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Smart Data

Smart Data – Innovations in Data

A technology programme of the Federal Ministry for Economic Affairs and Energy (BMWi)

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Foreword

Data is the resource of the future. Today, it is collected and stored in all areas of life and business. The mountain of data is growing exponentially. The global volume of data is doubling every two years. In the mobile phone network we all use it is doubling every 18 months. This means we are already dealing with massive – and ever proliferating – amounts of data.

If we succeed in evaluating this data intelligently and comply with the principles of data diversity and data sovereignty, enormous potential for value creation can be generated – in particular for German small and medium-sized enterprises. Big data can become the driving force for innovative business models and products. The potential appears to be immense: Global turnover in big data solutions is expected to reach approximately 85 billion US dollars in 2026.

However, the intelligent and trustworthy use of this fast-growing data pool is not only a source of innovation and growth. It also raises important questions for businesses and consumers: How can the constantly increasing volume of data be analysed and processed efficiently? How can we ensure that data is used in a legally compliant way? What about the security and protection of what is often very sensitive data? When are anonymisation and pseudonymisation required?

Big data technologies are already becoming increasingly commonplace in many areas such as marketing and finance. In other fields, especially more regulated and sensitive areas such as industry, mobility, energy and health, targeted stimuli are required. With the "Smart Data – Innovations in Data" technology programme, the Federal Ministry for Economic Affairs and Energy is supporting 13 selected and pioneering demonstration projects that are developing innovative services in these specific fields within the European framework.

In addition, the "Smart Data Forum" will intensify international links with other big data initiatives and provide a demonstration and experience centre for smart data technologies from Germany. This will allow us to boost the broad use of intelligent big data technologies at an early stage.

The technology programme aims to develop the German market for smart data technologies, develop practical and secure solutions for their use, and thus assist small and medium-sized enterprises in particular in activities related to big data.

Let's rise to the challenge together!

Yours faithfully,

Sigmar Gabriel
Federal Minister for Economic Affairs and Energy

Smart Data – Innovations in Data

In the digital age, data is the resource for creating economic value. It is available in ever increasing amounts: By 2020, the global volume of data is expected to reach 40 zettabytes (1000^7 bytes). The reasons for this unprecedented growth include the increasing use of digital services such as social media and online streaming as well as the Internet of Things. The US-based IT consulting and market research company Gartner has identified three characteristics of big data that complicate its processing with traditional systems. These include the volume of data, its diversity and dimensionality – or variety – and the rate at which it is produced and processed – its "velocity".

The new methods and approaches employed by information and communication technology (ICT) to handle, analyse and interpret these quantities of data are summarised under the term "smart data". The market for such solutions has seen rapid growth in recent years and this is set to continue. Studies predict global turnover from smart data solutions will increase to more than 50 billion euro in 2017.

Germany has a good chance of playing a leading international role in these technologies. Established companies in the IT industry, numerous research institutions and many startups are already active in the smart data field. In many branches, such as finance and commerce, technologies for the economic utilisation of the data collected are also very advanced. Overall, the exploitation of smart data is still in its infancy, with the focus mainly on a few specific areas such as online advertising and e-commerce.

The approach of the technology programme

With the "Smart Data – Innovations in Data" technology programme, the Federal Ministry for Economic Affairs and Energy is making an important contribution to the broad development of this market in Germany. The technology programme follows the objectives of the Digital Germany 2015 ICT strategy, which was developed under the leadership of the Federal Ministry for Economic Affairs and Energy, and the forward-looking "Internet-based services for the economy" project within the framework of the federal government's High-Tech Strategy 2020.

The thirteen demonstration projects selected for funding are developing innovative services in four fields: industry, mobility, energy and health. The focus is on projects that aim to develop solutions tailored especially to the needs of small and medium-sized enterprises (SMEs) due to their straightforward data-security and data-quality functionality. This includes suppliers and users and is expected to reduce the technical, structural, organisational and legal barriers to the deployment of smart-data technologies for both. At the same time, the potential inherent to large volumes of highly dimensional data should be harnessed and the inevitable

risks associated with utilising such volumes of data should be made visible and manageable.

The Federal Ministry for Economic Affairs and Energy is funding "Smart Data – Innovations in Data" with approximately 30 million euro. The companies and organisations involved are providing a further 25 million euro. This means the programme has a total volume of approximately 55 million euro.

The technology programme focusses on the use of smart data in the areas of industry, mobility, energy and health. Its objective is to give impetus to the development of legally compliant, secure and viable solutions.

The fourth industrial revolution

Data can be used in industrial settings to develop and deploy autonomous systems that use innovative robotics and automation technology. Increasingly, customers' wishes and individual requirements need to be considered. The analysis and utilisation of data makes it possible to improve quality, optimisation and efficiency across corporate boundaries and enables customer-group-specific and individualised products to be manufactured. In smart factories, such as those being developed in the context of Industrie 4.0, all of the objects and products are individually identifiable, are locatable at any time, and continuously provide information about their condition. This allows value networks to be controlled in real time, but also requires that planning for factories, product development and production no longer be considered separately, but as an integrated, coherent process (so-called continuous engineering).

