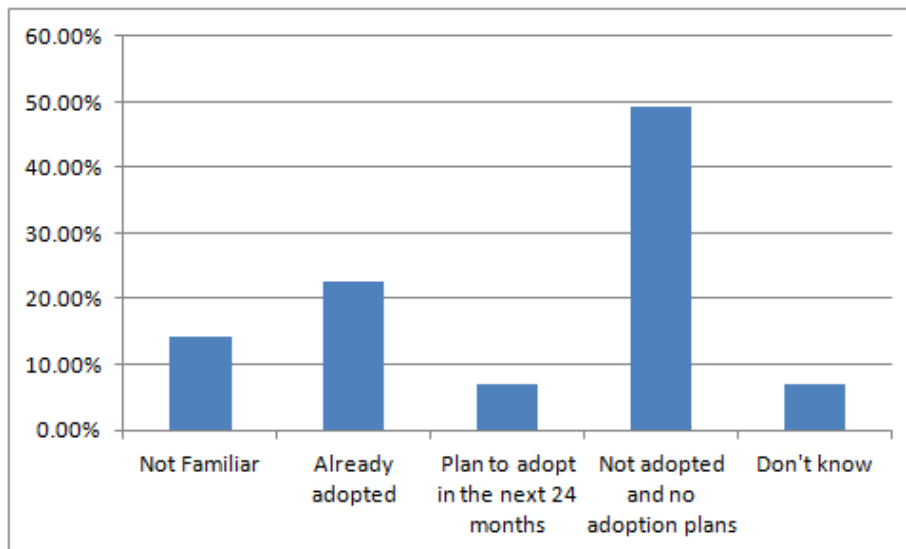
Source: IDC's Vertical Markets Survey, 2013 (% of respondents)

One of the barriers to adoption is lack of skills. This relates both to IT staff able to implement and maintain the appropriate advanced technologies and the insufficient number of analysts able to correctly interpret the data and generate actionable information for the businesses creating value.

In particular, a key element of Big Data is the newest technology involved, Hadoop, an open-source processing framework that allows large analytical queries to be broken down to many small queries that can be run in parallel and then reassembles the results into one data set. Hadoop skills are in short supply, and experience in building, implementing, and managing Hadoop environments is even rarer, although the ecosystem is expected to grow very quickly. Currently, the vast majority of Hadoop projects are pilots and proofs of value, and there are very few live production environments in Europe. This lack of skills extends also to other technologies, such as Cassandra and NoSQL databases.

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The role of the statistician has been reborn with the rise of Big Data, combining analytical and statistical skills with some level of business understanding to create the "data scientist". The job of the data scientist is to bring the data together from diverse datasets and then explore it to find patterns, trends and insights. By necessity, the data scientist has in-depth knowledge of statistical tools and techniques, but also needs either the business acumen to apply what they have learned to the organization, or the communication skills to explain the implications of their findings to business executives. Data scientists continue to be difficult to find.

In addition, business analytics skills with particular industry-specific expertise are in high demand. This means that people with a mix of business and IT skills are needed with the creativity to imagine and realize data's full potential, in addition to business analytics strategy and project management capabilities. The challenge is that the skills are rare; due to the nascent state of the market, experience is scarce and expensive when it exists.

Table 14 Big Data Impact on e-Skills

	e-Skills		
	Infrastructure	**Application**	**General**
Increased demand	Skills on Big Data technologies (Hadoop, Cassandra, NoSQL databases)		Data protection/ privacy protection skills
Decreased demand	None obvious	None obvious	None obvious

Source: IDC, 2014

Table 15 Big Data Impact on e-Leadership Skills

	e-Leadership Skills		
	Management	**Hybrid Business/IT**	**Industry-specific**
Emerging demand	Strategic management of data protection/ privacy issues in Big Data environment	Management of interaction with business line managers	Combination of business analytics skills with industry-specific skills and understanding of Big Data Design of new products and services based on big data + mobile, cloud, social...

Source: IDC, 2014

4.3. Skills Implications for SMEs

Big Data is currently really a large-company play. This in part reflects a lower need for Big Data technologies in the SME area. Indeed, nearly one third of European companies with less than 100 employees believe that the current explosion of data will have a limited or no effect on their companies (against only 13% of companies with more than 5000 employees).

Nonetheless, many SMEs feel similar pressures of large companies in the management and analysis of an increasingly high number of unstructured data and IDC expect analytics to become increasingly appealing to European SMEs, especially to mid-market organizations. Finding scarce skills is a significantly greater challenge for resource-strapped SMEs. SMEs should look for cloud-based services that shield the organisation from technical specifics and allow them to leverage new Big Data technologies from a standard query layer, for example SQL over Hadoop.

5. Social Business

5.1. Description of the Trend

Social business is the umbrella term that includes all of an organization's enterprise social activities, both internal and external. IDC distinguishes between social marketing, the use of social tools and techniques, and reaction to social data, as an external process, and enterprise social networks as the internal use of social techniques in order to facilitate collaboration, knowledge sharing, and support business processes to deliver a better experience in the communication with the stakeholder. Figure 6 below shows the main elements.

