

Germany – Excellence in Big Data

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1 Messages of Greetings

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Sigmar Gabriel, Federal Minister for Economic Affairs and Energy

Data is the commodity driving our digital age. If a company is to thrive in today's economy, it must know how to handle data in the right way. Gathering, processing, linking up, and protecting data will increasingly become core capabilities that enable companies to be successful. This is the meaning of »big data« – the term used to refer to the unparalleled volumes of data available today.

Big data is global and knows no national borders. No country can pull up the drawbridge to stop data flows or make exclusive use of them. This alone is reason enough for a modern economy like Germany to explore this trend. We are in the process of doing this and can rely on a broad base of knowledge and capabilities in this area as we do so, concentrating on those aspects that have defined the Germany economy in the analogue world. We want to use ICT to become even stronger than we already are in areas including industry, the health sector, mobility, and energy. These are sectors in which we need to start using big data today, in order to maintain our competitive edge tomorrow.

The Federal Economic Affairs Ministry's »Smart Data« programme is designed to enable Germany to use ICT to pool its strengths. The 'Smart Data Forum', which also receives funding from the Economic Affairs Ministry, is to communicate the findings and new insights to SMEs, thus alleviating their concerns and providing encouragement.

By its very nature, digitisation transcends boundaries – the walls that exist between different sectors, the bounds of our imagination and, most importantly, the borders between different countries. This is why the »Smart Data Forum« is designed around international cooperation. We are joining together with Bitkom, representing the ICT industry, and Germany Trade and Invest (GTAI) to foster global networking to the benefit of all involved.

As this brochure convincingly shows, Germany is ready for the era of big data. It provides an overview of Germany's capabilities in the field of big data, of the diversity of the programmes and initiatives in place, as well as of the institutions and companies involved.

I am confident that this brochure will be an immensely useful source of information to you in your work, and invite you to use it to discover the world of big data in Germany. On this note, I hope you enjoy reading this brochure and that it acts as a source of inspiration to you.



A handwritten signature in blue ink that reads "Sigmar Gabriel". The signature is fluid and cursive.

Sigmar Gabriel

Federal Minister for Economic Affairs and Energy

Thorsten Dirks, President, Bitkom e.V.

Big data has helped people make significant strides towards solving large-scale challenges particular to 21st century life. For instance, urban planners and automotive manufacturers can use big data reports to mitigate transport problems and significantly reduce emissions, respectively. Medical professionals can draw upon big data to provide improved treatment for widespread health concerns such as cancer and cardiac arrests. Many different kinds of big data applications are currently in use – in the health industry, civil sector, automatic vehicles, Industry 4.0, intelligent power grids, transport systems of the future and intelligent educational networks.

These applications open up enormous commercial possibilities. Intelligent data analysis provides companies with a tremendous opportunity to better understand and streamline their business processes. Moreover, big data also serves as a catalyst for new business models – especially in the German and European digital sector.

Many of the companies in this sector have set international standards. Our publication introduces a whole series of big data providers who have established a strong foothold on the US market, such as SAP Hana. This in-memory platform allows users to analyse vast volumes of data in real time.

Germany and Europe have set high standards for data protection and security, which motivates German and European IT companies to be more precise, reliable and trustworthy than their overseas competitors. German IT companies in particular are known for their security and reliability. That being said, European IT companies need to take care that stringent protective regulations do not hinder the innovative capacity of the European big data industry.

German concerns are among the world's best when it comes to incorporating big data into science and research. Research and application are closely interlinked, as the work of the Fraunhofer-Gesellschaft shows. Quality research, a large number of industrial companies with traditionally strong competitive positions and highly efficient infrastructures make Germany a strongly appealing investment location. Germany has already attracted high-profile investors – for example, IBM chose to establish its global headquarters for Watson Internet of Things in Munich.

Moreover, Germany's political realm is in tune with the zeitgeist, and serves as a reliable partner for companies and investors. The Federal Ministry for Economic Affairs and Energy's »Smart Data – Innovationen aus Daten« technology program distributes €55 million in grant funds, of which the ministry itself contributes €30 million. Meanwhile, the Federal Ministry of Education and Research is currently building two large big data centres of excellence in the German cities of Berlin and Dresden/Leipzig.

I would like to invite everyone who is interested in big data to read the following 240 pages and get to know the German companies and institutions who are productively engaging with this topic. We will introduce you to pioneering research institutes and technology providers who make excellent use of big data. We will also show how German companies incorporate data analysis in practice. And, last but certainly not least, we will show you why big data is so important for Germany.



A stylized, handwritten signature in black ink, consisting of a large, sweeping initial 'T' followed by several loops and a final flourish.

Thorsten Dirks
President
Bitkom e.V.

2 Management Summary

2 Management Summary

Since the first major technological breakthroughs that have created the buzz around big data, the strategic relevancy and market landscape for the next generation of analytical solutions have significantly changed. It has been roughly about 10 years ago that technologies named Hadoop or SAP HANA have started to change the way we think about managing large amounts of data. With the advent of the cloud age and the ongoing digitization of business models and processes in nearly every industry, the capabilities to efficiently and creatively managing huge and fast-growing volumes of data (»big data«) have become an independent IT-management discipline as well as a strategic success factor for every company – and economy.

Top management has realized over the last years that »big data« has come out of its hype- and innovation stage to become a major catalyst for nearly every aspect of the digital transformation process that currently drives senior executives as one of the key levers to spur innovation and retain competitive strength in a world disrupted by global internet firms and aggressive, asset-light start-ups. Thereby »big data« has matured to be the IT-management discipline that mainly enables the transformation process to become a »data-driven« company that is tightly connected to its customers and partners and able to adapt its business processes and models in near real-time.

While Germany may not be at the forefront of the innovations in the consumer internet, its capabilities and data-related assets in the field of big data are impressive. Germany can rely on a core economic backbone which is the large number of highly competitive engineering and manufacturing companies. Automation, innovation and process efficiency are at the heart of German firms. These success factors are now being leveraged by the commercialization of all the industrial and logistics data building the next generation of smart industry solutions named »industrial internet« or »Industry 4.0«. Other sectors like retail and logistics, healthcare and public sector make also significant contributions to a growing and valuable »big data« ecosystem in Germany consisting of innovative technology providers, IT service firms, governmental and academic institutions as well as disruptive startups. The following examples will illustrate leading firms, projects, initiatives and thereby highlight Germany's distinctive strengths and locational advantages when it comes to invest in the next generation of »big data« solutions.

Companies & Technologies

- **T-Systems** – T-Systems is a front-runner towards the ongoing digitization of today's business and society. As a Big Data pioneer T-Systems offers a complete, fully integrated value chain with comprehensive consulting, designing, developing, and operation services. The highly standardized, but best-of-breed Big Data technology stack covers all Big Data aspects and combines network, infrastructure, data integration, data management, data access, analytics, visualization, governance and security solutions from leading Big Data vendors. T-Systems utilizes a cloud-based and highly scalable production network for individual best-in-class Big Data solutions. More than 600 specialists for BI & Big Data support customers in Big Data projects and meet highest professional, technological and security requirements. Analysts gave T-Systems repeated top ratings among Big Data providers.

- **SAP HANA** – SAP HANA is one of the market leading in-memory data processing and analytics platforms. The platform holds the power to simplify both the user experience and the overall IT landscape, creating a smaller data footprint, increased system throughput, and easier data processing and operation. For this reason, SAP has evolved SAP HANA from a database to a full business platform that acts as the basis for all future SAP products. The SAP HANA platform combines database, data processing, and application platform capabilities in-memory. By providing advanced capabilities – such as predictive text analytics, spatial processing, and data virtualization – on the same architecture, it further simplifies application development and processing across Big Data sources and structures. The key advantages of SAP HANA are: a) real-time computing, b) open platform, c) Basis for major SAP applications, will become underlying technology for all SAP applications. Currently the SAP HANA ecosystem incorporates: 3,200 startups developing on HANA platform, 1,340 SAP HANA One customers, 7,000 SAP S/4HANA trained partners persons and 990 authorized SAP S/4HANA resellers.
- With over 45 years of customer-centric innovation, **Software AG** is ranked as a leader in many innovative and digital technology categories. Software AG offers the first end-to-end Digital Business Platform - based on open standards, with integration, process management, adaptive application development, in-memory data, real-time analytics and enterprise architecture management as core building blocks. The modular platform allows users to develop the next generation of application systems to build their digital future today. Big Data technologies are at the core of the Digital Business Platform providing market-leading capabilities for streaming analytics and in-memory data processing. Apama Streaming Analytics serves proven complex event processing capabilities to make real-time decisions based on streaming data (e.g. Sensors, Social Media) with the ability to analyze millions of events per second. In combination with the Big Data In-memory technology Terracotta, enterprises are able to process, analyze and predict big data in real-time to implement new business solutions (e.g. Internet of Things, Predictive Maintenance, Fraud Detection, Production Monitoring, Internet-scale applications). In its long-lasting research tradition Software AG has established a worldwide collaborative network with many organizations, among them numerous renowned universities and research institutes, enterprises, government institutions, partners and customers and takes advantages of the close vicinity to them.
- **Apache Flink** – A Stratosphere ([↗stratosphere.eu](http://stratosphere.eu)) fork that became an Apache Top-Level Project in December 2014, Apache Flink is an industry leading open source stream and batch data distributed processing platform, with a streaming dataflow engine at its core. Flink provides data distribution, communication, and fault tolerance for distributed computations over data streams and APIs that enable software developers to rapidly build new applications that run on the Flink engine. In late 2014, a company called data Artisans was founded by the original creators of the Apache Flink project, in order to build the next-generation platform for programming data-intensive applications. Today, Apache Flink is in production at prominent companies.

Investments

- **IBM Watson** – With a global presence, IBM is one of the world's leading providers of Business and IT Solutions. In Germany, IBM Research and Development fulfills a key role in the development of IBM's Big Data, Analytics and Cognitive Computing capabilities. IBM provides enterprise grade Software, IT and Business Solutions. End of 2015 IBM recently announced that the company that Munich, Germany will serve as the global headquarters for its new Watson IoT unit, as well as its first European Watson innovation center. The campus environment will bring together 1000 IBM developers, consultants, researchers and designers to drive deeper engagement with clients and partners, and will also serve as an innovation lab for data scientists, engineers and programmers building a new class of connected solutions at the intersection of cognitive computing and the IoT. The center will drive collaborative innovation with clients, partners and IBM researchers and data scientists to create new opportunities for growth in IoT. It represents IBM's largest investment in Europe in more than two decades.
- **Cisco** announced in March 2016 an investment of \$500 million in Germany over the next three years, to help accelerate the country's digitization. The program is called »Deutschland Digital« and focuses on innovation, security and education. Planned investments foresee funds for specific digitization projects, research projects, an expansion of the Cisco Networking Academy®, and direct investments in venture funds, as well as to human resources and infrastructure spending. Cisco will also expand its investment in start-ups and venture funds in Germany with priority areas such as security, cloud, and Internet of Things (IoT). Cisco is already focused on the emerging startup ecosystem in Germany, having recently made an investment in IoT provider ↗[relayr](#), headquartered in Berlin.

Projects & Platforms

- The **Berlin Big Data Center** (BBDC) – Led by TU Berlin (TUB), the BBDC's mission is to perform ground-breaking R&D, train tomorrow's data scientists, and enable deep data analysis on massive heterogeneous datasets and high velocity data streams. Currently, the BBDC groups are conducting fundamental research that will yield a novel, automatically scalable solution capable of performing deep big data analysis. The R&D activities include:
 - developing an integrated, declarative, and scalable open-source system that enables the specification, automatic optimization, parallelization, hardware adaptation, fault-tolerance, and efficient execution of data analytics on Apache Flink,
 - conducting research in machine learning (ML) methods, scalable ML, declarative data programming models, and the usage of software defined networks for data processing, among other things, and
 - transferring the new technology to support innovation in enterprises and empower them to conduct sound data-driven decision-making. Among its successes is Emma, a language for parallel data analysis.

- **ParStream** – ParStream Inc is an IoT analytics and Big Data platform company with headquarter and development in Cologne, Germany. ParStream was founded in 2008 by Michael Hummel and Jörg Bienert and received venture funding from top tier venture capital firms.. ParStream has developed one of the most comprehensive platforms in the Interactive Analytics for Big Data category and lately got acquired by Cisco. The approach was to build a new computing architecture capable of massive parallel processing, configured and optimized for large amounts of data, and employing new and patented indexing methods to achieve real-time query response times.
- **Blue Yonder** delivers the best decisions on pricing, replenishment and customer targeting to the retail sector. Its solutions use ground-breaking machine learning, developed and managed by the most qualified team of PhD data scientists in retail. Founded by ex-CERN scientist Professor Feindt in 2008, Blue Yonder's solutions are unique due to their advanced quality, such as the NeuroBayes algorithm developed by Professor Feindt during his tenure at CERN. Blue Yonder delivers 500 billion decisions per month for its customers typically raising KPIs like profit or revenue by 10 per cent. It delivers these decisions to many of the largest and most influential European retail brands in grocery, fashion and commerce. In May 2016 Blue Yonder opened an office in Dallas and is already working with US customers. Blue Yonder's priority is to help retailers improve their customers' experience in the omni-channel world.
- **RapidMiner** provides an industry leading open source predictive analytics platform. RapidMiner's effortless solution makes predictive analytics lightning-fast for today's modern analysts, radically reducing the time to unearth opportunities and risks. RapidMiner delivers game-changing expertise from the largest worldwide predictive analytics community. RapidMiner has users in more than 100 countries world-wide with the biggest deployments in Germany, USA, France, Finland, and Hungary. Customers include many large, mid-sized, and small enterprises and organizations.
- **Datameer's** mission is to make big data analytics easy for everyone. From ending world hunger, to solving complex business problems, to curing cancer, the company believes that the world's most challenging issues can be solved with data. That is why Datameer is so deeply committed to lowering the barrier to entry and putting the power of big data analytics directly into the hands of those who know their data best. Datameer makes big data analytics simple. Datameer gives users a unified, self-service environment to integrate, prepare, analyze, visualize, and operationalize big data analytics. Hundreds of customers, including CIOs, CMOs, CTOs, doctors, scientists, law enforcement officials, and even Olympic athletes all rely on Datameer to help them get from raw data to insight faster than ever. Datameer combines Hadoop's unlimited storage and compute power with a common spreadsheet interface and powerful functionality, quickly transforming businesses into agile, data-driven organizations.
- **Siemens MindSphere** – Reducing cycle times, increasing flexibility, enabling individualized mass production, and minimizing the consumption of energy and other resources – these are the challenges manufacturing companies face today. To remain competitive, they need to improve their entire value chain, from design and production planning to engineering

and services. This also means that in order to make the right decisions early, a vast quantity of captured data (»big data«) must be analyzed, and it must be determined which of all these data are truly necessary. Smart data in the end make it possible to increase production efficiency, tap the full potential of the plant and allow the creation of new digital services. MindSphere is an open IT ecosystem, which makes it possible to exchange data across company borders and can also link a wide variety of products, no matter the manufacturer. MindSphere is running on SAP HANA cloud platform, one of the most advanced and powerful cloud infrastructures worldwide. This partnership not only provides latest technology for the challenges of industrial IoT but also offers easy usability of MindSphere. So to speak, MindSphere is the answer for the consolidation of information technology and operations technology.

- **Here Deutschland** – Here is a global provider of real-time traffic data and related navigation services. It focuses on data aggregation, big data analytics and creation of services in and for the automotive, mobility and enterprise sectors. Here has 6,500 employees globally and 1,000 nationally. The company recently got acquired by a consortium of German car manufacturers. Among the challenges are providing people better and more accurate traffic services, the development and the acceptance of automated driving as well as the management of fixed and mobile assets. Its traffic data is using information from over 100 source types and billions of GPS probe data points gathered every day. Over the years we have created database of over one trillion GPS probe data points contributing to our traffic products today. As cars become connected to the Internet they will generate tremendous amounts of data. The ability to share this data across all car makers globally, while protecting driver privacy, is essential to making automated driving a reality. In order for a vehicle to effectively »see around corners« beyond the reach of its on-board sensors it is mandatory to aggregate and analyze car sensor data at scale to provide a real-time picture of the road network to vehicles on the road.
- The **Industrial Data Space** is a virtual data space using standards and common governance models to facilitate the secure exchange and easy linkage of data in business ecosystems. It thereby provides a basis for creating and using smart services and innovative business processes, while at the same time ensuring digital sovereignty of data owners. The Industrial Data Space initiative was launched in Germany at the end of 2014 by representatives from business, politics, and research. Meanwhile, it is an explicit goal of the initiative to take both the development and use of the platform to a European and global level. The Industrial Data Space comes as an initiative that is organized in two branches: a research project and a non-profit user association. The research project is of precompetitive nature and aims at the development and pilot testing of a reference architecture model of the Industrial Data Space. Plans to take the Industrial Data Space to a European level to provide a European Data Space are currently in preparation: The Roundtable on Industrial Data Platforms in Brussels on Feb 17, 2016 (led by Commissioner Oettinger) clearly showed the need for a European Data Space.
- DPD in Germany is part of DPDgroup, the second-largest international parcel delivery network in Europe. **DPD's industry-leading Predict service** is setting a new standard for keeping customers closely in touch with their delivery, with real time tracking of their delivery, a one-

hour delivery window and a range of options for redirecting parcels. In 2014 DPD succeeded in reducing its delivery time window radically, with the aid of technology based on Big Data. Because DPD exploits the available digital possibilities to their full extent, consignees can now integrate parcel deliveries into their everyday routine more efficiently than ever before. Big Data plays a major role in enabling DPD to achieve its goals and optimise its services further. Predictive analytics for instance, has enabled the company to analyse local transport conditions, to forecast the probable stop density and delivery time windows, and to establish a hypothesis about consignee behaviour. In addition, with the aid of machine learning the probability that the predicted delivery time window will be met is calculated on the day of delivery on the basis of the historical experience of the individual driver, together with data relating to the weather, traffic and population density on the individual delivery tour.

3 Excellence in Big Data – German Policy Background

3 Excellence in Big Data – German Policy Background

Support programmes of the German Federal Ministries

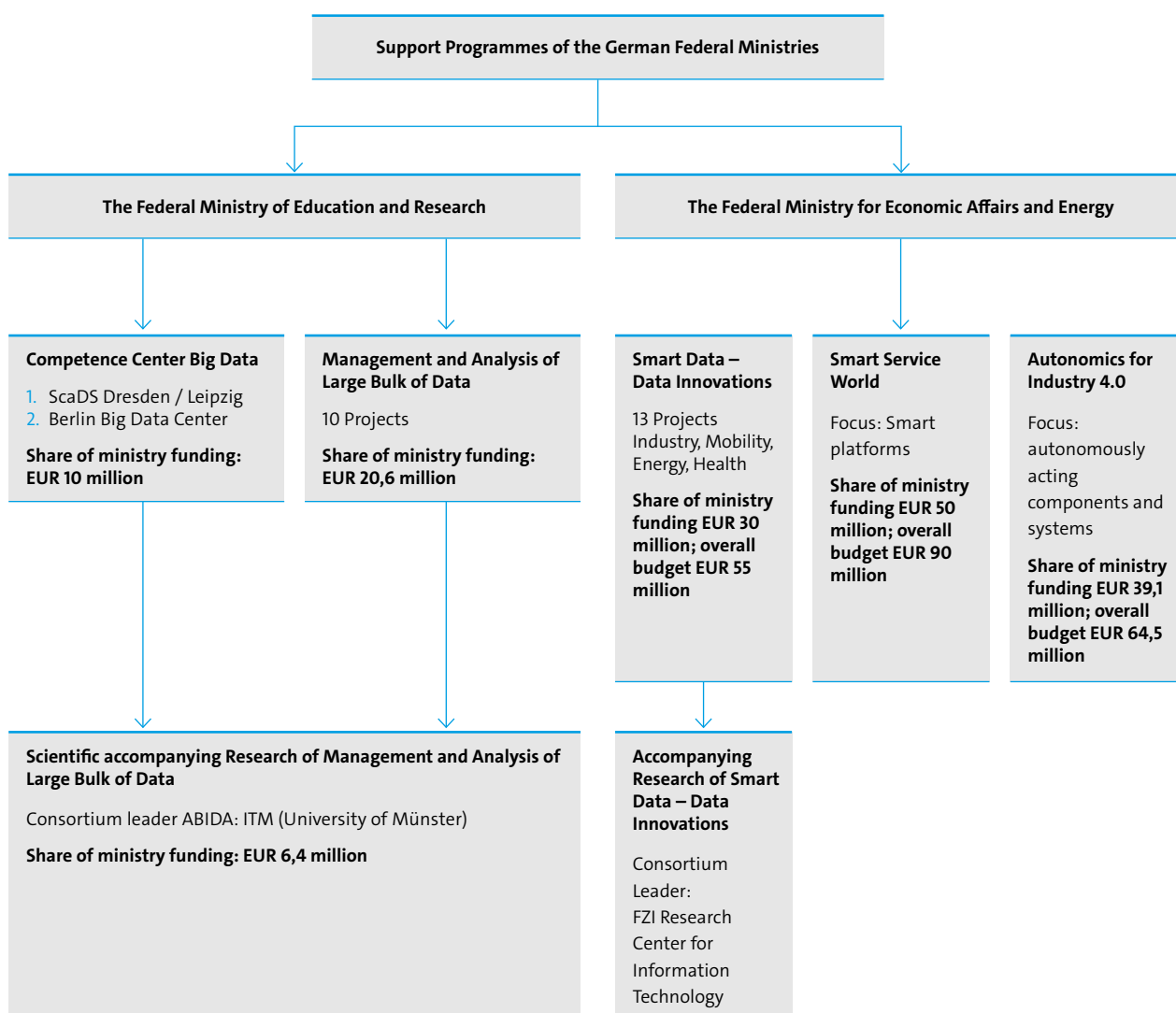


Figure 1: Support programmes of the German Federal Ministries

For international cooperation in a field of technology the laws and the political framework are of great importance. For this reason, the technology promotion programs of the federal government which are particularly relevant for big data are presented in this introductory chapter. Other technology programs – for example, the programs »Algorithms for Big Data« of the German Research Foundation or »Super Computing and Big Data« of the Helmholtz Association – will be mentioned in the following chapters, but not be characterized in detail. The chapter will also give a brief overview of the legal framework for Big Data in Germany.

3.1 Promotion Programmes for Big Data initiated by the Federal Ministry for Economic Affairs and Energy

3.1.1 »Smart Data – Data Innovations«

Initiator and purpose

The Federal Ministry for Economic Affairs and Energy started the call for proposals for the technology programme »Smart Data – Data Innovations« (↗[Figure 1](#)) in November 2013. It is part of the High-tech Strategy entitled »Innovation for Germany« of the German Federal Government.¹ The programme is aimed at boosting the development and testing of new technologies in the field of big data with a focus on security and legal compliance for the usage in the private sector as well as for the general public.

Funding period, scope and type of funding

The participating projects receive support over a three-year period. The funding of all supported projects started between autumn 2014 and spring 2015.

The »Smart Data – Data Innovations« programme is an instance of the annually held competition of the Federal Ministry for Economic Affairs and Energy. Funds are awarded to collaborative projects of precompetitive character. The programme comprises a six-step application process and deems four groups of applicants eligible: private sector companies, universities, non-university research institutions and educational establishments. For each of the supported projects the project-related funds are managed by the Project Management Agency of the German Aerospace Centre (DLR). The overall funding amounts to EUR 55 million – whereas EUR 30 million is the share of the ministry.

Objectives and projects supported

All funded projects have in common, as their main objective, the development of innovative products and services inducing an early and widespread application of big data technology throughout the whole German economy. In particular the projects should focus on system solutions which are easy of access and tailor-made for the integration in SMEs. A further defining feature of the projects is preparing the ground for big data technology by abolishing obstacles in technical, structural, organisational and legal dimensions.

The number of supported projects is 13. With four projects each in the focus areas of industry and mobility, these two are the best covered fields of application for big data technology by this

¹ On 20 August 2014, the Federal Cabinet approved the Digital Agenda, which is central to the economic and innovation policy. The Digital Agenda sets out the guidelines of the Federal Government's digital policy and concentrates its actions on a number of key fields.

programme. Furthermore three big data projects in the area of health and two projects in the area of energy are supported. »Data Intelligence for Clinical Solutions« in the field of health is a singular pilot project.

Accompanying research of »Smart Data – Data Innovations«

In the course of the tendering procedure of the Federal Ministry for Economic Affairs and Energy for the technology programme »Smart Data – Data Innovations« an accompanying research was announced. The purpose of the accompanying research is the support of the big data technology competition winners through project support, the transfer of technology and know-how as well as the initiation of networks among the actors.

The ministry adjusted the duration of the accompanying research to the funding periods of the supported technology projects. For this reason the term of the accompanying research extends over four years from 2014 to 2018.

The single targets of the accompanying research are:

- Consultancy support to boost the pursuit of the individual aims of the projects supported. This includes a continuous monitoring of big data technologies and their commercial use in all sectors.
- Addressing the cross-sectional issues such as data protection, data security or new business models so that all projects supported may benefit of moderated working groups on these topics.
- Supervision of the projects and ensuring the fulfilment of the central research aspects and their sustainability.
- Building and promoting networks for project-spanning coordination and targeted knowledge transfer as well as the organisation of the communication of the research results.

The FZI Forschungszentrum Informatik is responsible for the scientific management of the accompanying research. It is supported by the Gesellschaft für Informatik e.V.

3.1.2 »Autonomics for Industry 4.0« and »Smart Service World«

Focus and Relevance

There are two funding programmes of the Federal Ministry for Economic Affairs and Energy which are closely linked with big data issues. These are the programmes »Autonomics for Industry 4.0« and »Smart Service World«, funded by the ministry with EUR 39.1 million and EUR 50 million, respectively. The first mentioned focuses on projects developing solutions for autonomously acting components and systems in the industrial application area, the latter mentioned on projects promoting smart platforms. Both programmes have a bearing on big data technologies through the support of projects merging state-of-the-art ICT with industrial production and aggregating and analysing data on integrated, intelligent technical systems.

The funding term of »Autonomics for Industry 4.0« extends from 2013 to 2016. The duration of the »Smart Service World« programme shall be four years, starting in 2015 and ending in 2019.

Projects overlapping with Big Data Technology

Individual projects which show a strong reference to big data or smart data technologies are:

- ENTOURAGE (Smart Service World): development and dissemination of an open standard for smart services. This standard should facilitate the mining, aggregation and processing of data from diverse sources for ubiquitous assistance solutions.
- CoCoS (Autonomics for Industry 4.0): development of a smart information and communication infrastructure which automatically recognizes the components of a production line and connects them with each other.
- MACSS (Smart Service World): development of a medical service platform which combines all data of a patient in a suitable way for attending physicians. Real-time data processing is integrated by the HANA platform.
- APPSist (Autonomics for Industry 4.0): development of a holistic solution for man-machine interaction in the production. The assistance system uses artificial intelligence, knowledge management and semantic technology to process the various data streams.
- GEISER (Smart Service World): utilisation of geospatial data with sensor data from cyber-physical systems by means of designing an open cloud service based on semantic and big data technology.

3.2 Promotion Programmes for Big Data R&D initiated by the Federal Ministry of Education and Research

3.2.1 Big Data Competence Center

Initiator, purpose, funding period

The Federal Ministry of Education and Research has been funding two Competence Centers since October 2014 and thereby is targeted at establishing two outstanding locations for big data research in Germany.

The funding scheme allows for a regular funding over four years with an evaluation of the performance of a Competence Center after three years. Depending on the results of the evaluation an additional funding is granted over a three-year period. Hence a maximum funding period of seven years is possible.

Scope and type of funding

The funding programme is part of the overall support programme »IKT 2020« of the German Federal Government which operational supervision is run by the Federal Ministry of Education and Research. Designated as eligible are universities, non-university research institutions and universities of applied science. The actual distribution of funds is project-related and is coordinated by the Project Management Agency of the German Aerospace Center (DLR). The subsidies can constitute up to 100 percent of the expenses per project. The overall funding amounts to EUR 10 million.

Objectives and projects supported

The Competence Centers are dedicated to future-oriented strategy development in the research area of big data by means of designing and executing prime research projects in the broader field of data science. This implies interdisciplinary approaches and a strong focus on algorithmic and technical results as well as the transfer of findings in scientific and economical fields of application. In particular an outstanding profile of competences in big data, a highly respected qualification programme and network activities with the world's leading research institutions and universities in the field of big data are envisaged.

The public tender was won by two university submitted proposals:

- the Berlin Big Data Center (BBDC) managed by the TU Berlin and
- the Competence Center for Scalable Data Services and Solutions (ScaDS) under the leadership of the TU Dresden.

BBDC is focused on the development of most innovative big data technology by combining the to date separated fields of data management and machine learning, while ScaDS is primarily concerned with the integration of data, knowledge extraction and visual analysis of large quantities of data.

3.2.2 »Management and Analysis of Large Bulk of Data«

Initiator, purpose, funding period

The Federal Ministry of Education and Research initiated the programme »Management and Analysis of Large Bulk of Data« through the announcement of a research funding programme in the Federal Gazette in February 2013. The overall purpose of this Big Data programme is the support of research projects helping to pave the way for intelligent processing of the exploding amount of data in all areas of economy and society. By this means one of the most important challenges of our time should be overcome.

The projects participating in the programme receive support over a three-year period. The funding of all supported projects started between autumn 2014 and spring 2015.

Scope and type of funding

The funding programme differentiates two types of project participant groups which are eligible to apply: collaborations of industry and non-university research institutions and / or universities as well as collaborations of non-university research institutions and / or universities. The funding is project-related and is coordinated by the Project Management Agency of the German Aerospace Center (DLR). The subsidies can constitute up to 100 percent of the expenses per project in case of projects of non-university research institutions or universities and otherwise up to 50 percent. The overall funding amounts to EUR 20.6 million.

Objectives and projects supported

The funding program addresses three main goals. Big data technology, including without limitation algorithms and data structures, should be leveraged in all industries by means of targeted research and development activities. It is expected that the German ICT sector is strengthened and that the German industry as a whole benefits from an increase of competitiveness. Moreover the creation of scientific progress and innovation in the field of data science should be advanced.

There are ten supported projects receiving on average EUR 2.06 million of funding. The projects cover a wide range of big data related applications such as cybersecurity (BDSec), geo-information systems (BigGIS), biomedicine (HUMIT), production control (FEE), measurement and simulation in engineering (VAVID) or news stream analysis (News-Stream 3.0).

Scientific accompanying research of »Management and Analysis of Large Bulk of Data«

The Federal Ministry of Education and Research initiated the programme »Management and Analysis of Large Bulk of Data« in February 2013. Apart from the pure research and development projects a scientific accompanying research programme (ABIDA) is supported to tackle the problems arising

with the implementation of big data applications. The accompanying research should provide technical and non-technical solutions for the obstacles in legal, social and economic dimensions.

The funding period of the interdisciplinary research programme is limited to four years, beginning in spring 2015.

Eligible to apply are individual applicants or collaborations of non-university research institutions and / or universities. The funding is project-related and is coordinated by the Project Management Agency of the German Aerospace Center (DLR). The overall budget of the programme is of approximately EUR 6.4 million.

The programme is geared to give answers to questions which cover the impact of the analysis of large quantities of data on the economy and on society as a whole. On the basis of the latest insights of the social-driven sciences specific big data applications should be assessed. In this way an advancement of the scientific understanding of the phenomena is expected and decision makers should have a better option for actions to their disposal.

The programme is managed by the Institute ITM of the Westfälische Wilhelms-Universität Münster and the Karlsruher Institut für Technikfolgenabschätzung und Systemanalyse (ITAS). Participating institutes are located at the Humboldt-University Berlin, TU Dortmund, LMU München and Universität Hannover. Several working groups deal with issues including ethics, economics, sociology, law and political sciences.

3.3 The legal framework for Big Data in Germany

3.3.1 Overview

Data protection plays an important role in Germany. It is important for both IT-suppliers and -users to process personal data in strict accordance with data protection law.

In Germany, data protection is primarily regulated by the Federal Data Protection Act (Bundesdatenschutzgesetz) implementing the EU Directive 95/46/EC on data protection (Data Protection Directive). Sixteen data protection agencies (DPA) on the state level – one in each state – and one federal agency are responsible for enforcing the Data Protection Act. If a company violates data protection law, DPAs can impose fines up to 300,000 Euros, consumer protection associations can challenge the company in court and the media will report on alleged violations.

German data protection law applies to personal data, which is »any information concerning the personal or material circumstances of an identified or identifiable individual«. The underlying principle governing German (and EU) data protection law is the permission or consent principle: processing of personal data requires statutory permission or data subject's consent. Another important principle is purpose limitation: Data collected for a specific purpose cannot be used for other purposes.

3.3.2 Big Data analytics and data protection law

In practice, one of the most important fields of data processing is using personal data when fulfilling contractual obligations. Use of personal data necessary to fulfil a contract is permitted under German law. This includes the use of big data analytics. An important example is fraud detection. Banks or other payment providers are contractually obliged to execute payments if duly authorised and to refuse fraudulent orders. Therefore, banks and other payment service providers must use up-to-date fraud detection applications to distinguish between authorised transactions and fraudulent attempts.

Processing of personal data is not limited to contract performance. Said processing can also be justified by data controller's legitimate interests, provided data subject's conflicting interests do not prevail. Such balancing test allows for analysing customer data in order to identify customer needs and send offers. However, creating customer profiles, in particular when combining data from different sources, e.g. social media, would violate customer's legitimate interests and is only allowed if customer consents.

An important sector for big data analytics is e-commerce. Analysing website visitor's behaviour or customer orders can yield interesting insights. Nevertheless, such analytics require customer's prior consent. German law sets forth several requirements for the consent to be valid. The company has to inform the consumer about the kind of data used, and the purposes and the extent of such use. The information the company provides must be clear and transparent to fully inform the customer. Consumer protection associations often challenge consent declarations in court, and German courts often invalidate such consent, in particular when given in general terms and conditions.

Big data analytics do not necessarily require the use of personal data. Analysing anonymous data can also be very useful. An interesting example is Web Analytics. In Germany, most data protection agencies consider IP addresses to be personal data, and its use requires website visitor's consent. In practice, this would make Web Analytics impossible. However, deleting part of the IP address renders such address anonymous. As anonymous data is not personal data, said analytics do not require anyone's consent. In general, anonymisation by deleting identifiable information, e.g. names, addresses or birthdates can extend data controller's possibilities for using and analysing data. At the same time, such privacy-preserving data mining protects data subject's rights and interests.

3.3.3 Big data guidelines – legal and ethical standards

In order to facilitate the use of big data analytics in Germany, in September 2015 Bitkom issued guidelines for big data applications. The guidelines have been drafted by a 30-member team, e.g. big data specialists, privacy advisors, lawyers, academics etc.:

1. Determine benefits of big data applications:

Big data applications should bring visible benefits to consumers, customers or the general public.

2. Use transparent applications:

Big data applications should be transparent to show data subjects which personal data are used and in which way.

3. Prefer anonymous or pseudonymous data:

Anonymous or pseudonymous data should be used if processing is of equal value. Nonetheless, some applications require personal data.

4. Balance the interests of all parties involved:

Personal data may be processed if controller's legitimate interests outweigh data subjects' interests. Under the same conditions, data may be used for purposes other than the data had initially been collected for. If these requirements are not met, personal data shall only be used with data subjects' consent.

5. Obtain transparent consent:

Where processing is based on consent, the approach to obtaining such consent should be transparent in order to inform data subjects about the data used and its purposes.

6. Create benefits for data contributors:

Big data applications should benefit those data subjects who make their data available.

7. Establish strong data governance:

Companies using big data applications shall establish strong data governance to ensure data are processed lawfully, responsibly and not excessively, and data subjects' rights and interests are protected. The company's data protection officer plays an important role to ensure such governance.

8. Protect data from unauthorised access:

Companies using big data applications shall take appropriate technical and organisational measures against unauthorized access to personal data.

9. No processing for unethical or immoral purposes:

Companies shall not collect, combine or process data serving unethical or immoral purposes. The same applies if the collection, combination or processing could harm data subjects.

10. Data sharing may be based on balancing of interest:

Sharing data with third parties is permissible if data subjects agree. Sharing can also be based on balancing of interests requiring the data controller to assess risks resulting from the third party's combining the received data with other available data. Data subjects have to be informed.

11. Enable data subject autonomy:

Companies using big data applications shall provide data subjects with sufficient information and answers to additional questions in order to promote data subject autonomy.

3.3.4 Conclusion

Given the importance of data protection in Germany, use of big data analytics require a compliance review be carried out at the beginning of the project. It is easier to design the application according to the legal requirements from the start than changing it after its implementation.

4 Excellence in Big Data – Research

4 Excellence in Big Data – Research

4.1 Research Centers and Research Institutions

This chapter provides a non-exhaustive overview of Germany's Big Data research activities. The first section covers Research Centres and Research Institutes, such as the Fraunhofer and Helmholtz societies, University Institutes such as the Hasso-Plattner Institute at the University of Potsdam, and highlights regional competence centres supported by the Federal Ministry of Education and Research such as Berlin's and Dresden & Leipzig's Big Data Centres. The German Research Center for Artificial Intelligence, the largest such organization in the world also relies on Big Data and is covered in this section.

The second section looks at large collaborative research initiatives.

The third section focusses on individual researchers and research groups at Universities who are working on Big Data. These are listed by location, in order to highlight cluster of excellence, such as Karlsruhe's KIT.

The fourth section gives an overview of German Research Institutes which participate in large scale international research projects, and the final section highlights an organization which bundles research and commercial resources.

4.1.1 Berlin Big Data Center

R&D Organisation	The BBDC (Berlin Big Data Center) at the Technische Universität Berlin Einsteinufer 17 10587 Berlin Prof. Dr. Volker Markl TU Berlin and DFKI +49 30 314 23555 prof@dima.tu-berlin.de http://bbdc.berlin
R&D activities	Lead by TU Berlin, the Berlin Big Data Center's mission is to perform groundbreaking R&D, train tomorrow's data scientists, and enable deep data analysis on massive heterogeneous datasets and high velocity data streams, jointly with our partners at TU Berlin, DFKI, Zuse Institute Berlin, Fritz Haber Institute, and Beuth Hochschule . Currently, we are conducting fundamental research that will yield a novel, automatically scalable solution capable of performing deep big data analysis. Our R&D activities include: <ul style="list-style-type: none"> ▪ developing an integrated, declarative, and scalable open-source system that enables: (a) the specification of advanced data analytics (e.g., based on methods drawn from machine learning), (b) automatic optimization, (c) parallelization, (d) hardware adaptation, (e) fault-tolerance, and (f) the efficient execution of analytics on Apache Flink, ▪ conducting research in statistical analysis and machine learning methods, scalable machine learning, declarative data programming models, debugging data analysis programs, adaptive processing of data and control flows, data storage, intermediate results, and consistency models, and the utilization of software defined networks for data processing. BBDC objectives include technology transfer to support innovation in enterprises and empower the general public to conduct sound data-driven decision-making.
R&D cooperation	<ul style="list-style-type: none"> ▪ DFKI (German Research Center for Artificial Intelligence), joint cooperation with a focus on language technology and data mining, SD4M (Smart Data for Mobility), BMWi (German Federal Ministry for Economic Affairs and Energy). ▪ SCaDS (Competence Center for Scalable Data Services and Solutions), close cooperation involving information integration and performance engineering, Big Data Competence Center Initiative, BMBF (German Federal Ministry of Education and Research). ▪ KTH Royal Institute of Technology, joint cooperation on the development of data streaming platforms, STREAMLINE Project, EU H2020.



	<ul style="list-style-type: none"> ▪ SZTAKI Hungarian Academy of Sciences, Institute for Computer Science and Control, joint cooperation on the development of analysis algorithms for data streams, STREAMLINE Project, EU H2020.
Cooperation with partners in industry	<ul style="list-style-type: none"> ▪ IBM, donated the largest PowerLinux Big Data Cluster available at any European university to TU Berlin. ▪ Zalando, collaborating on a scalable data science project. ▪ Amazon, collaborating on scalable machine learning. ▪ data Artisans, collaborating on advancing Apache Flink, an open source big data analytics platform. ▪ Oracle, R&D on declarative specification and optimization of data analysis programs. ▪ Rovio Entertainment, collaborating on the evaluation of a unified analytics solution that can simultaneously handle both data-at-rest and data-in-motion. ▪ Daimler, collaborating on the analysis of Industrie 4.0 data streams.
Additional Information	<ul style="list-style-type: none"> ▪ The BBDC is funded by the BMBF (Federal Ministry of Education and Research). ▪ Close cooperation with the SDF (Smart Data Forum). ▪ Founding Member and Co-creator of the SRIA (Strategic Research and Innovation Agenda) of the BDVA (Big Data Value Association), cPPP, EU H2020.

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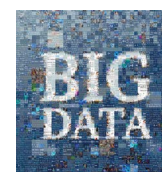
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4.1.2 Competence Center for Scalable Data Services and Solutions Dresden/Leipzig

R&D Organisation	<p>Competence Center for Scalable Data Services and Solutions ScaDS Dresden/Leipzig www.scads.de</p> <ul style="list-style-type: none"> ▪ Prof. Dr. Wolfgang E. Nagel Coordinator Technische Universität Dresden wolfgang.nagel@tu-dresden.de ▪ Prof. Dr. Erhard Rahm Co-Coordinator Universität Leipzig rahm@informatik.uni-leipzig.de
R&D activities	<p>ScaDS Dresden/Leipzig is one of two BMBF-funded competence centers for Big Data research in Germany. It bundles the Big Data expertise of the TU Dresden and the University of Leipzig and involves numerous partners from further scientific institutions and industry. The competence center addresses Big Data challenges of diverse scientific and commercial application fields such as life sciences, material and engineering sciences, environmental and traffic sciences, digital humanities, and business applications (↗Figure 2). The major focus of research is set onto scalable data integration, knowledge extraction and visual analysis. Moreover, the center investigates novel Big Data architectures, data life-cycle management and workflows as well as large-scale data analysis.</p> <p>An integral part of ScaDS Dresden/Leipzig is a service center that technically and methodically supports domain experts to efficiently handle big data from data acquisition over multi-staged data processing towards result examination, and even long-term storage.</p> <ul style="list-style-type: none"> ▪ In the research field of Big Data integration we investigate large-scale methods for automating complex ETL workflows including parallel deduplication processes. We further address privacy-preserving data integration on anonymized data as well as flexible graph-based data integration approaches as an initial step for large scale graph analytics. ▪ From a data management perspectives, researchers at ScaDS Dresden/Leipzig leverage existing open-source tools like Spark and augment it with in-memory technology to move large-scale data processing infrastructures towards general platforms for realtime-analytics. ▪ In the field of knowledge extraction and data analysis we explore efficient methods for text, image and video analysis as well as analysis of High Throughput Sequence data (HTS). Deep machine learning techniques are studied and applied to heterogeneous application fields, i.e. to annotate image contents with ontological terms in the environmental and life sciences. For scalable graph analytics we are developing a new Hadoop-based framework called Gradoop. In the digital humanities ScaDS Dresden/Leipzig provides standardized text-services such as efficient text storage or citability of text fragments for humanists and carries out research on text reuse.



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	<ul style="list-style-type: none"> In the field of visual analysis we conduct research on visualizing large scale scientific data such as particle flows or microscope images. Moreover, novel genome and transcriptome visualizations for scientists from bio informatics are developed. <p>To process large data sets and complex analysis chains special focus is put to the provisioning and extension of architectures for big data processing on multi purpose computing clusters as well as large scale high performance computing (HPC) systems. Here, the software stack is enhanced by tools for data analytics, such as Apache Spark, Flink, and Hadoop, and frameworks for deep learning. Users can use these frameworks directly in their HPC computing session to process TB of data within hours on our computing environment. Furthermore, complex workflows can be formulated via sophisticated tools, such as KNIME or within the HPC middleware UNICORE to support large-scale computing needs.</p>
R&D cooperation	<ul style="list-style-type: none"> Leibniz Institute of Ecological Urban and Regional Development Max Planck Institute of Molecular Cell Biology and Genetics (MPI-CBG) <p>Many further associated partners (17 in total) such as:</p> <ul style="list-style-type: none"> Netzwerk Logistik Leipzig-Halle e.V. University Hospital Carl Gustav Carus - UK Centre for Environmental Research – UFZ Helmholtz-Zentrum Dresden-Rossendorf – HZDR
Cooperation with partners in industry	<ul style="list-style-type: none"> Intel: IPCC – Intel Parallel Computing Center NVIDIA: CUDA center of excellence

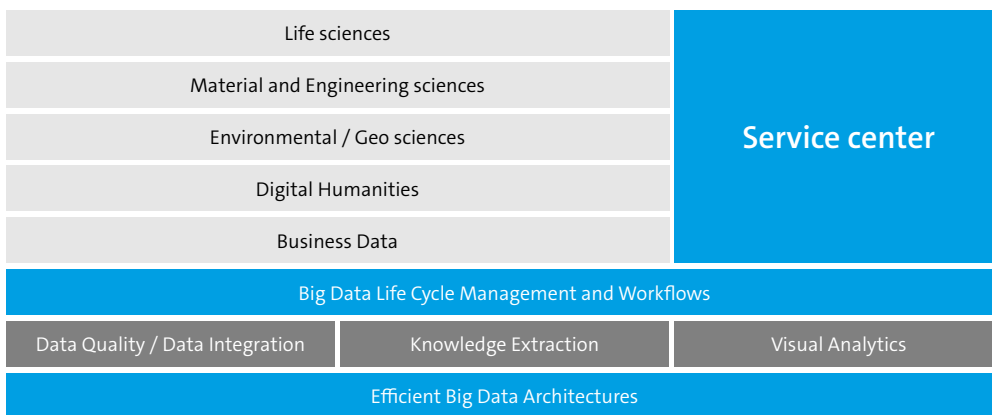


Figure 2: Big Data Center ScaDS Dresden/Leipzig

4.1.3 Consulting and Technology Partner – Fraunhofer Alliance Big Data

Organisation	Fraunhofer Alliance Big Data Schloss Birlinghoven 53757 Sankt Augustin www.bigdata.fraunhofer.de Dr. Dirk Hecker dirk.hecker@iais.fraunhofer.de +49 2241 14 1509
Offerings and competences	The Fraunhofer Alliance Big Data accompanies enterprises on their way to a »data-driven company«. Along the entire big data process chain Fraunhofer serves as an independent consulting and technology partner. The offerings are modular and can be adapted to the needs of large and small companies. They reach from the elaboration of big data roadmaps to the development of individual big data solutions and the qualification of personnel. We use high-capacity scalable IT infrastructures and handle key technologies, e.g. for capturing sensor data, distributed data management, parallel data processing, machine learning, visual analytics, data security and privacy.
Business areas and showcases	In the Big Data Alliance, 28 Fraunhofer institutes (↗Figure 3) bundle their expertise in important business sectors, as demonstrated by the following showcases. <ul style="list-style-type: none"> ▪ Life sciences and health care: The search for new anti-cancer drugs requires detailed microscopic analysis of millions of differently treated cells. With its Zeta software Fraunhofer FIT helps users in several pharmaceutical enterprises to evaluate such high-throughput experiments. The runtime of the studies is decreased by determining for every single cell in which phase of the cycle the cell division is interrupted. ▪ Production and industry 4.0: Monitoring complex technical processes requires suitable process models which are difficult to create with human expertise alone. Using data-driven methods of unsupervised machine learning the ProDaMI suite of Fraunhofer IOSB succeeds in timely detecting creeping changes in continuous processes of the pharmaceutical and chemical industries. ▪ Logistics and mobility: smaRTI enables an intelligent flow of materials across sectors and supply chains. In the Internet of Things objects equipped with auto-id technologies like RFID, RTLS and barcodes direct themselves through the logistical network. Pilots are evaluated by Fraunhofer IML with its customers in airfreight, fast-moving consumer goods (FMCG) and letter post. ▪ Energy and environment: The increase of decentral fluctuating supply challenges European energy markets. By incorporating weather prognosis data EMS-EDM PROPHET is able to predict short-time supplies of renewable energies as well as local demand and connects industrial productions into smart grids. More than 40 licensees across Europe use this solution of Fraunhofer IOSB. ▪ Business and finance: Electronic payments require an efficient risk and fraud management. MINTIFY rule is a fraud mining system to detect misuse of credit cards that can provide rules to any application system and adjust them in real time. MINTify rule protects a portfolio of many millions of credit cards at a European payment processor. The solution is marketed by Fraunhofer IAIS and Paymint AG. ▪ Security: Today's automotive systems are complex distributed structures with partially more than 70 electronic control units (ECUs). This increases the potential of threats which suppliers, producers of devices and system integrators have to fend off. Fraunhofer AISEC offers them its automotive lab with environments for testing the security properties of ECUs, head units, telediagnosis and diagnostic interfaces.
Training program	<ul style="list-style-type: none"> ▪ An extensive training and certification concept introduces young academics, experts and managers to big data methods and qualify themselves as data scientists. Certificates on three levels – basic, advanced and senior – are awarded by Fraunhofer's center for personal certification. ▪ The training program comprises fundamental and advanced courses. A one-week basic course provides the knowledge for the first level examination. It creates a shared understanding between professionals from different disciplines and enables them to efficiently collaborate in a team of data scientists. ▪ Advanced courses enable business experts to examine the opportunities and risks of data-driven business models, smart products and services, individualized user experiences and optimization of business processes. Data engineers learn how to describe and integrate data effectively and data security analysts are introduced to the special challenges of big data to security and privacy. Data analysts learn how to develop predictive models with machine learning algorithms in order to detect patterns in data, to predict trends and to



derive recommendations. Software engineers are trained to implement robust scalable solutions with modern datastores, distributed file systems and distributed workflows.

- Further courses focus on sector-specific application areas such as smart grids and smart buildings, social media and multimedia analytics for business, data management and text analysis in life sciences. Some of them were created as blended courses for EIT Digital, the European Institute of Innovation and Technology. The curriculum and selected learning material are provided to the EDSA project to establish a European Data Science Academy.

Cooperation

- Big Data Value Association (BDVA).
- Smart Data Innovation Lab
- Networked European Software and Service Initiative (NESSI)

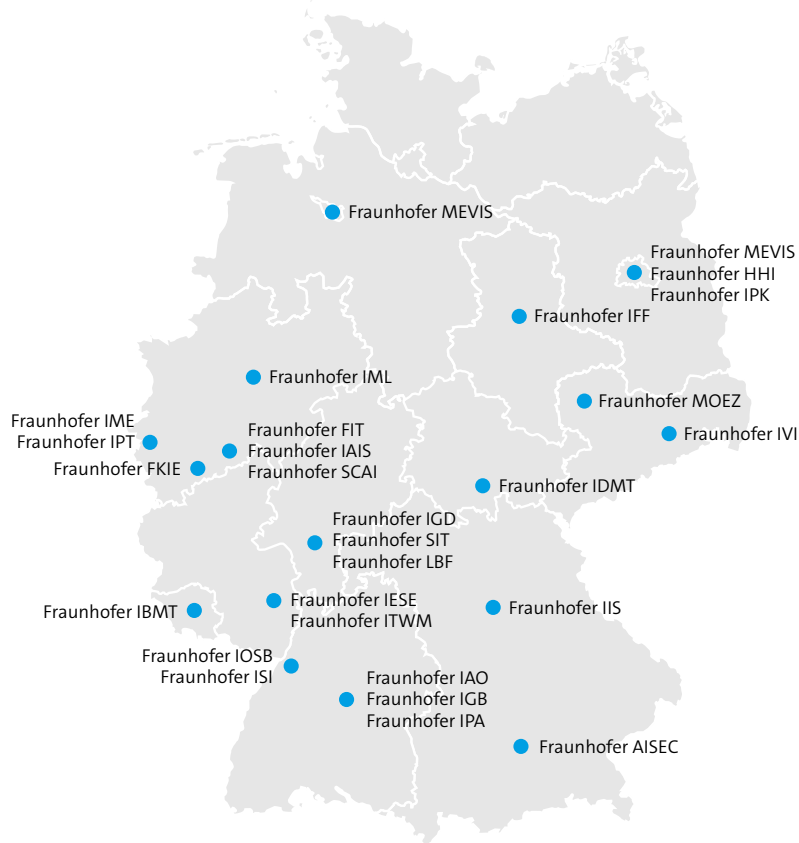


Figure 3: Fraunhofer Alliance Big Data – Member Institutes

4.1.4 Analysis, Access and Targeted Use of Large Data Quantities – Fraunhofer IAIS

R&D Organisation	Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS Schloss Birlinghoven 53757 Sankt Augustin www.iais.fraunhofer.de Dr. Stefan Rüping stefan.rueping@iais.fraunhofer.de +49 2241 14 3512
R&D activities	<ul style="list-style-type: none"> ▪ Big data analytics: We investigate high-capacity methods of machine learning and semantic technologies for scalable big data architectures. For massive data streams we develop distributed online learning methods in real time. An important application area is industrial analytics. European projects: FERARI, iPRODIGIT, VaVel, SoBigData, Big Data Europe ▪ Machine learning: Our most important theoretic contributions to machine learning in the last decade have been echo state networks, graph kernels and subgroup mining. Current activities focus on pattern mining for fraud detection, mining time series of sensor data for complex event detection, predictive analytics and privacy-preserving data mining. European projects: SAKE, REACH ▪ Deep learning: With enough big data to train multiple layers of artificial neural networks, deep learning has revolutionized the understanding of unstructured data. We develop deep learning technologies for automotive intelligence, image and video analysis, interpretation of 3D-sensor data and audio mining. European projects: i-PROGNOSIS ▪ Text analytics: We develop algorithms for semantically mining unstructured text data, including sentiment analysis, topic detection and summarization. Novel deep learning algorithms make text analytics scalable to very large collections of data. European projects: EPP ▪ Linked Data: We integrate heterogeneous data sources with very efficient methods based on semantic technology standards and linked data principles. Our analytics and question answering methods can work on top of linked data. European projects: HOBBIT, SAKE, Big Data Europe ▪ Question answering: We develop algorithms for answering questions on structured datasets using linguistic analysis and user intent detection methods. Combined with speech recognition, this gives users easy access to large and possibly complex datasets. European projects: HOBBIT ▪ Interactive and visual analytics: We develop methods and applications that bridge the gap between user and machine: One-click mining, interactive data mining for decision support and visual analytics for interactive exploration and model debugging. European projects: datAcron, DART, VaVel ▪ Data scientist training: The demand for data scientists cannot keep pace with the expected growth of big data. We have created a modular vocational training program for data scientists with the option of personal certification. European project: EDSA
R&D cooperation	<ul style="list-style-type: none"> ▪ Israel Institute of Technology: big data analytics, EU-project FERARI ▪ Open Data Institute, data scientist curriculum, EU-project EDSA ▪ EIT Digital, data science training ▪ Philips Research, Eindhoven: machine learning, EU-project REACH ▪ iMinds: question answering, EU-project HOBBIT
Cooperation with partners in industry	<ul style="list-style-type: none"> ▪ Siemens: Privacy-preserving big data analytics toolbox ▪ Deutsche Telekom: data scientist training ▪ PwC: Strategic data science consulting ▪ Mercedes: interactive visual analytics
Additional Information	<ul style="list-style-type: none"> ▪ Coordination of the »Big Data Alliance« of 28 Fraunhofer Institutes ▪ Coordination of Fraunhofer's data scientist training and certification program ▪ Coordination of the European project FERARI ▪ Coordination of the European project »Big Data Europe« ▪ Leading role in the Industrial Dataspace consortium ▪ Member of the Big Data Value Association (BDVA)

4.1.5 Intelligent Solutions for the Knowledge Society – German Research Center for Artificial Intelligence

R&D Organisation	<p>Deutsche Forschungszentrum für Künstliche Intelligenz GmbH (DFKI) German Research Center for Artificial Intelligence</p> <p>Trippstadter Straße 122 67663 Kaiserslautern www.dfki.de info@dfki.de</p> <p>Geschäftsführung: Prof. Dr. Dr. h.c. mult. Wolfgang Wahlster (Vorsitzender) Dr. Walter Olthoff</p> <p>Vorsitzender des Aufsichtsrats: Prof. Dr. h.c. Hans A. Aukes</p> <p>Contact partner DFKI: Reinhard Karger, M.A. +49 681 85775-5253 reinhard.karger@dfki.de</p> <p>Social: www.facebook.com/DFKI.GmbH https://twitter.com/DFKI https://www.youtube.com/dfkivideo</p>
R&D activities	<p>Research for Data-driven Innovation at DFKI – Projects in the BMWi Smart Data Program:</p> <p>The German Federal Ministry for Economic Affairs and Energy (BMWi) selected 13 projects for funding in 2014 at the start of its Smart Data Technologies Program.</p> <p>DFKI Kaiserslautern, Saarbrücken, and the Project Office in Berlin are involved in five of these projects: Smart Data for Mobility (SD4M) and Smart Data Web (SDW) – Data Analysis for Mobility Providers and Supply Chain Management; SmartRegio – Trend Analysis Based on Heterogeneous Big Data; PRO-OPT Big Data – Production Optimization in Smart Ecosystems; and Clinical Data Intelligence – Links Patient Data, Optimizes Treatment. More Information: http://sd4m.net http://smartdataweb.de www.smartregio.org www.pro-opt.org www.klinische-datenintelligenz.de</p>
R&D cooperation	<p>DFKI is cooperating closely with the scientific environment at the respective sites. DFKI is the only German research institute for Computer Science being a member in the three leading research clusters and co-founder of Software Campus, Academy Cube, Smart Data Innovation Lab and Volkswagen Data Lab.</p>
Cooperation with partners in industry	<p>DFKI-Shareholders</p> <ul style="list-style-type: none"> ▪ Airbus Group ▪ BMW AG ▪ CLAAS KGaA ▪ Deutsche Post AG ▪ Deutsche Telekom AG ▪ Deutsche Messe AG ▪ Empolis Information Management GmbH ▪ Fraunhofer-Gesellschaft e.V. ▪ Google Inc. ▪ Harting AG & Co. KG ▪ Intel Corporation ▪ John Deere ▪ KIBG GmbH ▪ Microsoft Deutschland GmbH ▪ Nuance Communications Deutschland GmbH ▪ RICOH Company, Ltd. ▪ SAP SE ▪ Saarland University ▪ Software AG ▪ Technische Universität Kaiserslautern ▪ University of Bremen ▪ VSE AG ▪ Volkswagen AG
Additional Information	<p>The German Research Center for Artificial Intelligence, with sites in Kaiserslautern, Saarbrücken, Bremen (with an associated branch in Osnabrück) and a project office in Berlin, is the leading German research institute in the field of innovative software technology. In the international scientific community, DFKI ranks among the most recognized »Centers of Excellence« and currently is the biggest research center worldwide in the area of Artificial Intelligence and its application in terms of number of employees and the volume of external funds. The financial budget in 2015 was 42,5 million Euro.</p> <p>DFKI projects cover the whole spectrum from application-oriented basic research to market- and client-oriented design of product functions. Currently more than 478 employees from 60 countries are conducting research focusing on Knowledge Management, Cyber-Physical Systems, Multilingual Technologies, Plan-Based Robot Control, Robotics Innovation Center, Innovative Retail Laboratory, Institute for Information Systems, Embedded Intelligence, Smart Service Engineering, Intelligent Analytics for Massive Data, Intelligent Networks, Agents and Simulated Reality, Augmented Vision, Language Technology, Intelligent User interfaces, Innovative Factory Systems.</p> <p>Impact: more than 98 professorships of former DFKI employees, and 70 spin-off companies with approximately 2500 highly qualified jobs.</p> <p>The research and technology development is carried out in the DFKI research departments, research groups and living labs.</p>



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4.1.6 Improving the Entire IT based Decision Support Lifecycle – FZI Research Center for Information Technology

R&D Organisation	<p>FZI Research Center for Information Technology at the Karlsruhe Institute of Technology Haid-und-Neu-Str. 10-14 76131 Karlsruhe www.fzi.de https://www.youtube.com/FZIchannel Jan Wiesenberger +49 721 9654-0 fzi@fzi.de</p> <p>FZI Research Center for Information Technology at the Karlsruhe Institute of Technology is a non-profit institution for applied research in information technology and technology transfer. Its task is to provide businesses and public institutions with the latest research findings in information technology. As an independent research institution, FZI works for companies and public institutions regardless of company size: from small business to large corporations, from local public administrations to the European Union. The FZI House of Living Labs offers a unique research environment for applied research. FZI has its head office in Karlsruhe and a branch office in Berlin.</p>
R&D activities	<p>FZI's Big Data research activities focus on improving the entire IT based decision support lifecycle:</p> <ul style="list-style-type: none"> ▪ gathering and integrating heterogeneous and possibly incomplete data from various sources, ▪ analyzing the data in real time or ex post for gaining insights, ▪ making good decisions based on the insights by applying optimization methods, and ▪ delivering the results in a context sensitive way to the appropriate stakeholders, paving the way for more user-centered and flexible Big Data solutions. <p>Scientists from different disciplines such as knowledge management, operations research, statistics, software engineering, embedded systems and robotics, investigate, and apply methods and tools from different domains such as semantic technologies, prescriptive analytics, complex event and stream processing, simulation and advanced (online) optimization. In addition FZI studies cross-cutting issues related to Big Data within the accompanying research for the technology programme »Smart Data – Data Innovations«, funded by Germany's Federal Ministry for Economic Affairs and Energy. Dedicated working groups discuss research questions concerning IT security and privacy, regulatory and legal aspects, as well as economic potentials and social acceptance. In 2016, the team has started their first European standardisation activities, working on a framework for classifying Smart Data technologies.</p>
R&D cooperation	<ul style="list-style-type: none"> ▪ BigGIS: The project develops, demonstrates and evaluates a new generation of geographical information systems (GIS) that can deal with high-volume, heterogeneous geo-temporal data to provide real-time support for complex public management and coordination tasks. Partners: Disy Informationssysteme GmbH, EFTAS Fernerkundung Technologietransfer GmbH, Exasol AG, Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg (LUBW), University of Applied Sciences Karlsruhe, University of Konstanz. ▪ BigPro: The goal of the project is to reach resilient and reactive production systems by developing a real-time Big Data platform providing services for a proactive and reactive disruption management. Partners: Asseco Solutions AG, cognesys GmbH, DFA Demonstrationsfabrik Aachen GmbH, EICe Enterprise Integration Center Aachen GmbH, EML European Media Laboratory GmbH, FIR at the RWTH Aachen University, i2solutions GmbH, Laboratory for Machine Tools and Production Engineering (WZL) of RWTH Aachen University, Robert Bosch GmbH, Software AG. ▪ ProaSense: The project develops a new architecture to detect potential failures in production processes ahead of time by applying proactive anomaly detection algorithms and new methods and tools for allowing the management of real-time Big Data applications. Partners: Hella Saturnus Slovenija, Institute of Communication and Computer Systems (ICCS) Greece, Jožef Stefan Institute (JSI) Slovenia, MHWirth Norway, Nissatech Serbia, SINTEF Norway, UNINOVA Portugal. ▪ ProvelT: The goal of the project is to develop a real-time monitoring and disruption management system for inbound logistics networks correlating real-time data from different sources and supply chain partners combining complex event processing and advanced online optimization. Partners: Geis Group, Karlsruhe Institute of Technology (KIT), LOCOM Software GmbH, PTV Group, Robert Bosch GmbH, ZF Friedrichshafen AG. ▪ Smart Data – Data Innovations: Accompanying research and lead of the working group that discusses cross-project research questions concerning IT security and privacy. Partners: German Informatics Society, Karlsruhe Institute of Technology (KIT), projects of the technology programme »Smart Data – Data Innovations«.



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Cooperation with partners in industry	<ul style="list-style-type: none"> ▪ 1&1 Telecommunication SE: The joint research project »Advanced Customer Insights« aims at modeling and predicting the behavior of telecommunication customers. In particular, the research project aims at developing novel analytical means to anticipate the probability of customer reactions to purchase and churn prevention campaigns. The goal is to provide data-driven decision support for customer targeting in marketing activities and dynamic customer lifecycle and retention management. ▪ Bayer AG: In a multi-year research cooperation FZI derives new methods to optimally and robustly combine statistical model forecasts and expert expectations using both in-memory data management and non-linear data reduction techniques. Data-analytical and visual forecast tools are developed to increase the accuracy of financial forecasts and prompt experts for commented corrective actions using high-dimensional statistics and visualization techniques for cognitive engineering. ▪ Several other research cooperations and projects focusing on the application of Big Data methodologies and techniques including partnerships with BASF SE, Dillinger Hütte, and Robert Bosch GmbH.
Additional Information	<ul style="list-style-type: none"> ▪ Coordinator of the accompanying research for the technology programme »Smart Data – Data Innovations«. ▪ FZI's Spin-off Datalyxt provides intelligent methods and algorithms for converting heterogeneous, unstructured sources from the web into structured and semantically enriched knowledge graphs at Big Data scale by combining distributed stream processing and visual learning techniques. ▪ Partner of the Smart Data Innovation Lab (SDIL), which is jointly operated by partners from science and business, offering a unique access to a large variety of worldwide leading Big Data and in-memory technology.

4.1.7 Supercomputing & Big Data – Forschungszentrum Jülich and Karlsruhe Institute of Technology

R&D Organisation	<p>Programme »Supercomputing & Big Data« of the Helmholtz Association Karlsruhe Institute for Technology Steinbuch Centre for Computing 76128 Karlsruhe Forschungszentrum Jülich GmbH Jülich Supercomputing Centre 52425 Jülich https://www.helmholtz.de/en/research/key_technologies/supercomputing_big_data/</p> <ul style="list-style-type: none"> ▪ Prof. Dr. Dr. Thomas Lippert th.lippert@fz-juelich.de ▪ Prof. Dr. Achim Streit achim.streit@kit.edu
R&D activities	<p>The programme »Supercomputing & Big Data« of the Helmholtz Association provides world-class instruments and infrastructures for high performance computing, e.g. the supercomputer JUQUEEN at Forschungszentrum Jülich, and for the management and analysis of large-scale data for computational science and engineering, e.g. the Large-Scale Data Facility at Karlsruhe Institute of Technology. In its Simulation Labs and its Data Life Cycle Labs (DLCLs), experts from different scientific domains cooperate with experts in HPC and data science, respectively. This is complemented with generic R&D of technologies, methods, algorithms and tools enabling secure and efficient management and analysis of scientific Big Data. The programme also collaborates with the Tier-1 centre GridKa of the Worldwide LHC Computing Grid (WLCG). In this publication, we will present selected highlights of the Big Data activities in the programme.</p> <p>Generic research data R&D activities address topics in management, metadata, repositories, storage, archival and security. These are carried out in collaboration with the European projects »Authentication and Authorization for Research and Collaboration« (AARC), the European Collaborative Data Infrastructure (EUDAT), Nanoscience Foundries and Fine Analysis (NFFA Europe) and INDIGO-DataCloud. Highlights are standardisation work regarding quality of services in storage and developments for distributed authentication and authorisation. For the latter Open-ID Connect is integrated into scientific computing infrastructures aiming to replace logins at Google or Facebook. Also OAUTH2 is extended to support services acting on behalf of users, even during their absence (delegation). This targets services of the traditional datacentres as well as third party cloud computing infrastructures. A standardisation recommendation is developed under the umbrella of the global Research</p>



Programme Supercomputing & Big Data

Data Alliance (RDA) to describe storage quality metrics such as access-latency, redundancy or retention-policies and includes methods for migrating data between storage locations with different qualities. Based on the metrics, users may select cloud storage to optimise on costs and efficiency.

Climate research belongs to the field of Big Data not only because of the large volume of data, but also due to the large variety of data. The **DLCL Climatology** investigates modern data management methods and tools to optimize various aspects of typical climate research data life cycles. It also actively contributes to. A core research activity addresses semi-structured geo-data from remote sensing devices mounted on satellites or aircrafts, which are stored in distributed MongoDB instances. The DLCL works on an automatic system to generate indexes for the databases depending on dynamic query patterns.

Furthermore, a full stack of applications for the interactive visualisation of climate data has been developed. The visualisation application runs in a browser without the need for the installation of software components. 3D-visualisation is based on WebGL. Data is transferred from a Nodejs-based cluster allowing to pre-process and filter semi-structured data that is stored in a MongoDB backend.

The **DLCL Neuroscience** addresses joint R&D on understanding the anatomical structure of the human brain on the level of single nerve fibers, which is one of the most challenging tasks in neuroscience nowadays. In order to understand the connectivity of brain regions and to study neurodegenerative diseases, a detailed three-dimensional map of nerve fibers has to be created. Neuroscientists use recent imaging techniques in post-mortem studies to derive patterns of connectivity between brain regions and to identify fibre tracts connecting layers and cells within brain regions. The DLCL Neuroscience has largely improved and automated the workflow for images obtained by Polarized Light Imaging (PLI), which allows the study of brain regions with a resolution at sub-millimeter scale.

The images of brain slices are processed with a chain of tools for cleaning, alignment, segmentation, and recognition. These tools have been integrated in a workflow for the middle-ware UNICORE, exploiting many of the workflow system features, such as control structures and human interaction. This has resulted in better reproducibility and faster processing, allowing the timely analysis of a large number of brain slices that are expected to be available in the near future.

The **DLCL Key Technologies** focuses on the systematic establishment of novel data life cycle management and data organisation technologies to enable common methods for data analysis, long-term archival including preservation and curation as well as data sharing. The long-term objective is to offer a minimal set of indispensable data organization components to satisfy the imaging community and to properly prepare for the long-term archival of the data and results. The results provided by the other projects and organizations, e.g. EUDAT and Research Data Alliance (RDA), are introduced to the various scientific imaging projects. R&D are conducted in data life cycle support including data organisation with metadata management enabling long-term preservation and policy enforcement in adapting and establishing server-side analysis and visualization tools for e.g. image preprocessing based on optimized generic data methods, and in community-specific tools, e.g. for automatic metadata extraction during ingest.