Mobility is becoming intelligent

In the mobility field, data from vehicles (eg. sensors and control systems) and infrastructure (eg. traffic management systems, roads, bridges) and their networking (Car2Car and Car2X communication, toll systems) play an important role. The data can be used for a range of purposes, for example to prevent traffic jams and collisions, or in personalised mobility concepts for specific target groups and the associated convenience services. New car-sharing concepts and charging infrastructure for electric vehicles are also data-intensive and require appropriate solutions.

From smart meter to smart energy

In the energy sector, the number of intelligent network components, smart electricity meters and networked smart-home appliances is growing rapidly and creating ever more data. Future areas of activity include the data-assisted integration of electricity from renewable energy sources, energy flow control and the prevention of voltage fluctuations and power cuts. This will be based on data analysis, consumption pattern recognition processes and demand prediction. Smart meters and smart grids enable new consumption and payment models (eg. real-time pricing) and allow different load profiles for residential, commercial and industrial customers to be identified and used to classify customer groups. They also offer new and comfortable ways of controlling electrical smart-home appliances.

Smart data in health

In the health sector, fields of application such as medical technology, health management, clinical research and biotechnology will benefit from smart data technologies. There are many potential applications in diagnosis and treatment, the organisation of patient care and in medical research in general. Big data solutions play a central role in individualised and case-specific therapeutic approaches. Likewise, crowdsourcing can be used to improve the provision of care or make patients' everyday lives easier. However, special data protection measures will be required in many of these scenarios.

The challenges of using smart data

Employing data meaningfully raises many new questions. While the economic potential of smart data should be harnessed, social acceptance is required. Three specialist groups address these issues across the "Smart Data – Innovations in Data" technology programme.

Acceptance by business and society

One of the key questions for smart data is how solutions can be made attractive for businesses and their customers in order to ensure successful implementation. Meaningful applications must first be found before new, economically attractive business models are developed for them. This is particularly true for small and medium-sized enterprises as they often do not have research and development departments that are able to recognise and exploit the potential of smart data.

Furthermore, social acceptance is an important prerequisite for smart data's wide use in Germany. In the end, new technologies come with questions and concerns. This is particularly true for smart data due to the use of data as a resource.

"The extent to which smart data is accepted by society depends above all on how the individual business models are perceived. Therefore, the various stakeholders in the economy, society and politics must work together closely on smart data solutions so that transparency, primarily, can be ensured. The 'Economic potential and social acceptance' specialist group is working on these very challenges," says Christof Weinhardt of the FZI Research Center for Information Technology, who leads the group and the programme's accompanying research projects.

Ensuring legal compliance

Exploring new technological approaches leads to new opportunities but also raises new legal questions. Ultimately, this is a field in which the legal boundaries have not yet been clearly defined. Nevertheless, legal compliance is absolutely essential to ensure the smart data innovations developed in the individual projects can be employed in practice without difficulties.

Dr. Oliver Raabe, director of the FZI Research Center for Information Technology and head of the legal framework specialist group, says: "The legal framework specialist group is helping to ensure the long-term success of projects by looking at things from a jurisprudential perspective at an early stage. Furthermore, we are also formulating recommendations for the sensible further definition of the legal framework. With our approach we want to contribute to the development of the legal principle of 'privacy by design'; in other words, the consideration of data protection at the design stage of a technology's development. The goal is a concept that enables data protection in an open society, which entails facilitating individual control over the knowledge obtained from data."

Security and data protection

The increased integration of smart data technologies in companies' value networks brings with it new security and data protection threats and challenges which conventional mechanisms cannot meet. Data protection must always be ensured. To this end, unwanted intrusions, such as data espionage or data manipulation, as well as IT infrastructure incursions and attacks carried out by internal perpetrators must be prevented.

"In the security specialist group we ask what level of security and data protection can be achieved when using smart data technologies without compromising the usability of the data. In this regard, we are working on application-specific security solutions that are tailored to the specific safety requirements. This is the only way to achieve a high level of protection that nonetheless allows smart data to be used," says Prof. Jörn Müller-Quade, director of the FZI Research Center for Information Technology and head of the security specialist group.

Support for networking and communication

The Federal Ministry for Economic Affairs and Energy (BMWi) has commissioned the FZI Research Center for Information Technology to carry out research to support the technology programme. The objectives of the accom-

panying research are to advise the projects being funded on the most efficient implementation of their initiatives, to network the individual projects, and to transfer valid results to the market.

The individual measures include the continuous and cross-project monitoring of big data technologies and their economic use in industry, the energy sector and mobility projects. In addition, the accompanying researchers are tasked with organising and moderating the specialist groups on cross-cutting issues such as data protection, data security, acceptance and new business models.

The accompanying research project manages the website www.smart-data-programm.de and provides an internal collaboration platform to facilitate coordination between the projects and thus support the exchange of knowledge in general. These measures are complemented by numerous events such as conventions and expert workshops. In addition, the accompanying researchers participate in relevant trade shows and promote networking with external actors such as associations and other initiatives.

Moreover, to ensure the long-term sustainability of the funding priority, the accompanying researchers elaborate concepts on how the links established during the lifetime of the project can be sustained and developed further after the funding period ends.