Figure 6 Social Business Elements
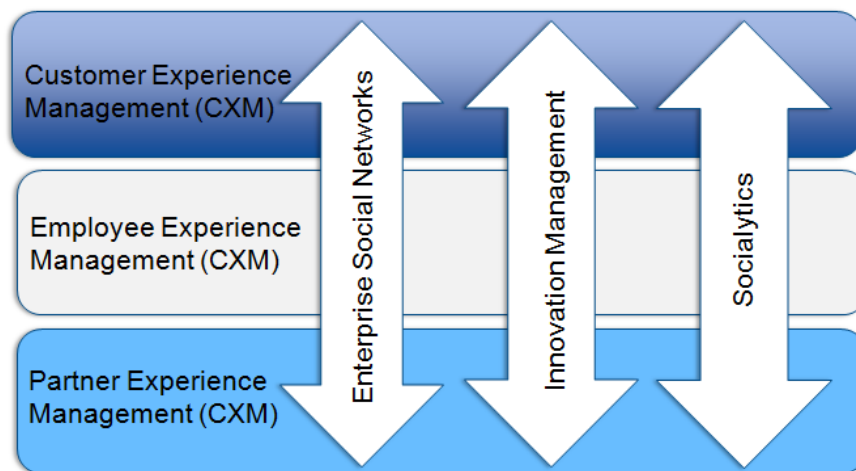
Source: IDC's Social Business Taxonomy, 2013

Enterprise social networks, with the subtheme of innovation management, have an impact in every aspect of a business, with the primary impact being on a business model or an organizational strategy. More broadly, an enterprise social network should connect all constituents that interact with employee, customer, partner, and supplier networks and will eventually be inherent in the way businesses operate, although this will take many years.

By soliciting the preferences and opinions of customers, partners, and suppliers, companies can begin to create a deeper connection and commitment in the context of business operations. Although it may seem like a rather simple task, managing the process from ideation (the process of soliciting and generating ideas) through **innovation management** (the process for creating innovative products and services) can be quite complicated. The main impacts of innovation management are:

- End-to-end innovation life-cycle process
- Enabling open innovation through crowdsourcing ideas and feedback
- Increasing customer, partner, and employee intimacy with product/service development process

Socialytics refers to the broad category of underlying analytic tools and applications that can be used to analyse social data being created through socially based interactions. This umbrella category embraces a large number of existing and emerging technologies that can be applied

to understand the relationship of people to topics, ideas, locations, or other people.

Meeting changing **employee, customer, and partner expectations** is becoming a business imperative, and with this, companies are assuming a more "social" workflow. As competitive pressure rises, companies will look for innovative ways to meet and serve these needs as well as to enhance operational and strategic decision-making. The notion of "experience" highlights how social business initiatives are maturing and coming together around three main categories — customer experience management, employee experience management, and partner experience management. Each category holds a set of social workflow impacts from both a user process and a technology perspective. Socialytics can be applied across experience scenarios and enterprise social networks to measure the impact of social processes on customer, content, and network behaviour.

Social technologies are becoming a core part of the next growth platform for IT. As the number of intelligent devices on the network outnumbers "traditional computing" devices by almost 2 to 1, the way people think about interacting with each other, and with devices on the network, is also changing.

5.2. Technology Adoption and its Impact on Skills

The social Web allows major transformation for organisations that want to leverage the marketing power of the social Web, although many organisations in Europe still act too little on this. There are several barriers to adoption:

- First, many organisations are concerned about the privacy of data.
- Second, the retention of data by various online parties is perceived as a risk by many because they lose track of company information.
- Third, it can be hard for marketers to measure and report the ROI for social Web activities — for example, if managers are not convinced of the benefits of being "liked" on Facebook, they need further persuading that social Web activities do pay off. In summary, gains can be classified into sales revenues, consumer insights, brand protection, lead generation, and call centre operations, while costs can be classified into people and technology.
- Finally, organisations are finding it difficult to integrate social media into internal business processes to fully achieve the benefits.
- Despite these barriers, in Europe the perception toward the benefits for using social technologies as a tool for marketing and acquiring feedback has increased. It is reflected in what IDC found in its annual survey among 700 end-user organizations, which showed that the top three activities around social business

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that European organizations are doing today are promotion, gathering customer feedback, and customer service[5].

The technology skill requirements for social business vary somewhat according to the specific area of social business:

- The technical skills required for enterprise social networks are relatively low; as most enterprise social networks (ESNs) are delivered over the cloud as an application targeted at administrators and end users, with a specific objective to make use and adoption as easy as possible.
- There are more technical skills required to manage the range of tools that support external-facing social business (promotion, advertising, community management, integration with ecommerce etc.) but as these activities also tend to be supported by applications rather than infrastructure, the skills required are closer to administration and business processes than technology.

Table 16 Social Technologies Impact on e-Skills

	e-Skills		
	Infrastructure	**Application**	**General**
Increased demand	Data protection/ privacy protection skills	Mobile and social apps development skills	Delivered over public cloud, so skills of selection, configuration, administration of public clouds
Decreased demand	None obvious	None obvious	None obvious

Source: IDC, 2014

Table 17 Social Technologies Impact on e-Leadership Skills

	e-Leadership Skills		
	Management	**Hybrid Business/IT**	**Industry-specific**
Emerging demand	Strategic management of data protection/ privacy issues in Social Media environment	Management of CRM-type tools used with social media (promotion, advertising, community management, integration with ecommerce etc.) Management of interaction with business line managers	Industry specific marketing skills to address best customer base

Source: IDC, 2014

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[5] For more information, see IDC's European Organizations Ramp Up in Social Business in 2013 - IDC #LP03V, July 2013

5.3. Skills implications for SMEs

So far, the uptake of social business has been stronger in large companies than in the SME market. However, usage is increasing: according to IDC survey results, just below of 30% of European SMEs (<250 employees) use social media tools for business purposes. Another 16-18% are planning investments by the end of this year.

European SMEs seem uncertain on how effectively to leverage these tools beyond marketing-oriented activities; moreover, many are – like larger organisation –facing difficulties in identifying how to integrate them effectively into internal business processes.

In theory, there is no IT skills barrier to SMEs wanting to adopt social business technologies as such. However, SMEs should focus on choosing integrated suites in order to reduce the need to transfer or integrate data between different application modules. This will certainly limit the skills requirements.