R&D cooperation

- CERN (Switzerland): partner in AARC, INDIGO-DataCloud and WLCG
- CSC (Finland): partner in EUDAT and AARC
- CNR (Italy): partner in NFFA Europe
- STFC (UK): partner in EUDAT and NFFA Europe
- INFN (Italy): partner in INDIGO-DataCloud and WLCG

4.1.8 Web science – Hasso Plattner Institute

R&D Organisation	Hasso-Plattner-Institut für Softwaresystemtechnik GmbH Prof.-Dr.-Helmert-Str. 2-3 14482 Potsdam www.hpi.de/naumann/ Prof. Dr. Felix Naumann felix.naumann@hpi.de +49 331 5509-280
R&D activities	<ul style="list-style-type: none"> ▪ Poor data quality is among the most serious obstacles to reap the benefits of big data and its economical and societal promises. Garbage-in-garbage-out is a common lament. We are researching highly-scalable methods to assess and improve data and information quality. In particular, we are developing data matching methods to de-duplicate large datasets of customers, products, etc. To this end, we devise intelligent and effective similarity measures and highly efficient, distributed candidate selection algorithms. In more recent work we are applying these techniques to dynamic, streaming data. ▪ While traditional data mining methods aim at discovery new knowledge and insights, our data profiling approaches discover interesting metadata on very large datasets. We are able to discover keys, foreign keys and other basic dependencies, which are excellent resources for any subsequent data processing task, such as schema reverse engineering, data integration, data cleansing, and query optimization. Our openly available framework Metanome includes many state-of-the-art algorithms for various profiling tasks. ▪ The focus of our Web science research group is on text mining for large document collections, such as news articles, patents, Wikipedia, tweets, or scientific articles. ▪ Information extraction, natural language processing, and pattern recognition methods are being developed to support predictions and recommendation tasks. In particular we are focussing on the challenges of named entity recognition (finding entities in text), named entity disambiguation (matching found entities to a reference knowledge base), and relationship extraction. One application is the discovery of networks among businesses using texts gathered on the Web. We are able to discover various relationship types, such as ownership, customer, partnership, etc. Finally, research on topic modeling and its application to Web collections are further studied, for instance to recommend tags or to analyze topic drift. ▪ Big data projects in other research groups at HPI include social media analytics, realtime security analytics, digital health, geoscientific data mining, automotive stream mining, and enterprise and retail analytics.
R&D cooperation	<ul style="list-style-type: none"> ▪ TU Berlin und Humboldt Universität zu Berlin: Stratosphere – Next Generation Big Data Analytics Platform (DFG Forschergruppe) ▪ Qatar Computing Research Institute: Metanome – High Performance Data Profiling and Analytics
Cooperation with partners in industry	<ul style="list-style-type: none"> ▪ Commerzbank AG: Text mining and graph analytics for risk assessment and fraud detection ▪ Deutsche Pfandsystem GmbH (DPG): Log analytics of reverse vending machines for fraud detection ▪ Concur: Data cleansing and similarity search for automated travel expense report processing
Additional Information	<ul style="list-style-type: none"> ▪ The DFG-funded research unit »Stratosphere« has spun off the Apache top-level project »Flink« (flink.apache.org), which has gained world-wide recognition as a leading open source platform for distributed stream and batch data processing. ▪ The master thesis of Markus Freitag »Optimization and Parallelization of Foodborne Disease Outbreak Analyses« won the TDWI Award 2015.



4.1.9 Analyze Genomes – Hasso Plattner Institute

R&D Organisation	Hasso Plattner Institute Prof.-Dr.-Helmert-Str. 2-3 14482 Potsdam www.hpi.de »Analyze Genomes: A Federated In-Memory Database Enabling Precision Medicine« http://we.analyzegenomes.com Dr.-Ing. Matthieu-P. Schapranow Program Manager E-Health & Life Sciences +49 (331) 55 09 -1331 +49 (160) 90 82 25 60 schapranow@hpi.de
R&D activities	Analyze Genomes: A Federated In-Memory Database Enabling Precision Medicine In an increasing number of cases, medical experts discover roots of complex diseases, such as cancer, within the human genome. Therefore, analyses of the individual genetic code of each patient are the foundation of the innovative precision medicine. For example, the genetic profile of a tumor sample can provide insights about the efficiency of available chemotherapies. However, the acquisition of the genetic profile is still time-consuming, e.g. due to the number of individual processing steps, the sheer amount of data, and the use of arbitrary data formats. The »Analyze Genomes« platform of the Hasso Plattner Institute (HPI) in Potsdam built upon latest in-memory technology enables new perspectives for precision medicine in the clinical routine. For the first time, it enables the analysis of big medical data and their combination with global medical knowledge in real time. As a result, medical experts are able to discover and assess available therapy options in a much faster way to initiate the best one for each patient individually. Together with experts from life sciences, such as medical experts, biologists, and geneticists, researcher of the HPI under the management of Dr. Matthieu-P. Schapranow have developed the cloud platform Analyze Genomes (Figure 4). It enables experts from various disciplines to perform real-time analysis of genome data on their own without the need for dedicated IT personnel. The in-memory technology researched at the chair of HPI founder Prof. Dr. Hasso Plattner provides the technology foundation for the rapid data processing and analysis. In the »Medical Knowledge Cockpit« doctors as well as patients obtain together a holistic view on individual genetic variants, biological connections, and links to worldwide available clinical trials. A time-consuming search in the Internet by medical doctors is no longer necessary as worldwide databases containing medical knowledge are searched automatically and relevant results are filtered on the patient's individual anamnesis. Clinicians can use the »Drug Response Analysis« to incorporate insights from documented historic cases to predict the efficiency of chemotherapies for actual patient cases. Through corresponding laboratory tests, these predictions can be validated to extend the knowledge about pharmaceuticals and their efficiency. Researchers can explore and assess individual changes within the DNA using the »Genome Browser« in freely selectable level of detail to identify sources of pathogenic changes. In addition to individuals, data of patient cohorts can be examined using the »Cohort Analysis«, e.g. to verify responder or non-responder for a specific medical treatment interactively. Translating biological connections and affected cell functions in the »Pathway Topology Analysis« helps to assess the impact of, e.g. of a specific tumor disease on the human body. Together with a team of cardiologic experts and researchers, we design in the »SMART« consortium specific software applications to establish a systems medicine approach for heart failure. For the first time, all individual sources of patient data, e.g. genome, proteome, and hemodynamics data, are combined in a single software system. This enables the combination and real-time analysis of patient-specific data to predict the outcome of alternative therapy options. As a result, clinicians and medical experts are supported in deriving the best patient-specific treatment option from the beginning. Furthermore, health researchers, public authorities, as well as small and medium-sized enterprises can explore distributed health care data using the real-time analysis functions developed in the »SAHRA« consortium. Thus, they get more detailed insights into regional health care structures using existing and regularly acquired public health care data. The »Analyze Genomes« platform enables a completely new way of working. Medical experts and researchers are no longer slowed down by long-running data processing. Instead they can test and verify their hypotheses directly. Through the integration and combination with worldwide sources of medical knowledge manual and time-consuming searches in the Internet are omitted. As a result, precise treatment decisions can be made always on the basis of the latest available, worldwide medical knowledge for the patient's sake.



R&D cooperation	<ul style="list-style-type: none"> Stanford University Massachusetts Institute of Technology (MIT) German Cancer Research Center (DKFZ) and National Center for Tumor Diseases (NCT) Charité University Medicine Berlin Max Delbrueck Center for Molecular Medicine (MDC)
Cooperation with partners in industry	<ul style="list-style-type: none"> SAP SE, healthcare and life sciences Intel Corp., life sciences research Bayer Healthcare, life sciences U.S. Department of Veteran Affairs
Additional Information	<p>Amongst others, the German Federal Ministry of Education and Research and the German Federal Ministry for Economic Affairs and Energy, generously support our research. Our life sciences activities are combined in the cloud platform »Analyze Genomes«, which was honored by, amongst others, the 2015 Personalized Medicine Award, the 2014 European Life Science Award for Top 3 Most Innovative New Services, and the 2012 Innovation Award of the German Capital Region. Furthermore, our research results are published in international journals and selected work is transferred to industry partners, who are responsible for commercialization. As a result, our findings support precision medicine to become a worldwide clinical routine.</p>

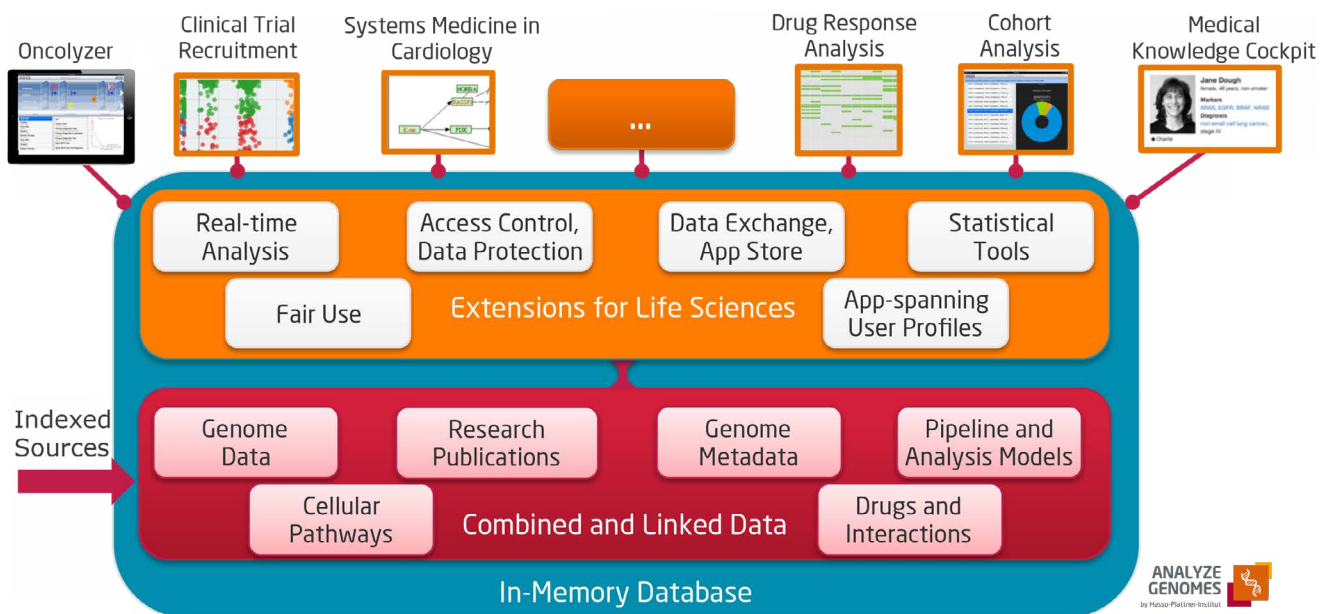


Figure 4: Cloud platform »Analyze Genomes«

4.1.10 Geoinformatics – GFZ German Research Center for GeoSciences – GeoMultiSens

R&D Organisation	GeoMultiSens – Scalable Analysis of Big Remote Sensing Data http://www.geomultisens.gfz-potsdam.de/ Dr. Mike Sips Coordinator GFZ German Research Centre for Geosciences sips@gfz-potsdam.de
R&D activities	<p>For more than 40 years, remote sensing satellite missions are globally scanning the earth's surface. A comprehensive analysis of this data has the potential to support solutions to major global challenges related to climate change, population growth, water scarcity, or loss of biodiversity. This analysis is a challenging task since</p> <ul style="list-style-type: none"> ▪ there is a lack of Big Data-adapted analysis tools and ▪ available data will increase significantly over the next years due to new satellite missions that will allow to measure data at higher spatial, spectral, and temporal resolutions than ever before. <p>GeoMultiSens enables comprehensive analysis and, hence, understanding of earth surface processes on a global scale.</p>
R&D cooperation	<ul style="list-style-type: none"> ▪ Helmholtz-Zentrum Potsdam Deutsches GeoForschungsZentrum GFZ, ▪ Humboldt-Universität zu Berlin, ▪ Konrad-Zuse-Zentrum für Informationstechnik Berlin (ZIB). <p>The consortium aims to develop an integrated processing chain comprising:</p> <ul style="list-style-type: none"> ▪ data acquisition, ▪ pre-processing and homogenization, ▪ data storage, ▪ remote sensing analysis, and ▪ visual exploration. <p>It will demonstrate its effectiveness on various remote sensing application scenarios. The consortium focuses on developing a scalable and modular open source Big Data system.</p>
Additional Information	A Big Data Programme project of the Federal Ministry of Education and Research.



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4.2 Collaborative Research Centers

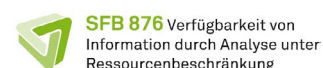
4.2.1 Cybernetic-Cluster – RWTH Aachen University

R&D Organisation	Cybernetic-Cluster IMA/ZLW & IfU RWTH Aachen University Dennewartstr. 27 52068 Aachen www.ima-zlw-ifu.rwth-aachen.de/en Director: Univ.-Prof. Dr. rer. nat. Sabina Jeschke Vice Directors: apl.-Prof. Dr. phil. Ingrid Isenhardt Dr. rer. nat. Frank Hees +49 241 80 91110 sabina.jeschke@ima-zlw-ifu.rwth-aachen.de
R&D activities	<ul style="list-style-type: none"> ▪ Intelligent Production: The focus is on methods and procedures to integrate data from automated and virtual production, allowing the AI based prediction of a system's behaviour and its control. Using a variety of data based techniques like regression, machine learning, natural language processing etc. as well as interactive and explorative visualizations like visual analytics, it is the goal to design, understand, evaluate and optimize new types of highly autonomous production systems. Here, biological inspired learning processes like (un)supervised and reinforcement learning come into play. A prediction of a casting process in automotive production has been developed and is in use. Other areas of interest are the integration of mobile robotical systems as well as the hybrid cooperation between humans and robots. ▪ Logistics 4.0: The concepts of »production 4.0« can seamlessly be extended towards logistics. During an EU project, a big data algorithm was developed, which is able to automatically plan the optimal and intermodal route for transport logistic service providers under the aspects of time, resources and environment. The algorithm is tuned and built on a large database of transport processes throughout Europe. Other projects are the sensor fusion and data interpretation in the field of autonomous cars and trucks. ▪ Advanced human-computer interaction: Future HCI in the field of cognitive computing will have to address the intuitive interaction of humans and technological systems in all areas. Taking the external context into account leads to novel methods of context detection and interpretation based on big data analytics. One major component and integral part of these systems is the ability to include human emotions into the interaction. A fully automatic multimodal emotion detection system for the automotive sector has been developed which continuously adapts the user interface of a GPS to the current temper and needs of the driver.
R&D cooperation	<ul style="list-style-type: none"> ▪ Ziekenhuis Oost-Limburg, Leuven, Belgium: Data analytics in emergency medical services ▪ Maastricht University, Netherlands: Joint theses, networked first aid responder systems ▪ MIT Media Lab, Massachusetts Institute of Technology, USA: Joint theses ▪ HKUST, HongKong, China: Cooperation in entrepreneurship
Cooperation with partners in industry	<ul style="list-style-type: none"> ▪ AUDI AG, Ingolstadt, Germany: Data analytics in automotive production ▪ BMW Group, Munich, Germany: Data analytics in automotive production ▪ Novartis AG, Nuremberg, Germany: Data analytics in pharmaceutical production ▪ Daimler AG, Sindelfingen, Germany: Overall study on the future of the working world (partly big data) ▪ Andersch, Frankfurt, Germany: Overall studies on 4.0 in different branches (partly big data) ▪ Interdigital, Wilmington, USA: algorithms and platforms for data integration in the field of smart cities
Additional Information	<ul style="list-style-type: none"> ▪ Award »Digitaler Kopf Deutschlands« for Prof. Jeschke within the German Science Year 2014 »The Digital Society« ▪ Innovation Award 2016 of the region »Münsterland« for the TelliSys consortium ▪ FRP.NRW Award 2011 for the innovative and efficient project coordination of TelliBox ▪ World Champion in the Festo Logistics League, within the RoboCup, 2014 & 2015



4.2.2 Big Data – Small Devices: Collaborative Research Center SFB 876, TU Dortmund University

R&D Organisation	<p>Providing Information by Resource-Constrained Data Analysis Collaborative Research Center SFB 876</p> <p>Otto-Hahn-Str. 12 44227 Dortmund http://sfb876.tu-dortmund.de Prof. Dr. Katharina Morik</p>
R&D activities	<p>The goal of SFB 876 is to provide information anytime, anywhere. Cyber-physical systems, the internet of things, scientific experiments – they all output big data. Timely information helps in emergency situations, e.g., mobile breath spectrometers allow for diagnoses even of unconscious persons, if they still breathe. Portable virus scanners are to detect nano-objects such that a quarantine of groups becomes obsolete, because the infection can be detected for each individual in real-time. Timely information can make our cities smarter: new dynamic microscopic traffic models detect disturbances early on. In logistics, processes will become more flexible, if containers can communicate using tiny electronic devices. Bringing computation and communication to machines is also a trend in factories, where control takes into account sensor data from manufacturing processes.</p> <p>Turning big data into smart data requires many steps of data analysis: methods for extracting and selecting features, filtering and cleaning the data, joining heterogeneous sources, aggregating the data, and learning predictions need to scale up. The algorithms are challenged on the one hand by high-throughput data, gigantic data sets like in astrophysics, on the other hand by high dimensions like in genetic data. Resource constraints are given by the relation between the demands of processing the data and the capacity of the computing machinery. The resources are runtime, memory, communication, and energy. Novel machine learning algorithms are optimized with regard to minimal resource consumption. Moreover, learned predictions are applied to program executions in order to save resources.</p> <p>The collaborative research center SFB876 is an interdisciplinary center comprising 14 projects, 20 professors, and about 50 PhD students or Postdocs.</p>
R&D cooperation	<ul style="list-style-type: none"> ▪ ISAS Leibniz-Institut für Analytische Wissenschaften – ISAS e.V.: Resource optimizing real time analysis of artifactious image sequences for the detection of nano objects ▪ Universitätsklinikum Essen: Feature selection in high dimensional data for risk prognosis in oncology ▪ University of Duisburg Essen: Analysis and Communication for Dynamic Traffic Prognosis
Cooperation with partners in industry	<ul style="list-style-type: none"> ▪ B&S Analytik GmbH, Dortmund: Analysis of Spectrometry Data with Restricted Resources ▪ Deutsche Edelstahl Werke GmbH, Witten, Data Mining for Quality Control



4.2.3 Cluster Data Engineering and Analytics – Technical University of Munich



Technische Universität München

R&D Organisation	Technical University of Munich Department of Informatics Boltzmannstraße 3 85748 Garching bei München http://www.in.tum.de Representative Chairs: <ul style="list-style-type: none"> ▪ Chair for Database Systems, Prof. Dr. Alfons Kemper & Prof. Dr. Thomas Neumann ▪ Chair for Decision Sciences and Systems, Prof. Dr. Martin Bichler ▪ Chair for Software Engineering for Business Information Systems (sebis), Prof. Dr. Florian Matthes
R&D activities	<ul style="list-style-type: none"> ▪ The R&D Cluster »Data Engineering and Analytics« of the Department of Informatics bundles various Big Data activities. The following sample selection of chairs illustrates the breadth and diversity of the research: ▪ The Chair for Database Systems performs research on the infrastructure for Big Data, hence enabling Big Data operations. The main focus is on building the main-memory database system HyPer. HyPer is a main-memory-based relational DBMS for mixed OLTP and OLAP workloads. It is a so-called all-in-one New-SQL database system that entirely deviates from classical disk-based DBMS architectures by introducing many innovative ideas including machine code generation for data-centric query processing and multiversion concurrency control, leading to exceptional performance. HyPer's OLTP throughput is comparable or superior to dedicated transaction processing systems and its OLAP performance matches the best query processing engines — however, HyPer achieves this OLTP and OLAP performance simultaneously on the same database state. Current research focuses on extending HyPer's functionality beyond OLTP and OLAP processing to exploratory workflows that are deeply integrated into the database kernel by utilizing HyPer's pioneering compilation infrastructure. Thereby, the »computational database« HyPer serves as the data management as well as the compute infrastructure for Big Data applications. ▪ The Chair for Decision Sciences and Systems focuses on particular use cases and application domains: The analysis and prediction of bid data in the context of ad exchanges and real-time bidding, besides social network analysis based on telecom data in collaboration with CMU and a national telecom (Prof. Krishnan) and also system monitoring and metering, and parameter estimation for automated resource allocation in data centers together with Huawei Ltd. ▪ The Chair for Software Engineering for Business Information Systems is concerned with the adoption of Big Data techniques in enterprises and performs empirical analysis of Big Data adoption in industry (Business Models, Big Data Use Cases, Practical Big Data Experiences, Software Architectures for Big Data). Moreover, the chair explores the application of Big Data techniques, in particular in the service platform monitoring and analytics project (part of TUM LLCM, http://tum-llcm.de/) and in the Lexalyze project where text mining and natural language processing is performed on large legal document collections, http://www.lexalyze.de)
R&D cooperation	<ul style="list-style-type: none"> ▪ Prof. Dr. Kemper & Prof. Dr. Neumann & Prof. Dr. Peter Boncz, VU Amsterdam & CWI (Guest Professor, Humboldt Prize) & Prof. Dr. Torsten Grust (University of Tübingen) ▪ Prof. Dr. Bichler & Prof. Dr. Ramayya Krishnan (CMU) & Prof. Dr. Jacob Goeree, UT Sydney ▪ Prof. Dr. Matthes & Prof. Dr. Rick Kazman, Software Engineering Institute (SEI, CMU) & Prof. Dr. Hong-Mei Chen, Shidler College of Business, University of Hawaii at Manoa
Cooperation with partners in industry	<ul style="list-style-type: none"> ▪ Oracle Labs, SAP, Fujitsu, Siemens, Tableau Software ▪ Huawei (collaboration on automated resource allocation in virtualized data centers) ▪ SAP XM (collaboration on real-time bidding) ▪ Government of New South Wales (collaboration on cap-and-trade systems) ▪ Allianz Deutschland, IBM Deutschland (Text Mining, Semantic Annotation of Legal Concepts in Terms and Conditions Using the Analytical Components of IBM Watson Explorer); BMW & Siemens (TUM Living Lab Connected Mobility, Ecosystem Platforms and Connected Mobility), www.tum-llcm.de
The Chair for Database Systems coordinates the new Master of Science program »Data Engineering and Analytics« that was established to train the new generation of Data Science professionals. Moreover, the chair holds best paper awards at BTW 2013, 2015 and ICDE 2014.	

Prof. Neumann was awarded with the VLDB 2014 Early Career Innovation Award. Prof Kemper received the GI Fellow award 2015. The Chair for Database Systems organizes the VLDB 2017 International Conference at TUM.

The **Chair for Decision Sciences and Systems** works on predictive and prescriptive analytics combining data analysis and optimization. Various projects were conducted in the field of marketing analytics including churn prediction, campaign management, and social network analysis in various service industries.

The **Chair for Business Information Systems** coordinates the TUM Living Lab Connected Mobility project (5 Chairs, 19 PhDs) that includes several topics related to Big Data: <http://www.tum-llcm.de>.

<p>Living Lab Connected Mobility project</p>	<p>The German automotive industry faces major challenges through new mobility concepts, digital business models and strong international competitors of digital mobility services. In support of the digital transformations in the area of smart mobility and smart city the Free State of Bavaria supports the TUM Living Lab Connected Mobility project, which is an interdisciplinary research project, which bundle the fields of informatic and transport research. The aim of this project is to deliver innovative contributions regarding the design, the architecture, and the scalable realization of an open, vendor independence digital mobility platform. This platform will be developed in a close cooperation with leading companies and will offer small and medium-sized companies a marketplace to develop and operate digital mobility services with substantial lower financial, organization and technical effort with the option of networking. (http://tum-llcm.de/en/)</p>
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4.3 Research Groups

4.3.1 Scalable Data Science and Big Data Management – TU Berlin

R&D Organisation	The DIMA (Database Systems and Information Management) Group at TU Berlin Prof. Dr. Volker Markl TU Berlin and DFKI Einsteinufer 17 10587 Berlin +49 (0) 30 314 23555 prof@dima.tu-berlin.de www.dima.tu-berlin.de
R&D activities	<p>The Database Systems and Information Management (DIMA) Group at TU Berlin and DFKI is one of Europe's leading data management groups focusing on scalable data science and big data management. Our R&D activities are centered on the delivery of cutting-edge systems, technologies, and tools for the storage, processing, and low latency management of massive amounts of heterogeneous data that address challenges along the entire data value chain, including information extraction, information integration, data analysis, facilitating decision-making, and benchmarking big data technologies.</p> <p>Major R&D activities at DIMA include:</p> <ul style="list-style-type: none"> ▪ Stratosphere, a multi-year, cross-institutional collaborative project, whose R&D produced a big data analytics platform, that is today, the Apache Flink open source platform for distributed stream and batch data processing, ▪ Mosaics, a project that aims to reduce the entry barrier and cost of analyzing large amounts of data-at-scale by simplifying the data analysis process through declarative programming languages, automatic optimization, parallelization, and hardware adaptation for data analysis programs, ▪ as well as a project investigating how to exploit heterogeneous hardware during the analysis of big data-at-rest and data-in-motion. <p>In our R&D we build and validate systems and tools in real-world settings, jointly with partners in application domains, such as information marketplaces and the information economy, logistics, healthcare, and Industrie 4.0, among others.</p>
R&D cooperation	<ul style="list-style-type: none"> ▪ BBDC Berlin Big Data Center, on declarative programming languages for data analytics, Big Data Competence Center Initiative, BMBF. ▪ KTH Royal Institute of Technology, cooperation on the development of data streaming platforms, EIT Digital. ▪ SZTAKI Hungarian Academy of Sciences, Institute for Computer Science and Control, cooperation on the development of analysis algorithms for data streams, EIT Digital. ▪ BSC Barcelona Supercomputing Center, development of a roadmap for the impact of modern hardware on big data and data science, RETHINK Big Project, EU FP7.
Cooperation with partners in industry	<ul style="list-style-type: none"> ▪ IBM, donated the largest PowerLinux Big Data Cluster available at any European university to DIMA at TU Berlin. ▪ Oracle, R&D on declarative specification and optimization of data analysis programs. ▪ SAP, collaborating on data programmability. ▪ Amazon, collaborating on scalable machine learning. ▪ Zalando, collaborating on a scalable data science. ▪ Internet Memory Foundation, collaborating on scalable contextualization of data streams.
Additional Information	<ul style="list-style-type: none"> ▪ Coordination of the BBDC (Berlin Big Data Center). ▪ Close cooperation with the SDF (Smart Data Forum). ▪ ↗ Apache Flink originated from the TU Berlin DIMA group. ▪ ↗ dataArtisans, a start-up building the next-generation platform for programming data-intensive applications was founded by DIMA members.



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4.3.2 Machine Learning – TU Berlin

R&D Organisation	Technische Universität Berlin Machine Learning Group Marchstr. 23 10587 Berlin Prof. Dr. Klaus-Robert Müller klaus-robert.mueller@tu-berlin.de
R&D activities	The research areas of the Machine Learning Group include statistical learning theory for neural networks, support vector machines and ensemble learning techniques. The group contributed to the field of signal processing working on time-series analysis, statistical denoising methods and blind source separation. The present application interests are expanded to the analysis of biomedical data, most recently to brain computer interfacing, genomic data analysis, computational chemistry and atomistic simulations.
R&D cooperation	<ul style="list-style-type: none"> ▪ Prof. V. Markl (TU Berlin: Big Data Technology / Large Scale Machine Learning) ▪ Prof. A. Villringer (Max Planck Institut für Kognitions- und Neurowissenschaften Leipzig: Neuroimaging) ▪ Prof. S.W. Lee (Korea University, Seoul, Korea: Brain-Computer Interfaces) ▪ Prof K. Burke (University of California – Irvine: Quantum Chemistry) ▪ Prof. M. (Sugiyama University of Tokyo: Machine Learning)
Cooperation with partners in industry	<ul style="list-style-type: none"> ▪ Siemens (Energy Technology, Optimized Control of Wind Turbines) ▪ Schering/Bayer (Computational Chemistry) ▪ P3 Group (Mobile Telecommunications) ▪ Facebook (Artificial Intelligence and Machine Learning) ▪ Amazon (Artificial Intelligence and Machine Learning)
Additional Information	In 1999 Prof. Müller received the annual national prize for pattern recognition (Olympus Prize) awarded by the German pattern recognition society DAGM, in 2006 the SEL Alcatel communication award and in 2014 he was granted the Science Prize of Berlin awarded by the Governing Mayor of Berlin. Since 2012 he is Member of the German National Academy of Sciences Leopoldina and he holds a distinguished professorship at Korea University in Seoul. He serves in the editorial boards of Computational Statistics, IEEE Transactions on Biomedical Engineering, Journal of Machine Learning Research and in program and organization committees of various international conferences.



4.3.3 Service-centric Networking – Telekom Innovation Laboratories & TU Berlin

R&D Organisation	Service-centric Networking (SNET) Endowed Chair of Deutsche Telekom at Telekom Innovation Laboratories (T-Labs) and Technische Universität Berlin (TU Berlin) TEL 19 Ernst-Reuter Platz 7 10587 Berlin www.snet.tu-berlin.de Prof. Dr. Axel Küpper
R&D activities	Data in today's business landscape are created and stored at exponentially large scales. Therefore, the need to improve business operations through data-driven decisions has emerged as an important objective for many growing companies. The SNET group at Telekom Innovation Laboratories and TU Berlin addresses those needs by combining computer science, engineering, mathematics, statistics, and predictive modeling to generate analytical insights about data from a variety of sources. Research activities in these fields comprise, but are not limited to Machine Learning, Data Mining, Spatio-temporal analysis, Time series analysis, Clustering, Big Data processing, Numerical simulations, Visualizations, Interactive services, Statistical learning, Distributed computing, Graph theory, as well as Linked and Open Data. SNET is conducting several industry and publicly-funded projects and supports different business domains like automotive, health, energy, retail, and mobile communications.



R&D cooperation	Telekom Innovation Laboratories, Germany; Aalto University, Finland; Centre National de la Recherche Scientifique (CNRS), France; Consiglio Nazionale delle Ricerche, Italy; German Research Center for Artificial Intelligence (DFKI), Germany; Deutsches Herzzentrum Berlin, Germany; EIT Digital, Europe; Eötvös Loránd University, Hungary; Eurescom, Germany; Fraunhofer FOKUS, Germany; Forum Virium Helsinki, Germany; i2cat Fundació, Spain; Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa, Portugal; IFB- Institut Français de Bioinformatique (CNRS), France; Institut Mines-Télécom, France; KTH Royal Institute of Technology, Sweden; LAL-Laboratoire de l'Accélérateur Linéaire (CNRS), France; Paulinenhaus Krankenhaus e.V., Germany; Politecnico di Milano, Italy; Stockholm University, Sweden; Universiteit Van Amsterdam, The Netherlands; University of Helsinki, Finland; VTT Technical Research Centre of Finland Ltd., Finland
Cooperation with partners in industry	Deutsche Telekom AG, Germany; T-Systems International GmbH, Germany; Bitplaces GmbH, Germany; Société Alfstore, France; Apizee - Easy Web Communications, France; Interoute Communications Limited, UK; medisite Systemhaus GmbH, Germany; Orange Communications S. A., France; QSC AG, Germany; Quobis Networks SLU, Spain; Reply, Germany; SixSq Sàrl, Switzerland; Telecom Italia Group, Italy; Unicon The Web Privacy Company, Germany
Additional Information	One of the major business domains covered by research activities of SNET is the retail market. SNET is working on innovative solutions for location-based customer intelligence and, together with Telekom Innovation Laboratories, founded the spinoff Bitplaces in 2012. Bitplaces along with its mobile intelligence cloud is one of the pioneers in the rapidly growing market for mobile marketing and location-based services. The customer intelligence technology developed at TU Berlin seamlessly extends app functionality, in particular allowing retailers and advertisers to target customers on a segment and context-oriented basis at the point of sale and beyond via their smartphone. The tools used include geofencing and also beacons if required, in compliance with strict German data privacy regulations. Modules such as performance and analysis tools as well as messaging services ensure that the scalable building block system covers the entire customer journey, both inside and outside.

4.3.4 Data Science – Beuth University of Applied Sciences Berlin

R&D Organisation	Beuth University of Applied Sciences Berlin Research Group »Data Science« Luxemburger Str. 10 13353 Berlin Prof. Dr. Alexander Löser (spokesman) https://projekt.beuth-hochschule.de/data-science/
R&D activities	We develop systems capable of marrying up text, tables, photos or even GPS coordinates and, above all, of making sense of them. Our major research activities are: <ul style="list-style-type: none"> ▪ NLP/Machine Understanding ▪ Deep Learning on GPUs and CPUs ▪ Massive Parallel Processing (MPP) Engines ▪ Spatial Data Bases ▪ Learning Analytics
R&D cooperation	The data science group is cooperating closely with excellent scientific partners. <ul style="list-style-type: none"> ▪ Berlin Big Data Center and TU Berlin (BMBF): Debugging Massively Parallel Processing Engines for Apache Flink or Apache Spark ▪ Fraunhofer FOKUS: Learning Analytics in 'Smart Learning' (BMBF) ▪ German Research Center for Artificial Intelligence (DFKI) and Charité: In-Database-Text-Mining in 'Smart Data Web' (BMWi) and 'MACCS' (BMWi) ▪ TU München and TU Dresden: Crowd based city logistics in realtime in project ExCELL (BMWi).
Cooperation with partners in industry	Our current projects are carried out with major international enterprises. <ul style="list-style-type: none"> ▪ Cloudera Inc.: Text Mining with Cloudera IMPALA ▪ SAP SE: 'As-you-type-NLP' on Shared Memory Databases in MACSS (BMWi) ▪ Siemens SE: NLP for Supply Chain Management in Smart Data Web (BMWi) ▪ Zalando SE: Fashion NLP Analysis in blogs for user trends <p>We also work with creative minds from startups on a variety of research projects.</p>



BEUTH HOCHSCHULE FÜR TECHNIK BERLIN
University of Applied Sciences



Additional Information	<p>Nearly 300 professors conduct teaching and research with 13.000 students at Beuth University of Applied Sciences in Europe's startup metropolis Berlin.</p> <p>The research group »Data Science« exists since 2015. Professors Stefan Edlich, Patrick Erdelt, Felix Gers, Kristian Hildebrand, Alexander Löser, Agathe Merceron and Petra Sauer work on both, fundamental and applied research problems.</p> <p>In 2016 the spin-off Pyramics received seed funding for an optical sensor and a data analysis platform for analyzing buying behavior at the point-of-sale. INDREX is another prototype currently tested with various industrial partners for managing text data in a relational DBMS, such as Cloudera IMPALA.</p> <p>The data science master program in English language will start in 2017 and will focus on the specific needs of startups and major industrial partners in Berlin.</p>
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4.3.5 Language Technology – TU Darmstadt

R&D Organisation	<p>Language Technology (LT) Group Computer Science Department TU Darmstadt Prof. Dr. Chris Biemann Hochschulstr. 10 64289 Darmstadt +49 6151 16-25411 www.lt.informatik.tu-darmstadt.de</p>
R&D activities	<p>The LT group conducts research on all aspects of natural language processing. Its special focus is set on statistical semantics, structure discovery in large corpora and cognitive computing. LT regularly publishes research papers and releases open source software related to the semantic understanding of natural language, including the computation of large-scale sense-aware semantic models using big-data principles, the induction of taxonomies from text, lexical substitution, word sense disambiguation and named entity tagging. A further specialty of the group is adaptive learning for natural language processing, where language processing modules are iteratively improved through constant annotation and usage, leveraging web-based annotation tools and crowdsourcing.</p> <p>LT was the first group in Europe to gain access to an IBM Watson private instance for teaching purposes.</p>
R&D cooperation	<ul style="list-style-type: none"> ▪ IBM Research: »JoBimText: Linking Language to Knowledge using Distributional Semantics« – Common Open Source Framework for language-independent computation of sense-aware semantic models; »Cognitive Lab« at TU Darmstadt ▪ JOIN-T: Joining Ontologies and Semantics Induced from Text (with University of Mannheim) funded by DFG ▪ Research Training Group GRK 1994: Adaptive Preparation of Information from Heterogeneous Sources (AIPHES) (with University of Heidelberg, HITS GmbH) funded by DFG ▪ SEMSCH: Semantic Methods for Computer-supported Writing Aids, funded by DFG
Cooperation with partners in industry	<ul style="list-style-type: none"> ▪ Siemens AG: LICORES: Linking unstructured content to domain-specific knowledge repositories using contextualized distributional semantics ▪ Deutsche Bahn AG: ABSA-DB: Aspect-based Sentiment Analysis for DB Products and Services ▪ Spiegel Verlag: DIVID-DJ: Data Extraction and Interactive Visualization of Unexplored Textual Datasets for Investigative Data-Driven Journalism, funded by VW Foundation ▪ KMU 2020: Dialog+ - Intelligent House Control with Speech, funded by BMBF
Additional Information	<ul style="list-style-type: none"> ▪ Awards: Wallenberg Academic Fellowship 2016; IBM Shared University Research Award 2013, Adolf-Messer-Prize of TU Darmstadt 2013; Appen Industry Award; IKT Innovativ Award Winner with Consetto UG ▪ Software products: JoBimText distributed semantic model computation; WebAnno web-based annotation platform; WebCorpus web-scale corpus processing; GermaNER open source named entity recognizer for German



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4.3.6 Big Data Competence Centre – University of Applied Sciences Darmstadt

R&D Organisation	Big Data Competence Centre Darmstadt University of Applied Sciences Darmstadt Haardtring 100 64295 Darmstadt www.fbi.h-da.de/bdcc/ Prof. Dr. Uta Störl uta.stoerl@h-da.de
R&D activities	Research activities of the Big Data Competence Centre focus on NoSQL database technologies. Currently our main research topic is schema management in NoSQL database systems. Together with our research partners in Rostock and Regensburg, we develop new approaches for schema evolution and schema extraction, as well as data migration strategies. As proof of concept, we developed Darwin, a schema management component for different NoSQL database systems. Further research topics are benchmarking of NoSQL database systems and Object-NoSQL mappers. We analyse and benchmark those tools using our Big Data Cluster
R&D cooperation	<ul style="list-style-type: none"> University of Rostock, Germany – Field of cooperation: Schema extraction for NoSQL database systems. Develop, implement, and benchmark new algorithms for schema extraction for NoSQL data. Project title: Darwin OTH Regensburg, Germany – Field of cooperation: Schema evolution and data migration for NoSQL database systems. Develop, implement, and benchmark new approaches for schema evolution and data migration. Project titles: Cleager, Darwin CCSOR (Competence Centre Stochastics & Operations Research) Darmstadt, Germany – Field of cooperation: Statistical analysis on big data.
Cooperation with partners in industry	<ul style="list-style-type: none"> Software AG, Darmstadt, Germany – Field of cooperation: Using the Big Data Cluster, the already existing research cooperation between Software AG and University of Applied Sciences Darmstadt expands by integrating Software AG's Digital Business Platform for doing Streaming Analytics. The Streaming Analytics Platform is not only used for educational purposes but above all to support researching students to do their master's or doctoral thesis. SAS Institute GmbH, Heidelberg, Germany – Field of cooperation: The already existing cooperation between SAS and our University will be expanded by a SAS-on-Hadoop installation on our Big Data Cluster for use in research as well as in education, especially within the new Data Science Master's Programme. Ordix AG, Wiesbaden, Germany – Field of cooperation: Benchmarking of NoSQL database systems. Besides benchmarking NoSQL database systems, we analyse and enhance NoSQL benchmark suites.
Additional Information	We have a strong focus on teaching students in Big Data technologies and analytics. There are different lectures using the Big Data Cluster with a broad range of big data technologies and tools (NoSQL database systems, MapReduce frameworks, Stream Processing engines, Graph Processing frameworks, Machine learning frameworks, Tools for Visualization etc.) Data Science Master's Programme: The Department of Mathematics and Natural Sciences and the Department of Computer Science have recently established a new Data Science Master's Programme, which will be launched in winter semester 2016 and will focus on scalable data management and data analysis.



4.3.7 Data-Driven Science – TU Dortmund University

R&D Organisation	TU Dortmund Faculty for Computer Science LS 8 Otto-Hahn-Str. 12 44227 Dortmund www.ai.cs.uni-dortmund.de/index.html Prof. Dr. Katharina Morik
R&D activities	<p>Modern science relies on data, new technologies gather terabytes of them. However, data alone do not deliver the insight that is needed for scientific progress. Scalable online or anytime algorithms are needed that support the overall cycle of analytics, from data exploration, feature extraction/selection and model selection to the real-time application of learned models.</p> <p>Genomic data are the best known source of a scientific break-through. Sophisticated analysis is necessary in order to find clear cancer indicators for a reliable survival prediction that enables personalized therapies (Lee, 2014).</p> <p>New astrophysics experiments contribute a tremendous amount of raw data in which the informative events are extremely rare. IceCube has been awarded the breakthrough of the year in 2013 by the Physics World. One of its challenges are new feature extraction methods that enable the detection of high voltage neutrinos (Morik & Collaboration, 2014).</p> <p>Engineering models take into account sensor data from manufacturing. Most often, data analysis is done offline and the insight gained is manually incorporated into the model. There is more to be gained, if we apply learned models directly to the process in real-time (Stolpe, 2016). In addition to saving several millions of EUR per year, better guarantees of sustainability are achieved by the direct integration of such advanced analytics into the manufacturing processes.</p> <p>Big data analytics provides methods for a variety of sciences. Scientists from other disciplines understand, apply and even create analysis pipelines easily using RapidMiner. Its community open source edition allows us to continuously contribute new operators and publish them at the marketplace.</p>
R&D cooperation	↗Dimitrios Gunopulos, University of Athens, Greece, European projects INSIGHT
Cooperation with partners in industry	<ul style="list-style-type: none"> ▪ RapidMiner – enhancing predictive analytics ▪ SMS group – data-driven optimization of BOF steel production ▪ Dillinger Hüttenwerke AG – integrated real-time system for data and model management using machine learning and optimization for BOF steel making
Additional Information	<ul style="list-style-type: none"> ▪ Member of the National Academy of Science and Engineering and the North-Rhine-Westphalia Academy of Science and Art. ▪ Coordinator of the European project MiningMart (IST 11993) ▪ Speaker of the Collaborative Research Center SFB 876 ▪ Spin-off: RapidMiner (↗p. 139), a leading international predictive analytics platform



4.3.8 Data Mining Group – TU Dortmund University

R&D Organisation	TU Dortmund University Fachbereich für Informatik 44221 Dortmund Prof. Dr. Kristian Kersting Data Mining Group
R&D activities	<p>The rise of big data presents both opportunities and challenges in domains ranging from business to sciences. The opportunities include better-informed business decisions, more efficient supply-chain management and resource allocation, more effective targeting of products and advertisements, better ways to »organise the world's information«, faster turnaround of scientific discoveries, etc.</p> <p>The challenges, however, are also big. Many pressing business and science questions require one to integrate information from many inter-related, heterogeneous data sources such as natural language text with hyperlinks, images, tables, and social networks, etc. They are difficult for machines to understand jointly and unambiguously.</p> <p>Consequently, the much celebrated democratisation of data does not mean dropping the data on everyone's desk and saying, »good luck«! It means to make data science methods usable in such a way that people can easily instruct machines to have a »look« at complex data and help them to understand and act on it.</p> <p>This is akin to Statistical Relational Learning, one of the most important breakthroughs in AI in the last 15 years, which has unified relational logic and databases with graphical models and probability theory. Unfortunately, it does not support convex optimisation commonly used in machine learning and data science. Therefore, we are additionally pushing declarative mathematical programming. This allows the user to specify data science models before she knows what individuals are in the domain and, therefore, before she knows what variables and constraints exist.</p> <p>It facilitates the formulation of abstract, general knowledge. And, it reveals the rich logical structure underlying many data science problems to the solver and, turn, may make it go faster. With this, people can start to rapidly develop statistical machine learning approaches for data science. For instance, adding just three lines of code makes a linear support vector machines aware of any underlying network that connects the objects to be classified.</p>
R&D cooperation	SFB876 projects on analysing big graphs and traffic data, ↗CompSustNet partner . University of Bonn, BLE and BMBF projects on plant phenotyping. University of Stuttgart, DFG project on lifted inference. HUJI, GIF project on lifted inference.
Cooperation with partners in industry	<ul style="list-style-type: none"> ▪ Google: Research internship of PhD student on compressed machine learning. ▪ LogicBlox: Declarative mathematical programming. ▪ SWYX: Big analytics in communication networks. ▪ WOOGA: Games Analytics
Additional Information	ECCAI Dissertation Award 2006, for the best European AI dissertation. ECML 2006 Best Student Paper Award. Fraunhofer ATTRACT Fellowship 2008. AIIDE 2016 Best Paper Award. ↗goedle.io , big data for marketing automation. ↗RLOOP : A Python framework for relational convex optimization

4.3.9 Algorithm Engineering – TU Dortmund University

R&D Organisation	TU Dortmund Fakultät für Informatik Prof. Dr. Petra Mutzel Lehrstuhl für Algorithm Engineering 44221 Dortmund ls11-www.cs.tu-dortmund.de petra.mutzel@tu-dortmund.de
R&D activities	The research of the group focuses on algorithms for the visualization, analysis, and optimization of discrete structured data, e.g., networks or graphs. The group is part of the DFG priority program 1736 »Big Data« with the project »Graph Based Methods for Rational Drug Design« in which new clustering and similarity algorithms will be developed. In the big data DFG Collaborative Research Center SFB 876 »Providing Information by Resource-Constrained Data Analysis« (see section 4.2.2), the group takes an active part in the project »A6: Resource efficient analysis of graphs« by developing new data mining methods. Applications considered so far of the group include data base analysis for drug design in cheminformatics, the planning of new high-voltage overhead lines, the planning of telecommunication networks, the optimization of spin glass systems in Physics, and the visualization of networks. Algorithm Engineering includes the design, the theoretical analysis, the implementation, and experimental evaluation of algorithms. This new field intends to bridge the gap between the efficient algorithms developed in algorithmic theory and the algorithms used by practitioners.
R&D cooperation	<ul style="list-style-type: none"> ▪ Prof. Giovanni Rinaldi (IASI-CNR Rome): Spin Glass Solvers & Max Cut ▪ Prof. Ivana Ljubic (ESSEC Business School of Paris): Design of communication networks, network design ▪ Prof. Marcus Schaefer (DePaul University, Chicago): Graph Embeddings ▪ Prof. Bojan Mohar (Simon Fraser University), Prof. Bruce Richter (University of Waterloo), Prof. Silvia Fernandez (California State University Northridge), Prof. Oswin Aichholzer (TU Graz), and others: Crossing Number of Graphs
Cooperation with partners in industry	<ul style="list-style-type: none"> ▪ Amprion GmbH and Spiekermann & Wegener Stadt und Regionalforschung: BMBF-Project »Evaluation and planning of high-voltage overhead lines«
Additional Information	<ul style="list-style-type: none"> ▪ Awards: Research Prize »Technische Kommunikation 2000« by the Alcatel SEL Stiftung für Kommunikationsforschung <p>important Big Data products:</p> <ul style="list-style-type: none"> ▪ Open-source tool (Java) »Scaffold Hunter« for the interactive visualization and analysis of data sets, in particular for large data bases of small molecules for drug design ▪ Open-source tool (C++) »OGDF: Open Graph Drawing Framework« containing algorithms and data structures in a modular form for graph analysis and visualization.

4.3.10 Frankfurt Big Data Lab – Goethe University Frankfurt

R&D Organisation	Frankfurt Big Data Lab Goethe University Frankfurt Robert-Mayer-Str. 10 60325 Frankfurt am Main www.bigdata.uni-frankfurt.de Prof. Dott. Ing. Roberto V. Zicari Lab Founder zicari@dbis.cs.uni-frankfurt.de Dr. Karsten Tolle Lab Director tolle@dbis.cs.uni-frankfurt.de
R&D activities	<p>The objective of the Frankfurt Big Data Lab is to carry out research in the domains of big data and data analytics from the perspective of information systems and computer science. Our approach is based on the interdisciplinary binding between data management technologies and analytics.</p> <p>The research activities of the Frankfurt Big Data Lab include:</p> <p>Big Data Management, Big Data Analytics, Linked Open Data (LOD), Big Data for Social Good, Data Processing Integration.</p> <ul style="list-style-type: none"> ▪ Big Data Management: Our work is concentrated on the evaluation and optimization of Operational data stores that allow flexible schemas, Big Data management and analytical platforms (Hadoop, Spark, In-Memory Databases, NoSQL, NewSQL, Graph Databases), Complex distributed storage and processing architectures, and Big Data Benchmarks. ▪ Big Data Analytics: We apply data analytics for various use cases in vertical markets. ▪ Big Data for Social Good: We started an initiative for Refugees Inclusion with the City of Frankfurt, Accenture Foundation, and other partners. <p>The lab is located in Frankfurt, the financial metropolis of Central Europe and targets to be a source of knowledge and expertise both for research and industry applications. The Lab is hosted at the Chair for Database and Information Systems (DBIS), Goethe University Frankfurt. One motivation of our Lab is to encourage the international research community to work on Big Data problems that have a potential positive social impact for mankind. The Lab operates using the following ethical principles as defined in the Data for Humanity initiative.</p>
R&D cooperation	Cooperation with the Sutardja Center for Entrepreneurship & Technology at UC Berkeley (USA) for applying Big Data technologies to vertical use cases, and for developing a Big Data Curricula for engineering students at UC Berkeley.
Cooperation with partners in industry	The lab has an industrial partnership with Accenture, Germany, to evaluate Big Data technologies and further evaluate hybrid data architectures based on In-Memory processing and Hadoop. The Lab cooperates with Geisinger Health System in USA. We have common research projects in the field of applying data analytics for healthcare.
Additional Information	Prof. Roberto V. Zicari initiated together with Prof. Andrej Zwitter (University of Groningen, the Netherlands) the Data for Humanity initiative, with the goal to bring people and institutions together who share the motivation to use Data for Common Good / human wellbeing

4.3.11 Algorithm Engineering – Goethe University Frankfurt

R&D Organisation	Goethe University Frankfurt am Main Algorithm Engineering Group Institute of Computer Science Robert-Mayer-Straße 11-15 60325 Frankfurt am Main Prof. Dr. Ulrich Meyer +49 69 798-28433 umeyer@cs.uni-frankfurt.de www.uli-meyer.de
R&D activities	<p>Our group is active in algorithms and data structures for advanced models of computation. In particular, we investigate the analysis, traversal and generation of huge networks (like the WWW-graph, social networks or genome assembly graphs).</p> <p>Concrete research topics include exploiting parallelism (multicores, distributed processing, GPUs) and memory-hierarchies (hard-disks, flash-memory, caches), dealing with large-scale dynamic data updates, approximation and online processing under resource constraints and reducing the consumption of energy by algorithmic measures.</p> <p>We do not only strive for theoretical results but intend to follow the whole algorithm engineering development cycle, i.e., design, analysis, implementation, and experimental evaluation form a cycle driving algorithm development.</p> <p>The group is particularly known for its theoretical and practical contributions to external-memory graph algorithms, e.g. speeding up basic traversal strategies by several orders of magnitude.</p>
R&D cooperation	↗DFG priority programme SPP 1736 Algorithms for Big Data ↗MADALGO (Centre for Massive Data Algorithms, Aarhus University, Denmark)
Cooperation with partners in industry	Bell Labs Dublin/IE (↗Dr. Deepak Ajwani , Cooperation in Large-Scale Network Analysis)
Additional Information	↗Coordination of ↗DFG priority programme SPP 1736 Algorithms for Big Data Award Germany Land of Ideas for ↗Ecosort (together with KIT Karlsruhe, 2011) Records in the ↗JouleSort Competition (together with KIT Karlsruhe 2009/10)



4.3.12 Applied Security Technology – Karlsruhe Institute of Technology

R&D Organisation	KASTEL – Competence Center for Applied Security Technology Am Fasanengarten 5 76131 Karlsruhe www.kastel.kit.edu/english/ Prof. Dr. Jörn Müller-Quade crypto-info@iti.kit.edu +49 721 608-44213
R&D activities	<p>KASTEL is a competence center for IT security funded by the Federal Ministry of Education and Research (BMBF) which combines the expertise of 13 research groups at the Karlsruhe Institute for Technology (KIT), the Fraunhofer IOSB and the Research Center for Information Technology (FZI) in multiple disciplines of computer science and law related to IT security, privacy, and data protection. In KASTEL, the security and privacy of Big Data applications is investigated in the context of smart environments and industry 4.0. Members of KASTEL are a part of several projects related to Big Data, where they provide expertise in security and privacy.</p> <ul style="list-style-type: none"> ▪ SDI-X is a research project accompanying the German nationwide Smart Data Innovation Lab, which offers low-threshold access to big data analytics for potential future users. Prof. Jörn Müller-Quade and his team work on providing easy-to-use tools, operational concepts and processes for enhancing privacy while mining data. ▪ Within the project »SMART Regio«, funded by the German Federal Ministry for Economic Affairs and Energy, Prof. Indra Spiecker does research on data-protection compliant solutions for »Big and Smart Data« problems using the example of energy industry. Furthermore she participates in an international research project on »commercial profiling«. ▪ Prof. Dennis Hofheinz participates in the DFG Priority Programme »Algorithms for Big Data« with the project »Scalable Cryptography«, where he and Prof. Eike Kiltz (RUB) construct a toolbox of cryptographic schemes that are suitable for huge sets of data. ▪ The Federal Ministry for Economic Affairs and Energy has set up an accompanying research project for the Smart Data – Data Innovation technology programme. PD Dr. Raabe leads the specialist group for law within this project, which aims to achieve legal conformity, synergies and transfer of technology. ▪ The Fraunhofer IOSB, headed by Prof. Beyerer works on machine learning for self-configuring intrusion detection systems. ▪ Prof. Hartenstein works on tunable security and secure data outsourcing.
R&D cooperation	<ul style="list-style-type: none"> ▪ Goethe University Frankfurt/Main (Smart Regio) ▪ Faculty of Law of Monash University Melbourne (commercial profiling) ▪ University Paris-Dauphine (commercial profiling) ▪ UCSD (with Prof. Mihir Bellare on security definitions) ▪ ETH Zürich (with Prof. Ueli Maurer on Abstract Cryptography)
Cooperation with partners in industry	<ul style="list-style-type: none"> ▪ CAS (research cooperation in cloud computing) ▪ Fiducia & GAD IT (research cooperation in cloud computing) ▪ ITK Engineering (research cooperation in cloud computing) ▪ USU Software AG (Smart Regio project) ▪ YellowMap AG (Smart Regio project)
Additional Information	The KASTEL-team which developed the concept of Blurry-Box Cryptography was awarded the first place of the security award Deutscher IT-Sicherheitspreis 2014. KASTEL cooperates closely with the FZI Research Center for Information Technology and the Helmholtz program »Supercomputing & Big Data«.



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4.3.13 Parallel Computing – Karlsruhe Institute of Technology

R&D Organisation	Karlsruhe Institute of Technology (KIT) Institute of Theoretical Informatics (ITI) Research Group Parallel Computing Prof. Dr. Henning Meyerhenke Am Fasanengarten 5 76189 Karlsruhe http://parco.iti.kit.edu
R&D activities	The research group is, among others, active in the field of Big Graph processing. We are developing (often parallel) algorithms for the analysis of massive complex networks such as web graphs, social networks and many others. Of particular interest are algorithms that help to explain the structure, dynamics and statistical features of such networks. Our algorithms are implemented within the software toolkit NetworkKit, an open-source effort driven by our group. NetworkKit allows interactive scripted workflows but is very fast at the same time by harnessing multicore parallelism with natively compiled code.
R&D cooperation	<ul style="list-style-type: none"> ▪ Professor Pierluigi Crescenzi, University of Florence, Italy (Large-scale Graph Analytics: Algorithms, Dynamics, Complexity) ▪ Professor David A. Bader, Georgia Institute of Technology, USA (Parallel Algorithms for Dynamic Graph Analytics) ▪ Professor Ilya Safro, Clemson University, USA and Professor Alexander Gutfraind, University of Illinois at Chicago, USA (Generating Large-scale Replicas of Real-World Networks) ▪ DFG Priority Programme »Algorithms for Big Data«
Cooperation with partners in industry	<ul style="list-style-type: none"> ▪ TEEC GmbH, Isernhagen and Fraunhofer SCAI Research project »A portable HPC toolbox for the simulation and inversion of wave fields«
Additional Information	Open-source software NetworkKit for large-scale network analysis, available under MIT license at http://networkkit.iti.kit.edu



4.3.14 Algorithm Theory and Algorithm Engineering – Karlsruhe Institute of Technology

R&D Organisation	Karlsruhe Institute of Technology Institute of Theoretical Informatics (ITI) Postfach 6980 76128 Karlsruhe Prof. Dr. rer. nat. Peter Sanders Secretariat: Anja Blancani blancani@kit.edu +49 721 608-43985
R&D activities	Data structures, fundamental algorithms, parallel algorithms, graph algorithms, algorithm engineering, communication efficient algorithms, distributed SQL, 3D image processing, CERN particle tracking
R&D cooperation	David Bader (Georgia Tech), graph analysis, parallel computing. Jesper Träff (TU Vienna), algorithms for MPI, load balancing CERN (Gentner Scholarship), algorithms for particle accelerators
Cooperation with partners in industry	Google (route planning), SAP (algorithms e.g. for HANA Vora), Facebook (graph partitioning), Intel (concurrent data structures), Microsoft (route planning)
Additional Information	DFG Leibniz Price, Google Focused Research Award, Prices for DIMACS Implementation Challenges and Sorting Benchmark, Foundational work for SAP HANA Vora



4.3.15 Smart Service Systems – Karlsruhe Institute of Technology

R&D Organisation	Karlsruhe Service Research Institute (KSRI) KIT Campus South Englerstr. 11 76131 Karlsruhe www.ksri.kit.edu Contact: Peter Hottum management@ksri.kit.edu Prof. Dr. A. Mädche, Prof. Dr. S. Nickel, Prof. Dr. G. Satzger, Prof. Dr. R. Studer, Prof. Dr. Y. Sure-Vetter, Prof. Dr. C. Weinhardt
R&D activities	<p>Research at KSRI is focused on several aspects of smart service systems, with regard to Big Data organized in the three fields of Service Analytics, Service Computing and Service Operations.</p> <ul style="list-style-type: none"> ▪ In the field of Service Analytics, data extracted from (digital) service systems is analysed in order to improve, extend, and personalise service provisioning and conceive novel, data-infused business models. Furthermore, in this context business intelligence & analytics systems are specifically designed from an end-user perspective in order to help improving human decision making. Examples are situation-awareness driven design of real-time business intelligence dashboards, behavioural recommender systems and interactive analytical systems. ▪ In the field of Service Computing, semantic technologies are leveraged in business processes, in big data integration and in large-scale data management. Furthermore, cognitive and semantic technologies are adapted for industrial applications in real-time and sensor-based systems leveraging NonSQL technologies. ▪ In the field of Service Operations, machine learning, operations research as well as simulation techniques are applied to business challenges with the aim of improving operational service processes. Specific focus domains are logistics and healthcare.
R&D cooperation	<ul style="list-style-type: none"> ▪ Seoul National University, Korea (Prof. Cho, Data Mining Lab – Designing Interactive Analytics Systems) ▪ Australian National University, Australia (Prof. Shirley Gregor, Knowledge Interface Systems) ▪ Cambridge Service Alliance / Institute for Manufacturing University of Cambridge (Prof. Andy Neely) ▪ Swiss Alliance for Data-Intensive Services, Switzerland (Prof. Christoph Heitz) ▪ IBM Research, USA (Watson Research Center)
Cooperation with partners in industry	<ul style="list-style-type: none"> ▪ IBM: Extending IBM Watson NLP capabilities ▪ Bosch: Intelligent Logistics Systems ▪ ABB: Industrial Services, Industrial Site of the Future ▪ KPMG: Business Intelligence & Analytics Lab (BIAL) ▪ BASF: Supply Chain Analytics ▪ Daimler and Volkswagen: Virtual Technologies for »Industrie 4.0« / ARVIDA
Additional Information	<p>The Karlsruhe Service Research Institute at KIT is one of the leading European research institutes in the field of Service Science. Since April 2008 KSRI has fostered interdisciplinary research on digital service systems in order to support and advance the progress of the service domain. As a public-private partnership of KIT, IBM Germany and Bosch, KSRI applies an »industry-on-campus« concept and closely links academia and business.</p> <p>With the Smart Data Innovation Lab (SDIL) at KIT, KSRI is involved in an outstanding nation-wide Big Data network and platform. With partners of the SDIL, KSRI investigates processes and business models focussing on Smart Data and Data Engineering. KSRI is participating in several DFG funded projects, e.g. the SFB Cognition Guided Surgery and the graduate school Energy Status Data. The focus of this PhD school is to analyse multi-modal energy data streams from households and industry in an interdisciplinary fashion – in order to identify unexpected events. Participants develop scientific methods to improve the reliability of the future decentralised and decarbonised electricity system.</p>



4.3.16 Data Mining – Karlsruhe Institute of Technology

R&D Organisation	Karlsruhe Institute of Technology (KIT) Institute for Applied Computer Science Hermann-von-Helmholtz-Platz 1 76344 Eggenstein-Leopoldshafen www.iai.kit.edu Prof. Dr. Ralf Mikut ralf.mikut@kit.edu +49 721 608 25731
R&D activities	Recent research activities include efficient algorithms for large-scale image analysis (associated project in DFG SPP 1736 »Algorithms for Big Data«), combination of data mining and image processing as well as methods to improve interpretability in data-driven model design. Application fields include biology, chemistry, medicine (BMBF project TELMYOS for an ear-muscle-based wheelchair control; associated partner in BMBF project I-CARE for modeling activation records for people with dementia), and smart energy grids (e.g., Energy Lab 2.0, Energy Systems 2050). As an example, we demonstrated the performance of our methods using three-dimensional videos of developing fly, zebrafish and mouse embryos that were acquired using light-sheet microscopy (Figure 5). These datasets easily reach multiple terabytes per embryo and thus require fast methods for reliable quantitative analyses.
R&D cooperation	<ul style="list-style-type: none"> Howard Hughes Medical Institute, Janelia Research Campus (Keller group) and Harvard Medical School (Kokel group): Large scale image processing in biology; KIT (Sanders, Strähle, Hagenmeyer, Döpmeier, Nienhaus, Stotzka, v. Wezel groups): Algorithm design and data handling, biological and technical applications; University of Bremen (Schultz group): BMBF project I-CARE; Universities of Heidelberg and Göttingen (Rupp and Liebetanz group): BMBF project TELMYOS; St George's, University of London (Hilpert group): Antimicrobial peptides.
Cooperation with partners in industry	<ul style="list-style-type: none"> Stadtwerke Karlsruhe (analysis of energy data), Fa. Bauerfeind (analysis of movement data), AWO Karlsruhe gemeinnützige GmbH (BMBF project I-CARE)
Additional Information	Open Source Software development: MATLAB toolbox Gait-CAD, Large-scale image processing toolbox XPIWIT



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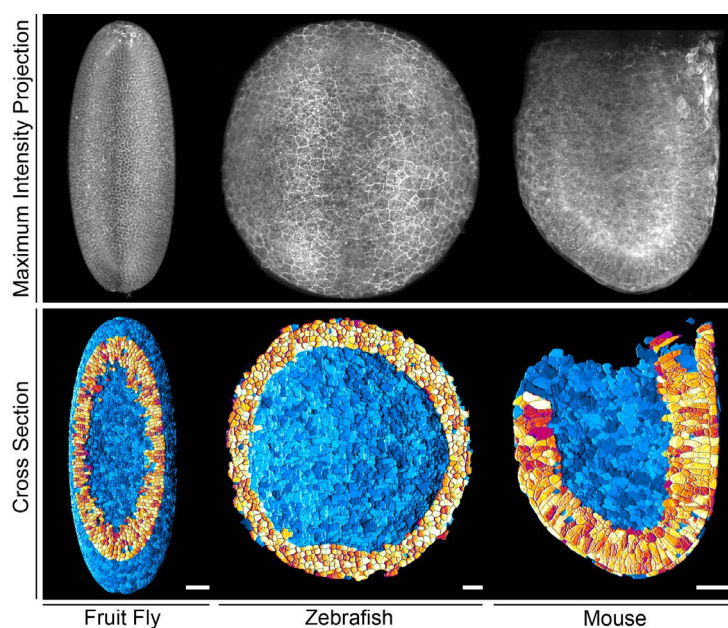
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Figure 5: Automated detection of cell membranes in light-sheet microscopy images of fruit fly, zebrafish, and mouse

4.3.17 Scalable Graph Analytics and Graph-based Business Intelligence – Universität Leipzig

R&D Organisation	Universität Leipzig Institut für Informatik Prof. Dr. E. Rahm
R&D activities	<p>Many application domains require capturing highly interconnected, heterogeneous data. Graphs are an intuitive representation of such data and graph analytics is a powerful approach to extract valuable knowledge. Graph analytics is not limited to the analysis of social networks and other kinds of networks but is a valuable approach to analyze all kinds of large volumes of interrelated data, e.g. as required for enhanced business intelligence and decision making.</p> <p>GRADOOP (Graph analytics on Hadoop) is a new scalable framework for graph analytics under development at the University of Leipzig. To allow data scientists and business analysts the declaration of complex analyses involving graphs in an easy and intuitive way, GRADOOP offers an expressive and flexible data model. Besides data management, the data model includes a wide range of analytical operators and advanced data mining algorithms. Operators as well as algorithms can be combined to complex analytical workflows and applied to different domains.</p> <p>Since many graph algorithms show an extremely high computational complexity, their efficient execution is the major challenge of graph analytics on Big Data. A common solution is to scale out data and computation across a cluster of machines. To provide such horizontal scalability out-of-the-box, GRADOOP is built on top of Apache HBase and Apache Flink, both industry-strength solutions for Big Data storage and processing.</p> <p>A major use-case is the application of graph analytics for Business Intelligence. Here, the flexible graph model allows integrating arbitrary business objects and their mutual relationships from productive business information systems. GRADOOP allows OLAP-style operations including aggregating business measures, creating topological graph summaries and extracting interesting patterns.</p> <p>Gradoop is an open-source development available under www.gradoop.org</p>
R&D cooperation	Competence Center for Scalable Data Services and Solutions ScaDS Dresden/Leipzig
Additional Information	http://dbs.uni-leipzig.de/research/projects/gradoop

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4.3.18 Machine Learning – Leuphana University of Lüneburg

R&D Organisation	Leuphana Universität Lüneburg Scharnhorststr. 1 21335 Lüneburg Machine Learning Group Prof. Dr. Ulf Brefeld brefeld@leuphana.de +49 4131 677-1663 www.leuphana.de/en/university/staff-members/ulf-brefeld.html
R&D activities	We are interested in statistical machine learning and data mining in the context of big data. A focus lies on sequential data that exhibits temporal and/or spatial dependencies. Examples are sentences, user sessions on the Web, player trajectories in computer games or team sports, competency tests. We study learning algorithms that map sequential inputs to arbitrarily complex target variables and contribute to natural language processing, recommender systems, personalization, sports analytics, and computer-based adaptive testing.
R&D cooperation	<ul style="list-style-type: none"> ▪ Leiden Institute of Advanced Computer Science (LIACS), Universiteit Leiden, Netherlands: Data mining for team sports on the example of football (soccer) ▪ FG Datenschutz und Datensicherheit, TU Dresden, Germany: Privacy and Inference ▪ Faculdade de Computação (FACOM), Universidade Federal da Mato Grosso do Sul, Brazil: Information extraction and transfer learning for natural language processing ▪ German Institute for Educational Research (DIPF), Frankfurt/Main, Germany: Computer-based adaptive testing



Cooperation with partners in industry	<ul style="list-style-type: none"> Zalando SE, Berlin, Germany: Recommender systems and personalization Universitäts- und Landesbibliothek (ULB), Darmstadt, Germany: Recommender systems and personalization
Additional Information	<ul style="list-style-type: none"> Improving formative assessments by capturing motivation with wearable sensors, together with T. Martens, O. Schneider, H. Rölke (DIPF), M. Dorochevsky (Nagarro AG), A. Ott-Kroner, K. Wuhler (Eckert Schulen, Germany) und H. Krömker (TU Ilmenau, Germany); funded by the Federal Ministry of Education and Research (BMBF), Germany Explaining competency by the usage of an electronic text book on the example of the subject history in secondary schools, together with W. Schreiber (KU Eichstätt, Germany) und U. Trautwein (Universität Tübingen, Germany), funded by Federal Ministry of Education and Research (BMBF), Germany Open-Domain Relation Extraction for Portuguese, together with E. R. Fernandes (UFMS, Brazil); funded by the Ministério da Educação (CAPES), Brazil

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4.3.19 Big Data Analytics – Bauhaus-Universität Weimar

R&D Organisation	<p>Bauhaus-Universität Weimar Big Data Analytics Bauhausstr. 11 99423 Weimar www.uni-weimar.de/medien/bigdata Juniorprof. Dr. Matthias Hagen matthias.hagen@uni-weimar.de +49 3643-58 3746</p>
R&D activities	<p>The research group Big Data Analytics at the Bauhaus-Universität Weimar is focusing on scalable data analysis and mining techniques and their interplay with research fields like visualization, retrieval and algorithm engineering. Tools and algorithms to support analytic processes in big data are developed in cooperation with experts and companies from diverse application areas.</p> <p>Within the Bauhaus-Universität Weimar, the Big Data Analytics group closely works together with the groups of Prof. Bernd Fröhlich (virtual reality and information visualization) and Prof. Benno Stein (data mining, machine learning, artificial intelligence).</p> <p>The major big data research activities of this 3-group competence team are in the fields of web search and mining (user understanding and support in search, text mining), natural language processing (argumentation, paraphrasing, authorship, text reuse), sensor data (predictive maintenance, location-based services), simulation (user behavior, physical systems), visualization (analytics results, similarities, simulation and sensor data, large models), and user interaction (2D/3D interaction metaphors).</p> <p>With the Digital Bauhaus Lab (DBL) – a new, interdisciplinary research center where computer scientists, engineers, and artists tackle major scientific and societal challenges of the information society – the Bauhaus-Universität offers a stimulating atmosphere for big data research. A technical highlight is a multi-user 3D display, the only one of its kind in the world, which is especially suited for visualizing complex spatial simulations. Among others, it will be used by computer scientists and civil engineers for collaborating on a virtual construction site. The DBL is also equipped with a 1600 cores, 2.2PB HDD cluster machine dedicated to big data problems and a high-performance cluster for engineering research.</p>
R&D cooperation	<ul style="list-style-type: none"> University of the Aegean, Universitat Politècnica de Valencia, University of Antwerp, Duquesne University (large-scale text forensics) Ural Federal University, Kontur Labs (categorizing one billion question queries)
Cooperation with partners in industry	<p>The group closely collaborates with regional companies (also many small to medium sized businesses) on different big data projects. The seven companies B-S-S Business Software Solutions GmbH, Carl Zeiss Microscopy GmbH (via the Carl-Zeiss-Stiftung), Dynardo GmbH, incowia GmbH, LEHMANN + PARTNER GmbH, match2blue Software Development GmbH, and OnCommerce GmbH are the donors of the endowed chair »Big Data Analytics« at the Bauhaus-Universität Weimar.</p>
Additional Information	<p>↗ EU project 3D-Pitoti (Prof. Fröhlich, open source point cloud rendering system)</p> <p>↗ Netspeak (Prof. Stein, web service for writing support based on three billion phrases)</p>

Bauhaus-Universität Weimar



Big Data Analytics

4.4 International Large Scale Research Project: »Earth Observation Innovation Europe« – A New Approach to Manage Big Data in Earth Observation

The European Space Agency (ESA), the European Commission and EUMETSAT, together with national Space Agencies and European Industry have been building up a large space infrastructure with dozens of satellites, which generate a continuous stream of Earth Observation data. With such data many new scientific, operational and societal needs can be addressed. This data stream now can also feed a flourishing down-stream industry, which requires various levels of data processing in order to provide an increasing diversity of products, information and services.

Driven by an expanding »Free and Open« data policy Earth Observation data has become a commodity for industry well-beyond traditional applications. Among others, large US companies, such as Google and Amazon, are building up big repositories of such data. Simultaneously, data volumes and data diversity and the demand to validate the data are increasing at a rate that is only surpassed by the need for rapid data delivery/access. In addition, heritage data from earlier missions, while considered an important asset, are still not yet fully exploited through coherent concepts for storage, long-term discoverability and valorisation. However, this is essential in addressing, for example, the challenges of Climate Change.

A Network of Earth Observation Application Platforms

The current quantum leap in the availability of Earth Observation data is further augmented by the fact that science and application projects increasingly built on a broad variety of data sources (Earth Observation and non-Earth Observation), leading to unprecedented higher-level products. Sometimes the products are also created with the help of substantial but almost »invisible« Earth Observation data contributions. At the same time, even with modern network and data handling services, fewer users can afford to bulk-download and consider all potentially relevant data. At the same time, there is a trend within and among the user communities to connect different competences, methodologies and data sets to achieve new results.