“Big data must become smart data”

Prof. Stefan Jähnichen leads the research project accompanying the “Smart Data – Innovations in Data” technology programme, which is being funded by the Federal Ministry for Economic Affairs and Energy (BMWi). He is the director of the FZI Research Center for Information Technology and teaches at Technische Universität Berlin.

Prof. Volker Markl is head of the Database Systems and Information Management Group (DIMA) at Technische Universität Berlin and the “Intelligent Analytics for Massive Data – Smart Data” research group at the German Research Center for Artificial Intelligence (DFKI). He holds a professorship at the School of Information at the University of Toronto. He is also is the director of the Berlin Big Data Center (BBDC) competence centre, which was set up by the Federal Ministry of Education and Research, and heads the Smart Data Forum, which is funded by the Federal Ministry for Economic Affairs and Energy.

Prof. Stefan Jähnichen and Prof. Volker Markl explain in an interview why big data is so important for Germany and what smart data means. They also describe the challenges faced by the “Smart Data – Innovations in Data” technology programme and the Smart Data Forum.

Data is increasingly referred to as a resource – as the oil of the 21st century. Is there any truth to this?

Stefan Jähnichen: We produce information every day in all areas of life, whether we’re at work, the doctor’s, the baker’s or behind the wheel – be it by smartphone, smartwatch or computer. This is text, image and sensor data. If we take into account the fact that we analyse, evaluate and utilise this data, then we can indeed consider information a resource. There is a tremendous amount of potential in these volumes of data – the big data.

According to the industry association BITKOM, big data is one of the most important high-tech trends alongside cloud computing and IT security. What makes the topic so current?

Volker Markl: As a result of digitalisation, the number of data sources and the volume of data available are growing. At the same time, networks are enabling new ways to access what are often very heterogeneous and distributed datasets. However, this data is neither information nor knowledge per se. Just like oil, data is a resource that has a variety of uses only after numerous processing and refinement steps. Big data is so topical because we now have the computing and storage capacities and the technologies to process these huge amounts of data in a beneficial way.

How does smart data differ from big data?

Stefan Jähnichen: Big data describes datasets that are too big, too complex and too heterogeneous or that change too fast to analyse and use them quickly and correctly with current data processing methods. However, the smart data approach goes beyond the basic concept of large amounts of data: smart data is useful, high-quality information obtained from heterogeneous datasets. Data quality, data security, data protection and its value are taken into consideration in addition to the technical mastery of the large volumes of data. Ultimately, knowledge is generated from the data. The basis for using such datasets are technologies that make complex processing possible, and thus generate knowledge that creates the added value that will become the foundation of the new information economy. That is why big data must become smart data.

What are the biggest challenges in the context of smart data?

Volker Markl: Firstly, the technology for complex analyses of large, heterogeneous and dynamic data sources is still in its infancy. Secondly, there is a lack of skilled data scientists who are able to perform big data analytics with the technologies that are available. This requires expertise in various fields of mathematics and computer science. And thirdly, there are still major challenges in data security and data protection. Digitalised data can be transferred, replicated, distributed and utilised very quickly. Therefore the technology debate needs to be accompanied by a discussion about data security and data protection and their effective and sensible enforcement. We need to be able to seize the opportunities of big data despite data protection. We need to think about whether our concepts are up-to-date, or whether we should be thinking about analysis protection

instead of data protection. Data is not the problem per se. It only becomes critical when something is going to be done with the data collected. We could perhaps think about a sort of personal data donor card – along the lines of an organ donor card – that places analysis protection in the foreground.

Stefan Jähnichen: The accompanying research project, the BARC Business Application Research Center, and the national IT user association VOICE questioned 340 IT and business decision-makers and found that data protection was one of the biggest challenges when using big data technologies. Since many application scenarios focus on the customer, their data requires special protection. To do this, companies must anonymise the data sufficiently and protect it against external attacks. The more widespread big data analysis becomes, the more complex the technical infrastructure will be. Protecting it and the data it contains is a major challenge. Legal clarity needs to be created around the use of smart data. We have set up the legal framework specialist group within the accompanying research project to address these issues.

In which area do you see the greatest potential?

Stefan Jähnichen: Virtually every social and economic field can benefit from the intelligent use of data. Finance and marketing are already employing big data technologies in many ways. There are also sectors in which particularly large volumes of heterogeneous data could be generated and evaluated but this has by and large not yet happened due to various hurdles. Healthcare is certainly one of the most exciting areas and yet also one of the most critical as it involves very sensitive data. In addition to health, the technology programme addresses the fields of mobility, energy and industry. These are economically important and eminent areas, and yet areas that are especially in need of protection and in which data must be handled particularly sensitively.

Volker Markl: I absolutely agree with Mr. Jähnichen. I would like to add that big and smart data are cross-cutting technologies that will pervade virtually all aspects of our lives and change them for the long term. As a result, I see even greater potential in data management and the software industry as a whole. The industry creates the basis for applications in the fields mentioned through data management systems and analysis technologies. I foresee a large share of the jobs being created in this area.

What is the objective of the Smart Data Forum?