6. The Internet of Things (IoT)

6.1.Description of the Trend

A convergence of rapidly maturing technologies and markets is driving the development of the Internet of Things (IoT), which is finally moving from the "visionary" phase to real applications and services. IDC estimates that by the end of 2013, the number of installed intelligent communicating devices on the network outnumbered "traditional computing" devices by almost 2 to 1 globally. This will change the way people think about interacting with each other and with devices on the network. IDC expects that within the next 12–24 months, there will be over 3.5 billion connected industrial products (including cars, planes, and boats), appliances/toys, and entertainment devices connected and communicating over the Internet. By 2020, IDC predicts 212 billion connected devices in the world. It is a true ecosystem, as no single vendor has the ability to provide all components within an IoT solution, which involves connectivity, and data transport, devices (sensors), analytics, software platform and management, consulting and support as well as security.

What is the Internet of Things?

The European Commission's 2009 "An IoT Action Plan for Europe" used a simple, but pragmatic definition identifying IoT as "a series of new independent systems operating with their own infrastructures which are partly based on existing Internet infrastructures, including three main types of communication: things-to-person (T2P), things-to-things (T2T), and machine-to-machine (M2M). This was one of the first definitions to underline that M2M is a subset of IoT (and not the same concept with a different name). However, it is definitely too narrow and now obsolete.

IDC research has focused more on the development of a taxonomy for the IoT ecosystem (presented in the next paragraph), rather than on a synthetic definition. Insofar as IDC uses a single definition for the IoT, it is the following:

- "The Internet of Things enables objects sharing information with other objects/members in the network, recognizing events and changes so to react autonomously in an appropriate manner. The IoT therefore builds on communication between things (machines, buildings, cars, animals etc.) that leads to action and value creation".

This covers all the basics of connectivity, devices, analysis, and action.

A recent IDC report on M2M found that the M2M solutions are only just emerging because (in part) they are so complex. No one company can own the end-to end supply chain for an M2M solution because it has so many parts. So partners are needed. However, these partners will differ depending upon which stage in the lifecycle the solution has reached (plan, build, and operate). The same is true for IoT. M2M solutions comprise six core areas. The same applies to IoT too. They are:

- Hardware (including semiconductors and CPE modules) either at the customers or suppliers premises;
- Connectivity/the network to link the "thing" to the internet and other things. Through connectivity information or data can be

requested by an analytical engine in the Application, and instructions on what to do next can be communicated back;

- Applications that take the data and turn it into actionable advice. The process of analytics and creating actionable advice is the value creation behind IoT;
- Platforms and Systems that host the Applications, manage device, and enable the Applications to operate;
- Business analytics that enable insights to be drawn from the mass of data available;
- Professional Services to design, build, and manage/operate IoT solutions.

However, not all these six areas are prevalent all the time in an M2M or an IoT solution. There are three stages in the lifecycle of an IoT solution:

- The planning phase (where the solution is scoped and designed);
- The build stage (where the solution is procured, assembled, and tested);
- The operate stage where the solution is managed and maintained.

The above can be brought together into one diagram (Figure 7).

Figure 7 The IoT Solution and its Digital Ecosystem
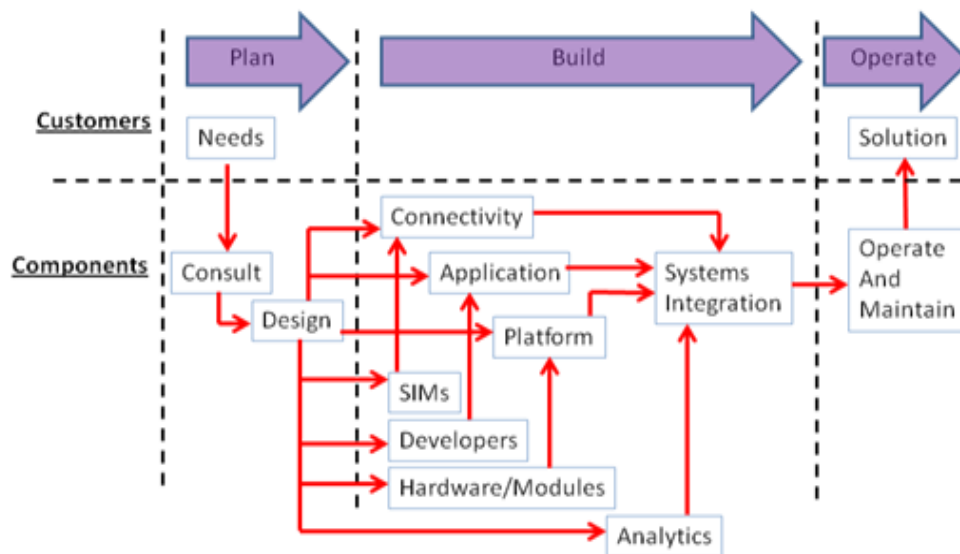
Source: IDC, 2013

6.2. Technology Adoption and its Impact on Skills

The emergence of the IoT is a global phenomenon, but there is still much discussion about the rate of growth, the most attractive market development opportunities, and the challenges to be met in a wide range of issues, from privacy and security, to the governance of these complex systems. This is a critical challenge for Europe. On the one hand, fast adoption and exploitation of IoT-based innovation could improve European competitiveness and drive much needed economic growth. On the other hand, there is a risk that the fragmentation of the European markets, and the well-known barriers to disruptive innovation and entrepreneurship in many relevant sectors (such as healthcare) may slow down diffusion and reduce the European industry in a follower status.

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Enabling technologies such as nanoelectronics, communications, sensors, smart phones, mobility, M2M, embedded systems, cloud computing and software will be essential to support IoT product innovation. Technical complexity will create a massive need for new skills. With many solutions still in infancy, demand for R&D skills is expected to be huge. IERC, the European Research Centre on Internet of Things, has identified some key areas of focus.