A new approach is being pursued in the Earth Observation sector for accommodating these developments and replacing the traditional one-to-one »data delivery« approach of the past. This new approach is encapsulated in two main ideas:

»Bringing the User to the Data« and »Connecting the Users«

Both ideas are aiming to better »empower the users« and to create a »sustainable system of interconnected and work environments«, with the objectives:

- to enable large scale exploitation of Earth Observation data in Europe (by large scale exploitation, one should not only consider the possibility to use a large volume and variety of data, but also the use of EO data by a larger number of users and a broader diversity of uses)

- to stimulate innovation with Earth Observation data (innovation relates to all new possibilities for data management, information and knowledge extraction summarised as the »Big Data« paradigm)
- to maximise the impact of European Earth Observation assets and to preserve European independence (a maximum of data users should be enabled to use high-quality European data for maximum benefit, without being dependent on a non-EU data sources and information systems).

Earth Observation Application Platforms, accessible through web browsers, virtual machines and other web-based interfaces, are a suitable means to address these objectives. Such platforms are virtual environments in which the users – individually or collaboratively – have access to the required data sources and processing tools, as opposed to downloading and handling the data ‘at home’. A key quality of such platforms is that they are shaped by and scalable to the needs and ambitions of users rather than by the available technology. Therefore, these platforms will be typically implemented in the »Cloud« connecting several thousand computer nodes across a network of data centres. Such platforms are intended to feature the following main functionalities:

- Data for both Earth Observation and non-Earth Observation applications
- Powerful computing resources
- Large-scale storing and archiving capabilities
- Collaborative tools for processing, data mining, data analysis
- Concurrent design and test bench functions with reference data
- High-bandwidth web-based access
- Application shops and market place functionalities
- Communication tools (social network) and documentation
- Accounting tools to manage resource utilization
- Security and privacy enforcement.

Conceptually, this approach is paving the way for an »Information as a Service« scenario (↗[Figure 6](#)). Earth Observation and non-Earth Observation data are flexibly and intelligently linked and combined by means of modern ICT services (»Infrastructure as a Service«, »Software as a Service«, »Data as a Service«, etc.) thus increasingly integrating the Earth Observation sector into the overall digital economy. The inherent challenge in such an approach is the orchestration of heterogeneous systems, data sets, processing tools, and distribution platforms leading to the creation of innovative and high-quality information services for a broad range of users.

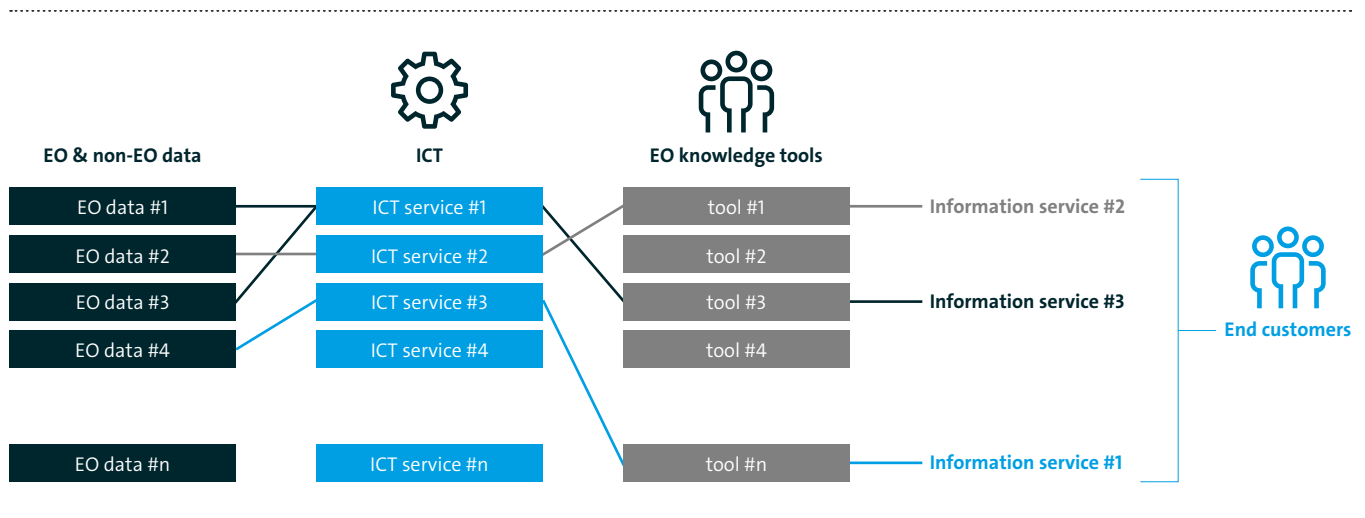


Figure 6: Model for the generation of »Information as a Service«

Existing Earth Observation platforms are often limited in interoperability and in most cases still follow a traditional requirements-driven development process rather than an evolution driven by user communities and their needs. Ideally, user communities will have access to a fully scalable IT-infrastructure enabling them to develop new business models and to introduce new applications and services. Crowdsourcing Platforms, which in some cases are already providing significant »Citizen Science« output, may provide a number of relevant pointers in this context. In the »EO Innovation Europe« scenario, each Earth Observation platform follows a particular organising principle aimed to strengthen the collaborative aspects within a particular community. The organising principles of the platforms are therefore already diverse and include:

- Thematic Exploitation Platforms (TEPs): ESA currently develops seven thematic exploitation platforms (for geo-hazards, polar, coastal environment, forestry, hydrology, urban and food-security)
- Regional/local EO Platforms, dedicated to specific geographical regions (e.g. Baltic, West Africa)
- Mission/Sensor EO Platforms (MEP): these are well suited for R&D mission communities like those of the Earth Explorers and heritage missions. A Mission Exploitation Platform is currently developed for Proba-V with the ambition to provide access to the data, computing resources and tools for data processing and analysis, including linking to other missions and new user communities.
- Technological Platforms to assess new technologies to be later rolled out to the other platforms types (e.g. ESA's G-POD platform).

The concept of platforms is already favoured by leading data and information management companies, such as SAP, and space derived data sets also include Navigation data. It is time to employ European industrial competences also in Earth Observation, Navigation (Galileo Program) and other sectors in which Europe has been building up major assets and capacities. This new approach can significantly catalyse the use of data and preserve European independence in the utilisation of modern space systems.

4.5 Joint Initiatives – Research & Industry: Big Data Innovation Center

R&D Organisation	Big Data Innovation Center http://bdic.ucc.ovgu.de bdic@ucc.ovgu.de SAP UCC Magdeburg Otto-von-Guericke University Faculty of Informatics Universitätsplatz 2 39106 Magdeburg
R&D activities	Embedded in SAP University Competence Center, the Big Data Innovation Center (BDIC) provides hardware, software and support services for Big Data research projects. The BDIC's main objective is to bring together companies and researchers for solving critical problems and building Proof-of-Concepts. The IT landscape and all of the standard services required are provided by the BDIC, which enables researchers and companies to focus on their research and not on administering complex system landscapes. We provide carefree hosted solutions including hardware, software, licenses and support as well as maintenance, monitoring, backup etc. (Figure 7) We have more than 15 years of experience in running non-profit IT services for teaching and research. More than 75.000 students and appr. 5.000 professors, lecturers and PhD students use over 450 SAP systems hosted by us for their classes and projects. We are running both physical and virtualized systems in our own certified data center to provide our customers with the solutions they need. Our experienced and highly specialized teams deliver IT solutions for every phase of your project: from IT backend over software advisory to support. Providing to you the carefree IT environment you need we enable you to focus on what matters to you – research and co-innovation.
R&D cooperation	We're currently providing SAP systems for over 450 universities, research institutions and educational organizations with more than 5.000 professors, lecturers and PhD students from Europe, the Middle East and Africa. This pool of highly trained, international researchers is continuously running numerous research and co-innovation projects with industry partners. Join us and become part of the Big Data movement.
Cooperation with partners in industry	Next to the industry partners involved with research projects, we have several strategic partners with which we've worked for a long time: <ul style="list-style-type: none"> ▪ SAP SE, founding member of the SAP University Competence Center, provides technology, licenses and enterprise grade support free-of-charge. ▪ Hewlett Packard Enterprise, founding member of the SAP University Competence Center, is the hardware partner of the BDIC and provides enterprise grade hardware for all of our research projects. ▪ T-Systems, founding member of the SAP University Competence Center, is one of the technology partners of the BDIC.

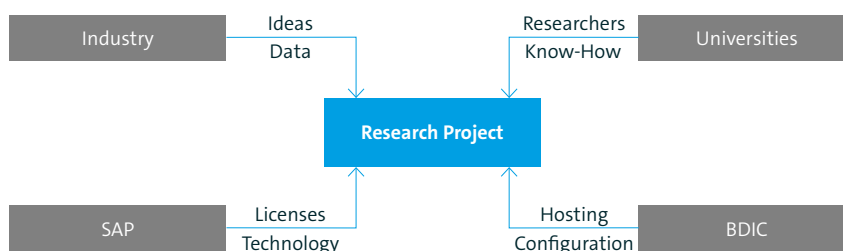


Figure 7: Big Data Innovation Center – Cooperation Model

5 Excellence in Big Data – Technology Providers

5 Excellence in Big Data – Technology Providers

This chapter highlights over 60 Big Data Providers – almost all of whom are active internationally and are committed to expanding their business in this area. From global Big Data Leaders, companies who have research and/or development activities in Germany have been included.

This overview is intended to help identify areas for collaboration between Germany and the rest of the world.

Providers are categorized according to a simple [classification scheme](#) based on Big Data Products and Services (Figure 8). Broadly speaking, we have distinguished between Consulting [1], Operations [2], Analytics Solutions [3], Visualisation & Dashboarding [4], Data Aggregation [5], Database / Data Management [6], Security Analytics [7], Appliances [8] and Storage [9]. Classification of providers is based on information provided by the individual companies.

4-Layer Model

Categories of Big Data Providers

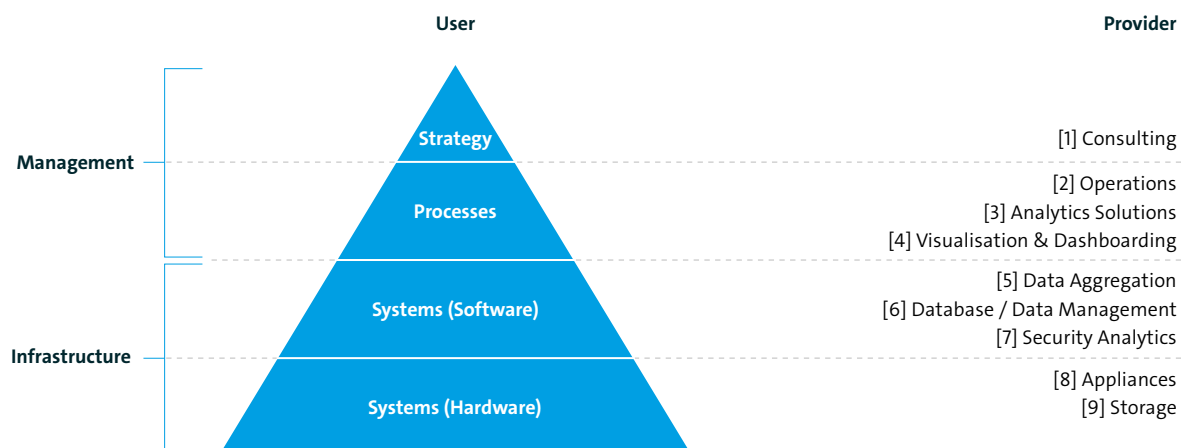


Figure 8: Categories of Big Data Provider²

² Source: Experton Group AG

Provider	Market Segments								
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Analyx									
Concline									
Kiana Systems									
PwC									
Trivadis									
Vico									
mgm									
ParStream									
#zeroG									
Continental									
Siemens Digital Factory									
dimensio informatics									
Device Insight									
IAV									
DATAlovers									
Webtrekk									
Brandwatch									
G Predictive									
Implisense									
Mapegy									
Datameer									
Here Deutschland									
RapidMiner									
Jedox									
Flinsta									
ubermetrics									
Actyx									
Averbis									
KPMG									
Sonean									
Synfio									
Parkpocket									
zeotap									

Table: Big Data Providers and their Portfolio – Overview

5.1 Accenture – End-to-end Big Data and Advanced Analytics [1]-[9]

Company	Accenture GmbH Campus Kronberg 1 61476 Kronberg im Taunus www.accenture.com Lukas Feuerstein Lukas.Feuerstein@accenture.com
Employees	Worldwide: 373,000 Austria, Germany, Switzerland (ASG/DACH) region: 7,000
Characteristics	<ul style="list-style-type: none"> Accenture is a leading global professional services company, providing a broad range of services and solutions in strategy, consulting, digital, technology and operations. Accenture Analytics part of Accenture Digital is our leading, global, end-to-end Big Data & Advanced Analytics capability, fuelling industry-relevant, transformational change to help our clients become value-led, insight-powered enterprises. We have a deep talent bench with Big Data Practitioners and experienced Data Scientists. We continue to demonstrate a strong commitment to analytics innovation with more than 23 Accenture Innovation Centers including 5 focused on advanced analytics. Accenture has alliances with 100+ technology market leaders. To address this we provide clients with a broad range of services including analytics strategy, business intelligence, big data, advanced analytics, data management & integration, cognitive computing and machine learning. Our portfolio includes also solutions for customer and marketing analytics, operations analytics (IoT, supply chain and logistics), risk and fraud analytics, HR analytics, finance and enterprise analytics, security analytics, visual analytics complemented with various Big Data and Analytics platforms on premise, in cloud and integrated with appliances to help our clients to become high performance insight-driven businesses.
Customer needs	<p>We are seeing the market undergo tremendous change – going through a fundamental shift away from traditional BI towards big data and advanced analytics.</p> <ul style="list-style-type: none"> Democratization of data: Increased focus on enabling decision-makers throughout an organization to independently explore and analyze data/insights; »need-it-now« in the channel-of-choice. Data discovery and visualization: Business users are demanding more flexibility in exploring insights (vs. standard reports); increased focus on advanced visualization; better identification of complex trends and faster decision making. Focus on advanced analytics: Organizational needs are shifting from structured reporting (»what happened«) to predictive insights (»what will happen«). Big data and hybrid architectures: Complex analytics needs require Big Data to work hand-in-hand with traditional architecture; hybrid is the new reality. Changing skills requirements: Given the above trends, new and more complete skill-sets are being demanded from analytics professionals – a combination of business, data science, visual aptitude, technology and other skills.
Big Data offerings	<p>We provide clients with a broad range of services while our capabilities continue to be unique in the following key ways:</p> <ul style="list-style-type: none"> Asset-Powered: Through our innovative and industrialized analytics platforms, we help clients solve their business problems quickly and create competitive advantage. The Accenture Insights Platform (AIP) is a comprehensive and scalable solution that allows organizations to get actionable insights and business outcomes quickly with a competitive, flexible commercial model. The platform offers various storage possibilities in the cloud, on premise or integrated with appliances, combined with leading edge integration pattern for real-time and sensor data – to generate insights. On top of that, AIP hosts an advanced analytics design studio, an integrated design, build, run studio environment enabling the agile development of industry and function-specific analytics solutions. To help organizations continuously predict, detect and combat cyber-attacks, we have differentiated security offerings that can be embedded in all of our products or services. For example, the Accenture Cyber Intelligence Platform combines artificial intelligence, cloud and analytic services to provide behavioral intelligence on demand, at speed and at scale to help organizations identify never before seen, network-born cyber threats. Industry Led: Our view of analytics is uniquely tied to industry and we have built industry-specific analytics solutions and capabilities across key areas of our business. We have developed industry-specific value frameworks that help identify areas in which big data analytics will add the most value, and high performance industry blueprints,



	<ul style="list-style-type: none"> ▪ Industrialized Capability: We have deep functional, business process and technical experience which enables us to develop an industrialized capability. We use our global delivery network (GDN), business process outsourcing (BPO) and innovation network to bring our clients value at speed.
Big Data	<p>In organizations that are using big data today, users report overwhelming satisfaction with their results, according to a Accenture Analytics survey ↗Big success from Big Data, and see big data as a catalyst for their transformation as digital enterprises.</p> <p>Users that have completed at least one project are very satisfied with their initial forays into big data. The vast majority who have completed their projects report that they are satisfied with their initial forays into big data. The vast majority who have completed their projects report that they are satisfied with business outcomes and that their big data initiative is meeting their needs. While a significant number of organizations may still be standing on the sidelines, big data users who start and complete projects see practical results and significant value. Organizations perceive big data to be critical for a wide spectrum of strategic corporate goals, from new revenue generation and new market development to enhancing the customer experience and improving enterprise-wide performance. The cumulative effect of introducing big data technologies and practices into the enterprise results in transformational change.</p>
Innovation	<p>We build innovation into everything we do. Accenture has demonstrated a commitment to analytics innovation for more than 20 years. Accenture Analytics relies on several channels to continually innovate including the Accenture Innovation Centers, academic alliances, the Accenture Connected Analytics Experience (ACAX), the Accenture Technology Labs and the Accenture Open Innovation Program, to name a few. ACAX is an immersive and collaborative analytics environment that helps insight-driven businesses to make faster, more informed decisions. In addition to our significant academic alliance with the Massachusetts Institute of Technology (MIT) Sloan School of Management and the School of Engineering, we have many other academic alliances – for example, with ESSEC (École Supérieure des Sciences Économiques et Commerciales), the Stevens Institute of Technology and Duke University.</p>
Benefit	<p>Big Data adds business value to our customers within in the following key areas.</p> <ul style="list-style-type: none"> ▪ Save costs for storing and processing big amount of data. One large national agency at a European government was experiencing slowdowns in utilization, cancelled queries and storage limitations. After implementing a new solution for big data processing, storage requirements fell by 90 percent, Total Cost of Operations (TCO) dropped, and previously impossible statistical analysis is now routine. ▪ Increase efficiencies: in processing big amount of data faster and in real time. A leading North American financial institution has already seen the transformative effects of big data play out in several areas of its operations: As multiple online banking applications struggled to perform real-time analysis on incoming data, a new Big Data architecture was implemented that will seamlessly scale as volume continues to grow. ▪ Customer intimacy: Improve understanding of the Customer to personalize the customer experience and generate new up- and cross sell opportunities. A leading B2C e-commerce portal in China has mobilized a global team of experts in machine learning, analytics and big data across Asia, Europe and the United States to derive insights from its online volume that will drive customer purchase recommendations. ▪ Generate new revenue: revenue through data monetization or value added services. For example, Precision Market Insights from Verizon generates analytics-driven behavioral insights based on mobile engagement, location and demographics information, creating a 360-degree view of the consumer. For outdoor advertisers such insights can measure the effectiveness of outdoor advertising units.
Countries and customers	<p>Accenture has a global focus and serves clients in more than 120 countries. We serve more than 80% of the FORTUNE Global 500 and 94 of the top 100. We also continue to build strong and enduring client relationships. All of our top 100 clients have been clients for at least five years, and 97 have been clients for at least 10 4years.</p>
Additional Information	<p>Accenture is continuing to invest in digital technologies in Germany and plans to ramp up headcount for Analytics, IoT and Big Data in Germany to 500 people. To drive innovation and differentiate with Big Data Analytics, Accenture invested more than €50 Million in the German region for example with the Accenture Future Camp or the Analytics Center of Excellence (CoE) in Kornberg. On top of that Accenture is also committed to various academic research cooperation's such as the Big Data Lab at Goethe University Frankfurt), to local startup ecosystems and platforms such as TedX Datanaut Contest and to build strong relationships to local partners such as SAP, Cloudera and SAS.</p>

In June 2016, Accenture opened up the Future Camp to develop new digital and data-driven prototypes that turn tomorrow into today. In a creative »Workshop« environment with cutting edge tools, top experts enable co-workers and clients to realize fresh ideas and solve specific questions with Design Thinking approaches. In the »Werkstatt« industry specific showcases, demos and digital tools to inspire and support the creative process towards customized solutions to make prototypes tangible.

In addition, Accenture has also established the Analytics Center of Excellence (CoE) in Kronberg. This center combines the power of our data science and big data talent, world-class platforms such as Accenture Insights Platform (AIP), the advanced analytics design studio and represents the »New Wave of Analytics« in the German market. Accenture teams work there together with industry practitioners, designers, software partners, universities, startups and our clients in an immersive environment- the Accenture Connected Analytics Experience (ACAX) – to develop innovative solutions based on data analytics capabilities and advanced visualization techniques. In the Kronberg center, Accenture has built innovative solutions for connected truck, smart customer targeting, predictive maintenance, next best action and IoT for our clients in a matter of a few weeks.

5.2 Atos Germany – E2E Big Data & Analytics Services [1]-[9]

Company	Atos Germany Otto-Hahn-Ring 6 81739 Munich de.atos.net Stefan Pieper stefan.pieper@atos.net +49 178 4686875
Employees	Worldwide: Approximately 100,000 Germany: Approximately 12,000
Characteristics	<ul style="list-style-type: none"> ▪ Provider of digital services ▪ Cross market provider of end-to-end big data & analytics services (consulting, labs, use cases, platform, appliance) called »Atos Codex«
Customer needs	In the digital transformation the customers facing four general challenges: Improving the customer experience, reinvent business models, increase the operational excellence and ensure trust & compliance.
Big Data offerings	Atos Codex is our solution brand for all data analytics related offerings as it provides data analytics end-to-end along the complete IT value chain. <ul style="list-style-type: none"> ▪ Consulting (Methodology & Data Science for data-driven organizations) ▪ Agile Labs & unique co-innovation programs ▪ Ready to deploy use cases to build best-in-class business solutions ▪ Industrialized platforms for leading TCO, agility & security ▪ High-Performance Computing via Bull Computing
Big Data	Using the standardized and preconfigured Atos Codex analytics platform reduces costs by 30-50%. The benefits of Atos Codex solutions depend on the concrete use case.
Innovation	<ul style="list-style-type: none"> ▪ Atos Codex is based on a preconfigured analytics platform plus a set of use cases developed as part of the joint investment program with Siemens. Especially for customers in the industry sector both companies developed a platform solution called Sinalytics. ▪ Atos Codex is also based the development of the Bull sequana Supercomputers by Atos – as a first exascale-class computer, Bull sequana is capable of processing a billion billion operations.
Benefit	Two examples for the business benefit of analytics services: <ul style="list-style-type: none"> ▪ Example 1: Reduce food waste for supermarkets – using predictive analytics to forecast demand to reduce overstock for superfluous supply by 98 percent. ▪ Example 2: Reduce service costs for wind farms. Predictive maintenance reduces service costs by up to 20 percent.
Prospects	http://atos.net/en-us/home/we-are/news/press-release/2016/pr-2016_04_07_01.html
Governmental R&D promotion programmes	EU-funded program: RepAIR – Future RepAIR and Maintenance for Aerospace industry: http://www.rep-air.eu/ German federal government funded program: GEMINI 4.0 – business models for Industrie 4.0.



Countries and customers	Atos operates in 72 countries; references are available from all over the world.
Future markets	We aim at strengthening our footprint in North America, among others.

5.3 Capgemini – Business Data Lake [1]-[9]

Company	Capgemini Potsdamer Platz 5 10785 Berlin www.de.capgemini.com/ <ul style="list-style-type: none"> ▪ Fabian Schladitz fabian.schladitz@capgemini.com ▪ Rüdiger Eberlein ruediger.eberlein@capgemini.com
Employees	Worldwide: >180,000 Germany and Central Europe: >10,000
Characteristics	<ul style="list-style-type: none"> ▪ Full service provider: business and technology consulting, solution implementation, Platform-as-a-Service, Insights-as-a-Service ▪ Technology: Hadoop, Spark, SAP HANA, IBM Watson, Oracle Big Data, Tableau, Qlik, R and others ▪ Industries: automotive, manufacturing, telecommunications, financial services, retail, logistics and transport, public
Customer needs	<ul style="list-style-type: none"> ▪ Meet the need for speed: In today's hypercompetitive business environment, companies need to find and analyze decision relevant data quickly. The challenge is going through the sheer volumes of data and accessing the required level of detail, all at a high speed. ▪ Understand the data: It takes a lot of understanding to get data in the right shape so that you can use visualization as part of data analysis. Without some sort of context, visualization tools are likely to be of less value to the user. ▪ Address data quality: The value of data for decision-making purposes will be jeopardized if the data is not accurate or timely. When considering the volumes of information involved in big data projects, it becomes even more pronounced. ▪ Display meaningful results: Plotting points on a graph for analysis becomes difficult when dealing with extremely large amounts of information or a variety of categories of information. ▪ Deal with outliers: The graphical representations of data made possible by visualization can communicate trends and outliers much faster than tables containing numbers and text. Users can easily spot issues that need attention simply by glancing at a chart.
Big Data offerings	<ul style="list-style-type: none"> ▪ Business Data Lake: allows to store all kind of data from both within the enterprise and outside of it and delivers business insight at the point of action where and when it is needed. ▪ HortonWorks: powers modern data architectures by enabling Hadoop to be an enterprise data platform that deeply integrates with data center technologies. ▪ Cloudera: supplies the industry's leading Hadoop distribution as well as a comprehensive set of tools and services to effectively operate Hadoop as a critical part of a technology infrastructure.
Big Data	<p>Big Data has strategic importance and requires special focus and attention during its adoption because technology to support Big Data is evolving rapidly. Effective utilization of Big Data requires a change in mindset regarding the way it is used. The challenge of Big Data is to handle the 3 V's: Volume, Velocity and Variety. The shift from structured to unstructured data has primarily been driven by the advent of social media etc.</p> <p>Capgemini has strategic alliances and partnerships with major vendors, for instance Pivotal, Hortonworks, Cloudera, Informatica, IBM, SAS and others. Some of the key analytics platforms are IBM BigInsights, Hortonworks Predictive Analytics, SAS Visual Analytics etc.</p>
Innovation	<ul style="list-style-type: none"> ▪ Data Warehouse Optimization ▪ Business Data Lake ▪ Targeted web pages and products ▪ Next best action ▪ Real-time offers ▪ Low latency event data ▪ Data Monetization ▪ New Revenue Streams



	<p>We leverage >1000 man hours of key learnings from our R&D and existing Big data delivery projects to enhance our solutions, best practices etc.</p> <p>Big Data Workforce</p> <ul style="list-style-type: none"> ▪ 300+ trained Big Data Practitioners ▪ Big Data Global Enablement by BIM LnD Academy ▪ Boot camps – IBM BigInsights, Pivotal, Splunk, Cloudera ▪ Building expertise via Mentorship, Research and Exploration initiatives <p>Key Offering</p> <ul style="list-style-type: none"> ▪ Broad range of solutions that enable organizations uncover significant value from their data ▪ Joint GTM offerings with key vendors such as Pivotal, Cloudera, HortonWorks etc.
Benefit	<ul style="list-style-type: none"> ▪ Strategic Value & Differentiation: Data Monetization ▪ Scale, Variability and Flexibility: Data Lakes ▪ Personalization & Intimacy: Data Science ▪ Speed and Responsiveness: Data Streams
Prospects	<ul style="list-style-type: none"> ▪ More information about all Capgemini Big Data solutions under: ▪ Insights & Data Worldwide: www.capgemini.com/insights-data ▪ Insights and Data Germany: www.de.capgemini.com/insights-data
Countries and customers	<ul style="list-style-type: none"> ▪ Germany, UK, France, Netherlands, USA and others ▪ Lufthansa Cargo, German Automotive OEM's, German telecommunication provider ▪ Leading Global Beverage Company, Ahold, BC Hydro, HMRC, Maharashtra Sales Tax, Network Rail and others
Future markets	NA, Europe, APAC, ANZ

5.4 Deutsche Telekom – a Telco Approach: Big Data Solutions and Services for B2B [1]-[9]

Company	Deutsche Telekom AG Friedrich-Ebert-Allee 140 Bonn www.telekom.com Contact: Dr. Susan Wegner Deutsche Telekom AG T-Labs (Research & Development) VP Smart Data Analytics & Communication wegners@telekom.de
Employees	Worldwide: 225,243 Germany: 68,754 (end of 2015)
Characteristics	Deutsche Telekom (DT) offers mobile and fixed line telecommunication, Internet, television as well as over the top services such as E-Mail, Cloud and Security for individual consumers and business customers. Our DT priorities in the field of Big Data are: <ul style="list-style-type: none"> ▪ Make use of Big Data technologies to advance DT's core business models. ▪ To address emerging customer needs by developing new data driven products and services to exploit long term business opportunities. ▪ Offering Big Data as a Service for other industries (e.g. Automotive, Manufacturing, Health).
Customer needs	One of the main roles of the Big Data at DT is improvement and optimization of internal services. Big Data helps us to tackle the challenge offering expected premium quality to our customers. This is achieved, among others, through an advanced knowledge of the customer base. Additionally, Business Customers beyond DT's core business, expect end to end system integration of state-of-the-art Big Data products with highest reliability and trustworthiness.
Big Data offerings	Core Business: Automated analysis of customer's comments with means of sentiment analysis. Predictive Services anticipating customer's needs to improve products and services. New data driven products: Statistical evaluation of traffic and movement streams in the mobile network to advance city planning, emergency management and network capacity planning. Big Data services for B2B: Integrated cloud based Big Data & Smart Analytics offerings for different industry sectors such as automotive, M2M.
Big Data	Big Data technologies offer an opportunity to perform tasks with tremendous efficiency in comparison with classical BI. Since the Volume of data could be dispersed over different clusters, analytics tasks could be paralyzed via the MapReduce paradigm. As the result new use cases could be implemented (e. g. real-time fraud detection, prediction of the influence of weather conditions on network quality); the old tasks could be performed with a higher efficiency (e.g. Network rollout optimization) and much faster speed. A rather new Big Data concept, which is addressing Velocity and Variety, is the development of a Data Lake. The aim is to centralize structured and unstructured Data in a way that new and unexpected customer insights can be generated with queries that run only against the Data Lake and not against different Data silos, that ensure much higher speed in getting the end results in comparison with classical BI.
Innovation	Motionlogic (p. 97) is a spin-off from the R&D Unit of DT that analyses traffic and movement streams based on anonymous signalling data from the mobile communication and WiFi network. In a financially viable way, it gives answers to questions that previously couldn't be analysed or that were could very expensive to obtain. One of the research projects of Telekom Innovation Laboratories in the area of Big Data is Synthetic Data. The solution identifies patterns in real data using Machine Learning and used it as 'baking forms' to create new artificial (synthetic) data sets with statistically similar characteristics, while ensuring absolute data privacy and security. To encourage Big Data innovation, DT initiated Data Lab under the umbrella of Telekom Innovation Laboratories. Data Lab offers to every unit in the company worldwide, access to a cloud based Big Data environment, and support in different kinds of Innovation Workshops as well as access to DT's mature knowledge base accumulated over the years.
Benefit	At DT Big Data enables new revenues sources through – advance of internal offerings; by developing new data driven solutions for our business customers; and by offering Big Data solutions as a service. Big Data technologies also encourage cost saving by efficiently optimizing business processes and enabling process innovations.
Countries and customers	Worldwide



5.5 Fritz & Macziol – Full-Service Portfolio [1]-[9]

Company	FRITZ & MACZIOL Software und Computervertrieb GmbH Hoervelsinger Weg 17 89081 Ulm www.fum.de/en Philipp Ripkens Marketing Manager Analytics and Data pripkens@fum.de
Employees	800 (in Germany)
Characteristics	Fritz & Macziol GmbH (F&M) with its headquarters in Ulm is a manufacturer-independent IT house with a full-service portfolio consisting of consulting, services, software, hardware and IT operation. Among its top partners are companies like Cisco, EMC, HPE, IBM, Microsoft, SAP as well as other leading manufacturers. Apart from traditional IT, the strategic value drivers such as Cloud, Mobility, Business Analytics and Industry 4.0 are some of the core competences of the company. According to an integrative approach, F&M specialists support customers to use technologies and applications exactly as needed, to optimize their processes and to successfully implement their digital corporate strategies.
Customer needs	<ul style="list-style-type: none"> ▪ New analysis methods and technologies for better customer service, e.g. marketing, sales, call center etc. ▪ Digitalization of the manufacturing process, connection of machine data, analysis and optimization of manufacturing processes, waste reduction, QM, efficiency increase, optimization of energy costs ▪ New agility in decision processes, fast decision making based on bigger and more heterogeneous data ▪ Emancipation of departments, sandboxes and analytics-as-self-service
Big Data offerings	<ul style="list-style-type: none"> ▪ Data scientist offerings, advanced analytics with statistical methods, text mining cognitive analyses (R Studio, SPARK, IBM SPSS, IBM Watson) ▪ Connection and analysis of audio- (phone, call center) data, video-, text- (mail) and internet data (twitter, facebook etc.), production data (e.g. sensors) ▪ Implementation of holistic IoT / industry 4.0 solutions in collaboration with our associate company Actemium, which is specialized in manufacturing technology and networking of production machines ▪ Implementation of data lake solutions as platform for structured, semi-structured and non-structured data based on hadoop technology (open data platform, Spark, IBM BigInsights, Hortonworks, EMC Pivotal)
Big Data	<ul style="list-style-type: none"> ▪ Common ability to analyze throughout heterogeneous data sources
Innovation	<ul style="list-style-type: none"> ▪ We consult manufacturer independently and generate the best results for our customers. ▪ We generate quick results, due to manufacturer independence. ▪ We capitalize on open source. ▪ We analyze the content of contact center data.
Benefit	<ul style="list-style-type: none"> ▪ Cost reduction, higher customer satisfaction due to optimized service
Countries and customers	<ul style="list-style-type: none"> ▪ Strong focus on the German market, customers spread across all industries, e.g. banking, financial markets, communications, media/entertainment, energy/utilities, healthcare, industrial products, insurance; public: government, education, retail, consumer products & services, travel/transportation

FRITZ & MACZIOL

Member of the **axians** ICT network

5.6 LC Systems GmbH – Data Analytics Solutions and Services [1]-[9]



Company	LC Systems GmbH Landsberger Straße 302 80687 Munich www.lcsystems.de Ulrich Barnewitz Director Operation & Sales ulrich.barnewitz@lcsystems.de +49 89 90405162
Employees	Worldwide: >80
Characteristics	As an innovative Swiss company operating on a global scale, LC Systems has offered for more than 25 years high-quality data center solutions along with comprehensive, well established services in the area of data analytics for every industry and for every stage in the value-added chain: from consulting, to implementation and advanced development through to managed services. LC Systems Germany is an independent subsidiary with consistently focus on data analytics solutions and services.
Customer needs	Consulting – We receive the requirements from specialist departments, structure them and develop concepts of how the requirements can be implemented professionally. Our strength lies in our ability to not only create a logical connection between the specialist departments, the applications and the data, but also to verify it together with experts in the field. Implementation – Our strength where realization is concerned is that we implement projects with our own long-standing consultants. Top priority is given to meeting the stated objectives, both where content and price are concerned. Operation – The »new« big data platforms have shown us that new operational requirements are present in the market. LC Systems has responded accordingly and offers customer-oriented services, especially in this area. It also knows how to reflect the platforms' unique in the services in a timely manner.
Big Data offerings	Splunk, Prelert, Elasticsearch, Hadoop
Big Data	The most important realization relating to big data is that you should only process data if the resulting findings meet the requirements of the customer's business case. At no time is it sensible to collect data and stockpile data. We support our customers in the big data environment, from application to the solution, supported by the corresponding business cases. Nowadays, we process everything from small data quantities of several gigabytes per day to large quantities of data totaling double-digit amounts of terabytes per day, making it possible to analyze and facilitate business processes.
Innovation	LC Systems primarily focuses on unstructured data in the big data environment. Some of our innovative solutions which can be implemented in a timely manner include analyzing this data and correlating it with existing structured data via modern interfaces, both for search purposes and for further processing, for example to issue an alert on reports or corresponding dashboards. Information on social media and the IoT relating to many different devices, in-house data and external data are becoming an increasingly important foundation for innovative corporate governance.
Benefit	Results and findings are made available to the relevant departments which process this data in their »own language« and at their »level of understanding«, even though actual information (e.g. Twitter feed, application log, etc.) would not be able to be read or evaluated as a source of information. The information is provided in real time, and comprehensive roll concepts enable the required level of data protection to be complied with at all times.
Countries and customers	Germany / Austria: Amadeus, Telefónica, Otto, Datev, Rohde & Schwarz, Axel Springer, Alcatel etc. Switzerland: Swisslos, Swisscom, PostFinance, Credit Suisse, Novartis Pharma etc.

5.7 Robotron Datenbank-Software – End-to-End IoT-Solution Development [1]-[9]

Company	Robotron Datenbank-Software GmbH Stuttgarter Str. 29 01189 Dresden www.robotron.de Dr. Uwe Wieland uwe.wieland@robotron.de +49 351 258592446
Employees	374 Robotron Group 467
Characteristics	Robotron is a software vendor for high-performance industry solutions and offers products, solutions and services for the utility sector, public administration and industry. We cover the entire software-lifecycle starting with the first idea to the final support of the process. Within the IoT context we provide end-to-end big data and analytics services based on Azure IoT Suite, Splunk, R and own products. Our services are including business consulting, solution design, technical concepts and proof of values, the realization of individual software solutions, implementation support and system set-up on-premise and in the cloud. Due to extensive experience and many years of industry knowledge Robotron offers its customers technical solutions know-how as well as advisory and coaching services.
Customer needs	Manufacturing companies are consistently facing shorter product life cycles, constantly growing quality requirements and a high competition. Therefore, data integration, flexible structures and processes as well as standardized data for quick decisions are needed to change from reactive to proactive processes to increase the operational excellence and ensure trust & compliance.
Big Data offerings	As consulting company with a focus on »Data-driven process optimization« we support companies to improve business processes and industrial processes on shop floor: <ul style="list-style-type: none"> ▪ Providing advisory and coaching services ▪ Realizing proof of concepts for their business context and creating new business models ▪ Designing and building big data solution architectures. ▪ Integrating heterogeneous data ▪ Creating real time dashboards and overviews for real time decision making <ul style="list-style-type: none"> ▪ Global Asset Management of heterogeneous equipment ▪ Energy Analytics ▪ Condition Monitoring and Predictive Maintenance ▪ Cycle-Time Analytics ▪ Quality Analytics ▪ Supporting in day-to-day business via managed Service/operational excellence
Big Data	The pure volume, the variety and data sources entails rising requirements of data analysis and data integration methods in real time for improving processes and developing new business models. Therefore new technologies including hybrid and cloud scenarios are necessary to be implemented. With our platform approach we can improve the sustainability, stability and security of industrial processes to enhance high cost savings.
Innovation	We have successfully established unique selling propositions in the analysis of technical and business processes and related heterogeneous equipment. We have own solutions and products for analytical optimization of production processes including forecasting software and time series analysis. Furthermore, we have specialized knowledge in advanced energy analysis of production processes and in pro-active service intelligence of complex, production-related equipment and IT systems. Another innovation is our new coaching approach with workshop and practical hands-on elements to enable your work force for Industrial Internet of Things.
Benefit	Quality improvements (increase of output), cost reductions through optimization and prediction, scalability through modern architectures, security along the value chain
Prospects	https://www.robotron.de/industrie/index.html
Countries and customers	Robotron operates within the EU and Russia, our customers range from global players to mid-market companies with a focus on OEMs, suppliers and utilities.

robotron
datenbank-software

5.8 T-Systems – End-to-End Service Provider [1]-[7][9]



Company	<p>T-Systems International GmbH Hahnstraße 43b 60528 Frankfurt www.t-systems.de www.t-systems.com With a footprint in more than 20 countries, 46,000 employees, and external revenue of 7.1 billion € (2015), T-Systems is one of the world's leading ICT providers. T-Systems offers a range of integrated solutions for business customers, including the secure operation of legacy systems and classic ICT services, the transformation to cloud-based services (including tailored infrastructure, platforms and software) as well as new business models and innovation projects for the business fields of the future, such as data analytics, the Internet of Things, M2M and Industrial Internet. T-Systems can provide all this thanks to its global reach in fixed-network and mobile communications, its highly secure data centers, a comprehensive cloud ecosystem built around standardized platforms and global partnerships, and the ability to offer top levels of security.</p>
Characteristics	<p>T-Systems is an End-to-End Service Provider with a complete value chain designing, implementing, running and continually optimizing the best custom-made Big Data architecture derived from multiple components and vendors. The provided technology stack covers all Big Data components and combines Infrastructure, Data Management, Data Access, Analytics, Visualization, Data Integration, and Governance & Security. T-Systems is the leading provider of first-class telecommunication infrastructure for Big Data solutions. Even Information Provisioning, which is the prerequisite for data-driven business models, is a key component of T-Systems Big Data approach. Due to its high competency in cloud computing, T-Systems has a focus on the provisioning and operation of innovative, cloud-based Big Data platforms and analytic solutions.</p>
Customer needs	<ul style="list-style-type: none"> ▪ Handling the large amount and various formats of data generated by machines, processes, and humans in real-time. ▪ The flexible implementation of integral Big Data solutions based on standardized modules. ▪ The new data world presents added security issues that put companies at greater risk.
Big Data offerings	<p>T-Systems utilizes its best of breed Big Data partner network to improve each component in a Big Data environment. The best technologies are provided according to the customer individual demand. The partners are leading Big Data vendors like: Cloudera, Hortonworks, SAS, Dell, Microsoft and many others. Selected Big Data offerings are:</p> <ul style="list-style-type: none"> ▪ Integrated Big Data solutions: Design, implementation, and operation of standardized Big Data solutions that cover the complete Big Data technology stack from network, infrastructure, platform up to analytics and visualization components. ▪ Platforms of the complete Hadoop Ecosystem: <ul style="list-style-type: none"> ▪ Dedicated Hadoop: Dedicated Big Data Hadoop platform in various package sizes and performance clusters. ▪ Dynamic Hadoop: Scalable Big Data platform in various package sizes and performance clusters. ▪ vCloud Hadoop: Flexible Big Data platform based on VMware. ▪ Azure: Big Data solutions based on the Microsoft Azure platform. ▪ HANA Platforms: <ul style="list-style-type: none"> ▪ Classic Services for SAP HANA: Dedicated HANA platform in various package sizes ▪ Dynamic Services for SAP HANA®: Scalable HANA platform in various package sizes. ▪ S/4HANA: Flexible cloud-based HANA platform. ▪ Smart Data Federation: Connection of HANA, Sybase IQ, Sybase ASE, and Hadoop to provide always the best platform according to the demand. ▪ Big Data Analytics: Various Big Data analytic and visualization components according to the individual customer demands. Operation of SAS Big Data Lab and SAS Visual Analytics on T-Systems' Big Data platforms. ▪ Data Driven Business Models: T-Systems supports solutions for data-driven business models. Focus areas for data-driven business models are: geo-analytics, mobility analytics, mobile targeting, media analytics, and financial institutions.
Big Data	<p>The complete Big Data offering is designed to cover typical Big Data challenges:</p> <ul style="list-style-type: none"> ▪ Velocity: The utilization of HANA based platforms and in-memory based analytic solutions allows the processing and analysis of data in a fraction of time (<ms).

	<ul style="list-style-type: none"> ▪ Variety: The utilization of Hadoop platforms allows the aggregation and management of unstructured data and data files with various formats. ▪ Volume: The utilization of Hadoop platforms allows the management of large data volumes. Databases with extremely large volumes (> 100 TB) are already managed. The management of mega platforms (> PB) is possible.
Innovation	<p>T-Systems is well-known for fully integrated, first-class Big Data solutions. T-Systems offering differentiates to most competitors by:</p> <ul style="list-style-type: none"> ▪ Providing and running a complete, but scalable and performant e2e Hadoop platform including all components of the Big Data ecosystem. ▪ T-Systems has established a production network to enable the efficient on-boarding and flexible up-/down-scaling of Dynamic Hadoop Resources and additional Big Data components according to the customer demand. ▪ Highest security features and reliable SLAs for the operation of Hadoop solutions. ▪ Telecommunication Network: T-Systems is the leading provider of first-class telecommunication infrastructure to ensure the connection of various data sources with Big Data platforms. ▪ The T-Systems Big Data platforms and solutions are a prerequisite of innovative T-Systems offerings like Industry 4.0 and solutions for the digitization of business and society. ▪ E-Mobility: A SAP HANA based solution for the digital transformation of enterprises. Data flows via sensors into the SAP HANA systems in the T-Systems cloud and provides key information about the current environment. The solution allows condition monitoring in real-time. ▪ Un-Outsourcer: With its new Un-outsourcer offering, T-Systems provides customers a flexible and results-oriented contract model for SAP services. A contract can be terminated at short notice. ▪ Close cooperation with T-Labs (Deutsche Telekom R&D Group) ensures the design and development of innovative Big Data solutions.
Benefit	<ul style="list-style-type: none"> ▪ Business Optimization: The design and development of individual, but highly standardized best-of-breed Big Data solutions allow the aggregation and analysis of complete business processes and new external data sources. The tapping of these new data sources is the foundation for generating new business insights and with that the optimization of business processes. ▪ Cutting costs: The highly standardized utilization of Big Data platforms and solutions allows the replacement or at least augmentation of existing data management solutions too significantly lower costs. ▪ New Business models: The tapping and refining of new data based on innovative Big Data platforms allow completely new insights and business models.
Prospects	<ul style="list-style-type: none"> ▪ Big Analytics for Small Data (AppAgile): Utilization of Big Data technologies for small data volumes with the possibility to flexible scale-up regarding data volume, data variety, and velocity. ▪ Data Lake: Utilization and extension of Big Data platforms for tapping and managing new and large data sources to set-up data lakes as integral and company-wide data lake. ▪ M2M Analytics: Design and development of analytic solutions with the focus on analyzing machine data for predictive analytics (prediction models).
Countries and customers	Worldwide, footprint in more than 20 countries
Future markets	T-Systems grows and goes with its customers. If new customers extend their Big Data solution to other international subsidiaries or if customers are going to set-up Big Data solutions in other countries T-Systems is able to provide and operate the required resources and solutions.

An excerpt of T-Systems customers

HAUFE.Gruppe



5.9]init[– Full-Service Provider for Internet and IT Projects [1]-[7]

Company	<p>]init[Köpenicker Straße 9 10997 Berlin www.init.de Contact: Cindy Fromm Cindy.Fromm@init.de +49 30 97006 187</p>
Employees	Worldwide: 350 Germany: 300
Characteristics	<p>]init[AG for digital communications is one of Germany's leading full-service providers for internet and IT projects. The owner-run company employs over 350 people worldwide in the online communication, IT services and data centre sectors.</p> <p>Since being founded in 1995,]init[has carried out projects for more than 500 organizations and brands from the public, business/industrial, financial and foundation/association sectors. Our Big Data range is mainly aimed at the public sector, mobility sector and financial sector.</p>
Customer needs	<p>Although Big Data is already used in business to make processes more effective, make informed decisions and create new business models, applications are still limited in security-sensitive sectors such as the public sector and financial sector. This is where our experience of over 20 years as a service provider for the public sector and the financial sector comes in and we advise you about possible uses against the backdrop of increased security needs and stringent data protection requirements.</p>
Big Data offerings	<ul style="list-style-type: none"> ▪ Consultancy, conception and requirements management: <ul style="list-style-type: none"> ▪ Architectures for storing large quantities of data ▪ Technology ▪ Visualization ▪ Stream processing ▪ Big Data processing with methods of artificial intelligence, machine learning or predictive analytics ▪ Big Data and cloud infrastructure service platform ▪ Infrastructure as a service with high security focus and smart service integration ▪ Social media text extraction and sentiment analysis
Big Data	<p>Along with other project partners (DB System, DFKI (German Research Center for Artificial Intelligence), idalab, PS-Team),]init[is developing a Big Data analysis platform as part of the Smart Data for Mobility Project. This platform creates an ecosystem for multimodal smart mobility services based on a Big Data analysis platform for intelligent data management to optimize the workload, planning and forecasting for mobility service providers as well as to make prices more flexible and optimize service for travellers. Previous, mainly technical, obstacles for using Big and Smart Data technology in the mobility sector should be minimized. In the first step, this platform focuses on the mobility sector. However, it can be used across all sectors. Large quantities of data in structured and unstructured forms from various sources and from various sectors as well as public administration are collected and input on this platform. Likewise, social media channels are used to acquire useful information by text extraction which can be used in combination with other data. Due to the heterogeneity of the data sources, the speed at which the data can change is also very varied. By linking and refining data and using developed analysis and prediction models, highly diverse smart services can be developed for each individual business case and implemented via standardized interfaces on the platform.</p>
Innovation	<p>Our consultants and architects have a wide range of experience across the Big Data sector and can offer unique expertise in the latest methods of machine learning, predictive analytics and datability. Projects are carried out using expertise from the SMART Data project and the public administration's understanding of the situation.</p>
Benefit	<p>Thanks to intelligent analysis of pre-existing data, companies are presented with new business potentials, forecasts and planning are improved and the use of resources is optimized. New services emerge from using, linking and refining structured and unstructured data as well as using social media sources and using the data obtained from this.</p>
Governmental R&D promotion programmes	<p>]init[is working on the project »SD4M – Smart Data for Mobility« and is developing a service platform spanning industry sectors which integrates data from various mobility providers and social media data and makes this prepared data available to various users. The Big Data analysis platform provides the basis for intelligent data management and the foundations for</p>



Supported by:



on the basis of a decision by the German Bundestag



	varied multimodal smart mobility services. This project is promoted by the Federal Ministry for Economic Affairs and Energy (BMWi) as part of the Smart Data Programme.
Countries and customers]init[operates in Germany, India, Abu Dhabi and Brussels and carries out projects with, i.a., BMWi (Federal Ministry for Economic Affairs and Energy), BMVI (Federal Ministry of Transport and Digital Infrastructure), NATO, ARD Digital, DIN e.V. (German Institute for Standardization), Beuth Verlag, ECB, Deutsche Börse, Bertelsmann Foundation, GIZ (German Corporation for International Cooperation), Council of the European Union, European Commission.

5.10 IBM – Solutions and Product Development in Germany [1]-[6][9]

Company	<p>IBM Deutschland GmbH IBM Allee 1 71139 Ehningen</p> <p>With a global presence, IBM is one of the world's leading providers of Business and IT Solutions. In Germany, IBM Research and Development fulfills a key role in the development of IBM's Big Data, Analytics and Cognitive Computing capabilities.</p>
Characteristics	IBM provides enterprise grade Software, IT and Business Solutions. IBM is an active supporter of a number of Open Source initiatives, and is a member of numerous international Standardisation organisations, and regional and national IT initiatives such as Germany's Plattform Industrie 4.0. IBM's Big Data, Analytics and Cognitive Computing initiatives provide extensible and performant Applications, Platform and Infrastructure capabilities at customers premises and in hybrid and public clouds.
Customer needs	<ul style="list-style-type: none"> ▪ Gaining insights and improving decision quality based on the optimal use of Big Data technologies and solutions ▪ Understanding the strategic challenges presented by Big Data, Analytics and Cognitive Computing ▪ Capitalising on the unique capabilities of Big Data, Analytics and Cognitive Computing ▪ Understand and implement change driven by Big Data, Analytics and Cognitive Computing
Big Data offerings	<ul style="list-style-type: none"> ▪ Data Management & Warehouse: Gain industry-leading database performance across multiple workloads while lowering administration, storage, development and server costs; Realize extreme speed with capabilities optimized for analytics workloads such as deep analytics, and benefit from workload-optimized systems that can be up and running in hours. ▪ Hadoop System: Bring the power of Apache Hadoop to the enterprise with application accelerators, analytics, visualization, development tools, performance and security features. ▪ Stream Computing: Efficiently deliver real-time analytic processing on constantly changing data in motion and enable descriptive and predictive analytics to support real-time decisions. Capture and analyze all data, all the time, just in time. With stream computing, store less, analyze more and make better decisions faster. ▪ Content Management: Enable comprehensive content lifecycle and document management with cost-effective control of existing and new types of content with scale, security and stability. ▪ Information Integration and Governance: Build confidence in big data with the ability to integrate, understand, manage and govern data appropriately across its lifecycle. ▪ Cognitive Computing: IBM's Watson suite of solutions addresses the need for IT solutions to be capable of interacting in a flexible and intuitive way through the ability to understand natural language.
Big Data	<p>IBM continues to invest in developing Big Data, Analytics and Cognitive Computing platforms and solutions in Germany. For example:</p> <ul style="list-style-type: none"> ▪ DB2 Analytics Accelerator delivers a real-time analytics solution on a single, integrated, system for transactional data, historical data, and predictive analytics. ▪ dashDB offers a simple and performant data warehouse, with the scale and agility of the cloud. IBM's data warehouse-as-a-service delivers high speed insights, in-database analytics, and connects seamlessly with a wide ecosystem of business intelligence tool sets, including Watson Analytics and many third-party BI tools. ▪ IBM Watson Analytics for Social Media is a social media analytics technology that helps to achieve a holistic view of consumers, market and competitors – all from millions of online sources.



Innovation	<ul style="list-style-type: none"> ▪ DB2 Analytics Accelerator for z/OS: transforms an IBM z Systems™ mainframe into a highly-efficient transactional and analytics processing environment, delivers significant improvements in response time on unpredictable, complex, and long-running query workloads. In-database analytics enable the acceleration of predictive analytics applications and transformation and multi-step processing facilitates consolidation of ETL/ELT processing. ▪ IBM dashDB a fully managed cloud data warehouse, purpose-built for analytics. It offers MPP scale (Massively Parallel Processing), and compatibility with a wide range of BI tools. dashDB is offered as a fully-managed IBM service in the cloud. A second deployment option is currently in early access preview for software defined environments (SDE). This allows to spend less time and resources building a data warehouse and focus on new solutions with dashDB. ▪ IBM Watson Analytics for Social Media enables customers to: Understand social behavior – Use visualization of social data to measure consumer sentiment and evaluate trends, gauge the reactions to a product or event, determine the effectiveness of marketing campaigns and more. Get more accurate insights – Extract multiple snippets of conversation from a single social post for a true picture of social sentiment. Enrich discoveries – Compare social media analytics results with other data sources for new insights derived from different views of information.
Benefit	By providing the infrastructure to develop and run Big Data, Analytics and Cognitive Computing solutions on premise, on server or in a hybrid cloud, customers can focus on using data to maximise business benefit with minimum overhead.
Prospects	<ul style="list-style-type: none"> ▪ Combining the Data, Analytics and Cognitive Computing with the agility and flexibility of cloud computing, IBM's Bluemix PaaS offers developers access to a wide range of public and private data sources, with the infrastructure to develop, automatically deploy and scale applications, with a particular focus on data-centric domain ▪ IBM's adoption of the Apache Spark platform reflects the increasing need to perform analytics on data in memory and on disk in a consistent and transparent way
Countries and customers	Worldwide

5.11 SAP – Application and Analytics Software for Enterprises [1]-[6][9]

Company	SAP SE Dietmar-Hopp-Allee 16 69190 Walldorf +49 6227 7-47474 www.sap.com Dr. Engelbert Quack Consulting Director SAP Deutschland AG & Co. KG Hasso-Plattner Ring 7 69190 Walldorf
Employees	Worldwide: 76,986 Germany: ~ 17,100
Characteristics	<p>Founded in 1972, SAP today is the world's leader in application and analytics software for enterprises in terms of market share and the market leader in mobile enterprise management. Further, SAP is the enterprise cloud company with the greatest number of users and the fastest-growing major database company. Our continued growth over more than four decades is attributable to relentless innovation, a diverse portfolio, and our ability to anticipate ever-changing customer requirements. With more than 310,000 customers in over 190 countries, the SAP Group includes subsidiaries in all major countries.</p> <p>Our company's culture puts our customer's success at the center of everything we do. With Run Simple as our operating principle, we focus on helping our customers master complexity and run their business better, which is the most intractable challenge facing business today. As at December 31, 2015, SAP SE directly or indirectly controlled a worldwide group of 255 subsidiaries in more than 180 countries to distribute our products, solutions, and services. Our subsidiaries perform tasks such as sales and marketing, consulting, research and development, cloud delivery, customer support, training, or administration.</p> <p>As market leader in enterprise application software, SAP (NYSE: SAP) helps companies of all sizes and industries run better. From back office to boardroom, warehouse to storefront, desktop to mobile device – SAP empowers people and organizations to work together more efficiently and use business insight more effectively to stay ahead of the competition. SAP applications and services enable customers to operate profitably, adapt continuously, and grow sustainably.</p>
Customer needs	<p>The world is operating in a time of accelerated change that has created new complexity, challenges, and opportunities for both customers and SAP. Digitalization represents more than a trend but a paradigm shift, one that is shaping whole industries, business models, and sources of competitive advantage.</p> <p>Software is at the heart of this transformation – for many organizations, it is the new differentiator. We recognize that enterprise software today must do far more than run business processes. It is an enabler for navigation complexity and unlocking innovation. Throughout our history, we have helped our customers manage other major paradigm shifts impacting their business, from the massive expansion of the Internet to globalization. Today, we are supporting their transition to a cloud-based world, as increasingly complex business problems demand simple solutions.</p> <p>With Digital Business Services we are providing customers with the software they want, in the method they want it so that they can get up and running as fast as possible. And when their solutions are live, they have instant access to our end-to-end support.</p>
Big Data offerings	<p>SAP'S END-TO-END SOLUTIONS</p> <p>Simple user experience designed with a mobile first mindset</p> <p>1 – APPLICATIONS</p> <p>As the market leader in enterprise application software, we offer end-to-end solutions specific to 25 industries grouped in six industry sectors and 12 lines of business, localized by country and for companies of any size.</p> <ul style="list-style-type: none"> ▪ Packaged solutions for 25 industries and 11 lines-of-business: On premise, cloud, hybrid ▪ SAP Business Suite optimizes all business-critical processes ▪ Market leader in products for business analysis and a technology leader for real-time analysis: Business intelligence, Predictive Analytics etc. ▪ S/4HANA: the next generation business suite ▪ 3,200 customers ▪ On premise, cloud and hybrid ▪ The digital core that drives digital transformation for reimagined business models, processes and decisions: internet of things and big data become accessible to any business ▪ New user experience with SAP Fiori



2 – SAP HANA PLATFORM

Nothing signifies the changes we are making at SAP – and for our customers – more than SAP HANA. The platform holds the power to simplify both the user experience and the overall IT landscape, creating a smaller data footprint, increased system throughput, and easier data processing and operation. For this reason, we have evolved SAP HANA from a database to a full business platform that will act as the basis for our products going forward.

The SAP HANA platform combines database, data processing, and application platform capabilities in-memory. By providing advanced capabilities – such as predictive text analytics, spatial processing, and data virtualization – on the same architecture, it further simplifies application development and processing across Big Data sources and structures.

Market-leading platform for real-time computing:

- Open platform
- Basis for major SAP applications, will become underlying technology for all SAP applications
- SAP HANA Cloud Platform enables customers to extend existing cloud applications or quickly develop entirely new ones
- SAP HANA Enterprise Cloud: access to the full potential of SAP HANA via managed cloud

Customers and Partners:

- 3,200 startups developing on HANA platform
- Around 1,340 SAP HANA One customers
- 7,000 SAP S/4HANA trained partners persons
- 990 authorized SAP S/4HANA resellers

3 – BUSINESS NETWORK

The cloud has profoundly changed the way people interact, and this impact will only grow as enterprises connect and collaborate in new ways with their global networks of customers and partners. We believe these new networks are transforming how companies do business, and we are helping to lead this wave of innovation.

SAP's Business Network companies provide the leading solutions in the areas of

- Goods and services: Ariba has a trade volume of more than US\$ 800 billion p.a., connecting 2.1 million businesses
- Travel and expense: Concur is being used by 40 million travelers
- Contingent labor: Fieldglass manages 2.1 million temporary workers p.a.

Big Data	<p>The SAP HANA platform combines database, data processing, and application platform capabilities in-memory. By providing advanced capabilities – such as predictive text analytics, spatial processing, and data virtualization – on the same architecture, it further simplifies application development and processing across Big Data sources and structures.</p> <p>Through the capabilities of SAP HANA, we can now enable real-time enterprise; we can leverage Big Data to achieve deeper insight; and we can empower users through the ease of mobile apps, so that people can access what they need securely and flexibly.</p>
Innovation	<p>To take over capabilities to the next level, we built open SAP HANA Cloud Platform, which is the embodiment of our SAP Cloud powered by SAP HANA strategy. The cloud platform enables ease and flexibility in building, extending, and integrating business applications – available to all SAP Partners, customers, and third-party developers – available to all SAP partners, customers, and third-party developers.</p> <p>Realizing that one size does not fit all, we are providing a bridge for our customers in the transition to the cloud. We also offer to manage mission-critical software such as SAP Business Suite and SAP Business Warehouse as well as custom SAP HANA applications in our cloud data centers.</p> <p>Our overarching goal is to create the broadest integration offering in the industry where customers can connect SAP and third-party software across heterogeneous environments by leveraging application lifecycle management to reduce IT complexity. Our customers can enhance the power of an integrated landscape with a refreshing user experience across multiple devices and interfaces. At the same time, all core applications can be built and run in the cloud or on premise, giving developers a powerful tool to build applications with flexibility and efficiency.</p> <ul style="list-style-type: none"> ▪ 14 Development centers (SAP Labs) worldwide ▪ 100 Development locations worldwide ▪ 13 Co-Innovation and Living Labs worldwide ▪ 21 Research locations worldwide ▪ Innovation Center in Potsdam, Germany ▪ Partner network with >12,100 SAP partner companies around the world ▪ Sapphire Ventures: Invested in >130 IT startups and >30 venture capital funds globally since 1996

	<ul style="list-style-type: none"> ▪ US\$ 1.4 bn capital under management ▪ Operates independently from SAP ▪ Provides SAP early visibility and access to markets, trends & innovation ▪ SAP Digital allows anyone to buy and use offerings from SAP and third-party suppliers with minimal human interaction.
Benefit	<p>We help customers Run Simple by innovating with SAP HANA platform as our foundation. This strategy combines ease of use and flexibility with sizeable computing power. Through the capabilities of SAP HANA, we can now enable real-time enterprise; we can leverage Big Data to achieve deeper insight; and we can empower users through the ease of mobile apps, so that people can access what they need securely and flexibly.</p> <p>As we aim to become »THE cloud company powered by SAP HANA«, we are going are beyond incremental change to achieve radical simplification – enabling our customers to stay ahead of trends, make better decisions faster, and propel innovation.</p>
Countries and customers	<p>When SAP customers Run Simple, it improves their ability ultimately to become best-run businesses that create more sustainable business models – which, in turn, help us ensure our own long-term viability. That is why we strive to provide more than just software and services; we continually engage with our customers at every stage – not only during the sales and implementation phases, but also through the sharing of best practices and innovations. More than more than 310,000 customers in over 190 countries rely on SAP's end-to-end solutions specific to 25 industries. SAP customers being in the middle of their digital transformation experience the possibilities generated by the usage of Big Data in different industries, e.g.: NCT (Healthcare), Munich City Utilities (Stadtwerke München) (Public Sector), Beiersdorf (Consumer Products), HSE24 (Retail), Mercedes-AMG (Automotive), Koehler Paper Group (Industrial Machinery & Components), Hamburg Port Authority (Transportation & Logistics), Sports:</p> <ul style="list-style-type: none"> ▪ Deutscher Fußball-Bund (DFB): With SAP's CRM solutions and SAP Event Ticketing, the association brings tailor-made campaigns to the pitch. ▪ FC Bayern Munich AG (FCB): Analyzing Big Data with the help of SAP HANA helps FC Bayern identify patterns in players' motions and take preventive action if such motions make players prone to injury. ▪ The TSG 1899 Hoffenheim soccer club uses advanced technology for its under-19 team to optimize training and gain a competitive advantage in developing professional players and talent.

5.12 The unbelievable Machine Company – Consulting and Implementation [1]-[6][9]



Company	The unbelievable Machine Company Grolmanstr. 140 10623 Berlin www.unbelievable-machine.com info@unbelievable-machine.com
Employees	Worldwide: Approximately 120 Germany: 105
Characteristics	<ul style="list-style-type: none"> ▪ Full-service provider for Big Data and cloud services for customers from all industries but primarily car manufacturing, other manufacturing, retail & banking ▪ Tailor-made solutions for every customer ▪ Broad knowledge in data science, data engineering and cloud services. We deliver projects »from idea to cable« (consulting and technical realization) ▪ Vendor-independent consulting ▪ Methods: neural networks/deep learning, machine learning, advanced analytics, Hadoop, ELK, Cassandra, etc.
Customer needs	<ul style="list-style-type: none"> ▪ Digital factory: machine/sensor data, condition monitoring/predictive maintenance, machine learning ▪ Predictive analytics such as customer behavior and fraud protection ▪ Global and organizational challenges (competition, cloud, technologies, data security, compliance, digital transformation, bimodal IT) ▪ Elevation of analytics from a reporting tool to a driver of business value ▪ Optimization of customer-retail relationships, identification of customer groups based on transaction data ▪ Monitoring of traffic, transactions and marketing-related KPIs in near time consolidation of (internal and external) data ▪ Leadership/Sponsorship within the corporation (business/IT departments) ▪ Data governance (consistency, importance) ▪ Development of skills
Big Data offerings	<ul style="list-style-type: none"> ▪ Guidance and consulting to identify business cases and lighthouse projects ▪ Data pool creation and exploration, proof of concepts, mathematical modelling ▪ System/Software architecture, data engineering and software development »on scale« ▪ Cloud and infrastructure services for Big Data projects ▪ Tailor-made training programs and knowledge transfer
Big Data	<ul style="list-style-type: none"> ▪ Volume: e.g. operation of several 50+ node Hadoop systems with several 10+ TB data ▪ Velocity: e.g. real time operational intelligence solutions based on Splunk/ELK or Kafka/Storm architectures (Lambda) ▪ Variety & Analytics: e.g. projects in the area of image detection/recognition using deep neural nets as a service (running on managed GPU hardware in our own datacenters), natural language processing solutions on 100+GB document stores and/or social media data pools ▪ Analytics: 90% of our data science/engineering projects include unsupervised/supervised machine learning and/or deep neural nets
Innovation	<ul style="list-style-type: none"> ▪ Quality leader: Acknowledged by Gartner as a Cool Vendor for »Big Data and Information Infrastructure« (2013) and by Experton Group as a Big Data Leader in »Big Data Operations« and »Big Data Consulting« (2015, 2016) ▪ Consulting, guidance, technical integration and 24/7 service from a single source
Benefit	<ul style="list-style-type: none"> ▪ Higher conversation rates ▪ Reduced and optimized maintenance cycles ▪ Near time monitoring ▪ Cloud services made in Germany (»Grundschutz«, ISO, PCI DSS, etc.)
Prospects	In Feb 2016 we launched our new service offering »Data Thinking«, a field in which we provide strategic consulting for C-level and decision makers. Data Thinking marks the shift from enablement to creatorship and leadership in the digital age.
Countries and customers	Germany, Austria, Switzerland (DACH) e.g. Deutsche Post, Metro, Gebr. Heinemann, Porsche, Parship, Delivery Hero, Bawag P.S.K.

5.13 Microsoft Deutschland – Comprehensive Big Data Platform [1]-[6]

Company	Microsoft Deutschland GmbH Konrad-Zuse-Straße 1 85716 Unterschleißheim Area Vice President International: Sabine Bendiek +49 89 31 76 0 Partners: +49 1806 30 25 25* Business customers: +49 1806 67 23 30* Consumers: +49 1806 67 2255* (*Additional fees may apply)
Employees	Worldwide: 130,000 Germany: 2,700
Characteristics	<ul style="list-style-type: none"> ▪ Providing software and services to make every person on the planet more productive to achieve more. ▪ Microsoft's offers the most comprehensive big data platform to help customers realize the value of their data dividend by combining diverse data streams, using new data analytics tools, delivering data insights to more people within the organization, and improving the speed of data processing and timeliness of access to data. With unmatched breadth across the enterprise-from IT to the office worker. Microsoft has the right solutions to make big data actionable for anybody and deliver the broadest benefits across an organization with data insights.
Customer needs	Companies today are facing an increasing diversity of data within their own businesses. This is being driven by business applications; unstructured social data; connected sensors and devices (»Internet of Things«) and much more. The modern enterprise needs a logical architecture that can smoothly scale to meet these volume demands with real-time processing power and the ability to manage any data type to rapidly connect the business to valuable insights. This means that the traditional data warehouse needs to evolve into a modern data warehouse. An increasing share of the new data is »cloud-born«, such as clickstreams; videos, social feeds, GPS, and market, weather, and traffic information. In addition, the prominent trend of moving core business applications like messaging, CRM, and ERP to cloud-based platforms is also growing the amount of cloud-born relational business data. Cloud-born data is changing business and IT strategies about where data should be accessed, analyzed, used, and stored. A modern data warehouse delivers a comprehensive logical data and analytics platform with a complete suite of fully supported, solutions and technologies that can meet the needs of even the most sophisticated and demanding modern enterprise – on-premises, in the cloud, or within any hybrid scenario.
Big Data offerings	<ul style="list-style-type: none"> ▪ The Microsoft Modern Data Warehouse is designed to scale to the most demanding enterprise requirements with performance at linear scale meeting any requirement. ▪ PolyBase, a feature of SQL Server DW and SQL Server 2016, allows to query Hadoop and DW together within the familiar SQL syntax. ▪ The new Azure Data Lake enriches the Hadoop ecosystem, by allowing customers to run all of their analysis on Exabyte's of data, without any limits. ▪ Microsoft provides a suite of big data and advanced analytics solutions like Azure HDInsight, Azure Data Factory, Microsoft R Enterprise and Azure Machine Learning, Cortana Intelligence and Cognitive Services. ▪ Microsoft provides solution templates for Log file analysis, Fraud detection, Social Media and Sentiment Analysis, Risk Modeling and Management, Energy efficiency, Politics, and Security.
Big Data	<p>Many industries have vast amounts of data but much of it remains unexploited today. Those data stores are only bound to increase further as our world becomes more hyper connected across devices, people and processes. The industry must respond to these changes given growing competitive pressures and thinning profit margins. Among key trends that are informing strategies around big data use within many industries:</p> <ul style="list-style-type: none"> ▪ Power shift to consumers: Social communities are driving preferences and defining products, generating interest from business leaders at companies to use this intelligence to build better customer engagement models and improve quality of customer experience (QoE). ▪ Operational insight and discover of new revenue streams: With growing competitive pressures, companies are looking to control costs by weeding out operational inefficiencies. But controlling costs alone isn't enough. Analytics applied to customer data is helping these industries identify new business opportunities and deliver more tailored, personalized offers and dynamic pricing models to customers.