Volker Markl: The changes associated with the use of smart data have, to all intents and purposes, the force of a revolution that transcends national borders. Countries around the world are researching and developing smart data solutions in parallel. Hence, the Smart Data Forum supports the technology programme with networking on the European and international level. We also want to involve users in the various industries more closely. In time, we will build a demonstration and experience centre for smart data solutions. In Germany we have an excellent research environment that is developing pioneering and world-leading big and smart data technologies. Overall, with the Smart Data Forum we want to show that technologies from Germany and Europe are world-leading and that the solutions based on them are generating huge potential for business, science and society.

What role does the research project accompanying the smart data programme play and how do you want to work together in the future?

Stefan Jähnichen: The research project's task is very broad. On the one hand, we are here to help the projects funded by the technology programme to implement their activities as efficiently as possible. We connect the individual projects with each other and ensure that valid results are transferred broadly to the market. We have also established three specialist groups on cross-cutting issues that affect all of the funded projects: These are legal issues, data security issues and questions on economic potential and social acceptance. Numerous events are planned in which all interested parties can participate. We also participate in trade fairs and conferences. Those are just some of the things we do.

Applications in industry

PRO-OPT – Big Data Production Optimisation in Smart Ecosystems

Modern industrial production processes are characterised by a high degree of division of labour. In addition to physical products, the vast volumes of data created in the various production steps are gaining in importance. This has led to digital collaboration and networking of individual companies in decentralised data systems – so-called smart ecosystems – becoming increasingly important. This presents the industry with major challenges.

"The data sources are distributed among various economically independent ecosystem participants. The volumes of data generated are very large, heterogeneous, and need to be used in real time to control ongoing operations," says Dr. Simon Becker of DSA Daten- und Systemtechnik GmbH, who also heads the PRO-OPT project. "The data also needs to meet different quality requirements." The companies have different evaluation objectives and have a vital interest in retaining authority and control over their own data."

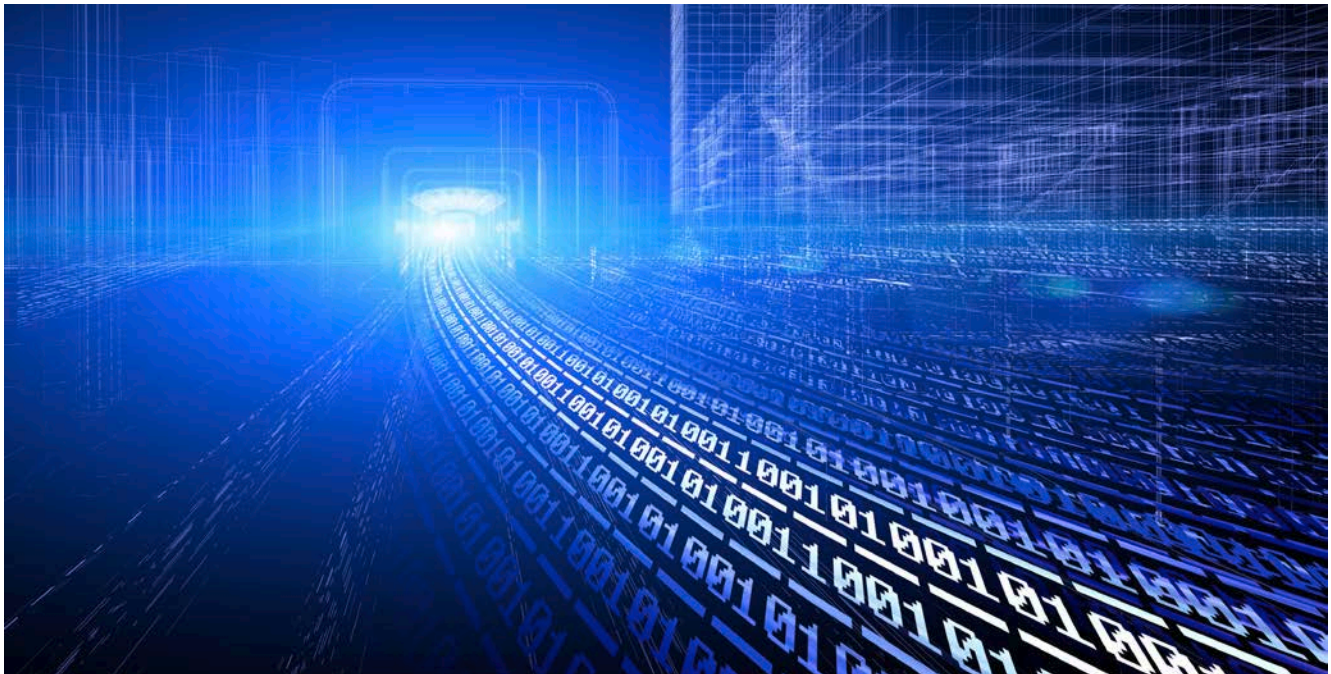
The PRO-OPT project is taking on these very challenges with the aim of developing smart data solutions for businesses – especially SMEs – and in doing so is digging up the data treasure in smart ecosystems. To do this, PRO-OPT follows an integrated modeling approach that takes local data sovereignty into account by modeling information together with its usage restrictions and its quality. The companies involved can then analyse this secure data precisely and integrate it into their own processes. Besides preparing the data, PRO-OPT provides the platform for the distributed data analysis, data visualisation and for the secure exchange of internal and external data in compliance with the usage restrictions.