These areas require new R&D and IT management skills and include:

- Architecture, covering issues around object identification, virtualization and decentralization
- Security, along the entire information life cycle
- Software and middleware, supporting data flows from sensing devices and including complexity management
- Interfaces, with a focus on multi-model interface approach
- Smart sensors, with a focus on integrating sensing and reasoning capabilities into networked devices
- Testing, in relation to initial large scale projects
- Standardization, ensuring interoperability across applications
- Business models, as IoT enables new products, markets and new ways of doing business
- IoT governance, with particular reference to the governance of "Things" and with the final aim to guarantee trust, identity and liability management
- Big Data and analytics skills, as the vast amount of data generated by IoT needs to be captured, stored and analysed in order to bring business benefits
- Systems management skills for these highly integrated, automated and scalable infrastructure will also be in demand
- Vendor management skills as the number of vendors within a given IoT ecosystem can be vast, and the handling the contractual and governance relationships complex
- Hybrid business (industry) specific and IT specific skills is going to be required to realise the full potential of the technology and its promise of transforming revenue streams and business models

The potential impacts on e-skills and e-leadership skills are presented in the tables below (Table 18 and Table 19)

Table 18 IoT Impact on e-Skills

	e-Skills		
	Infrastructure	**Application**	**General**
Increased demand	Skills on Big Data technologies (Hadoop, Cassandra, NoSQL databases) Systems management skills for highly integrated, automated and scalable infrastructures		Vendor management skills for handling vast and diverse vendor ecosystems
Decreased demand	None obvious	None obvious	None obvious

Source: IDC, 2014

Table 19 IoT Impact on e-Leadership Skills

	e-Leadership Skills		
	Management	**Hybrid Business/IT**	**Industry-specific**
Emerging demand	Strategic management of data protection/ privacy issues in IoT environment	Combination of business analytics skills with industry-specific skills and understanding of IoT Management of interaction with business line managers	Analysis and understanding of emerging IoT potential to meet new customer/business needs

Source: IDC, 2014

6.3. Skills Implications for SMEs

At this point, IoT is largely a large enterprise or public sector game (RFID, Smart Grids, Smart Cities etc.) with SME being cautious towards the adoption of new technologies, especially in a tough economic environment, and are, in general, complexity-adverse. Indeed, many current IoT examples are with large organisations.

Nonetheless, a successful smart initiative calls for the coordination of all stakeholders. In a smart grid project, the idea is to combine all small and medium energy sources. In a smart city project, many city actors are to be involved, ranging from public authorities, large companies and SMEs.

Moreover, SMEs can benefit from the creation of a new smart infrastructure to rethink at their offering and portfolio. Smart buildings, for example, can offer strong opportunities to SMEs to launch new services and/or work in a different way.

Small and mid-companies with niche technical expertise tied to IoT requirements will also find tremendous opportunities in the years ahead. Other SMEs tied in the value chain of larger players in more traditional sectors such as manufacturing, logistics and retail will be pushed to move to IoT type of solutions.

# 7. Customer Experience IT: Unifying IT Investments

7.1. Description of the Trend

Customer experience IT (CXIT) refers to the IT-related investments required to manage and optimise the customer's (or a citizen's) experience with an organisation. This is a new concept reflecting the increasing convergence of innovative IT (mobile, social technologies, cloud, Big Data, IoT) into applications and services centred on the customer experience, implemented through investments made by business managers other than CIOs. This means also that the IT investment decisions in the organizations are migrating from the IT department to other departments, primarily marketing and customer service but not only.

This IT-related investment can include software, hardware, or services (Figure 8) as follows:

- Software can include systems that interact directly with customer/citizen, such as e-commerce applications and apps for tablets and other smart mobile devices. However, it can also refer to applications that optimise the organisation's interaction with the customer/citizen, aimed at making these interactions more relevant, useful or profitable. This latter category might include analytics software that allows the organisation to understand customers/citizens better and uses this understanding to improve services to them and to develop better offerings for them;
- Hardware can include kiosks and interactive displays that allow quick and easy interaction with the organisation;
- Services can include those services that interact directly with consumers/citizens, such as customer care services. However, services can also mean those services that organisations buy in order to select and deploy CXIT-related products and services more effectively, such as consulting and IT development and implementation services.

Figure 8 Customer Experience IT Perimeter and Ecosystem

Source: IDC, 2014

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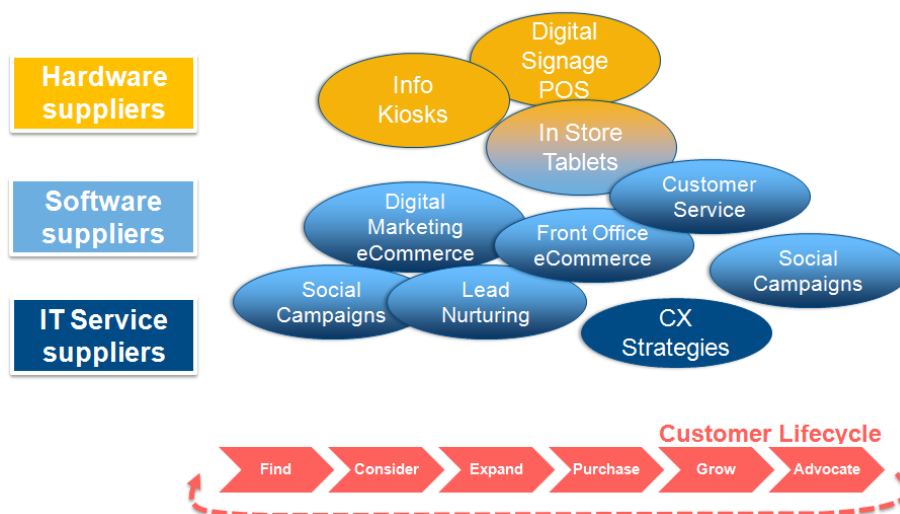
Organisations have been spending money on what is here termed CXIT for decades, but it is only in the last two or so years that this has become a discrete and urgent area of technology spending for European organisations. There are several reasons for this.

