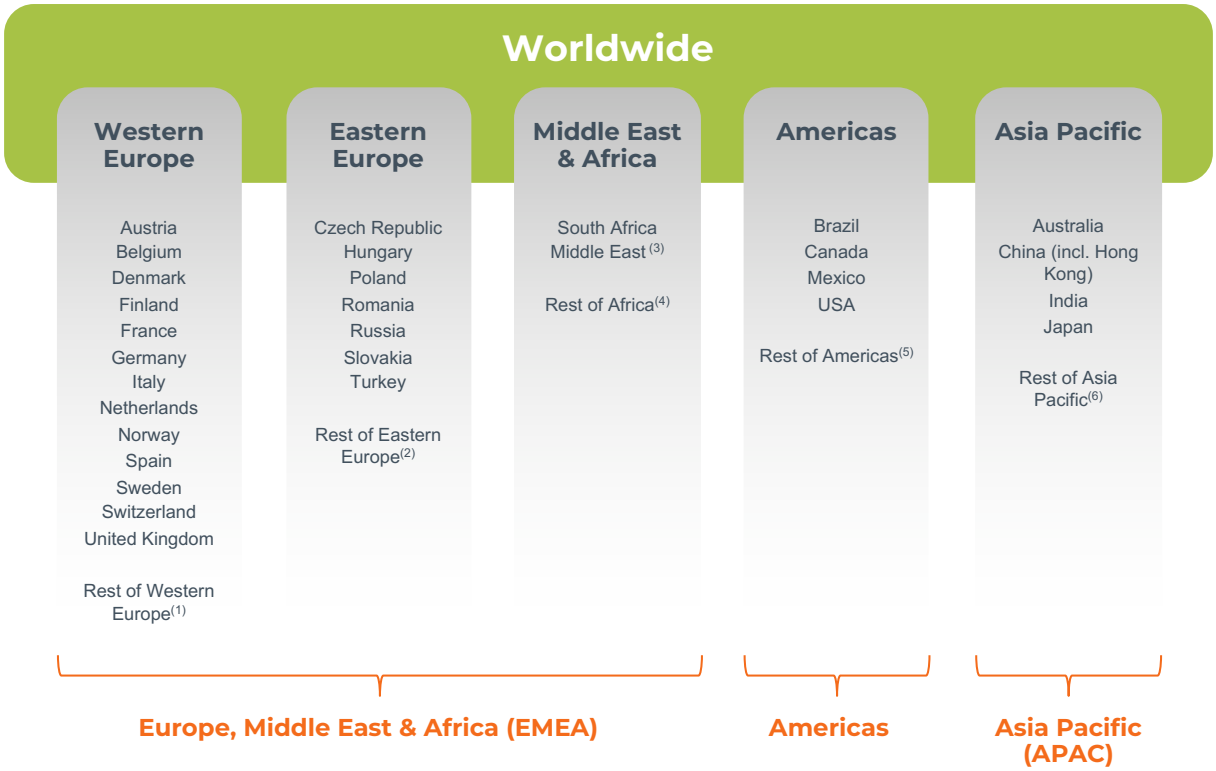
Segmentation

Christophe Châlons,
Chief Analyst
PAC – a teknowlogy Group company
cchalons@teknowlogy.com

Latest update: April 12, 2019

TABLE OF CONTENTS

1. GEOGRAPHICAL MARKET COVERAGE



(1) Rest of Western Europe incl. Greece, Iceland, Ireland, Liechtenstein, Luxembourg, Malta, Portugal

(2) Rest of Eastern Europe incl. Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Estonia, Georgia, Latvia, Lithuania, Macedonia, Moldova, Montenegro, Serbia, Slovenia, Ukraine

(3) Middle East incl. Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates, Yemen

(4) Rest of Africa incl. Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Cote d'Ivoire, Democratic Republic of the Congo, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Republic of Congo, Rwanda, São Tomé und Príncipe, Senegal, Sierra Leone, South Sudan, Sudan, Suriname, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe

(5) Rest of Americas incl. Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bolivia, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago, Uruguay, Venezuela

(6) Rest of Asia Pacific incl. Afghanistan, Bangladesh, Bhutan, Brunei Darussalam, Cambodia, Fiji, Indonesia, Kazakhstan, Kiribati, Korea, Kyrgyz Republic, Lao, Macao, Malaysia, Maldives, Marshall Islands, Micronesia, Mongolia, Myanmar, Nepal, New Zealand, Pakistan, Palau, Papua New Guinea, Philippines, Samoa, Seychelles, Singapore, Solomon Islands, South Korea, Sri Lanka, Taiwan, Tajikistan, Thailand, Timor-Leste, Tonga, Turkmenistan, Tuvalu, Uzbekistan, Vanuatu, Vietnam

2. IT EXPENDITURE

IT EXPENDITURE			
Personnel Expenditure	Hardware Expenditure	SITS Expenditure	Miscellaneous Expenditure

Important notes

- ***Captive IT activities*** *include all activities of captive IT suppliers with their parent or sister companies, i.e. internal revenues and revenues with associated companies.*
- *teknowlogy considers exclusively non-captive revenues in rankings and market figures. Captive revenues are booked as internal IT expenditure (mainly personnel and hardware).*

Personnel

Includes all personnel-related costs:

1. IT salaries
2. Other staff costs

Hardware

Refers to all IT equipment (see “Hardware” section) and includes the purchase value.

Software and IT services (SITS)

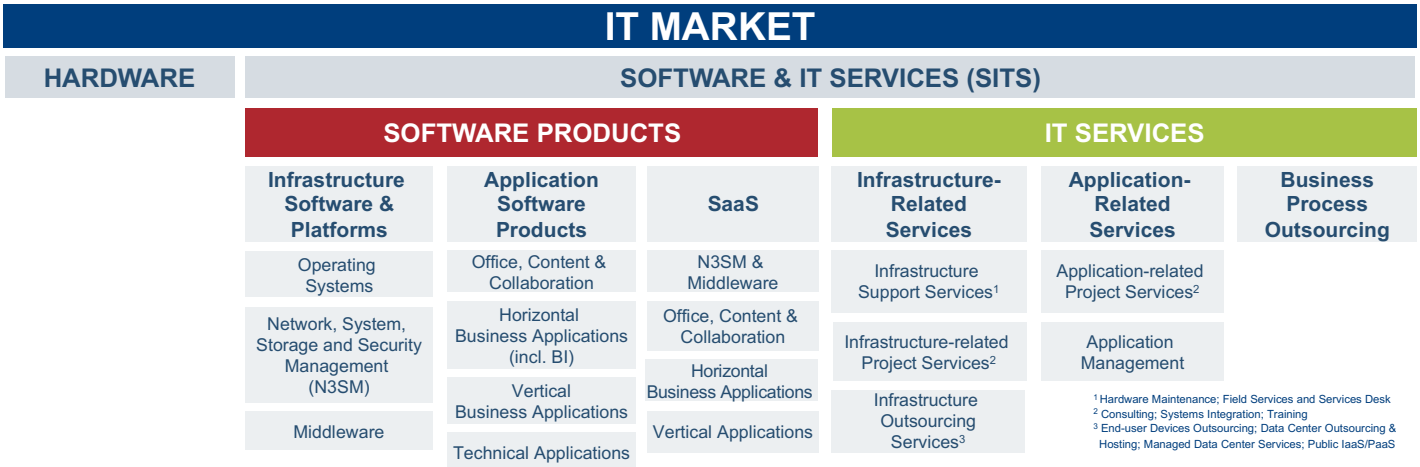
Refers to all software and IT services (see following sections) and includes the purchase value.

Miscellaneous

Includes all other costs related to the IT that are not part of the previously mentioned three categories:

- Data-related telecom equipment and services (e.g. routers, leased lines, X25, etc.);
- Consumables, energy, offices, etc.
- Financing costs (for purchasing hardware, software and IT services).

3. IT MARKET



Hardware

…refers to the purchase value of:

- Mainframes,
- Servers,
- PCs,
- Workstations,
- Storage,
- Monitors,
- Printers,
- Other terminals (e.g. ATM's, cash registers),
- Networking equipment (LAN, switches; excl. WAN).

4. SOFTWARE PRODUCTS

SOFTWARE PRODUCTS		
Infrastructure Software & Platforms	**Application Software Products**	**SaaS**
Operating Systems	Office, Content & Collaboration	N3SM & Middleware
Network, System, Storage and Security Management (N3SM)	Horizontal Business Applications (incl. BI)	Office, Content & Collaboration
Middleware	Vertical Business Applications	Horizontal Business Applications
	Technical Applications	Vertical Applications

4.1 Infrastructure software and platforms

Important notes

- teknowlogy figures for infrastructure software and platforms only include revenues from licenses and maintenance/support. All related revenues from **implementation services** (consulting, implementation/customization, training) are booked as **infrastructure-related services revenues**.
- For examples, see ***"4.4 Product/provider examples"***.

4.1.1 Operating systems

Proprietary as well as open operating systems and system-level software:

- Operating systems & sub-segments
- Networking software
- System utilities
- Virtualization, cloud, container engines and environments

4.1.2 Network, system, storage and security management (N3SM)

Network, system and storage management software for all types of hardware (from mainframe to PC); cyber security: cryptographic software, access control, intrusion detection system (IDS), intrusion prevention systems (IPS), antivirus, anti-spyware, anti-keylogger, anti-subversion, anti-tamper, anti-spam, firewall, internet security:

- Network management
- System management
- IT operation management
- Legacy system management
- Cloud, containers, IaaS system management

- DevOps tools and platforms
- Storage management
- Storage, software-defined storage, backup
- Network & infrastructure security
- Application & data security
- ID & access management
- Governance, risk & compliance

4.1.3 Middleware

Data engines/database engines, analysis/modelling/design, software engineering, code generation, rules engines, test & quality, BPM/BAM, application servers, web services tools, connectors, EAI, MOM

4.2 Application software products

Important notes

- Application software products can be either out-of-the-box solutions, such as most productivity software products and business applications for the small office/home office market, or more complex/process-oriented solutions that require implementation and customizing services, such as business applications for the mid-market and for large enterprises.
- Application software products are often sold as packaged solutions, including hardware and services, e.g. implementation services. The value of the hardware and services resold is excluded if it can be determined.
- teknowlogy's figures for application software products only include revenues from licenses and maintenance/support. All related revenues from **implementation services** (consulting, implementation/customization, training) are booked as **application-related services revenues.**
- teknowlogy does not consider gaming/entertainment software as part of application software products.
- For examples, see ***"4.4 Product/provider examples"***.

4.2.1 Office, content and collaboration

Office automation includes software such as word-processing, data spreadsheet, and/or presentation software.