	<ul style="list-style-type: none"> ▪ Telco Network and Media online performance improvements: For telcos, insights gleaned from data around network performance – load and roaming usage patterns, performance of new applications and devices on its networks, etc – can deliver valuable intelligence to its customer care, marketing and engineering teams. Similarly, for media content companies, big data analysis is becoming a must-do in order to create optimal online experiences and content packages that can ensure visitor »stickiness«.
Innovation	<ul style="list-style-type: none"> ▪ Azure Data Lake provides a rich set of innovation. Batch, interactive, streaming, machine learning. Allows for exploratory analytics over your data. Do analytics with Hadoop and just pay-per-Query, provides an innovative new business model. ▪ Cognitive Services create several new abilities by providing easy to integrate like language understanding, Social sentiment, people identification, emotion recognition, linguistic analytics, Academic knowledge discovery, Image plus video search and many more. ▪ Azure Machine Learning provides a web base interface to build, test, and deploy predictive analytics models. This provides a library of algorithms and samples to get quickly started. ▪ Sample applications like http://www.how-old.net/ and https://www.mymoustache.net/ provide a glimpse of what is possible today. ▪ In combination with augmented 3D reality like Hololens, very new applications are possible https://www.microsoft.com/microsoft-hololens
Benefit	<p>Example – Monetization of data for new services: An emerging business opportunity in the telco space is the ability to monetize data for new services. For example, one way to do this is by contributing to location analytics in the retail industry, giving retailers the ability to look at mobile phone geographic data in the aggregate to help them determine where to build new stores. This is an area where we expect to see significant development in the near future. Since telecommunications companies collect location data from mobile phones on such a massive scale, they can combine that with the demographics of phone users help people determine things like where in a particular town is there is a high concentrations of 25 to 34 year olds at 5:00 p.m. (good place to open a bar), how traffic gets from suburbs to downtown at different times of day, from what areas of the metropolitan area does traffic flow into the central business district at different times of day, and of course, it can help determine targeted coupons and advertising.</p>
Prospects	<ul style="list-style-type: none"> ▪ PowerBI data visualization leveraging Spark on Hadoop with Real-Time and integrated R-Language support. ▪ Power Apps to easily Develop and deploy mobile Apps cross all major devices in the market.
Governmental R&D promotion programmes	Microsoft provides a German Cloud offering with T-Systems operating the Datacenters in Frankfurt and Magdeburg under German Law and data security rules. Specific programs for public sector customer may apply.
Countries and customers	Microsoft operates today worldwide and has currently 30 datacenters in operation.
Future markets	Extending the reach to Africa and South America is on the roadmap for the coming years. Today Africa is sourced from Asia as well as Europe. In South America Microsoft operates a pair of datacenters in Brazil.

5.14 Mieschke Hofmann und Partner – from Strategy to Realization and Coaching [1]-[6]

Company	Mieschke Hofmann und Partner Gesellschaft für Management- und IT-Beratung mbH Königsallee 49 71638 Ludwigsburg www.mhp.de Contact: Alf Porzig Head of Competence Center BIGDATA alf.porzig@mhp.com +49 151 20301626
Employees	Worldwide: 1,500
Characteristics	<ul style="list-style-type: none"> ▪ Symbiosis of management and IT consulting, process consulting. ▪ Comprehensive consulting portfolio across the entire value chain. ▪ Industry focus on automotive and manufacturing industry, transfer of strategic innovations to other industries. ▪ MHP offers a comprehensive Big Data approach covering all aspects from digitalization strategy, creating business models and use cases, proof of concepts, Big Data architecture up to realization and coaching.
Customer needs	MHP's customers are facing all aspects of the digital transformation and data driven processes. Vehicles, customers, machines and services get connected and allow for new insights about the customer behavior and the product usage. Therefore the data itself and the data driven services (like e.g. predictive maintenance) become part of the product.
Big Data offerings	Based on the experience of numerous Big Data projects MHP has created »Data Driven Excellence«, a comprehensive process model for setting up a future Big Data and data driven process landscape. In the MHP BIGDATA Lab customers can perform proof of concepts and create a data driven Big Data architecture. With Big Data Analytics we support our customers in gaining new insights about customers, product usage and business or production processes.
Big Data	<p>In the connected world all kind of data and data formats must be processed at any time at any velocity and any volume. The user's behavior (e.g. usage of apps) is changing continuously. The Big Data landscape must e.g. be able to analyze any kind of usage or production data and connect it to the existing business processes. This includes all aspects of Big Data Analytics like data mining/pattern recognition, text mining, machine learning, complex event processing, strategic and tactical (real-time) analysis.</p> <p>But Big Data also has deep impact on the companies' organizational structures. Knowledge silos must be integrated, relevant skills and organizational structures must be developed. And cross-departmental Big Data processes must be created.</p>
Innovation	<p>The data must fulfill two principle tasks. It must work in the operational processes as well as for the analytical aspects. »Data Driven Excellence«, MHP's process model for setting up future Big Data landscapes, brings these two tasks in line with our customer's business strategy.</p> <p>The MHP BIGDATA Lab enables our customers to innovate with new technologies, to learn from the data and to generate new use cases in a vendor independent environment.</p>
Benefit	Companies will not be able to compete in future markets if they are not able to make use of their data. Along the entire value chain additional value is generated by Big Data analytics and data driven processes continuously optimize the business.
Countries and customers	Germany, USA, UK, China, Switzerland



5.15 Telefónica Deutschland – Information on Movement Patterns [1]-[6]

Company	Telefónica Deutschland Holding AG Georg-Brauchle-Ring 23-25 80992 München www.telefonica.de advanced-data-analytics@telefonica.de
Employees	Telefónica Group: 130 k Telefónica Deutschland: 9,5 k (12/2015)
Characteristics	<ul style="list-style-type: none"> ▪ Telefónica Deutschland offers mobile and fixed telecommunications services for private and business customers. With a total of 48.3 million customer accesses, the company is one of the three leading integrated telecommunications providers in Germany. In the mobile segment alone, Telefónica Deutschland serves more than 43 million accesses, making it the country's market leader. ▪ Telefónica Deutschland's business processes generate and process huge amounts of partly exclusive data, e.g. location information of mobile phones based on their communication with the mobile network cells. After anonymization, this data becomes an important raw material for advanced data analytics and products built on the basis of statistical analyses. ▪ Telefónica Deutschland's approach to Big Data is based on the idea that people must be able to benefit from data. Information flowing through our network can help save lives through early indications of health problems, enable facts-based government decisions for the benefit of all or improve the quality of life for city dwellers by untangling traffic flows. ▪ Already, Telefónica Deutschland uses insights from big data internally to optimize network roll-out according to actual demand and to optimize products and services. Furthermore, the company offers data-driven insights to third parties. Advanced data analytics enables the conception of countless new ideas and solutions, e.g. in the realms of mobility, health, private consumption and public administration. The product »Mobility Insights«, which provides analyses of traffic data, is one of the first advanced data analytics products coming out of Telefónica Deutschland. ▪ Protecting customer data and ensuring that individuals retain control over their own information is the basis for Telefonica Deutschland's data analytics business.
Customer needs	<p>Having to manually gather data is expensive and time-consuming. Individuals, municipalities and private companies alike are often forced to make investments or other decisions on the basis of assumptions or out-of-date sample data. That usually leads to less-than-ideal outcomes. For municipalities, for example, tracking air quality is a complex and costly process. Telefónica Deutschland and its partners have started a pilot project in Nuremberg to test a new and superior way of evaluating air quality based on mobile data. With the help of this information, municipalities can introduce measures against emissions.</p> <p>In the transport sector, public administrations and private companies can leverage data supplied by Telefónica Deutschland to improve welfare – with the social, health and economic benefits that a smart city concept promises. Transport companies for example must plan new routes, capacities and timetables, and set up infrastructure for airports and train stations. And they need to understand how different modes of transport compete with each other and how they are connected (e.g. customers travelling by train between cities but using private car for last mile). Retailers need to decide where to best place their points of sale and decide on opening hours. Advertising companies face the challenge of having to choose optimal locations for billboards.</p>
Big Data offerings	Mobility Insights is an already available B2B product, offering customized solutions and visual interpretations of data relevant to a customers' problem. Mobility Insights offers up-to-date information on movement patterns, based on extrapolations from more than 40 million mobile phones.
Big Data	Mobility Insights provides near-real-time consumer insights. The product is based on several billion mobile network events per day, created by over 40 million users (e.g. calls, text messages, initiation of an Internet session).
Innovation	The core of Telefónica Deutschland's Mobility Insights product is a novel anonymization procedure that the company has developed for which it has filed a patent application. The entire processing of information is divided into several logical layers: segmentation, transformation, aggregation and extrapolation. Processing occurs in independent IT-areas in separate high security computing centers. With this approach, Telefónica Deutschland goes



beyond German legal requirements and sets new standards internationally. The procedure was developed in close coordination with German data protection authorities. Another innovation is the methodology by which the mobile network events are interpreted and converted into location insights.

Benefit	Telefónica Deutschland has access to a vast amount of data related to its core business, which it intends to use to improve the welfare of society as a whole as well as serve the needs of individual customers. Compared to traditional analyses, the data at hand is more automated, more current, more precise and more affordable. While sample sizes of traditional methods were typically in the hundreds or thousands, Mobility Insights offers a huge leap to sample sizes in the millions. On the basis of movement flows, a large number of new solutions and services will be created in the future, which will benefit a lot of people. Cities can use these analyses not only to plan traffic more accurately, but also to better control pollutant levels at certain highly frequented locations. Retailers may better plan the location of outlets and understand the dynamic development of footfall around the shops. The advertising industry can more efficiently plan and monitor the location of billboards or digital signage. Future consumer applications may for example revolve around better traffic or schedule information.
Countries and customers	Telefónica Deutschland operates in Germany only, while our parent company Telefónica S.A. offers big data solutions around the world (e.g. in China, Spain, UK, and Brazil)

5.16 nugg.ad – Multichannel Audiences & Data Management [1]-[6][9]

Company	nugg.ad Rotherstr. 16 10245 Berlin www.nugg.ad welcome@nugg.ad nugg.ad is a company of Zalando Media Solutions
Employees	~ 60
Characteristics	nugg.ad – Europe’s Audience Experts: The nugg.ad Smart Audience Platform™ offers real-time data technology for multichannel audience targeting as well as data management platform solutions – for more effective digital advertising. We enable our partners to deliver highly target group-specific display, video and mobile advertising, while ensuring a maximum level of data privacy. nugg.ad target groups are a market standard for digital audience campaigns in many countries. Media companies, publisher sales houses and agencies benefit from experienced consulting and know-how in technology, business models and consumer privacy. nugg.ad’s technology is based on real-time machine learning and data computing, highly scalable algorithms and a smart combination of different data sources. These include market research information, measurements of online user behaviour and factual data, individual advertiser and campaign data.
Customer needs	More effectiveness in digital marketing: The effectiveness of nugg.ad’s audience targeting methodology is proven in many case studies. Companies increase their brand impact, performance and sales KPIs and audience targeting quality with nugg.ad. More transparency and insights in digital marketing: Our integrated research and data science approach offers a new level of transparency – with advanced target group insights and reports on intent to buy, brand awareness, target group share and ad exposure.
Big Data offerings	<ul style="list-style-type: none"> ▪ Multichannel Audience Targeting: Reach your audience with highly effective display, video or mobile advertising. ▪ Data Management Platform: nugg.ad’s Smart DMP collects, stores and analyses all kinds of data and enables smart combinations of different data types (e.g. factual and predictive). ▪ Data Marketplace: The Data Marketplace enables a controlled exchange of target group information between different data providers and data consumers. ▪ Audience and Research: Research partner for in-depth studies, evaluation, insights and customised target groups.



Big Data	The nugg.ad system computes up to 1 Mio. data points per second and delivers more than 80 data points per anonymized user profile. More than 40 Bn. data predictions are generated per month in Europe via nugg.ad. By using real-time machine learning technology, data for hundreds of millions of anonymized web profiles is constantly updated based on factual data measurements.
Innovation	In comparison to other platforms, nugg.ad's smart technology is not only capable of gathering and managing, but also of computing extensive target group information in real-time for a large number of users. nugg.ad provides a broad range of relevant target groups while ensuring maximum privacy through an advanced data anonymisation system. nugg.ad's big data based approach provides the digital advertising market with highly scalable audiences and maximum reach in defined target groups – in numerous international markets. nugg.ad's technology originated from its pioneering predictive targeting approach, which nugg.ad developed and constantly enhanced during the last 10 years – in cooperation with various institutions and research partners.
Benefit	Benefits for companies working with nugg.ad: <ul style="list-style-type: none"> ▪ Verifiably more effective online / mobile advertising – through smart technology ▪ Broad range of high-reach audiences + individual target groups, all based on an extensive data protection and security approach ▪ Applicable on different channels – display, video, mobile, cross-media etc. ▪ Valuable target group insights.
Countries and customers	E.g. Germany, France, Italy, Switzerland, Austria, Denmark, Norway, Sweden, Benelux, Poland and other markets. Customers include media agencies such as VivaKi, media sales companies such as Ströer Digital Media, Axel Springer / Media Impact, Ringier, Zalando Media Solutions, Le Figaro and many more. Case studies with major advertisers are available on: www.nugg.ad/casestudies

5.17 Fujitsu – Services and System Platforms [1]-[3][5][6][9]

Company	Fujitsu Mies-van-der-Rohe-Str. 8 80807 München www.fujitsu.com
Employees	Worldwide: Approximately 159,000 Germany: more than 5,000
Characteristics	<ul style="list-style-type: none"> ▪ Technology Solutions: Services (Solutions/System Integration and Infrastructure Services) and System Platforms (System Products and Network Products) ▪ Ubiquitous Solutions: PCs/Mobile Phones and Mobilewear ▪ Device Solutions: LSI devices and Electronic components ▪ Fujitsu as Big Data vendor provides with PRIMEFLEX for Hadoop a powerful and scalable platform for Big Data analytics complemented by cloud and consulting services. PRIMEFLEX for Hadoop combines the convenience of pre-configured and pre-tested hardware with the economic advantages of selected software, available as ready-to-run appliance and reference architecture. Fujitsu's Big Data platform has been designed for customer use cases of all industries
Customer needs	Main demand is integration of structured and unstructured data from multiple data sources and automation of data import and processing. Self-service analytics is required especially for more agility and/or analysis of sensitive data. A right sized and scalable infrastructure integrated with datacenter processes is a prerequisite.
Big Data offerings	FUJITSU Integrated System PRIMEFLEX for Hadoop, PRIMEFLEX for SAP HANA, GlobeRanger
Big Data	E.g. in life science and healthcare the volume of genomic data is enormous. Here Big data technologies open new horizons enabling agile analytics on raw data in petabyte scale. Real-time stream and event processing in different velocity is required e.g. in finance, sports or retail. The heterogeneity of devices, sensors and context data needs to be solved in combined IoT and Big Data use cases especially in Industrie 4.0.



Innovation	<ul style="list-style-type: none"> ▪ For key global R&D sites, located in the USA, China, Europe, Japan ▪ R&D expenditure: 202.7 billion yen (US\$ 1.69 billion), approximately 4.3% of revenue. ▪ PRIMEFLEX for Hadoop is a platform with all capabilities for volume, velocity and variety which brings big data to the fingertips of business experts and bridges the gap between IT and use case. The out-of-the-box functionality can be extended by specific expertise and solutions from our broad R&D engagement. ▪ The ability to process vast amounts of especially unstructured data enables use cases e.g. in the health care industry to analyze genome data of thousands of patients in order to find curation for diseases and cancer. PRIMEFLEX for Hadoop is an ideal platform for various use cases since it allows business users, experts, scientists, etc. to immediately work with hidden information from their own data sources. ▪ Fujitsu's Big Data solution PRIMEFLEX for Hadoop has been developed in one of Fujitsu's innovation labs from highly skilled data scientists in order to provide a best in class solution to customers.
Benefit	<ul style="list-style-type: none"> ▪ Big Data provides a huge potential to predict opportunities and risks, take faster and better decisions, create new opportunities and values for businesses and the society. By selecting Fujitsu as a partner for your Big Data journey, you will experience less complexity and fast time-to-value, while reducing risks and focusing on your core business. Fujitsu is a one-stop shop for Big Data where organizations can get optimized Big Data infrastructures including hardware, software and services, as well as Integrated Systems covering the most relevant technology concepts – all from a single source. ▪ Using an integrated system reduces complexity, shortens time to production and minimizes risk, and contributes to operational efficiency, better resource utilization and considerable cost savings. An Integrated System is a pre-defined, pre-integrated and pre-tested combination of data center components. It includes servers, storage, network connectivity and software. Integrated systems are either pre-installed in the factory and therefore arrive ready-to-run, or they are delivered as reference architectures, which can be easily adapted according to customer-specific requirements. All typical activities, such as infrastructure design, component integration and testing have been conducted before project start. The onsite activities are correspondingly confined to the deployment of the Integrated System and the integration into the production environment.
Governmental R&D promotion programmes	http://www.smarteremc2.eu/?page_id=17
Countries and customers	Worldwide coverage in terms of 100+ operating countries

5.18 Motionlogic – Mobility Analytics Technology [1]-[3][8]

Company	Motionlogic GmbH Winterfeldtstr. 21 10781 Berlin www.motionlogic.de +49 30 8353 54283 info@motionlogic.de
Employees	30
Characteristics	Motionlogic provides mobility analyses of traffic and movement streams based on anonymous signaling data from the mobile communication network.
Customer needs	Mobility insights are highly relevant for a broad range of industries such as transport, retail, public authorities, and public safety. Traffic patterns help customers to answer questions such as: <ul style="list-style-type: none"> ▪ How many people travel between cities or between certain parts of cities? ▪ How high is the volume of traffic on a given route? ▪ To what extent does footfall vary on a certain shopping street per day or per week?
Big Data offerings	<ul style="list-style-type: none"> ▪ Motionlogic Analytics Suite (a web-reporting & visual BI-Tool, easy to use) ▪ Motionlogic Consulting (a business- & it-consulting unit to support mobility analytics projects) ▪ Motionlogic API (a flexible programming interface for developers & system vendors)
Big Data	We're processing signaling events of more than 40M mobile network subscribers, in near real time, 365days/24h each. Motionlogic derives information from data by using cutting edge processing technologies, like GPUs and Machine Learning Algorithms.
Innovation	Motionlogic provides aggregated analyses of traffic and movement streams that either couldn't be analyzed before, or only at great expense. These analyses help to dramatically reduce the risk involved in decision making processes. The result is that we deliver added value to our customers, to consumers, and to society as a whole. As a German-based subsidiary of Deutsche Telekom our approach of »Privacy-by-design« is a strong asset and most important part of our DNA. Founded in Berlin, Motionlogic is a spin-off by Telekom Innovation Laboratories (T-Labs), the research and development unit of Deutsche Telekom.
Benefit	In a financially viable way, we give answers to questions that previously couldn't be analyzed or that could only be done so at great expense. Our projections can offer significant support in making strategic decisions and operational improvements in the transport and other industries. Our goal is generating a deeper understanding of traffic and movement streams, so as to provide a basis for both enterprises and consumers to make informed decisions.
Prospects	After a successful launch of our products in Germany, Motionlogic now turns into a provider of »enabling technologies« to support mobile network providers and system vendors. Our vision is to become the most relevant provider for mobility analytics technology – in every market in which we're active. We're proud to announce a new product: Motionlogic Analytics Server, which is an out-of-the box server appliance for mobile network operators.
Countries and customers	Germany, Poland, Czech Republic, Croatia Case Studies: <ul style="list-style-type: none"> ▪ A retail chain requested recommendations for changing opening hours at several stores, based on hourly traffic data. The customer was able to raise their visitors count by more than 10%. ▪ One of Germany's largest cities wanted to analyze the traffic flow between city-districts and suburbs. Motionlogic provided a detailed origin-destination-matrix with new insights about traffic demands and demographics of commuters. ▪ Over a nine months period, tourist counts were provided to a major Croatian city. The city used these figures to understand trends in tourist numbers and to analyze preferences of tourists from different countries (Who is visiting which sights?).
Future markets	Europe and North America



5.19 Dastani – Predictive Analytics Consulting [1]-[3]

Company	<p>Dastani Consulting GmbH – The Predictive Analytics Company Database Marketing – Data Mining – Customer Relationship Management Im Westpark 8 35435 Gießen-Wettenberg +49 641 98446-16 Managing Director: Dr. Parsis Dastani dastani@dastani.com www.dastani.de www.predictive-analytics.com</p>
Employees	15 (all in Germany)
Characteristics	<ul style="list-style-type: none"> ▪ Dastani Consulting is a leading management consultancy in the field of predictive analytics, with 20 years' experience in the areas of forecasting models for the realisation of potentials, revenue and business planning, customer value prediction, sales optimisation and resource planning. ▪ Big data analytics by Dastani Consulting enhances efficiency in the marketing and sales functions. Clients for data-driven marketing include commercial enterprises, car manufacturers, logistics solution providers as well as companies operating in other sectors. Our 20 years' experience in data-driven projects also produces enquiries relating to other commercial activities, such as international clearing.
Customer needs	<p>In the last few years, companies have increasingly approached us with the question as to how they can best exploit their existing data. This is a new trend and in the end, it is always about performance indicators, for example: How can we raise our contribution margins? How can companies boost their revenue with existing customers, or acquire profitable new customers? As a management consultancy, we are often commissioned to extract and leverage specific insights from big data.</p>
Big data: What we offer	<p>Target Group Predict: This predictive analytics application enables B2B companies to find those potential customers that are most likely to buy their products. This is achieved by using a text mining algorithm to analyse data from company websites, portals and classified directories.</p> <p>Customer Value Prediction: This software helps companies raise their customer value. The predictive analytics application examines up to 1,000 variables per customer to exactly determine the revenue potential.</p> <p>Next Best Offer: The predictive analysis software indicates which products a specific customer is likely to buy next. Automated offers related to these products will boost conversion rates and customer satisfaction.</p> <p>Big Data Solutions: Dastani Consulting supports companies in conceiving and establishing big data solutions. Existing data can be put to use in developing financial performance indicators, forecasting the development of the business, identifying revenue potentials or implementing control systems.</p>
Big Data	<p>Dastani Consulting combines a wide range of analytical techniques in its consulting work. We analyse enormous quantities of data using our own-developed algorithms and text mining processes. We identify patterns in B2B companies' customer databases and apply these to web information covering all companies, i.e. millions of data sets.</p> <p>Our own customer community includes distributors with extremely large customer bases. Adolf Würth GmbH, a specialist dealer in assembly and fastening materials, sells more than 100,000 products to 500,000 active customers just within Germany. The sales function totalling 3,000 employees is controlled very precisely using Customer Value Prediction from Dastani Consulting.</p> <p>We also analyse a massive, Europe-wide data volume for one of the top three parcel services, and process the settlement of a monthly clearing volume of many million Euros.</p> <p>Our next-best-offer project with Conrad Electronic is characterised by both volume and pace. Just the business customer area already has a product range comprising 700,000 articles. Using self-learning software, this distributor predicts with a high level of probability which products an individual customer will buy on his next shop visit. These articles are displayed automatically in real time.</p>
Innovation	<ul style="list-style-type: none"> ▪ Dastani Consulting's solutions are innovative because we approach them with unrestricted methodology and a strict orientation to results. We apply numerous instruments with a high level of agility to ensure maximum benefit to the customer. We have been advancing our know-how in the field of predictive analytics over the last 20 years with measurable success.

	<ul style="list-style-type: none"> ▪ Our experience and open approach to big data methodology gives us a competitive edge. We are able to respond to all questions concerning big data. ▪ The entire field of ‘recommendation’ would be unthinkable without big data. The sales functions of large distributors or companies in other sectors have of course always been managed in some way. But scoring by customer value plus a sales strategy based on turnover potential can only be effectively put into practice with the aid of big data. Moreover, big data allows many support processes, such as clearing, to be applied at a significantly higher quality level whilst demanding less resources.
Benefit	Dastani Consulting’s clients are better at exploiting revenue potentials, opening up new up-selling and cross-selling potentials, acquiring new customers with the highest affinity for their products coupled with the lowest sales costs, and boosting their margins. They reduce costs by applying efficient support processes.
Prospects	Almost all our projects lead to new solutions. Currently we are testing the extent to which our Target Group Predict algorithm (see above) is able to raise ‘share of wallet’ i.e. a client’s own revenue with a customer compared to his competitors’ revenue. In other words, which C-class customers display the highest potential?
Countries and customers	<ul style="list-style-type: none"> ▪ Germany: Adolf Würth GmbH, Conrad Electronics, BMW, UNICEF, Knauf Interfer ▪ German office, projects rolled out Europe-wide/in the DACH (Germany/Austria/Switzerland) area: STILL GmbH, Triaz-Gruppe, BCA ▪ French office, project rolled out Europe-wide: DPD Group

5.20 Empolis Information Management – Big Data Analysis as a Service [1]-[3]

Company	Empolis Information Management GmbH Europaallee 10 67657 Kaiserslautern www.empolis.com Martina Tomaszowski Vice President Sales & Marketing +49 631 68037 0
Employees	146
Characteristics	Empolis provides solutions that enable companies and organizations to analyze, interpret and automatically process the rapidly growing amount of structured and unstructured data. They utilize their knowledge capital to improve enterprise-critical business processes enabling decision-makers, employees and customers to reliably receive precise and relevant information, situation-appropriate and task-relevant, for faster and better decisions. Big Data Technologies, Big Data services (IaaS/PaaS/SaaS), Big Data enablement (consulting/IT services/implementation/integration,) Big Data software (semantic processes/text mining/AI) All branches and industries, e.g. mechanical engineering, digital health care, insurance, etc.
Customer needs	Nearly 80% of all existing data is generally only available in unstructured form and does not contain additional, descriptive metadata. This content, therefore, cannot be machine-processed automatically with conventional IT. It demands human interaction for interpretation, which is impossible to achieve when faced with the sheer volume of information.
Big Data offerings	Our solution portfolio is based on the three pillars »smart content«, »smart service« and »smart intelligence«, which are all available in the Empolis Smart Cloud. <ul style="list-style-type: none"> ▪ Smart Content: Intelligent content structuring and processing for automated information delivery to any desired device, by means of modularization, linking and linguistic analysis. ▪ Smart Service: Streamline knowledge-intensive business processes with semantic search, case-based reasoning and adaptive decision trees. ▪ Smart Intelligence: Systematic analysis of information to help identify opportunities, for early risk identification and fast, intelligent decision-making.
Big Data	Based on the highly scalable product Intelligent Access System (IAS), Empolis offers methods and technologies for analyzing unstructured content perfectly suitable for a wide range of applications: In-Memory-Computing, semantic search, text mining and linguistics is able to semantically annotate and process an entire day of traffic on Twitter in less than 20 minutes, or the German version of Wikipedia in three minutes.
Innovation	IAS has the ability to »understand« unstructured data, e.g. text, and transforms the data into so called »Smart Information« with semantic annotations. In this manner, analyses are based on the actual context and relationships to structured data are established. For accessing information, IAS is an absolutely unique system since it covers the entire spectrum of proven methods: ranging from keyword-based, to associative/statistical and semantic methods, and including adaptive decision trees. These methods are integrated entirely and connected with other methods, such as information extraction, case-based reasoning, rule processing, classification and ontologies.
Governmental R&D promotion programmes	Empolis engages in numerous national and international research and development projects such as the THESEUS research program, which developed application-oriented basic technologies and standards for a new, internet-based knowledge infrastructure. Empolis is also an associate of the DFKI (German Research Center for Artificial Intelligence) and a member of the Fraunhofer IAIS (Institute for Intelligent Analysis and Information Systems) advisory board.
Countries and customers	Currently, around 500 installations exist around the world, and nearly 620,000 professional users rely on Empolis solutions on a daily basis to serve approx.. 34 million end customers.



5.21 Semantis – Consulting and Visual Analytics [1]-[4]



Company	Semantis GmbH P.O. Box 120548 69067 Heidelberg www.semantis.de Oliver Roser +49 6221 6560484 excellence@semantis.de
Characteristics	Semantis provides consultancy, professional data analytics and information services. We offer, as information provider, country wide KPI benchmarks for specific industries. Our motivation is to open up easy understandable insights by applying big data derived visual analytics. Our priorities are <ul style="list-style-type: none"> ▪ implement data analytic methodology in client enterprise units and organizations ▪ provide strategic consulting regarding semantic information architecture for valuation and embedding new data sources (e.g. IoT, structured and unstructured data) <p>Semantis as official member of the SAP PartnerEdge open ecosystem focuses on customers using SAP ECC. We provide our services also on SAP HANA-based infrastructure.</p>
Customer needs	<ul style="list-style-type: none"> ▪ Making sense of available smart or big data is key factor for our clients to improve decision processes and related revenues. ▪ Companies gain increasing knowledge and deeper understanding by reducing uncertainty. ▪ Identification of relevant data makes potential of new business models accessible.
Big Data offerings	Besides our big data consulting services, we offer enterprise integrated data analytics. As cloud service we offer accessible big data based intel. E.g. our cloud based service www.insurance-benchmark-brazil.de covers areas like <ul style="list-style-type: none"> ▪ Brazil market overview, KPIs and detailed insights ▪ Market analysis to identify new revenues potential ▪ Information on competitors, <p>Customers in Brazil, in a declining environment over the last years, have been looking for standard benchmarks and ad-hoc analytic solutions as convenient cloud-based service.</p>
Big Data	The combination of internal data (on premise) with weekly updated 20 years history of supervisory proven data on the whole insurance market creates each week more than 60 GB of derived data with several 100 Million rows of financial figures. On this basis we extract and determine several thousand KPIs and aggregated information. In business perspective we use well known statistic and analytic methods to provide insights. Semantis focuses on visualization all data providing easy interpretation and understanding.
Innovation	Applying the analytic data process chain on business big data we focus on delivering insights through beneficial visualizations. We are applying state of the art object-functional paradigms on big data, which in addition perfectly fit for businesses using e.g. IOT data streams.
Benefit	Integrating modern business information architecture ensures recurrent revenues based on <ul style="list-style-type: none"> ▪ fact based decision making and visual communication ▪ embedding current analytic capabilities in operational business ▪ providing focus on relevant business innovation drivers <p>Unlike pure information providers and research institutions, Semantis offers with SAP SE and SAP partners complete transformation consulting and change management to achieve identified opportunities.</p>
Prospects	Semantis and SAP SE together are targeting to provide innovative KPI-Benchmark insights for SAP enterprise support clients.
Countries and customers	Worldwide

5.22 Twenty Billion Neurons – AI Solutions based on Deep Learning [1][3]-[6]

Company	Twenty Billion Neurons GmbH based in Berlin, Germany and Toronto, Canada
Employees	Worldwide: 11 Germany: 9
Characteristics	Twenty Billion Neurons provides its customers with artificial intelligence solutions based on the deep learning techniques that lends its power and versatility to the workings of neural networks in the human brain. Our software modules have superior processing capabilities specifically related to the processing of text, image, video, speech and other sensory data related to human cognition. The core of our central system intelligence adapts itself flexibly to new data sources so that the development of custom predictive analytics and cognitive computing applications is cost-effective across industries and functions. Deep learning as a technique is clearly preferred by leading data companies such as Google, Facebook or IBM Watson in the vast majority of analysis settings.
Customer needs	We help our customers automate tasks within the realm of Big Data analytics, complex problem solving and predictive analytics. Our software can discover patterns and trends in data sets that prove invaluable in guiding users in their decision making by means of simplified dashboards or reports. In other cases, we are able to fully automate such decision making processes by teaching systems to take appropriate actions upon specific input combinations. In all cases, the application of deep learning results in leaps of efficiency and quality of your processes.
Big Data offerings	Our A.I. software can learn to solve a very broad variety of problems and is particularly effective in dealing with the full variety of data types at any volume. On exemplary application is the automatic detection and match of visual and text content such as in image recognition and precise filtering of inappropriate content. Another application could be a predictive maintenance system in which our custom sensor data module detects data anomalies and triggers reliable maintenance measures. As our A.I. software is fully driven by its input data and can learn universally it can process a very broad range of data types. Hence it can be applied with comparably small adaptations to a multitude of customer applications.
Big Data	The versatility of our A.I. engine stems from its ability to learn from the data it is confronted with. Once trained these capabilities can easily be transferred to similar data creating massive economies of scale. Hence, the required volume of data to create a custom solution depends on the uniqueness of the data: one application might need millions of sensory data sets to master a relatively unique mix of inputs, another might only require a few hundreds of common life images to identify a desired content in them. Once trained there is no limit to the volume and velocity of data that can be processed. As our software adapts itself to data inputs it can also easily cope with a great variety in the data.
Innovation	The Deep Learning technique itself significantly outperforms traditional machine learning/A.I. approaches where a data processing module is usually programmed manually and also has to be manually adapted. We specifically designed our hard- and software infrastructure to deliver fast solutions and flawless and secure operation. Twenty Billion Neurons is the first company making this technique accessible to the German market at scale.
Benefit	With the capability of our solutions companies can now even realize efficiency in processes which simply would not have been cost-effective were they performed by humans. Existing approaches to solve computer vision or natural language processing tasks are becoming redundant with the introduction of our technology. As a team, we complement the flexibility and power of our A.I. solutions with experienced world-class data scientists and capable project management to ensure the best results. Don't hesitate to contact us to start the journey.
Countries and customers	Germany (focus), Europe, North-America
Future markets	Asia



5.23 Cisco Systems – Integrated Infrastructures and Analytics [1][3]-[9]

Company	<p>Cisco Systems GmbH Am Söldnermoos 17 85399 Hallbergmoos www.cisco.com/de Contact: Dr. Dirk Mahnkopf +49 228 329 5003</p>
Employees	Worldwide: 71,500 Germany: 1,000+
Characteristics	<p>Cisco (Nasdaq: CSCO) is the worldwide leader in IT that helps companies seize the opportunities of tomorrow by proving that amazing things can happen when you connect the previously unconnected. At Cisco customers come first and an integral part of our DNA is creating long-lasting customer partnerships and working with them to identify their needs and provide solutions that support their success. Cisco products and solutions cover Enterprise Networks and Software Defined Networking (SDN), Internet of Things, Mobility, Collaboration, Security, Data Center, Analytics and Automation.</p>
Customer needs	<p>Data is driving digital transformation, and data is the true competitive advantage. A major industry transition is underway where companies are looking for answers: How should they transform themselves to use rapidly evolving digital technologies? Data delivers the insights that lead to better decisions. It enables organizations to be more effective. And data delivers better experiences to customers, partners, and employees to create longer lasting and more productive relationships. Cisco has a broad big data portfolio. We provide integrated infrastructures and analytics to support our Big Data partner ecosystem. We bring 30 years of leadership and vision to guide businesses through networking and infrastructure challenges. We help customers create integrated infrastructures that in turn connects their data from the data center to the edge. Cisco and our partners connect all company data and hyper-distributed environments to unlock data from a hardware or software standpoint.</p>
Big Data offerings	<p>Cisco UCS Integrated Infrastructure (UCS) for Big Data integrates industry-leading computing, networking, and management capabilities into a unified, fabric-based architecture optimized for big data workloads. Cisco UCS changes the way organizations do business through policy-based automation and standardization of IT processes. Cisco UCS combines industry-standard x86-architecture blade and rack servers, networking, and enterprise-class management into a single system. The system's configuration is entirely programmable using unified, model-based management to simplify, and accelerate deployment of enterprise-class applications and services running in bare-metal, virtualized, and cloud-computing environments. Cisco Application Centric Infrastructure (ACI) is a new operational model enabling Fast IT. ACI provides a common policy-based programming approach across the entire Big Data infrastructure, beginning with the network and extending to all its connected end points. This drastically reduces cost and complexity for Hadoop. Cisco Connected Analytics for the Internet of Everything (IoE), a family of pre-packaged analytics software, gives organizations the tools to take on this data challenge directly. Each analytics package is designed to give organizations across industries access to real-time information, predictions, and trends that can have an immediate impact on your business. Security and IT Operations Analytics provides customers with comprehensive, continuous visibility of their IT environment to defend against multidimensional cyberattacks, both known and unknown threats, and to better manage their IT Operations.</p>
Big Data	<p>Cisco is partnering with key industry Big Data ISVs to provide pre-tested and pre-validated solutions on a Cisco UCS Integrated Infrastructure for Big Data. These include market leading Hadoop software vendors (MapR, Hortonworks, Cloudera, IBM), and key analytics players such as Platfora, SAP, SAS and Splunk. Customers of Cisco use these solutions to manage and analyze massive datasets, in many cases Petabytes of data. Use cases of references range from storing and analysing machine generated data to customer data.</p>
Innovation	<p>Over the past 30 years, Cisco has been one of the most innovative companies not only in networking, but also the broader IT market. For example: In 2013, Cisco unveiled its Application Centric Infrastructure (ACI) solution. Cisco's ACI is a new operational model enabling Fast IT. ACI provides a common policy-based programming approach across the entire ACI-ready infrastructure, beginning with the network and extending to all its connected end points.</p>



Hadoop and ACI working together, can instantly and cost effectively scale capacity and deliver exceptional performance for the growing demands of big data processing and analytics. ACI uses intelligent, policy based flow let switching and packet prioritization to deliver:

- Throughput on demand
- Leading edge load balancing across the Hadoop cluster
- Agile, automated configuration of the cluster topology

With the ACI integration, secure connectivity to diverse data sets becomes a part of a user defined policy which is automated and does not compromise on security and access management.

Benefit	<p>The true value from data and analytics comes from acting on the insights found when connecting the unconnected.</p> <p>Cisco brings together data and analytics in a way no other company can. We can connect more people, processes, data, and things than any other company. Our proven network expertise translates to domain expertise for hyper distributed data environments. Cisco's powerful computing infrastructure enables you to make informed decisions using all of your data assets, whether in motion or at rest, all connected securely by Cisco's intelligent network. We can also bring analytics to data wherever it is. No matter how big or how remote, we can help you turn information into insights almost instantly: insights you can use to change behavior, capture opportunity, respond to threats, and improve your business.</p>
Countries and customers	<p>Cisco is a global company and operates in 165+ countries worldwide. Cisco is doing business with virtually all Fortune 500 companies.</p>
Future markets	<p>Cisco has 380 sites and nearly 70,000 channel partners worldwide. Digitization is a huge opportunity for Cisco. As Big Data and Analytics play a key role in Digitization, Cisco directly addresses the demand for solutions and advice from virtually all verticals, and also from public sector organizations.</p>

5.24 Blue Yonder – Solutions for Retail [1][3]-[5]

Company	Blue Yonder Ohiostraße 8 76149 Karlsruhe Dunja Riehemann Dunja.Riehemann@blue-yonder.com
Employees	Worldwide: 150 Germany: 120
Characteristics	<ul style="list-style-type: none"> Blue Yonder delivers the best decisions on pricing, replenishment and customer targeting to the retail sector. Our solutions use ground-breaking machine learning, developed and managed by the most qualified team of PhD data scientists in retail. Founded by ex-CERN scientist Professor Feindt in 2008, Blue Yonder's solutions are unique due to their advanced quality, such as the NeuroBayes algorithm developed by Professor Feindt during his tenure at CERN. Blue Yonder delivers 500 billion decisions per month for its customers typically raising KPIs like profit or revenue by 10 per cent. It delivers these decisions to many of the largest and most influential European retail brands in grocery, fashion and commerce including Natsu, Kaufland, and Otto. In May 2016 Blue Yonder opened an office in Dallas and is already working with US customers. Blue Yonder's priority is to help retailers improve their customers' experience in the omni-channel world. We deliver an 80% reduction in out of stock rates and a 15% increase in revenue through our Replenishment and Price Optimization solutions. Our unique machine learning algorithms turn retailers' data into automated decisions that deliver an optimum level of stock availability that in turn delivers a better experience for the customer.
Customer needs	<p>Many retailers now claim, and all of them are aspiring to offer all products, across all platforms, deliverable all the time – they have promised the ultimate consumer experience. The reality is that most retailers are struggling to accelerate the decisions they need to make to deliver on their customer experience promises – thanks largely to the lack of investment in the supply chain. Typically run on legacy systems, while current supply chain models give a good analysis of long term demand, they do not fulfil the need to make a huge number of quick decisions where margins and inventory are lost and won.</p> <p>Blue Yonder's Machine learning algorithms deliver retailers the best decisions for the supply chain enabling them to respond to rapid shifts in customer demand. Blue Yonder has proved that a retailer can deliver the best customer experience and deliver on profits too!</p>
Big Data offerings	<p>Blue Yonder's Price Optimization solution tests and measures interactions between changes in price and demand. It then uses the automatically set prices to maximize revenue or profit, depending on the retailers' strategy. Using current and historic sales data, article/item master data as well as continuous optimization and testing, the Price Optimization solution goes beyond simple competitive and rule-based pricing, enabling the retailer to optimize and automate thousands of price updates per day. Whether grocery or fashion, retailers' pricing is the core strategic component affecting company profitability. On average, we have proven that a 1% change in price leads to a 10% change in revenue.</p> <p>Blue Yonder's Replenishment Optimization is a predictive application to automate ordering products for stores. It increases availability, reduces stock levels and handling cost, and reduces waste. The software as a service achieves this through a data-backed optimization process that allows retailers to achieve automation in their store ordering, freeing capacities for handling exception and managing strategic trade-offs. Due to Blue Yonder's market leading prediction technology, multiples of these previously conflicting goals can be improved all at the same time, e.g. increasing availability and reducing markdowns in comparison to conventional solutions.</p> <p>The optimal balance between these goals is given by the customer's business strategy and translated into thousands of automated daily replenishment decisions, closing the infamous gap between strategy and execution.</p>
Big Data	<p>Any prediction using data is only as good as the understanding of the underlying problem. The best decisions are based on knowing how to ask the right question of your data. Most companies are still struggling to extract value from the vast amounts of data available to them. Blue Yonder's machine learning algorithms handles the key challenges of integration, storage and processing in one service and by working with Blue Yonder's data scientists, the right questions are asked of the data to fit the retailers' unique strategy.</p> <p>For our customers we automate more than 500 billion decisions per month, most of them</p>



	<p>mission critical, raising KPIs like profit or revenue by 10 per cent. For the multichannel retailer Otto for example we improved the forecast quality by 40 per cent and reduced surplus stock by 20 per cent. So far, Blue Yonder's decisions have delivered a reduction of 2 million articles being returned. They are based on highly accurate granular forecasts stemming from the 'bottom up' approach to predictions taking into account more than 200 factors – e.g. historic sales data, promotions, and external data including competitors and weather.</p>
Innovation	<p>Blue Yonder, with its CERN heritage, has been the forerunner in predictive applications for Retail. Their forecasts are based on highly accurate probability densities taking into account lots of influencing factors, from historic sales data to competitor pricing.</p> <p>Blue Yonder's fundamentally different approach to predictive applications enables retailers to manage their high-level KPIs top-down, automatically breaking them down into thousands of individual KPI-based replenishment decisions supporting the strategic direction of the business.</p> <ul style="list-style-type: none"> ▪ Crucially, this provides competitive advantages for retailers by improving one business goal without a trade-off on another. For example, higher availability with the same inventory levels or the same availability with lower inventory or even higher availability with less inventory (multi-optimization). ▪ In today's retail environment, the amount of data and the millions of daily decisions that need to be made simply cannot be managed manually. Gut feel does not cut it and basing decisions on what you did yesterday will see retailers miss out on margins. Today, using big data from customer information and transactions to deliver valuable decisions requires machine learning algorithms. It also allows retailers to automate the every day operational decisions releasing them to focus on delivering the best customer experience. ▪ Blue Yonder began life in its current form by entering a competition to predict Otto's season's sales numbers of all children's clothes articles in every size and color. It beat 13 other companies with the best prediction by 40%, which lead to a 20% reduction in left-over stock at the end of the season.
Benefit	<p>Blue Yonder delivers 500 billion decisions per month, manages hundreds of stores, hundreds of thousands of products and affects millions of consumer purchases.</p> <p>In customer projects, Blue Yonder achieved:</p> <ul style="list-style-type: none"> ▪ Increased profitability due to better utilization of available resources: 5% ▪ Increased product availability by reducing 'out of stocks' from 6% to less than 1% ▪ Revenue growth of 5-10% as a result of improved service levels ▪ Reduced stock level by 20% during markdown optimization <p>Further benefits: Short in time value – the cloudbased »intelligent layer«, with its web services, via purpose built standard API, enables easy integration with existing infrastructures: 3-6 months typical project duration</p> <p>High return of investments is achieved through the collaboration consulting model, combining data scientists with retail experts, automation und decision optimization: 10x ROI.</p>
Prospects	<p>Customer targeting: Most advertising and couponing today is doubly ineffective as it wastes advertising budgets and consumers' attention. A lot of marketing processes are still stuck in a 20th-century mind-set and value ad-hoc decisions over automatable systematics. Blue Yonder wants to enable its customers to produce and distribute advertising that is proven to be effective and highly profitable, and at the same time relevant and of interest to the consumer.</p>
Governmental R&D promotion programmes	<p>SePiA.Pro is a BMWi-funded research project implementing a smart service platform for industrial big data applications, which is conducted by a collaboration of Blue Yonder, TRUMPF, Daimler, TWT, German Research Center for Artificial Intelligence, and the University of Stuttgart. The project focuses on the optimization of production lines and distributed machine tools. Blue Yonder's data scientists are developing the smart prediction services, which compute the forecasts needed for optimizing the targeted production and maintenance processes.</p>
Countries and customers	<p>Blue Yonder works with the biggest retail brands across Europe. Since May 2016 Blue Yonder also operates in the USA.</p>

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Smart Data

5.25 Infomotion – Professional Big Data Services [1][3][4][6]

Company	INFOMOTION GmbH Ludwigstraße 33-37 60327 Frankfurt am Main www.INFOMOTION.de
Employees	249
Characteristics	<p>INFOMOTION GmbH is one of Germany's leading consultancy companies for Business Intelligence (BI), Business Analytics and Big Data established in 2004. Headquartered in Frankfurt/Main the company covers an extensive service portfolio, including strategic BI & Big Data consulting, design, implementation and on-site support for effective BI solutions as well as coaching and training.</p> <p>INFOMOTION is an industry and branch independent BI & Big Data consultancy company with a primary focus on technologies SAP HANA, Cloudera, Hortonworks, Datameer and others.</p>
Customer needs	<p>Our customers experience challenges in one of the following areas:</p> <ul style="list-style-type: none"> ▪ Finding Big Data use cases to optimize and identify new business models ▪ Experiencing performance issues concerning their operative BI-architecture and software ▪ Gathering experience with new technologies to drive innovation within the company ▪ Missing Big Data technical implementation and analytical skills ▪ Lacking processes and methods to make Big Data projects successful ▪ Reducing licenses and maintenance costs.
Big Data offerings	<p>With an extensive background in BI and Big Data project experience INFOMOTION has developed standardized customer specific services, which help customers to get acquainted with Big Data:</p> <ul style="list-style-type: none"> ▪ Big Data Science Lab: INFOMOTION has its own Big Data Science Lab giving its customers the possibility to try out Big Data technologies without having to buy licenses and hardware. Together with your data and our lab we jointly dive into the world of Big Data. ▪ Big Data Strategy: Many companies do not know where to start with Big Data. Together with our strategy experts we develop a realistic roadmap for your company, which will guarantee useful results in the short and long term. ▪ Open Data Platform: The INFOMOTION Open Data Platform helps you find, connect and manage data from external sources. You do not have to worry where to retrieve the data from and how to use it: our data – your solutions. ▪ Big Data Implementation: INFOMOTION helps to develop and execute architectures, policies, practices and procedures, based on Big Data technologies. We support the full data lifecycle from raw data, data processing and data visualization to support the business users in their daily routine to optimize their business processes. ▪ Coaching & Training: The INFOMOTION BI and Big Data Academy offers technical as well as non-technical training in the field of Big Data. If your company is already actively executing Big Data projects and you might require a second opinion or architectural review, you can rely on our coaching services.
Big Data	<p>INFOMOTION considers Big Data more as an addition to the traditional BI stack. With new technologies available in the market, such as the Hadoop ecosystem and SAP HANA, new opportunities arise to work with huge amounts of data, whether they are structured, semi-structured or unstructured. Stream processing is increasingly being used by customers, as processing big volumes alone is not enough. Data has to be processed fast, so that a company can react to changing business conditions in real time. Traditional discovery tools are being used to discover correlations in subsets of data to be further explored by machine learning algorithms using the parallel processing power of Big Data architectures on the complete volume of data. We are experts in combining new and old technologies to create the best of both worlds for our customer with maximum value and minimal cost.</p>
Innovation	<ul style="list-style-type: none"> ▪ The innovation department of INFOMOTION is responsible for monitoring the BI and Big Data market with the aim to evaluate newly emerging technologies, so that we can offer our customers innovative solutions to drive their daily business. New Big Data technologies enable customers to think outside of the box and develop new strategies, resulting in real-time solutions improving internal and external processes.

	<ul style="list-style-type: none"> With our Big Data Science Lab we invite customers to work on their data with us and without too much of an investment. Many of our customers were not able to integrate external public data sources (i.e. market research data) into their internal organizational data. New Big Data technologies and our Big Data Science Lab provide them with a better understanding of market influences on their daily business. It gives them the opportunity to store, use and analyze data on a deep granular level.
Benefit	<p>Economic benefits customers gain by applying Big Data products, solutions, or services from INFOMOTION:</p> <ul style="list-style-type: none"> Evaluate Big Data technologies in the Big Data Science Lab to reduce cost (hardware / personnel / software) Explore your own data without investing in the development of technical skills Replace existing EDWH layers with Big Data technologies to reduce license and hardware costs. Improve the reusability of company and external data in Big Data use cases.
Prospects	<p>INFOMOTION has extensive expertise in SAP HANA and Hadoop and has created an integration method for both, so that the former is utilized for in-memory technology of the actual and operational data, while the latter can be used as storage for cold data (off-loading).</p>
Countries and customers	<p>Germany, Austria Our customers are working on innovative projects. For more information, call +49 69 97460-700.</p>
Future markets	<p>Switzerland</p>

5.26 Software AG – Streaming Analytics and In-Memory Data Fabric [1][3][4][6]



Company	Software AG Postfach 13 02 51 64242 Darmstadt www.softwareag.com Mr. Guido Falkenberg guido.falkenberg@softwareag.com +49 615192-0
Employees	Worldwide: 4,337 Germany: 1,178
Characteristics	<p>With over 45 years of customer-centric innovation, Software AG is ranked as a leader in many innovative and digital technology categories.</p> <p>Software AG offers the first end-to-end Digital Business Platform – based on open standards, with integration, process management, adaptive application development, in-memory data, real-time analytics and enterprise architecture management as core building blocks. The modular platform allows users to develop the next generation of application systems to help customers build their digital futures today. Market-leading Big Data technologies are core capabilities of the platform to develop and run new business applications and services.</p>
Customer needs	<p>Software AG helps enterprises and public organizations to build innovative digital applications leveraging big data technologies, e.g.</p> <ul style="list-style-type: none"> ▪ Process, analyze and act upon large data volumes in real-time ▪ Internet of Things (IoT) – ability to connect and analyze production processes, device and location data (e.g. Industry 4.0) ▪ Real-time fraud detection, e.g. rogue financial trading activities and market abuse ▪ Extreme application scalability and performance of online business ▪ Fast, positive customer experience for Web and mobile apps ▪ Predictive maintenance to improve product quality and development ▪ Real-time tracking and monitoring of logistics to optimize the supply-chain ▪ Reduce costs and improve scalability by offloading data from databases to in-memory.
Big Data offerings	<p>Big Data In-Memory data and streaming analytics technologies are at the core of Software AG's Digital Business Platform offering market-leading capabilities to process big data in real-time.</p> <ul style="list-style-type: none"> ▪ Apama Streaming Analytics: A platform for real-time Big Data analytics (Complex Event Processing, Predictive Analytics) and intelligent automated action on fast-moving data (event streams). ▪ Terracotta In-Memory Data Fabric: Software AG's Terracotta In-Memory Data Fabric is a platform for distributed and high-available in-memory data management with extremely low, predictable latency at any scale.
Innovation	<ul style="list-style-type: none"> ▪ Software AG's Apama Streaming Analytics platform serves proven scalability, management and application development capabilities to make right decisions at the right time. With ultra-low-latency event pattern detection and the ability to maintain the state the product provides robust capabilities to analyze millions of events per second. Long-running pattern detection is supported via the integration of the Terracotta In-Memory Data Fabric and a comprehensive set of connectivity to existing (e.g. databases, messages) and new data systems (e.g. Internet of Things or Social Media). And with the Predictive Analytics add-on, predictive models create repeatable, self-learning processes that adjust dynamically over time. ▪ Software AG's Terracotta is an in-memory data fabric platform to move and process terabytes of high-value data in machine memory. This extensive software-based product enables scale-up and scale-out in-memory application scenarios across multiple servers based on mainstream Java, operating system and hardware environments. Terracotta implements Ehcache the most widely used standard caching API and provides Hadoop-ready integration to allow fast movement of in-memory data between Terracotta and Hadoop. ▪ Apama and Terracotta are fully integrated with Software AG's Digital Business Platform enabling enterprises to design, implement and govern digital transformation strategies and applications. Platform capabilities, such as integration (application, data, B2B, API), application development, process automation and intelligence are seamlessly integrated with Apama and Terracotta to better achieve a business value for big data scenarios. ▪ Software AG drives co-innovation with customers and partners by providing the implementation technology and methodologies to combine these with customers' innovative business ideas.

Benefit	<p>Leveraging Software AG's technologies has been proven in mission-critical business scenarios delivering true business and technology benefits:</p> <ul style="list-style-type: none"> ▪ Improve product and manufacturing quality ▪ Increase customer insights and experience ▪ Open up new cross- and up-sell opportunities ▪ Enhance the reach of doing business (e.g. mobile, API) ▪ Gain competitive advantage with new business models and applications ▪ Avoid financial or operational risks ▪ Ensure availability at peak processing times ▪ Gain real-time visibility into operations (e.g. supply chain) ▪ Reduce costs and improve customer experience of Internet-scale applications
Governmental R&D promotion programmes	<p>Software AG plays a significant role in Europe's largest Software Cluster Software Innovation for the Digital Enterprise, and is engaged in several projects funded by e.g. the European Commission or German government.</p> <ul style="list-style-type: none"> ▪ Federal Ministry for Economic Affairs and Energy: »Smart Data Programme« (iTESA, sd-kama) ▪ Federal Ministry of Education and Research: »Big Data Programme« (BigPro, iPRODUCT) ▪ European Commission: »Horizon2020« (RADAR-CNS) ▪ The Hessen State Ministry of Higher Education, Research and the Arts: »LOEWE« (TrustCom)
Countries and customers	<p>Big data customers:</p> <ul style="list-style-type: none"> ▪ ING enhanced control with an automated solution that monitor for rogue trading activities and market abuse. ▪ Schwering & Hasse implemented a quality management solution across its complete »transparent factory« to have a greater level of awareness of production operations than ever before. ▪ Royal Dirkzwager implemented a solution that offers more real-time data, to quickly develop and market new maritime logistics products, gaining a huge strategic advantage. ▪ ADEO operates at a massive scale – yet is focused on delivering personalized service. The in-memory enabled integration solution handles millions of messages between the central systems and sales systems every day and speeds up communication between them. ▪ CERN developed an in-memory cluster solution for monitoring the research facilities and building technology with reliable handling of even the highest traffic.
Future markets	<p>Emerging digital technologies (e.g. IoT, VR, 3D-Printing, Wearables) and new digital business models (e.g. Fintech, Connected Cars, Industry 4.0) will drive the future market for digital business and big data platforms.</p>

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5.27 TWT – Consulting and Innovation Service Provider [1][3][4][6]

Company	TWT GmbH Science & Innovation Ernstaldenstraße 17 70565 Stuttgart www.twt-gmbh.de Dr. Markus Pfeil +49 711 215777-0
Employees	Germany: 300
Characteristics	<ul style="list-style-type: none"> IT System House, Consulting and Innovation Service Provider for the High Tech Industry Business Areas: Automotive, Aerospace, Automation, Health Care, and Energy Relevant Key Competences: Design Thinking, Service Computing, Mobile Computing, Data Management & Integration, Predictive Data Analytics, Recommender Systems, Complex Data Visualization, IT and Management Consulting, Usability Engineering
Customer needs	The design, development, tests, and operation of products and production facilities result in a tremendous amount of data that offers business and innovation potential far beyond our imagination. Product development and respective simulation, measurement and test data associated with real-time operational data as well as data resulting from connected objects machines and products are just examples for potential data sources. We support our customers in organizational implementation of big data, deriving knowledge and coherencies by evaluating, analyzing, understanding, and linking heterogeneous data and predicting potential operational threats.
Big Data offerings	<ul style="list-style-type: none"> IT and Management Consulting: Human-centered Smart Data: A stakeholder-centric approach for realizing the potentials of big data for different business units (e.g. research & development, sales, aftersales). The combination of strategy and communication consulting with deep big data and domain expertise reflects the interdisciplinary approach which addresses the dimensions people, business, and technology. Smart Data Hub: A modular data integration system relying on open standards and allowing for transparent real-time integration of data sources, ranging from sensors to enterprise databases. Data Management and Recommender Systems: Data analytics systems offering domain-relevant evaluations of a plethora of data pools and sensor information. Predictive Analytics Services: Data analytics based on computational statistics and machine learning for predictive data analysis in customer relationship management, testing or digital prototyping.
Big Data	Big data is a key for real-time customer behavior, which is mandatory for a customer-centric car development. The introduction of autonomous vehicles and the respective camera, radar and lidar systems for environment perception produce data volumes in the range of several petabytes per day. While part of the data is required for the safe maneuvering of the vehicle, a significant amount of operational vehicle data, traffic and construction site information, dynamic traffic signs or local danger spots is transferred to cloud-based backend systems. Big Data approaches are going to account for the data volume and velocity to predict traffic, to provide individual navigation services or to forecast dangers.
Innovation	<ul style="list-style-type: none"> Human-Centered Smart Data: An interdisciplinary approach towards an agile organizational implementation of smart data (Dimensions: People, Business, Technology) Comprehensive domain knowledge, especially in the automotive and aerospace domain, combined with highly skilled data scientists Cross-disciplinary process and technical expertise at the interface between information technologies and (systems) engineering Close cooperation with universities and research institutes, allowing for a fast transformation of scientific findings to commercial innovation.
Benefit	Our solutions drastically reduce product development costs and times, and build the foundation for highly individualized services by applying our knowledge in Big Data and Predictive Analytics.
Governmental R&D promotion programmes	<ul style="list-style-type: none"> Shared E-Fleet Project, funded in the ICT for Electromobility Program – Federal Ministry for Economic Affairs and Energy Sepia.Pro Project, funded in the Smart Service World Program – Federal Ministry for Economic Affairs and Energy
Countries and customers	Germany: Daimler AG, BMW AG, AUDI AG, Porsche AG, Siemens AG, Robert Bosch GmbH, MAN Truck & Bus, Airbus, MTU, GKN, Continental, IBM



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5.28 idalab – Agency for Data Science [1][3][4]

Company	idalab GmbH Alexanderstr. 7 (10th floor) 10178 Berlin www.idalab.de Paul von Büнау +49 30 814513-0 paul.buenau@idalab.de
Characteristics	<ul style="list-style-type: none"> We give our clients the decisive advantage from data, machine learning, and artificial intelligence. We combine deep mathematical expertise with strategic thinking and a passion for our clients' success. We tailor sophisticated tools to the exact needs of our clients to make a tangible impact. Neither do we offer a standardized platform for data science, nor do we sell software licenses. We focus on mobility, the biopharmaceutical industry, and the public sector.
Customer needs	Our clients come to us because we help them harness value from their data. One of the most fascinating challenges lies in performing predictive analytics on the basis of unstructured data.
Big Data offerings	<ul style="list-style-type: none"> Engineering of New Products and Research: We develop the engines that power innovative data products. At the frontiers of advanced analytics and strategy, we shape new perspectives for our clients' products. We customise AI algorithms and mathematical tools to deliver the intelligence edge that will have an impact. Fusing creativity and accuracy, we make reliable predictions, perform effective optimisations, or reveal patterns of insights from data. Process Improvement and Data-Driven Automation: We improve operations using machine learning. With the big picture in mind, we look for ways to significantly improve our clients' performance. We deploy machine learning, mathematics, and AI where it matters, starting with the quick-wins and advancing towards the next revolution. Our work is guided by results from real field tests, which empower us to establish feedback-loops as early as possible. Roadmapping, Assessment, and Strategy: We help our clients navigate the world of Big Data, machine learning, and AI. To do so, we chart a clear path accelerating the contribution of data and algorithms to our clients' strategic vision. We discover and prioritise use-cases, assist in buy-vs-make analysis, find the right people to staff an in-house data analysis team, perform data science due-diligence, and partner in innovation programmes.
Big Data	We focus exclusively on projects where deep methodological expertise is required. In our missions, we use methods such as natural language processing, neural networks, and Bayesian modelling. We have solved complex data problems with our know-how in time series analysis, discrete optimisation, and customer segmentation.
Innovation	<ul style="list-style-type: none"> About 80% of our projects enable new strategic directions for our clients. Catenion can now predict the probability of success of phase III clinical studies in oncology. Our algorithm curates the content of UBS Planet Art, the Bloomberg Terminal for contemporary art. We developed a text classification algorithm for Lieferando.de, which facilitates highly-customised recommendations. We also regularly participate in R&D programmes with universities and institutes.
Benefit	Benefits gained by our clients are many and include among others: improved allocation of R&D spending for clinical trials, personalised product recommendations ensuring customer satisfaction, and strengthened brand positioning as an innovative actor.
Governmental R&D promotion programmes	<ul style="list-style-type: none"> SD4M – Smart Data for Mobility – with DFKI (German Research Center for Artificial Intelligence),]init[, PS-Team, DB Systel ALICE Research Project – Autonomous Learning in Complex Environments ABBO Research Project – Analysis and Prevention of Organised Fraud in Online Trade
Countries and customers	idalab operates mostly in Germany, as well as in other countries of the European Union. Our clients comprise Razorfish, comdirect, Lieferando.de, Visual Meta, Catenion, Affinitas, and Outfittery.

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Smart Data

5.29 Siemens Mobility – Smart Data Analytics for Rail Customers [1][3][4]

Company	Siemens AG Wittelsbacher Platz 80200 München www.siemens.com Gerhard Kreß gerhard.v.kress@siemens.com
Employees	Worldwide: 348,000 Germany: 144,000
Characteristics	<ul style="list-style-type: none"> ▪ Business focus: Mobility division in Siemens ▪ The primary business model is for Siemens is B2B, here focus is on service business ▪ This offering focusses on big data driven insights in the rail industry.
Customer needs	Customers constantly aim to improve the performance of their rail assets to fulfill the ever increasing demands on them. Availability of the vehicles and the infrastructure is a key lever, as well as management of the operational risk and reduction of lifecycle cost.
Big Data offerings	<p>Siemens offers a set of data services for its rail customers based on big data:</p> <p>Smart Monitoring, which helps customers visualize the location, technical data and condition of the rail assets. The customer can assess the situation of the asset and initiate corrective action when required directly from the tool.</p> <p>Smart Data Analysis, which uses advanced data analytics to generate additional insights from the rail data, e.g. asset condition assessment or predictive maintenance. This offering allows the customers to take preventive action and optimize their processes prior to any operational impact.</p> <p>These offerings are developed by Siemens Mobility powered by the Sinalytics platform from Siemens. The Sinalytics platform ensures the market leading platform capabilities, unlimited scalability and sufficient performance for the big data analytics activities.</p>
Big Data	<p>The data service offerings rely on the data available for rail assets. This includes diagnostic information (event messages), sensor data (time series data), but also work orders for the depots, spares data, weather data and geographical information. The data volumes are large, as a single vehicle will easily deliver over 1 billion data points per year, the newest vehicle models are even factors above this volume.</p> <p>The key target is to identify upcoming failures of rail assets and their components by identifying predictive patterns or abnormal conditions of such components.</p> <p>The data is analyzed mostly by using data mining and machine learning algorithms, often using supervised learning techniques. Also unsupervised learning techniques are getting used more and more often.</p>
Innovation	<p>With Sinalytics Siemens offers leading technology for big data analytics. For instance, in the mobility market, the Siemens solution is unique and setting the market standard. It offers the full range from data transmission over the visualization to the analysis of the asset data. At the same time, it is supported by a cybersecurity program which ensures data security and privacy.</p> <p>End result of the analytics is an actionable proposal for the customers to drive up asset availability and improve the performance of the asset. The level of functionality and the scope is unrivaled in the industry and can only be reached by the unique combination of world class big data analytics and rail engineering know how.</p>
Benefit	For our customers, this means they can increase the performance of their assets and reach an outstanding availability so that they can improve their offerings towards their own customers. As an example, our customer Renfe has been able to use the extremely high availability of the Velaro trains to bring many passengers on the journey from Madrid to Barcelona from the plane to the train.



5.30 Codecentric – Custom Built Fast Data Stacks [1][3][5][6]

Company	codecentric AG Merscheider Str. 1 42699 Solingen www.codecentric.de Stefan Siprell stefan.siprell@codecentric.de
Employees	Worldwide: 320 Germany: 200
Characteristics	<ul style="list-style-type: none"> Thought leader in technology consulting and Agile Development Full support of customers from Data science to technology Preference of open-source best-of-breed over commercial all-in-one stacks
Customer needs	Customer needs range from a strategic answer to digitization down to pre-flight checks of newly built NoSQL solutions.
Big Data offerings	<ul style="list-style-type: none"> Data science consulting from Descriptive to Prescriptive Analytics Data technology consulting with SMACK, Hadoop or Elastic tools Cloud technology consulting in building an on-premise or using a public cloud
Big Data	Big Data is the foundation on which digitization rests: no 1:1 interaction is possible if the customer is not known and understood. Volume and Variety is mastered by most technologies. The current challenge lies in the reduction of latency between data – insight – reaction without sacrificing the richness of context. We cover all four states of the Analytic Value Escalator (Gartner).
Innovation	<ul style="list-style-type: none"> We engineer custom built Fast Data stacks based on innovative open-source modules. We build the software using lean / agile methods. We analyze requirements and build a matching platform as we are not bound to an individual vendor. Examples of new business-cases: real-time street-map updates based on swarm vehicle data, retail and insurance digitization, real-time advertising bidding We have close ties to the Silicon Valley and continuously scout for innovative yet enterprise ready technologies.
Benefit	The IT industry is experiencing an upheaval in technologies and methods. By using best-of-breed platforms, our customers can face today's problems without sacrificing the ability to execute in the future.
Prospects	We are the only consulting company worldwide which has partnerships with all of the SMACK (Spark, Mesos, Akka, Cassandra and Kafka) vendors.
Countries and customers	Germany, Switzerland, Austria, Netherlands



5.31 Syncwork – Consulting, Solution Design, Implementation [1][3][6]

Company	Syncwork AG Lietzenburger Straße 69 10719 Berlin www.syncwork.de Jörg Frank Director Systems Development
Employees	Approximately 100 (95 work in Germany)
Characteristics	<p>Syncwork combines management consulting and information technology consulting to cover the entire value chain: from a business analysis to technological consulting and solution design up to implementation services. Methodical and business know-how, a leading edge technical knowledge, consulting competence, and a long time experience are the key factors to provide value for our clients.</p> <ul style="list-style-type: none"> Innovate and improve business processes using new technological approaches Tame giant datasets and a plethora of data sources Establish validated and verified business insights that were previously not available.



Customer needs	<p>Our customers are faced with these fundamental questions and challenges:</p> <ul style="list-style-type: none"> ▪ How can we gain a competitive advantage by using big data technology? How can we avoid disadvantages if competitors do so? ▪ How to achieve, test and validate new insights gained by integrating different business domains? ▪ How can we adapt to regulatory requirements based on big data technologies? ▪ How to setup a cost efficient & scalable IT-architecture and integrate it with our current IT-landscape?
Big Data offerings	<p>We help companies to find improvements for their business processes by using big data technology and quickly create big data solutions to deal with his challenges.</p> <ul style="list-style-type: none"> ▪ We support companies by quickly implementing proof of concepts for their big data approaches. ▪ We support clients to build a big data solution in our lab environment. ▪ We increase reporting speed using solutions based on SAP HANA, Hadoop Ecosystem and Spark. ▪ We support clients to seemingly inseparable integrate Big Data technologies in existing IT-environments. ▪ We create Big Data analytic solutions to help the customer to adapt to regulatory requirements.
Big Data	<p>The pure volume of the data yielding permanently increasing requirements for complex data analysis and data integration methods.</p> <ul style="list-style-type: none"> ▪ Classic data warehouse-scenario with a well-known and modeled schema is the prerequisite to process and analyze data fast and efficiently. ▪ We now face situations where the schema of the data is unknown or must adapt to fast changes. ▪ The variety of the data and data sources is growing with high speed. Data are ingested and later integrated using exploratory analytics and derived taxonomies. ▪ Classic IT-architectures are not able to cope with these challenges in an economic fashion: A new efficient and scalable hardware and software environment becomes necessary. ▪ Complex computational analysis with varying parameters is now feasible to support urgent business decisions.
Innovation	<p>In general big data is an innovative field with high potential of new applications. We provide and elaborate Big Data use cases that can easily be prototyped. Once a Big Data proof of concept is established, the customer can easily enlarge it, since the environment is scalable at comparatively low cost and further use cases can be added.</p> <p>We differ from other market participants since our approach to Big Data is based on our long term experience in the Validation and Verification in the software development life-cycle in the regulatory environment. Our goal is to integrate Big Data Projects imperceptibly into the software development and business process.</p> <p>Our customer could connect different data silos of different business domains and gain new business insights and perspective. Using Informatica PowerCenter and SAP HANA technology, taking off load of the customer's current mainframe and increasing the reporting velocity by orders of magnitude on TIBCO Spotfire.</p> <p>Our key players offer Big Data lectures at academic institutions and mentor master theses at universities. We also publish together with the Fraunhofer IAIS.</p>
Benefit	<p>Our customers gain several benefits by using our services in implementing Big Data systems.</p> <ul style="list-style-type: none"> ▪ Cost reduction and scalability by using the Hadoop ecosystem. ▪ Enhanced analysis of e.g. customer behavior and customer interaction. ▪ Optimized channel marketing. ▪ Improving business processes. ▪ Using Big Data technologies in regulated environment (e.g. validated Big Data systems in pharmaceutical industry).
Countries and customers	Germany, Austria, Switzerland

5.32 Analyx – Marketing Decisions [1][3]

Company	Analyx GmbH Oderberger Straße 44 10435 Berlin http://analyx.com Dr. Oliver Beck Geschäftsführer +49 171 6852813
Employees	Analyx Ventures: >120 Analyx Poland: 24 Analyx Germany: 4
Characteristics	Analyx makes sense of Big Data and helps clients worldwide to understand their consumers better via advanced analytics. We strongly believe in the power of advanced analytics on big datasets when it is combined with common business sense and experience in how certain industries work. With this combination of industry knowledge and analytical power we support consumer-oriented industries such as TelCo, FMCG, Automotive, Durables and Retail Banking by providing them with software tools and consulting services.
Customer needs	Our customers are marketing decision makers facing diverse marketing challenges from »how to optimally structure the product portfolio« to »how to set the optimal price level for a product« or »which customers are most likely to end their contractual relationship within the next six months and how I can optimally act to avoid this«. Another important marketing challenge relates to how to spend the marketing budget most efficiently across marketing channels, products, product attributes or even geographical regions.
Big Data offerings	Besides our consulting services we currently offer the following five software tools to clients: <ul style="list-style-type: none"> ▪ PortfolioWorx: Generating insights for product portfolio optimization through simulations that allow to remove products from the market, change product characteristics and compare the result to your current product market share – risk-free. ▪ PricePromoWorx: Understanding consumers and their shopping behavior better through analysis of sales data and the additional intelligent analysis of existing data helps to recognize effects of promotions and pricing strategies and to increase revenue and sales. ▪ SpendWorx: Using Big Data Analytics and simulations to find the optimal budget amount and the optimal media mix regarding channels, products and regions to reach budget goals. ▪ BrandWorx: Understanding drivers of the brand funnel quantitatively and optimization of campaigns accordingly. ▪ CustomerValueWorx: Determining the most suitable measures, depending on customer value and customer loyalty in the long term to prevent customer churn and increase marketing revenue. Each software tool can be flexibly customized to the client's datasets and requirements.
Big Data	Some of the datasets that we are handling in client projects can certainly be considered »big« in size. Most often those datasets are machine-generated such as logfile or sensor data. Those datasets then require elements of a typical Big Data stack for their analysis, e.g. storage in a distributed file system and distributed analytics. Another topic where we deal with Big Data technology is in the analysis of images. This task almost always requires modern GPU-based processing to handle the computational load. Some of our Big Data software products such as PortfolioWorx deeply integrate computation on GPUs for all tasks related to image processing.
Innovation	<ul style="list-style-type: none"> ▪ We are bringing a unique combination of business acumen and state-of-the-art Big Data analytics to marketing decision makers. Our focus is always on the business question first, but then we apply state-of-the-art analytical methods such as econometrical models or modern methods of machine learning and other Big Data technologies to answer those questions. ▪ For our consulting services we consider that blend of serious management oriented consulting with really modern advanced analytics as truly innovative and value creating. In addition we typically aim at leaving a software tool with our clients rather than only presenting project results. This enables the client to actively pursue their topic of interest beyond the period of the project. In our experience this can make a consulting project for a client more valuable and »lasting«. ▪ Our software tools reflect the state-of-the-art in current methodology and technology, too. For achieving that we are doing a lot of internal R&D and partner with universities while constantly evaluating new methods or technologies as they are emerging. All software tools have been designed from the ground up with user experience in mind to give even the most time-pressed marketing manager the possibility to conveniently explore outcomes of many alternative scenarios.