PRO-OPT enables companies to design production and value chains more effectively and to fix errors promptly – or even prevent them – through the effective, timely and inter-company analysis of production 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 technology, e-energy, ambient assisted living and intelligent mobility. PRO-OPT is using car production technology as an example application scenario, as the industry has a key position in Germany and often sets the direction for other sectors.

Further information: www.pro-opt.org

Project partners: DSA Daten- und Systemtechnik GmbH (consortium leader), AUDI AG, camLine GmbH, the German Research Center for Artificial Intelligence (DFKI), the Fraunhofer Institute for Experimental Software Engineering IESE



Interview with Dr. Simon Becker, PRO-OPT, consortium leader

Dr. Simon Becker leads the smart data project "PRO-OPT – Big Data Production Optimisation in Smart Ecosystems" and is Product Portfolio Architect Software at DSA Daten- und Systemtechnik GmbH

Let's talk about Industrie 4.0. Why does smart data play such an important role here and what are the concrete benefits of smart data solutions for German industry?

The central tenet of Industrie 4.0 is that products and production environments carry, provide and exchange diverse information about individual objectives, statuses, history and work processes at all times. In our case – vehicle diagnostics and commissioning in Audi's vehicle production chain – we look at the individual vehicle properties collected by the diagnostic system and other systems, and at the current status of the diagnostic system itself. Considerable volumes of heterogeneous and semi-structured data come together that can only be processed with smart data solutions. The situation is similar in our work with product management systems in which traceability data is collected even for the smallest component in each finished product.

PRO-OPT wants to use smart data to improve production and value chains in industry and to optimise processes. How does this work in practice?

As outlined above, we are already taking an integrative approach at one plant. Merging product data with process data usually represents a hurdle that has to be overcome. This is the only way to gain the comprehensive overview of the production system needed to enable the desired optimisation potential. With this view, the necessary measures can be introduced quickly on both the product and process sides. We want to expand this, firstly by going beyond the borders of the plant, and later by transcending even the company boundaries, in an attempt to reduce these barriers.

What is the significance of data quality, data sovereignty and the right to disclosure?

From the start of the project we found it very difficult to motivate people to exchange more data across company boundaries. At the theoretical level, it is easy to convince everyone involved about the potential for improvement. But when it comes to providing actual data – even if it's just for our experiments – reservations come to the fore. We expect that the PRO-OPT platform, with its underlying modeling approaches, will help maintain data sovereignty while also promoting data exchange. There is also the effort of compiling the necessary information from the various data sources. Data quality is a key issue for us, for example when handling subjective product data from web forums.

Why did you select the automotive industry as the application scenario for the project?

Primarily for pragmatic reasons: All of the PRO-OPT industry partners are active in this branch. Moreover, we believe that the industry is very well suited to testing such a platform. Here we are dealing with a very complex product, long supply chains and a very interesting mix of large corporations, SMEs and small service providers. Crowd data is also available: Almost everyone has an opinion about their car and many express them too.

How important are smart data solutions for SMEs?

In general, data analysis is an issue of immense importance. Many innovative business models and the optimisation of existing models are based on the analysis of data. The heterogeneity and volumes of data alone necessitate the targeted use of smart data solutions. However, companies should proceed prudently. Not all data analysis issues require a complete tool chain.

SAKE – Semantic Analysis of Complex Events

SAKE
Semantische Analyse Komplexer Ereignisse

Mechanical engineering has always been one of Germany's economically strongest industries. The branch owes its success to increasing levels of automation, which is leading to ever more industrial production processes being monitored by sensors. Intelligently processing the huge information flows is central to guaranteeing smooth production processes. However, conventional data analysis tools are not designed to handle such tremendous volumes of real-time data.

"SAKE aims to develop a framework for analysing sensor data. First we convert all of the information supplied to a uniform format that allows us to merge even extremely heterogeneous data," says Henrik Oppermann of USU Software AG, who leads the project. "We modularise the data and no longer need to process the entire dataset – only the parts that are beneficial and actually relevant."

This delivers significant resource savings. It also makes it possible to process such enormous data streams like those created in Industrie 4.0 applications in the first place. SAKE will create individual applications for different purposes from ready-made modules. The project continuously evaluates the modules in practical settings at the plants of the participating industrial partners. SAKE carries out the analysis with modern machine learning techniques.

The project focuses mainly on applications in mechanical engineering. The project participants are currently concentrating on detailed error analysis for printing presses, with the aim of developing an automated self-optimisation system and an automatic failure prediction algorithm. In another scenario, SAKE is developing error detection software for the optimised and safe operation of compressor systems, such as those used in refineries, the automobile industry and the chemical industry.

To enhance user-friendliness for end users, the SAKE framework allows the results of analyses and the causes of errors to be delivered in natural language. After the processing is complete, the user receives clear information not only about whether there is an operating error but also about the causes. The resulting optimisation of processes and procedures can lead to reductions in production costs of up to 50 percent, according to a study by McKinsey.

Further information: www.sake-projekt.de

Project partners: USU Software AG (consortium leader), AviComp Controls GmbH, Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS, Heidelberger Druckmaschinen AG, ONTOS GmbH, Leipzig University

Interview with Henrik Oppermann, consortium leader, SAKE

Henrik Oppermann leads the "SAKE – Semantic Analysis of Complex Events" smart data project as well as research at USU Software AG

SAKE stands for Semantic Analysis of Complex Events. What does that mean and which complex events specifically?