Content includes document management, web content management, archiving (documents, e-mails, ERP/FI data), digital asset management, and document-based workflow.

Collaboration includes messaging and groupware systems, platform-independent UC applications and software to enhance and connect VoIP and UC platforms via telephony systems and groupware specialists.

4.2.2 Horizontal business applications (incl. BI)

Horizontal business applications includes Accounting & Finance, Supply Chain Management, Distribution & Purchasing, Human Resources Management, CRM / Sales Management / Sales Force Automation, Supplier Relationship Management, Procurement, Product Lifecycle Management, Enterprise Asset Management.

Business Intelligence (BI) includes software tools for reporting, analytical applications, corporate performance management and GRC (Governance, Risk and Compliance); some of the core functions of BI solutions include: Reporting & query, Analysis, Balanced Scorecards, Dashboards, Planning, Budgeting and Forecasting.

4.2.3 Vertical business applications

This includes specific vertical business applications, such as:

- **Manufacturing:** material resource planning (MRP), quality management, manufacturing execution systems, supply chain management (SCM), logistics, distribution & purchasing, product lifecycle management (PLM)
- **Banking:** account management, payment transactions, credit management systems
- **Insurance:** policy and product management, claims management, commissions and partner management
- **Public sector:** tax & revenue management, grant management, clinical, patient management
- **Telecom/utilities:** billing/metering, network maintenance management
- **Retail & wholesale:** point of sales, merchandising, supply chain management (SCM), logistics, Distribution & purchasing
- **Services:** services automation
- **Transport:** booking systems, traffic control systems, supply chain management (SCM), logistics, distribution & purchasing

4.2.4 Technical applications

This includes technical and graphical software, incl. CAD, GIS, command control and SCADA (e.g., plant management in manufacturing or utilities, network management in telecom, utilities or transport, C3I in defense, etc.).

4.3 Software as a service (SaaS)

Software as a service (SaaS) includes network, system, storage and security management (N3SM), middleware, as well as applications (e.g. business applications, BI, office, content and collaboration, etc.) sold “as a service”.

For examples, see ***“4.4 Product/provider examples”***.

4.4 Product/provider examples

4.4.1 Operating systems

Operating systems (OS)	Product/provider examples
Operating systems & sub-segments	IBM OS (system i, system z), Unix (IBM AIX, HP UX, Oracle Solaris), Linux (Red Hat, Novell, Ubuntu, SUSE, etc.), Apple, Microsoft, Android, etc.
Networking software System utilities	IBM, Oracle, HP, Dell EMC, Fujitsu, Microsoft, Red Hat, VMware, Apple, Samsung, Cisco, Ericsson, Nokia, Huawei, etc.
Virtualization, cloud, container engines and environments	VMware, IBM, Micro Focus, Red Hat, Dockers, OpenStack, Citrix, Microsoft, AWS, Google, etc.

4.4.2 Network, system, storage and security management (N3SM)

Network, system, storage & security management (N3SM)	Product/provider examples
Network management System management IT operation management Legacy system management Cloud, containers, IaaS system management DevOps tools and platforms	Nokia, Ericsson, Cisco, VMware, OpenStack, IBM, HP, Del EMC, Juniper Networks, Huawei, etc. IBM, CA Technologies, BMC, ServiceNow, Micro Focus, Oracle, Dell EMC, Splunk, ASG, LANDesk, Beta Systems, NetIQ, Red Hat, Dynatrace, Microsoft, Dockers, OpenStack, Kubernetes, VMware, Pivotal, Citrix, Micro Focus, AWS, Nagios, Axway, Google, etc.
Storage management Storage, software-defined storage, backup	EMC, Veritas, Oracle, IBM, Oracle, HP, Beta Systems, Hitachi, NetApp, AWS, Google, Microsoft, etc.
Cyber security Network & infrastructure security, application & data security, ID & access management, governance, risk & compliance	Symantec, McAfee, Check Point Software, IBM, Microsoft, CA Technologies, Oracle, Dell EMC, Palo Alto Networks, Fortinet, CyberArk, Kaspersky Labs, Trend Micro, etc.

4.4.3 Middleware

Middleware	Product / Supplier Examples
Data engines and databases SQL-based, in-memory, cloud-based	Oracle, IBM, Microsoft, Software AG, Teradata, InterSystems, MariaDB, MongoDB, SAP, PostgreSQL, Red Hat, Redis, etc.
Data management Extract, transform, load (ETL) engines, product information management (PIM), master data management (MDM) and enterprise information integration (EII)	IBM, Informatica, Oracle, SAP, Talend, Teradata, Orchestra Networks, Tibco, ASG, Open Text, Software AG, Information Builders, LANSA, SAS Institute, Profisee, Pivotal, etc.
Portals & internet platforms Digital front office platforms	HP, IBM, Oracle, Liferay, Microsoft, Adobe, Optimizely, Citrix, Google, Salesforce, Jahia, Open Text, Red Hat, Magento, etc.
Application development Software engineering tools & integrated development environments (incl. 3GL, 4GL, RAD, OO, Cloud, DevOps, etc.), code and application generators	Microsoft, IBM, Oracle, Progress Software, Magic Software, Eclipse, Micro Focus, OutSystems, Mendix, AWS, Salesforce, NetBeans, GitHub, Adobe, Zend, etc.
Application infrastructure Application servers, cloud platforms, container platforms	IBM, Oracle, SAP, Microsoft, Salesforce, Fujitsu, Google, AWS, Red Hat, Apache, Cloud Foundry, Docker, Citrix, etc.
Application management Automated software quality, test tools, migration, performance and configuration management	IBM, HP, ASG, Dynatrace, Apache, Selenium, CA Technologies, Micro Focus, Zend, SensioLabs, Opsview, CAST Software, BMC, NetIQ, Axway, Nastel, etc.
Application and infrastructure integration IT BPM/BAM, connectors, APIs, EAI, ESB, SOA engines, cloud service brokers, cloud orchestrators, transaction and messaging systems, EDI, FTP	IBM, Tibco, Software AG, Axway, Red Hat, Progress Software, Information Builders, Red Hat, OpenStack, Cloud Foundry, Kubernetes, Microsoft, Oracle, SAP, Google, Cisco, Apache, RabbitMQ, SEEBURGER, Edicom, Indra
IT governance Portfolio and IT project management tools and platforms	CA Technologies, Microsoft, IBM, Planview, Oracle, Sciforma, NetSuite, ServiceNow, SAP

4.4.4 Office, content and collaboration

Office automation	Product/provider examples
Office automation	Microsoft, Corel, Apple, Google Apps, etc.
Content	
Document management / document workflow	Documentum (OpenText), FileNet (IBM), Lotus Domino (IBM), Microsoft, ITESOFT, Global 360, Progress Software, i-Flow (Fujitsu), OpenText ECM, Docubase, Doc@post, DocuWare, etc.
Web content management	Adobe Scene7, Adobe Experience Manager, Sitecore, WordPress, Drupal, etc.
Collaboration	
Messaging and groupware systems	Microsoft, IBM, BlueKiwi (Atos), etc.
Platform-independent UC applications	Unify, Cisco, Microsoft, Esnatech (Avaya), estos, etc.

4.4.5 Horizontal business applications (incl. BI)

Horizontal business applications	Product/provider examples
Accounting & finance	SAP, Oracle, Sage, Microsoft, Infor, Cegid, Unit4, Workday, etc.
Human resources management	SAP, Oracle, Sage, Meta4, Workday, etc.
CRM / sales management / sales force automation	Oracle, SAP, Salesforce, etc.
Supplier relationship management, procurement	SAP, Oracle, etc.
Business intelligence (BI)	
Multi-dimensional analysis, statistics and technical data analysis tools, data mining	Oracle, SAP, SAS, IBM, Microsoft, Information Builders, Tibco, etc.
BI reporting and decisional tools (front-end)	SAS, IBM/Cognos, SAP/BusinessObjects, Oracle/Hyperion, Microstrategy, QlikView, Tableau, etc.

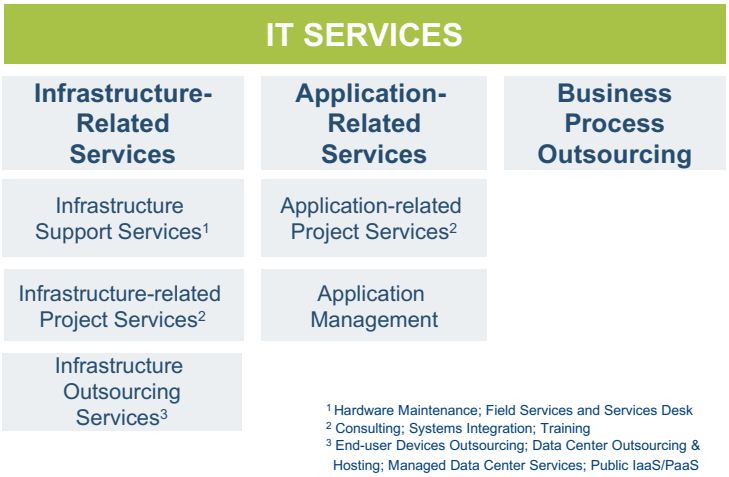
4.4.6 Vertical business applications

Vertical business applications	Product/provider examples
Supply chain management, logistics, distribution & purchasing	SAP, Oracle, Infor Global Solutions, Manhattan Associates, i2, etc.
Material resources planning	SAP, Oracle, Infor Global Solutions, QAD, etc.
Product lifecycle management	Siemens/UGS, SAP, Dassault, PTC, etc.
Process manufacturing	SAP, Aspen Tech, etc.
Discrete manufacturing	SAP, Infor Global Solutions, Oracle, QAD, etc.
Banking	Sungard, Oracle, ACI, FIS, Temenos, etc.
Insurance	Misys, Tieto, etc.
Healthcare	Siemens Medical, Cerner, McKesson, Allscripts, etc.
Government	SAP, Oracle, Unit4, Cegid, etc.
Telecom	Amdocs (Cramer), Convergys, Oracle (Portal Software), Comverse, LHS, etc.
Utilities	SAP, Oracle, etc.
Retail & wholesale	SAP, Oracle, Aldata, Wincor Nixdorf, Cegid, etc.
Transport	Amadeus

4.4.7 Technical applications

Technical applications	Product/provider examples
CAD / CAM	Dassault, Siemens/UGS, PTC, Autodesk, Missler, etc.
GIS	Aspen Tech, ESRI, etc.
Network control systems	Siemens, ABB, PSI, etc.
Visualization and simulation systems	MSC, Thales, etc.
Graphical software	Adobe, Quark, Corel, etc.