Benefit	By using our Big Data software products and services clients can manage product portfolios on a more informed basis, set pricing strategies while being aware of their expected revenue impact, invest media spendings according to their highest expected marketing ROI or manage customer churn based on statistical evidence which customer is more likely to be won back. All of those activities can have a direct impact on the economic well-being of most companies.
Countries and customers	Germany, Austria, Switzerland, Poland Volkswagen AG, BSH Hausgeräte GmbH, Mister Spex GmbH, Deutsche Telekom AG, Vodafone Kabel Deutschland GmbH, Henkel AG & Co. KGaA

5.33 Conslin – Monitoring of Customer Opinions [3]

Company	Conslin AG Leonrodstraße 68 80636 München www.conslin.com +49 89 3063650 contact@conslin.com Dr. Dirk Schachtner
Employees	Germany: 90
Characteristics	<ul style="list-style-type: none"> ▪ Customer Voice Monitoring – Product Observation: Complete and precise monitoring of customer opinions on the internet ▪ Reliable Product Observation and Monitoring in online sources worldwide for industries such as Automotive, Consumer Goods, Pharma
Customer needs	Use customer voices on the internet as a 360° radar and early warning system for product observation throughout the complete product lifecycle, improve products and services and reduce quality cost through early detection of product faults.
Big Data offerings	<ul style="list-style-type: none"> ▪ Product Observation: Reliable monitoring to fulfill legal product observation duties ▪ Product Launch Monitoring: Detection of faults, weaknesses and strengths in the critical product launch phase ▪ Social Media Monitoring: Substantial monitoring which detects and analyzes all relevant customer statements independently from the use of keywords ▪ Benchmarking: Authenticity and relevance of benchmarking through analysis of opinions from competitors' customers in order to learn from the best ▪ Virtual Product Clinics: Successful product development based on real customer experiences in real-life situations
Big Data	Processing of hundreds of thousands of customer statements in more than 20 languages from multiple online sources every day. Analytics based on proprietary 24/7 cockpit solution CIMS.
Innovation	<ul style="list-style-type: none"> ▪ Pioneer in the field of complete and precise monitoring in more than 20 languages and a multitude of countries ▪ Conslin is the only monitoring provider to define and guarantee the fulfillment of quality standards in terms of completeness and correctness of data. Moreover, Conslin provides full content analysis including translation of every customer opinion ▪ Faster detection of product faults, product observation throughout the complete life cycle, product improvement on basis of real customer experiences in real-life situations (virtual product clinics) ▪ Solutions are based on a proprietary set of methods and software developed by Conslin over the last 15 years
Benefit	Reduction of quality cost in general, reduction of costly product recalls, sales increase through targeted development, avoiding image damages.
Prospects	The Conslin Intelligence Management System (CIMS) Version 6.0 is currently under development.
Governmental R&D promotion programmes	All R&D investments are self-financed.
Countries and customers	Europe, USA, China, India, South America Volkswagen Group, Daimler, Jaguar Land Rover, Webasto, RWEL
Future markets	South Korea, Japan, Malaysia, Indonesia



5.34 Kiana Systems – Complex Data Projects [1][3]

Company	KIANA Systems GmbH Im Helmerswald 18 66121 Saarbrücken www.kiana-systems.com Ushan Ganeshanathan CEO Dr. Mathias Bauer Chief Data Scientist +49 681 830-4375
Employees	Germany: 17
Characteristics	KIANA Systems is a leading provider of Big Data analytics, data mining and machine learning technologies based in Europe. KIANA helps companies worldwide implement a data-driven strategy and leverage the potential of data analytics to make faster and smarter decisions and gain competitive advantage. KIANA's customers are large DAX30 corporations, hidden champions and innovative startups from across all industries. The company was founded as a spin-off of the renowned German Research Center for Artificial Intelligence (DFKI) initially under the name of mineway in 2001. Give us the data – we can solve the problem.
Customer needs	KIANA's strength is its agility and customer-centricity in solving client needs across industries and functions. We help our customers realize complex data projects successfully or help them build their own Data Science Labs or analytics software. KIANA is not centered around particular industries but rather around the world-class expertise of its data scientists and its capability to solve unique problems quickly and cost-efficiently.
Big Data offerings	KIANA's big data offering is as wide and deep as our customers' demands. Following please find a sample list of projects we have already implemented: <ul style="list-style-type: none"> ▪ Marketing & Sales: Adaptive Websites, Social Genome Analysis, Churn Modelling, Customer Segmentations, Automated Pricing, Salesforce Planning ▪ Industry 4.0 and IoT: Advanced Automation, Smart Energy, Predictive Maintenance, Modelling of Complex Sensory Systems ▪ Selection of reference industries in alphabetical order: Automotive, Banks & Insurances & Other Finance, Energy, FMCG, Industry, Internet companies, Media, Mobility & Travel, Pharma, Retail, Service Sector
Big Data	KIANA handles projects with any data complexity many of which involve large data volumes from multiple data sources, real-time analysis and decision-making. It can help clients implement the latest tech stacks and build their own big-data platform.
Innovation	<ul style="list-style-type: none"> ▪ KIANA has one of the most experienced data science teams in Europe ▪ KIANA has developed libraries of proprietary data mining and machine learning tools ▪ KIANA has a track-record of successful projects since 2001 ▪ Strong partnerships with some of the world's best research institutions eg. The German Research Center for Artificial Intelligence (DFKI) or the Fraunhofer Society
Benefit	Companies who apply big data analytics are on average significantly better than their competitors. Our customers usually make the same experience. A large insurance could sustainably reduce a high-level of customer churn by 50% with KIANA's help. A large retailer realizes higher margins and sales volumes through dynamic real-time pricing across tens of thousands of products.
Countries and customers	Worldwide with a focus on Europe and a strong footprint in Germany. References include Lufthansa, Weselmann, Thomas Cook, E.ON, ETH Zürich, TUI, Weleda, Nordsee, kohlfarma and many others
Future markets	In Europe



5.35 PricewaterhouseCoopers – Strategy Services and Analytical Pre-configured Applications [1][3]



Company	PricewaterhouseCoopers AG Wirtschaftsprüfungsgesellschaft Friedrich-Ebert-Anlage 35-37 60327 Frankfurt am Main www.pwc.de Andreas Hufenstuhl +49 20 3317-5064 andreas.hufenstuhl@de.pwc.com
Employees	Worldwide: 208,000 Germany: 9,800
Characteristics	<ul style="list-style-type: none"> ▪ PwC is the leading auditing and consulting firm in Germany. ▪ PwC offers its clients a full spectrum of services across the digital transformation of companies – from strategy through execution. PwC's Data & Analytics experts support companies in analysing data and obtaining the value they need to gain a competitive advantage. ▪ Why PwC? PwC advises on all facets of Data & Analytics, including business models, predictive analytics and maintenance, Industry 4.0, cybersecurity and forensics, as well as analytics along the corporate value chain.
Customer needs	The challenges PwC's clients face include differing maturity levels regarding data analyses, tapping the potential of unused data and using it for business modelling and decision-making.
Big Data offerings	We support our clients with a broad range of solutions to increase net revenues or to decrease the operational cost throughout the full project life cycle. For further information, please visit: www.pwc.de/bigdata or www.pwc.com/bigdata
Big Data	Many of our solutions are based on huge machine log files or unstructured internal/external data. In order to generate the right insights within this data portfolio, we deal with Big Data technologies to manage data velocity and variety. In a second step, we enrich existing internal structured information systems with the findings from the unstructured data world. In this way, our clients benefit from past investments and can already use the new outcome of our Big Data analysis for their decision-making processes.
Innovation	<p>PwC is working jointly with clients, universities and government organisations to develop industry solutions for the latest market or digital innovations. PwC's Digital Experience Centre in Frankfurt am Main (launch: autumn 2016) will provide our customers with a live experience of our latest analytical innovations.</p> <p>Because of our long, deeply trusted history with many global brands and regional industries, PwC has extensive industry expertise and supports its clients from strategy through execution. We know our clients' business, new regulations, market trends and supporting data sources in depth, which allows us to advise our customers step by step along the Big Data journey.</p> <p>Many new business models like usage-based insurance, predictive maintenance or financial risk avoidance would not exist without the new analytical opportunities that Big Data technologies provide.</p>
Benefit	Key to each solution and service is the customer time to unlock data value. Our portfolio of strategy services and analytical pre-configured applications allows our customers to achieve their Big Data goals with a minimum of business and IT involvement. We focus on achieving the maximum scope coverage by orchestrating existing services and often start our individual customisation process with a 70% solution after the first project iteration.
Prospects	See more at: www.pwc.de/bigdata or www.pwc.com/bigdata
Governmental R&D promotion programmes	In October 2015, PwC announced a cooperation with Fraunhofer IAIS on Big Data and Industry 4.0. The cooperation covers the areas of healthcare, communication, mobility, energy and environment. Together with other leading industrial companies, PwC and Fraunhofer founded the association Industrial Data Space e.V., which focuses on data exchange across industries.
Countries and customers	The PwC network operates in 157 countries.

5.36 Trivadis GmbH – Professional Big Data Services [1][3]

Company	Trivadis GmbH Lyoner Strasse 15 60528 Frankfurt www.trivadis.com Dr. Normen Müller normen.mueller@trivadis.com Mathias Walter mathias.walter@trivadis.com
Employees	Worldwide: 650 Germany: 200
Characteristics	»IT's all about Data«. Trivadis has a strong focus on databases for more than 20 years. IT Consulting, System Integration, Solution Engineering, IT Training and providing IT Services – this is our business.
Customer needs	Insight and understanding – that's the essence as well as the challenge of Big Data for your business. Using the gathered knowledge efficiently makes the difference between a successful Big Data project and a plain vanilla technology driven approach.
Big Data offerings	Explicitly reveal your implicit knowledge by using adequate methods and technologies – that's our approach.
Big Data	For us »Big Data« means discovering and transforming data into smart information. Finally, our goal is to achieve excellent knowledge. To provide this, we are using our own methodology – a Business Impact Analysis – to ensure that there is a strong alignment between business goals and technological possibilities.
Innovation	<p>Our perspective-driven innovation is to understand »Big Data« as the disjoint extension to »Business Intelligence«. We understand both to be each a set of methods and techniques for the transformation of raw data into meaningful and useful information for business analysis purposes. In this sense »Big Data« just adds new methods and techniques yielding one cooperation set (cf. Logical Data Warehouse).</p> <p>By leading a scientific project with focus on distributed computing Trivadis will enhance performance and robustness in the big data environment. These efforts are planned to be integrated as the underlying abstraction layer of Apache Spark. Existing technologies and own scientific research is combined to achieve a maximum of benefit for our customers.</p>
Benefit	Our experience – Your Benefit: where to use Big Data? We have learned that there is no »single answer«. It is business case driven. More than 400 database and Data Warehouse projects (on premise, hybrid, cloud) in the last 4 years confirmed our statement. This is the experience we have to offer.
Countries and customers	Switzerland. Germany. Austria. Luxemburg. Danmark. Liechtenstein. SBB, Credit Suisse, UBS, Novartis, Nespresso, Daimler, Boehringer Ingelheim, BMW, Lufthansa, Deutsche Bahn, Sony DADC, ORF, Verbund (www.verbund.at), ÖBB, Österreichische Post, Austrian Airlines.



5.37 Vico Research & Consulting – Social Data Analytics [1][3]

Company	VICO Research & Consulting GmbH Friedrich-List-Strasse 46 70771 Leinfelden-Echterdingen www.vico-research.com +49 711 787829-0
Employees	Germany: 65
Characteristics	VICO is the largest German provider of social media listening solutions and web intelligence systems. Its variety of systems, products and accompanying services is unique on a global level. Current studies describe VICO Analytics as one of the top 10 most advanced social media listening systems in the European market. The technology leadership is additionally proven by awards for its channel monitoring and review monitoring systems. While most of the providers focus on systems for the analysis of internal data, VICO is a software-as-a-service provider that offers services in a cloud that allows analysis of internal and external data. VICO is active in the analysis of prices, shops, reviews, social media, online media, service, market research and offers specific corresponding operational and strategic services.
Customer needs	Today, companies are more and more facing the challenge to respond to shifts in markets fast and well founded. The difficulty is in the availability of relevant parameters at the right time to be able to reach the right decisions. An automated extraction of market, social media and other newsworthy data from the great mass of unstructured data is necessary in order to ensure transparency for the whole company including division-specific use cases. VICO Analytics combines social media monitoring and web intelligence in one solution. In addition, we provide extensive strategic advice and qualitative evaluations in the form of highly diagnostic management reports. Therefore, we prepare information from the social web, so that it can be used as a decision memo for your processes.
Big Data offerings	We extract information from big/social data and integrate it into our customers business processes by using/offering the following proprietary technologies, tools and services: big data analysis, social media listening, big data cloud solutions, product intelligence systems, web intelligence solutions, customer insights, content and text analysis, review and rating monitoring, social CRM, alerting systems, price monitoring, social media channel monitoring, shop monitoring, data integration, community management, market research, etc.
Big Data	<ul style="list-style-type: none"> ▪ Data processing of >10 billion social media documents ▪ Data collection of 30-70 mio social media documents per day ▪ Data cover of >400 mio international websites ▪ Usage of text mining (e.g. NLP) and data mining analytics
Innovation	<ul style="list-style-type: none"> ▪ Highly interactive analytical cloud Dashboard ▪ Bring your own Data interface allows combination of internal data with external data from shops, social media and many more ▪ Management Dashboards show relevant information everywhere in your company ▪ Integrated view on social media, reviews and prices ▪ Big Data Analytics of your unstructured data/texts/content in a cloud to a very comparable price
Benefit	VICO's software-as-a-service solution extracts relevant product, brand or market information from social web and other data sources and displays them in intuitive flexible dashboards with configurable charts and multiple filter functions. By this means, VICO Analytics provides real time insights like the share of voice, sentiment, trends, relevant influencers, critical events, etc. Moreover, VICO Analytics amalgamates social listening, review, price and further data in order to gain and innovative insights in cause-effect chains of the respective markets. These market insights help to make profound business decisions as well as to react fast to a shift of the market.
Prospects	VICO PRISY (Product Information System): Comprehensive real-time product and market information in one solution
Governmental R&D promotion programmes	Worldwide leading partners in artificial intelligence and in big data: German Research Center for Artificial Intelligence (DFKI), TU Berlin, Karlsruhe Institute of Technology (KIT), Fraunhofer IAO, Ben Gurion University (Israel), Jozef Stefan University (Slovenia), T-Labs (Telekom) The VICO system of the future is able to connect data sources of any kind, store the retrieved data, hold it accessible at any time and integrate any kinds of data processing components through defined interfaces. The results of the data processing can be accessed from various kinds of systems or applications.



Countries and customers	We operate worldwide across all industries. We rate over 130 international top brands among our customers like BMW, Vorwerk, Allianz, Ferrero, Deutsche Telekom, Unilever, Generali, LG Electronics, etc.
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5.38 mgm technology partners GmbH – Services for Real Time Data Exploration [1][4][5][9]

Company	mgm technology partners GmbH Frankfurter Ring 105a 80807 München www.mgm-tp.com christian.winkler@mgm-tp.com +49 89 358680-796
Employees	Worldwide: 450 Germany: 400
Characteristics	<ul style="list-style-type: none"> Professional services (software industry), software projects, no body leasing Hadoop ecosystem, ingestion and real time reporting Industries: eCommerce, Automotive, Market research, Retail and Public sector
Customer needs	<ul style="list-style-type: none"> Build a long-term sustainable platform. Benefit from open source offerings without sacrificing professional maintenance Combine batch and real time processes Stay independent of vendors
Big Data offerings	<ul style="list-style-type: none"> Ingest a very big amount of semi structured data with e.g. Apache Kafka Store, aggregate and analyze geo-temporal data Build specific services for real time data exploration including visualization Help companies to become data-driven, both technologically and functionally – e.g. via change management
Big Data	Big Data allows us to analyze customer needs more extensively. By building working prototypes in a very fast way using the agile methodology, we can avoid large investments in non-working solutions. We have implemented solutions with many billion datasets which still scale excellently. We use Presto for analyzing standard data and many solutions tailored to the customers' needs.
Innovation	<ul style="list-style-type: none"> Although we use a conservative technology stack, the combination of these technologies is unique within our industry. Customers can transform their organization to a data driven enterprise through a combination of scalable batch technologies with real time ingestion and exploration. We use Open Source projects as external R&D and return our knowledge gained back to the community.
Benefit	Customers can innovate their business model without thinking too much about the technology used and additionally get support for their change management. This way they can easily adapt to the changing market conditions and keep in front of their competition.
Prospects	Real-time architecture will be a future trend, together with loosely coupled systems which can scale independently. Machine learning is getting more and more attention and we have already successfully applied these techniques in ongoing projects. Apart from that, natural language processing will become a megatrend.
Countries and customers	<ul style="list-style-type: none"> Germany: Federal Tax System, LIDL, BMW, AUDI France: Darty Kazakhstan: Kaspi bank World-wide: Hewlett Packard
Future markets	Other countries within the EU, USA, Vietnam



5.39 ParStream – IoT Analytics and Big Data Platform [1][6]

Company	ParStream Große Sandkaul 2 50667 Köln + 49 221 9776148-0 Joerg.Bienert@parstream.com
Employees	Worldwide: 25 Germany: 25
Characteristics	<p>ParStream Inc is an IoT analytics and Big Data platform company with Headquarter and development in Cologne, Germany. ParStream was founded in 2008 by Michael Hummel and Jörg Bienert, two experienced IT managers who worked at Accenture and several other IT companies until then.</p> <p>ParStream has developed one of the most comprehensive platforms in the Interactive Analytics for Big Data category. The approach was to build a new computing architecture capable of massive parallel processing, configured and optimized for large amounts of data, and employing new and patented indexing methods to achieve real-time query response times.</p>
Customer needs	ParStream's vision is to revolutionize the big data/analytics market for the Internet of Things. To achieve this, ParStream is conducting fundamental research and driving innovation in database and analytics technology, allowing users to perform real time analytics on big data in new innovative ways and at a significantly lower cost.
Big Data offerings	<p>ParStream's Analytics Platform was purpose-built for scale to handle the massive volumes and high velocity of IoT data. The Platform helps companies generate timely, actionable insights from IoT data by providing more innovative and efficient ways to analyze that data – faster, with greater flexibility and closer to the source.</p> <p>The Platform uniquely queries at the source of data for real-time analysis as data is being loaded. It also provides unified analytics of real-time data in every query and generates more accurate insights for decision-makers with the continuous import of new data.</p> <p>The Platform is powered by ParStream DB, a patented database which has consistently been recognized for industry-leading performance with sub-second query response times in analyzing billions of rows of data. It also includes innovative and unique features such as Geo-Distributed Analytics, Alerts & Actions, Time Series, Advanced Analytics, interfaces for the leading streaming/ETL technologies, and seamless integration of the leading visualization tools for IoT.</p>
Big Data	<p>Customers are using ParStream to analyze tens of billions of rows, Terabyte and soon Petabyte of data interactively. ParStream has to ingest up to several millions of rows per seconds generated by IoT infrastructures.</p> <p>ParStream provides descriptive analytics capabilities through a standard SQL interface and is used for predictive analytics and machine learning by seamless integration of R and other frameworks.</p>
Innovation	<p>Unlike many other products, that are built upon existing technologies like Postgres, Hadoop etc, ParStream was built from the ground up in C++, focusing on performance and efficiency from the first line of code. It combines a unique feature set.</p> <ul style="list-style-type: none"> ▪ Pure speed – being able to process huge volumes of records (100s if billions) in sub-second response times ▪ Accommodation of data in motion – supporting continuous and fast data imports while concurrently analyzing the data without performance degradation ▪ Simultaneous analysis of historical and current data without cubes – correlating the two as new information continuous to come in at the Big Data rate ▪ Flexible support of complex and ad hoc queries – a data structure that can concurrently support multiple complex queries and easily generated ad hoc queries ▪ Concurrency – Given its unique analytical indexing ParStream is able to only accelerate query processing, but to execute them very resource efficient. This directly maps to the ability to offer high concurrency while maintaining fast query response times. ▪ Low TCO – ability to scale and perform on minimal and commodity hardware while still ensuring high levels of fault tolerance and availability ▪ Robust integration – ability to integrate with existing data and server infrastructure and third party software stacks via standard protocols ▪ Flexibility – running on standard Hardware and Cloud environments. Scaling from small Edge computers to large server clusters ▪ Support for Fog Computing: Storing and analyzing data at the geographically distributed Edges of an IoT Infrastructure.



Benefit	ParStream's capabilities reach far beyond what is possible with Hadoop and relational DB systems so far, combined with high flexibility and low TCO. Therefore ParStream enables new applications, new use cases and even new business models. Customers implement new processes for gaining insight, increasing productivity and create new revenue streams. For example, a customer in renewable energy calculated, that based on Real-Time analytics with ParStream, he will be able to increase efficiency by 15% which translates into a yearly business value of more than 150 Million USD.
Prospects	ParStream has earned multiple accolades including the M2M Evolution IoT Excellence Award, CIO Magazine #1 Big Data Startup, and Gartner Cool Vendor. On November 3, 2015 Cisco completed the acquisition of ParStream. The ParStream acquisition complements Cisco's data and analytics portfolio, enhancing Cisco's ability to provide deep analytics at the networks edge, where data is increasingly being generated in huge volumes.
Countries and customers	ParStream has customers in Germany, France, United Kingdom, Italy, USA and China.
Future markets	After the acquisition by Cisco, ParStream is now able to adress a global market.

5.40 #zeroG – Big Data Strategy Consulting for Airlines [1]

Company	#zeroG – A Company of Lufthansa Systems Am Prime Parc 1 65479 Raunheim
Employees	Germany: 15 (backed by >1000 employees of Lufthansa Systems)
Characteristics	<ul style="list-style-type: none"> Consulting Services in the area of Digital Transformation, Customer Experience, Data Science, and Data Engineering with focus on the aviation industry. #zeroG is a unique combination of people with a deep understanding of the airline world: processes, IT applications and data. We are balancing experience and innovation by hiring talented people who add new views on what digitalization means for the airline industry.
Big Data offerings	<ul style="list-style-type: none"> Digital Readiness Index for the Aviation Industry: This index allows for comparing an airline's digital readiness to other airlines and other industries. Customer Experience Management: The experience along the entire customer journey is a key driver for loyalty with an airline. Our customer experience management experts help our clients to increase both, loyalty and revenue by improving the experience. Data Science Services: Our data scientists know the aviation industry and the major data sources and systems. This enables us to communicate effectively and bring data driven products to the market more quickly compared to non-aviation focused consulting firms. Data Engineering: Our data engineers know the data generated by aviation specific IT applications inside-out. They know how to enrich this data with other data sources – such as social media or weather data – helping the data science team to become as efficient as possible Data Products: In order to kick-start data driven initiatives within airlines, we offer a suite of pre-defined scenarios (e.g., statistical models and corresponding elements of business processes) combined with proven artifacts of modern Big Data Information Architectures.
Big Data	<p>Airline processes today generate a vast amount of data of various kinds. Starting from the reservations data, operational processes data, weather data and more recently also data from the social networks. Integrating all this data – customer consent assumed – leads to the ability to improve business processes in three ways:</p> <ul style="list-style-type: none"> Enhance: Existing analytical process-steps will be extended by state-of-the art statistical models which have been trained and tested on big data sets rather than on samples. Cloud deployments allow for scale-out compute clusters leveraging Big Data sets rather than simplified assumptions or sampled data sets. Embed: Existing business processes will be extended by advanced analytics leveraging data from various sources, combining real-time data streaming with batch analytics (Lambda-Architecture).



- **Employ:** Using agile approaches and an existing Big Data infrastructure and culture, new data driven products will be created leading to an increase in customer loyalty and a higher operational efficiency.

All of the »Three E's of Data Science« mentioned above rely on large amounts of integrated data from various sources and kinds. This includes web traffic data and goes as far as jet engine telemetry data.

Innovation	<ul style="list-style-type: none"> ▪ Every industry is unique in certain ways – the aviation industry is no exception. The core flight product being a low margin business, we help airlines to add innovative, data driven aspects to business process – typically focussing on increasing the customer satisfaction along the complete journey and not just while the customer is on board an aircraft. We offer the unique combination of aviation industry and customer experience knowledge with analytical and data expertise ▪ Our core market focus is the aviation industry. Knowing the business inside out is a key enabler to define digital transformation strategies that have impact on the airline performance short term while fulfilling the long term strategy. Experienced consultants with deep aviation data knowledge ensure short times to market and high solution quality ▪ The customer experience is gaining a lot of attention in the passenger aviation industry currently. Today, the mobile devices create the connected passenger who wants to interact with the airline at any point in time – as it fits the passenger's current state in one of the parallel journeys he or she is in. With integrated data in the backend combined with realtime data streams, airlines can treat each customer more individually creating an individual customer experience – regardless of your booking class. A transparent opt-in based usage of customer data is the key to success. ▪ Furthermore, operational processes generate more and more data and each aircraft generates TBs of data per hour of flight. Today's available technologies allow for cost effective storage and compute power to leverage that data and increase operational performance (example: predictive maintenance plus smart global warehousing of spare parts). ▪ With mobile devices creating the connected passenger, who wants to interact with the airline at any point in time, more and more airlines are shifting their focus to become more customer-centric, improving the experience along the entire customer journey. This requires understanding of customer needs for the specific situation the customer is in. With integrated data in the backend combined with realtime data streams, airlines can treat each customer more individually creating an individual customer experience. A transparent opt-in based usage of customer data will build the necessary trust that is key to success. ▪ Big data products for the aviation industry are currently in the planning state.
Prospects	#zeroG is offering the first »Digital Readiness Index« for comparing different airlines along relevant dimensions wrt. Digitalization and digital transformation.
Countries and customers	#zeroG operates today primarily in the German market but we are currently acquiring new projects in Europe. We are establishing partnerships with selected companies globally. Reference customers: Lufthansa German Airline plus others
Future markets	We plan to expand into the Middle-East, Asia, Oceania and the Americas.

5.41 Continental – Data Driven Services for Automated Driving Vehicles [2]-[6][9]

Company	Continental AG Vahrenwalder Str. 9 30001 Hannover www.continental-corporation.com External Communication Interior Division: Sebastian Fillenberg
Employees	More than 212,000 employees in 55 countries
Characteristics	Continental develops intelligent technologies for transporting people and their goods. As a reliable partner, the international automotive supplier, tire manufacturer, and industrial partner provides sustainable, safe, comfortable, individual, and affordable solutions.
Customer needs	Providing intelligent mobility solutions.
Big Data offerings	The Continental Backend Platform provides data driven services for the realization of intelligent and automated driving vehicles, e.g. up-to-date and highly accurate road information including road geometry, traffic signs, traffic flow and weather information. Moreover, it enables the rapid and cost effective development of data driven applications by providing a set of core services for e.g. connecting vehicles and backend, storing and analyzing data, or data governance. Typical applications built on top of the Continental Backend Platform range from remote diagnosis up to safety functions for the automated driving vehicle.
Big Data	Within the Continental Backend Platform various data sources (e.g. vehicle sensor data, traffic information, map data, weather data) are being processed, both, in real-time and non real-time. Big Data technologies are used for ingesting, processing/analyzing and storing data. For example, distributed DBSCAN algorithms implemented using Spark are applied for clustering sensor data.
Innovation	<ul style="list-style-type: none"> ▪ Automated creation of a Road Database based on vehicle sensor data. ▪ Provision of data driven core services for highly automated driving functions. ▪ Comprehensive knowledge of Automotive and Big Data ▪ Vehicle functions to improve safety, comfort and efficiency
Benefit	New, innovative services and functions (e.g. Real-Time Traffic Information, Green Wave Assist, Cruising Chauffeur) that will boost vehicle sales.
Governmental R&D promotion programmes	Ko-HAF – funded by BMWi CAR-BITS.de – funded by BMWi Car2MEC – funded by StMWi
Countries and customers	Europe, USA, Canada, Japan
Future markets	China



5.42 Siemens Digital Factory – MindSphere – Siemens Cloud for Industry [2]-[6]

Company	Siemens AG Digital Factory DF PL DS Schuhstr. 60 91052 Erlangen www.siemens.com/plant-data-services www.siemens.com/mindsphere DF PL DS pds.industry@siemens.com mindsphere.industry@siemens.com
Employees	348,000 employees in more than 200 countries (Sept. 2015)
Characteristics	<p>Siemens AG is a global technology powerhouse that has stood for engineering excellence, innovation, quality, reliability and internationality for more than 165 years. The company is active in more than 200 countries, focusing on the areas of electrification, automation and digitalization. One of the world's largest producers of energy-efficient, resource-saving technologies, Siemens is No. 1 in offshore wind turbine construction, a leading supplier of combined cycle turbines for power generation, a major provider of power transmission solutions and a pioneer in infrastructure solutions as well as automation, drive and software solutions for industry. The Digital Factory (DF) Division offers a comprehensive portfolio of seamlessly integrated hardware, software and technology-based services in order to support manufacturing companies worldwide in enhancing the flexibility and efficiency of their manufacturing processes and reducing the time to market of their products.</p>
Customer needs	<p>Processing of large volumes of data plays a major role particularly in companies leveraging a high degree of software in manufacturing – the so-called digital enterprise. Cutting throughput times, increasing flexibility, complex production processes, margin pressure, enabling individualized mass production and optimizing consumption of energy and resources are some of the challenges facing manufacturing companies today. They have to optimize the entire value chain, from design, production planning and engineering to services. This also entails analyzing the vast amount of collected data – big data – and recognizing what is really important to enable the right decisions to be made in good time. Siemens Digital Factory is helping customers to tackle their own big data challenges in order to boost their competitiveness. Increasing digitalization poses great challenges for industries worldwide. New products must be brought to market in ever-shorter timeframes and more individualized, companies must become more flexible and more efficient. All with no loss of quality, or even improved quality, in some cases.</p> <p>With ever increasing data volumes, it becomes more and more important to understand data, and turn them into added value. Industrial customers nowadays realize the advantages to utilize data in order to grow their own business by creating additional digital business and service models. Digitalization is transforming prevailing thinking of doing business and it spares no one – not even the complex industrial sector. A turning point has been reached: customers there need to find new ways to optimize asset value and performance.</p>
Big Data offerings	<p>When it comes to data analytics in specific, Siemens has a profound understanding of customer needs and processes, which is essential to create value. By focusing on smart data, instead of just big data, Siemens Digital Factory engineers can combine product know-how and process expertise with data analytics to help customers reduce unplanned downtimes and improve operational efficiency. With Plant Data Services, Siemens is turning data into value in order to maximize plant performance – such as optimizing energy performance, mastering asset uptime, maximizing process efficiency and enhancing industrial cyber-security.</p>
Innovation	<p>With MindSphere – Siemens Cloud for Industry, Siemens Digital Factory is offering its customers a solution to tackle their own big data challenges. MindSphere is an open ecosystem, which interlinks industrial assets, machines, production facilities or entire fleets with digital data. MindSphere is running on SAP HANA Cloud Platform. The connection of industrial assets to MindSphere can be achieved simply, securely and regardless of its manufacturer thanks to open interfaces. This allows data exchange across company boundaries.</p> <p>MindSphere offers the possibility to develop and market dedicated applications from Siemens (so called MindApps), but also from others (i.e. OEM, end customers, specialized app developers). All in all, MindSphere provides the technological ecosystem for creating additional digital service and business models from Siemens and 3rd party suppliers.</p> <p>MindSphere has been designed as an open ecosystem which invites everyone to join: software developers, end customers, OEM, system integrators, competition.</p>



Benefit	The goal of MindSphere is to enable industrial customers to develop, run and sell their own digital services and using big data to strengthen their own market position and refine their own industry expertise, be it for end customers or OEM. Digital services offer a competitive advantage for customers in general in the form of higher product and system availability as well as improved productivity and efficiency. MindSphere enables different target groups to create additional business models based on big data and data analytics. Example are i.e. offering machine uptime, global fleet management and/or machine-hours instead of the mere machine.
Prospects	Siemens is now bringing MindSphere – Siemens Cloud for Industry into the market. The platform will initially be available as a beta release, which will be continuously further developed. Also further applications are already in the pipeline and will be made available to users on an ongoing basis.
Countries and customers	The company is active in more than 200 countries.

5.43 dimensio informatics – Database Turbo [2][3][5][6][8]

Company	dimensio informatics GmbH Brückenstrasse 4 09111 Chemnitz www.dimensio-informatics.com Dr. Sebastian Leuoth Leuoth@dimensio-informatics.com
Employees	15
Characteristics	<ul style="list-style-type: none"> Developer and provider of state-of-the-art software technology to solve performance problems The patent-pending, multi-dimensional semantic DIMENSIO index is based on a self-learning process employing neural networks. DIMENSIO is applied in databases to accelerate complex or slow queries by up to three orders of magnitude. Immense performance gains have been achieved in data warehouse applications, full-text searches, image data evaluations, geographical information systems, hospital information systems etc. A wide range of industries benefit from DIMENSIO: insurances, telecommunication companies, public sector, hospitals etc.
Customer needs	The processing, the analysis and the identification of relevant data is very time-consuming. Our customers have to deal with database response times in the range of minutes or even hours with their existing hardware. Scaling up on hardware cannot keep pace with the increasing customer requirements and data volumes. The non-invasive implementation of DIMENSIO »kills two birds with one stone«: it immensely speeds up the response times of database queries and the customer can continue to use his existing hardware park.
Big Data offerings	DIMENSIO is the ultimate database turbo which ensures ultrafast data access thanks to artificial intelligence.
Big Data	Big Data is the processing and analysis of large amounts of data from different heterogeneous data sources. Often these analyses are extremely complex and time-consuming and the technical equipment of companies is usually not suited to accomplish the tasks in a satisfactorily short period of time. Queries which last hours or even days are not uncommon. The conventional method to address this performance problem is to stock up on additional hardware but this only postpones the problem as technology, which is fast today and sufficient tomorrow, will be totally slow and outdated the day after tomorrow. dimensio informatics is actually able to solve the problem of complex queries by offering an intelligent software technology which extremely accelerates database queries thus making big data analyses finally possible. To name just one example out of many: A query which used to take 3.5 hours was reduced to only a matter of seconds thanks to DIMENSIO.
Innovation	<ul style="list-style-type: none"> Traditional database indexes are one-dimensional and can only map columns of exactly one table. These are not helpful for complex queries where each index alone reduces the number of hits in a single table only to a limited extent and only the combination of several attributes leads to an adequate selection. The magic formula of DIMENSIO is the so-called »multi-dimensional indexing« of any number of columns (regardless of their order) in any number of tables. Besides this the out-of-the-box DIMENSIO index is based on



	<ul style="list-style-type: none"> ▪ a self-learning process employing neural networks. This machine learning method clusters data according to their similarities in a »semantic map« and stores them in the DIMENSIO index. This is then used to optimize the database queries.
Innovation	<ul style="list-style-type: none"> ▪ This self-learning, multi-dimensional indexing is a unique method of optimizing and accelerating database queries. ▪ DIMENSIO differs from other solutions by employing artificial intelligence to gather information about data. This information is then used to structure and cluster the elements. ▪ The minimally invasive integration in existing applications, networks or DBMS enables big data projects. Queries which would have been impossible due their long response times or timeout settings can now be run within a short period of time. ▪ DIMENSIO makes existing IT landscapes fit for big data analyses.
Benefit	<ul style="list-style-type: none"> ▪ Time savings & process optimization: <ul style="list-style-type: none"> ▪ Data analyses up to 10,000 times faster compared to conventional solutions ▪ Response times of long-running queries are extremely shortened ▪ Impossible queries are made possible ▪ Workarounds (to counteract performance problems) become obsolete ▪ Cost savings & resource optimization <ul style="list-style-type: none"> ▪ No investment in additional hardware is necessary (»kill it with iron« – KIWI) ▪ Lower investments in additional CPU licenses for databases ▪ Extended operation of existing IT systems ▪ Longer and optimized use of existing DB licenses ▪ Failing execution plans can be avoided ▪ Better acceptance & customer satisfaction <ul style="list-style-type: none"> ▪ Shorter waiting times reduce user and customer complaints and increase the acceptance of applications (e.g. geographical information system, portals)
Prospects	DIMENSIO Inspector: This novel tool was developed to automatically analyze and graphically visualize database queries within a very short time. The DIMENSIO inspector features a user-friendly and intuitive interface and can display performance-critical areas. Its main objective is to quickly estimate the performance potential of DIMENSIO.
Countries and customers	Germany, Austria, Switzerland, The Netherlands Die Mobiliar (Insurer), Swiss Canton of Aargau (public administration), KABEG (health sector)
Future markets	Europe

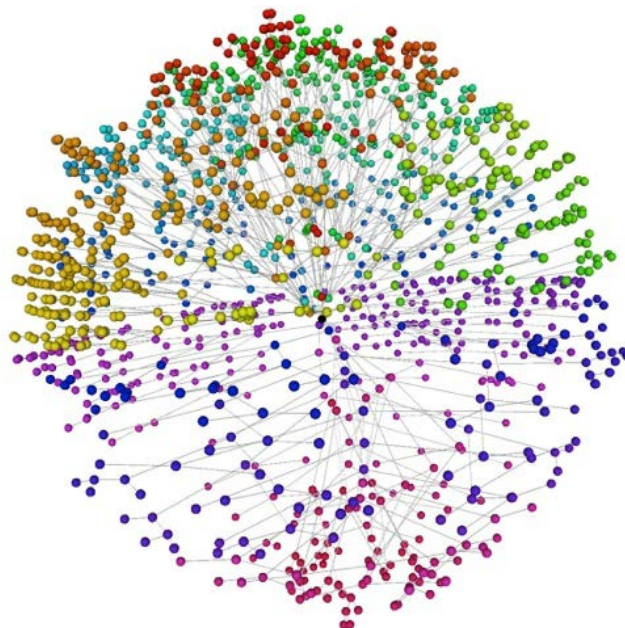


Figure 9: Project Example with 13,000 Records with 998 Dimensions

5.44 Device Insight – SaaS for Industrie 4.0 / IoT [2][3][5][6][9]

Company	Device Insight GmbH Willy-Brandt-Platz 6 81829 Munich www.device-insight.com Julia Diesing Head of Marketing +49 89 45454480 julia.diesing@device-insight.com
Employees	55 (April 2016)
Characteristics	Device Insight provides Software-as-a-Service solutions for Industrie 4.0 / Internet of Things use cases in various industrial sectors like industrial automation, HVAC, automotive, transport and logistics, vending, energy as well as smart home and smart building. Device Insight's core product is the IoT platform CENTERSIGHT®, a software suite that supports global connectivity of sensors, machines, vehicles, facilities and devices as well as providing data acquisition, reporting, remote services, alerting and data analytics functionalities.
Customer needs	Customers are in need of end-to-end IoT solutions that allow them to collect, store and analyse machine and sensor data and combine it with existing company data. The challenge is to gain valuable real-time insights on the machine condition, machine usage and energy consumption. By predicting component failures or machine availability Device Insight reduces operating risk and allows customers to establish new business models (e.g. pay per use) or offer new services (e.g. guaranteed machine availability, warranty extension). Device Insight not only provides the tools for IoT Data Analytics but offers IoT data analytics consulting services as well.
Big Data offerings	Real time data analytics, condition monitoring, predictive maintenance, complex event processing, alerting on machine availability
Big Data	Device Insight's Big Data solutions offer storage and analysis of large or complex IoT / Industrie 4.0 data sets, usually over the Internet, as cloud hosted services. The amount of data coming from different sources like machines and sensors is growing constantly. New sensor data is generated and transmitted multiple times per second. Deployments of hundreds of thousands of connected assets are not unusual for IoT projects. Structured machine data can be combined with unstructured data such as service tickets.
Innovation	Device Insight integrates Big Data applications into its IoT platform CENTERSIGHT and uses tools and applications within the Big Data domain such as storage of massive time-series data and complex event processing. The combination of Big Data analytics and IoT enables customers to collect and process huge amounts of data from machines in the field. New insights into machine performance and reliability can be generated. Those insights can flow back into R&D to optimize future products. In order to being able to select and integrate the most suitable tools for end-to-end IoT solutions, all components are integrated using a micro service architecture. As IoT projects grow, hundreds of thousands of devices are connected to the cloud IoT platform. CENTERSIGHT supports deployment models ranging from on premise installations, hybrid cloud hosting and full public cloud deployments.
Benefit	Device Insight provides Internet of Things solutions and enables its customers to deploy highly scalable IoT platforms. By collecting and analysing vast amounts of data clients are able to gain valuable insights and build new business models. The key benefits are: <ul style="list-style-type: none"> ▪ Availability prediction / maximization of machine availability ▪ Optimization of production site capacity ▪ Analysis of unknown machine errors (e.g. Field Test Support) ▪ Insights regarding real asset usage by end customers ▪ Cost control (e.g. improved parts and plant component management) ▪ Development of new business models (e.g. pay per use, pay per outcome)
Countries and customers	Europe, North America, South Africa



5.45 IAV – Connected Car Platform for Reliable Highly Automated Driving [2][3][5][6][9]

Company	IAV GmbH Carnotstraße 1 10587 Berlin www.iav.com Benedikt Schonlau +49 8458 3430-66855
Employees	Worldwide: >6,500
Characteristics	Our business model: Turnkey B2B solutions, Data analysis, Data warehouse / storage solutions Our Priorities: Automotive Engineering, Mobility, Intelligent Transport Systems
Customer needs	Challenges: Implementing data warehouses and IT solutions into technical departments, Providing secure and reliable handling for of huge amount of data, to share data between different companies, organizations
Big Data offerings	Measurement data storage and analytics <ul style="list-style-type: none"> ▪ Storing of huge data amounts (> 1Petabyte) on premise or on Microsoft Azure with different application platforms and analytics engines ▪ Provision of connected car platform for reliable highly automated driving ▪ Reliable and secure data transport ▪ Provision of cloud algorithms ▪ Cloud-based data fusion
Big Data	<ul style="list-style-type: none"> ▪ Data amounts from Petabyte to Exabyte can be hosted ▪ Millions of clients can be connected ▪ Analytics are done in a scalable organization with huge amount of virtual machines ▪ Analytics are done with special automotive highly automated driving analytics suites and special connected cars analytics suites
Innovation	IAV provides a vehicle manufacturer independent platform which can be completely booked as a service and can be adapted to all required customer interfaces. This service lowers the entry threshold for non-automotive grade customers for mobility, highly automated driving and intelligent transport systems. Our service is experience and business proofed for our customers.
Benefit	Our services can be used by the customers out of the shelf without any know-how transfer and investment costs.
Countries and customers	Services are offered worldwide and our customers are automotive manufacturers and suppliers



5.46 DATAlovers – Sales and Marketing Lead Prediction [2][3][5][6]

Company	DATAlovers AG Fischtorplatz 11 55116 Mainz www.data lovers.com +49 6131 3270080 Andreas Kulpa COO andreas.kulpa@data lovers.com
Employees	Worldwide: 14 Germany: 14
Characteristics	<ul style="list-style-type: none"> Sales and Marketing Lead prediction Mid-size to enterprise companies which have own or outsource B2B Sales/Marketing activities
Customer needs	<p>Traditional approaches to lead generation are inherently limited. In the way they use available online and social data. In the way they handle that data. And in the way they reach out to customers and prospects.</p> <p>The traditional approach is embodied by mailshots that sing your product's praises, or an initial approach in the form of cold calls – in short, the classic push model. Addresses are purchased from external sources or generated via promotions and campaigns. Key moments and requirements are overlooked, and acceptance levels within the target group decrease over time.</p>
Big Data offerings	<p>bearch SaaS (https://www.bearch.de/) Find, label, and profile businesses and markets Whether you want to find a new supplier, an SEO expert, or information about a new competitor, bearch is the first real full-text search engine that allows you to search the entire online content of a company. Take advantage of the range and depth available from bearch when looking for businesses.</p> <p>bearch+ – We know your next 1.000 customers! You give bearch the description for your target groups and bearch identifies potential new customers for you. Discover new markets and develop new business – automatically. How does it work? Businesses are described via the data vectors that encapsulate over 10,000 business vectors. bearch creates a profile that it uses as a basis to identify lookalikes – statistical twins – via online search. That's not all it does bearch also goes beyond the traditional targeting approach to identify leads and markets outside the traditional targeting approach for you when you ask it to display potential purchasers. This allows you to find potential sweet spots that your business had previously overlooked – with an assessment of your likelihood of success included.</p>
Big Data	<p>All our products and services are based on internet and social media crawled data. Just for Germany the base volume of data is around 10 TB for each crawl. We crawl in a continuous process, so we have constantly changing information's about businesses. We index text, all sorts of documents, social media content, news.</p> <p>For our algorithms of machine learning / AI we truly need massive amount of data. So big data is the basis for all our professional services/products.</p> <p>We enrich traditional company data with more than 10.000 automated generated business attributes (comprehensive digital company signature).</p> <p>The data capturing and analysing processes are conducted on a real-/near time basis.</p>
Innovation	<p>In order to generate new business from new data – digital, web, social, mobile – new approaches and tools are required. DATAlovers AG offers enterprises a business solution that can easily be used as »software as a service«.</p> <p>Data is the new fuel for the growth of enterprises and markets. Intelligent collection, analysis, and use of data can systematically open up new business opportunities. In particular, with digital data such as web, mobile, social, and search, new customers, markets, and competitive advantages are readily available.</p> <p>We apply AI Deep Learning Algorithms to the data, so everybody can use the intelligence easily and intuitive. Exception Reporting and Alerting automatically detects relevant communication and sales trigger.</p>
Benefit	<p>Smaller target groups with a much higher probability. Flat price model compared to classic B2B data provider. We don't need human overhead so our pricing is comparable or lower than regular providers. But the main benefit comes out of quality and probability.</p>
Prospects	Public bearch – From the 1st of June we are proud to announce a public Version of our SaaS Search Engine bearch.



Countries and customers	Currently we do have indexed Data from companies in Germany, Switzerland, Austria and UK. We operate this business out of Germany.
Future markets	Benelux, Italy, Spain, France, Poland

5.47 Webtrekk – Analytics and Real-Time Data Management Platform [2][3][5][6]

Company	Webtrekk GmbH Robert-Koch-Platz 4 10115 Berlin www.webtrekk.com Nadja Börner sales@webtrekk.com
Employees	Worldwide: >20 Berlin: 130
Characteristics	<ul style="list-style-type: none"> ▪ The Webtrekk Digital Intelligence Suite has integrated analytics, data management and marketing solutions to help customers target anyone, anywhere, at any time. ▪ Webtrekk's top priority is turning data into profit while offering industry-leading, fully-certified data protection. ▪ Webtrekk serves companies in E-Commerce, Retail, Finance, Publishing, Automotive, B2B & Industry, Telecom and Travel & Service.
Customer needs	<p>Companies today know that they need to be data-driven. Everyone has heard this – maybe even from their boss. However, data is often stored in data silos that exist independently from one another. The challenge is to connect these silos and use the data for targeted, automated marketing campaigns.</p> <p>Webtrekk DMP can create meaningful user profiles based on cross-device data. This enables our customers to build segments based on behaviour, purchase history, etc., and to use their data in real-time for targeted marketing campaigns.</p>
Big Data offerings	<ul style="list-style-type: none"> ▪ Analytics: Webtrekk Analytics offers in-depth, raw data analytics for onsite, app and mobile tracking. Analytics works hand in hand with Marketing Automation and DMP to optimise digital marketing campaigns. ▪ DMP (Data Management Platform): Webtrekk DMP is a central hub that stores and unifies data, and then sends it exactly where it is needed. This way, data from disconnected sources can be used to drive business goals in real time – not collect dust in a data warehouse. ▪ Marketing Automation: Webtrekk Marketing Automation uses granular data to generate personal, impactful recommendations. It also allows interactions with users on different channels – from onsite suggestions to emails to external advertisements. ▪ Tag Integration: With Tag Integration, the marketing department is in control. No complex coding, no waiting for IT, no hassle.
Big Data	<p>Webtrekk DMP solves the challenge of too much data. These days, mere data collection is no longer the issue; the issue is activating all of that data. Unlike other DMPs, Webtrekk DMP is directly integrated with an enterprise analytics solution. Therefore, customers can supplement their own proprietary analytics data with data from third-party sources: customer relationship management systems, inventory information, even weather forecasts. Marketers need a solution to translate their data and make it available across each and every channel. Webtrekk DMP does exactly that.</p>
Innovation	<ul style="list-style-type: none"> ▪ Marketing Suite: Webtrekk combines analytics, DMP and automated marketing solutions into a single, integrated suite. Users can collect data, act on it and test changes on a user-by-user level without having to worry about whether or not their tools get along. ▪ Data Protection: Webtrekk adheres to the most stringent data protection policies in the world. We have received the Certified Data Protection seal from TÜV, the German Technical Inspection Association, and are compliant with the EU Privacy Directive. ▪ Full Transparency: Whether our solutions are users for search engine retargeting, newsletter remarketing, real-time advertising or anything in between, users have unfettered access to all of their raw campaign data. They will never be left guessing how effective campaigns were, or what exactly they are paying for.



	<ul style="list-style-type: none"> ▪ Data Leakage Prevention: Webtrekk users know where their data is, what it is used for and who has access to it. That isn't always the case. Especially when multiple providers are involved – one for analytics, another for real-time bidding, another for remarketing and so on. The more data gets swapped around, the greater the chance for data leakage. Webtrekk lets customers cut down on the number of providers they use, and cut down on data leakage in the process.
Benefit	Webtrekk's roots will always be in analytics. But as digital marketing evolves, it is clearer than ever that simply having lots of data is not enough. Webtrekk therefore strives not simply to provide data, but to supplement that data with solutions that drive profit.
Countries and customers	Webtrekk has offices in Germany, China, Italy, The Netherlands and Spain. Webtrekk customers include Nike, Zalando, ING DiBa, Hugo Boss, Banco Popular, Vogue and more than 400 other companies.
Future markets	Northern and Eastern Europe, North America, Asia

5.48 Brandwatch – Social Media Monitoring, Social Analytics [2][3]

Company	Brandwatch GmbH Schönhauser Allee 112 10439 Berlin www.brandwatch.com/de kontakt@brandwatch.com Contact: Susanne Ullrich Marketing Director DACH/FR
Employees	Worldwide: >350 Germany: >49 (Berlin, Stuttgart)
Characteristics	<ul style="list-style-type: none"> ▪ Business model: SaaS solution for Social Intelligence + Services (Setup, Training, Reports). Brandwatch offers its product on a subscription model. Additional services can be added as one-offs or on an ongoing basis. ▪ Priorities in the field Big Data: Social Media Monitoring and Social Analytics (incl. API for data export), Social Media Command Center // clients: over 1,200 brands and agencies worldwide from various industries ranging from finance and healthcare to consumer goods, technology, and many others.
Customer needs	<p>Our customers are faced with the challenge of making the best business decisions – mostly in real-time. To make well-informed and strategic business decisions as well as being alerted on brand reputation risks our customers need to understand how they're brand, spokespeople and products are being discussed online, as well as what's being said online about their competitors and their market.</p> <p>Brandwatch Analytics provides a sophisticated and powerful platform to find exactly the conversations brands and agencies are looking for, and then filter and customize dashboards to easily analyze that data. Brandwatch Vizia, the social command center platform, helps to spread this valuable information across the company by bringing data from many different sources together to get even more valuable insights in real-time. In addition, specific reports by the Brandwatch Research Services team can pull in-depth insights for different departments.</p> <p>We also believe in focusing on what we do best – social listening and analytics – and partnering with other best of breed partners to offer customers even more choices when building the technology solutions that fit their specific needs.</p>
Big Data offerings	<p>The Brandwatch Analytics platform gathers millions of online conversations every day and provides users with the tools to analyze them.</p> <p>Brandwatch Vizia distributes social data and insights through visually-engaging displays. With Vizia, Brandwatch clients can establish a central social hub to manage social activities and spread social intelligence throughout the enterprise.</p> <p>Brandwatch has an API (Application Programming Interface) that allows customers to access their Brandwatch Analytics data, metadata and metrics outside of the app, either to create their own reports or products, or to integrate it into other business applications.</p>
Big Data	Brandwatch works hard to ensure its technology is powerful and flexible enough to deliver market-leading coverage, even as the web changes and evolves. In fact, Brandwatch crawls over 80 million sources (social networks, blogs, forums, news sites, reviews etc.) and brings clients clean, accurate data, as it happens. The Analytics platform has one of the most comprehensive Query creation capabilities on the market, allowing for precise, accurate and targeted search



	<p>Queries resulting in better quality data.</p> <p>Brandwatch Vizia is making it quicker and easier to see how changes in social data correlate with what's going on in the wider world. Brandwatch has built a Vizia app framework to do exactly this, e.g. for weather data or Google Analytics. These new apps provide context: where social efforts make an impact and are impacted – both inside and outside of an organization.</p>
Innovation	<p>The Brandwatch roadmap constantly adapts and changes according to its vision of the market, and the changing needs of its clients. The Brandwatch UI has been designed with flexibility in mind. Brandwatch gives its users complete control to analyze and represent the data in the way they want. All of Brandwatch's technology and data collection is proprietary technology, meaning Brandwatch has complete control and flexibility over their data sources and innovation. The company releases product updates every fortnight, ensuring the platform is ever-evolving and adapting to clients' needs.</p> <p>Brandwatch continues on its impressive business trajectory with strong tech industry backing from venture capitalists including Partech Ventures, Highland Europe, Nauta Capital, Gorkana and independent investors.</p>
Benefit	<p>The Brandwatch platform is incredibly flexible and powerful, making it adapted to many use cases. It is well-suited for brand monitoring through a wide range of features that suit this need, from sophisticated search abilities and global coverage, to powerful Rules and Alerts.</p> <p>Most common use cases are: Campaign Measurement, Community Management, Competitor Benchmarking, Customer Service, Influencer Marketing, Lead Generation, Market Research, PR Measurement, Product Development, Reputation and Crisis Management.</p>
Prospects	<p>To be released soon: Instagram Channels: an additional Social Analytics Channel</p> <p>Brandwatch Audiences: influencer technology that enables clients to discover the people that matter to them and get instant insights about any audience to power their Influencer Marketing & PR efforts</p>
Countries and customers	<p>Countries: United Kingdom, USA, Germany, Singapore</p> <p>Reference customers (globally): Heineken, Dell, Seat, Walmart, Sky, The Guardian, British Airways, BT, Cisco, L'Oréal, Mindshare, Ogilvy, Monster</p>

5.49 G|Predictive Gradient – Marketing Campaign Management [2][3]



Company	Gpredictive GmbH Lilienstraße 11 20095 Hamburg www.gpredictive.de Contact: Björn Goerke bg@gpredictive.de
Employees	Germany: 27
Characteristics	Gpredictive is a Software as a Service solution (SaaS). The software enables its users to carry out complex selections for direct marketing campaigns in a simple, fast and accurate manner. The pricing follows a subscription model. Gpredictive is a »tool« that encapsulates the statistical problem and the data mining process in the background. Gpredictive delivers out-of-the-box predictive analytics without the need for knowledge about statistics or data mining. The user defines his direct marketing campaign(s) within the software and independently performs the selection. The software supports the selections by identifying those customers most likely to respond to the campaign with a purchase or a booking.
Customer needs	Many companies spend a great amount of time on the selection of customers for a direct marketing campaign as well as on the acquisition of the relevant data. Gpredictive reduces this workload to only a fraction of that time. In addition, the software applies pattern recognition which provides greater accuracy and leads to a higher success rate for the entire campaign. The pattern recognition runs in the background without any need for experience in statistics or the like. The main objective is to permanently reduce campaign costs whilst increasing campaign success with improved accuracy. Like this, the monthly costs for running Gpredictive ultimately pay for themselves.
Big Data offerings	Gpredictive simply allows for better direct marketing. Campaigns are planned and conducted easily. A customized selection can be created and downloaded in just a few clicks. This selection is supported by pattern recognition.
Big Data	<ul style="list-style-type: none"> ▪ Volume: Our customers have billions of data records (many terabytes) in their databases that the software swiftly processes. ▪ Velocity: Our customers' data is constantly subject to change: new transaction data is added, new products are ordered or returned, or order details change. Gpredictive reacts to these changes immediately and processes them in real time. ▪ Variety: We primarily process structured data originating from CRM systems.
Innovation	The core of innovation lies in the fact that customers can make use of and carry out pattern recognition without any knowledge of statistics or data mining. So far, it has been necessary to build a team of data scientists and a specific software stack. From now on, every marketer can build his/her own predictive models. Seamlessly integrating the existing predictive models into the process of managing direct marketing measures allows companies to greatly increase their productivity.
Benefit	In addition to the enormous time savings when selecting recipients for campaigns, customers can also use Gpredictive to significantly increase sales and reduce acquisition costs. In just a few clicks Gpredictive users can become a predictive company with a long-term competitive advantage.
Countries and customers	Germany, Austria, Switzerland: Ascopharm, Tom Tailor, Westfalia, Peek&Cloppenburg
Future markets	United Kingdom, France, Poland, Netherlands, Sweden, USA

5.50 Implisense – Sales Intelligence for B2B [2][3]

Company	Implisense GmbH Spiekermannstraße 31a 13189 Berlin www.implisense.com Dr. Andreas Schäfer andreas.schaefer@implisense.com
Employees	12
Characteristics	<ul style="list-style-type: none"> Pre-structuring Public Big Data about companies for B2B Sales and Marketing Developing one of the fastest predictive analytics algorithms that model & predict new customers based on previous wins in under 15 seconds
Customer needs	Finding new customers is an essential activity for every business. As times changes, the process changes as well. With digitalization there are new and more efficient ways how to find a customer. For a cold client acquisition a lot for sales organizations access publically available data. Structured part of this data is usually poor.
Big Data offerings	Data-as-a-Service, Software-as-a-Service, customized Intelligence Reports, CRM Plugins all connected to our data and analytics backend
Big Data	Our backend continuously crawls, pre-structures and append company related data points out of regulatory filings, financial statements, corporate websites, job ads, industry data, news data and geo data from OSM by applying text mining technologies. Company related data points are mentioned topics, places, peoples, brands, products and technologies. Then it computes digital similarities between companies to make predictions about future business partners. Most of the relevant data sources are unstructured text data and change on a weekly basis.
Innovation	<ul style="list-style-type: none"> The company is one of the technologically leading suppliers of sales intelligence for B2B. The team and product have been repeatedly awarded for their excellence, for example at the BMWi Gründerwettbewerb IKT Innovativ in 2011, the 15. NUK Business Plan Competition in 2012, and the IT Innovation Award 2013 (CRM category), and at WECONOMY 2013. Our offering respects European privacy laws and has one of the fastest modeling approaches. Our Data-as-a-Service allows 3rd party providers like publishers to embed our data intelligence into their offerings without the need to invest in a similar service. New products and services can be built in a very short and resourceful manner. The founders of Implisense have worked for many years in fundamental and applied research, among others at Stanford University, Xerox Research and Fraunhofer.
Benefit	Implisense already managed to approve performance of cold calling for various customers by more than doubling the success rate in some cases.
Prospects	In 2016 Implisense will publish CRM Plugins for Microsoft Dynamics CRM, Infor CRM, Sage CRM and Salesforce CRM as well.
Governmental R&D promotion programmes	Implisense is part of ODINE, a program to European SMEs to grow their open-data idea into a sustainable business.
Countries and customers	Germany, reference customers are Cisco Germany, Deutsche Telekom, Fraunhofer
Future markets	Europe



5.51 Mapegy – Innovation Insights Platform [2][3]

Company	Mapegy GmbH Bismarckstr. 10-12 10625 Berlin www.mapegy.com Dr.-Ing. Peter Walde (CEO)
Employees	10-15
Characteristics	Mapegy is organizing the world's information on innovation to answer questions about what technologies, markets, companies and experts to invest in. We offer an intelligence platform (SaaS) our customers can log in and get technology and market insights on all technology driven industries worldwide.
Customer needs	In a complex world of information overload, it gets more and more difficult to stay ahead of competition and on the pulse of time. Our service helps all innovators worldwide (from companies to start-ups, from universities to students and subject experts) making well informed innovation decisions.
Big Data offerings	We retrieve and analyze innovation-related publications worldwide, identify crucial facts and figures and offer an easy-to-use, innovation insights platform for everyone.
Big Data	Our main information source includes more than 100 million patents, 150 million scientific publications, millions of daily distributed press publications, 10 thousands of technical standards, and millions of blogs and websites. This is a tera- and petabyte of data that are updated daily. Yet, our core competence is developing algorithms and AI that connect crucial facts and figures on all companies and experts and the topics they drive.
Innovation	Our USP: we are building an Innovation Graph and use our own cutting edge algorithms and AI to connect the crucial points on all innovation-related aspects globally. It is not just about Big Data; it is about Smart Data.
Benefit	So far, innovators used expensive consultancies and reports only to be informed. Those who cannot afford such luxuries used Google instead and spend hours to retrieve millions of publications they had to browse through. With us, everyone can get insights at a glance, with a click and at a reasonable price.
Prospects	Up until now, only managers and big corporates could afford innovation intelligence tools. Yet, innovation is and should be driven by everyone: students, experts, managers, startups, universities, SMEs or corporations. Our insights platform aims to also provide valuable and affordable insights to these individuals.
Countries and customers	Our customers range from Fortune 500 companies globally like Daimler or Henkel, to universities, consultancies, SMEs and individuals.



5.52 Datameer – Self-service, Big Data Analytics Platform [3]-[6]

Company	Datameer GmbH Große Ulrichstraße 7 – 9 06108 Halle (Saale) +49 345 279 5030 emea@datameer.com
Employees	Worldwide: 200 Germany: >60
Characteristics	Datameer is a self-service, big data analytics platform with a purpose-built open architecture to accommodate the constantly evolving Hadoop ecosystem. It is important for businesses to focus on getting to the fastest time to insight and implementing business value rather than on the technical details. Big data can be found in any industry and as such, Datameer is helping companies in retail, telecommunications, financial service, oil and gas and technology, among others. Over 200 customers have selected Datameer to get from raw data to insights faster.
Customer needs	Companies understand the value of analyzing big data, but the real subject matter experts, the business users, are unable to integrate, analyze, and visualize their own data without the costly and time-consuming process of involving IT or a data scientist. Hadoop is inherently technically complex and lacks an end-user interface.



	<p>Today's speed of business requires data-driven decisions, fast. Unless you're enabling the subject matter experts to work with the data directly, you're slowing down the process, and competitors who have this access will gain valuable ground.</p>
Big Data offerings	<p>Datameer gives business users a self-service, end-to-end platform that sits natively on Hadoop. This approach drastically reduces both the cost and the time it takes to get to insight. Specifically, it allows users to access, integrate, analyze, visualize and operationalize massive amounts of both structured and unstructured data using wizard-led data integration, iterative point-and-click analytics and drag-and-drop visualizations. Data is presented in a familiar spreadsheet-style interface and can be visualized at every step of the process, enabling business users to quickly gain the insights they need to make decisions.</p>
Big Data	<p>Datameer is native on Hadoop, rendering it less complex, expensive, and time consuming to deploy and use than traditional and legacy data warehouse and business intelligence solutions. Hadoop brings a new way to store and analyze data – since it is linearly scalable on low cost commodity hardware, it removes the limitation of storage and compute from the data analytics equation. Instead of pre-optimizing data in the traditional ETL data warehouse and BI architecture, Hadoop stores all of the raw data and, with Datameer, applies all transformations and analytics on demand. For easy data importation, Datameer offers over 70 connectors to the most common ones and an SDK for those less-common, so users can load structured, semi-structured, and/or unstructured data from any source with ease.</p>
Innovation	<p>Traditional data warehousing requires an incredibly lengthy process to find any sort of meaningful insight from data – time to pull together all of the data sources, determine the important business questions, map the business process and architect and implement the system. If new data sources or questions arise, you have to start all over. Datameer's technology reduces the cycle from 18 months to a few hours. And, it removes the need for IT to be involved so the real stakeholders, the business analysts, can work directly with the data. Datameer is an all-in-one tool for data integration, analytics and visualization. In traditional business intelligence, there are typically three different tools and three different teams involved. With these features combined, there is no other tool on the market that allows you to get from raw data to insight in such a short period of time.</p>
Benefit	<p>Companies in retail, financial services, gaming, telecommunications, technology, among others are using Datameer to get amazing results. In just 2-4 weeks, they gained insights that helped them:</p> <ul style="list-style-type: none"> ▪ Increase customer conversion by 60% ▪ Improve targeted advertisement resulting in an estimated \$1.65 million in savings ▪ Reduced customer acquisition cost by 30% ▪ Increase revenue by \$20 million ▪ Double their revenue.
Prospects	<p>Datameer Cloud is a new enterprise cloud offering that delivers big data analytics-as-a-service, fully managed by Datameer and running on Microsoft Azure HDInsight. It provides customers a one-stop-shop to integrate, prepare, analyze, visualize and operationalize data of any size, type or source. Datameer aligned with Azure HDInsight to help companies looking for the agility to meet new data-driven business requirements, faster. Now, business analysts can start using Datameer's end-to-end big data analytics platform in a matter of hours, without the time and cost to implement hardware and software infrastructure, requiring on-going IT resources, or having to find scarce, expensive Hadoop skills.</p>
Countries and customers	<p>Datameer runs globally including in North America, EMEA, APAC, Middle East and South America. Datameer counts American Airlines, American Express, Citi, British Telecom, Visa, Workday, CDW, Newegg, MachineZone, Otto Group, Cardinal Health, Sears, Comcast, Surfdomo, Yapi Kredi, priceline.com, Telefónica, and even the U.S. Women's Olympic Cycling team, among its customers.</p>

5.53 HERE Deutschland – Traffic Data Management [3]-[6]

Company	HERE Deutschland GmbH Invalidenstraße 116 10115 Berlin http://company.here.com , http://360.here.com info@here.com +49 30 446760
Employees	Worldwide: Approximately 6,500 Germany: >1,000
Characteristics	<ul style="list-style-type: none"> ▪ Licensing of data and services ▪ Data aggregation, big data analytics and creation of services in and for the automotive, mobility and enterprise sectors
Customer needs	Among the challenges are providing people better and more accurate traffic services, the development and the acceptance of automated driving as well as the management of fixed and mobile assets.
Big Data offerings	<ul style="list-style-type: none"> ▪ HERE HD Live Map: the world's most advanced cloud-based mapping service providing highly accurate and continuously updated mapping assets to support connected ADAS and highly automated driving solutions. It provides dynamic content layers updated in near-real-time. These layers are updated via a tile-based approach, allowing for real-time road network changes to be delivered over the air in a data efficient manner. ▪ HERE Real Time Traffic: delivering up-to-the-minute information about current traffic conditions and incidents that could cause delays, including slower than normal traffic flow, road works and accidents. It then helps drivers make the best decision about the rest of the journey by improving the accuracy of arrival times. ▪ HERE Predictive Traffic: helping in planning journeys up to 12 hours in advance. It accurately estimates how long it will take by factoring in real-time traffic, historical traffic flow data and other factors like average seasonal conditions and holidays. It's perfect when journeys are time-critical. ▪ HERE Traffic Analytics: helps enterprise and government customers make informed decisions about future traffic flow management by using historical road traffic data. It's about understanding what's happened before to improve what's yet to come.
Big Data	<p>Our traffic data is using information from over 100 source types and billions of GPS probe data points gathered every day. Over the years we have created database of over one trillion GPS probe data points contributing to our traffic products today.</p> <p>As cars become connected to the Internet they will generate tremendous amounts of data. The ability to share this data across all car makers globally, while protecting driver privacy, is essential to making automated driving a reality. In order for a vehicle to effectively »see around corners« beyond the reach of its on-board sensors it is mandatory to aggregate and analyze car sensor data at scale to provide a real-time picture of the road network to vehicles on the road.</p>
Innovation	<p>HERE HD Live Map is the world's most advanced cloud-based map asset commercially available for vehicles today and is ready to be deployed in connected vehicles in North America and Western Europe. HERE HD Live Map is the first ever map from HERE which is self-maintaining: through multiple modes of sensor aggregation and ingestion the vehicle's map is updated and delivered in near real-time.</p> <p>HERE Real Time Traffic is the most comprehensive, global traffic service commercially available on the market today. To ensure the information is available 24 hours a day, real-time data is collected and updated every 60 seconds from over 100 reliable sources. We offer 100% coverage in 58 countries with pinpoint accuracy down to 10-metres. For increased safety a Traffic Safety Warning feature prompts drivers to slow down in anticipation of a quickly building traffic jam ahead, often before it becomes visible.</p> <p>Among the services that wouldn't be possible are without big data and analytics are accurate real-time traffic information and dynamic real-time maps that enable vehicles to effectively »see around corners« beyond the reach of its on-board sensors.</p> <p>While HERE HD Live Map is a new solution developed by HERE, we are currently providing either parts or full specifications of HD Live Map for automated driving testing purposes to more than ten automotive companies.</p>
Benefit	HERE partners and customers benefit from the added value our solutions bring to their products, including better, more accurate and reliable traffic services, hazard warning systems and automated driving.