Firstly, expectations of how people interact with organisations through technology are changing. Organisations and consumers alike are moving to a new, next-generation IT paradigm (the Third IT Platform), and this is creating radical new expectations about technology usage among consumers, business customers and indeed employees.

The chief elements of the Third IT Platform are mobile devices (and the applications and serves that run on them), social media, cloud and Big Data. Together, they constitute an unstoppable "wave" of new technology that is as profound in its effect as was the arrival of the networked PC and the web browser in the 1990s, and this wave of change is something that enterprises and public bodies simply have to incorporate and adapt to. People in their overlapping roles of consumer, business customer and citizen increasingly want personalized services (often using social media, and almost certainly powered by heavy-duty analytics) delivered over smart mobile devices such as tablets and smartphones, often delivered through the cloud.

Crucially, customers/citizens are importing Third IT Platform technologies and services into the workplace and are expecting to use them when they communicate with the public sector, meaning that they are expecting the level of ease-of-use and enjoyability as employees and citizens that they get as consumers. That means that in the world of the technology 3rd Platform, creating an enjoyable and fruitful user experience (UX) is important not just for consumer-facing organisations, but for business enterprises and public-sector organisations as well.

This change in expectations is strengthened by the arrival in the economy and the workforce of "digital native" workers, consumers and citizens who have only ever experienced ubiquitous, highly mobile "always on" internet-based ICT services. Digital natives are taking their (high) expectations of personal technology and online services use from their personal and school lives into the world of business and public service.

Smart mobile devices may be intuitive to use, but for the organisations (such as retailers) trying to sell products and services over these devices, and for the social media and other advertising-funded organisations trying to win "eyeballs" and drive up usage over these devices, they are very different from the PC and laptop environment. In addition, they not necessarily easy to understand and exploit as a channel market – screens are smaller, sometimes much smaller, and the web browsing experience is generally degraded on smartphones, for example. Customers punish poor consumer/ customer experiences on smart mobile devices more brutally than on PCs and laptops, meaning that UX (user interface) design becomes more important in the world of tablets and smartphones.

Currently, for example, many consumers using tablets and smartphones prefer to use dedicated apps to interact with their favourite brands and online services, rather using mobile web browsing. Apps are tightly designed to make consumer interaction easy and fast, and they provide utility-generating services to consumers by sending them "push notifications" of offers, news, gossip, discounts and so on. Dedicated

apps are currently popular with users of smart mobile devices precisely because they – or at least the best ones - are specifically designed to provide the maximum utility (and fun) with the minimum "friction" (hassle) during online surfing. A well-designed app can drive customer engagement, satisfaction and revenue, and can therefore be a competitive differentiator. Commercial and public organisations alike have to deal with this change in online behaviour.

Secondly, commercial organisations are being forced to look more than previously towards revenue growth, as opposed to cost cutting, in order to drive new value creation. More than five years after the fall of Lehman Brothers that triggered the "credit crunch" and the subsequent economic downturn, organisations in the public and private sectors alike are still focused on streamlining their operations and controlling their costs. However, most of the "low hanging fruit" of cost cutting has already been "picked" – the scope for major new cost cutting programs is tending to diminish as organisations begin to reap the first generation of cost reduction programs put in place in 2009 onwards. While using IT to cut and control corporate costs will remain a priority for a long time for IT buyers (indeed it will probably remain a priority forever), it is nevertheless the case that organisations are being forced by necessity to look more to top-line growth for value creation, as the payback from new cost cutting projects gets smaller.

CXIT technologies aim to increase customer/citizen satisfaction and loyalty and (in the case of commercial organisations) to monetize existing customers better and to identify new revenue streams. They are therefore a potentially important tool in driving up the organisation's top line.

7.2. The Impact on Skills Requirements

There are several technical and business skills demanded for organisations to take full advantage of CXIT, many of which are closely related to the above underlying technology areas described.

They are the following (see Table 20 and Table 21):

- Application and website design specialists focused on UX. CXIT obviously drives demand for UX (user experience) design specialists whose role is to ensure that apps and web pages are attractive, easy to use and deliver the maximum utility and enjoyment for users
- Application and website developers and testers. CXIT priorities will continue to drive demand for developers and testers of customer/consumer focused apps and websites during our forecast period [to 2018?]. These skills are likely to be kept mostly onshore, due to the need for fast turnaround and close collaboration involving physical proximity with people from the "business side"
- "Agile development" specialists. CXIT technologies will often be deployed in consumer-facing or citizen-facing environments and will require constant and fast improvements / evolution, and indeed even those deployed for business-to-business purposes will need to be capable of fast and iterative development. For these reasons, we expect "Agile" development to remain an

important (if not the dominant) development technique for new CXIT applications.

- IT architects and security. CXIT projects will fail unless they are properly architected and they fit into the overall IT strategy and infrastructure of the organisation, and unless they are secure and robust. This means that the organisation needs to involve architects and security specialists, and the CIO / IT department will need to be involved in planning, deployment and support in order to ensure that new CXIT deployments are properly integrated with the rest of the IT estate.
- Big Data and analytics specialists. CXIT will generate – and will use – enormous amounts of consumer/customer/citizen related data, and will drive demand for Big Data and analytics specialists.
- Business analysts and consultants with strong understanding of CXIT products and services. CXIT technologies will generally be deployed into business-critical contexts; their success will be important to driving up the loyalty and satisfaction of the organisation's customers (or citizens) and indeed to driving up enterprise revenues. This will mean CXIT will – when done properly – be implemented as part of business-led (rather than technology-led) projects, which means that the organisation needs to deploy executives, analysts and consultants with a strong understanding of both CXIT and the commercial and business needs of the organisation.