By complex events we mean the processing of event data in real time, which is also known as complex event processing. This is an established procedure that is already used by Twitter and stock tickers. However, SAKE is about processing information in the Internet of Things and analysing sensor data from machines, or, as in one of our applications, from printing presses. We are dealing with machines with 2,500 sensors and 4 million events per day. You can imagine the volumes of data created every day when not just one but thousands of such machines are monitored. SAKE aims to translate this data into a semantic format, ie. to enrich it with background knowledge. This enriched data is then the basis for developing new error prediction algorithms. This is the innovative core of the SAKE project: higher quality predictions that avoid costly false alarms.

Why is smart data of such crucial importance for mechanical engineering?

Mechanical engineering is going through a phase of transition in which the quality of products is no longer the primary criterion in purchasing decisions; rather the manufacturer's service is becoming increasingly important. Intelligent technologies like SAKE harness new insights from bulk data in the hundreds-of-terabytes range that help equipment manufacturers to improve the quality and efficiency of their products which they can then pass on directly to their customers as a service. For example, maintenance windows can be scheduled better or equipment optimisation for increased efficiency could be offered for free but with the manufacturer receiving a percentage of the savings made by the customer. Thus, the new technologies are enabling new business models.

Which areas and fields of business are involved in the SAKE project?

SAKE is based principally in mechanical engineering. We are working on software solutions for the optimisation of printing machines and an innovative data-driven control technology for turbo compressors. Another field of business is IT monitoring.

Are the results and solutions from the SAKE project transferable to other areas?

Largely speaking, yes. In the area of energy production, the technologies can be transferred one to one. Take the example of wind farms: Early fault detection and knowing the optimal time for effective maintenance is an important economic factor in this field as well. In principle, SAKE is constructed in such a generic way that other areas such as mobility and health can also make use of the technology with appropriate adjustments to the evaluation algorithms. This requires knowledge models to be exchanged, ie. the background and domain knowledge we use to enrich the machine data analysis in order to achieve better results.

SIDAP – Scalable Integration Concept for Data Aggregation, Analysis and Preparation of Big Data Volumes in Process Manufacturing

The process industry plays an important role in Germany's industrial and high-tech sectors. The industry develops and operates highly automated plants for the production of pharmaceuticals and specialty chemicals worldwide. The plants incorporate devices from multiple vendors which control the production processes – sometimes together and sometimes independently. A huge amount of heterogeneous data is created. To date, this data has been processed and stored in separate IT systems. The data evaluation is limited mostly to a section of a plant or a subprocess and is not performed system-wide. The equipment manufacturers also collect data independently of the operators about the operation and lifecycle of their devices. Despite the large volume of data being collected, the potential benefits to be gained from comprehensively analysing as much data as possible are rarely or never realised.

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. SIDAP is developing a smart data solution that 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.

The project, which is under the direction of Dr. Thorsten Pötter of Bayer Technology Services GmbH, is developing new methods and models for the individual analysis and secure integration of the data collected. "An important focus of SIDAP is transferring 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," says Pötter.

The project carries out all of these steps in close collaboration with the SIDAP project partners: leading actors in the process industry, IT and production control system providers and researchers from industry and academia.

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.

Further information: www.sidap.de

Project partners: Bayer Technology Services GmbH (consortium leader), Evonik Industries AG, Gefasoft AG, IBM Deutschland GmbH, Kröhnert Infotecs GmbH, Technical University of Munich

Interview with Dr. Thorsten Pötter, consortium leader, SIDAP

Dr. Thorsten Pötter leads the smart data project "SIDAP – Scalable Integration Concept for Data Aggregation, Analysis and Preparation of Big Data Volumes in Process Manufacturing" and is the vice president and head of OSS manufacturing at IT Bayer Technology Services GmbH

Scalable integration concept for data aggregation, analysis and preparation of big data volumes in process manufacturing – that is a long and complicated name. How would you describe the project in a few simple sentences?

There is a saying that succinctly describes the basic idea behind the project: "Only a fool learns from his own mistakes. The wise man learns from the mistakes of others." Accordingly, within the project, we utilise each partner's many different datasets. Using the experiences and mistakes of all, in the form of heterogeneous volumes of data, we try to extract relevant information for shared use cases. A concrete example is valves, such as those used in many chemical plants. With the diverse usage data we want to create a framework for use utilisation optimisation. If successful, this can be transferred to other components such as pumps. Our concept is to develop concrete solutions for specific examples and to test them thoroughly so they can subsequently be used in similar processes.

What role does smart data play in the process industry?

In terms of the amount of data that we have been generating for years, we are no different to other areas such as the automotive industry. In contrast, 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. 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.

What are the biggest challenges you are facing?

The legal framework is probably one of the most important aspects. More clarification is needed, especially in the areas of copyright and data usage rights, in order to ensure the 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?

What new possibilities does SIDAP create for small and medium-sized enterprises?

We are currently establishing and expanding a shared knowledge base that is supplied with information and used by all of the project partners – including two SMEs. 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.