Countries and customers	HERE operates globally with key markets including Australia, France, Germany, the US and UK. Among its customers are market leaders like Amazon, AUDI, BMW, Baidu, Bosch, Continental, Daimler, Esri, FedEx, Garmin, General Motors, Honda, Microsoft, Opel, Oracle, Porsche, Samsung, SAP, Toyota, UPS, Volkswagen, Volvo, Yahoo.
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5.54 RapidMiner – Open Source Predictive Analytics Platform [1][3]-[6]

Company	RapidMiner GmbH Stockumer Straße 475 44227 Dortmund www.RapidMiner.com Contact Germany: contact-de@rapidminer.com Global Contact: contact@rapidminer.com
Employees	Worldwide: 100+ Germany: 30+
Characteristics	<ul style="list-style-type: none"> ▪ Leading Provider of Predictive Big Data Analytics Software ▪ Expert in Big Data, Predictive Analytics, Data Mining, Text Mining, Image Mining, Audio Mining, Web Mining, Machine Learning ▪ Predictive Analytics Solutions for all industries
Customer needs	Big Data promises significant business value, but is worthless if unleveraged. The volume and variety of data and the velocity of its creation are ever increasing. Those who manage to successfully derive insights and to take appropriate actions to avoid risks and leverage opportunities best, make their companies more data-driven and predictive, transform their industries, and have a significant competitive edge. RapidMiner provides the leading platform to integrate data from all types of sources, to automatically build predictive models using machine learning, to derive insights and predictions, to operationalize and automate, and to integrate the predictions and actions into business and IT processes.
Big Data offerings	<p>RapidMiner provides world-leading predictive analytics software:</p> <ul style="list-style-type: none"> ▪ RapidMiner Studio: predictive analytics suite with an easy-to-use graphical user interface (GUI) for integrating data of all types and to automatically generate insights and predictive models. ▪ RapidMiner Server: faster processing, sharing of resources in teams, user management, rights management, model deployment, automation, integration, web services, and process scheduler. ▪ RapidMiner Radoop: seamlessly integrates parallel and distributed data storage, data processing, predictive modeling, and model deployment on Hadoop clusters leveraging Spark, Storm, and MLlib into the graphical RapidMiner user interface for easy and fast big data analytics and for its deployment.
Big Data	<ul style="list-style-type: none"> ▪ Variety: RapidMiner integrates data from all types of sources, structured & unstructured, incl. files, SQL and NoSQL databases, text documents, web pages, web services, social media, images, audio, time series, IT systems, sensors, etc. ▪ Volume: RapidMiner can handle all volumes of data leveraging in-memory, in-server, in-database, and in-Hadoop processing. ▪ Velocity: RapidMiner offers distributed parallel processing in Hadoop and Storm as well as in-memory processing. ▪ Value: RapidMiner generates predictive insights and forecasts, individualized predictions and recommendations, and automates and integrates these into your business and IT processes to enable you to leverage the value of Big Data.
Innovation	<ul style="list-style-type: none"> ▪ RapidMiner provides the leading open source predictive analytics platform, offering 250+ machine learning and predictive modeling techniques and 1500+ data processing operators. ▪ Thanks to an open API and its predictive analytics marketplace, RapidMiner's functionality can be easily extended by everyone and RapidMiner Extensions can be made available to everyone on the marketplace and downloaded from the market place and leveraged with just a few clicks. ▪ RapidMiner has more than 250,000 active users world-wide, whose expertise is leveraged for automated recommendations inside RapidMiner using the Wisdom of the Crowds. ▪ RapidMiner's R&D department cooperates with many universities and partner companies to develop innovative machine learning algorithms and industry applications.

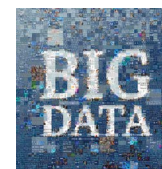


	<ul style="list-style-type: none"> ▪ R&D projects are funded by the BMBF (e.g. projects DS4DM, FEE, Pro Mond, STEPS), the EU (e.g. projects e-Lico, PRESED, Vista-TV), industry partners, and RapidMiner itself and create innovative solutions for predictive data stream analytics (Vista-TV), prediction and prevention of critical situations (FEE), predictive maintenance for predicting and preventing machine failures (STEPS), web mining and information extraction (STEPS), predicting assembly plans for new product designs (Pro Mond), predicting and optimizing steel product quality (PRESED), and many more. ▪ Gartner, Forrester, and KDnuggets rank RapidMiner as leader for advanced analytics and predictive analytics platforms.
Prospects	RapidMiner R&D continuously adds new innovative solutions and functionalities to the RapidMiner platform.
Governmental R&D promotion programmes	RapidMiner participates in various BMBF- and EU-sponsored research & innovation initiatives related to big data and predictive analytics .
Countries and customers	RapidMiner has users in more than 100 countries world-wide with the biggest deployments in Germany, USA, France, Finland, and Hungary. Customers include Airbus, BMW, Daimler, Deutsche Telekom, Intel, Lufthansa, Nokia, PayPal, Sanofi, Volkswagen, and many more large, mid-sized, and small enterprises and organizations.
Future markets	RapidMiner intends to further expands its business in the USA, Europe, Asia, South America, and Australia.

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5.55 Jedox – Corporate Performance Management [3][4][6][8]

Company	Jedox AG Bismarckallee 71 79098 Freiburg www.jedox.com +49 761 151470 Kay-Ingo Greve Jedox CEO +49 761 151 470
Employees	Worldwide: 130 Germany: 90
Characteristics	<ul style="list-style-type: none"> Jedox is a leading Business Intelligence and Corporate Performance Management solutions provider. Jedox's unified planning, analysis, and reporting software suite empowers decision makers from finance, sales, purchasing, and marketing. The Jedox Suite provides a highly-scalable analytical OLAP database server that delivers real-time performance with any data. The engine enables complex planning and forecasting with in-memory rules modeling, predictive analytics and instant consolidations and reporting over large multi-dimensional datasets as well as reporting clients for all platforms. Jedox provides unique innovations with its OLAP Accelerator, based on the computing power of the latest NVIDIA® Tesla™ Graphics Processing Units (GPU) as used in the high performance computing sector. GPU technology is able to manage continually expanding data volumes and complex calculations, a powerful engine for the analysis of Big Data. Jedox's GPU technology is used across industries, but is particularly often used in banking, manufacturing and marketing.
Customer needs	The sheer amount of data – Big Data – is not the only challenge that businesses are confronted with. It is rather the diversity of different data formats which need to be harmonized and turned into »Smart Data«, as well as a lack of standardization that form an issue in Big Data analytics. Modern manufacturing lines, for instance, provide tons of data – machine statuses, sensor measurements etc. – to the production system. Customers are challenged by these problems and the demand for 100% quality management. Therefore, for time-critical processes, businesses are looking for a solution which can standardize AND analyze those big data sets.
Big Data offerings	<ul style="list-style-type: none"> Production Intelligence: The Jedox »Production Intelligence« project is an Industry 4.0 initiative for predictive maintenance that advances data-driven optimization on complex manufacturing processes. In this use case – in-line quality measurement of car parts in an automotive supplier manufacturing line – different sensors provide data or pre-analyzed measurement values to the central Jedox GPU database. To turn this unspecific data sets into »smart data«, Jedox provides continuous real-time bulk insertion into the In-Memory database, online classification for feed-back loops and machine learning algorithms like »Deep learning« directly on the database values for e.g. Predictive Maintenance. Social Analytics: The Jedox Social Analytics App supports real time GPU analytics for social media data from Twitter. Jedox provides several analytics on that data like sentiment analysis, localized full-text search, Top 100 analysis or trending tag comparison. The Jedox OLAP Accelerator (GPU technology) enables the Jedox Server to analyze, predict and visualize Big Data from any source without wasting hardware. GPU-based Big Data Analytics in Finance: Especially in fast-paced sectors such as trade, investment banking, or in equity trading, complex planning scenarios, as well as ad hoc and what-if analyses need to be carried out in real time. The Jedox GPU Accelerator's especially rapid query times also allow i.e. portfolio risk assessments to be run through in real time.
Big Data	<ul style="list-style-type: none"> Production Intelligence: In this project automobile supplier Fischer IMF produces around 10,000 chrome auto parts per day. There are up to 1,000,000 possible errors per item that need to be analyzed in about 1 second. Predictive analysis on the basis of historical data is enabled by Deep Learning algorithms used within the OLAP database to support predictive maintenance (and also other solutions). Social Analytics: The Jedox app processes a continuous data input of about 30 million Twitter entries per day in real-time with more than 500 million filled data cells in the OLAP database. Sentiment analysis i.e. returns the result (positive/negative meaning) on an input of more than 50 million cells immediately. GPU-based Big Data Analytics in Finance: A leading international banking institute is using Jedox in-memory technology to analyze more than 3 trillion data cells and computes approx. one million bank transactions per minute.



Innovation	<ul style="list-style-type: none"> ▪ Worldwide, Jedox is the first BI provider that has pioneered tapping into the power of GPU technology to accelerate complex multi-dimensional computing tasks. Jedox's GPU innovations were recognized by the »Cool Vendor« prize from global analyst Gartner. ▪ Unlike other Big Data providers, Jedox does not only offer a database but comes with a native ETL component to extract, transform and load disparate data into the Jedox OLAP database and provides data analytics functionality in one unified tool. For the user, this means that applications run significantly faster, and important data is provided instantly. Additionally, GPUs can be utilized for even shorter query and write-back times. ▪ Each time-critical business opportunity is enabled through real time GPU analytics on databases, e.g. analyzing of continuous data such as activity trackers, or optimizing manufacturing through »Predictive Maintenance« in real-time. ▪ Big Data and GPU analytics are partially based on the research projects »Production Intelligence« and »Distributed GPU Database Server« (see Governmental R&D programmes).
Benefit	<ul style="list-style-type: none"> ▪ »Big Data« needs to be harmonized and processed into »smart data« in order to enable business opportunities. Jedox GPU technology allows users to make calculations quickly and extremely accurately without having to invest in an expensive database. Jedox offers a very cost-efficient and scalable »all in one« solution that not only supports enterprises, but also enables e.g. SMEs to benefit from Industry 4.0 innovation due to its cost-efficiency and scalability.
Governmental R&D promotion programmes	<ul style="list-style-type: none"> ▪ Jedox Industry 4.0 project »Production Intelligence« (Partners are: Zeiss, Fraunhofer IPM, Fischer IMF, Micronas). Project is funded through the German Federal Ministry of Education and Research (BMBWF) under the funding code 01IS15011 and is supervised by the German Aerospace Center (DLR). ▪ GPU research project »Distributed GPU Database Server« (Partner: University of Applied Sciences Offenburg): Project was funded by the »Central Innovation Programme for SMEs« (ZIM) and supported by the German Federal Ministry for Economic Affairs and Energy (BMWi).
Countries and customers	Worldwide (Americas, APAC, EMEA, DACH), 1,900 organizations are using Jedox technology. A small selection of Jedox reference customers: ABB, Siemens, Mercedes-Benz, Swissport, Sanofi, Western Union, Canon, BP, C&A.

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5.56 Flinsta – Identification of Behavioral Patterns [3][5]



Company	Flinsta GmbH & Co. KG Grafenberger-Allee 128 40237 Düsseldorf
Employees	5
Characteristics	FLINSTAs Mission is to make E-Commerce a Goldmine through a significant Update of the Customer Journey and Customer Experience Design using predictive analytics.
Customer needs	Users of online-shops decide in seconds, whether the presentation of a product suits their expectations. Presenting something generic, with the wrong attitude, mood or style costs e-commerces real money due to abortion rates and a higher percentage of return shipments.
Big Data offerings	FLINSTA delivers three services for e-commerces: <ul style="list-style-type: none"> ▪ Personal Funnel: FLINSTA predicts 5 dimensions of individualisation for each individual shop-user: motivation, intention, fashion/taste, mood and network-relations. ▪ Personal Configuration: FLINSTA predicts, what version/configuration of a product will make the shop-user click the most. ▪ Personal Selection: FLINSTA predicts, what size & fit (fashion e-commerces only), color (...) will suit the shop-user best and is less likely to end as a return shipment.
Big Data	FLINSTA uses BigData Analytics to identify behavioral patterns and cluster based on Shop-Logfiles, CRM- and PIM-Databases. Data Volumes reach hundrets of Millions of Datasets containing a huge variety regarding formats and quality. Cloud Based GPU Analytics is used to drive model based and model free Machine Learning.
Innovation	FLINSTAs core innovation is the combination of psychosocial models based on BigData Clusters for E-Commerce Funnels and Product-Presentations.
Benefit	FLINSTAs Customers are e-commerce companies which benefit from less abortions and more checkouts due to curated, individualised and personalised landingpages, newsletters, itempages and search-results.
Governmental R&D promotion programmes	FLINSTA is part of an international consortium transferring existing research on BigData into concrete markets.
Countries and customers	Germany, Netherlands, UK, France. FLINSTAs customers are e-commerces, online-gaming companies and e-commerce consulting companies.
Future markets	Ireland, Italy, Spain, Portugal

5.57 uberMetrics Technologies – Social Analysis and Public Information Streams [3][5]



Company	uberMetrics Technologies GmbH Alexanderplatz 1 10178 Berlin www.ubermetrics-technologies.com Contact partner: Patrick Goldschmidt
Employees	Germany: 34
Characteristics	Ubermetrics's Software as a Service monitoring technology integrates information analysis across sources and media channels to identify emerging risks, potentials, and trends to help companies optimize their business responses. Ubermetrics's customers inform their most critical decisions for use cases in the areas of Marketing, PR, Sales, Strategy, and Supply Chain Management.
Customer needs	The amount of new information created daily is truly immense. Every minute, hundreds of thousands of documents, tweets, blogs, and news are published – public information that is often ignored by companies as they are simply overwhelmed by this flood of input and thusly fail to systematically evaluate these amounts of equally valuable information from external sources. As a result, they fail to react to powerful information about their customers, their products, their competition, and suppliers.
Big Data offerings	Our product, Ubermetrics Delta, is built on the belief that every company should be armed with the best information possible to support and guide their business decisions. That's why we developed a high-performance stream processing engine that combines natural language processing (NLP), text mining and statistical algorithms to extract the most relevant documents, facts and statistics to help companies make the best decisions on the critical facts they need to know. Ubermetrics helps companies across industries and departments by monitoring, e.g. company image, supply chains, and customer satisfaction. Individual interfaces to customer-specific Business Intelligence solutions can be created by the customer, based on the Ubermetrics API (application programming interface).
Big Data	Ubermetrics Delta is a powerful information discovery tool that extracts meaningful information from more than 400 million online and offline sources in over 60 languages in real time. It processes on average 40,000 relevant documents per minute to support and guide business decisions. Ubermetrics deploys and controls all parts of the employed technology stack, including the crawling technology, content extraction algorithms, analytics, and scalability, touching upon public online and offline information streams from sources such as blogs and microblogs, news articles and press releases, social networks, online forums, images and videos, reviews and comments, as well as TV, radio, and print publications. During five years of business experience and constant technology improvements, we assure that our technology stack can process these information streams with the speed of Software as a Service.
Innovation	Ubermetrics's unique virality analysis visualizes information flow and influence paths based on links, comments and retweets to predict virality and identify key influencers. Ubermetrics Delta processes 10x more data than competitors and delivers real-time results regardless of terms and volume. Finally, we assure the highest data security that adheres to strict EU privacy regulations. The staggered staging system is applied and the „defense in depth“ system provides multiple security layers.
Benefit	Our customers can access all public online and offline information in a single, comprehensive solution. Customized reporting templates with real-time content provide our customers with relevant information to speed up and optimize decision processes. Ubermetrics media monitoring solution helps business make smarter decision. In the field of Marketing and PR the technology can harness public information to improve campaign effectiveness, identify influential opinion leaders for cooperation purposes, or measure the ROI of PR activities. In Sales Ubermetrics Delta can identify highly qualified prospects and sales opportunities. Companies that depend on complex supply chain infrastructures use Ubermetrics early warning system to detect indirect supplier problems such as strikes, natural disasters, or political upheavals before they impact supply chains. Finally, the technology helps companies of all industries to develop effective strategies for fast-paced markets to stay ahead of competition.

Governmental R&D promotion programmes	Ubermetrics participates in the research project „Smart Data Web“ which is funded by the Federal Ministry for Economic Affairs and Energy. The project connects Big-Data technologies, Web 3.0, and Industry 4.0 aiming to realize data value chains that use the latest Big Data technologies and analysis methods in order to use signals from internal databases and external data streams to extract new machine-readable facts.
Countries and customers	Reference customers: BMW, DHL, Deloitte, Microsoft, Zalando, Activision/Blizzard, TÜV Rheinland. The scalability of the technology, the business model, and the language coverage supported by the system allow internationalization, which has already successfully been achieved in Austria (Burton Snowboards, Wilder Kaiser), Switzerland (Chrome AG), and Spain (Opodo Ltd., D.A.S. Spanien).
Future markets	USA

5.58 Actyx – Innovative Industry 4.0 Solutions based on Big Data [3]

Company	Actyx AG Siegessstr. 24 80802 München https://actyx.io/ contact@actyx.io Contact Person: Dr. Roland Kuhn (CTO)
Employees	currently less than 20
Characteristics	<ul style="list-style-type: none"> ▪ We develop innovative Industry 4.0 solutions based on Big Data technologies in cooperation with small and medium-sized manufacturers in Europe with the goal of creating a fully connected manufacturing operations management system. ▪ The factory of the future aggregates data from operators, customers, suppliers, machines, environmental sensors, processes, orders and other sources to gain flexibility, react to changes in real-time, and constantly optimize planning and execution. This conserves resources (natural and otherwise) and unlocks new business models.
Customer needs	We help our customers identify the data necessary to achieve their business goals, analyze and visualize these data, and integrate the automated extraction and usage of insights from these data in our customers' production processes; the foremost goal is to assist personnel at all levels in doing their job by giving them the information they need, where they need it and when they need it. This spans from making the processes transparent via improving the quality of the master data up to a fully automated planning and execution environment.
Big Data offerings	Actyx offers a software-based business transformation through <ul style="list-style-type: none"> ▪ Digitalization Strategy Audit: assessment of the status quo, definition of a transformation strategy. ▪ Development of tailored software solutions implementing the digitalization strategy. ▪ Augmentation of existing ERP software with automated data registration, visualization, real-time Big Data stream analysis, configurable alerts, and reactive real-time planning.
Big Data	Detailed production process updates are analyzed both in real-time and on-demand in order to extract process step timings, cost per piece, machine capacity utilization, but also to identify bottlenecks. Real-time analytics based on machine learning flag anomalies like unusual delays or performance degradation, notifying and alerting the operator or supervisor immediately. Incremental updates to the overall production status are fed back into the continuous reactive planning process to react flexibly to delays.
Innovation	<ul style="list-style-type: none"> ▪ High quality data collection and analysis is the foundation for precise planning and delivery predictions; Big Data enables a qualitative improvement in adherence to delivery dates. ▪ The ability to analyze vast amounts of data is used to gain deep insights into the production performance at unprecedented levels of transparency; in this fashion Big Data enables qualitative improvements in resource planning, conservation and efficiency. ▪ The utilization of leading-edge open-source technologies allows these benefits to be realized at significantly lower cost and complexity than with traditional purely proprietary tools. ▪ Reactive software architecture ensures resilience and responsiveness even under failure conditions.



Benefit	<ul style="list-style-type: none"> ▪ More precise cost estimates, price offers, and planning ▪ Shorter lead-times, higher product quality, increased operational efficiency ▪ Flexibility and adaptivity to evolve the business ▪ Foundation for data-driven business models
Countries and customers	DACH
Future markets	Central Europe

5.59 Averbis – Information Discovery [3]

Company	Averbis GmbH Tennenbacher Str. 11 79106 Freiburg www.averbis.com Contact partner: Philipp Daumke +49 761 708394-0 philipp.daumke@averbis.com
Characteristics	Averbis is a leading provider of text analytics and automated classification of documents. We analyze unstructured data of all kinds, e.g. social media data, company-internal data, emails, patents and research literature. By this, we automate cognitive business processes and lower our customers' costs, boost productivity and contribute to informed decision-making.
Customer needs	The explosion of digital data in all industries requires new solutions for data-driven decision-making. 80 to 90% of data is unstructured and the amount of unstructured data in enterprises is growing significantly. Many organizations understand that their unstructured data stores include information that could help them make better business decisions.
Big Data offerings	We provide Information Discovery, a next-generation text analytics and data exploration platform that allows you to get insights in your unstructured data and explore important information in the most flexible way. Information Discovery collects and analyzes all kind of documents, such as patents, research literature, databases, websites, and other enterprise repositories.
Big Data	Organizations collect huge amounts of data every data (volume). Data comes in all types of formats – most of it in unstructured format. This holds for social media data, mails, PDFs, patents, research literature and many more (= variety). As this data streams in at an unprecedented speed, it must be dealt with in a timely manner (= velocity). We analyze unstructured data for insights that lead to better decisions and strategic business moves.
Innovation	Averbis offers a matchless integration of text analytics, text classification and search technologies into a single product – Information Discovery. Our solution allows you to analyze all kind of unstructured data on a large scale, particular know-how is available in Pharma and Healthcare, Patents and Automotive industry. Our quality makes us unique: we predict diagnoses for rare disease patients, we increase accuracy in patent classification by 400%, we automatically sorting documents into 1.500 different categories with high precision. Our sustained commitment to R&D yields the innovations that give us our competitive advantage.
Benefit	We automate cognitive processes of all kind and produce significant time and cost savings for our customers. Examples include decision support for medical doctors, patent monitoring for IP professionals, R&D monitoring for Pharma, social media monitoring or the monitoring of production processes in various industries.
Countries and customers	We are active worldwide for Pharma (incl. Hoffmann-La Roche, Novartis), Patent (incl. European Patent Office), Automotive (incl. BMW Group) and Healthcare (incl. RHÖN-KLINIKUM AG)

averbis
text analytics

5.60 KPMG – Pre-built D&A Solutions [3]

Company	<p>KPMG AG Wirtschaftsprüfungsgesellschaft Klingelhöferstraße 18 10785 Berlin www.kpmg.de Thomas Erwin Partner Consulting +49 621 4267-249 terwin@kpmg.com KPMG AG Wirtschaftsprüfungsgesellschaft is a member firm of a global network of legally independent member firms affiliated with KPMG International Cooperative. KPMG AG Wirtschaftsprüfungsgesellschaft has no authority to obligate any other KPMG member firm from this network.</p>
Employees	Worldwide: Approximately 174,000 Germany: >9,800
Characteristics	Accountancy and business consultancy Our priority in the field of Big Data/Data & Analytics is to focus on real business problems/ requirements, solving these with meaningful algorithms and innovative as well as efficient technologies. We are technology-independent and develop solutions for all industries.
Customer needs	Our clients often have a mass of unorganized/unstructured data, some of which is subject to major quality issues, already available within multiple data sources. Clients face the issue that they neither have the technology nor the know-how and capabilities to make use of this data. With our pre-defined solutions and our D&A experts we can support our clients to organize the data, develop insights and generate value from the data. In a global environment defined by constant disruption, business leaders need D&A they can trust to make proficient decisions and create sustainable competitive advantage. KPMG has earned that trust with an evidence-based, business-first approach that is at our core.
Big Data offerings	Worldwide we offer more than 125 pre-built D&A solutions along the value chain for clients in all industries. Using these solutions our clients can generate growth, control and lower their risks and reduce costs. Some of the solutions deal with client and market data (e.g. ›Customer Compass‹ (customer journey analysis) or ›Bottlenose‹ (social media streaming)), others use internal e.g. transactional data to generate value (e.g. ›Process Mining‹ (process optimization) or ›KREO‹ (supply chain analytics)). We also offer solutions that deal with our client's third party providers, e.g. to control financial and geopolitical risks (›Third Party Intelligence‹).
Big Data	In our D&A solution portfolio we also have real big data solutions that are not just business intelligence solutions. Alongside purely structured data, we also analyze unstructured data in our solutions (e.g. call center records or YouTube videos) to model the customer journey, for instance. When talking about social media analysis (as part of some of our D&A solutions) we are dealing with enormous data volumes in real time to indicate, for instance, supplier risks or upcoming social media storms. From a business requirement perspective not all D&A solutions need to be real big data, but if it makes sense and adds value we have the capabilities and solutions to deal with it.
Innovation	We bring innovative D&A technology, solutions and experiences together for clients through KPMG member firms around the world, e.g. our Insights Centers for individualized data analysis in London, Frankfurt, Hong Kong and New York and different academic alliances. KPMG is an audit company with more than 125 years of experience. As such we are used to analyzing data and finding the essential (needle in a haystack). On the one hand we have business and industry experts and are able to combine this expertise with technology and D&A know-how. On the other hand we are technology-independent and will always help to choose the best solution to fit our client's needs. Furthermore, we address the question of how much trust we place in D&A and develop new thought leadership on the theme of trusted analytics. The main business opportunities from these innovative solutions are new product offering opportunities and fast ad-hoc analysis to generate rapid value (growth, risk, cost). As Digitalization and Data & Analytics are strategic growth initiatives at KPMG, these topics are strongly prioritized within our internal R&D projects. We are investing globally more than 250 million US dollars in staff, technology and new D&A solutions.
Benefit	Applying our D&A products means that our clients gain access to a network of more than 4,300 D&A experts worldwide (24% annual growth). We can implement and individualize our pre-built solutions based on clients' preferred technology. When implementing innovation we are always looking for a holistic and therefore sustainable approach – not only considering the implementation of the solution but also looking at any necessary process, people or culture-related changes.
Countries and customers	KPMG is operating worldwide in all industries. In 2015 we generated revenue of 1.3 billion US dollars through our D&A solutions (57% annual growth rate).





5.61 Sonean GmbH – Ecosystem Intelligence [3]



Company	SONEAN Bleichstrasse 5 61476 Kronberg (Frankfurt) www.sonean.com Dr. Murat Ünal uenal@sonean.com
Employees	Worldwide: 15 Germany: 10 (founded in 2013)
Characteristics	Connecting data intelligently, using social network analysis, and dynamic monitoring of entire ecosystems (focus on investment sector, technology, agricultural machinery, and other relevant industries).
Customer needs	Managing and reducing complexity on a global scale by providing ecosystem intelligence which delivers timely and actionable intelligence about our client's competitive and external environment in order to spot risks and opportunities in a timely fashion.
Big Data offerings	Ecosystem Intelligence (development and monitoring of the entire ecosystem of actors in which our clients are embedded across dozens of countries), provision of social network analytic data and special reports for strategy, compliance, risk management, and other crucial purposes.
Big Data	It is all about connecting the nodes. We start our monitoring process with developing an ecosystem map of our client's organization, covering thousands of its customers, competitors, and other relevant institutions/stakeholders as well as their ties to each other which are then dynamically monitored, where data is intelligently connected (using social network analytic insights) and provided to our customers for entire regions and the global market place.
Innovation	<ul style="list-style-type: none"> Our ecosystem intelligence is the result of over a decade of preparation and strong academic research. Today we provide one intelligence source for the client, one standard, one language, and dynamic intelligence that covers the entire relevant ecosystem in which our customer operates, across dozens of markets. It is updated daily and provides a vast reservoir of insights It thus reduces opportunity costs greatly, provides complementary and independent intelligence and comes at a fraction of current monitoring costs with a multiple of the intelligence output in terms of quality. Hereby we use proprietary processes, and databases
Benefit	As stated we provide global intelligence that is relevant to the client, encompassing thousands of relevant actors (customers, competitors, multipliers such as universities etc.) that are dynamically monitored and risks as well as opportunities spotted. Hereby we automate entire processes, focus on central actors and search in dozens of languages. The client typically reduces intelligence costs by over 80-90% and gets a multiple of quality output and can thus use the intelligence for strategy and decision making based on a single platform created.
Prospects	We will make ecosystem data available for investment related purposes in order for investors to go beyond financial and non-financial data (such as environmental, social and governance data) and include social network related insights in their entire investment process.
Countries and customers	Our colleagues are currently based in Australia, Canada, Qatar, Spain, Turkey, and Germany and we serve clients from the US, and Switzerland covering 50-60 distinct markets.
Future markets	Focus will be mainly the USA, United Kingdom, Switzerland, and Germany (headquarters of clients) but monitoring will be carried out on a global scale out of Germany with local market assistance.

5.62 Synfioo – Transportation Monitoring [3]

Company	Synfioo GmbH August-Bebel-Str. 27 14482 Potsdam www.synfioo.com Marian Pufahl Managing Director Sales & Marketing marian.pufahl@synfioo.com
Employees	9
Characteristics	<ul style="list-style-type: none"> 360° transportation monitoring for all participants in the supply chain Synfioo finds all relevant disturbances per shipment from a broad variety of external (e.g. traffic, weather, transit times at tunnels and borders, strikes) and internal (e.g. truck GPS positions, transport plans, schedules) data sources Usage of complex event processing (CEP) technology with a multitude of connected data sources and fine-tuned logistics specific data queries
Customer needs	Transport planners are usually responsible for multiple simultaneous transports (100 or more) – it is not possible for one planner to manually keep an eye on all possible disruptions for each single transport. The Synfioo software solves this problem with a variety of data sources that are evaluated for each single transport in real-time.
Big Data offerings	<p>Synfioo 360° transportation monitoring comprises 3 services.</p> <ul style="list-style-type: none"> The basis is the Information Catalyzer Service which connects the available logistics information sources, correlates and aggregates events, and provides tailored notifications. On top, Synfioo's Impact Discovery Service connects external notifications to the own supply chain and calculates detailed deviations across the whole chain. The Event Prediction Service correlates actual and historic data to predict up-coming deferrals and enables early re-planning.
Big Data	Numerous data sources are queried constantly for each one of thousands of transports per day on the Synfioo cloud platform. A broad range of data formats is used (web services, APIs, HTML, RSS, PDF, etc.) and harmonized in the system. Out of this data stream and stored historic data, future events are predicted by machine learning algorithms and the combination of data sources.
Innovation	<ul style="list-style-type: none"> For the first time, real-time event data beyond traffic information can be used for monitoring, planning and scheduling of individual transports. Synfioo uses big data technology (complex event processing), connects relevant real-world data sources and automatically generates specific data queries for each individual transport. The basic concept and first prototypes have been developed in the EU-funded research project »GET Service« until Sept. 2015 by a consortium of industrial and academic partners. The founders of Synfioo took part in this project as members of the Hasso-Plattner-Institute at the University of Potsdam.
Benefit	The Synfioo services enable more robust transportation chains and early re-planning in case of disruptions. Delays in the transportation chain are immediately visible and can be taken into account for re-planning efforts and communication between transportation partners. The specific identification of delay reasons provides a greater transparency for analyses of own transport executions.
Countries and customers	Serving the European market from Potsdam (near Berlin), Germany. Reference customer for Transport Service Providers: Jan de Rijk Logistics, Netherlands
Future markets	Europe, USA & Asia



5.63 Parkpocket – Broker of Smart Parking Data [6]

Company	Parkpocket GmbH Balanstraße 73 Building 08 3rd Floor 81541 Munich https://parkpocket.com Dr. Karoline Bader
Employees	Germany: 16
Characteristics	<ul style="list-style-type: none"> ▪ Business Model: Data Licensing ▪ Focus on real-time off-street parking data ▪ Key market: automotive and navigation industry
Customer needs	Automotive and navigation companies lack a digital parking solution for their customers. Car park operators on the other hand lack access and visibility to their customers. parkpocket's distribution of smart parking data via interface (API) solves both of these problems.
Big Data offerings	The core product is a smart parking data set consisting of real-time occupancy rates of car parks and additional information attributes (Figure 9). It can be customized according to the customers' needs, delivered via API and integrated into various digital devices, navigation systems and connected car solutions.
Big Data	Data in the parking market is only accessible in a very unstructured and fragmented manner. parkpocket's processes gather that amount of data and transform it into smart parking data. In the end, the customer will be delivered a customized set of data that allows for pricing estimations and detailed comparability between different parking options.
Innovation	parkpocket set up a data ecosystem in which it has positioned itself as a neutral data broker. parkpocket is in the center between cities, car park operators and customers, such as automotives, navigation companies and ICT firms.
Benefit	parkpocket enables its B2B customers to offer an intelligent parking solution to their users. Due to the increase of transparency in the parking market, users will save time, money, stress, CO2 emissions and other negative effects of unnecessary traffic jams.
Prospects	In the future, parkpocket plans to enable car park operators to offer reservation and payment via the parkpocket platform. Another exciting field that parkpocket plans to get involved in is flexible pricing which will be interesting in terms of enhancing traffic management of cities and also revenue optimization of car park operators. Finally, parkpocket's vision is to provide its smart parking solution for self-driving cars in the future.
Countries and customers	At the moment, parkpocket operates in Germany, Austria and Switzerland preparing to roll-out to cover Europe until 2018.

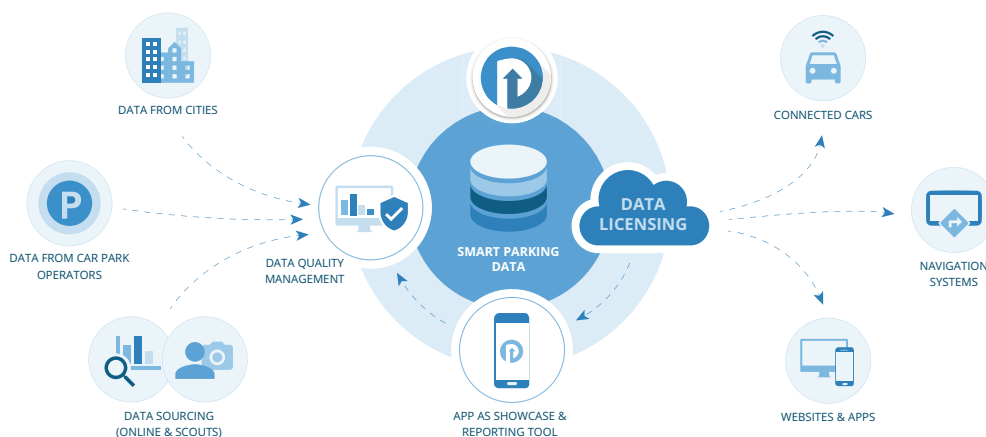


Figure 10: Smart Parking Data Set

5.64 Zeotap – Technology Platform for Mobile Operators to Monetize Data [6]



Company	zeotap GmbH Rosenstrasse 18 10178 Berlin www.zeotap.com Daniel Heer CEO & Founder +49 30 5557 8678
Employees	Worldwide: 35 Germany: 10
Characteristics	<ul style="list-style-type: none"> zeotap makes telco data from leading mobile operators easily and safely accessible across industries through a fully privacy-certified global cross-operator platform Our first key industry is the global mobile advertising market zeotap was founded in 2014 and already has partnerships with 6 major mobile operators across Europe, India and North America Beginning 2016 zeotap won its first two awards from the advertising world: the i-Com Global Mobile Award and the Unilever Foundry50
Customer needs	We give mobile operators an attractive end2end technology platform to monetize their data safely and add value in across different industries. Within mobile advertising, brands and agencies so far have few ways to target their audiences effectively on people's favorite device. This is because outside the walled gardens such as Google and facebook there is a massive lack of data. zeotap changes this. Our technology lets advertisers target their desired audiences on an impression-by-impression level precisely and at scale. This reduces wastage significantly and makes mobile the attractive personal marketing channel that it is while guaranteeing brand safety. Likewise, consumers profit from more relevant advertising and publishers and app producers can monetize their inventory more effectively, invest in better user experience and have less reason to indulge in intrusive advertising practices. Our technology also enables audience validation for any mobile campaign within our markets.
Big Data offerings	Determium™ is a global privacy-by-design technology platform that can safely make telco data accessible in multiple ways to cater to different clients needs. Determium™ is the first telco data platform that is ePrivacy certified and compliant with local telco data regulations in all of zeotap's active markets.
Big Data	zeotap's Determium™ platform maps, anonymizes, analyses and segments a variety of different telco data attributes in the millions and is able to enrich up to 10 billion ad impressions globally and in real-time.
Innovation	<ul style="list-style-type: none"> ePrivacy certification and privacy-by-design technology platform Global scalability across mobile operators at full security Direct possibility to enrich up to 10 billion daily mobile ad impressions Fast time-to-market at no integration costs for mobile operators
Benefit	Telecom-Data-as-a-Service is a \$79bn market opportunity for telcos in 2020 and the chance for numerous industries to develop better products and services and competitive advantages using one of the richest data sets in the world.
Prospects	Introduction of further industry solutions
Countries and customers	Tier1 mobile operators on three continents: Europe, Asia, North America

6 Excellence in Big Data – Applications, Industries and Enterprises, Initiatives and Ecosystems

6 Excellence in Big Data – Applications, Industries and Enterprises, Initiatives and Ecosystems

The sixth chapter focuses on the strategies, projects and ecosystems of Big Data Users in Germany. The chapter begins with an overview of two joint industry and research collaborations.

User contributions are grouped based on coarse grained use cases. In many companies, Big Data is in it's infancy, so we have also included projects which although still in the research and development phase, have nonetheless demonstrated their value by being singled out for special sponsoring and public support.

A number of experts in the most important branches have also provided their view of the state of play in those industries.

6.1 Application Platforms

6.1.1 Smart Data Innovation Lab – Karlsruhe Institute of Technology

R&D Organisation	Smart Data Innovation Lab (SDIL) Prof. Dr. Michael Beigl TECO / Karlsruhe Institute of Technology (KIT) teco.kit.edu Vincenz-Priessnitz-Str. 1 76131 Karlsruhe +49 721 608 41700 Michael.Beigl@kit.edu
R&D activities	<p>The Smart Data Innovation Lab (SDIL) offers big data researchers unique access to a large variety of Big Data and In-Memory technologies. Industry and science collaborate closely in order to find hidden value in big data and generate smart data. Projects are focused on the strategic research areas of Industrie 4.0, Energy, Smart Cities and Personalized Medicine.</p> <p>The hardware and software provided by the SDIL platform enables researchers to perform their analytics on unique state of the art hardware and software without acquiring e.g. separate licensing or dealing with complicated cost structures, providing external research and industrial partners with access to e.g. SAP HANA in-memory databases and/or the IBM SPSS Modeler predictive analytics tools running with SPSS Analytic Server integrated with the Apache Spark and Hadoop. The platform also offers access to easy to use big memory solution BigMemory Max by Software AG to scale up existing algorithms as well as diverse open source analytics and data processing tools.</p> <p>Within the SDIL numerous successful projects with regard to energy consumption optimization, anomaly detection, quality improvement or efficiency analysis and improvement of industrial production have already been conducted. It provides industrial data providers with a chance to analyze their data fully secured on-premise together with an academic partner.</p> <p>Template agreements and processes ensure fast project initiation at maximum legal security fit to the common technological platform. A standardized process allows anyone to set up a new collaborative project at SDIL within 2 weeks.</p> <p>In order to close today's gap between academic research and industry problems through a data driven innovation cycle the SDIL provides extensive support to (publicly and privately funded) collaborative research projects free of charge.</p> <p>The SDIL is coordinated by the TECO research group and the SDIL Platform is operated by the Steinbuch Centre for Computing (SCC) both at KIT.</p>

 Smart Data
Innovation Lab

 **KIT** **SIEMENS**
Karlsruhe Institute of Technology

  **BOSCH**

  **JÜLICH**
FORSCHUNGSZENTRUM

  **EnBW**

  **TRUMPF**

 **software AG**

 **Fraunhofer**
IAIS

<p>R&D cooperation</p>	<ul style="list-style-type: none"> ▪ Close collaboration with international Big Data Innovation Space like the French TeraLab within the BDVA, the European Big Data Value Public Private Partnership ▪ Together with the Fraunhofer IAIS and the DFKI the KIT supports the SDIL through the BMBF-funded project »Smart Data Innovation processes, tools and operational concepts« (SDI-X) <p>Collaboration with the Smart Data initiative, the Smart Data Forum and the German Big Data Competence Centers</p>
<p>Cooperations with partners in industry</p>	<p>The SDIL is supported by the following HW Core-Partners:</p> <ul style="list-style-type: none"> ▪ IBM sponsoring an IBM Watson Foundation Power 8 (4TB RAM, 140 cores, incl. SPSS, Hadoop/Spark Support, ...) ▪ SAP sponsoring SAP HANA (4TB RAM, 320 cores, incl. Vora, Predictive Analytics Library, ...) ▪ Software AG sponsoring their Terracotta and Apama platforms <p>The Data Innovation Communities are co-led by industrial and academic partners</p> <ul style="list-style-type: none"> ▪ Energy: EnBW together with KIT ▪ Personalized Medicine: Bayer together with Forschungszentrum Jülich ▪ Industrie4.0: Trumpf together with DFKI ▪ Smart Cities: Siemens together with FhG IAIS <p>An updated list of projects with industry partners is available at: www.sdil.de/projects</p>
<p>Additional Information</p>	<p>Within the state of Baden-Württemberg the SDIL is also offering free consulting to KMUs as well as a free first time analysis of their data sources through the Smart Data Solution Center Baden-Württemberg (SDSC-BW) funded by the local Ministry of Science, Research and the Arts (MWK)</p>

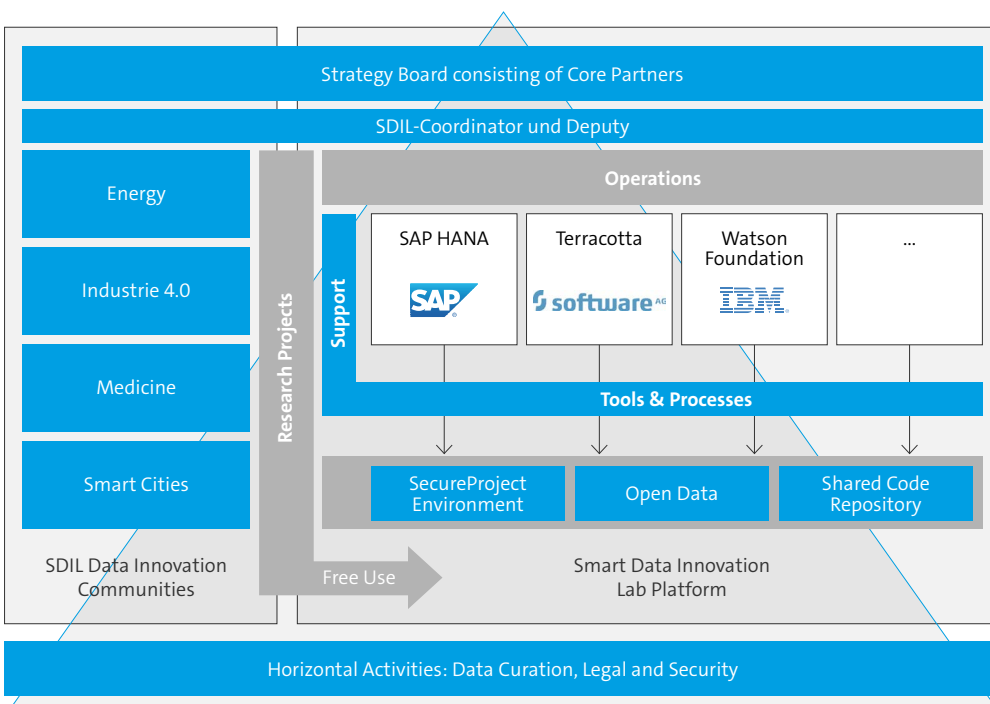
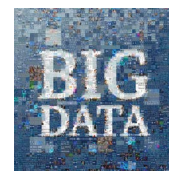


Figure 11: SDIL’s free Testbed for Data-driven Innovation based on State-of-the-Art Analytics

6.1.2 Industrial Data Space – Fraunhofer-Gesellschaft

R&D Organisation	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e. V. www.fraunhofer.de
R&D activities	<p>The »Industrial Data Space« is a virtual data space using standards and common governance models to facilitate the secure exchange and easy linkage of data in business ecosystems. It thereby provides a basis for creating and using smart services and innovative business processes, while at the same time ensuring digital sovereignty of data owners.</p> <p>The Industrial Data Space initiative was launched in Germany at the end of 2014 by representatives from business, politics, and research. Meanwhile, it is an explicit goal of the initiative to take both the development and use of the platform to a European and global level. The Industrial Data Space comes as an initiative that is organized in two branches: a research project and a non-profit user association. The research project is funded by the German Federal Ministry of Education and Research (BMBF). It is of precompetitive nature and aims at the development and pilot testing of a reference architecture model of the Industrial Data Space. The work of the research project is tightly connected with the activities of the user association named »Industrial Data Space e.V.«. The main goal of the user association is to identify, analyze and evaluate the requirements of user companies to be met by the Industrial Data Space. Furthermore, the user association contributes to the development of the reference architecture model and promotes its standardization.</p> <p>Plans to take the Industrial Data Space to a European level to provide a European Data Space are currently in preparation: The Roundtable on Industrial Data Platforms in Brussels on Feb 17, 2016 (led by Commissioner Oettinger) clearly showed the need for a European Data Space. A concerted action at a European level is required to drive the advancement and proliferation of digital platforms for smart data management that at the same time ensures digital sovereignty of all participating stakeholders.</p> <p>With a focus on the secure exchange and easy combination of data assets in business ecosystems, the European Data Space will enable companies of various sectors and sizes to leverage the business opportunities which digitization brings about without losing control over the use of their data.</p> <p>The design of the European Data Space will follow principles derived from strategic user requirements, including: a decentral data architecture without central data lake instances, collaborative data governance models, economic valuation of data in use and scalability in terms of deployment scenarios.</p> <p>With this federated approach, the European Data Space will recognize the existence of a variety of different data platforms (e.g. Internet of Things clouds) and resulting multi-homing requirements of data providers and data users. The European Data Space will advance data interoperability for European data value chains at a business and technical level via a comprehensive architectural blueprint to be taken up by various stakeholders and by demonstrating the feasibility and viability of its design in in-depth use case scenarios.</p> <p>The European Data Space will make intensive use of existing contributions from member states, including the Smart Industry initiative in the Netherlands, the work on Economy of Data in France, the Industrial Data Space initiative started in Germany and the FIWARE initiative. The European Data Space will also make use of existing standards such as RAMI4.0 and blockchain. Through its consortium members, in particular the FIWARE Foundation, the associated results will be made available as open standards themselves.</p>
R&D cooperation	<p>International R&D partners which are part of the initiative European Data Space to take the Industrial Data Space to a European level, include the following:</p> <p>Smart Industry platform in the Netherlands: The Dutch Smart Industry platform was set-up by the FME, the federation of the Dutch manufacturing industry. The organization represents 2,200 companies in many different industry sectors. The Smart Industry platform adopted in 2014 an action plan to stimulate digitalization in Dutch industry by fostering public-private collaborations in so-called fieldlabs. Several fieldlabs were set-up, e.g. on secure data sharing, smart maintenance and smart supply chains. The platform expressed its clear support for the proposal and will provide access to fieldlabs aligning their national initiatives with developments on a European scale. In addition it provides a platform for setting-up further pilots/business cases/fieldlabs based on the outcomes of the European Data Space.</p> <p>Pan-European I4MS: The European Data Space will be aligned with the I4MS (ICT Innovation for Manufacturing SMEs) FoF-PPP action, which is a 150 M€ initiative designed to help more than</p>



250 high-tech manufacturing SMEs exploit through ten open calls the experimentation of more than 150 innovative ICT services for advanced manufacturing processes, in collaboration with more than 120 ICT partners and competence centers all over Europe.

BEinCPPS: The European Data Space is well aligned with the BEinCPPS Innovation Action on cyber physical production systems connecting the cloud to the shopfloor. The main goal of BEinCPPS is the creation of five Innovation Hubs in selected Vanguard Regions: Lombardia (IT), Euskadi (ES), Baden-Wurttemberg (DE), Norte (PT) and Rhone Alpes (FR).

The European Data Space is deeply aligned with FIWARE, NESSI, EFFRA, DBVA and the AIOTI associations. The FIWARE Foundation will participate directly in the European Data Space initiative. Several other participants in the European Data Space initiatives are members of the European Association for the Factory of the Future (EFFRA), the European Association of Big Data (BDVA) and the European Alliance of the Internet of Things (AIOTI), as well as member of the Industrial Research Advisory Board (IRAG) of EFFRA. The European Data Space participant ATOS is a founding member of the European Technology Platform NESSI (Networked European Software and Services Initiative) and a major partner in Future Internet-related initiatives being member of the FI PPP Steering Board and Industrial Advisory Board. Since 2014, ATOS is a founding member of the Big Data Value Association (BDVA) as well as also member of the 5G PPP Steering Board. At national level, ATOS is currently holding the Presidency and Secretary of PLANETIC for ICT, as well as the Vice-presidency of Internet for Future Internet technologies, and is member of several others, such as Logistop for Integral Logistics or the Spanish Railways Technology Platform. Furthermore, the European Data Space is aligned with the Vanguard Regions initiative in which leading industrial regions commit to the industrial future of Europe supported by Smart Specialisation. The aim is boosting new growth through bottom-up entrepreneurial innovation and industrial renewal in European priority areas.

**Cooperations
with partners
in industry**

Partners in industry which are part of the initiative European Data Space to take the Industrial Data Space to a European level, bring in their expertise as explained in the following: ATOS, PricewaterhouseCoopers (PwC), Santander, Siemens, and Telefónica are among the European market leaders in their respective areas and they bring strong expertise in the provision of services and solutions for Security, Privacy and Trust (ATOS, PwC and Santander) and data evaluation (Siemens and Telefónica). They also bring expertise and know-how for commercialisation and exploitation of innovative solutions and a strong record of doing that in European and International level. PwC contributes to the initiative by identifying the general requirements for the architecture of the European Data Space and will develop a certification approach. ATOS and INNOVALIA are leading the European network of poles for FIWARE for Industry (Portugal, France, Germany, United Kingdom and Spain) with the support of the Fraunhofer-Gesellschaft (FhG) as German Hub manager and INNOVALIA is leading the development of the community around the I4MS CPPS competence centers (Spain, Portugal, Italy, Germany and France) connecting directly with the Vanguard initiative. Banco Santander is one of the Eurozone's leading banks and will bring its expertise in financial products and services to the design of innovative Smart Financial services as value added data services associated to the European Data Space. In addition, it will collaborate in the commercialisation and exploitation activities. It will also contribute application use case pilots, bringing cross-domain expertise from the financial sector.

6.2 Mobility – Automotive

Competition and key drivers

The automotive industry in Germany is one of the largest employers in the country, with a labor force of over 793.000 (2015) people working in the industry (Statista_01). The automotive sector has significant economic importance for German industry with an overall revenue in Germany of 404,8 bn Euro. 65,1% (263,4 bn euro) of the revenue was produced abroad, 34,9% (141,3 bn euro) is domestic revenue (Statista_02). Furthermore the VW Group, Daimler Group and the BMW Group achieved an overall world-wide revenue of 454,93 bn € in 2015 (Statista_03).

Being home to the modern car, the German automobile industry is regarded as the most competitive and innovative in the world, and has the fourth highest automobile production in the world. With an annual output close to 5.3 million cars Germany is the absolute leader of car production in Europe since the 1960s.

Currently, five German companies and seven marques dominate the automotive industry in the country: Volkswagen AG (and subsidiaries AUDI and Porsche), BMW AG, Daimler AG, Adam Opel AG and Ford-Werke GmbH. Nearly 5.3 million vehicles were produced in Germany (Statista_04), and approximately 8.6 million were produced overseas by German brands in 2013 (Heymann, Eric, 2014). Alongside the United States, China and Japan, Germany is one of the top 4 automobile manufacturers in the world.

The automotive sector is a key industry for the increasing digitalization and already today, manufacturing processes are largely automated and a highly connected OEM and supplier ecosystem exists. The potential of Big Data solutions is to improve the coordination of production processes and to achieve more transparency and flexibility within the automotive industry is obvious.

The increasing connection of cars and digitalization of business processes is the foundation for new business models and services in the automotive area. Data driven business models will have a tremendous impact on the Germany automotive market. And with that in mind not the Asian competitors anymore are most dangerous for the German Automotive industry, but those from Silicon Valley. Additionally, traditional IT service providers compete against specialists from the automation industry with increasingly similar offerings.

Industry Challenges

The automotive market undergoes tremendous changes. The selling of cars in the German domestic market is only slightly inclining. The growing car markets are China, India, Brazil and Russia. According to McKinsey, by 2020, over half of all cars marketed worldwide will be sold in these regions. Customers ask for new services like car-sharing and higher security efforts. Driving-based insurances policies and optimized traffic management are further topics.

According to McKinsey the number of connected cars will grow from 12% (2016) to 22% (2020). Based upon that increasing number of connected cars new business models will evolve. Not necessarily in line with traditional business propositions, these new business models will include new and unusual service bundles. Bundling of car leasing and usage-based car insurance might become a popular bundle in the next few years with high impact on car sales and insurance sales too. Furthermore people are connected, companies are connected and now devices and machines are connected, too (Industry 4.0). Machina Research (Machina) predicts that by 2020, there will be 1.8 billion machine-to-machine connections in the automotive space alone. The increasing digitization of the automotive business processes is the foundation for cost optimization and digital business processes.

A further trigger of change is consumers' increasing awareness of the need for fuel economy. Alternative, more efficient drives (e-mobility) and car-sharing models (urbanization) are booming. Some 59 percent of generation-Y drivers expect to be using a car powered by alternative energy in five years' time; compared to 41 percent who think they will still be driving gas or diesel vehicles. According to KPMG, 92 percent of consumers state fuel efficiency as their top priority when buying a car (KPMG).

Self-driving cars are set to become a realistic prospect on our streets in a matter of years. ABI Research estimates that around 80 million of these vehicles will be sold by 2020. In addition to automotive players, technology leaders (such as Google, HERE, QNX, Intel and Nvidia) are paving the way for innovations and introducing consumers to the benefits of these new technologies (Gartner).

Changes in customer behavior are reshaping the entire automotive ecosystem. Consumers want to choose the color of their car themselves, select the interior – including entertainment and navigation systems with cell phone integration – and have complete price transparency. Above all, they want to be able to do these things anytime, anyplace, and at the touch of a button. The entire value chain is geared toward these new customer-driven processes. According to McKinsey, the global market for online car services will increase more than five-fold by 2020 – from 30 billion euros to 170 billion euros.

Consumers' online behavior is impacting the sales channels. Their always-on mentality and the power of social media are having a lasting effect on product development. And these changes are widespread, affecting all aspects of the business – from IT, to sales and marketing, to user departments. To survive and thrive in this marketplace, automotive players need to embrace these developments and adapt their business accordingly.

After all, connected products and assets turn the service model around, making it proactive instead of reactive. The goal is to ensure a customer experience with consistently high quality, addressing each customer individually and digitizing the customer dialog. The increasing digitalization of the automotive industry has an huge impact on future business processes and business models. The automotive manufactures transfer from car produces to providers of mobility services.

Technology Facilities

As the Automotive industry is really globalized and highly standardized, all global OEM's are working in international bodies to drive new standards and industry directions. The OEM's are attached very much to their ecosystem of suppliers and vendors in order to drive innovations technically and from an industry perspective. Research and technology development is happening globally today.

The German Association of the Automotive Industry or VDA (German: Verband der Automobilindustrie e. V.) is a German interest group of the German automobile industry, both automobile manufactures and automobile component suppliers and is well-known for driving activities of the German automotive industry. The VDA hosts the world's largest motor show, the biannual International Motor Show Germany (IAA) in Frankfurt. Furthermore it is the driver for combining the strengths of the automotive industry and consolidates the manufacturers of passenger cars, trucks, vans and buses, the suppliers of parts and accessories, as well as the makers of trailers and bodies. This high degree of networking reflects the strength of the German automotive industry – a model that sets the standard for other automotive nations.

Innovations and knowledge transfer

The OEM's use their own core R&D capabilities to develop new business models, develop new strategies for innovations. A lot of core research and development is happening in the ecosystems of the industry with partners and vendors driving new innovations globally. Because of its standardization across the globe, cooperation with standard bodies is also key and driven by all participants within the industry.

Germany is where the automobile was invented, and this is where it is constantly being reinvented – with an annual 20 billion euros spent on R&D, resulting in more than 3,650 patents each year (VDA). This is a strong foundation for shaping future innovations and business approaches within the automotive industry.

Big Data

Cross-enterprise R&D projects and co-operations based on big data and analytics are in the early stages. Especially the new business models around connected-Car are of tremendous significance for the automotive players. Connected cars generate huge volumes of data that must be securely processed and analyzed in the cloud. This development is becoming an everyday reality for the automotive industry and comes along with an huge demand for first-class Big Data solutions as this level of connectivity will, have a significant impact on data traffic – both in terms of volume and quality/complexity.

The current trends and challenges in the automotive industry come along with an increasing digitization of the automotive world. The implementation and offering of new services like connected car and self-driving cars, customer intimacy, smart factory and predictive

maintenance, digital engineering and new insurance models generate enormous volume of new data. Without smart Big Data solutions and services the management and refinement of this data into information in an efficient and value-generating way is simply impossible.

An important aspect in automotive is the »connected car«, which also includes objects within the car, information systems and drivers' smartphones. The automotive manufacturers as the »masters« of all vehicle sensor data are »sensing« the potential power and also the huge business potential of this topic, which is gaining traction with real implementations that do not only deal with infotainment, but address the connectedness with external services for smart control, including use cases such as smart home control (prior to arrival), the localization of power supplies for electric vehicles and insurance policies that adapt to the driving behavior (pay as you drive, PAYD tariffs). CPS (cyber-physical systems), cloud services, big data and analytics, mobile devices and security are contributing to help integrate additional services such as connected car and autonomous driving into this mobility service that relies heavily on Big Data solutions.

Further scopes of activity for Big Data are customer intimacy with the goal to generate a better brand-loyalty on utilizing the personalized digitalized communication channels. Smart factory and predictive maintenance concepts are the foundation for agile and well-maintained production processes. Big data platforms and real-time analysis turns data into information, what is the main resource for smart factory and predictive maintenance. Digital engineering within the cloud prepares the way to the next car generation. Manufacturing companies will start to recognize the opportunity of big data and analytics and think how to use piles of data from their enterprise engineering and manufacturing system to drive some analysis and use it for decision making of future vehicles and automotive services.

6.2.1 Initiative within the Volkswagen Group IT – Volkswagen Data:Lab

Volkswagen Data:Lab	Volkswagen Data: Lab Postal address Wolfsburg: Volkswagen Aktiengesellschaft Brieffach 011/1808 38436 Wolfsburg Postal address Munich: c/o MAN SE Ungererstr. 69 80805 Munich Contact: Cornelia Schaurecker Director of Volkswagen Data:Lab
Big Data strategy/initiative	<ul style="list-style-type: none"> ▪ The Volkswagen Data:Lab is a future oriented, data-driven innovation hotspot for the Volkswagen Group brands, markets and business departments. It is building Use Cases across the whole automotive value chain in the areas of Big Data Analytics, Artificial Intelligence, Machine Learning, Connectivity and Internet of Things. ▪ As a technology scout and think tank it showcases what may be possible. The goal is to leverage the value of Big Data, Data Analytics and Machine Learning for Volkswagen Group through innovative prototyping. ▪ An experienced internal team of specialized Data Scientists closely collaborates with external partners. Our extensive innovation network consists of Group internal teams, experts from leading technology providers, research facilities and universities as well as carefully selected technology startup companies from all over the world.
Innovation/Knowledge transfer	<p>We have competences in the following areas:</p> <ul style="list-style-type: none"> ▪ Artificial Intelligence (Machine Learning: Computer Vision (e.g. environment sensing), Deep Learning (e.g. sensing and environment sensing), logic (e.g. automatization, process optimization) etc.); ▪ Robotics (Autonomous & Intelligent Mulit-Agent Systems, Distributed Agent Systems, Sensor Fusion etc.); ▪ Predictive Analytics (e.g. prediction models for markets, customer needs, purchase behavior, etc.); ▪ Internet of Things (e.g. various devices, Smart Cities, etc.); ▪ Connected Customer and Car, Smart City (concepts, services, apps, algorithms etc.). <p>Furthermore the Volkswagen Data:Lab is building, driving and leveraging an extensive innovation network. Cooperations with international R&D partners and leading players from various industries are established in the above mentioned areas. We are interested in collaborating with the best partners to leverage joint potential.</p>
Additional Information	<p>Internal results: Various breakthrough achievements in multiple Use Cases across the whole Automotive value chain.</p> <p>External awards and achievements e.g.:</p> <ul style="list-style-type: none"> ▪ Awarded the designation of Landmark in the Land of Ideas 2015 as part of the contest »Germany – Land of Ideas«, an initiative from the German Government aimed at promoting Germany as a land of innovative future oriented ideas. ▪ Finalist in Handelsblatt Digital Business Innovation Award 2015. ▪ Finalist in Wirtschaftswoche Digital Transformation Award 2015.



6.2.2 Efficient test management through real time analysis – Mercedes AMG

Company	<p>Mercedes-AMG GmbH www.mercedes-amg.com The company Mercedes-AMG specializes in unique and performance vehicles and this is what it expects from its IT. Especially in the area of test and quality management it is important to be up to date and use optimization potentials.</p>
Challenge	<p>The testing of new vehicle components and their development is a sophisticated and costly part of the vehicle development process. Faster test results are not only important because of lower costs, but also to be one step ahead of the competition through fast product launches.</p>
Solution	<p>The use of SAP HANA® in engine testing makes the processing and visualization of thousands of data points possible within seconds. Comparing data of the engine testing with existing real time recordings makes the smallest deviations visible and allows immediate reactions to improve the usage of the test system.</p>
Business Value	<p>The benefit consists, above all, in the saving of time during the testing of the engines and in the analysis of the data, which accelerates and improves the development.</p>
Big Data	<p>Using real time processing of data and predictive analytics, cost can be avoided. By means of SAP HANA®, Mercedes-AMG can analyze tens of thousands of data objects per second, which have been read by the engine sensors. This way, failed test runs can be stopped after three instead of fifty minutes, what finally can mount up in one additional day of testing per week.</p>
Innovation	<p>So far, the engine testing had to be completed entirely to get necessary outcomes, now the usage of Big Data technologies enables Mercedes-AMG to detect the smallest deviations and to intervene in test processes early on.</p>
Prospects	<p>The ongoing development of a platform, which provides – tailored to the development and producing processes – the relevant data for every employee, makes an integrated 360 degree view and new techniques of analysis possible, also on mobile devices.</p>
Big Data Provider	<p>SAP Deutschland SE & Co. KG www.sap.de info.germany@sap.com +49 6227 7-47474</p>



6.2.3 Production Optimization in Smart Ecosystems – AUDI – Pro-Opt

Title	Pro-Opt – Big Data Production Optimization in Smart Ecosystems www.pro-opt.org
Company	AUDI AG Auto-Union-Str. 1 85057 Ingolstadt Contact: DSA Daten- und Systemtechnik GmbH Dr. Simon Becker simon.becker@dsa.de +49 2408 9492-650
Project Partners	DSA Daten- und Systemtechnik GmbH (Consortium Leader), camLine GmbH, German Research Center for Artificial Intelligence (DFKI), Fraunhofer Institute for Experimental Software Engineering IESE
Challenge	Today's industrial production processes, e.g. in the automotive industry, are characterized by a high degree of division of labour. More and more, the cooperation of companies in the value chain takes place in decentralized digital data systems – so-called smart Ecosystems. In many cases it would be useful to perform integrated data analysis along the whole supply chain. The challenging task is managing and analyzing the enormous amounts of data: in individual companies, data are stored in different formats, often redundant and, in many cases of divergent quality. In addition, companies have a vital interest to keep control over their own data. On the other hand, the tradeoff of sharing data is not apparent and hard to assess.
Solution	The PRO-OPT project is taking on these very challenges with the aim of developing smart data solutions for companies – especially SMEs – and in doing so is making valuable data available within smart ecosystems. Therefore, PRO-OPT follows an integrated modeling approach that takes into account local data ownership by modeling data including the specification of restrictions concerning its usage. Also, data quality is considered. The companies involved can then analyse data efficiently across company boundaries. Besides preparing the data, PRO-OPT provides the platform for distributed data analysis, data visualisation and for inter-company data exchange in compliance with the specified usage restrictions.
Business Value	PRO-OPT enables companies to improve production processes along the value chain aiming at improving the products as well. For that reason a platform is provided allowing smart inter-company analysis of distributed data. Furthermore, by making its technology available, the project creates an important stimulus for the development of new business models and processes. The results of the project can be used in a variety of domains such as vehicle and medical industry, e-energy, ambient assisted living and intelligent mobility. PRO-OPT uses car production as an example domain, as this industry has a key position in Germany and often sets the direction for other sectors.
Governmental R&D program	A Smart Data Programme Project of the Federal Ministry for Economic Affairs and Energy



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Smart Data

6.2.4 Cooperative Intelligent Transportation System – HERE Deutschland

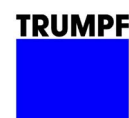
Company	HERE Deutschland GmbH Invalidenstr�a�e 116 10115 Berlin +4930446760 info@here.com http://company.here.com http://360.here.com
Competitive environment/ Driving factors	HERE is a leading location cloud company. It enables high quality maps and real-time location applications and experiences for people, vehicles, enterprises and governments. With a global network of more than 200 field offices across 56 countries and major product development sites in Germany, India, the Netherlands and the United States, HERE is providing location services around the world, including real-time traffic feeds across 58 countries and public transit routing for 1,100 cities. As the only pure play location company with global scale, HERE is well-positioned to bring the benefits of location cloud technology across industries and markets. This includes the automotive space where HERE is working with most of the global OEM brands on automated driving topics. Additionally, through its Digital Transportation Infrastructure program, HERE is driving the development of Cooperative Intelligent Transportation Systems (C-ITS) underpinned by mobile networks. Among the factors the company is exposed to are the proliferation of sensors, the ubiquity of powerful mobile networks, the increasing maturity of big data analytics and automation. Location cloud technology and location intelligence is of ever-increasing importance for a variety of industries and markets, including automotive, enterprise, consumer and internet of things.
Challenges	We are faced with the challenge of how to unlock the true value of the data being generated by connected vehicles and all the other elements of the connected mobility ecosystem. Today there are a lot of data silos, creating a very fragmented picture which is hugely restrictive to building effective services as scale matters. To unify the disparate elements of the fragmented road networks, the first major step is therefore to collaborate around big data. There needs to be a means by which we can pool certain data into a single system for our collective benefit – for safer roads, more enjoyable driving etc.
Big Data strategy/ initiative	The big data strategy of HERE revolves around making sense of the diverse data within the mobility ecosystem to create value for its customers by providing services and experiences like more accurate traffic information, hazard warning systems, automated driving, multi-modal mobility solutions etc. In 2015 HERE initiated industry-wide efforts to drive a global standard for how in-vehicle sensor data is transmitted to a location cloud. The aim of these efforts is to accelerate the development of automated driving and to ensure that the results are available globally. With a standard format for this data, modern vehicles can more easily transmit to the cloud information about road conditions in real-time to improve safety for drivers. The data generated would be analogous regardless of vehicle manufacturer and could be pooled, processed and analyzed quickly to create a detailed live view of traffic conditions. In early 2016 HERE unveiled HERE HD Live Map, the world's most advanced cloud-based mapping service providing highly accurate and continuously updated mapping assets to support connected ADAS and highly automated driving solutions. It provides dynamic content layers updated in near-real-time. These layers are updated via a tile-based approach, allowing for real-time road network changes to be delivered over the air in a data efficient manner.
Innovation/ Knowledge transfer	We are currently working with more than ten automotive companies on automated driving projects. This is showcasing the high importance of cooperation around R&D.



6.3 Mechanical Engineering / Automation / Industrie 4.0

6.3.1 Platform for Smart Services – TRUMPF Werkzeugmaschinen

Project	SePiA.Pro – Service Platform for Intelligent Plant Optimization in Manufacturing
Company	TRUMPF Werkzeugmaschinen GmbH + Co. KG Johann-Maus-Straße 2 71254 Ditzingen www.trumpf.com Dr.-Ing. Christian Bauer Entwicklung Basistechnologie +49 7156 303-32316 Christian.Bauer@de.trumpf.com
Project Partners	TWT GmbH Science & Innovation, Blue Yonder GmbH, German Research Center for Artificial Intelligence, Daimler AG, TRUMPF Werkzeugmaschinen GmbH + Co. KG, University of Stuttgart
Challenge	<p>One of the major challenges regarding Big Data in industry is the smart evaluation of sensor data and order parameters in production plants. The main challenge for TRUMPF customers is an increasing need for individuality in their products. This individuality of products comes with a main focus on flexibility in their production processes, and a reduction of the lot sizes down to lot size 1.</p> <p>In addition to that, individual production processes are already highly optimized. The interaction between those processes, the networking of different machines and software systems, and non-value-adding processes provide a high potential for optimization. To meet these challenges and lift those potentials Big Data is the key by linking information of different sources and applying intelligent algorithms.</p> <p>Most crucial restrictions by applying those algorithms are security of knowledge and intellectual properties of our customers. Information deserving protection includes not only data but also the algorithms themselves.</p> <p>Therefore a principle is necessary that is not only capable of transferring data in a secured manner, but also is able to provide function shipping to execute algorithms on premise. For TRUMPF the focus of development shifts from single machines to connected production systems and the according software tools for optimizing the value chain.</p>
Business Value	TRUMPF addresses these challenges with different business models that expand the existing portfolio accordingly. TRUMPF assists its customers by consulting them how to optimize their production following lean principles. In addition to that, founding the new company AXOOM was a huge step into addressing the changing markets and requirements in IoT-World.
Solution	The project »SePiA.Pro« aims to develop a cloud-based platform solution that offers Smart Services for small and medium-sized companies. These services are flexible, portable, transferable and safe and therefore bring benefits for all stakeholders in the process: manufacturers, service providers and operators while data authority stays with the data owners
Innovation	The services provided by the SePiA.Pro platform have the potential to optimize processes throughout the whole production process, from order management to better machine capacity management.
Governmental R&D program	A project of the Smart Service World Programme of the Federal Ministry for Economic Affairs and Energy



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6.3.2 Anomaly Analysis – CLAAS E-Systems



Source: CLAAS

Figure 12: Advanced data analytics helps improving performance of mobile agricultural machines

Company	CLAAS E-Systems KgaA mbH & Co KG Bäckerkamp 19 33330 Gütersloh Thilo Steckel +49 5247 12-2074 thilo.steckel@claas.com
Employees	Worldwide: 11,500 Germany: 5,200
Characteristics	CLAAS is a leading manufacturer of mobile agricultural machines with primary focus on harvesting technologies (↗Figure 10). To provide seamless integration of machines from different brands into production processes and Management Information Systems, leading-edge technologies are available. Serious attention is devoted to research and development activities to improve customer benefits, e.g. machine productivity and operational availability.
Customer needs	Farmers and agricultural contractors request high machine performance in low deterministic environments. High level decision support, advanced automation and assistance systems are required to leverage installed machine performance under all conditions. Customers expect significant benefit from advanced data analytics.
Big Data offerings	CLAAS has a long history in providing client solutions to process large amounts of machine sensor data, remote sensing data and business data. Advanced data analytics is seen as an evolutionary way to improve entire farm operations. Offerings focus on improved machine and process performance and availability of machines.
Big Data	The majority of currently available machines is equipped with CAN-Bus technology. Based on that, an industry wide standard protocol (ISO11783) to connect machines with implements and infrastructure is established. Furthermore connectivity via all types of GSM-networks is state of the art. Current developments focus on direct machine to machine communication. These facts are paving the way to apply new and advanced algorithms for better decisions and higher productivity. Whereas traditional systems are limited to analyze a small number of attributes in low frequency with simple descriptive statistics, new systems make use of algorithms for anomaly detection and machine learning by considering thousands of attributes in high frequencies like 25 milliseconds. Results in terms of decision support are fed back to machine operators immediately. Within the AGATA-project, funded by the Federal Ministry of Education and Research, combine harvesters stream process data into a Hadoop environment to conduct supervised and unsupervised anomaly detection. This research project is a joint effort from CLAAS, German Center for Artificial Intelligence (DFKI), Fraunhofer Application Center Industrial Automation (IOSB-INA) and other industry partners.
Innovation	Currently, anomalies in agricultural processes are usually recognized by human experts in a heuristic way. Advanced technologies and algorithms provide means to either detect anomalies in a highly dimensional state (several thousand attributes) space where human reach their limits or deliver hints to support heuristic approaches. Furthermore machine

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	learning will support machine operators on different levels of skill. Results can be made available in near-time to the operator to raise the machine's performance to a higher level. All process stages – plan, control, document – will profit.
Benefit	<ul style="list-style-type: none"> ▪ Improve performance ▪ Exhaust installed capacity ▪ Improve precision (»precision farming«) ▪ Improve system availability and disposition ▪ Improve adaptability to dynamic situations ▪ Reduce stress
Governmental R&D promotion programmes	BMBF-Call: »Management und Analyse großer Datenmengen« BMEL: »Programm zur Innovationsförderung des BMEL«
Countries and customers	Worldwide, reference customers subject to specific tasks
Future markets	Markets with highly mechanized environments and shortage of labour.