5. IT SERVICES



5.1 Infrastructure-related services

In terms of technology, infrastructure-related services relate to:

- Infrastructure software & platforms: operating systems, N3SM, middleware;
- Hardware products and IT equipment.

5.1.1 Infrastructure support services

Hardware Maintenance – Repair and support, for all types of hardware (from mainframe to PC) and related system software (proprietary or open systems).

Field Services and Service Desk – Field Services (installation, configuration and roll out of infrastructure, operational support; on customer's site) and (stand-alone) Service Desk

Important note

- teknowlogy figures for infrastructure support services do not include maintenance, field services and service desk that are embedded into an outsourcing agreement.

5.1.2 Infrastructure-related project services

5.1.2.1 Infrastructure-related consulting

In terms of services, infrastructure-related IT consulting includes:

- Consulting on the architecture of information systems: all services related to the architecture of equipment, systems, networks, and, more generally, the technological design of information systems;
- Consulting on the selection/ implementation of technology and technical packages: All services (selection of solutions, design, implementation, benchmarking, evaluation,

preliminary studies, audits, etc.) related to the preparation and implementation of infrastructure software & platforms, such as OS, middleware technologies, etc.;

- Consulting on technical and miscellaneous project management: services for managing and supporting infrastructure-related projects;
- Also includes infrastructure-related consulting services related to industrial information systems, control/ command/ supervision, simulation, and embedded software in the areas of defense, transport, energy, telecommunications etc.

5.1.2.2 Infrastructure-related SI

SI includes both types of IT services invoiced on a time & material (also known as T&M, contract staff, staff augmentation, body shopping, etc.) basis as well as fixed-time/fixed-price basis.

In terms of services, infrastructure-related system integration includes:

- Assistance regarding the architecture of information systems;
- Assistance in the selection/ implementation of IT equipment, infrastructure software & platforms;
- Deployment and integration of distributed systems (workstations, PCs, LANs);
- Fixed-price support services for computer operations and users;
- Integration of telecom networks and systems;
- Integration of corporate networks and systems;
- Integration/ projects for the design/ development/ deployment of infrastructures;
- Also includes infrastructure-related system integration services related to industrial information systems, control/ command/ supervision, simulation, and embedded software in the areas of defense, transport, energy, telecommunications etc.

5.1.2.3 Infrastructure-related IT training

Infrastructure-related IT training can focus on either end users or IT professionals, and includes two types of delivery:

- Standard infrastructure-related IT training, including all multi-customer seminars;
- Customized infrastructure-related IT training, including on a one-on-one basis.

The infrastructure-related IT training market is broken down into two segments:

- Technical infrastructure-related IT training;
- Professional infrastructure-related IT training.

5.1.3 Infrastructure outsourcing services

According to teknowlogy's segmentation, outsourcing is characterized by:

- Long-term contracts (3 to 10 years or even more);
- Often takeover of the outsourcing customer's assets (human resources and/or infrastructure) by the outsourcer;
- Takeover of responsibility by the supplier: performance of defined services, fulfillment of defined service level agreements – not only provision of staff and/or infrastructure;
- Payment: still very often on a fixed-price basis, but modular in order to respond to the changes in customers' requirements. Payment conditions are increasingly variable, e.g. dependent on the degree of utilization (keyword: "outsourcing on demand"). Additionally, the price may also be based on non-IT measurements ("business metrics").

Infrastructure refers to any type of hardware (servers, desktops, storage, printers, ATMs, POS…) and related software (infrastructure software & platforms)

5.1.3.1 End-user devices outsourcing

In terms of services, this outsourcing segment includes:

- Outsourcing of mostly large PC installations and PC networks, as well of other end user devices; incl. operation, help desk, software distribution, etc.

This also includes the operation of decentralized infrastructure like ATM/ cash dispensers and POS/ point of sales.

5.1.3.2 Server outsourcing & hosting

In terms of services, this outsourcing segment includes:

- Outsourcing of the data center (in mainframe environment and/or in client/server environment), most of the time including the transfer of both human resources and infrastructure assets;
- Hosting of an application, including server / mainframe and basic system operation, but excluding application management;
- Web hosting - hosting of a customer's web site
- Managed Services: (Remote) Managed Services for IT on client's premises and/or third-party cloud services
- Legacy & Hosted Private Cloud: Traditional outsourcing/hosting services (legacy or private cloud)
- Public IaaS/PaaS: Resources (infrastructure and/or platform) based on a Cloud architecture are hosted by a provider and made available to several customers ("one-to-many" model) over the internet.
- Backup/ disaster recovery services on a stand-alone basis will be booked as Data Center

Outsourcing. Managed Security Services on a stand-alone basis will be booked as Hosting. However most often these services are embedded in a more comprehensive outsourcing agreement.

5.2 Application-related services

In terms of technology, application-related services relate to:

- Application software (custom development or packaged software);
- Any application: office/ collaboration/ ECM, BI, horizontal business applications, vertical business applications, technical applications.

5.2.1 Application-related project services

5.2.1.1 Process & application-related consulting

In terms of services, process & application-related consulting includes:

- Process definition, design, assessment, improvement or re-engineering as well as process/IT alignment;
- Consulting on the organization of information systems: all preliminary services, such as studies prior to the development and/or implementation of new applications, overhaul of processes and procedures involving information technology, preparation of changes in application systems, etc.;
- Consulting on the selection/implementation of application software and packages. This covers consulting on application software products, such as enterprise resource planning (ERP), customer relationship management (CRM), supply chain management (SCM), human resources management (HRM), point of sales, core banking systems, etc.;
- We consider both commercial and administrative processes and related applications, such as ERP, CRM, SCM, HRM, point of sales, core banking systems, as well as technical processes and related applications, such as industrial information systems, control/command/supervision (SCADA), simulation, and embedded systems.

5.2.1.2 Application-related SI

SI includes both types of IT services invoiced on a time & material (also known as T&M, contract staff, staff augmentation, body shopping, etc.) basis as well as fixed-time/fixed-price basis.

In terms of services, application-related system integration includes:

- Design/development of customized management information systems or applications;
- Design/development/implementation of packaged-based information systems or applications (ERP, CRM, etc.);

- Maintenance of applications (customized or package-based) on time & material contracts;
- Integration projects for customized and package-based applications;
- Also includes application-related systems integration services related to industrial information systems, control/command/supervision, simulation, and embedded software in the areas of defense, transport, energy, telecommunications etc.

5.2.1.3 Application-related IT training

Application-related IT training can focus on either end users or IT professionals, and includes two types of delivery:

- Standard application-related IT training, including all multi-customer seminars;
- Customized application-related IT training, including on a one-on-one basis.

The application-related IT training market is broken down into two segments:

- Technical application-related IT training;
- Professional application-related IT training.

5.2.2 Application management

According to teknowlogy's segmentation, application management (AM) is characterized by:

- The maintenance and enhancement of existing applications (custom development and/or customized software products), sometimes even their initial development;
- A long-term (multi-year) contract with a commitment to fulfilling pre-defined service level agreements (SLAs) on a fixed-price basis.
- Often, specialized IT staff is transferred.

Important note

- teknowlogy figures include both "stand-alone AM" (dedicated AM contracts) and "embedded AM" (AM embedded in comprehensive outsourcing contracts).

5.3 Business process outsourcing (BPO)

According to teknowlogy's segmentation, **business process outsourcing (BPO)** is characterized by:

- The takeover of responsibility for an entire business process (or parts of it);
- The transfer of the specialized administrators besides the related infrastructure and application management.

Important notes

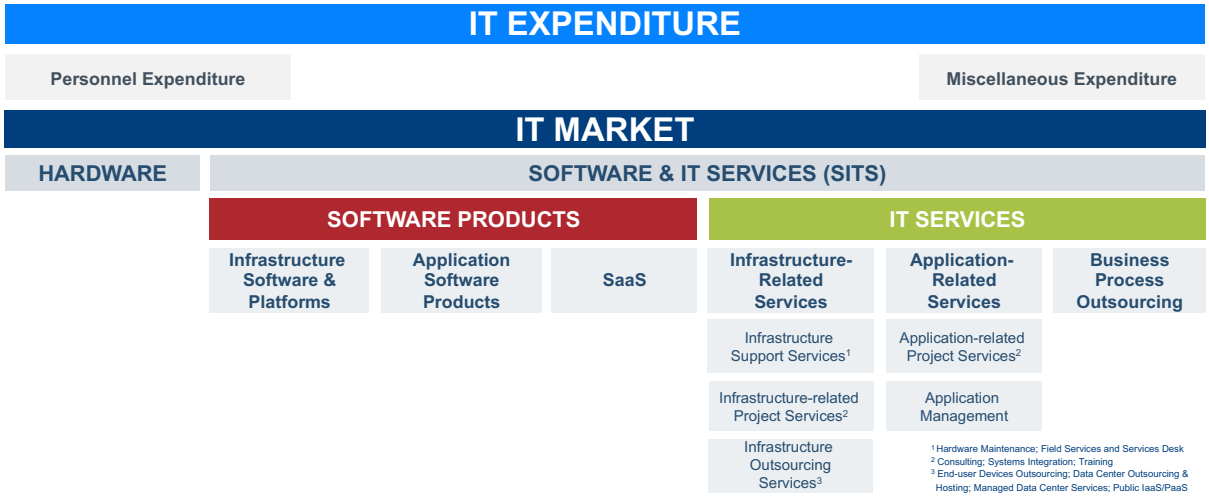
- BPO also includes processing services such as payroll, card or transaction processing.
- teknowlogy only considers processes that are to a significant degree supported by IT (e.g. accounting, human resources, logistics, billing, card processing, etc.).