Smart Data Web – Data Value Chains for Industrial Applications

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. However, the development of new technologies, new regulations and laws as well as new products from competitors can also have far-reaching effects on production processes. The information is often available for a relatively long time on news websites or social networks before it reaches businesses so they can react to it.

By automatically linking public data streams with corporate information networks, manufacturing companies would be able to react faster and more confidently to changes. That is what Smart Data Web wants to achieve. 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. This is how German industry will be connected directly to the so-called Web 3.0, an extension of the conventional Internet in which exact meanings are attributed to information in order to facilitate cooperation between humans and machines. In the future this will allow businesses to optimise their planning and decision-making processes decisively.

A major focus of Smart Data Web is supply chain management. "Germany's key industries such as mechanical engineering, and 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 here leads to enormous costs and can, in extreme cases, have consequences that threaten the survival of SMEs in particular," says Prof. Hans Uszkoreit from the German Research Center for Artificial Intelligence (DFKI) in Berlin who leads the Smart Data Web project.

Another deployment scenario for Smart Data Web is 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 and more innovative suppliers for their own products.

Further information: www.smartdataweb.de

Project partners: German Research Center for Artificial Intelligence (DFKI) (consortium leader), Beuth University of Applied Sciences Berlin, Siemens AG, uberMetrics Technologies GmbH, Leipzig University, VICO Research & Consulting GmbH

Interview with Prof. Hans Uszkoreit, consortium leader, Smart Data Web

Prof. Hans Uszkoreit leads the project "Smart Data Web – Data Value Chains for Industrial Applications" and is the scientific director, head of language technology, and spokesperson for DFKI Berlin

What challenges does industrial production face and how does Smart Data Web help to overcome these?

One focus of Industrie 4.0 is the extraction and use of all production- and company-related data. In our highly interconnected world, industrial companies are not islands. Constant adaptation to the market, upstream industries, sources of raw materials, transport routes, competition regulators and service sectors is critical 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.

What approach is the project taking in this regard?

Smart Data Web aims to create a new knowledge network of data tailored especially to the needs of German industry. Existing public data sources such as commercial and social media are used to achieve this. We use tried and tested methods to structure and process these vast amounts of data, but we are also developing new methods for the deeper semantic analysis of bulk data. These will be tested and deployed in selected value chains.

Let's talk about social media data. What role does data protection play within the Smart Data Web project?

In Germany, data protection and the protection of personal rights are a precondition for any collection or use of data. On the one hand, German businesses want to use social media data resources like their competitors do in other parts of the world. On the other hand, the data must be anonymised or filtered to a level that prevents any invasion of privacy or that hinders informational self-determination. This creates challenges in terms of the technologies that can only be overcome with a combination of technical and legal expertise. For this reason, we work with experienced lawyers and make use of the accompanying research project for exchanges with legal experts and the other smart data projects.

Are there overlaps with other areas of the programme such as mobility, energy or health?

The approach of combining public data and sources of knowledge with company-specific and internal data can certainly be applied beneficially in other economic sectors as well. We work very closely with the Smart Data for Mobility (SD4M) project as their planned mobility platform also connects publicly available data with proprietary data and uses the latest mass data analytical tools to do this.

What are the specific benefits of Smart Data Web for small and medium-sized enterprises?

Our approach helps SMEs in the data business that offer data enhancement services as well as companies in the manufacturing sector who want to use refined data. For data analysis service providers, the central use of open sources, standards and tools lowers the barriers to entry. 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. This also means client companies avoid becoming dependent on a single provider of such services. Furthermore, Smart Data Web lowers the cost of data analytics products, making them affordable for SMEs as well.

Applications in mobility

ExCELL – Real-time Analysis and Crowdsourcing for Self-organised City Logistics

Long traffic jams, clogged feeder roads and a lack of parking spaces: the traffic situation in German cities vexes many motorists – and it is expensive to boot. It costs businesses – especially tradespeople and service providers who are on the roads every day – time and fuel and thus a lot of money. 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 optimised.

The team of the "ExCELL – Real-time Analysis and Crowdsourcing for Self-organised City Logistics" project has taken up the challenge of improving the efficiency of road transport. The project is developing a platform that makes current traffic data available and, based on this, uses an algorithm to optimise 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 should improve customer satisfaction, for example by informing customers about delays in good time. The system should be able to calculate delays by matching the current position of the tradesperson with the route to be travelled and current and forecast traffic conditions. The fleet of tradespeople should move through the city more efficiently as the platform optimises their routes. For example, should 15 different locations need to be visited in the city within one week, the system will determine the optimal sequence. The platform should also be able to plan routes exactly: it should provide warnings about congestion, predict traffic development, and suggest alternative routes. Another side effect: the improved efficiency in dispatching should increase employee satisfaction as well.

ExCELL reveals hidden potential efficiency savings by collecting and systematically evaluating various data, such as geo or traffic data. Thus, 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. Starting in 2016, the system will be extended to urban freight and delivery services – from deliveries to retailers and courier services and taxi companies to nursing services. Under the leadership of FELD M GmbH, the project partners at Beuth University of Applied Sciences Berlin, ENTIRETEC AG, MING Labs GmbH, TU Dresden and the Technical University of Munich want to save money on Germany's roads for small and medium-sized enterprises.