Table 20 Impact of Customer Experience IT on e-Skills

	e-Skills		
	Infrastructure	**Application**	**General**
Increased demand	IT architects and security.	Application and website design specialists focused on UX. Application and website developers and testers "Agile development" specialists	
Decreased demand	None obvious	None obvious	None obvious

Source: IDC, 2014

Table 21 Impact of Customer Experience IT on e-Leadership Skills

	e-Leadership Skills		
	Management	**Hybrid Business/IT**	**Industry-specific**
Emerging demand	Chief Digital Officers Business analytics and marketing skills based on strong understanding of CXIT products and services	Complementary CXIT and industry-specific business skills	Management of customers loyalty and satisfaction in business-critical contexts with a focus on revenue generation

Source: IDC, 2014

7.3. Skills Implications for SMEs

The demands on SMEs are similar to those of larger enterprises. Customers will expect the same type of interaction with smaller companies as with larger. Addressing this issue is a question of competitive advantage for SMEs. Without constantly improving the digital front end to service customers, SMEs are likely to lose out to larger competitors – or indeed to more pioneering SME peers.

8. Diffusion of ICT and Staying Safe: IT Security

8.1. Description of the Trend

Today's global economy increasingly relies on data and information carried through the internet. A broad variety of information assets ranging from credit card numbers, social security numbers, email addresses and passwords to highly valuable intellectual property and nation-state's information are stored digitally and transferred through communication networks. The protection of these information assets underpins the sustainability and profitability of small to large organisations and the effectiveness of government bodies.

IT security is increasingly becoming a CxO level discussion rather than a mere technology issue as high level executives are more aware, not only of the potential financial impact of a security breach, but also of potential irreversible damage to intangible assets such as brand, reputation or intellectual property.

With the adoption of new technologies and the continued expansion of organisations' IT environment, the growing number of cyber-attacks is increasing in complexity and sophistication whilst also becoming more difficult to detect. Organisations and their confidential data are being targeted with attacks carried out by professional hackers working together in a more organised manner.

Technologies, such as virtualization and cloud, make the once valid paradigm of securing the enterprise perimeter no longer effective, as the physical perimeter is not clearly delimited anymore. As a result, the explosion of security threats and attacks are overwhelming organisations' IT departments. IT departments have to manage, process and translate literally millions of security threat-related messages every day. This daily deluge of security data is being generated by the numerous 'point' security solutions deployed across the enterprise: firewalls, intrusion prevention and detection, access control, identity management, anti-virus, etc.

This reality is also reflected in how high security is on the investment agenda of IT departments. According to IDC's European Enterprise Services Survey of 732 Western European organisations, IT security is the most important investment area in 2014 across all countries regions

Figure 9 Security Tops the Investment Agenda

Q: Which of the following Back Office technology areas represent an investment priority for your organization in the next 12 months? Percentage of organizations rating each area as "High" or "Essential" priority
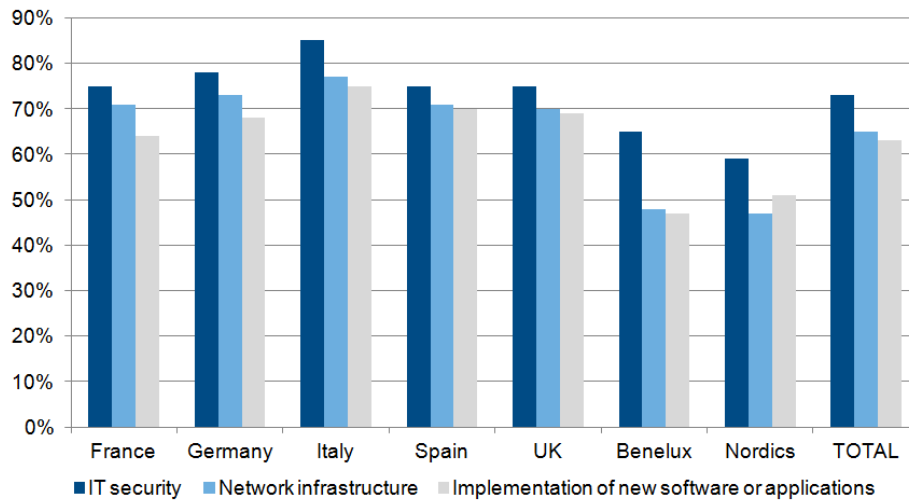
Source: IDC's European Enterprise Services Survey, 2014 (% of respondents)

8.2. The Impact on Skills Requirements

Amidst this increasingly complex IT security environment, the Chief Information Security Officer (CISO) is being elevated to an executive level role. CISOs are expected to have a strategic business leadership responsibility rather than a technical focus. CISOs are expected to ensure the security strategy is in line with the business strategy and to ensure information assets are protected over time. Because of this change in a CISO's job description, CISOs now require larger budgets and an increasing number of skilled resource to ensure they is able to fulfil their responsibilities and achieve their objectives.

A broad variety of IT security skill sets is essential to ensure organisations have the right personnel in place. These include assessment of an organisation's requirement to comply with the necessary regulations and standards, conducting security audits internal to the organisation and at an organisation's service providers, ongoing management of IT security operations, delivery of security awareness training, etc.

Each of these functions requires specific technical and business skills such as:

- **Standards and regulations certifications and skills**, such as the ISO/IEC 27000-series, the EU Data Protection Directive (95/46/EC), Electronic Communications Directive (2002/58/EC), Sarbanes Oxley, Information Technology Infrastructure Library (ITIL)
- **Professional and product certifications**, such as Cisco, CheckPoint, and RSA to name a few etc.
- **Industry certifications**, including PCI-DSS (Payment Card Industry Data Security Standard), and ISA/IEC-62443 (secure in industrial automation and control systems)

- **ISACA Certification and frameworks**, such as Control Objectives for Information and Related Technology (COBIT), Certified Information Systems Auditor (CISA), Certified Information Security Manager (CISM).