Process cluster	Process	IT share	To be considered
HR	Payroll	70% - 90%	Yes
	Travel expense accounting	20% - 30%	No
	Recruiting, separation/compensation, training	80% - 90%	Yes
	Benefits administration	80% - 90%	Yes
Sales/ CRM/ billing	Billing/invoicing	70% - 90%	Yes
	Loyalty card processing	80% - 90%	Yes
	Clearing	70% - 80%	Yes
	Call center	20% - 30%	No
	Customer care	30% - 80%	Case by case
Financial accounting	Purchase-to-pay (incl. accounts payable)	80% - 90%	Yes
	Order-to-cash (incl. accounts receivable)	60% - 70%	Yes
	Record-to-report (incl. general ledger, fixed assets, reconciliations, inter-company accounts)	60% - 70%	Yes
	Revenue collections (3rd-party collections)	20% - 30%	No
	Fin. planning and analysis (incl. performance analysis, internal audit, treasury and risk management)	50% - 60%	Yes
Logistics / SCM/ procurement	Procurement (incl. sourcing, catalog management, indirect procurement administration)	60% - 70%	Yes
	Inventory planning & management	80% - 90%	Yes
	Supply chain BPO (incl. order management, transportation management fulfillment, A/R)	20% - 80%	Case by case
	Logistics execution (incl. transport)	10% - 20%	Yes
Document management	Inbound print/ mailing services	70% - 100%	Yes
	Outbound print/ mailing services	70% - 100%	Yes
Financial processing	Check processing	80% - 90%	Yes
	Payment & credit card processing	80% - 90%	Yes
	Transaction processing/ credit & loans & mortgages	60% - 80%	In most cases
	Transaction processing/ securities (excl. bank-to-bank services)	70% - 80%	Yes
	Claims processing	50% - 70%	Case by case
	Policy management	70% - 80%	Yes
Other verticals	R&D	10% - 20%	No (if SW engineering, then ITO!)
	Manufacturing	0% - 10%	No
	E-government	30% - 70%	Case by case
	Road charging	50% - 80%	In most cases
	Billing (for telecoms, utilities)	50% - 90%	Yes
	Information brokerage	10% - 70%	Case by case
	Reservation services (platform, excl. call centers)	50% - 90%	Case by case
	Passenger revenue accounting for airlines	50% - 90%	Yes
	Fleet management	20% - 30%	No
	Facility management, security, catering, cleaning etc.	0% - 20%	No
	Smart metering	60% - 80%	Yes
	Pharmacovigilance	50% - 90%	Yes
	Clinical data management	60% - 90%	Yes

Note: We exclude intra-industry BPO (e.g., bank-to-bank payment operated by a bank for another bank).

6. VERTICAL SECTORS

teknowlogy provides market figures for each of the above-mentioned nine vertical sectors, for the following 18 IT expenditure and IT market segments:



To download an Excel document matching the NACE 2.0 classification with teknowlogy's vertical segmentation, please click here.

Manufacturing

- Automotive & discrete manufacturing incl.
  - Aerospace & defense
  - Electrical engineering & high tech
  - Mechanical & plant engineering
  - Construction
- Process manufacturing incl.
  - Metal
  - Chemicals
  - Pharmaceuticals
  - Oil, gas & mining
  - Food & beverages, tobacco
  - Textile, paper, others

Banking

- Retail banking
- Wholesale/corporate banking
- Investment banking
- Private banking

Insurance

- Life & pension
- Property & casualty
- Private health
- Reinsurance

Public sector

- Government (incl. federal, regional, and local administration, education, etc.)
- Health and social services (incl. payers and providers)
- Defense

Telecommunications

- Fixed carriers
- Mobile carriers
- Virtual network operators (VNO)
- Internet service providers

Utilities

- Electricity
- Water
- Gas
- Waste disposal
- Heat

Retail & wholesale

- Wholesale
- Retail (food)
- Retail (non-food)

Services & consumers

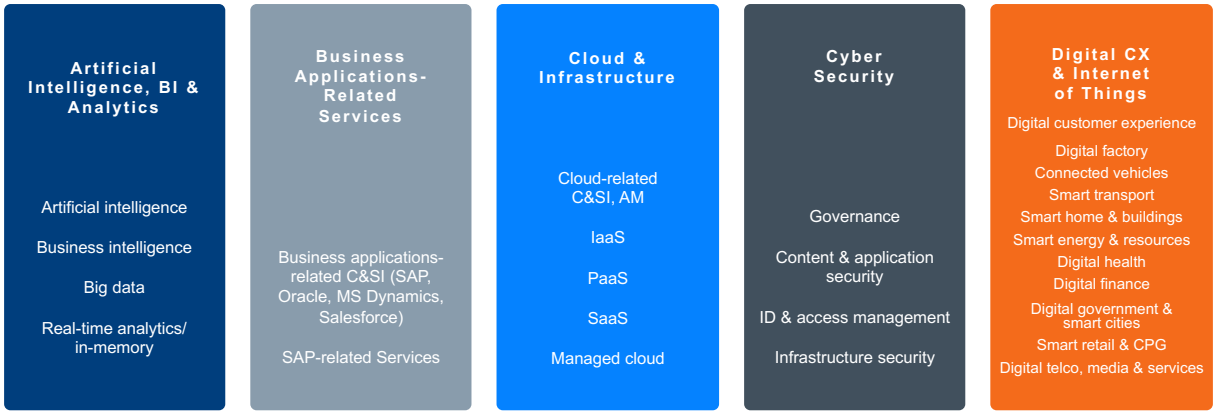
- Media
- Professional services
- Facility management
- Tourism

The **Consumers** segment refers to the use of IT in households. It covers individual consumers, usually in a multi-person environment (e.g. a family), with a possibly differentiated use of IT products and services.

Transport

- Rail and public transport
- Freight
- Aviation
- Postal services

7. TOPICS



7.1 Artificial intelligence, business intelligence & analytics

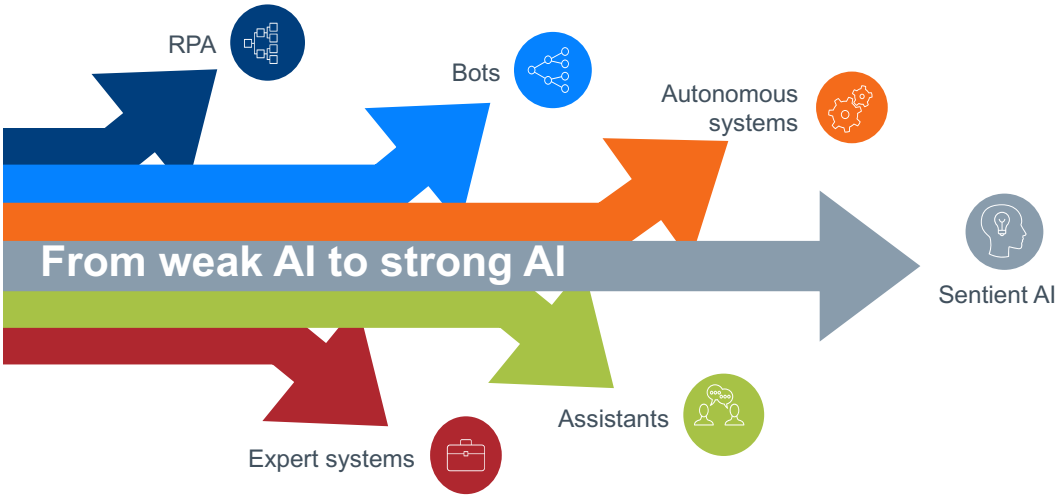
Artificial intelligence (AI)

Since 2015, artificial intelligence is back in the forefront of the academic and IT worlds. And the hype has kept growing over the past years, having reached the general public. Many people have become aware that AI could impact all sectors and industries, but only a few really understand what AI is, how it works and its current limits. The fact is that the term is complex and there is no consensus to define AI, everyone has their own perception, sometimes fueled by numerous science-fiction books, movies, and TV shows. At teknowlogy, we have gathered different information and sources and came to this definition:

AI is the **combined use of algorithms, knowledge bases (big data sets), and neural networks/ deep learning techniques to mimic and complement human abilities** in a variety of domains, including:

- Perception and understanding;
- Reasoning and problem solving;
- Learning and training;
- Interaction with surroundings and people.

teknowlogy does not consider AI as a unique technology; that would be a **sentient AI,** which does not exist yet. Instead, we acknowledge that AI techniques can enhance and augment multiple solutions, such as RPA (robotic process automation) and RDA (robotic desktop automation), expert systems (designed to perform specific tasks), chatbots, assistants (helping consumers and employees in various tasks) and autonomous systems (such as industrial robots and cars).



These solutions already existed before. They can be greatly enhanced through the use of technologies that form the foundation of artificial intelligence – which we call **AI fundamentals.**

AI fundamentals

Fundamentals	Definition	Types of solutions
Algorithmic studio	Development studio allowing R&D on algorithms with learning platforms	*IDEs, data science studios, etc.*
Semantic text analysis	Ability to scan and understand massive amounts of texts in the aim of understanding the meaning of it	*Search engines, automatic classifying & summarizing, chatbots, etc.*
Text to text translation	Ability to process a text and keep the meaning in another language	*Automatic translation*
Natural language processing	Ability to process text, even though the input is in natural language	*Chatbots, virtual assistants, communicating robots, etc.*
Speech recognition	Ability to understand spoken words (as well as the associated emotions)	*Speech-to-text, phone conversation analysis, etc.*
Image recognition	Ability to recognize objects, people, patterns, etc. in an image	*Facial recognition, plate recognition, image classifying, etc.*
Video recognition	Ability to analyze all elements in a video (with the yet-to-be-reached goal of anticipating the next frames)	*Automatic chapters and subtitling, identification of people talking or risky situations, etc.*
Process automation	Ability to automate a process by learning from the users	*Virtual assistants, RPA, etc.*
Deep learning framework	Neural networks-based platforms allowing the (supervised or not) training of algorithms	*R&D, implementation of AI solutions*

In our reports and market figures, we consider all the applications leveraging these AI-related technologies.

Big data

Defining big data

One of the thorniest problems with this market is actually defining it. When does a large dataset become “big data”? Most people indistinctively “know it when they see it” but pinning down a definition is something that the industry has been arguing about for some time.

So, most people decide for some variant of the “three V’s” definition, originally suggested about a decade ago in a somewhat different context: i.e. that big data is a data set with **volume**, **variety** and **velocity.** Others add a fourth ‘V’, even a fifth, with a number of suggestions for what those should be. teknowlogy believes the best definition uses four V’s, where the fourth characteristic is **“value”.**

The volume part of the definition is self-explanatory, although putting a precise figure on it is difficult: Big data starring with terabytes and stretching up to petabytes – and beyond. What makes it big data is the combination with **variety**; we (and others) refer to its structure: Big data problems generally relate to the data with freeform text, photos or other media where the structure is loosely defined and likely to change. **Velocity** means the speed of data generation and thus processing speed – this is particularly an issue with machine-generated data (like commodity trades and prices); however, where millions of users are concerned, they also generate large data volumes at high velocity. Often, techniques for pre-filtering and discarding unwanted data without storing unnecessarily large quantities are needed or desirable. And the **value** characteristic is an essential part of defining the new market. Big data is all about providing *cost-effective* solutions to big data problems using tools and techniques different from those that have been developed over the last 20-30 years for analyzing the highly-structured, aggregated and generally numeric data relating to business operations.

To be more precise, we see the big data market as comprising ***solutions for problems where the volume of data, and its variety OR volume mean that they cannot be cost-effectively managed and analyzed with traditional database tools and techniques.***

Most often, big data solutions start with the data storage in non-relational databases, commonly using Apache Hadoop tools, the open-source data storage solution derived from work at Yahoo, Google and others. Several alternatives to this approach are also in use, and indeed many of them are more mature, robust and usable by the average nosiness than the Hadoop-based solutions. These often start from a more traditional, but massively parallel database – such as EMC Greenplum or Teradata’s Aster Data.