6.3.3 Advanced Analytics for the Internet of Things, Services and People – ABB

Company	ABB AG Kallstadter Str. 1 68309 Mannheim www.abb.de Contact-center@de.abb.com
Competitive environment/ Driving factors	ABB is a leading global technology company in power and automation that enables utility, industry, and transport and infrastructure customers to improve their performance while lowering environmental impact. The ABB Group of companies operates in roughly 100 countries and employs about 135,000 people. Innovation and quality are the hallmarks of our offering, which ranges from switches to industrial robots to engineering and expert service, from power transmission and distribution networks to software that manages entire factories. ABB's operations are globally balanced and distinguished by strong positions in all of the world's principal markets.
Challenges	<p>ABB's areas of business face two key global trends in our business. One is the shift towards renewables, which is accelerating despite the low oil price – 2015 was a strong year for investment in renewables, with 121 gigawatts of capacity added. This results in unprecedented demands to manage the complexity of the »digital grid« of the future. The other is what we call the industrial »Internet of Things, Services and People«, resulting for example in growing intelligence of machines that is driving quantum leap improvements in productivity and safety in industry. As a global leader in power and automation technologies, ABB is driving this change and supporting our customers to benefit from both of these shifts. We see them as key to our business, now and in the future, and essential to solving the underlying causes of key challenges that are affecting the world today, namely climate change and weak economic growth.</p> <p>In power generation, renewables are transforming the energy mix, putting pressure on traditional producers to rethink their business models while lessening environmental impact and dramatically increasing grid complexity. The future grid will be far more complex with multiple feed-in points from traditional power plants to large-scale renewables on the suppside, and a coexistence of traditional demand patterns and microgrids and nanogrids on the demand side. Managing this complexity will require intelligently automated, digital power grids that can anticipate demand and supply patterns, while routing and transporting power to the ever-increasing number of consumption points of electricity.</p> <p>On the automation side, advances in sensor technology, combined with ubiquitous connectivity and massive increases in our ability to process and store data, are enabling machines to become more and more intelligent, as well as to learn and to interact with humans in new ways. The basis for this is the industrial Internet of Things, Services and People. In time, this will enable the next stage of industrial automation, in which machines and entire process chains learn to reason and take decisions, making processes self-regulating and self-optimizing.</p>



Raw data is useless, unless it is turned into knowledge. Data needs to be analyzed and applied ambitiously and innovatively – to the benefit of decision-makers, the individual industry, and the whole network. The answer is software-based analytics and decision tools suited for industrial operations management solutions. Big data expands the view of enterprises by increasing the range and variety of data that can be analyzed so that you have additional context and insight to enable better decision making. In addition, big data scales in a predictable and straightforward way, both in size and speed, so that business analytics reporting solutions can grow with your business. Speed is also important. With decreased time to actionable results, big data can provide an advantage by adding a real-time view capability that can enable your personnel to be more responsive in day-to-day situations.

Big Data strategy/initiative	<p>Data collection and data analysis may increase knowledge and enable predictions, but unless someone acts on these, there will be no effect on the plant performance. Only when the knowledge is turned into actions and issues are resolved will there be a benefit from analyzing more data. In other words, knowing what is faulty is one part of the equation, but fixing it is another part. Providing remote access to data and analytics to service experts will close the loop of continued improvement. Online availability of support from a device or process expert is essential for a quick resolution of unwanted situations. Coupling remote access with the new technologies now available enables earlier detection and better diagnostics, and therefore facilitates faster service – resulting in better planning and an increase in plant and operational efficiency.</p> <p>ABB follows a holistic approach in developing new service offerings based on advanced data analytic. Key objective is to leverage the available data to gain insights that will trigger specific actions in the industrial systems. To achieve this objective, Big Data technologies have been successfully applied in several research and development projects and pilot implementations. Examples are big data analytics of alarm management data from process plants, root cause isolation in large-scale industrial systems, or semantic search for faster problem resolution by case-based-reasoning.</p>
Governmental R&D programs	<p>ABB Corporate Research Germany is the coordinator of the cooperative project FEE funded by the Federal Ministry of Education and Research under the project call »Management and Analysis of Large Data Sets (Big Data)«. The goal of the BMBF research project FEE is therefore to detect critical situations in the plant at an early stage, and to develop assistance functions that support plant operators in decision making during critical situations. For this purpose appropriate real-time big data methods will be developed that will utilize the available heterogenous mass data from the plants. Early warnings will be provided to the operator in order to enable proactive instead of reactive actions. Furthermore, assistance functions will be developed that support the operators in deciding on their intervention strategy.</p> <p>ABB is also partner of the Smart Data Innovation Lab (SDIL) hosted at the Karlsruhe Institute of Technology (KIT).</p>
Innovation/ Knowledge transfer	<p>ABB works with several research organizations like universities or the Fraunhofer-Gesellschaft. Beside such bilateral activities, ABB is an active contributor in Germanies committee work around Industrie 4.0 (Plattform Industrie 4.0, ZVEI, VDI/VDE, VDMA) and in the Industrial Internet Consortium. ABB, being a truly global company with strong representation in Europe and north america, has thereby the unique opportunity to transfer knowledge between the different approaches and innovation cultures, also bridging this gap within customer collaborations. Innovation transfer is also e.g. taking care of in pilot customer projects, bringing together ABB's research, development and business teams with the according teams from customers and/or partners.</p>
Business model	<p>Business models coming with Industrie 4.0 or the Industrial Internet are shifting from pure product business towards service business. This is new to both the suppliers and their customers, and the majority of the organization struggle to adapt to this new kind of business. ABB's concept of the Internet of Things, Services and People merges the changes in technology (things), business models (services) and organizations (people). The new service business models will focus on data-driven services, based on big data technologies. However, the first step towards the service world will be business models around product-service-systems (PSS). In PSS, traditional products are being enhanced by data-driven services, enabled by cheaper sensor, communication and data management technologies, providing additional services such as predictive maintenance to the customer. It is important to understand that value in PSS (or cyber-physical-systems, CPS) is generated on the physical level, i.e. the product is still providing value to the customer, and on the cyber-services level, supporting the physical value</p>

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creation through data-driven services. However, the intermediate level of data storage (data layer), e.g. a digital twin, produces only costs and does not bring value per se, but enables the cyber-services.

With respect to big data in the industrial context, new business ecosystems will form, bringing IT companies and industrial partners closer together. One requirement to be successful in such ecosystems is that the business model of each partner needs to be successful, in order to allow the whole ecosystem to be successful. This requires an adaption of the innovation speed (IT companies are usually faster than the industrial partners) and a stronger partnership between ecosystem participants, compared to today's supplier-customer relationships.

Additional information	Project Web-Site FEE: http://www.fee-projekt.de/index_en.html Web Site Smart Data Innovation Lab: http://www.sdil.de/en/ ABB's IoTSP Web-Site: http://new.abb.com/about/technology/iotsp
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6.3.4 Event Monitoring in Value and Supply Chains – Siemens, uberMetrics, VICO – Smart Data Web

Title	Smart Data Web www.smartdataweb.de
Companies	<ul style="list-style-type: none"> ▪ Siemens AG Otto-Hahn-Ring 6 81739 München ▪ uberMetrics Technologies GmbH Alexanderplatz 1 10178 Berlin ▪ VICO Research & Consulting GmbH Friedrich-List-Straße 46 70771 Leinfelden-Echterdingen
Project Partners	German Research Center for Artificial Intelligence (DFKI) (Consortium Leader, Contact: Prof. Dr. Hans Uszkoreit + 49 30 23895-1800), Beuth University of Applied Sciences Berlin, Leipzig University, Siemens AG, uberMetrics Technologies GmbH, VICO Research & Consulting GmbH
Challenge	Germany's key industries such as mechanical engineering, the automotive, chemical, pharmaceutical and electronics industries are based on clusters of highly specialised small and medium-sized companies that build upon each other in complex value and supply chains. Disruptions in supply chains lead to enormous costs and may in extreme cases have consequences that threaten the survival of companies, SMEs in particular. Therefore, in industrial production processes, it is important to be informed as early as possible about events that could lead to a significant disruption in the value and supply chains. Such disruptive factors might include natural disasters, political unrest or strikes. Information about disruptive factors is often available for a relatively long time on news websites or social networks before it reaches businesses so they can react to it. Constant adaptation to the market – upstream industries, sources of raw materials, transport routes, competition regulators and service sectors – is crucial for success. Internal company data must be linked to external data about customers, suppliers, transport routes and service providers in a semantically correct way. Industrial companies that are able to use these data resources quickly and systematically will have a clear competitive advantage.
Solution	The project aims to build a bridge between two previously separated worlds of data: the publicly accessible Internet and internal corporate networks. The consortium is developing a new type of open knowledge network that gathers relevant public data, analyses it, prepares it individually, and makes it available. Smart Data Web aims to create a new knowledge network of data tailored especially to the needs of German industry. In order to achieve this goal, existing public data sources such as commercial and social media are analysed by Smart Data Web's analysis pipeline. We use both well-established methods to structure and process these vast amounts of data as well as newly developed methods for the deeper semantic analysis of bulk data. These technologies will be tested and deployed in selected value chains.
Business Value	Smart Data Web facilitates entry to data organisation and utilisation for SMEs in the manufacturing sector that do not have the means to develop proprietary knowledge modeling and data-structuring systems. In the future this will allow businesses to optimise their planning and decision-making processes decisively, with a major focus in supply chain management. Smart Data Web can further be used for market monitoring and research. Company or specific market-segment analyses should enable businesses in the future to quickly gain an overview of the competitive situation, identify potential new customers, and find cheaper as well as more innovative suppliers for their own products.
Governmental R&D program	A Smart Data Programme Project of the Federal Ministry for Economic Affairs and Energy





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6.3.5 Sensor Manufacturer – Big Data as a new Partner of Six Sigma: Optimization of Discrete Manufacturing

Company	<p>User of the big data solution:</p> <p>The (anonymous) client is a mid-sized German company acting as supplier for the automobile industry in an international context. They engineer and produce sensors and electronic components for leading OEMs in the private and commercial vehicle industry segment. Not only is the focus on the development of products, a key role also plays the establishment of the manufacturing and logistics processes. Those processes have to run effective and efficient once they are going into series production.</p> <p>The topic of process optimization via Six Sigma is an integral element of the company's operational-excellence-program. This program simultaneously improves customer satisfactions and competitiveness.</p> <p>The Six Sigma Black Belt team looks into a continuous and lasting optimization so products and processes meet those requirements. Due to the increased complexity of production processes, new methods of analyzing need to be identified. Beside existing experience and expertise, process data of automated production lines is an additional component to create explanatory models which are used to improve the mastered processes.</p>
Challenge	<p>Realizing significant improvement of process efficiency by reducing calibration steps while keeping the same calibration method alive and having the same quality outcome.</p>
Solution	<p>With the help of the programming language „R“ a heuristic forecasting method was implemented during the modelling and deployment phases of the data mining process. Measurements of already manufactured sensors together with its resulting correct calibration settings were provided as a start. By using various regression algorithms, such as generalized linear model and random forest, models were trained to identify the correlation between measuring and target variable. The models were verified by a cross-validation technique, which uses 10% of the data to train the models and 90% of the data for validation purpose. This approach allows for the best utilization of the database and minimizes falsification of identified model parameters. Sufficient data of already conducted measurements and calibrations was available for the analysis. Due to limited resources and the large amount of data, the analysis approach was split into two steps. First, the most significant measurement points of the calibration unit had to be identified. This was achieved by using the fastest algorithm (generalized linear model) and the simplest forecasting model. While executing this step and adding more and more measuring points, an optimal combination of measuring points was achieved, when it did not improve the results and the data mining expert couldn't see any economical quality improvement by adding another measuring point, visibly shown through a quality criterion. With the optimal combination of measuring points the approach proceeded to the next step. In order to forecast the target variables as precisely as possible the optimal forecasting algorithms for each target variable was determined based on the identified set of measuring points.</p>
Business Value	<p>A significant speedup of the calibration process has been reached through a tremendous decrease of 99 percent of necessary calibration measures. The procedure to identify the correct calibration settings has been replaced by the new forecasting algorithm.</p>
Recommendation	<p>Already existing data has been used for this project. It was shown that the available capabilities of that data had not approximately been recognized. It shows other organizations that already existing and used data as well as alleged data graveyards are often underestimated. Especially in this project a minimization of calibration steps by 10 percent was considered to be successful. Instead a minimization of 99 percent had been reached.</p>
Big Data	<p>This solution includes a regression analysis of 51.5 billion readings from production processes. Before the introduction of this approach over 500 measuring points were necessary for calibrating the sensor. Due to the big data approach seven significant measuring points could be identified. Those seven measuring points lead to the same quality results for the calibration as the 500 measuring points before.</p>
Innovation	<p>A general approach to adopt Six Sigma would not have led to the same results for a process optimization because of the huge amount of data. Together with the integration of data mining algorithms complex interdependencies within the existing process data could be identified and lead to explicit explanations for process optimizations.</p>

	In addition to hypothesis testing with Six Sigma the organization applies the forecasting model also to non-hypothesis procedures within conventional Six Sigma projects.
Prospects	The next step will be the operationalization of the forecasting solution through the deployment of the forecasting algorithm into the process. Forecasts will be directly calculated in the database using Oracle R Enterprise. R-functions are provided within the database and assembled into SQL commands. This allows a nearly real time execution of the forecasting models.
Big Data Provider	Robotron Datenbank-Software GmbH Stuttgarter Straße 29 01189 Dresden Contact person: Uwe Wieland +49 351 25859-2446 uwe.wieland@robotron.de

6.3.6 Analysis and Evaluation of Sensors and Numerical Simulations – VAVID

Title	VAVID (German acronym) – Comparative Analysis of Engineering Measurements and Simulation Data www.vavid.de
Project Partners	Fraunhofer SCAI, Bosch Rexroth Monitoring Systems GmbH, Scale GmbH, GE Global Research, GNS Gesellschaft für numerische Simulation mbH, SIDACT GmbH, TU Dresden Contact: Prof. Dr. Jochen Garcke, Fraunhofer-SCAI jochen.garcke@scai.fraunhofer.de
Challenge	In the past years, we experience an enormous increase of data in the whole field of engineering. In the same time, data sources become more heterogeneous. As an example, complex simulations, used to virtually develop products, create huge amounts of data that require integration and data analysis.
Solution	The project VAVID aims to develop techniques that enable an efficient analysis and evaluation of numerical simulations and sensor performance data. Through the comparison of achieved results, we intend to identify and use the relations and differences between underlying objects. Therefore, we use parallel data processing to develop methods for data compression, data management, efficient analysis as well as the creation of interactive visualizations.
Business Value	VAVID will help to exploit potentials for data analysis over the vast amount of available data. This includes more efficient implementation of new analysis methods and prove of their effectiveness, respectively. The project results will increase the reliability of data evaluations for monitoring and predictive maintenance purposes on the hand. On the other hand the engineers' effort in the virtual development process will be reduced due to new analysis tools and much more efficient handling and processing of the large amount of simulation data.
Governmental R&D program	A Big Data Programme project of the Federal Ministry of Education and Research.

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6.3.7 Innovation Management – Koehler Paper Group



Company	<p>Papierfabrik August Koehler SE www.koehlerpaper.com</p> <p>The Koehler Paper Group delivers about 500,000 tons of paper every year to their customers and is the market leader in this product segment. The traditional company headquartered in the Black Forest in Germany wants to keep this position. Therefore it relies on constant innovation – also through IT. Using SAP HANA® the family-run business accelerated its reporting. But plans go further than this.</p>
Challenge	<p>The Koehler Paper Group is examining its processes and systems on a regular basis and is constantly looking for possibilities for optimization. A traditional company – like the Koehler Paper Group – only works thanks to long-term thinking and that is why the company relies in terms of investments on quality – not only for its production facilities, but also for hard- and software.</p>
Solution	<p>The implementation of SAP NetWeaver® Business Warehouse Accelerator several years ago was the first step to accelerate analyses and reporting. Its consistent further development is the platform SAP HANA®. By means of the In-memory technology, Koehler is able to analyze data a lot faster and much more detailed. The company wants to obtain new insights by conducting comprehensive analyses of high volumes of data. Koehler wants to use the new findings to stay market leader in its core area and to enhance its expertise in other areas. To reach these ambitious goals, innovations in product development as well as in IT are indispensable.</p>
Big Data	<p>Browsing and analyzing high volumes of data: This is the specialty of SAP HANA®. A project team consisting of the Koehler Paper Group, SAP and Dell proved, that it is possible to implement the solution within a very short period of time. The team only needed three days to put hard- and software into operation and to transfer all data. This was very important for the Koehler Paper Group because as being a medium-sized company it did not have time and capacities for extensive preliminary investigations. Three days were also sufficient time to pass on the most important know-how to the employees of the Koehler Paper Group. The IT department of the family-run company has a comprehensive previous knowledge and learned all details about maintenance and administration rapidly.</p> <p>The implementation was followed by a long trial period. Finally, SAP HANA® was launched about four weeks later. Thanks to SAP HANA®, more than 100 user analyze data faster.</p> <p>From the purchasing of the raw materials to the receipt of the final product, the company is able to select according to different criteria and to analyze data in a minimum of time. So far, the IT department had to make a pre-selection, now the end-user go through their data on their own and find, what they are looking for.</p> <p>Meanwhile, the whole SAP NetWeaver® Business Warehouse runs via SAP HANA®. As a result, the company can carry out all reports and analyses in real-time. The whole information cycle was accelerated that way: Data can be analyzed and saved faster. Not only the executive board, division and section manager but also administrators in sales and finance use SAP HANA®. All of them retrieve data in real time and profit from a free data modelling system as applied in internet search engines.</p>
Business Value	<p>The users analyze their data within a fraction of a second – and do not have to wait minutes to get a response from the system. Your trains of thought are no longer interrupted and you can work more effective.</p>
Innovation	<p>The operating costs of Business Warehouse decreased by about one third thru SAP HANA®. The departments carry out analyses on their own and do not need the support of the IT department any more. The IT department has more time left for other tasks and does not require external consultants as often as it did before. The time for analyses could be reduced from more than five minutes to about five seconds. Moreover, decision-makers like administrators gain new findings through data that never could be analyzed before. Also, the company is able to interpret completely unstructured data by all thinkable criteria. This is possible because of the vertical structure of the database, which produces results a lot faster than the ones with a conventional, horizontal structure. Information is stored in a way that ensures a very quick reaction time on requests.</p>

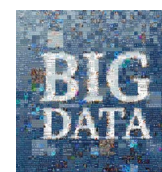
Prospects	For the future, Koehler plans on recording and analyzing data of the production process, machinery and quality in real time using SAP HANA®. The real-time analyses will not only include ex post evaluation but also make forecasts possible. Due to that, new findings will be gained, not only to improve productivity and product quality, but also to increase the competitiveness.
Big Data Provider	SAP Deutschland SE & Co. KG www.sap.de info.germany@sap.com +49 6227 7-47474

6.3.8 Proactive Disturbance Management – Robert Bosch – BigPro

Title	BigPro
Companies	<ul style="list-style-type: none"> ▪ Demonstrationsfabrik Aachen GmbH Campus-Boulevard 57 52074 Aachen Contact Partner: Felix Basse f.basse@wzl.rwth-aachen.de +49 2418028674 ▪ Robert Bosch GmbH Robert-Bosch-Platz 1 70839 Gerlingen-Schillerhöhe Contact Partner: Roland Schmidt Roland-G.Schmidt@de.bosch.com +49 7121351532
Project Partners	Forschungsinstitut für Rationalisierung e.V. (FIR e.V.) / RWTH Aachen University, FZI Forschungszentrum Informatik am Karlsruher Institut für Technologie, Software AG, i2solutions GzmbH, cognesys gmbh, Asseco Solutions AG, Robert Bosch GmbH, RWTH Aachen University
Challenge	Since production systems are becoming more and more technically mature today's manufacturing industry sees itself confronted with a bigger and bigger pile of data. To make this data pile processable and, even more important, useable we made it our duty to develop models and algorithms to handle this abundance of data.
Solution	The goal of this project is to develop a Big-Data platform which is easy to implement and independent from its business area of implementation. Through this platform we gain access to real-time production process data which helps developing a data pattern detection. The data patterns are linked to known failures to detect them. By simplifying data patterns BigPro introduces a proactive disturbance management system to help identify production dysfunctions early or even prevent them. By formalizing human input (language) on process quality we add another dimension to the disturbance management system. Another aim is to develop a concept of visualizing the collected data to illustrate disturbances and countermeasures user-oriented to reach the best possible support of the decision-making level.
Business Value	BigPro pursues the goal of reducing failures during production. Thus, the overall business goal is to increase the Overall Equipment Efficiency (OEE) by decreasing unplanned downtimes, improving maintenance planning and increasing production process efficiency.
Big Data Provider	A Big Data Programme project of the Federal Ministry of Education and Research.



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6.3.9 Process Control – Bayer Technology Services – SIDAP

Title	SIDAP – Scalable Integration Concept for Data Aggregation, Analysis and Preparation of Big Data Volumes in Process Manufacturing
Company	Bayer Technology Services GmbH Kaiser-Wilhelm-Allee 50 51373 Leverkusen Contact: Dr. Thorsten Pötter + 49 214 30-23258 www.sidap.de
Project Partners	Bayer Technology Services GmbH, Gefasoft AG, IBM Deutschland GmbH, Kröhnert Infotecs GmbH, Technical University of Munich
Challenge	<p>The legal framework is probably one of the most important aspects of this project. More clarification is needed, especially in the areas of copyright and data usage rights, in order to ensure that projects and solutions are legally sound. Another challenge lies in the semantic comparison of the data, in other words the way the models need to be set up so that the information provided can be used by all parties. How does data need to be processed so that sensitive process expertise is not distributed freely?</p> <p>We deal mostly with highly sensitive gases and liquids that are sometimes an environmental and health hazard. Unplanned equipment stops can lead to costly maintenance and cleaning work. Therefore, it is important to keep the number of such incidents as low as possible, and this is where smart data or the analysis of data generated every second comes into play.</p>
Solution	SIDAP aims to develop a data-driven and service-oriented software solution that makes it easier to access structural information and data streams in engineering and process control systems for interactive analyses. The solution collects large amounts of data and information from the distributed IT systems at the manufacturing sites involved, sets these in relation to each other, and formats them. It allows us to make predictions about the wear and tear on individual components such as valves. By altering the timings within the processing plants correspondingly, their lifetimes can be optimised and maintenance shutdowns can be scheduled better.
Business Value	<p>The smart data solutions developed within the project will be used to identify in the massive volumes of cross-company operational data the causes of equipment failures and previously unknown relationships within this context. They will also be used to develop specific countermeasures. The objectives are to improve product quality, reduce device and equipment failures, improve device performance and increase machine availability. Improved machine availability forms the basis for further automation and the remote monitoring of plants. It is an important focus of SIDAP to transfer the approaches developed to meet the requirements and needs of small and medium-sized enterprises. SMEs are considered at all times so that they can benefit economically from the solutions we develop.</p> <p>Possible business models that can arise, especially for SMEs, are data provision, the development of infrastructures for collecting the data, and the provision of smart data services such as special prediction algorithms.</p>
Governmental R&D program	A Smart Data Programme Project of the Federal Ministry for Economic Affairs and Energy



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6.3.10 Demand Signal Management – Beiersdorf



Company	<p>Beiersdorf AG www.beiersdorf.de</p> <p>As a global consumer goods company offering well-known brands like NIVEA, Eucerin or Hansaplast, the Beiersdorf AG wants to react specifically to its customer's needs. To understand the demand and the buying behavior of the consumer in every single market on a global level is crucial for the coordinated positioning of the brand portfolio.</p>
Challenge	<p>The Beiersdorf AG needs a consistent and comprehensive overview on the own brands as well as on the relevant competitors in the respective markets to plan and run appropriate marketing activities. Currently, the understanding and interpreting of the different signals of demand is a highly manual effort, which is also time-consuming and prone to error. Therefore the technical challenge consists in the implementation of a central platform, which is able to detect and illustrate patterns and signals of demand. These signals originate from various data sources and include besides data from market research also sales and panel data. Consequently, the data harmonization is an important and indispensable condition for an informative reporting and analysis system.</p>
Solution	<p>The usage of the Demand Signal Management application based on SAP HANA® offers Beiersdorf a central platform for the aggregation of all data which is relevant of the market. In addition to the pure data harmonization, the Demand Signal Management provides new analytical perspectives (e. g. on new product attributes) and shows the main reasons for the market share trends of the owns brands but also of the brands of competitors. Decisions can be made faster and more effectively on a basis of a high volume of data. The understanding about the brand development in the single markets increases and the brands can be developed further specifically. As a result, revenue potentials can be won and the market value can increase.</p>
Big Data	<p>Market data of the own products and brands as well as of the ones of the competitors from over 60 countries (more than over 500 databases) is collected, harmonized and analyzed. The data indicate new findings, e. g. it makes the aimed focusing on fast-growing brands and markets possible. The availability of the analyzed data in real time allows a suitable reaction to competition activities as well as the tracking of own product launches.</p>
Innovation	<p>The application of sophisticated Big Data technology makes it possible to get a global overview of the brand strength, brand positioning and the market shares of the single brands as well as their competitors.</p>
Benefit	<p>The benefit for companies is diverse. Faster reporting by automated data harmonization reduces time differences between global and local reporting. The combination of different KPIs from various sources enables the companies to get a better view on the data and serves as a basis for business relevant decisions. For this purpose, the reasons for changing market shares and new trends need to be detected and – embedded in a real time application – used.</p>
Prospects	<p>Beiersdorf plans the integration of more data sources to derive more potentials. SAP HANA® provides the optimal platform and environment to generate new findings from even bigger data sources in the future.</p>
Big Data Provider	<p>SAP Deutschland SE & Co. KG www.sap.de info.germany@sap.com +49 6227 7-47474</p>

6.3.11 Product Development with Simulations based on Big Data – SPINNER

Company	<p>SPINNER GmbH Erzgiessereistr. 30 80335 Munich www.spinner-group.com Contact: Dr. Christoph Neumaier Innovation manager christoph.neumaier@spinner-group.com SPINNER's markets: Niches of passive RF components for salutary products SPINNER's KPI: Swift changes in product variations</p>
Challenge	<ul style="list-style-type: none"> ▪ With Big Data, we get a deeper insight into the possibilities of a technology ▪ Constraints are directly visible in the abstract parameter space ▪ Big Data creates an intuitive way for checking the requirements of functional specifications and quotations
Solution	<ul style="list-style-type: none"> ▪ Prerequisites: Highpower computing on graphics cards (GPUs) for enhanced single simulations, distributed computing for parallel computation of parameter space samples ▪ With the help of extensive simulations, an overview of the parameter space is created ▪ Learning the behaviour of the system is facilitated which rapidly creates know-how ▪ This know-how is saved in the database and with intuitive postprocessing tools it is available to anyone who uses it – company-wide
Business Value	<ul style="list-style-type: none"> ▪ Significant reduction of development time once the database is setup ▪ Improved time to market for variations
Innovation	<ul style="list-style-type: none"> ▪ In contrast to sequential linear manipulations made in classic product development, the Big Data way allows combining different characteristics at once ▪ Disruptive innovations need an easy way for fast research and fast result documentation ▪ Change in paradigm: the engineer nomore drives simulations – qualifies – changes parameters – drives simulations, but sets up parameter space sampling, adds constraints and decides afterwards which design fits the design recommendations best
Prospects	<ul style="list-style-type: none"> ▪ Integrating more and more pieces of information into one database, preparing it for even smarter designs



6.4 Logistics

6.4.1 Real Time Tracking of Delivery – DPD Dynamic Parcel Distribution



Company	DPD Dynamic Parcel Distribution 63741 Aschaffenburg Contact: peter.weber@dpd.com
Competitive environment/ Driving factors	<p>DPD in Germany is part of DPDgroup, the second-largest international parcel delivery network in Europe. A workforce of 8,000 and 9,000 delivery drivers are in daily operation on behalf of the company's customers. Every year the No. 2 on the German parcels market ships around 350 million parcels.</p> <p>Through innovative technology, local knowledge and dedicated customer care, DPD provides the best possible experience for both shippers and shoppers. DPD's industry-leading Predict service is setting a new standard for keeping customers closely in touch with their delivery, with real time tracking of their delivery, a one-hour delivery window and a range of options for redirecting parcels. In recognition of this innovation DPD received the Digital Transformation Award 2015. As part of DPDgroup, DPD in Germany has access to over 22,000 local Pickup points across Europe, and delivers to 230 countries worldwide.</p> <p>In recent years DPD has significantly expanded its business model: whereas until a few years most of its deliveries were to business customers, as a result of e-commerce private customers have today become the larger target group. While companies can be relied on to be available to accept deliveries during their business hours, services now have to be provided to more and more private consignees who are, as a rule, not at home during the day and can therefore not be expected to accept a time window of half or even a whole day for their delivery.</p> <p>However, the digital transformation has made available entirely new possibilities for narrowing down the time window for deliveries, and for providing consignees with the relevant information in advance.</p> <p>In 2014 DPD succeeded in reducing its delivery time window radically, with the aid of technology based on Big Data.</p>
Challenges	<p>As a leading innovator in B2C parcel shipping DPD focuses above all on the premium segment – in other words on shippers who wish to offer their customers more than just classical parcel shipping. Every consignee has different requirements, and in today's world they have increasingly varied lifestyles and working hours. A parcel service has to have the right answers to these changes, and DPD's response has been to put consignees in control of their parcels. Because DPD exploits the available digital possibilities to their full extent, consignees can now integrate parcel deliveries into their everyday routine more efficiently than ever before. All they need is a smart phone in order to track the progress of their parcel at every stage of the delivery in real time. In this way DPD makes parcels digital, linking the online world of e-commerce with the offline world of physical goods. Big Data plays a major role in enabling DPD to achieve these targets and optimise its services further. For example, predictive analytics has enabled the company to analyse local transport conditions, to forecast the probable stop density and delivery time windows, and to establish a hypothesis about consignee behaviour.</p> <p>In addition, with the aid of machine learning the probability that the predicted delivery time window will be met is calculated on the day of delivery on the basis of the historical experience of the individual driver, together with data relating to the weather, traffic and population density on the individual delivery tour.</p> <p>Thanks to these mechanisms it has been possible to improve the accuracy of the delivery time window by more than 3%, while at the same time reducing the cost of unsuccessful deliveries. The number of complaints from customers received by Customer Service has also been successfully reduced.</p>
Big Data strategy/ initiative	<p>Within its Big Data strategy, DPD in Germany is focussing on</p> <ul style="list-style-type: none"> ▪ Data Governance, Data Quality Management and Master Data Management. ▪ Traditional BI furthermore provides analytical content enabled by IT. <p>DPD's modern BI platform is a self-service architecture that enables business users to implement interactive analysis and collaborative sharing of content and insights. Data Lakes are provided and widely used to analyse specific special business problems or purposes.</p>

Innovation/ Knowledge transfer	DPD is in constant dialogue with its partners and service providers in order to adapt and optimise the company's Big Data strategy on an ongoing basis. For this purpose, for example, strategic workshops are organised with suppliers such as SAP or Microsoft, together with a cooperation with universities in the field of data labs and data science.
Business model	BIG Data helps us to optimise our existing business model and to develop it further. It is also likely that it will provide us with access to new possibilities in the future.

6.4.2 Smart Port Logistics – Hamburg Port Authority

Company	Hamburg Port Authority AöR Contact Person: Sascha Westermann ITS and Intermodal Traffic Management sascha.westermann@hpa.hamburg.de
Challenge	Existing infrastructures must be used intelligently and efficiently, as there are limits to how much roads, railways and waterways can be extended in the confined port area. HPA was quick to identify the opportunities that IT offers. Hamburg's port makes up about a tenth of the city's total area and is located right at its heart. In fact, the port's central location poses a number of tough challenges for its operator, Hamburg Port Authority (HPA). These problems include how to effectively manage burgeoning commodity flows within a limited space, avoid truck waiting times and deliver an overarching picture of the current situation for better decision-making.
Solution	To help it network traffic flows and manage them more efficiently, HPA worked with T-Systems, Telekom Innovation Laboratories, DAKOSY and SAP to introduce the cloud-based SPL (smartPORT logistics) information and communication system, which untangles the daily jumble of more than 140,000 truck journeys in the port and optimizes commodity flows. As a result, current information and forecasts about traffic around the port can be accessed via mobile end devices such as tablet PCs and smartphones, and even telematics units installed in driver cabs. The system also gives drivers approaching Hamburg information about traffic bottlenecks, free parking spaces and more besides. This helps to untangle the increasingly dense traffic within the limited confines of the port and cut delivery times. Drivers are only shown the information that is relevant to them in their current location. This approach utilizes the benefits of geofencing – as truck drivers pass through an area with a series of selectable radii, information thresholds are triggered that the system uses to separate important data from irrelevant information.
Big data	Cloud-based traffic management generates large volumes of data. Some 8,000 trucks undertake approximately 140,000 journeys at the site every day. Meanwhile, more than 100 rail companies operate services at the facilities, making the Port of Hamburg Europe's biggest rail hub. The sheer volume of traffic and transport data is enormous. There are also numerous parties involved, such as the port authorities, shipping agents, carrier companies, parking lot operators and terminal operators, all of whom have their own systems and types of data. Thanks to its gigabit cables, the Port of Hamburg has adequate bandwidth to transfer this volume of data. What's more, storage space is now unlimited. All this means there are no more limitations on technical infrastructure. The real challenge is to capture and apply data accurately – and that also applies to traffic data. Indeed, that is the only way that the huge volumes of data can be transformed into added value for the port, drivers, shipping companies and terminal operators.
Innovation	Today, although individual companies have optimized their own processes and systems, the goods/traffic system as a whole has not been optimized. SPL enables the port authorities and transport and logistics companies to monitor transport consignments in real time so that goods can be moved more efficiently and more safely, thereby improving satisfaction all round, particularly among end customers. The movement of trucks and containers is more efficient, because the right information is available at the right time and the right place. Terminal operators are hitting new key performance indicators and expanding their know-how, while traffic and transport data is available in real time. Drivers, meanwhile, get an up-to-the-minute overview of traffic, their jobs and their destination – all delivered direct to their smart device. The flow of traffic and.



the goods transport chain are interlinked (including estimated time of arrival, or ETA) and are thus optimally coordinated.

The next step will be to extend the system to include more participants and sources of information, such as data on the availability of containers. HPA is therefore offering a service marketplace that gives a growing number of players in the port economy access to data. Shipping companies, terminal operators, shipowners and storage facilities, some of which are still using their own systems for now, could get involved in the future

Benefits	<p>Everyone at the port benefits from the advantages. The shippers and hauliers have access to traffic and infrastructure information, it is easier for drivers and dispatchers to communicate with each other and the different fleets are monitored from an overarching perspective. The port is improving the efficiency of its road network, making better use of the parking spaces available and can develop additional services.</p> <p>The port companies are also boosting their efficiency, because they can provide their goods and containers in better time.</p>
Prospects	<p>In the future, SPL can be extended to more logistics areas of the port such as rail freight and shipping traffic, as these too can be optimized through traffic management. The current optimization problems in these areas can also be mapped with big data in the cloud, just as road traffic can. The same know-how, with a little modification, can be applied to ships and trains, too.</p>
Big Data Provider	<p>T-Systems (Contact person: Ulf Jasser, Ulf.jasser@t-systems.com), Telekom Laboratories, DAKOSY, SAP</p>

6.4.3 Traveller Early Situation Awareness – travel-BA.Sys – iTESA

Title	iTESA – intelligent Traveller Early Situation Awareness
Company	travel-BA.Sys GmbH & Co. KG Alexanderstr. 38 45472 Mülheim an der Ruhr Contact Person: Uwe Gabriel uwe.gabriel@travelbasys.de +49 208 30672-554 www.smart-data-itesa.de
Project Partners	travel-BA.Sys GmbH & Co. KG (consortium leader), Fraunhofer Institute for Transportation and Infrastructure Systems IVI, Software AG, Inquence GmbH, Independent Centre for Privacy Protection Schleswig-Holstein
Challenge	From natural disasters and epidemics to terrorist attacks and political unrest: travel always carries risk. This applies both to tourists on holiday in foreign countries and business travellers touring the booming economic regions of the world. In the chaos of an acute crisis, it takes time for individual pieces of information to come together like puzzle pieces to give a complete picture of the situation. Because of this, it is often difficult for companies to meet their statutory duty of care for their employees and customers in times of crisis. Small and medium-sized enterprises in particular lack the capacity to meet the legal requirements for the protection of life, limb and health of their employees through global risk monitoring.
Solution	iTESA identifies travel risks anywhere around the world and develops alternative routes in the case of an emergency – in real time as soon as a crisis occurs. To do this, iTESA scours the global flood of data from public internet sources – from social networks, news articles, and information from public authorities, through to news wires and press releases. This is done with special attention to data protection rules. The system then assesses the credibility of the information and classifies the risk. This enables the system to precisely appoint the need for action. iTESA informs the companies via app about any employees or customers who are affected by the crisis or who could approach the hotspot. Situation reports, warnings and suggestions for alternative routes provide the basis for informed decisions and actions.
Business Value	iTESA enables companies to fulfill their duty of care to employees or clients. They are well informed about the situation on the ground and can therefore make well-founded decisions to protect the affected colleagues and clients. They can provide security. That distinguishes them from their competitors. Usually providing Smart Data applications result in huge invests. So SME are not able to participate these benefits. The iTESA business model plans to earn low margins by each company but from a high volume of companies. Keeping the fact in mind that German economy is supported by 3.6 million SME and appx. 180 million business trips per year this business model becomes a realistic plan. An extension of general iTESA functions to other transportation based industries might be a further step to generate new business models.
Governmental R&D program	A Smart Data Programme Project of the Federal Ministry for Economic Affairs and Energy



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6.4.4 City Logistics – FELDM – ExCell

Title	ExCell – Real-time Analysis and Crowdsourcing for Self-organised City Logistics
Company	FELD-M GmbH Sandstr. 33 80335 München Contact Person: Mathias Wrba mathias.wrba@feld-m.de +49 89 5529756-12
Project Partners	Beuth University of Applied Sciences Berlin, Technical University Dresden, Technical University of Munich, MING Labs GmbH, ENTIRETEC AG
Challenge	The London-based Centre for Economics and Business Research puts the cost of traffic jams in Germany at 8 billion euro annually. They estimate it will reach 33 billion euro in 2030. Furthermore, a study by the Federal Motor Transport Authority found that German transport companies travel nearly six billion kilometers per year without cargo on board. In order to maintain competitiveness in the face of increasing levels of traffic, costs must be reduced and dispatching optimized. The biggest challenge lies dormant on the side of the users: We found that many SMEs still create their personnel and shift plans by hand. While many businesses appreciate the added value that digitalization and services like ExCELL could bring, they are hesitant to implement them.
Solution	The ExCELL-team is developing a platform that makes current traffic data available and, based on this, uses an algorithm to optimize companies' logistic routes. The system will be tested in practice in Dresden in 2016 with tradespeople and their clients, such as property managers. The platform creates a comprehensive picture of the traffic situation in real time. ExCELL then links this overview with operational data such as planned journeys through the city to clients as well as with crowdsourced data: all of the partner companies transmit their exact position in the city traffic using GPS. Thus they provide the information needed to calculate the optimal dispatching and routes.
Business Value	ExCELL reveals hidden potential efficiency savings by collecting and systematically evaluating various data, such as geo or traffic data. It creates a real-time image of the traffic conditions and determines the optimal dispatching and routes through city traffic so that internal planning can be made more efficient. That saves time and money: vehicles in the fleet reach their destinations faster and use less fuel, the wear on the vehicles decreases, and customer and employee satisfaction increases. We want to expand geographically. Dresden is the beginning, later we want to open up to other German conurbations. We are also planning to improve in terms of quality. As things stand, if a traffic jam occurs, we don't know the cause. However, it makes a difference whether a road is closed for a demonstration or because of a serious traffic accident. In this respect users from our community could help locally, for example by sending a photo of the demonstration. This enables ExCELL to understand if it is a short term obstruction or if it should propose alternative routes to users for a longer period. We are also toying with the idea of building an open data platform. We could provide data that other companies, such as start-ups, could base their services on.
Governmental R&D program	A Smart Data Programme Project of the Federal Ministry for Economic Affairs and Energy

FELDM

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Smart Data

6.4.5 Smart Data for Mobility – DB System

Title	SD4M – Smart Data for Mobility
Company	DB Systel GmbH Marktstraße 8 10317 Berlin Contact Person/consortium leader: Ingo Schwarzer ingo.schwarzer@deutschebahn.com +49 30297-16370 www.sd4m.net
Project Partners	German Research Center for Artificial Intelligence, idalab GmbH,]init[AG für digitale Kommunikation, PS-Team Deutschland GmbH & Co. KG
Challenge	The use of mobility options varies greatly and is very difficult to predict for operators – be it on the road, rails or in the air. At the same time, transport capacity is a perishable good: an empty seat on a plane or a subway train cannot be resold for the same journey after an empty trip. This makes precise demand forecasting particularly important so that capacities are used optimally and resources are used efficiently. Because a typical journey involves multiple systems (e.g. a taxi to the airport), it is necessary to consider the performance of the overall system, such as a large city, in its entirety.
Solution	The SD4M project is developing a cross-industry service platform for the mobility sector that evaluates data from mobility operators and other data sources, such as social media, and makes this available in a processed form for further use. We want to experiment with a variety of open data sources. We see potential in news sites and other news sources, including news agencies such as DPA and Reuters. Of course we also want to take advantage of traffic jam and construction site information, as well as official timetable and transit system data, city and local maps, event schedules, tourist information and so on. Moreover, anything that is available in real time is exciting. We want to include data from forums and blogs and experiment with a variety of social media data that we feed into the system from Twitter or Facebook for example.
Business Value	The advantages for the provider are clear, as processes can be optimised by integrating smart data. The use of transport systems is an area, in which significant improvements can be made for all customer groups and employees in the mobility branch as well as for infrastructure operators. Numerous applications are conceivable. We differentiate between a number of categories. For example, forecasts should control the capacity requirements in public transport systems. That can be the case when the number of taxis in a particular location needs to be increased due to unexpectedly high demand or when public transport needs to be drawn on to provide special journeys. But that is just one example.
Governmental R&D program	A Smart Data Programs Project of the Federal Ministry for Economic Affairs and Energy



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6.5 Healthcare: A Future in Digital Health – Transforming Healthcare for Patients, Professionals and Providers

Starting position and future trends

Ten billion people – that's the global population projected by 2050, and with many enjoying longer lives, the services required by healthcare systems will have to adapt and grow. No one can be certain how the industry will evolve, but with new challenges come exciting solutions. What we can be certain of is that future trends will be driven by unprecedented access to Big Data and a greater involvement by the patient or healthcare consumer in shaping and benefiting from services.

The face of healthcare is changing:

- Genomics: DNA sequencing costs a hundred thousandth of what it did a decade ago – an even faster decrease in cost than the cost of computing per Moore's law
- Aging population: The number of people aged 60 years and older will rise from 900 million to 2 billion between 2015 and 2050 (moving from 12% to 22% of the total global population)
- Increase of chronic diseases: 73% of all deaths will result from chronic diseases by 2020
- Shortage of skilled workforce: By 2035, the world will fall short of the number of needed healthcare workers by 12.9 million; today, that figure stands at 7.2 million
- Medical errors: In the United States alone, medical errors kill more than 1,000 people each day – this costs the nation \$1 trillion each year.

The healthcare market has significant economic importance for German industry with an overall spend of 325 bn Euro, which translates into 3.910 Euro per capita and a share of 11.2% in GDP terms (BMG). All in all around 230.000 companies in Germany compete for a share in this market, which has consistently demonstrated higher than average growth rates (BMG).

70% of the German core healthcare market is financed through the instruments of the social security system. This core market encompasses all areas of »classic« healthcare provision including all privately financed products and services.

Challenge

A new era of true digital connection is giving people greater access to health information and resources via the Internet, not only driving revolutionary advancements in medical research and technology, but creating the promise of a new, individualized approach toward »personalized« medicine. Digital innovation is already helping the healthcare industry anticipate real-time demand and supply for services, streamline prevention and treatment, and give patients greater control over their health.

Such progress requires quick and ongoing adaptations by healthcare providers, insurers, and life sciences organizations. What is emerging is a healthcare ecosystem, moving beyond traditional hierarchies, in which all healthcare shareholders participate and benefit. Leaders will be inspired to reevaluate services, customer experience, and business networks and create:

- Business models that will support a patient-centric value chain and leverage a provider's key strengths
- Business processes that will promote patient engagement and optimize clinical outcomes, resource planning, and care collaboration
- Workforce structures that will support changing roles for physicians, nurses, and care teams.

The demographic shift in Germany, an acute shortage of skilled medical professionals, medical technology advances and an increasing health awareness in the general population have led to an increasing demand, not only for traditional services in healthcare, but also in products and services in the secondary market. Government and payors have responded to these pressures with initiatives to lower the cost of care through increased competition and innovation, while striving to guarantee quality and affordability. This places high demands on transparency and access to data from all stakeholders.

Healthcare data has been accumulated in large amounts from a variety of sources: Clinical, public health, payors, research, patient-generated and social networking. Analysis of large-scale information to determine previously unknown insights regarding past performance, current status and future events, promises to revolutionize the healthcare market and is urgently sought after by regulators, payors, providers and industry. This »data-driven« approach is closely linked to topics such as cloud computing, mobility, social networking and IoT.

First open-data healthcare projects have demonstrated that large amounts of heterogeneous information can be used and analyzed together successfully, although data heterogeneity increases the effort for data integration and analysis significantly.

Besides data normalization, reconciling privacy, security and ethical concerns remains a key challenge when working with large-scale healthcare data sets. While national healthcare initiatives and regulatory modifications will create the necessary framework, vendors who can provide analytics, data management, security and communications expertise will be best positioned to meet customer expectations.

One thing, though, remains true in the age of »Big Data«: Regardless of whether datasets are small, medium or large, a sufficient level of data quality is mandatory to obtain valid answers to the problem at hand and propose evidence-based solutions for the many challenges facing our healthcare systems.

The big picture: Healthcare goes Digital

Five technology trends are changing how healthcare works now. We are witnessing an unmatched era of digitally driven innovation. Breakthrough technologies have matured and hit scale together, which will change how we provide healthcare. A digital network solution is arising that blurs the lines between patient, professional, and provider for more responsive, patient-centric care. Five defining technology trends have already emerged which are powering this digital healthcare network:

- **Hyperconnectivity:** Every patient, healthcare organization, and machine is connected – changing all the established rules for healthcare channels. Connectivity drives the collaboration of patients, providers, and supporting businesses and assets in the digital healthcare network.
- **Super Computing:** Networking and in-memory computing allow for the creation of an infinite number of new business opportunities for the healthcare industry. For example, genome sequencing costs decrease even faster than Moore's law.
- **Cloud Computing:** Technology adoption and business innovation now move at lightning speed. Technology infrastructure can be rented to eliminate barriers to entry, and transactions among healthcare players are moving to new cloud-based collaboration platforms that can connect millions of users.
- **Smarter World:** »Smart« devices, wearables, sensors, robotics, 3D printing, and artificial intelligence are the new normal. This technology can turn Big Data in healthcare into smart data, resulting in insights for clinical decisions relevant to each patient's specific situation.
- **Cyber Security:** The digital healthcare network is a prime target for digital attacks and sabotage. Because trust remains the ultimate business currency, healthcare organizations must make cybersecurity a top priority in designing and operating a digital business network.

Transitioning to digital healthcare

1. The digital healthcare network

The healthcare market is a high-tech sector and as such plays an important role in technical advancement. No other industry invests as much in R&D as the healthcare sector. This is especially the case in biotechnology, medical engineering, innovative pharmaceuticals and new care models (BMG). The catalyst of this change is access to various types of healthcare information and the promise of analyzing these large amounts of data to gain new insights. McKinsey lists healthcare as one of the five industries which stands to benefit most from Big Data (Kayyali, Knott, & Van Kulken, 2013).

The digital healthcare network is the foundation for a new, consumer-centric healthcare system. It consists of next-generation digital solutions and an open platform for communication and integration that enables shared, connected, and fluid data among all network stakeholders, including those beyond traditional healthcare boundaries.

2. What's driving the switch to digital?

The traditional value chain for healthcare providers is evolving, driven by:

- Cost pressures, demographics, and the rise of chronic diseases
- A digital, »connected« patient, empowered and also sharing valuable data with the wider community
- The emergence of digital technology and advanced medical devices, sensors, and wearables for extended monitoring and prevention
- Artificial intelligence – turning Big Data into smart data to make clinical decisions more fact-based.

3. What does digital healthcare look like?

The transformation of healthcare offers many opportunities for both established organizations and new players. All future healthcare services will reflect:

- Value-based care, adapting structures to focus on patient outcomes at the lowest possible cost
- Patient engagement, encouraging the digital patient to take a more responsible role in disease management and prevention
- Personalized medicine: Groundbreaking insights into the human body at unprecedented, highly granular levels
- Participatory research and clinical trials, including more stakeholders and a higher number of participants
- Balanced demand and supply with real-time insight and predictive analysis to optimize service offerings and eliminate waste.

Example: Digitized healthcare in real life: Personalized Medicine

Patients can receive a very personalized experience in cancer diagnosis and therapy based on the latest clinical research and an ultra-personalized genome profile.

A well-informed and highly empowered healthcare consumer manages his well-being using digital technology that includes a personalized health app. He gets a reminder for a recommended routine checkup due to his personal health plan and age. His physician offers online appointment scheduling that the patient initiates right through the app.

During the checkup, the physician finds that a biopsy is needed, orders the procedure for the patient, and the assistant schedules the appointment with the hospital together with the patient. The patient receives detailed instructions and further information on the planned procedure.

Learning that the biopsy is positive for cancer, the patient researches various sources and finds out that personalized offerings exist for his cancer type. He also finds out that his employer pays for such programs. The diagnostic service provider recommends optimal treatment options and clinical studies based on the patient's genetic profile and the latest findings in clinical research. The patient starts treatment at a hospital that specializes in his type of cancer.

All relevant data are made available in anonymous format for secondary scientific usage and clinic trials in the digital health networks. This ensures continuous learning from each individual case.

6.5.1 Medical Allround-Care Service Solution – Charité – MACSS

Title	MACSS (Medical Allround-Care Service Solutions) – a smart patient-centered comprehensive electronic health care service platform for the integrated care of chronically ill patients
Organization	Charité – Universitätsmedizin Berlin Dept. of Nephrology Charitéplatz 1 10117 Berlin www.charite.de www.macss-projekt.de Prof. Dr. Klemens Budde klemens.budde@charite.de +49 30 450514072
Challenges	<ul style="list-style-type: none"> ▪ Structural problems in the communication of a tertiary referral center with chronically ill kidney transplant patients and referring physicians in the lifelong multi-disciplinary care for multimorbid patients. Communication between physicians and between patient and physician still relies on »old« technologies (e.g. telephone, letter, fax) leading to delayed and wrong treatment decisions due to systematic problems in the continuous data exchange of a highly complex treatment. ▪ Long distance for patients from rural areas to the specialized healthcare at Charité transplant centre. During their regular short visits patients misremember or forget important details. ▪ Necessity for excellent adherence to a complex treatment regiment consisting of multiple expensive medications. ▪ High risk of dangerous drug interactions and life-threatening complications explaining the need for a close surveillance of treatment and importance of lifelong precise documentation of symptoms and vital signs. Risk for early graft loss due to complications or poor adherence in the face of severe organ shortage. ▪ High cost burden due complex and expensive therapies in light of limited medical resources and time constraints in the healthcare system. ▪ Need for a systematic aggregation and exchange of all treatment data for medical and scientific purposes in order to systematically analyse large amounts of structured and unstructured data. ▪ Need for highest data protection standards in highly sensitive medical data.
Solution	<ul style="list-style-type: none"> ▪ MACSS – Medical Care Allround-Service Solutions – comprises the prototype of a new patient-centered smart electronic health care service platform. It aims to achieve better patient safety and to interlink clinical researchers, health insurance companies, patient organizations and health-care service providers in order to improve both, the physician-to-patient and the physician-to-physician communication within a single joint communication platform across existing software systems in the therapy of chronically ill patients. All relevant patient data from the patient himself, from other physicians and from hospital systems will be integrated and combined. The communication within a single platform allows optimized drug dosing and close surveillance of chronically ill patients. ▪ Real-time transfer of patient data via a mobile bidirectional application on the smartphone within the clinical routine treatment of the patient will lead to better drug safety and timely detection of complications resulting in less hospitalisations and better outcomes. Systematic integration of cyberphysical systems in the treatment of a chronic illness with modern communication technology. The mobile application facilitates treatment adherence and documentation in patient diaries and enables better patient empowerment.



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	<ul style="list-style-type: none"> ▪ The MACSS platform aggregates, analyzes and recombines medical data for different information services by using innovative technologies such as advanced memory databases. A major goal of this innovative personalized real-time therapy is to improve health care in a cost effective way by using modern big data technologies. High quality data provided by the MACSS platform will enable new patient centered research initiatives e.g. on quality of life or other patient reported outcomes. MACSS platform will provide the basis for scientific research projects of different stakeholders under real life situation. Such services are an important part of the business model. ▪ Development of a prototypic German data safety concept at the data trust center Charité. The patient carries his data, aggregation of data only within the data trust center at Charité. ▪ Other business models include the implementation of the platform in other transplant centers worldwide and the adaptation of the platform including the proven data protection scheme for other chronic illnesses.
Business Value	<ul style="list-style-type: none"> ▪ The Charité – Universitätsmedizin Berlin develops within a consortium (Beuth University of Applied Sciences, German Research Center for Artificial Intelligence, SAP SE, smartpatient gmbh, Dosing GmbH) and in cooperation with health insurance companies, patient associations, pharmaceutical industry and other enterprises) the prototypic MACSS platform: a new comprehensive patient-centered smart electronic health care service platform for the integrated care of chronically ill patients.
Innovation	<ul style="list-style-type: none"> ▪ This project develops for the first time a comprehensive mobile real-time bi-directional application, which interlinks all patient data including data from a mobile smartphone application into clinical routine. For the first time data from cyberphysical systems are integrated into the treatment of transplanted patients. By this means it aims to constantly improve both, the physician-to-patient and the physician-to-physician communication. ▪ The platform provides real-time high quality research data and offers new research opportunities for patient reported outcomes. ▪ Based on personalized, reliable and effective telemedicine services it is possible to avoid hospitalizations, improve the quality of life, reinforce adherence and enable substantial cost savings in the health care system. ▪ Prototypic data protection concept for medical data at the data trust center Charité.
Prospects	<ul style="list-style-type: none"> ▪ Adaptation to other chronic illnesses such as hypertension, diabetes, cancer.

6.5.2 Optimization in Surgery Processes – KARL STORZ – InnOPlan

Title	InnOPlan – Innovative, Data-driven Efficiency of Surgery-related Process Landscapes
Company	KARL STORZ GmbH & Co. KG Mittelstraße 8 78532 Tuttlingen Contact Person: Dr. Norbert Hansen norbert.hansen@karlstorz.com +49 7461 708 8627 www.innoplan-project.de
Project Partners	KARL STORZ GmbH & Co. KG, HB Technologies AG, Heidelberg University Hospital, University of Hohenheim, Leipzig University, SMARTIT® – Kawetzki, Sprung, Streng GbR
Challenge	The operating theatre is the heart of a hospital. It is paramount that proceedings here run smoothly. However, the individual process steps often do not complement each other optimally. The better individual devices are networked, the more trouble-free their interaction will be in critical moments.
Solution	The InnOPlan project aims to optimize processes in operating theatres and surgery processes in hospitals using big data. Initially, research will be carried out into how medical devices need to be designed so they can become intelligent data suppliers. Methodologies and tools will then be developed to process the often unstructured datasets generated and to extract relevant information. Based on this, an attempt will be made to network the data with processes both inside and outside the operating theatre in order to optimize clinical and logistical operations, surgical planning and equipment availability.
Business Value	Hospitals will function more efficiently with the new technologies and be able to optimize processes in the operating theatre environment. For example, the assignment and use of equipment in operating theatres can be planned better. As a result, equipment availability can be optimized and process costs in the hospital can be reduced. The improved level of organization and the resulting optimized capacity utilization benefits the hospital in two respects: Firstly, all processes become even more focused on medical tasks than they were before. Secondly, the improved level of organization has economic benefits for the hospital and subsequently for the healthcare system as a whole. For hospitals, it could become possible to compare data – with respect to data protection – from patients with similar disease progressions and to draw conclusions about effective treatments and therapies based on big data analyses. This would improve medical care for patients, which in turn would relieve pressure on the health insurance funds and thus the hospitals as well. The added value lies therefore not only on the administrative level, but in the future also on the medical level.
Innovation	InnOPlan will also outline business models for storing data generated by devices on an online smart-service platform – with particular regard for data security. This data can then be used by companies that do not have access to a sufficient amount of data to develop their own medical software.
Governmental R&D program	A Smart Data Programm project of the Federal Ministry for Economic Affairs and Energy



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6.5.3 Smart Analysis – Health Research Access – GeWINO – SAHRA

Title	SAHRA – Smart Analysis – Health Research Access
Company	GeWINO – Gesundheitswissenschaftliches Institut Nordost der AOK Nordost Wilhelmstraße 1 10963 Berlin Contact: Prof. Dr.-Ing. Thomas P. Zahn thomas.zahn@nordost.aok.de +49 800 265080-20330 www.gewino.de
Project Partners	data experts GmbH, the Hasso Plattner Institute at the University of Potsdam, TMF – Technologie- und Methodenplattform für die vernetzte medizinische Forschung e.V.
Challenge	In Germany, unlike other European countries, findings from healthcare research have until now rarely been usable in treatment consultations between patients and doctors. Furthermore, healthcare data is particularly sensitive. The protection of commercial secrets and strict compliance with data protection regulations and their technical, legal and organizational implementation therefore constitute one important focus of the SAHRA project.
Solution	The SAHRA project will make it possible to combine claims, treatment, study and reference data in accordance with privacy legislation and make it available to healthcare researchers. The objective is to anonymise data that is already available (since 2006) and collected in accordance with the rules in Germany so that no inference can be made about specific individuals. It should however be possible to gain fundamental insights into changes in regional healthcare demands, the development of chronic diseases and the effectiveness of therapies and treatment models.
Business Value	Data-based healthcare research, if carried out transparently and without economic interests, can reveal deficiencies in healthcare processes and serve patients, doctors and local authorities as a basis for informed decisions. An initial pilot of the SAHRA platform will provide performance indicators on the development of regional nursing-care of the elderly for all of the municipalities in Northeastern Germany, in cooperation with the specialist unit »Aging and care in the community«.
Governmental R&D programs	A Smart Data Programme Project of the Federal Ministry for Economic Affairs and Energy



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6.5.4 Personalized Treatment for Tumor Patients – National Center for Tumor Diseases



Organization	<p>NCT – National Center for Tumor Diseases www.nct-heidelberg.de At the National Center for Tumor Diseases in Heidelberg doctors and scientist work together to achieve a common goal: to defeat the cancer. Every year 10,000 patients are treated here. Again and again new forms of therapy arise – as every tumor is unique. The IT-solution »Medical Research Insights« based on SAP HANA helps the scientists to develop individual methods of treatment for patients.</p>
Challenge	<p>The success chances of the various treatment methods for the single tumor patient are only vaguely to predict – with the consequence that therapies, which are costly and beset with side effects, do not improve the medical condition.</p> <p>It is a fact that complex diseases need complex analyses. There are more than 100 different types of cancer, whereas every type of cancer differs in its characteristics and development. Therefore it is very important that affected patients get an individual and personalized treatment. To develop a fast and effective treatment, the NCT needs to analyze a high volume of data in real time. Earlier, the NCT had to browse through a wide range of data bases, create lists of patients, print the patient files and check manually if the criteria for one of the ongoing clinical studies were met.</p>
Solution	<p>To provide patients from the first day of their diagnosis to the optimal treatment, it is necessary to determine the most promising therapy for his genetic profile. For this, structured (tumor documentation, medical files, clinical studies etc.) and unstructured data (doctor's letters, handling instructions, test studies, press releases etc.) need to be analyzed in terms of the patient's profile. SAP developed for NCT a solution based on SAP HANA. It enables its users, including doctors, scientists and other medical personnel to work more efficient and simpler. Together with the users an application was developed, which makes it possible to cluster patients according to various characteristics. The goal was to combine patient data from different sources and to visualize all information of the patient's history in a graphical timeline. By using this new solution, employees are able to record and analyze a high volume of data about every patient in real time.</p> <p>Doctor's letters, MRT results, genetic analyses or cancer registry files: All information flows together centrally. In a short range of time, it is possible to predict which therapy promises the biggest success.</p>
Big Data	<p>NCT uses more than 15,000 protocols to treat more than 10,000 patients every year. Every patient generates up to 1,200 data points.</p> <p>The use of Big Data-technologies enables the integration of all of this data with a high volume of data from various sources. The analysis of the patient data is extended to the analysis of unstructured data, e.g. doctor's letters. Now these analyses, which took weeks in the past, can be carried out within minutes and the findings can be used for the benefit of the patient.</p>
Business Value	<p>The biggest win for NCT and its patients consists in the significantly increased transparency of the patient's history. Another advantage for the research center is the faster and promising matching of patients with appropriate studies. Among the pure patient data, a real time identification of tumor types is made possible to generate the most effective treatment method for the patient. As a result, not only the diagnosis of tumors is accelerated, but also the life expectancy of the tumor patients is increased.</p>
Innovation	<p>This project shows how intelligent combinations of technical expertise and practical design of the user interface can revolutionize working – not only in hospitals. Employees of NCT are able to browse and filter a high volume of data through one single and simple interface. The SAP HANA-platform supports patient care by delivering detailed and illustrated timelines of treatment activities, operations, chemotherapies and home visits.</p>
Prospects	<p>It is conceivable for the future, that health insurances use this possibility and compare treatment processes. Also the patient can profit by retrieving his state of health including recommendations from his mobile devices. The possibilities in the medical sector are diverse.</p> <p>NCT and SAP are planning on to continue their cooperation and to extend the analysis of patient data based on the SAP HANA-platform. NCT wants to use data analyses in real time to support each type of the diagnosis and every step of the ongoing therapy with the goal to improve the life and future of people who suffer from cancer.</p>
Big Data Provider	<p>SAP Deutschland SE & Co. KG www.sap.de info.germany@sap.com +49 6227 7-47474</p>

6.6 Energy

6.6.1 Smart Data and Service Platform – EWE

Company	EWE AG Tirpitzstraße 39 26122 Oldenburg www.ewe.de <ul style="list-style-type: none"> ▪ Olaf Kyek +49 441 4805-4080 ▪ Christian Arnold +49 441 4805-5114
Competitive environment/ Driving factors	<p>EWE AG is one of the largest utility companies in Germany. Based in Oldenburg, Lower Saxony, EWE provides power, natural gas, telecommunication and IT services (via its subsidiary BTC AG) to customers with a regional focus on the northwest of Germany, Brandenburg and Rügen, as well as parts of Poland and Turkey.</p> <p>The German energy system is undergoing a game-changing transformation, known as the »Energiewende« or »energy transition«. A former centralized energy system is evolving into a market-oriented, decentralized renewable energy system. As a result, major drivers for EWE are smart grids, smart markets and smart data.</p> <p>The energy market is constantly changing: Wholesale prices are collapsing due to priority policies concerning renewable energy, the constantly rising number of renewable energy producers needs to provide not just power, but also network resilience, and new competitors are entering the promising digital service market enabled by smart metering.</p>
Challenges	<p>The German energy transition describes a national shift from nuclear and fossil fuels to renewable energies. With this transition, Germany is facing the challenge of global warming and of decarbonizing the country's energy system. EWE's answer to the energy transition is digitalization by two means: digital enablement of the grid infrastructure and development of a Smart Data and Service Platform (SDSP) as an information backbone for the entire energy system. The platform includes big data technology and appropriate analytical features that increase efficiency within existing business and enable new business models.</p>
Big Data strategy/ initiative	<p>EWE's big data initiative currently is in the state of Group-wide initialization, including making platform decisions and hiring data scientists, accompanied by initial »proof of concept« projects and »datathons«. Consequently, an innovation pipeline is filled with new ideas for utilizing big data technology. Promising data-based business models will finally be demonstrated and monetized.</p>
Governmental R&D programs	<p>Leading a consortium of 32 partners, EWE AG initiated enera (www.energie-vernetzen.de), the largest project (EUR 170 million/four years) to be realized in the SINTEG funding program of the Federal Ministry for Economic Affairs and Energy. Big data is one of three focal areas of the SINTEG program.</p>
Innovation/ Knowledge transfer	<p>EWE AG cooperates with leading partners in the field of big data to foster the implementation of the SDS platform, such as the R&D divisions of SAP, Siemens, Software AG and BTC AG. Moreover, universities and research institutes support our activities (RWTH Aachen, Universität Duisburg-Essen, OFFIS Institute, Oldenburg and Jacobs University Bremen).</p>
Business model	<p>Currently about 20 data-driven business models are waiting to be tapped by EWE's center of excellence for big data. Most of these business models will be tested in the field and evaluated in the course of the enera project. As an example, BTC AG plans to increase efficiency for electricity retail companies by improving the accuracy of forecasts using smart meter data.</p>
Additional information	<p>For additional information related to EWE's data-driven business models, please contact Dr. Matthias Postina (matthias.postina@ewe.de) or, specifically for electricity retail companies, Mr. Frank Lange (frank.lange@btc-ag.com). For information concerning the SDS platform, contact Mr. Jens Walter (jens.walter@ewe.de).</p>



6.6.2 Data Hub for Smart Energy Use – Stuttgart Airport – SmartEnergyHub

Title	SmartEnergyHub – Data Hub for Smart Energy Use
Company	Flughafen Stuttgart GmbH (Stuttgart Airport) Contact persons – Consortium leader: Fichtner IT Consulting AG Dr.-Ing. Albrecht Reuter +49 711 8995-1964 www.smart-energy-hub.de Holm Wagner wagner@stuttgart-airport.com +49 711 9483664
Project Partners	Fichtner IT Consulting AG (consortium leader), Fraunhofer Institute for Industrial Engineering IAO, Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS, in-integrierte informationssysteme GmbH, SevenZone Informationssysteme GmbH
Challenge	Operators of large-scale infrastructure services, like airports, seaports, general industrial and chemical parks, manufacturing facilities, and office blocks are confronted with particular challenges due to the increasing decentralization, flexibilization and intermeshing of the energy market. To meet the needs of evolving market conditions and to gain economic advantages from the possibility of intermeshed operation, smart networking of the operator's own infrastructure is necessary. The ICT requirements of infrastructure services operation for purposes of smart networking and control are, firstly, high-performance databases with cloud-based in-memory technology that can acquire and process large data volumes over short periods. Data storage may be provided as an on-site solution or as a service. Secondly, software components are needed that permit straightforward and standardized tie-in of system elements and their control with centralized visualization of information to support decision-taking.
Solution	The SmartEnergyHub project is currently developing a smart data platform by means of which infrastructure service providers can undertake forecast- and market-based energy management with the aid of sensor data. This platform's task is to merge large volumes of diverse data from heterogeneous sources and to gain new insights from their analysis, so »big data« becomes »smart data«. On this foundation, new procedures for optimizing infrastructure services operation are designed, taking Stuttgart Airport as an application example. In this way, users can, for example, implement measures for energy saving, cost optimization and CO2 reduction. Operators of key infrastructure facilities are significant consumers, but at the same time generators, of energy. Additionally, these infrastructure operators possess substantial storage capacities and can provide appreciable load shifting potentials.
Business Value	Presenting a major challenge to these facility operators is the provision of technical infrastructure services reliably, robustly and cost effectively while continuously optimizing them. The increasing exploitation of regenerative energy sources, changes in energy source cost structures, technological innovations, and legislative developments present further challenges to operators. A promising approach is to apply cost-based control systems coupled with novel real-time-capable energy management systems that can depict dynamic developments during the course of the German government's energy turnaround process and at the same time allow the provision of new services and business models.
Innovation	New smart data solutions founded on sensor-based and networked smart IT systems offer many opportunities to exploit previously unused potentials for future operation of infrastructure services, in particular energy systems. And this not only at a single, specific location or in a plant, but also through energy pooling by the cooperation of various operators or the collaboration of infrastructure service providers with energy supply utilities and energy network operators. The required new solutions are created in the SmartEnergyHub project under the application of big data technologies and platforms. At the same time, technical, structural, organizational and legal frameworks are considered and solutions provided for overcoming obstacles. Through its cloud implementation on the high-performance In-memory platform, the projected SmartEnergyHub as an open and highly scalable energy management platform holds the promise of a cost-effective utilization possibility for small and medium-sized enterprises as well as major companies alike.
Governmental R&D programs	A Smart Data Programme Project of the Federal Ministry for Economic Affairs and Energy



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6.6.3 Trend Analysis – YellowMap – SmartRegio

Title	SmartRegio – Trend Analysis Based on Heterogeneous Mass Data
Company	YellowMap AG CAS-Weg 1-5 76131 Karlsruhe Contact Person: Richard Wacker richard.wacker@yellowmap.de +49 721 9638-505 www.smartregio.org
Project Partners	German Research Center for Artificial Intelligence (DFKI), Disy GmbH, Goethe University Frankfurt, USU Software AG
Challenge	Typical municipal utilities face technical challenges and increased competition due to market liberalization and the transition to renewable energy. They need to invest and to take local trends into account in doing so. Where will more electricity be fed in from renewable sources? Where will people buy electric vehicles? Where will new products and services such as smart homes, automation technology and dynamic tariffs be in demand?
Solution	SmartRegio wants to enable companies to identify regional trends based on local mass data. The spectrum ranges from search queries, transactions, social media posts, open platforms and Wikipedia through to data collected by the city, municipality or infrastructure operators. Taken together, this data reflects a large part of the everyday lives of the people and reveals changes in behaviour and trends. SmartRegio's objective is to conflate and analyse this data. A modular platform will evaluate the data in terms of time, geography and content. It will reveal relevant changes and enable the data to be prepared for different recipients.
Business Value	For companies, large-scale market studies will no longer be necessary in a variety of situations; rather they will be able to access what they are looking for immediately. Furthermore, the history of locally available products and services can also be reconstructed. If a person wants to open a pizzeria in a certain location, they can find out how many similar businesses have been tried previously in that location, whether local people liked eating out in the past and whether they will do so more in the future. The necessary information is obtained from the existing data stream. Strategic consulting for typical municipal utilities: The opportunity lies in the ability to offer carefully tailored products and services. Such offers need to pick up on the trends, issues and technologies that meet the regional requirements. This leads to increased acceptance and satisfaction, the company image is improved, new business opportunities are generated and investments can be planned better.
Governmental R&D programs	A Smart Data Programme project of the Federal Ministry for Economic Affairs and Energy



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6.7 Retail, Wholesale and Customer Experience

6.7.1 Drivers, Challenges, Innovations

Competition and key drivers

Why Big Data in retail? In times when technology is becoming ubiquitous and an essential part in our lives, it does not surprise, that the retail industry – as touching everybody's lives – also relies more and more on technology as well as its data to remain successful in an increasingly competitive and disruptive market environment.