This is not an exhaustive list but presents some of the most common skills currently needed by IT security departments of public and private sector organisations to secure sensitive data and applications (see Table 22 and Table 23)

Table 22 Impact of IT Security e-Skills

	e-Skills		
	Infrastructure	**Application**	**General**
Increased demand	Professional and product certifications, Industry certifications ISACA Certification and frameworks Design and management of end-to-end protection of emerging smart networks and cyber infrastructures		Skills to design and implement sophisticated identity and access management solutions Standards and regulations certifications and skills
Decreased demand	None obvious	None obvious	None obvious

Source: IDC, 2014

Table 23 Impact of IT Security on e-Leadership Skills

	e-Leadership Skills		
	Management	**Hybrid Business/IT**	**Industry-specific**
Emerging demand	Strategic business leadership responsibility rather than a technical focus (CISO role) Develop and implement the company's security strategy coherently with the business strategy, insuring that information assets are protected over time	Management of interaction with business line managers	

Source: IDC, 2014

The constant and rapid evolution of both technology, threat landscape and attach sophistication force organisations to reassess their security posture on a regular basis. Furthermore, these constant changes oblige the IT security industry to develop new products (software and hardware) and regulations in order to remain capable of offering an effective protection against cyber-attacks. These industry developments are increasingly widening and constantly changing the range of skills required within IT security departments and making investments in developing those skills necessary.

Public and private sector organisations that recognize this trend and act in advance to invest and develop security skills and put in place

appropriate security products will be in a much better position to secure their information assets.

8.3. Skills Implications for SMEs

Although most SMEs may not get under as frequent attacks as "household names" companies, the security threat is as real for smaller companies as for large and as much of a concern, particularly since most SMEs are not able to deploy the same number of resources towards IT security protection. However, for SMEs that are looking to deploy security skills internally rather than engage a managed security service provider, in addition to the above skills there are specific security certifications for smaller organisations, such as IASME, a UK-based standard for Information Assurance at Small to Medium Enterprises.

However, lack of skilled resources (IT security experts instead of IT generalists) is a strong inhibitor in SMEs, as many small and mid-companies do not have the ability to set up effective security governance programs. Effective security governance would enable to overcome the silos approach that has characterized security investments in the past, allowing a holistic management of security (encompassing technology and procedures), and realizing the full benefits of security investments. More skills will be in demand to go through a full assessment of company's risks and the establishment of effective security policies.

In this context, security as a service can be also a viable solution for SMEs: It eliminates capital spending around the hardware needed to run security technologies, freeing up IT budgets for other areas, a key advantage considering tight SMBs' IT budgets:

- It makes security spending predictable;
- It overcome IT security skills' problems, particularly evident within SMEs, which usually have IT generalists rather than security experts working in the IT department (if any);
- It offers an easy solution, easy to implement, install, manage and upgrade;
- It offers a scalable solution, in case the company grows in size or need to protect new assets.

Despite this, the penetration of security SaaS is expected to remain lower in SMEs than in larger organizations, at least in the short-term. Although SaaS is a very appealing concept for SMEs, larger companies have been better at recognizing the benefits that it can bring to their organizations. SMEs' adoption has been lower particularly at the low end of the market (companies with 20-99 employees), where IT laggards are usually prevalent and adoption of innovative technologies is usually delayed until they become mass-market. SaaS seems no exception.

9. Concluding Remarks

9.1. Impact on the Demand for e-Skills

In 2014, the further growth of the main disruptive ICT trends already identified the previous year highlights their cumulative approach and their convergence in a new emerging paradigm of use of IT for business strategies. This increases the tension on the demand for e-skills, by accelerating the emerging demand for new, more sophisticated skills and at the same time reducing gradually the demand for traditional e-skills. The result is a general feeling of displacement and uncertainty in the orientation of young graduates or ICT professionals towards the best combinations of skills and professionalism.

By looking across the analysis of the demand of e-skills for each main trend, we notice several common elements, presented in the following Table 24. In summary, these are the main considerations:

- High-level ICT practitioner skills are in increasing demand, but this is coupled with lower demand for traditional technical skills, particularly in the infrastructure and traditional IT management area.
- A revival of hardware innovation (driven by hyperscale data centres, storage, and all the new devices connected to the IoT) stimulates demand for highly specific hardware-related and systems management skills particularly in the ICT industry.
- The demand for highly specialized resources tends to move from the ICT users to the ICT vendors, while the profiles required by ICT users become more business-oriented and project-oriented, with a strong focus on the design of new services and apps, and the ability to outsource/ rely on standardized platforms and services;
- The applications skills area is the most dynamic, naturally so given the emergence of the so-called "apps economy". This builds on software skills but with very innovative demands, including the capability to manage a flexible and never-ending apps process (while in the traditional software industry, once an application was deployed that was the end of development, save for some maintenance intervention). In addition, apps development may require feeding on inputs from customers, internal users, and external volunteers (e.g. the potential role of crowdsourcing).
- The emergence of highly integrated, automated and scalable infrastructures is driving new demand for standardization and interoperability skills (within the ICT industry) and capability to understand, select and manage standards and interoperability (within the ICT user industry).