Market segments

We segment the **big data software** market into:

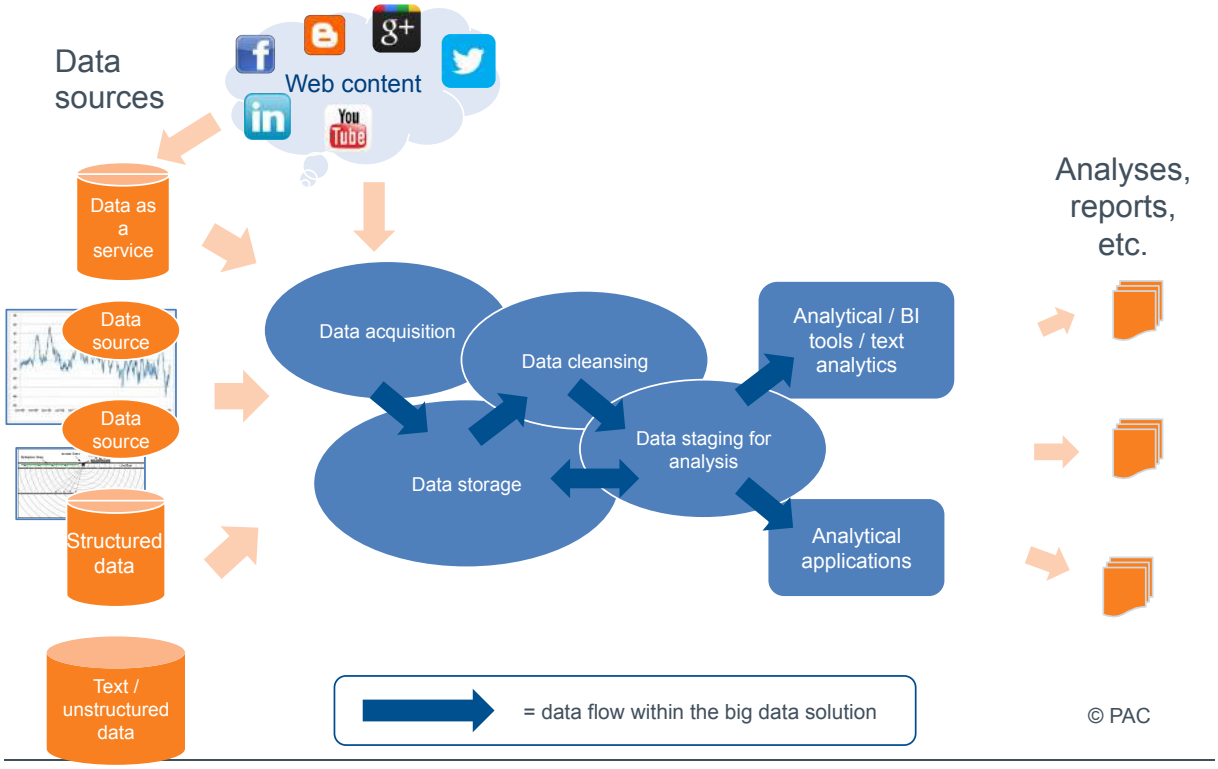
1. **Data infrastructure** that is concerned with **collecting, storing and retrieving the data.** Many of these are open-source tools based around the Hadoop dataset, but increasingly these are being bundled in commercial offerings alongside storage, integration and other facilities from large and small vendors;
2. **Applications & analytics** – these are the tools to make use of big data, which range from established business intelligence tools to dedicated applications for retrieving and analyzing data in proprietary social media sets, such as Twitter Firehose.

Note: We consider software as a service (SaaS) in our software figures.

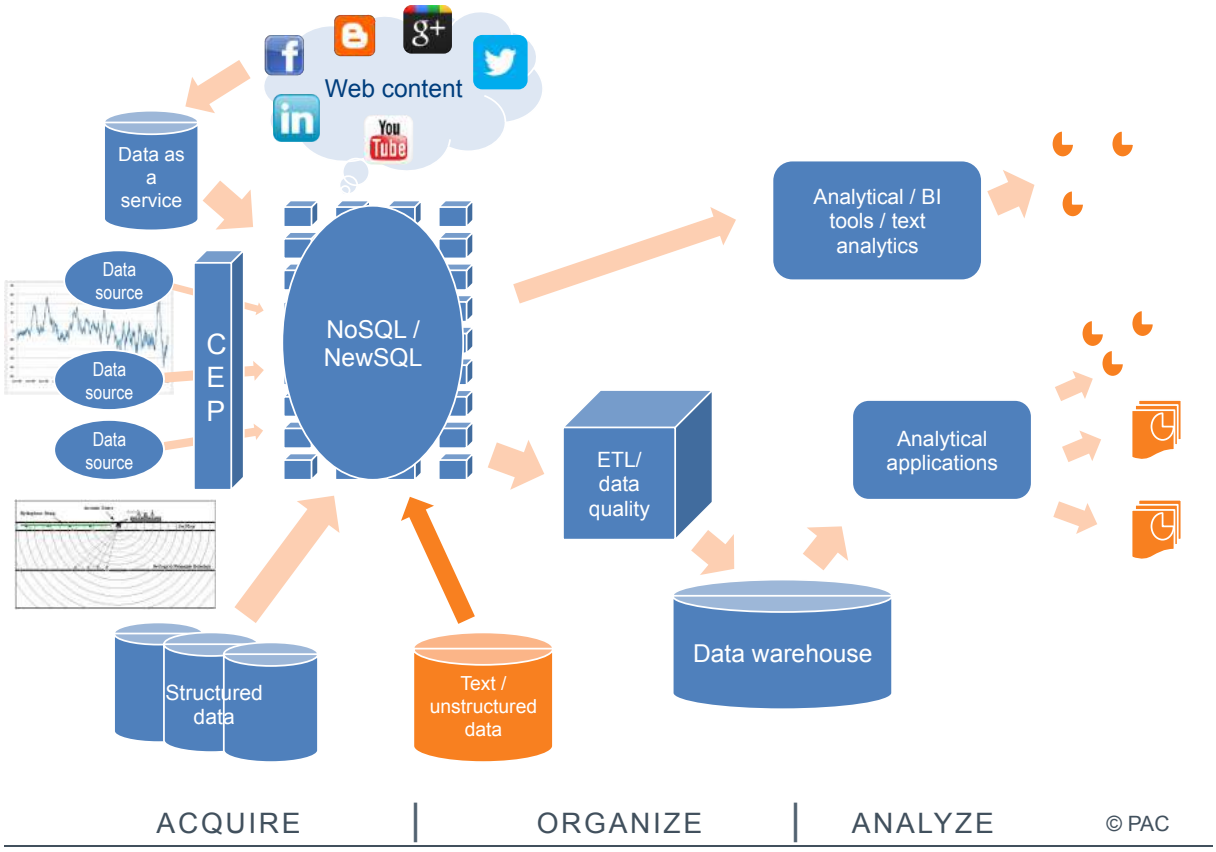
We segment the **big data services** market into:

1. **Consulting, systems integration, training and application management related to data infrastructure software;** this includes services related to the selection, implementation, customization and integration of standard software as well as to the development, implementation, integration and maintenance of custom software;
2. **Consulting, system integration, training and application management related to applications & analytics software;** this includes services related to the selection, implementation, customization and integration of standard software as well as to the development, implementation, integration and maintenance of custom software;
3. **Hosting and support:** hosting of big data solutions, and the selection, deployment, integration and maintenance of the related servers and storage.

Big data supplier landscape – functional view



The big data landscape – process view



Business intelligence (BI)

From the software point of view, BI is a generic term that embraces a large variety of software tools for reporting, analytical applications, corporate performance management and GRC (governance, risk and compliance). In addition, a number of infrastructure components belong to BI, including data management systems (data integration, data quality and data governance), databases and data warehouses.

BI solutions are often offered as part of a BI suite. But there are many specialized tools available for specific functions, such as reporting or data integration. In addition, many business application suites include BI functions, also referred to as 'embedded for BI'. For instance, there is almost no solution for customer relationship management (CRM) that does not include reporting.

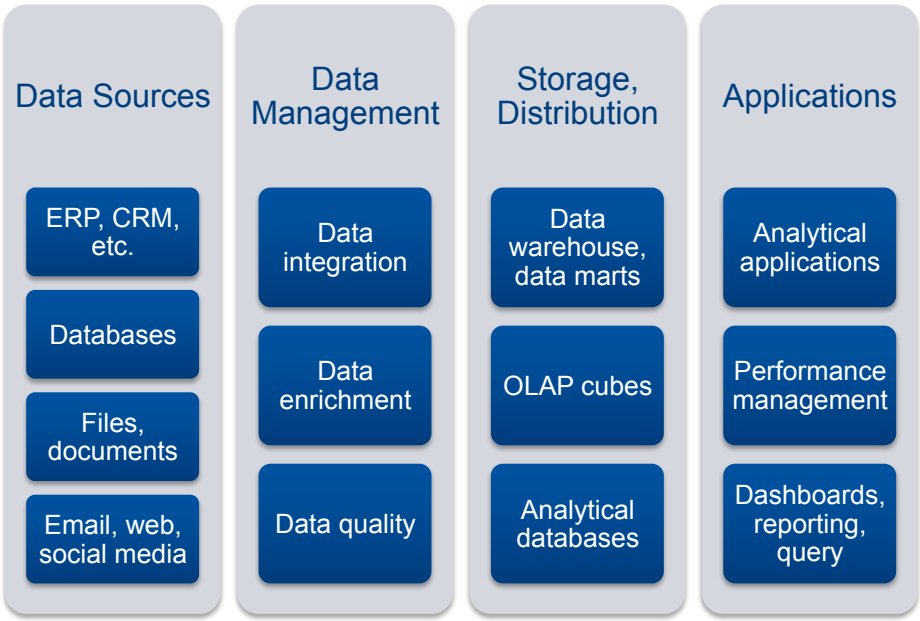
Some of the core functions of BI solutions include:

- Reporting & query
- Analysis
- Balanced scorecards
- Dashboards
- Planning, budgeting and forecasting

More specific feature include:

- Statistics
- Predictive analysis
- Optimization
- Complex event processing
- Text-mining and sentiment analysis