As Germany's Chancellor Angela Merkel stated already in fall 2015, data is the »fuel of the 21st century« and everybody has heard buzzwords such as »Business Intelligence«, »Big Data« or »Predictive and Prescriptive Analytics«. But what does this imply for retailers, their strategies and their core business processes?

Retail represents the third largest industry in Germany generating about 470 Billion € annual sales with 3 Million employees in 300.000 companies, while 50 Million consumers are shopping at German retailers on a daily basis (HDE, 2016). According to Ulrich Binneböbel, expert at the German Retail Federation (Handelsverband Deutschland, HDE), »one of the central challenges in retail is the topic big data«. He sees the intelligent connection of data and generation of benefits for customers as focus areas in the near future (HDE 03/2016).

Industry Challenges

What can retailers do to successfully compete in this dynamic marketplace? With the retail industry evolving quickly as consumer demand for goods and services evolves, new competitors enter the marketplace, and new technologies are introduced, the question turns to what retailers can do to successfully compete in this dynamic marketplace. The answer is three-fold:

- By differentiating the shopping experience through the meaningful use of technology,
- personalizing promotions and experiences for customers, and
- effectively predicting and prescribing what will sell, when, where, and to whom.

And the path to achieving these things is through data.

In order to gain insight at a particularly volatile time for the industry, Microsoft recently conducted a survey with retail executives to gain insight into their business challenges and learn about how they are currently using, or plan to use, data analytics and the cloud to stay relevant with today's consumers. When asked about their organization's current business environment, 73% of those surveyed acknowledged that the retail marketplace is changing and 40% are seeing their businesses change rapidly (Microsoft).

Innovations and knowledge transfer

What Big Data key areas are forward-thinking retailers focusing on? Based on the survey results, there are three key areas regarding big data that forward-thinking retailers are focusing on:

- **Commerce »anywhere, anytime«:** Customers are making their purchases online, in traditional brick-and-mortar stores, from »pop-up« stores and other sources. They might shop downtown with friends on Saturday; online at midnight on Wednesday; or while working out or sitting on a train, using a mobile device to purchase an item they just saw on TV or in a newspaper. Using big data to analyze who buys what, where and how helps retailers to streamline and target their marketing activities more efficiently.
- **Personalized promotions and experiences:** Retailers are providing customers with tailored purchasing opportunities based on an analysis of their real-time and historical purchasing data. For example, by offering personalized and dynamic discounts or with options to purchase online and pick-up in-store or purchase instore and ship anywhere. Brick-and-mortar stores are using analytics to offer real-time »recommended for you« suggestions instore, duplicating the familiar online recommendation experience.
- **Situational awareness:** The Internet of Things and its sensors provide retailers real-time information of shoppers' or articles' location through the use of QR codes, RFID tags, NFC, beacons, and other sensors. Enabling retailers to deliver real-time coupons, product information, and even games and promotions to customers. For example, using Wi-Fi signals on customers' smartphones, it is possible to track them through the store and send them personalized coupons and product information as they shop. Situational awareness also provides retailers with information about the flow of customers through a store and its analysis provides insights into how to better organize merchandise to drive purchases.
- **Diverse Data + New Analytics + Expanded information access:** Connecting the diverse sources of retailers' internal data, analyzing it using new analytics algorithms, e.g. Machine Learning, and combining it with external (public, purchased) data results in expanded information access. Big data analytics provides predictive and prescriptive results which, for example, enable executives to make decisions about promotions, pricing, inventory, and sales associates can access real-time information about products and customers to help drive sales. Using the cloud and its ability to store data inexpensively, everyone from executives to individual employees in retail locations can review historical data, as well as use real-time sales figures and inventory to make fast, well-informed decisions that can enable them to do their jobs better and increase sales.

Big Data

Which data platform and analytics solution are needed? The right data platform and analytics solution are needed in order to process, predict and visualize the data that streams into a retail business 24/7, 365 days a year and many retailers have existing analytics solutions in place, where internal data is store and analyzed. For Big Data analytics large amounts of data

need to be analyzed in near real time and ideally enhanced with additional external data. So, when replacing or augmenting existing solutions to achieve business benefits and realize cost efficiencies, two platform alternatives come into play:

- **Cloud-based analytics solutions** offer benefits for retail businesses such as scalability and cost. Cloud services enable retailers to quickly scale up or down on demand, and pay only for what they use, gaining processing power to fuel advanced data analytics capabilities. With a payment model of paying only for the services used, cloud services are an economical way for even the smallest retailer to benefit from cloud solutions.
- **Hybrid Cloud solutions** are for retailers that might not be ready to move to a full cloud solution. This enables them to move part of their data and computing needs to the cloud while maintaining on-premises data as well. The hybrid cloud combines benefits of cloud computing: scalability, elasticity, cost benefits, familiar tools and apps, with the enhanced security of on premise solutions.

Retail businesses who take the opportunity now to evolve their business practices by bringing the power of the cloud and advanced analytics to their companies will find themselves uniquely situated for a competitive advantage in an ever tightening retail marketplace.

6.7.2 2016 – The Year of the Algorithm

How machine learning is driving the future of retail and the speed of decision making

The retail landscape has changed, driven by customer expectation. Today shoppers expect to be able to shop on any platform, at any time, and have their purchases delivered to them in a range of ways, from click and collect to one-hour delivery. In addition, and thanks to the digital world, pricing is comparable through a few touches of a smartphone, giving shoppers the power to make easy decisions based on price.

Investment in new channels has not met your expectations of profit and is falling short of customer experience: Sound familiar?

Retailers have made promises to deliver exactly what their shoppers want, making customer experience the key focus of their corporate strategies. Investing in mobile, omni-channel and social media has also become a priority (PAC 2015).

This has led to heavy investment in building new channels for customers, but many are failing to convert that investment into customer loyalty and profits. This is down to the retailer struggling to keep up with the speed of their customers, leaving them unable to deliver the right product, on the right platform, at the right price and via the delivery method the customer wants.

This comes down to the fact that decision making in the retail supply chain is not fast enough. The investment in customer facing platforms has not been matched in the supply chain – the place where decisions now need to be made at the speed of customer expectation.

How to fulfil customer experience strategies at scale

Many retailers are not taking advantage of machine learning to drive faster decisions.

To operate at scale, retailers need to leverage their their data to deliver faster decisions that can reduce the amount of stock, the number of write-offs and start accounting for variables such as holidays and seasonal effects. Machine learning algorithms can deliver on the retailers brand promise to customers whilst achieving their profit goals

According to a recent study (KPMG / Bitkom Research, 2016), only 22% of retailers analyze data using modern methods with the goal of optimizing business processes. They are the retailers of the future and the rest need to follow their lead in order to remain competitive.

Greatest Challenge for Merchandising and Supply Chain Processes

Customer experience of the omni-channel retailer is growing ever more important in the fight for profitability. To keep customers premium experience throughout the entire purchasing process and to create a comfortable and positive buying experience, a more holistic customer experience is required. Online and offline offers, as well as click and collect purchases that combine online and stationary retail, need to work together harmoniously to create a seamless experience for the customer. This much we know, however attractive offers and permanent product availability pose great challenges for retail. Retailers must be able to offer customers the optimal price all the time, on every channel, and avoid out-of-stock situations. Fail to deliver on that omni-channel brand promise and retailers risk losing customers, margins, profits and their future.

How do machine learning algorithms help revolutionize retail

Machine learning algorithms and cloud-based predictive applications help retailers by supporting daily operational decisions making them more profitable. Machine-learning methods enable retailers to optimize replenishment by basing it on data from internal processes, taking external factors such as weather reports, holidays and promotional campaigns into account as well. Furthermore, they make it possible to review and revise prices constantly. The more exact a retailer can be about which article will be in demand next, the more efficiently they can order products from suppliers and offer them to customers at the exact moment they are looking for it. Real-time analyses also help to match prices with demand, stock levels and competitive offers.

In addition, it is extremely important for retailers to identify potential buyers in advance. Retailers can identify customers according to their anticipated purchasing behavior based on customer targeting. Which customers are inspired to make a purchase after reading targeted advertising?

To this end, it is important that prices and availability are driven by demand. Algorithms learn how to assess the many complex interdependencies and their relationships to one another and then acquire an experience-based knowledge that is far more precise and complex than human experience. Moreover, automation allows them to ensure human capabilities as well as speed in the necessary decision-making. Machine learning algorithms based on valid data are the basis for better and more efficient decisions in retail.

Future of Retail: Find the right operational approach for your strategy

To deliver on the promises retailers have made to customer experience – and to profit in the omni-channel retail world – businesses need to learn that by using data they will find success.

Not every retail company uses predictive analytics and those that do not are not only wasting money on unnecessary storage, but are at risk of falling strategically behind the competition. One of the most important tasks in 2016 will be to further advance businesses with the use of algorithms. 2016 is the Year of the Algorithm: The algorithm that helps companies to utilize their untapped data potential in a profitable way.

6.7.3 Gathering data, tapping areas of potential – how the Otto Group uses Big Data

otto group

The Otto Group is a globally active group of retail and service companies with a history that stretches back more than 65 years. Through the Group's 123 major companies we have a presence in over 30 countries in Europe, North and South America, and Asia. Our activities are grouped into three main business areas: Multichannel Retail, Financial Services, and Service. Globally, the Otto Group's companies operate over 100 online shops, which makes us one of the leading online retailers to the end consumer worldwide. In the 2015/16 financial year the Group generated revenues of over 12 billion euros.

Three years ago the Group Business Intelligence Division – or »Group BI« – was established. Today this specialist area comprises around 30 employees from a range of disciplines including IT, Psychology, Biology, Linguistics, and Business Economics. Our young division has a clear mission: to use data to tap into new revenue streams and realise potential earnings in e-commerce. The areas of application are many and varied, ranging from semantic product search to algorithm-driven size recommendation.

To offer you an example, for the Otto Group company Hermes – Germany's largest Post Office-independent B2C logistics services provider – Group BI also developed the technical infrastructure for online Parcel Delivery Notification. Based on historical delivery times and data analysis, this lets our customers know when to expect delivery of their order within a 2 to 4-hour time window. Out of respect for the trust our customers place in us, the Otto Group has very strict standards when it comes to data protection and data security. In close touch with the worldwide developer community.

Besides developing specific solutions, at Group BI we also see ourselves as a Group-wide innovation driver. Our staff benefit here from their outstanding networks within the global tech community. In fact, Group BI started its career by setting a record: as initiator of a Data Science competition in article classification on »Kaggle«, the world's largest Web platform for Data Science challenges, we activated over 3,500 international teams. What's more, in 2015 the Otto Group was the only German online retailer to present its in-house developed solutions at the Strata + Hadoop World in New York. This conference is seen as the world's most important network meeting for the Big Data community.

The trigger for establishing a Group Business Intelligence Division was the increasing importance of Big Data for e-commerce; there is no doubt whatsoever that data now represent the core currency in online business. This is also evident in media-user behaviour, which has seen print catalogues and paper-based advertising media replaced to a large extent by Web-based media as the key action-chain channel. Here too, the market is becoming more and more fragmented: linear buying processes are become increasingly rare, as customers come into contact with retailers via a variety of touchpoints which include apps, Web-based offers and social media. The challenge is therefore to reach customers via the right channel for them, with messages relevant to them – and here the huge data set available to the Otto Group thanks to its broad retailer portfolio is a tremendously valuable asset.

Establishing our own advertising marketer

To be able to address customers optimally on the Web, in 2015 and in close cooperation with Group BI, the Otto Group established its own online advertising marketer, Otto Group Media. On the one hand this enables our company to market advertising space via Group companies' online shops, which have a reach of over 25 million users monthly. And on the other, in collaboration with a number of strong partners, Otto Group Media builds targeting offers in particular for our female customer target group; after all, 80 percent of our customers are online-savvy women with a keen interest in products! Through this approach, the Otto Group is able to give advertisers the opportunity to run data-steered campaigns within particularly attractive, high-value environments. Going forward, Otto Group Media will concentrate on expanding its mobile offers, which include embedding tailored advertising in smartphone apps.

As a core driver, enabler, catalyst and in-house solution provider – Group BI has many facets. That said, our mission can be summed up in just one sentence: »Driven by data, inspired by our customers.«

6.7.4 Meaningful Personalization – BRAIN Platform – Otto

Company	Otto (GmbH & Co KG) Werner-Otto-Straße 1-7 22179 Hamburg David.Cordes@otto.de BjoernArno.Stachmann@otto.de
Competitive environment/ Driving factors	Otto is one of the world's leading mail order and e-commerce companies. We aim to provide the best customer experience possible in e-commerce. The key to success is the personalization of the experience according to the individual customer's needs.
Challenges	To provide meaningful personalization a detailed picture of the user is needed. Huge amounts of data from various sources have to be collected. Complex algorithms and advanced statistical methods require enormous processing power and the results have to be made accessible in real time while the customer is shopping online.
Big Data strategy/ initiative	A key initiative in achieving this goal is the development of the BRAIN Platform which integrates classical high-end databases (Teradata) with big-data technology (Spark, Hadoop, Hive, Impala and HBase on Cloudera) and a live stream processing engine (based on Ignite and Kafka). BRAIN provides real time access to customer data, 360° customer profiling, advanced data science capabilities, big data processing as well as classical data warehousing features. Data is loaded from various sources via ETL (Talend) or Messaging (Kafka). The processing jobs are managed and orchestrated by Talend and Control-M. Classical warehouse data is stored in Teradata. Big data is stored as parquet-files on Hdfs to be queried with Hive and Impala. 360°-Profiles are accumulated in HBase using Spark. Together these form an information warehouse. An in-memory database will enable extremely fast reporting. Our Analytics Stack provides an environment for deeper analysis, data science and machine learning using Spark with Python and Scala. Real time features are implemented according to the lambda architecture. A speed layer processes the click stream data while the user is still online using Ignite. A fast serving layer makes data from streaming and batch available for personalization in our shop.
Business model	OTTO is a driving force in online retail, the company uses the latest technology and is actively shaping the market. Over 2.1 million items and around 5,200 brands at otto.de, convenient shopping on all user devices, Number 1 in Germany in Fashion and Lifestyle (B2C), 6 Million active customers, 20 Million orders per year.

6.7.5 Couponing and Multichannel Marketing Platform – PAYBACK

Company	PAYBACK GmbH Theresienhöhe 12 80339 München info@PAYBACK.net
Competitive environment/ Driving factors	Fifteen years ago, PAYBACK developed a revolutionary bonus programme. Today, with 28 million active customers in Germany and 90 million worldwide, PAYBACK is the largest programme of its kind – and is constantly reinventing itself. As a pioneer of digitization in retail, the company is »the missing link« between the offline and online retail worlds and changing the landscape of relevant offers and marketing. Last year, PAYBACK sent out 20 billion coupons to its customers in Germany, making it not only the market leading bonus programme but also the biggest couponing and multichannel marketing platform worldwide. With this massive digital transformation as the companies' new backbone, PAYBACK has expanded its success from Germany to Poland, India, Mexico, Italy and in May 2015, PAYBACK was launched in the US as »Plenti«.
Challenges	PAYBACK and its partners understand that consumer behavior is changing rapidly and that the consequently altered consumer needs will shift existing business models. Especially the knowledge about the ways of communication enables the PAYBACK network to build up powerful competitive advantages. PAYBACK owns an unrivalled picture of various B2C markets and their future potentials. It has detailed big data knowledge and uses data driven marketing to adress customers with the right offer at the right time via the right channel.
Big Data strategy/ initiative	For several years, the »digital transformation« affected all areas of our daily life. PAYBACK has recognized this trend from its very early beginning and therefore not only successfully unlocked new channels and media, but also linked them together from scratch. Today, all PAYBACK services are available at all touchpoints – within the partner stores, in web stores and on mobile devices. In combination with this ubiquitous access to offers, the success of PAYBACK is based on the individual and relevant addressing of customers. PAYBACK determines the most relevant content at any touchpoint and for each customer on a 1:1 basis – via data analysis and smart interpretations. In addition, PAYBACK uses innovative technologies like BLE beacons, geofences, etc.) Already at the beginning of all »digitization efforts«, PAYBACK has recognized that data collection is not enough, but that smart interpretation and integration of all customer insights into the individual customer journey must be the central aim of all data strategies. Thanks to the high profile and its popularity among consumers, PAYBACK is also able to measure »touchpoint data«, such as interactions at the POS itself. A current challenge is to receive, analyze and use all data in realtime or at least near-time to determine the next best offer based on the current context of the user.



6.7.6 360° View on Customers – Home Shopping Europe



Company	<p>Home Shopping Europe GmbH www.hse24.de</p> <p>Home Shopping Europe is the leading teleshopping provider in Europe. Not only through TV, but also through call centers, internet and mobile devices the company interacts with its customers. In such a hybrid multichannel environment a lot of information in various types and amounts is generated, which needs to be analyzed in order to result in direct actions for the customer in order to continuously improved service level and stand up against the competition.</p>
Challenge	<p>It is crucial to know and to react on the needs of the customers. Therefore a 360 degree view is required to guarantee the best service. The task of the IT department is to provide other departments like Sales, Marketing and Operations appropriate information about the customers. Among the challenge to satisfy the demands of the customers every time, e.g. it is crucial for HSE24 to reduce high return quotas. That is only possible by optimizing the service on the one hand and individualizing customer contact on the other hand. Moreover it is important to predict current opinions, purchasing preferences and other indicators of the viewers during the TV broadcasting and to adjust the ongoing program optimally.</p>
Solution	<p>To find out how the buying behavior of the customers is affected significantly (concrete: when and in which context does the customer buy) HSE24 uses SAP CRM powered by SAP HANA. The solution focuses on a first-class customer service including all relevant information, attributes, taxonomies and indicators to improve the service and the customer satisfaction. Thanks to the Big Data platform, the sales team gets the appropriate data and tools to work timely and efficiently. The former heterogeneous system was replaced by an integrated platform that integrated and optimized all customer specific processes of the Sales, Customer Service and Marketing departments.</p>
Big data	<p>All data as well as a 360 degree view on the customer's need is provided in real time for HSE24. The volume of data increases rapidly. Approximately 1.5 million active customers are able to retrieve and produce data any time by using the internet, the telephone, applications on their mobile devices or emailing. More than 1,400 employees handle around 35,000 calls every day. To address the customer needs completely, all relevant data, structured and unstructured, needs to be accessible harmonized in real time.</p>
Business Value	<p>The benefit generated by the use of Big Data technologies in the area of CRM especially consists in the simplicity and the speed of recording, completing and using customer data. A 360 degree view on the customer results in a tailored service and enables the customers of HSE24 to get his special shopping experience. This individual customer contact enables – among the usage of up- and cross selling potentials – a reduction of the return quota possible. If the company succeeds in reducing returns by 1%, it can save seven-digit sums. SAP CRM powered by SAP HANA enables companies to customize their products and services according to their customer's needs instead of controlling it by generic market data.</p>
Innovation	<p>By using SAP HANA, HSE24 has the opportunity to predict and control the customer's behavior. A 360 degree view enables a targeted customer contact using campaigns or emailing and leads to lower return quota. Information from all interaction channels, which has not been used before, results in a more flexible creation of new offers by the means of real time processing and analysis. Therefore HSE24 can create better offers for their customers, which are tailored to the customer's demand and needs.</p>
Prospects	<p>The usage of Big Data revolutionizes the product development, sales and customer experience. Also for an expansion in new markets, such a real time platform is an important criterion for success.</p>
Big Data Provider	<p>SAP Deutschland SE & Co. KG www.sap.de info.germany@sap.com +49 6227 7-47474</p>

6.7.7 Near-Time Monitoring of Relevant System Interfaces for the Home Delivery Service – Gebr. Heinemann

Company	<p>Gebr. Heinemann SE and Co. KG</p> <p>Gebr. Heinemann is one of the major distributors and retailers in the international travel market. The passenger is the sole focus of the company's attention and is the center of all efforts and the many exceptional services available. Alongside the established online pre-order service for the duty-free range of international brand products, since spring 2014 the company has been operating the home delivery service. This service offers high flexibility for airport passengers; while items can be purchased in the shop at the airport as standard, it is also possible for them to be ordered – either in store or online – and delivered to an address of the customer's choice. The service saves time and offers more convenience and practicality.</p>
Challenge	<p>The home delivery service is the only service of its kind. The handling of online transactions alone demands the integration of a complex system landscape with various interfaces to internal as well as external systems. To be able to guarantee the »full service for passengers« at the highest possible quality, a central platform is required. The platform monitors all relevant processes and interfaces, visualizes relationships, patterns and temporal processes and installs warning systems to raise an alarm if necessary. All of this happens in near real-time, known as near time.</p>
Solution	<p>The *umDataMonitor from *um is implemented as the central platform. A »unique platform for monitoring data landscapes«, the *umDataMonitor is a cloud-based and cloud-distributed big data PaaS solution for near-time processing and analyzing of any data sources and data streams, and can be scaled at any time. The platform is operated in the highly secure and multi-certified *umCloud in accordance with German data protection law and enables modular development and integration of any data-based processes and applications. The platform is complemented with expert knowledge in data science (machine learning, predictive analytics, etc.) to form a complete package that is crucial for the seamless functionality of Gebr. Heinemann's home delivery service.</p> <p>All relevant interfaces for ERP and CRM systems as well as interfaces for various external systems (flight data check, etc.) are currently being monitored in near time and many analyses are being performed. The primary challenges involved in this process are the merging of different data sources and formats in a query-optimized high performance index as well as the interpretation and subsequent determination of threshold values for automated alerts. The system has been in operation since spring 2014.</p>
Big data	<p>Currently, 20+ GB of data is being imported, processed in near time and transferred into various applications (monitoring, alerting) each day. The primary sources are Apache weblogs, application error logs, various databases with interface status messages, log data from external interfaces, and relevant server data and system data. V(olume) will grow more and more in the future, V(elocity) is mission-critical and key to the implemented platform solution, while V(ariety) is one of the central challenges.</p>
Business Value	<p>With this solution, Gebr. Heinemann is for the first time able to receive a near real-time insight into the complex system processes – i.e. communication between machines – of the home delivery service. The employees in the business and IT departments can be proactive in the event of an error and can ultimately guarantee high quality throughout this unique online transaction process. This will result in a sustainable increase of customer satisfaction.</p>
Innovation	<p>Gebr. Heinemann's home delivery service, implemented in spring 2014, is a service currently provided by no other. Big data forms the basis for the implementation and integration of significant support processes for this innovative business model. Generating the »one view« of the home delivery service's core processes, end-2-end, is crucial for success across all systems.</p>
Prospects	<p>In the medium term, the platform will lead to collaboration of the business and IT departments in order to both view holistically and optimize business processes based on big data. Significant core processes and support processes for Gebr. Heinemann will be visualized and monitored at a central department and will trigger alerts to the business department and/or IT department if necessary.</p>



Gebr. Heinemann
Gegründet 1879

Big Data Provider	<p>The unbelievable Machine Company GmbH (*um) Klaas Wilhelm Bollhoefer Chief Data Scientist Grolmanstr. 40 10623 Berlin</p> <p>The near-time monitoring of complex system processes and business processes is relevant for any issues spanning different sectors and departments. The solution developed in the project can always be applied for any data sources and data streams and adjusted to the interests of various stakeholders. The main focus lies on the »in-time« analysis of relevant processes and interfaces. Project experience indicates that the entire system must be coordinated optimally in order to enable a smooth flow of data and information – from the data layer to the analysis and application layers to the representation layer. Achieving this requires an agile process model and a well-attuned team of data scientists, data engineers, system architects and customer representatives during the implementation and integration stage.</p>
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6.7.8 More Profitable Customer Experiences – Kaiser’s Tengelmann

Company	<p>Kaiser’s Tengelmann GmbH Contact person: Mark Michaelis Retail Systems & Services Manager</p>
Challenge	<p>Historically, sales forecasting at Kaiser’s Tengelmann was done for the most part manually by the employee. With Blue Yonder’s solution, they wanted to optimize and scale processes to deliver profitable store replenishment.</p> <p>Kaiser’s Tengelmann needed to improve the operational efficiency and cost of store based replenishment. Improving predictions to better reflect true customer demand patterns of SKUs at store level would allow the business to plan sales and inventory more effectively.</p>
Solution	<ul style="list-style-type: none"> ▪ In 2013, a proof of value ran in three stores. From October to December, Blue Yonder’s solution automatically ordered all liquor and canned fruits and vegetables. The goal of this pilot project was to test and refine the way the system works on a daily basis. The replenishment team consisted of three people who supported and managed the process at Tengelmann. ▪ Store-based replenishment parameters vary by location, which is a challenge when it comes to procuring goods based on demand. Kaiser’s Tengelmann was looking for a practical solution that was easy to manage centrally and could be integrated into their system but reflected true local demand. In this way, every employee could benefit from the software. The new inventory management system put in place in 2011 met all the necessary conditions for the project. ▪ During the pilot project, machine learning algorithms and Blue Yonder’s retail expertise helped reduce out-of-stock and excess inventory, which made replenishment more manageable and cost-efficient for each store. Reducing manual intervention and complexity means store replenishment processes enable a more agile supply chain and more productive operations. Based on the successful pilot project, Kaiser’s Tengelmann decided to implement the solution across the board.
Business Value	<p>Using Blue Yonder’s replenishment solution, Kaiser’s Tengelmann has significantly improved operational efficiencies and reduced cost at their stores. They can also accurately assess customer demand at SKU/store level. The much improved sales forecasts increase sales by reducing the out- of-stock level. Better availability of goods leads to higher customer satisfaction.</p>



6.8 Public Sector

Challenge

Big Data is the ocean of information we swim in every day – vast zettabytes of data flowing from our computers, mobile devices, and machine sensors. With the right solutions, government organizations can dive into all that data and gain valuable insights that were previously unimaginable to improve citizens' lives.

Government needs relevant, timely insights to solve issues affecting the quality of life of their citizens. Unfortunately, insights remain hidden due to

- Can't analyze bad data (got to have a good data set and available data)
- High workloads and scarcity of technical skill sets
- Inaccessible data and technology
- Difficulty protecting citizen privacy and security
- Siloed approaches and analytics technologies
- Lack of predictive, real-time insights
- Lack of interagency and inter-departmental collaboration
- Obtaining an IT architecture that is agile enough to adapt

These issues worsen when you need insight from multiple government departments and agencies. Government stakeholders can't afford to waste time manually sifting through scattered data locked in silos. Answers and insight are needed immediately.

Technology Development

Break down silos by arming cross-agency stakeholders with the same insight for better data driven decisions:

Simplify your IT architecture and get more value out of your data management systems with a Big Data platform.

Combine in-memory processing with an enterprise data warehouse to harness Big Data and boost performance at the speed of thought.

By means of Big Data, government organizations can:

- Use self-service & automated analytics that do not require tech skillsets
- Access, secure data sets from analytic tools that work together
- Manage controls & compliance & limit display of sensitive information
- Share information & work together to quickly solve policy issues
- Garner Live, predictive real-time insights
- Virtualize data across a logical Big Data warehouse and gain insight without moving data
- Use predictive analytics to anticipate future events and achieve better outcomes

- Gain location-based insight by analyzing massive amounts of spatial data in real time
- Analyze streaming data in real time – and take immediate action
- Combine Big Data with mobile to deliver anywhere, anytime business intelligence
- Leverage text analytics to uncover actionable insights in unstructured data
- Use high-impact data visualizations to share insights and facilitate faster decisions
- Engage with your constituents effectively – and individually – using insights from Big Data
- Identify and address potential fraud, waste and abuse before it happens by uncovering patterns in Big Data.

Know how

In order to better use data as a resource to positively change people's lives, organizations need to embrace a collaborative mindset and share data across departmental silos. They need to work together using real time and historical data with little or no support from IT and data scientists. With Big Data solutions you can have a comprehensive – yet simple – integrated platform that helps unlock the real value in data for smarter decision making.

Big Data

In order to provide citizen services, protect society and make the economy prosper; public sector organizations must fuse data with analytics that understand and can recommend decisions that will focus government on outcomes. It must be able to enable government stakeholders to take advantage of predictive analytics to confidently anticipate what comes next and guide more forward-looking decision making. The foundation should be a flexible, secure, real-time innovation platform that makes all this possible. Big data platforms enable instant processing of vast amounts of data so insights can be instantly acted upon to impact constituents quality of life.

Further Information

Big data solutions can help government organizations to deliver greater value to your constituents. Organizations can better execute strategy through increased organizational alignment, agile planning and analysis, and increased transparency and accountability. Our solutions are designed to let you act in the moment by connecting and empowering people with live analytics.

By integrating governance risk and compliance activities into underlying processes you can ultimately strengthen data access, privacy and security.

The rewards are significant if government organizations are able to interpret massive amounts of data in real-time to boost real-time analysis, awareness, and prediction across a wide range of scenarios.

6.8.1 Anonymous Police Authority

Title	Modern technologies for evaluation of measurement data in the area of Internal Security
Company	Anonymous security authority
Challenge	<p>Caused by the digital transformation, the public sector faces new challenges. With the help of modern technology new possibilities are available for these challenges. E.g. the claim of the citizens towards the municipality in terms of simple e-services executing regulatory processes is changing. Multichannel solutions in application platforms can help to meet such requirements. Due to cyber criminality, agreements on committing crimes, etc., especially in the area of Internal Security require an investment in modern technologies for defense and the investigation of crimes. More traces are left by the increasing use of digital media. These traces can be used to convict perpetrators or to recognize patterns to initiate individual patterns. The present case in context of Big Data and the Public Sector is related to the segment of the security authorities. Nowadays, criminality leaves important traces through modern media and technology. These need to be analyzed efficiently to ensure a reliable investigation and argumentation. This situation is a not only a German, but a global problem. In Germany federal facilities are responsible for the Internal Security. For these the present case is relevant.</p> <p>During investigative procedures of a case several data medium with possibly more than terabytes of data volume are seized. Moreover, the data is stored in different formats on the medium. Structured and unstructured data needs to be analyzed. The appropriate Forensic experts store and interpret the information. A special forensic software produces an image of the data medium. Thanks to the underlying functions data can be filed in way, which facilitates making the data usable for courts.</p> <p>More relevant data can be found by analyzing telephone, communication and radio wave data. Also, social media is focused more and more. If social media is involved to solve a crime, then it can be classified as Big Data.</p> <p>The analysis of the images is very time-consuming and mostly only forensic experts are able to carry them out. Investigation procedures can be finished before all the data is analyzed completely. In this case relevant data (e.g. social media data) cannot be used and correlated for the investigation. Moreover, the volume and the complexity of data will increase in the following years. Telephone or communication data, which is relevant to show networks and to detect connections, will be necessary for evaluations.</p> <p>Due to the fact that we are talking about Big Data modern technologies are required to reach target-orientated results and information.</p>
Solution	<p>The aim is to combine data container from forensic applications and to replicate them in an in-memory data base while gathering further information for correlations. This powerful database is a forensic analysis platform, which is able to analyze a huge amount of seized data medium. In addition, further functions within the platform are required to carry out the analyses. Correlations of information from different data sources get possible. The involvement of various data sources makes new investigative findings possible. The analysis platform can interpret structured and unstructured data and takes temporal, special and content-related information into account. The evaluation of Big Data is realized by correlating data from different sources.</p> <p>The analysis of several terabytes of information is day-to-day-business. Modern technologies enable textual, geo-visual and predictive analyses. E.g. the technology checks the meaning of texts in social media automatically. The system understands the context of the information and evaluates it as relevant (positive or negative). By means of the examination results the data base is expanded and the system gets trained.</p> <p>In the present case relevant digital information is checked automatically and can be used for the investigation of the crime.</p>

6.8.2 Disaster Management – Stadtentwässerungsbetriebe Köln (Municipal Drainage Cologne)

Title	sd-kama – Smart Data Disaster Management
Company	Stadtentwässerungsbetriebe Köln, AöR Ostmerheimer Straße 555 51109 Köln Contact Person and Consortium Leader: geomer GmbH Dr. Stefan Jäger sj@geomer.de +49 6221 89458-40 www.sd-kama.de
Project Partners	geomer GmbH (consortium leader), the German Aerospace Center (DLR), Fraunhofer Heinrich Hertz Institute, Software AG, Stadtentwässerungsbetriebe Köln, AöR
Challenge	Despite technological progress, flooding cannot be prevented – be it due to thaw, long and strong rainfalls or inclement weather. When nature shows its full force, it can often mean disaster for residents in river basins. One reason for this is that there is no current and comprehensive picture of the situation in the affected areas, for example in terms of the extent and intensity of the flooding. Reports of dam failures only trickle in slowly. The damage to buildings and the risks for their inhabitants are unknown. Destroyed infrastructure forces rescuers to take detours. The emergency personnel also lack reliable information. This can lead to a poor assessment of the situation on the ground and result in them not reacting quickly and effectively enough.
Solution	The sd-kama project is therefore developing a geo-intelligent and real-time information system that enables targeted disaster management. It is intended for all those involved in preventive measures and active disaster management, such as rescue workers or the authorities. The focus is on the emergency task forces in charge of professional and volunteer emergency responders. The special feature: sd-kama systematically collects and analyses all relevant information from various data streams. The result is a complete picture of the situation in the disaster zone that shows both the area and the people that are affected. At the same time, sd-kama only extracts information that is relevant for the crisis teams and operation controllers.
Business Value	sd-kama enables teams to better assess risks, make the right decisions and coordinate forces and resources efficiently. Another advantage is that sd-kama looks into the near future. The system compares various flooding scenarios created by existing systems and combines them in a simulation that can predict the future course of a flood more precisely than it was possible before. This enables team leaders to make decisions based on more accurate forecasts and enables them to prepare earlier and better. We are looking at two specific developments: first, creating an open architecture so that sd-kama can be used not only in Cologne and on the Rhine, but in other regions too. We are also planning to open the app to private volunteer helpers. The floods on the Elbe and Danube showed that volunteers can make very meaningful contributions to crisis management. It would also be possible, as a service provider, to make all of the information available to external users. sd-kama could report impassable roads – in a similar way to satnav systems that provide warnings about traffic jams. Logistics companies and service providers, such as taxi drivers, could also benefit from this.
Governmental R&D program	A Smart Data Programme Project of the Federal Ministry for Economic Affairs and Energy



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6.9 Other Branches

6.9.1 Big Data-driven Marketing – ProSiebenSat.1 Media

Company	ProSiebenSat.1 Media AG Medienallee 7 85774 Unterföhring Big Data-driven Marketing: Which measurable influence does television advertising have on online behavior? ProSiebenSat.1 provides facts with Big Data and Data Science.
Challenge	On the one hand ProSiebenSat.1 Media AG sells classic TV advertising and on the other hand it is involved with several e-commerce companies. This involvement includes amongst others air time for commercials promoting the e-commerce offering. Thus ProSiebenSat.1 takes great interest in systematically identifying precisely which share TV commercials have in the value creation of an advertised e-commerce company. How many users visit an e-commerce website because of the TV commercial? And how much turnover do users who verifiably visited the website due to a TV commercial generate in a certain period of time? Using a Big Data approach, we developed a method to measure TV influence on website traffic.
Solution	A Hadoop cluster containing collected traffic data was available from a previous joint project by inovex GmbH and ProSiebenSat.1. This cluster was used by the inovex data science team for analytic purposes. An agile implementation ensured that all challenges that typically accompany an innovative project could be solved in time and in budget. The first stage of the solution already is in productive use. Further stages are currently developed in a proof of concept phase. Standard solutions for the analysis of web traffic cannot relate events from outside the internet – such as broadcasts of TV commercials - to online behavior. This is why ProSiebenSat.1 decided to apply a custom big data solution.
Business Value	<ul style="list-style-type: none"> ▪ Meaningful, measurable proof of the economic value of TV advertising for the promotion of e-commerce offerings ▪ Creating predictions for the efficiency of planned TV advertising ▪ Optimizing media planning for TV advertising, most efficient use of marketing budget
Innovation	Based on our current state of knowledge ProSiebenSat.1 pioneers big data aided advertising evaluation with this project, connecting online and TV effect analysis for the first time. As yet no comparable implementations have been published in the media industry. <ul style="list-style-type: none"> ▪ Using the existing big data pool to answer business relevant questions ▪ General validation of TV advertising impact ▪ Comparability of TV and online advertising impact ▪ Specific objectification of the advertising services ProSiebenSat.1 offers its e-commerce partners in joint ventures ▪ Strengthening ProSiebenSat.1's position in the market against its competition
Prospects	ProSiebenSat.1 places itself as the leading data hub for TV analytics. In this context several big data and data science initiatives are planned or already in development, such as. <ul style="list-style-type: none"> ▪ App tracking ▪ Synchronizing TV and online advertising campaigns ▪ Integrating weather data.
Big Data Provider	inovex GmbH Ludwig-Erhard-Allee 6 76131 Karlsruhe F.R. Germany Contact: Dr. Lars Perchalla Head of Data Science lars.perchalla@inovex.de



6.9.2 Insurance

Competition situation, leader

The insurance industry is a key sector in Germany and well reflected in shaping the future having major overlap to business and trade. The entire German insurance market is divided into producers and risk holders of the direct insurance and reinsurance, providers of solutions, products, advice, information and (assistance) services as well as customers who are listed within the primary insurance policyholders. Insurance holders can be private persons or public institutions, commercial enterprises or larger industrial trusts. The mainly unregulated global reinsurance market is a submarket that shows specific features given the characteristics of the reinsurance industry. The direct insurance market includes, private businesses and public law-governed insurance businesses, which are overseen by the BaFin, with a total of 428,1 million contracts and a revenue of €193,8 milliards during 2015. The German global players are: Allianz SE, Munich Re Group and Talanx AG.

In Germany all insurances comply with the principle of branch separation. This includes the life assurance and the health insurance as well as the damage and accident insurance. The latter are share companies, insurance associations based on mutuality and public law insurances. In addition, there are European joint stock company insurers, abbreviated SE, with head offices in Germany which essentially have a European wide business activity. In Germany the sales of insurance solutions can be carried out by company owned divisions, company linked divisions or independent partners.

These are primarily, representatives holding exclusivity, agencies, general representatives, larger dealers and dealer pools, but also innovative digital Start-ups companies acting as aggregators (through internet platforms), for selected products or as »disruptors« offering the entire product range.

After the deregulation in 1994, a high-class functioning insurance industry has emerged in Germany. For the future the limits of insurability can also be expanded to include new modern products. For this highly complex market this expansion is nonetheless achievable as there is a very large group of graduates, very well trained and highly skilled academics, and specialized insurance employees.

A further aspect concerns the individually installed internal control and management systems which are complemented by GDV sector initiatives to which each insurance company has (voluntarily) agreed, such as the code of conduct for data protection or the code of conduct for distribution. They belong to the strict compliance demands and result in sophisticated quality-driven product differentiation.

Challenge

The world stands before mighty geographical, demographic and political changes. The insurance industry is particularly a section exposed to these change. Therefore the sector is called on and feels obliged to accompany people and industries with their life planning respectively commercial activities, to give advice and consequently to continuously and proactively adapt its own business model and to renew it adequately and evolutionary.

A significant recent challenge for the German insurance market results from the »zero interest rate policy« of the European Central Bank (ECB). The industry wide challenges to further improve customer satisfaction within a global mass individualisation to make products simpler and more transparent and to relieve customers from pain-points is achievable. As of beginning 2016 worldwide operating internet enterprises, like Google, are (still) resisting to enter into the German insurance market as a risk carrier and product supplier.

A decisive aspect however is: who owns and takes the customer interface? To keep the ownership, each insurance company must indicate to what extent it can develop and supplement its core business with outside- branch business and services. Such a development has already happened in other markets (e.g., transport and mobility).

In a nutshell: All customer contact points of the customer circles are to be linked up. Fundamentally, the use and application of Big Data expert's assessment are based on the integration and combination of internal and external data sources and data streams of different kinds. From this one can derive new value added insights by applying novel technological and analytical tools. As a result a high potential of new prospects appear for the core business.

From Big Data new opportunities emerge for individualized marketing and distribution. They result through the integration of social media, location, and demographic data with own data obtained from insurance contracts and customer stock as well as real time data transparency from controlling and customer stock. Moreover Big Data methods can be invoked for mastering IT security and the development of new products (e.g., Cyber Risk coverage).

Technology promotion, innovation, knowledge transfer

In the German insurance industry the promotion of professional and technical innovation as well as knowledge transfer are provided through an architecture composed of traditional and modern pillars and carries as well as information platforms such as conferences. They include regulators (BaFin), specialized bodies (GDV, associations of the various classes of insurance) and a number of research centres, higher education institutions and academies which provide teaching and research in the areas of insurance business studies and law, finance and actuarial sciences as well as business IT, mathematical economics and statistics. Moreover, there are numerous scientific associations (e.g., DAV, DGVFM, IVS, VVB, German Insurance Science, various support groups, research organizations, forums, spin-offs from universities), independent industry initiatives, and education and training institutions.

From a private-sector position, there is a strongly competitive market for services for insurers in B2B and B2C in the areas of strategic, organizational, functional and technical consulting, market research and system integration of hardware and software for insurance companies.

Common Big Data projects

Common Big Data projects, which have highlighted the importance and potential benefits for the insurance industry, are carried out by selected research centres and scientific associations. The contributions of the German Actuarial Society e.V. (DAV) and the German Society for Insurance and Financial Mathematics (DGVFM) are of particular importance.

The DAV working party for digitalizing, Big Data and Cloud Computing (short: DBC) is engaged in the »21st century world currency«. Digitization and Big Data are also the main topics of the 2016 DAV members' meeting.

Beyond its activities in the field of education and training and the promotion of young talent, and as a professional organization operating in the German science and industry covering the fields of insurance and financial mathematics and the quantitative risk management mathematicians, the DGVFM is particularly concerned the transfer of current research results into actuarial practice.

To unify all its diverse activities under a leading theme, the DGVFM union has set the following »Topic of the Year« for 2016: »Big Data in the insurance sector-algorithms, analysis and statistics«. The subgroup of insurance mathematics of the German Association of Insurance Science is also focusing on the very same topic. Additionally, the insurer forum Leipzig GmbH is currently investing in the creation of an insurance innovation lab.

Summary

Companies that aim to succeed are those that look out for the appropriate environment; and if they cannot find such, they generate them themselves (as suggested by George Bernard Shaw).

Big Data is one of the most powerful levers that the insurance industry is just beginning to use.

The slogan is: Depart from traditional data collectors and risk carriers and embrace modern and innovative risk consultancy for customers in a world of »Internet of Everything«. The insurance industry will be appreciated for Big Data applications and information technologies in a similar manner as the reputation which it possesses in trade and industry. Currently, the range of specific interventions is rapidly growing.

6.9.3 Telecommunications Industry

Competition and key drivers

The telecommunications industry in Germany is very diverse and there are about more than 100 telecommunications providers active in Germany. They address the many dimensions of the telecommunications market providing fixed and mobile network connectivity and are also the backbone of the digitization infrastructure of Germany. Besides numerous local and regional communication service providers, 3 mostly internationalized organizations like Deutsche Telekom with a high focus on Middle and Eastern Europe, Vodafone as a global player and Telefónica with a very international setup across Europe and the Americas are present. The market is highly competitive and beyond the core networking business, new business models around IoT/Industrie 4.0, cloud and industry platforms are emerging as well as new over-the-top players have significant influence on the business of the telcos. Telcos are at the forefront of digitizing their core business. All telco companies are under high pressure to improve their customer experience and need to completely redefine their relationship with their customers to keep or extend their business and they are developing new digital services which need to fulfill the needs of the B2C and B2B markets. Deutsche Telekom with its high focus on the best network in Europe and with its T-Mobile US business growing fast is the biggest telecommunications provider with German heritage. The strong combination of Deutsche Telekom as the network carrier plus its strategic IT- and Cloud Service Provider division T-Systems is a stronghold against the competition and differentiates Deutsche Telekom from many competitors. The regulatory environment of Germany and the EU and the adherence to the strong privacy and security regulations are key competitive drivers for German communications and cloud service providers (CSP).

Industry Challenges

On one hand all CSP'S are extending their business operations into new areas and new business models. On the other hand they are facing high investments into their core infrastructure because of the ever growing expansion of the network traffic. Strategic network planning and monitoring to drive the right investments and decisions at the right time is based on big data and analytics as a core capability discipline of the telcos today. The new business areas of the telcos in the Industry4.0/IoT space, their industry platforms providing services like Smarter Home/Smarter Healthcare/Smarter Cities are all data-driven business operations and telcos are providing new information supply chains to be monetized from the data gathered from things, machines, sensors, customers and intelligent processes. Big Data and Analytics is the key enabler of those new business areas. The telecommunications industry is at the forefront of capitalizing the knowledge of data, information and using big data, analytics and cognitive technologies in their core processes.

Technology facilities

As the telecommunications industry is really globalized and highly standardized, all telcos are working in international bodies to drive new standards and industry directions (e.g. TMF, IEEE, ITU-T, IETF, W3C). Telcos are attached very much to their ecosystem of partners and vendors in order to drive innovations technically and from an industry perspective. Research and technology development is happening globally today. Nevertheless telcos are also engaged in EU programs like Horizon 2020, Connecting Europe Facility to drive the digital economy and society forward. Because the telecommunications industry is extending its business far beyond the core networking side, especially programs and projects addressing the digitization of the industries has become focus of the telcos and they engage in those fields.

Innovations and knowledge transfer

Telco companies use their own core R&D capabilities to develop new business models, develop new strategies for innovations. A lot of core research and development is happening in the ecosystems of the industry with partners and vendors driving new innovations globally. Because its standardization across the globe, cooperation with standard bodies is also key and driven by all participants within the industry. Nevertheless as the industry is transforming fast and new trends are happening in the cloud and network business space, the software-defined everything paradigm is coming across new network clouds bringing NFV's (virtualized network functions), software-defined networks, compute and storage). Therefore telcos are also heavily engaged in opensource communities like Openstack and others.

In Germany we see a lot of cooperation happening with bodies like Bitkom, partnering with universities and research facilities like Fraunhofer Institute.

Driving innovation and knowledge transfer is happening via the open ecosystems of partners, global standard bodies and more and more via cross-industry engagements like in the Industry4.0/IoT, Healthcare, Smarter Cities and cloud space.

Big data

Cross-enterprise R&D projects and cooperations based on big data and analytics are in the early stages. Telco companies when they are engaged in setting up industry data lake type of structures and industry clouds will also drive more and more R&D in the big data and analytics areas in order to manage, monetize and deliver critical information supply chains for multiple enterprises or whole industries in the future.

Further information

Industry framework to drive big data and analytics into core processes of the industry and establish a digital ecosystem.

- <https://www.tmforum.org/strategic-program/big-data-analytics/>
- <https://www.tmforum.org/vertical-markets-connected-ecosystems/iot/>
- New innovations in communications / production / embedded environments
- <http://www.esk.fraunhofer.de/>
- Nationaler IT Gipfel
- <http://www.bmwi.de/DE/Themen/Digitale-Welt/nationaler-it-gipfel.html>

This is an important body of the German ITK industry and government to shape future trends and activities driving the digitization of the whole German society.

6.9.4 360 degrees view on customers – E-Plus Mobilfunk

Company	E-Plus Mobilfunk GmbH E-Plus-Straße 1 40472 Düsseldorf www.eplus-gruppe.de
Challenge	<p>As every telecommunication company E-Plus is confronted with constantly growing amounts of data, resulting for example from social media, mobile computing or web tracking. Exploiting this data and using it as a significant knowledge benefit and competitive advantage is a big challenge.</p> <p>With almost 26 million customers the E-Plus Group is Germany's third largest mobile communication company measured by number of customers. Since 2005 the company follows a very successful multi-brand strategy. By offering several clear and understandable brands and products, like BASE, simyo, blau.de, AY YILDIZ or Ortel Mobile, E-Plus is able to serve more individual customer demands than any other provider in Germany. With economically priced and tailor-made solutions E-Plus is one of the innovators of the branch. Back until 2009 the E-Plus Group used a data warehouse with more than 40 small OLAP cubes for analyzing their data. Due the lag of cross-linking between the single data sources an integrated view of the data was not possible. In addition the data were partial inhomogeneous and offered only few dimensions and a low level of detail. In the course of new tariff plans, distribution- and sales projects this solution was finally outdated.</p>
Solution	<p>In the first step E-Plus and ORAYLIS built a Business Warehouse (BWH), based on Microsoft BI on top of the existing Oracle DWH. Together with the established service provider the project »4th Generation BI« (4GBI) started 2 years later. Until 2015 all data sources had been united on one Big Data Platform by using a Microsoft Analytics Platform System (APS). During the implementation the focus was strictly on agile development processes.</p> <p>Beside the infrastructure, a new business culture as well as the build-up of internal BI- and Big Data knowledge was vital to the success. Therefore a BI competence centre with own budget was implemented as part of the controlling department of E-Plus. All employees have technical and functional skills and develop proactive ideas, discover new correlations of data and create new tools for the specialized departments.</p>
Business Value	<p>For many years E-Plus follows a very successful multi-brand-strategy. By having several clear and understandable brands and products, E-Plus is able to serve specific and individual customer demands. For this purpose the company uses the advantages of modern Business Intelligence. Modern Big Data solutions are offering complete new options for developing innovative tariff plans and customer related solutions. Accurate forecasts form a reliable base for future plans and investments. In addition internal processes are optimized and overheads are significantly reduced.</p>
Innovation	<p>The big data analysis provides full transparency of customer demands and their behaviour. The often quoted 360 degrees view on customers becomes true. At the same time prediction patterns and accurate analysis enable forecasts and measurement of success. This way performance can be scaled immediately after activation and irregularities can be discovered fast and efficiently by using fraud analyses.</p> <p>Knowledge of the clientele and segmentation of target audiences offer complete new possibilities regarding innovative tariff plans and individual offers. Generally the base of planning and decision making is now much more reliable. Internal processes have been optimized and overheads are reduced sustainably.</p>
Prospects	<p>In the future data from external sources will be integrated into the analysis model. The focus is clearly on social media platforms like Facebook and Twitter. In addition portals and mobile access will be extended and professional competence will be consolidated. User guidance will be optimized for enabling specialised departments to run their own analyses.</p>
Big Data Provider	<p>ORAYLIS GmbH Business Intelligence Klaus-Bungert-Straße 4 40468 Düsseldorf www.oraylis.de Contact: Eicke Schütze e.schuetze@oraylis.de +49 211 179 456-127</p>

E-PLUS GRUPPE



6.9.5 Digital Transformation in Aviation – #zeroG

Company	#zeroG A Company of Lufthansa Systems Am Prime Parc 1 65479 Raunheim Peter Ahnert Managing Director peter@zerog.aero
Competitive environment/ Driving factors	<p>#zeroG is a 100% subsidiary of Lufthansa Systems. Consequently, the airlines of the LH Group are key customers for us. Lufthansa Systems is a partner of more than 300 airlines worldwide when it comes to data driven products for the aviation industry (e.g., flight planning, network planning, crew management, etc.). The already established business relationships give #zeroG direct access to many senior executives of major airlines around the globe. Our focus on aviation, the data universe found in almost any airline allows us to offer shorter times to market for new data driven initiatives and products.</p> <p>The airline industry is beginning to undergo a digital transformation. Many airlines already started a number of digital initiatives, some set-up true transformation programs. As these activities require a lot of experience, knowledge and skills, which the airlines are lacking, the demand for advice and solution competencies is growing continuously.</p> <p>The number of passengers is growing significantly over the past few years. The airline business is at the same time a low margin business. Hence, the importance of a digital strategy has grown and will continue to grow in the next years. Airline executive have noticed that new data driven products can extend the revenue base of an airline while increasing customer satisfaction and in the end customer loyalty with an airline - way beyond classical bonus programs. Digitalization also allows for automation of tasks increasing the operational efficiency.</p>
Challenges	<p>Finding the right talent is becoming more and more difficult as technical or mathematical knowledge alone is not enough. It is the rare combination of technical skills, people skills, domain knowledge, business knowledge, and creativity. We are focusing on interdisciplinary teams working on a big data or strategy engagement instead.</p> <p>Many processes in the aviation industry generate data which is not being used or stored in data silos across the whole enterprise. Integrating this data while following the data privacy rules is a key enabler for optimizing processes and the creation of new data driven products – some of which will be offering new services directly to customers with a high degree of automation.</p>
Big Data strategy/ initiative	<p>#zeroG is a unique combination of people with a deep understanding of any aspects in the airline world. We focus on balancing the experience and innovation by hiring talented people who add new views on what digitalization means for the airline industry. We think Big Data from the business perspective and our holistic approach ensures that big data analytics will have a positive impact on our clients business.</p> <p>We aim for board support for the digital transformation and the associated projects as the digitalization will transform almost every part of the business. When it comes to project delivery within the strategy, we follow an agile approach of interdisciplinary teams with all the required subject matter experts directly involved in the delivery. This allows for an iterative approach with sub-releases of minimum viable products which will be extended step-by-step towards the target solution picture.</p> <p>We successfully delivered the conceptual and technical approach architecture for customer centric big data projects for a major German airline. Furthermore, we are currently shaping the digital strategy for multiple other airlines in Germany and Europe.</p>
Governmental R&D programs	<p>The Open Data movement is supporting a »data driven thinking« within airlines and is triggering the publication of data to the external world and inviting people to use and work with that data.</p> <p>Big Data research programs are helping us today via our research partnerships, e.g. in the areas of privacy preserving data mining or the semantic web.</p>
Innovation/ Knowledge transfer	<p>R&D cooperation are key to our long strategy as new data driven products require touchpoints which allow for next generation of employee and customer interactions. The mobile channel is of significant importance when it comes to customer interaction.</p> <p>We strongly believe in a close cooperation with our clients as the digital transformation and sub-projects based on the digital strategy of an airline can only be successfully deployed in short timeframes and multiple iterations, if cross-company teams are being formed who can take over responsibility in the long run.</p>



6.9.6 Digitized Farmland: Precision Farming thanks to Big Data

Agricultural sector in Germany – trends and challenges

The agricultural sector is one of the world's key industries in terms of growth and future significance. As a result of world population growth and limited fossil fuel resources, it will become even more important in securing food supplies and sourcing energy from renewable raw materials. The agricultural sector in Germany comprises around 270,000 businesses employing 600,000 workers and is a major part of the German economy, producing goods worth more than 50 billion euros every year. Productivity in agriculture has virtually doubled in the last 20 years, while at the same time manpower levels have gone down by more than 80 percent. In the last five years labor productivity in German agriculture has risen more sharply than in any other sector of the German economy. Nevertheless, the sector is under immense economic pressure – mainly due to the severe decline in producer prices.

Since upstream suppliers, such as seed or machinery manufacturers, for example, as well as the food industry and retail trade, are working to optimize their products and services using cutting-edge technologies, agricultural businesses cannot shut themselves off from technological developments taking place in the sectors in which their suppliers and customers operate. Whereas most investment in the past went into machinery, the focus is now shifting to ways of networking work processes and the exchange of data associated with this: starting with business management, compliance with accountability obligations in relation to public bodies, optimization of logistics and goods distribution systems, communication with processors and the retail trade, through to the systematic provision of quality information to end users. Close collaboration with service providers such as contractors and farm machinery syndicates also means there is a greater need for data exchange and cooperation. For it is their services that enable farmers to make optimal use of production equipment, e.g., harvesters. It is always a challenge to make the best use of machinery in situations where the weather plays a vital role and time is of the essence, like the harvest, or to deploy special technology to work the fields.

Evolution of precision farming

In the same way that industrial firms are working on their own digitization under the slogan »Industry 4.0,« the agricultural sector is focusing on the topic of »Farming 4.0« or »precision farming.« This relates to processes involving the site-specific, targeted management of agricultural land. One example is the use of soil sensors that help determine the right time for sowing, fertilizing and irrigating. The sensors record relevant environmental information, such as sunshine duration and soil moisture levels up to a depth of 40 cm, and send it to the cloud in real time. The data is then processed directly and sent back to the farmer and GPS-guided machines, which are partially automated and accurate to within a centimeter. Not a single square meter is covered twice, saving the farmer valuable time and resources. Small-scale inventory management of crops and soil facilitates more targeted sowing and fertilization. This leads to savings in resources and less ecological damage due to the reduced use of herbicides and mineral fertilizers. State-of-the-art technology also protects wildlife: drones with thermal

cameras detect deer and hares in the field, sending warnings before any animals are harmed – which also prevents damage to the harvest. Precision farming also allows the use of »digital maps« in farm management for planning future farming measures or providing public bodies with proof of measures already implemented as part of agricultural development activities.

Security issues and data protection

With »Farming 4.0« leading ICT companies have introduced the German federal government's high-tech strategy into agriculture and together are succeeding in demonstrating how logistics can be extensively orchestrated in the field. From the combine harvester grain tank that can monitor itself and request the next transport vehicle, to logistics solutions offered by the transportation company or a food producer's production planning system, consistent processes are being created and a transparent exchange of information is taking place that also takes into account strict data protection requirements.

An enormous volume of data can therefore be collected along the entire agricultural value chain. However success is not guaranteed by the quantity of data alone: analysis of the data is crucial here. Processing large volumes of data into useful information creates clear competitive advantages. Big data analyses of structured and unstructured data form the basis for quicker and better decision-making. Big data helps farmers to work proactively and with some degree of automation, enabling them to put digitization to ideal use. Fears that farmers' data could fall into the wrong hands (for example speculators, who could use the data to draw conclusions about the harvest, giving them advantages in stock market dealings) are the reason why some farmers still have reservations. Therefore if agriculture wants to digitize itself successfully, it needs a comprehensive security concept. Data protection is a top priority, but so are secure and encrypted communication channels. To combine the vast number of different data sources and, for example, supplement local data with earth observation and weather data provided by researchers, high-security cloud infrastructures have to be created and brought together in communities as and when appropriate. If these conditions are met, big data can also provide the basis for extensive and sustainable precision farming.

6.9.7 Consulting

»Made in Germany« is not only a seal of approval for goods produced on German soil, but is a distinction for its consultancy services as well.

In the maturing field of Big Data Consultancy, being a trustworthy, experienced and competent partner for clients is a key success factor (Bitkom, 2015). Although trust in consultancy originates from brand, personnel and standing of the individual consultancy firm, there are also unique characteristics which can be generalised for Big Data Consultancies based in Germany.

These characteristics are created by values and specific expertise, which are unique due to Germany's history, professional culture, economic structure and legal environment.

Longevity, thoroughness and precision in advising clients

The majority of Germany's consultancies is part of its famous »Mittelstand« (SME) (Der Mittelstand ist Deutschlands Geheimwaffe, 2014) and share the same values as their peers in the production sector. In order to survive international competition, they strive for customer intimacy by adhering to typical German ways of doing business. Three words, which are difficult to translate, characterise the way German Consultancies advise their clients: »Langlebigkeit« (longevity), »Gründlichkeit« (thoroughness) and »Präzision« (precision). These characteristics, based on a distinct professional culture, result in maintaining longstanding relationships with clients and enabling them to excel in applying Big Data.

Masters in Industry 4.0

Industry 4.0 is one of the key areas where Big Data Consultancy is internationally at the forefront. German government and industry realised that Industry 4.0 is essential to remain its position as a leading industrial nation. The associated digital transformation of industry was urgently required, leading to an intense national cooperation between research institutions, industry and other stakeholders (Industrie 4.0 hat die Fabriken erreicht, 2016). Consultancies play their part in the digital transformation of Germany's production sector and are actively involved in the aforementioned initiatives. As a result, the consultancy methodologies in the field of Industry 4.0 are backed by a solid scientific knowledge background. Combined with a longstanding experience consulting in industry makes German consultants among the masters in Industry 4.0.

Security aspects are of utmost importance

In order to remain a sustainable competitive advantage in an industrial environment, the information acquired by Big Data applications needs to be secured in such a manner that industrial espionage is prevented (Mit Industrie 4.0 steigt das Angriffsrisiko, 2015). German consultancies seasoned in an industrial environment are very aware of the importance of security and the essential role it plays in retaining a sustainable competitive advantage. Security aspects are therefore of the utmost importance to German consultants.

Strong sensibility for privacy issues

The cultural and legal environment in Germany is very sensitive for privacy issues; firms in Germany uphold high standards concerning privacy, a standard which is shared by German consultants. German consultancy therefore manages to remain a fine balance in applying Big Data in an economically sound and profitable manner, while at the same time having a strong appreciation of privacy aspects.

6.9.8 Sports – Gaining a Competitive Edge by Exploiting the Digital Transformation

Competition and key drivers

Athletes and teams work to gain a competitive edge. When they find something that works, the competition copies it. The playing field is then leveled and the cycle starts again. Yet something new is happening in sports that offers the possibility of a competitive edge that is tougher to copy. The sports industry is experiencing a massive digital transformation centered on the capture, real-time analysis, and utilization of (big) data. Traditional methods in athlete management, scouting, health, fitness, training, development, game execution, and compliance are all being transformed by the digitization of sports. The result is the »digital athlete.«

Complexity Alert

New data collection technologies are hitting the market at a rapid rate. Most devices are point solutions that have a specific purpose – from heart or load monitoring to health and nutrition information. As devices become mainstream, they will provide massive amounts of data on every individual athlete. Unfortunately, the information captured is unique to each device and stored independently. This results in data silos from the multitude of devices that are not linked. Therefore there is little transparency across all facets of the athlete's performance. The problem gets worse as you utilize these technologies across an entire team or association. There is no consistent way to turn mass data into smart data, nor clear responsibilities for data ownership or security. This creates complexity.

Complexity is a barrier to gaining a competitive edge. Time is precious in sports. Schedules are demanding, and the pace is relentless. There is little time between events to scout and prepare for the next opponent or engage with the athlete. You can't afford to waste time manually sifting through scattered data locked in silos. Answers and insight are needed immediately. Speed and efficiency are critical to gaining a competitive edge. You can't reschedule just because you're not ready.

The Digitization of Sports

Five technology trends are transforming athlete performance:

- hyperconnectivity,
- supercomputing,
- cloud computing,
- a smarter world, and
- cybersecurity.

Leading sports organizations are determining how to best leverage these technologies to gain a competitive edge. New innovations enabled by the real-time data collection from wearables, sensors, and video are hitting the world of sports at a rapid pace. These offer exciting opportunities for athletes, teams, leagues, and associations to collect data on an athlete and team at unprecedented levels.

Innovations and knowledge transfer

The answer is simple – Make sense of the data. Running simply requires reimagining athlete and team insight by having a deep, unified view of an athlete and team across all data sources. It's when you can process vast amounts of athlete and game data in real time to get immediate answers. It's when you have a platform that integrates all facets of team operations, enabling you to work smarter so you can spend more time on the field and less on administration. An integration of all of the applications and data sources across the team in real time enables you to gain key insights from the sea of data being collected on the athlete.

Big Data

Act on it in real time to deliver an impact. The foundation of the digital athlete is a flexible, secure, real-time innovation platform that makes all this possible – SAP HANA. In-memory technology enables instant processing of vast amounts of data so insights can be instantly acted upon to impact athlete and team performance.

The Future

From wearables that collect athlete data to mobile apps for athlete engagement, everything in sports is going digital. As a result, industry leaders are supplementing observation and gut feel with data to make better-informed decisions. This will quickly become the norm as more positions are filled by the »connected generation.«

IT is increasingly becoming a match winner in the world of sports. Clubs can engage their fans and audiences even more, improve their team's and player's performances, and strengthen their marketing and business streams.

- 77,7 million Data points are captured and processed within one hour of football (soccer) training.
- 99,9% time compression of content required for team presentation in order to prepare for a match (6,000 minutes of generated content down to approximately eight minutes).
- 7TB uncompressed data generated during a single major league baseball game. At 2,430 games per year, that's 17 petabytes of raw data per.
- 173 million IDC estimates that wearable device shipments will reach 173,4 million units by 2019, up 500% in just five years.
- \$125M to \$4,7B Growth of the sports analytics market from its current level to 2021.

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8 Abbreviations

Abbreviations	Meaning
ACI	Application Centric Infrastructure
AIOTI	European Alliance of the Internet of Things
AISEC	Fraunhofer Institute for Applied and Integrated Security
ANZ	Australia and New Zealand
APAC	Asia and Pacific
API	Application Programming Interface
B2B	Business to business
B2C	Business to customer
BaFin	Bundesanstalt für Finanzdienstleistungsaufsicht / German Federal Financial Supervisory Authority
BBDC	Berlin Big Data Center
BDCC	Big Data Competence Center
BDIC	Big Data Innovation Center
BDVA	Big Data Value Association
BEinCPPS	Innovation Action on Cyber Physical Production Systems
Bitkom	Bundesverband Informationswirtschaft, Telekommunikation und neue Medien e. V. / Federal Association for Information Technology, Telecommunications and New Media
BMBF	Federal Ministry of Education and Research
BMWi	Federal Ministry Economic Affairs and Energy
CEO	Chief Executive Officer
CEP	Complex Event Processing
CPU	Central processing unit
CSP	Cloud service provider
D&A	Data & Analytics
DACH	D (Deutschland), A (Austria), CH (Switzerland, lat. Confoederatio Helvetica).
DAV	Deutsche Aktuarvereinigung e.V.
DBC	DAV-Arbeitsgruppe zur Digitalisierung, Big Data und Cloud Computing
DFG	Deutsche Forschungsgemeinschaft e.V. / German Research Foundation
DFKI	Deutsche Forschungszentrum für Künstliche Intelligenz / German Research Center for Artificial Intelligence
DGVFM	Deutsche Gesellschaft für Versicherungs- und Finanzmathematik
DLR	Deutsches Zentrum für Luft- und Raumfahrt e. V. / German Aerospace Center
DMP	Data Management Platform
DPA	Data Protection Agency
DT	Deutsche Telekom

Abbreviations	Meaning
E2E	End-to-end
ECU	Electronic control unit
ECU	Engine control unit
EDSA	European Data Science Academy
EDWH	Electronic Data Warehouse
EFFRA	European Association for the Factory of the Future
EIT	European Institute of Innovation and Technology
EMEA	Europe, Middle East, and Africa
EO	Earth Observation
ESA	European Space Agency
ETL	Extract, Transform, Load
EU	European Union
FIT	Fraunhofer Institute for Applied Information Technology
FMCG	Fast-moving consumer good
FOKUS	Fraunhofer Institute for Open Communication Systems
GDV	Gesamtverband der Deutschen Versicherungswirtschaft / German Insurance Association
GPS	Global Positioning System
GPU	Graphics Processing Units
GTAI	Germany Trade & Invest
GUI	Graphical User Interface
HCI	Human-Computer Interaction
HDE	Handelsverband Deutschland – HDE e.V.
HHI	Fraunhofer Heinrich Hertz Institute
HPA	Hamburg Port Authority
HPI	Hasso-Plattner-Institute
HVAC	Heating, Ventilation and Air Conditioning
I4MS	ICT Innovation for Manufacturing SMEs
IAIS	Fraunhofer Institute for Intelligent Analysis and Information Systems
IAO	Fraunhofer Institute for Industrial Engineering
ICT	Information and Communications Technology
IEEE	Institute of Electrical and Electronics Engineers
IESE	Fraunhofer Institute for Experimental Software Engineering
IETF	Internet Engineering Task Force
IIS	Fraunhofer Institute for Integrated Circuits

Abbreviations	Meaning
IML	Fraunhofer Institute for Material Flow and Logistics
IoE	Internet of Everything
IOSB	Fraunhofer Institute of Optronics, System Technologies and Image Exploitation
IoT	Internet of things
IPM	Fraunhofer Institute for Physical Measurement Techniques
ISST	Fraunhofer Institute for Software and Systems Engineering
ISV	Independent Software Vendor
ITU	International Telecommunication Union
ITU-T	ITU Telecommunication Standardization Sector
IVI	Fraunhofer Institute for Transportation and Infrastructure Systems
KIT	Karlsruhe Institute of Technology
KMU	Kleine und mittelständische Unternehmen / small and medium enterprises
KPI	Key Performance Indicator
KSRI	Karlsruhe Service Research Institute
LT	Language Technology
M2M	Machine to Machine Communication
MACSS	Medical Allround-Care Service Solution
MEP	Mission / Sensor EO Platforms
MRT	Magnetresonanztomographie
NA	North America
NCT	National Center for Tumor Diseases
NESSI	Networked European Software and Service Initiative
NFC	Near Field Communication
NLP	Natural language processing
OEM	Original Equipment Manufacturer
OLAP	Online Analytical Processing
QR	Quick Response
RFID	Radio-frequency identification
ROI	Return on Investment
RSS	Really Simple Syndication
RTLS	Real-Time Locating System
RWTH	Rheinisch-Westfälische Technische Hochschule / RWTH Aachen University
ScaDS	Competence Center for Scalable Data Services and Solutions
SCAI	Fraunhofer Institute for Algorithms and Scientific Computing

Abbreviations	Meaning
SCC	Steinbuch Centre for Computing
SDE	Software Defined Environment
SDF	Smart Data Forum
SDIL	Smart Data Innovation Lab
SDN	Software Defined Networking
SDSC-BW	Smart Data Solution Center Baden-Württemberg
SDSP	Smart Data and Service Platform
SFB	Sonderforschungsbereich / Collaborative Research Center
SKU	Stock Keeping Unit
SLA	Service Level Agreement
SMACK	Spark, Mesos, Akka, Cassandra, and Kafka
SME	Small and medium enterprise
SPL	Smart Port Logistics
TCO	Total Cost of Ownership
TDWI	The Data Warehousing Institute
TEP	Thematic Exploitation Platforms
TU	Technical University
UCC	University Competence Center
UI	User Interface
USP	Unique Selling Proposition
VDA	Verband der Automobilindustrie e. V. / The German Association of the Automotive Industry
VDE	VDE Verband der Elektrotechnik Elektronik Informationstechnik e.V. / VDE Association for Electrical, Electronic & Information Technologies
VDI	Verein Deutscher Ingenieure / The Association of German Engineers
VDMA	Verband Deutscher Maschinen- und Anlagenbau / German Engineering Federation
VW	Volkswagen
W3C	World Wide Web Consortium
ZVEI	Zentralverband Elektrotechnik- und Elektronikindustrie e.V. / German Electrical and Electronic Manufacturers' Association

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The Smart Data Forum strengthens connections and encourages knowledge exchange among smart data stakeholders coming from the fields of economy, politics and science, on the national as well as the international level. As an information platform, meeting point, and exhibition space, it demonstrates Germany's achievements in smart data. It offers a platform to raise the visibility of outstanding projects and companies, hosted in Germany.

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Bitkom represents more than 2,300 companies in the digital sector, including 1,600 direct members. With more than 700,000 employees, our members generate a domestic turnover of 140 billion Euros a year, exporting high-tech goods and services worth another 50 billion Euros. Comprising 1,000 small and medium-sized businesses as well as 300 start-ups and nearly all global players, Bitkom' members offer a wide range of software technologies, IT-services, and telecommunications or internet services. They produce hardware and consumer electronics or operate in the sectors of digital media and the network industry. 78 percent of the companies' headquarters are located in Germany with an additional amount of 9 percent in other countries of the EU and 9 percent in the USA as well as 4 percent in other regions. Bitkom supports an innovative economic policy by focussing the modernization of the education sector and a future-oriented network policy.

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