Table 24 Summary of Main Demand of ICT Practitioners Skills

	ICT Industry		ICT User Industries	
	Increased Demand	**Reduced Demand**	**Increased Demand**	**Reduced Demand**
Infrastructure	Design, development and management of data centres and cloud services Integration of fixed-mobile systems (BYOD management) Data protection/ Privacy protection/ new IT security challenges Systems management skills for highly integrated, automated and scalable infrastructures (IoT) Design and management of end-to-end protection of emerging smart networks and cyber infrastructures	Operational skills to manage and maintain corporate IT systems Maintenance and support of legacy systems (PCs, desktops...)	Selection, configuration, combination, orchestration of cloud services, either public, private or hybrid Integration of fixed-mobile systems (BYOD management) Systems management skills for highly integrated, automated and scalable infrastructures (IoT) Data protection/ Privacy protection/ new IT security challenges Implementation and management of end-to-end protection of emerging smart networks and cyber infrastructures	Operational skills to manage and maintain corporate IT systems Maintenance and support of legacy systems (PCs, desktops...)
Application	Development and implementation of apps/ services based on mobility/cloud/Big Data/ Social Media/ IoT Business data analytics, Data scientists, Big Data skills Apps, web, IT service development for customer-centred design and deployment (CXIT)	Maintenance of legacy applications	Development and implementation of apps/ services based on mobility/cloud/Big Data/ Social Media/ IoT + industry knowledge Business data analytics, Data scientists , Big Data skills Apps, web, IT service development for customer-centred design and deployment (CXIT)	Maintenance of legacy applications
General	Skills to design and implement sophisticated identity and access management solutions Skills on standardisation/ IT regulation/ interoperability developments Ownership of skills certification	Traditional IT management skills focused on proprietary systems and custom developments	IT asset management and governance expertise Implementation of sophisticated identity and access management solutions Skills on standardisation/ IT regulation/ interoperability developments Ownership of skills certification	Traditional IT security skills by public cloud users Traditional IT management skills focused on proprietary systems and custom developments
R&D	Sophisticated R&D and development skills (especially for interoperability and standardization challenges)	None evident	Sophisticated R&D and development skills, focused on industry needs	None evident

9.2. Impact on the Demand of e-Leadership Skills for SMEs

Since the definition of e-leadership skills is relatively recent, we qualify their demand as emerging, and we are unable to identify any decreasing demand trends: it seems inappropriate to look for a reduction of something that did not really exist until now. The following Table 25 summarizes the main demand trends by type, and the corresponding implications for high-tech and high growth SMEs, who use digital technologies to leverage their competitiveness and their business development capability.

We do not analyse in depth the trend of demand of e-leadership skills by the majority of traditional SMEs. While all SMEs certainly need a set of ICT services just to stay in business, their need for ICT and for e-leadership skills vary depending on their industry and business model and is not necessarily the driving factor of their competitiveness. It would be impossible to summarize their needs and their requirements in this study.

In summary, the emerging demand for e-leadership skills is driven by the digital transformation process of enterprises, and the cumulative impact of main technology innovation trends. In our view, e-leadership skills can be articulated in three main strands, complementary to each other: general management skills, hybrid business-IT skills, and industry specific skills.

The main drivers of demand are the following:

- With the diffusion of cloud, IoT, CXIT the enterprise perimeter is no longer clearly defined. Therefore, the e-leader must have strategic management skills of business, technical, operational and contractual relationships with IT suppliers, partners, clients over extended value chain/ digital ecosystems, as well as with other business line managers in their organization. The key word is strategic management: the e-leader action must build on a strategic vision of the business evolution and transformation.
- The demand for hybrid business/IT skills is driven by the need to exploit IT for business growth opportunities, including in particular the ability to grow and nurture an apps system, to build a "data supply chain" with the organization's data flows, and to manage in the appropriate way data and privacy protection issues.
- The demand for industry-specific e-leadership skills is focused on the in-depth understanding of sectorial business development opportunities driven by IT innovation, particularly for customer-centred IT systems and processes.

Looking closely at the implications for high-tech and high-growth SMEs the following considerations emerge:

- High-tech and high-growth SMEs will have similar e-leadership skills needs than large enterprises, because customer expectations and requirements will be similar, but at a different scale level and with different viewpoints. For example, they will also need to manage relationships in the digital value chain, but from the point of view of a junior partner.
- Depending on their size and business model they may not need a CIO: the e-leaderships skills may be those of the entrepreneur himself. Actually, "native" digital enterprises (web entrepreneurs)

may have "innate" e-leadership skills and leapfrog other companies with a creative use of IT innovation. However, they still may not have the full range of e-leadership skills needed.

- SMEs will face harsher choices in terms of sourcing their needed e-leadership skills: should they buy, hire or train existing employees? Given their limited resources, they will have to be careful and invest well in the priority skills most functional to their business model.

Table 25 Summary of Main Demand of e-Leadership Skills

	Emerging Demand	Implications for High tech, high growth SMEs
General Management	Strategic management of business and contractual relationships with IT suppliers - partners - subcontractors – clients over extended value chain/ digital ecosystems In-depth understanding of IT offshoring/ outsourcing issues and cost-benefits balance to make informed choices Strategic Management of interaction between CIOs and business line managers	Strategic management of the role of the company in the digital ecosystem with specific attention to SMEs vulnerabilities (insufficient IPR protection, for example). Ability to outsource/delegate necessary IT services and make appropriate buy/train decisions of necessary skills
Hybrid Business/ IT	Strategic management of company information and data flows, including design and development of "data supply chains" to leverage company's data and partners' data and make them usable Combination of business analytics skills with industry-specific skills and understanding of IoT issues Strategic management of data protection/privacy issues	Similar demand, since customer expectations will be similar "Native" digital companies (e.g. web entrepreneurs) may have innate e-leadership skills in this area Challenge to source/ maintain scarce specialist skills, particularly data analytics and data scientists skills
Industry Specific	In-depth understanding of industry-specific business development opportunities driven by IT innovation Combination of business analytics skills with industry-specific skills and understanding of IT innovation implications for business processes Ability to use IT for customer-centred apps and services (CXIT) within specific industry	Similar demand, since customer expectations will be similar Risk of missing e-leadership skills necessary for competitive advantage; relative relevance linked to business model

10. Main Sources

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