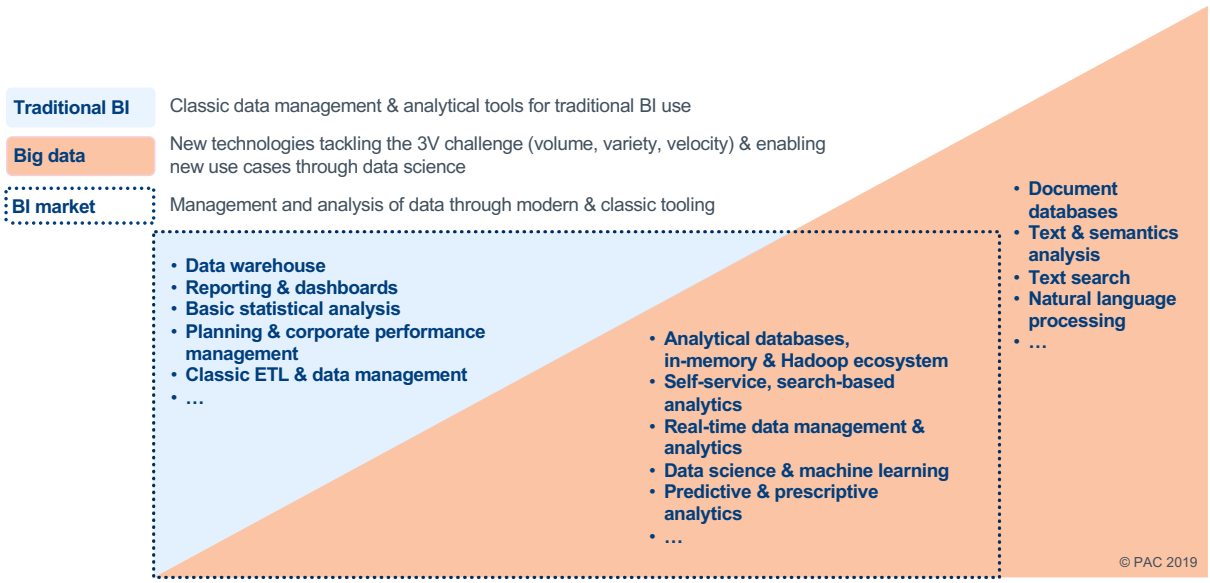
BI key components are:



© PAC

- Data warehouse (DWH) = data warehouse systems
- Analytical DB = analytical databases such as HP Vertica, Teradata, Oracle Exalytics, SAP HANA or IBM Netezza
- Data management (DM) = data integration, data quality and master data management
- Reporting = reporting, ad-hoc reporting
- Analysis and advanced analysis = among other things, data mining, text analysis, predictive analytics
- Planning & CPM = planning systems, CPM, consolidation, GRC

Business intelligence vs. big data – perimeters and overlap



7.2 Business applications-related services (BAS)

Includes consulting and systems integration (C&SI) revenue related to the implementation, customization, integration and evolution of:

- **Oracle Applications, including**
  - Agile
  - ATG Web Commerce
  - Auto Vue
  - Eloqua
  - Endeca
  - Haley
  - Hyperion
  - InQuira
  - JD Edwards
  - MetaSolv Software
  - Oracle CRM on Demand
  - Oracle E-Business Suite
  - Oracle Fusion Applications
  - Phase Forward
  - Portal Software
  - Primavera
  - PeopleSoft
  - RightNow
  - Siebel
  - Taleo
  - iFlex
  - Retek
  - Vitrue
  - WebCenter

- **Microsoft Dynamics, including:**
  - Microsoft Dynamics CRM
  - Microsoft Social Listening (Netbreeze)
  - Microsoft Dynamics Marketing
  - Microsoft Dynamics AX (Axapta)
  - Microsoft Dynamics GP (Great Plains)
  - Microsoft Dynamics NAV (Navision)
  - Microsoft Dynamics SL (Solomon Software)
  - Parature

- **SAP, including**
  - SAP Business Suite
  - SAP Business All In One
  - SAP Business One
  - SAP Business ByDesign
  - SAP Business Objects
  - SAP InfiniteInsight (KXEN)
  - SuccessFactors
  - Ariba
  - Fieldglass
  - Hybris
  - Camillion
  - JAM

- **Salesforce, including**
  - Sales Cloud
  - Service Cloud
  - Marketing Cloud
  - Work.com
  - ExactTarget Marketing Cloud
  - Community Cloud
  - Salesforce Chatter

…as well as upcoming acquisitions and brands.

SAP-related services

Cloud and HANA segmentation

SaaS-related
Related to the implementation, customization and integration of SAP's SaaS solutions (e.g. SuccessFactors, Ariba, Cloud for Customer, Concur, ByD, etc.

IaaS-related
Related to the migration of on-premises SAP solutions to run in an IaaS model (hosted private and/or public IaaS).

HANA-related
Related to the implementation, customization and integration of SAP's HANA solutions and platforms.

- **HANA platform-related:** C&SI services related to the implementation of the HANA platform and custom development on the HANA platform.
- **HANA applications-related (SoH & S/4):** C&SI Services related to the implementation of Suite on HANA (SoH) and S/4 HANA (S/4).

Topic segmentation – SAP topics

for more details, please go to the SAP solution explorer at http://sap.com

Financials: financial and management accounting, financial supply chain management, treasury applications, GRC (governance, risk, and compliance)

HCM = human capital management: workforce analytics, talent management, workforce process management, workforce deployment, end-user service delivery

CRM = customer relationship management: marketing, sales, service, partner channel management, interaction center, web channel, business communications management, real-time offer management

SRM = supplier relationship management: procure to pay, catalog management, centralized sourcing, centralized contract management, supplier collaboration, supplier evaluation"

Analytics: analytic applications, business intelligence, data warehousing, enterprise information management, enterprise performance management, governance, risk, and compliance

Database & technology: application foundation & security, business process management & integration, content and collaboration (portals), database (including Sybase ASE, Sybase Anywhere, Sybase IQ), in-memory computing (HANA), etc.

Mobility: mobile applications, mobile analytics, mobile platform (Sybase unwired platform, Afaria, Sybase 365)

Cloud: SAP's SaaS solutions (Business ByDesign, CRM on demand, SuccessFactors, Ariba, etc.)

Industry-specific solution (ISS) manufacturing: manufacturing resource planning (production planning, production control, material management), supply chain management, manufacturing execution systems, quality management, dispensing management, recipe management, laboratory information management, dangerous goods management, production data acquisition, batch management, product lifecycle management (life-cycle data management, program and project management, life-cycle collaboration, quality management, enterprise asset management, environment, health and safety), etc.

ISS banking: risk control, payment transactions, processing, account management; credit loans, mortgages; securities, corporate finance, insurance, deposits, risk management, treasury management; mobile-, internet-, self-service banking; branch banking

ISS insurance: collection & disbursement, risk management, policy management, product management, claim management, asset management, management of provisionary systems, customer data management

ISS utilities: energy trade, energy data management, billing, supply chain management

ISS telecom: billing, network lifecycle management, service fulfillment, supply chain management

ISS public: e-government, education, healthcare systems, supply chain management

ISS retail: merchandise management, supply chain management, trade management, risk management

ISS services: project management, supply chain management, partner management, facility management, media systems

ISS transport: sales and distribution, transportation management, asset management and operations management for airlines, railways (passenger & cargo)

7.3 Cloud and infrastructure

Cloud computing refers to the operation of a virtualized, automated, and service-oriented IT infrastructure that allows the flexible provision and usage-based invoicing of resources, services, and applications via a network or the internet.

The cloud computing concept means a way of provisioning and using technology, not a technology in and of itself. Generally, it does not refer to a specific technology, but rather to a set of combined technologies and concepts. That is why there are still many different definitions of cloud services in the market.

Moreover, the cloud concept is not entirely new. It rather combines a number of IT trends from the past, such as automation, centralization, shared services, service orientation (SOA), virtualization, and externalization (outsourcing, managed services).

However, cloud computing has particular characteristics that distinguish it from classic IT resource and service provisioning – or characteristics that are at least commonly associated with cloud services, even though most of the following are only 100% true for a few public cloud offerings.

Most existing cloud offerings include the following aspects – to a greater or lesser degree:

- Massive scalability
- Shift of costs from CAPEX to OPEX
- Per-usage pricing (per user and/or per volume/transaction)
- No long-term commitments
- Self-service-based (normally realized within public clouds, partly still restricted within private clouds)
- Service-oriented (reusable services are loosely coupled and orchestrated as required)
- Multi-tenant architectures (normally the basis for public clouds, but not always provided within private clouds)
- Virtualized infrastructures

- Rapid provisioning (normally realized within public clouds, partly still restricted within private clouds)
- Shared single instance (not in the sense of one single data center but one application instance/release, centralized support, further development, management, etc.)
- Standardized
- Easy-to-use/easy-to-consume, leveraging B2C concepts (B2C/B2B convergence)

In this document, cloud services will be considered in a broader sense (e.g., not necessarily multi-tenant), ranging from widely dedicated single-tenant architectures (a dedicated database, middleware, one single application instance) to multi-tenant architectures (a core SaaS model with a shared infrastructure, one single application instance). There is also a multitude of mixed architectures (e.g. a dedicated application instance and database, running on a virtual server).

Private vs. public cloud

In-house private cloud: implementation and operation of cloud architecture within a company or organization.

Hosted private cloud: operation and provision of cloud architecture by an external provider, specifically for one customer. This cloud model is very close to traditional hosting concepts but based on cloud architecture. An external provider is in charge of managing and running the customer's private cloud (normally built by the provider in charge of the operation). The cloud is basically dedicated ('private') but the provider, nevertheless, has the possibility to share resources like staff or facilities across several customers.

Public cloud: Resources based on cloud architecture are hosted by a provider and made available to several customers ('one-to-many' model) over the internet.

Managed cloud: managed services for in-house private clouds, and/or (third-party) public, or hosted private cloud solutions (IaaS, PaaS, or SaaS). The provider typically takes over responsibility for ongoing services around automation, integration, governance, and security, identity and access management (IAM), etc., for one or several cloud solutions (but not for the operation of the cloud solutions themselves in the case of third-party cloud solutions).

Cloud computing services (public cloud and hosted private cloud)

IaaS (infrastructure as a service): This is the basis of cloud architecture. It is the dynamic provisioning of computing, storage, and network resources. IaaS users, in particular system administrators and IT architects, can access these infrastructure resources as required.

Cloud computing provides access to computational resources, i.e., CPUs. So far, such low-level resources cannot really be exploited on their own, so they are typically found as part of a 'virtualized environment' (not to be confused with PaaS below), i.e., hypervisors. Cloud computing providers, therefore, typically provide their customers with computing resources (i.e. raw access to resources, unlike PaaS that offers full software stacks to develop and build applications), typically virtualized, in which to execute cloud services and applications. IaaS (infrastructure as a service) offers additional capabilities over a simple computing service.

Data & storage clouds deal with reliable access to data of potentially dynamic size, weighing resource usage against access requirements and/or quality definitions.

PaaS (platform as a service): This sits on top of the IaaS architecture and comprises the middleware and/or development platform, which enables IaaS users – in particular application developers and IT architects – to develop applications within the cloud and/or operate them.

It provides computational resources via a platform upon which applications and services can be developed and hosted. PaaS typically makes use of dedicated APIs to control the behavior of a server-hosting engine that executes and replicates the execution according to user requests (e.g. access rate). As each provider presents their own API based on its respective key capabilities, applications developed for one specific cloud provider cannot be moved to a different cloud host. There are, however, attempts to extend generic programming models with cloud capabilities (such as MS Azure).

SaaS (software as a service): SaaS includes network, system, storage and security Management (N3SM), middleware, as well as applications (e.g. business applications, BI, office, content and collaboration, etc.) sold 'as a service'.

Note: teknowlogy figures for SaaS include the software part (licenses and maintenance), as well as the hosting part (operation of the solution and related infrastructure) of a SaaS agreement.

BaaS (business process as a service): This goes beyond the traditional IT cloud architecture. Also known as platform-based business process outsourcing (BPO), it offers an externally provisioned service for managing an entire business process, such as claims processing, expense management, or procurement (internet-enabled). Unlike traditional BPO, which often requires the service provider to take over an existing software installation, the 'process cloud' uses a SaaS platform to automate highly standardized processes.

It differs from SaaS in that it provides end-to-end process support, covering not just software but also processes supported by people, such as contact centers. These processes are typically priced on a per-transaction rather than per-seat basis.

Cloud-related C&SI

Cloud-related C&SI		
Segment	**Cloud deployment**	**Description**
SaaS-related	Total cloud-related C&SI	Implementation (including data migration), customization, orchestration and integration of SaaS solutions
Infrastructure transformation	Public & hosted private cloud-related	Implementation, orchestration, and integration of IaaS services (public & hosted private)
Infrastructure transformation	In-house private cloud-related	Implementation, orchestration and integration of in-house private cloud infrastructure, including infrastructure deployment
Application transformation	Public & hosted private cloud-related	Migration of on-premises applications (custom software as well as standard software such as SAP or Oracle Applications), and their implementation, customizing, and integration to run on IaaS services (public & hosted private)
Application transformation	In-house private cloud-related	Migration of on-premises applications (custom software as well as standard software such as SAP or Oracle Applications), and their implementation, customizing, and integration to run on in-house private cloud infrastructure

7.4 Cyber security

Governance
Systems

Content and application
Infrastructure

Cyber security: broad segmentation of products, technologies and services		
Cyber security products/solutions		**Sub-segments**
	Governance, risk management and compliance	• Information security management systems • SIEMS: Security information and event management
	Identity and access management (system)	• Electronic access control (identification and authentication), SSO, Tokens systems for ICT hardware, systems and networks
	Data (content) security	• Encryption, cryptography and digital signature solutions • Public key infrastructure solutions • Digital rights management solutions • Content filtering and anti-spam • Data loss/leak prevention, secure data deletion, secure archiving, data recovery solutions
	Applications security	• Application security, design, coding development and testing
	Infrastructure (network) security	• System and network security software (firewalls, anti-virus, intrusion detection, tracking and tracing) • Terminal security (fixed or mobile) solutions and endpoint hardening solutions • Vulnerability scanners • Secure communications: email, phone, video-conferencing and messaging systems
	Hardware infrastructure (device/endpoint) security ***Not considered in our cyber security scope***	• Secure personal portable devices and identity documents • Hardware security modules • Enrolment and issuance systems (for access control and identity management) • Biometrics systems • Network cryptologic systems, special casings etc. for IT hardware
Cyber security services		
	Auditing, consulting planning and advisory services	• Security audit, vulnerability and intrusion testing, and risk and threat assessment • Security strategy, planning and management advice • Security certification and conformity/compliance assessment • Digital forensics: post-event (incident/intrusion) analysis, investigation and proof preservation
	System integration and implementation	• Security engineering, design and architecture development • Implementation and integration, interoperability testing • Implementation support (technical assistance/expert support services)
	Management and operations services	• Operational support (technical assistance/expert support services) • Managed security services, security system management and operations • Secure outsourcing • Continuity and recovery management • Trusted third party, e-content and e-reputation services
	Security training	• IT/cyber security education and training

SITSI cyber security segmentation by type of cyber security

Please note that:

- *The segmentation is based on products and solutions. Thus, services are segmented only by type of services.*
- *SITSI figures do not include hardware figures for cyber security.*
- *C&SI figures do not include services related to the hardware part of cyber security.*

7.5 Digital customer experience & Internet of Things

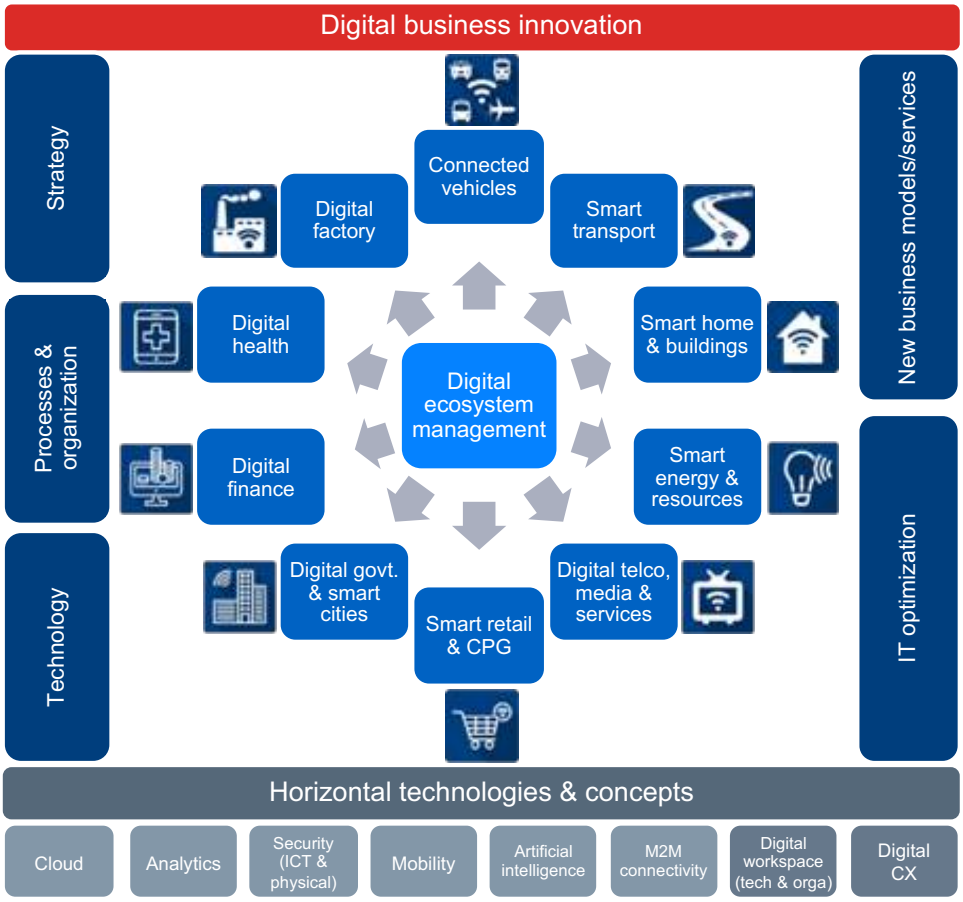
Digital business innovation

Use of technologies to create and operate innovative services, business models and processes

teknowlogy differentiates between three main aspects of digitalization: changes in the customer experience, new opportunities at production, product and service levels, as well as digital workspace:

Digital customer experience	Internet of Things	Digital workspace
The digital enterprise focuses on fundamentally **reshaping and optimizing interactions with customers** via digital channels, such as web, mobile, or social media. Interactions may include content and applications, sales and commercial activities, marketing, as well as customer service.	The Internet of Things (IoT) will bring digital **transformation to the production processes and the end products** of companies in many different industries. By adding local intelligence to products and machines and by providing holistic platforms for data aggregation and analysis, companies will be able to transform their business models and provide new high-value services to their customers.	Highly **collaborative and agile workspaces** are a substantial part of digitally integrated enterprises. In order to **improve the employee experience while ensuring high security and efficiency standards**, a holistic design and service concept is needed. Key issues include workspace design, technology integration, infrastructure management and end-user support, as well as a digital working culture and its organization.

Digital business innovation



Digital customer experience

Digital Customer Experience Segmentation	
1. Software Products (topic view)	
1.1. Digital Content & Applications	**Development & delivery platforms** Website development platforms Cloud & Mobile Apps Development platforms WCM (web content management) solutions Product Information Management (PIM) – Catalog Management Digital / Media asset manage solutions (MAM)
1.2. Digital Sales & Commerce	**Multi-channel commerce platforms & suites (Social, mobile, web, POS)** Omni-channel commerce platforms & suites (web, mobile, social, POS) Order Management & fulfillment solutions, digital payment solutions Analytics and reporting related to sales & commerce
1.3. Digital Marketing	**Digital marketing platforms & suites** Digital marketing platforms & suites Multi-channel campaign management Marketing automation & marketing process management Social media analytics, customer & marketing analytics
1.4. Digital Customer Experience & Service	**Customer experience platforms & suites** Customer experience platforms & suites Social customer experience Multi-channel contact center & customer service Customer portals & community management solutions
2. Services (topic view)	
2.1. Digital Content & Applications	Services related to development & delivery platforms
2.2. Digital Sales & Commerce	Services related to multi-channel commerce platforms & suites (social media, mobile, web, POS)
2.3 Digital Marketing	Services related to digital marketing platforms & suites
2.4. Digital Customer Experience & Service	Services related to customer experience platforms & suites
3. Services (services view)	
3.1. Digital Consulting	**Technology and business consulting related to digital projects** Digital strategy consulting Digital technology consulting Organizational transformation
3.2. Digital Technology Implementation	**Technology sourcing or development and implementation related to digital projects** Technology selection Solutions design and development Front office implementation
3.3. Digital Technology Integration	**Integration with existing systems of technologies related to digital projects** Backend integration of marketing and commerce platforms Data integration Content management integration
3.4. Digital Operations & Management	**Operations and management of digital infrastructure and applications** Digital solutions hosting & managed services Infrastructure support services & application management Business process outsourcing

Digital contexts

Digital factory	Connected vehicles	Smart transport	Smart home & buildings	Digital health
A digital factory uses smart products and smart services to become a highly efficient and integrated cyber-physical production system. This covers the improvement of internal production processes, intra-logistics and the supply chain, and also the delivery of smart products and services to help others realize a digital factory. Related terms: Industrial IoT, smart factory, "Industrie 4.0"	Connected cars, trucks, buses, ships, trains and other vehicles can continuously, bidirectionally communicate with ecosystems (e.g. owners, drivers, OEMs, insurers, garages) and environments (traffic signals, other vehicles, smart homes, etc.). IoT-related technologies enable smart services such as traffic management, predictive maintenance, convenience services, after-sales solutions, etc. Related terms: smart vehicles; sub-topics such as connected cars, connected trains, autonomous driving, car-to-car communications (C2C)	Smart transport comprises applications which, without embodying intelligence as such, aim to provide innovative services relating to different modes of transport & traffic management, and enable various users to be better informed as well as to make safer, better coordinated and 'smarter' use of transport networks. Related terms: n/a	Usage of technical systems and technology in buildings (residential & institutional) to increase e.g. the quality of living/working, safety, energy efficiency based on connected and telecontrolled devices and installations as well as automated processes (heating, surveillance, domestic appliances, entertainment, etc.) Related terms: smart living, eHome	Digital health is the convergence of the digital revolution with healthcare, living, and society. IoT-related technologies are used to improve access, reduce costs, increase quality and security, reduce inefficiencies in healthcare delivery, and make medication more precise in combination with personalized genomics. Related terms: n/a

Smart energy & resources	Digital finance	Digital government & smart cities	Smart retail & CPG	Digital telco, media & services
Usage of IoT technologies and analytics (incl. artificial intelligence, AI) to develop or optimize end-to-end energy management systems and energy exploration (oil & mining) as well as to enable new business models for energy consumption. Related terms: smart energy	The digitalization of processes in the financial services industry, including the creation of new paradigms and services or the enhancement of existing ones, by means of technologies such as real-time analytics, mobility, blockchain or artificial intelligence (AI). Related terms: fintech, insurtech, digital banking, blockchain	Ubiquitous and transparent integration of digital IT-based systems to help increase operational efficiency, improve citizens' and visitors' experience through data-based information and services. Based on IoT networks and platforms which can collect, secure and combine data from other ecosystems, remote equipment and mobile devices. Related terms: n/a	Smart retail & CPG refers to the implementation of digital devices, connectivity modules, hardware and software into products, stores and warehouses to improve customer experience, customer loyalty, customer retention, in-store operations and warehouse management. Related terms: smarter commerce	The digitalization of core customer services and related industries as well as telco, media and digitalized business services as an integral part and enablers of cross-industry ecosystems. Related terms: smart media publishing

Technology domains

Local intelligence

Activities associated with the enablement of data capturing, processing and response on local devices (things)				
Technology	Description	Hardware	Software	Services
1. Local intelligence				
1.1. Sensors	Sensors for temperature, pressure, humidity, gas, acceleration, gravity, vibration, sound, electrical fields, GPS	Physical sensors (analog, digital)	Virtual sensors	Infrastructure services
1.2. Actuators & chips	Electronic components, integrated circuits or monolithic integrated circuits on small plates of semiconductor material ("chips") , being able to receive and act based on information and commands	Actuators, integrated circuits (IC), microprocessors, storage, microcontrollers	Software on chip	Infrastructure services
1.3. Embedded systems	An embedded computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing requirements	Chipsets, control units	OS, middleware, tools	Application services, infrastructure services

Enterprise processes (1/2)

Activities associated with the connection of intelligent devices to the vertical IT layer (commercial, technical IT backend systems) within a company; enabling backend systems to understand machine data				
Technology	Description	Hardware	Software	Services
2. ERP	Extending existing ERP systems or developing new solutions in order to read, store and process machine data within corporate business processes	IT hardware (server, storage, network)	ERP applications	Application services, infrastructure services
3. Industry business solutions				
3.1. SCM	Connecting IT systems/ processes across different stakeholders within a horizontal supply chain including sourcing and trade processes	Industrial PCs, IT hardware, appliances	OS, middleware, tools, platforms, horizontal/ vertical business apps	Application services, infrastructure services
3.2. PLM	Extending existing PLM systems or developing new solutions in order to read, store and process machine data within corporate business processes; PLM solutions comprise applications that help create, design, visualize, simulate, provide, and manage product data over the entire product lifecycle.	IT hardware (server, storage, network)	PLM applications	Application services, infrastructure services
3.3. MES	Extending existing MES systems or developing new solutions in order to read, store and process machine data and make this data available for business decisions	IT hardware (server, storage, network)	MES applications	Application services, infrastructure services
3.4. SCADA	Custom-specific solutions for automating industrial production processes, energy production and distribution, medical backend systems and transportation	Industrial PCs, IT hardware, appliances	OS, middleware, tools, platforms, horizontal/ vertical business apps	Application services, infrastructure services
3.5. Industry-specific MIS	Industry-specific management information systems for dedicated purposes, or value-added services	IT hardware (server, storage, network)	Horizontal business applications/BI	Application services, infrastructure services

Enterprise processes (2/2)

Activities associated with the connection of intelligent devices to the vertical IT layer (commercial, technical IT backend systems) within a company; enabling backend systems to understand machine data				
Technology	Description	Hardware	Software	Services
4. Marketing, sales & commerce, CX				
4.1. Digital content & applications	Website and mobile app development platforms Web content management (WCM), web hosting, product information management (PIM), digital asset management (DAM)		SaaS, cloud platforms, software, tools	Strategy & technology consulting, implementation & integration, hosting, managed services, BPO
4.2. Digital sales & commerce	Omni-channel commerce platforms & suites including order management, fulfillment, digital payment solutions as well as sales & commerce analytics		SaaS, cloud platforms, software, tools	Strategy & technology consulting, implementation & integration, hosting, managed devices, BPO
4.3. Digital marketing	Platforms & suites for marketing automation & marketing process management including marketing & social media analytics as well as multi-channel campaign management		SaaS, cloud platforms, software, tools	Strategy & technology consulting, implementation & integration, hosting, managed services, BPO
4.4. Customer experience integration platforms	Integrated customer experience, omni-channel content & customer service, commerce, marketing, and analytics platforms & portals		SaaS, cloud platforms, software, tools	Strategy & technology consulting, implementation & integration, hosting, managed services, BPO

Horizontal integration (1/2)

Activities associated with the horizontal integration of local (intelligent) devices and backend systems within one or multiple organizations				
Technology	Description	Hardware	Software	Services
5. Analytics	Aggregating, storing and analyzing data (from machines, humans, other systems) in order to gain business insights	IT hardware (server, storage, network)	Horizontal business applications/BI	Application services, infrastructure services
6. Machine data cloud platform	Providing a cloud-based infrastructure platform between sensors/embedded systems and backend systems for connectivity, data integration and storage	IT hardware (server, storage, network)	Virtualization engines & environment, cloud/IaaS platforms	Cloud integration, operation
7. Artificial intelligence	Artificial intelligence (AI) is the combined use of algorithms, knowledge bases (big data sets), and neural networks/deep learning techniques to mimic and complement human abilities in a variety of domains.	Industrial PCs, IT hardware, appliances	OS, middleware, tools	Application services, infrastructure services
8. IT security				
8.1. Data (content) security	Security measures including encryption, cryptography & digital signature solutions, public key infrastructure solutions, digital rights mgmt. solutions, content filtering & anti-spam, data loss/ leak prevention, secure data deletion, secure archiving as well as data recovery solutions	IT hardware (server, storage, network)	Middleware, tools, platforms	Application services, infrastructure services
8.2. Applications security	Includes application security design, coding development and testing	IT hardware (server, storage, network)	Middleware, tools, platforms	Application services
8.3. Infrastructure (network) security	Includes system & network security software (firewalls, antivirus, intrusion detection, tracking and tracing), terminal security (fixed or mobile) solutions & endpoint hardening solutions, vulnerability scanners as well as secure communications: email, phone, video conferencing & messaging systems	IT hardware (server, storage, network), telecom hardware	OS, middleware, tools, platforms, applications	Application services, infrastructure services

Horizontal integration (2/2)

Activities associated with the horizontal integration of local (intelligent) devices and backend systems within one or multiple organizations				
Technology	Description	Hardware	Software	Services
9. Mobility	Mobile workplace (incl. apps for the mobilization of the workplace e.g. e-mail or office applications), mobile process apps (e.g. mobile ERP, CRM, SCM or BI, including mobile app development), mobile device & apps management (incl. middleware for remote mgmt and security of mobile devices and apps); focus on human-to-machine (or human-to-human)	IT hardware (server, storage, network), telecom hardware	OS, middleware, tools, platforms, mobile business apps	Application services, infrastructure services
10. M2M connectivity	connectivity enablement, operation, SIM card integration; focus on machine-to-machine	IT hardware (server, storage, network), telecom hardware	OS, middleware, tools, platforms	Application services, infrastructure services, telecom service
11. Human-machine interaction				
11.1. UCC	Design of workstream collaboration platforms, including voice and messaging infrastructure as well as collaboration and unified communications tools and apps	IT hardware (server, storage, network), telecom hardware	Applications, middleware, tools, platforms	Application services, infrastructure services, consulting & systems integration
11.2. Interfaces	Design and implementation of human-machine interfaces; machine data extraction interfaces	Panels, exchange interfaces	OS, middleware, tools, platforms	Consulting & systems integration
11.3. I/O design	Design of new I/O concepts (e.g. augmented reality, cognitive control)	n/a	Tools, platforms	Consulting & systems integration
11.4. Roles & processes	Design and implementation of new business processes associated with IoT technologies / adjustment of existing business processes to new IoT-based opportunities	n/a	Tools, platforms, applications	Consulting, training

8. ABOUT TEKNOWLOGY GROUP

teknowlogy Group is the leading independent European research and consulting firm in the fields of digital transformation, software, and IT services. It brings together the expertise of four research and advisory firms, each with a strong history and local presence in the fragmented markets of Europe: Ardour Consulting Group, BARC (Business Application Research Center), CXP and PAC (Pierre Audoin Consultants).

We are a content-based company with strong consulting DNA. We are the preferred partner for European user companies to define IT strategy, govern teams and projects, and de-risk technology choices that drive successful business transformation.

We have a second-to-none understanding of market trends and IT users' expectations. We help software vendors and IT services companies better shape, execute and promote their own strategy in coherence with market needs and in anticipation of tomorrow's expectations.

Capitalizing on more than 40 years of experience, we operate out of seven countries with a network of 150 experts.

For more information, please visit www.teknowlogy.com and follow us on Twitter or LinkedIn.