Further information: www.excell-mobility.de

Project partners: FELD M GmbH (consortium leader), Beuth University of Applied Sciences Berlin, TU Dresden, the Technical University of Munich, MING Labs GmbH, ENTIRETEC AG

Interview with Mathias Wrba, consortium leader, ExCELL

Mathias Wrba leads the smart data project "ExCELL – Real-time Analysis and Crowdsourcing for Self-organised City Logistics" and is a user experience consultant at FELD M GmbH

You are planning a platform that optimises routes and dispatching in cities for small and medium-sized enterprises. What are the benefits?

ExCELL 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.

You are responding to industry-specific needs. What would the platform look like for a nursing service, for example?

When planning routes for home care services, we need to consider which member of the nursing staff provides care to a particular patient. In examples like this you cannot simply suggest the most efficient set of routes, but need to consider the relationship between two people. Optimal dispatching and routes can be found for each nurse to get to their regular patients. The pleasant side effect of this increased efficiency: the less time the employees spend in their car, the more time they have for patients. That is something that is important to nursing staff. In this way, we increase the satisfaction of both caregivers and those in need of care.

What challenges do you face?

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. Digitalisation has not yet taken hold everywhere among small and medium-sized businesses. This leads to the second challenge: Many businesses appreciate the added value that digitalisation and services like ExCELL could bring, but they are hesitant to implement them. We still have a lot of convincing to do.

You have focussed so far on tradespeople. In 2016 you are setting your sights on many aspects of urban transport. Which applications are you planning?

We want to expand geographically. Dresden is the beginning, then 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.

iTESA – intelligent Traveller Early Situation Awareness

From natural disasters and epidemics to terrorist attacks and political unrest: travel always carries risk. This applies both to tourists on holiday in distant countries and business travelers 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 pieces of a mosaic to give a complete picture of the situation on the ground. This means businesses lose valuable time for assessing the situation their employees or customers are in and taking measures to protect them. 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.

The "iTESA – intelligent Traveller Early Situation Awareness" smart data project addresses this information gap, thus returning to companies their ability to take decisions and act. iTESA identifies travel risks around the world and develops alternative routes in the case of an emergency – in real time as soon as a crisis occurs. Companies are thus in a position to get employees or customers already in the affected area to safety. They can also cancel their travel plans at short notice if necessary.

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. Using a combination of various special data mining analyses and learning algorithms, the iTESA solution identifies current travel risks. This is done with special attention to data protection rules. The system then assesses the credibility of the information and classifies the risk. iTESA ranks the level of danger posed by a crisis and plays through possible deterioration scenarios. This enables the system to precisely assess the need for action. Hysteria and scaremongering are avoided.

A geographical link is then established which stands out for its accuracy. iTESA is able to locate a crisis precisely. The system can, for example, identify the exact streets affected by violent protests in a capital city. It then matches the location of the crisis with the trip information in corporate travel systems, while of course taking German legal data protection regulations into account. iTESA then informs the companies via an 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.

The project partners (travel-BA.Sys GmbH & Co. KG, the Fraunhofer Institute for Transportation and Infrastructure Systems IVI, Software AG, Inquence GmbH and the Independent Centre for Privacy Protection Schleswig-Holstein) share an ambitious wish: iTESA should become no less than a guardian angel app for travellers with which companies can reliably fulfill their duty of care.

Further information: 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

Interview with Uwe Gabriel, consortium leader, iTESA

Uwe Gabriel leads the smart data project "iTESA – intelligent Traveller Early Situation Awareness" and is the manager of public affairs and projects at travel-BA.Sys GmbH & Co. KG

You are planning an app that gives real-time travel warnings. How does that help businesses?

iTESA enables companies to fulfill their duty of care to employees or clients. Our app bundles all information about crises in real time, analyses the risks, identifies affected employees or customers and displays courses of action. Companies 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.

What makes iTESA special compared to traditional travel warning systems, for example those provided by diplomatic services?

There are four key differences. Firstly, thanks to automation, iTESA draws on a much broader database and is therefore more thorough. We shine light into every corner of the world, not just the big cities. Secondly, the system is accurate. For example, we can narrow down local unrest to the street level and assess the risk for travellers based on that. Thirdly, iTESA is individual and therefore tailor-made. We only issue warnings for people who are directly affected or threatened by the crisis. Companies get the information that is precisely relevant for them and their employees or customers. Fourthly, we always give warnings when the available data shows that the situation on the ground is becoming dangerous for travellers.

What challenges are you facing at the moment?

We are currently refining our concept. For example, we are working on the details of alternative routes. There are questions such as 'is it safer to leave the country in question by plane or by bus?' We are looking at the service for expats – ie. employees delegated abroad for a certain period. If they are in a country such as South Korea, the employees can move freely and, for example, take spontaneous trips in a rental car. However, we then lack the movement information to assess risk. At the same time, the employer still has a duty of care to the employee during the international assignment. These subtleties are the challenges that make iTESA exciting.

So far you have focussed on small and medium-sized enterprises and travel companies. In which areas do you plan to use iTESA in the future?

We imagine that iTESA could bring real added value to the logistics industry. When transporting goods and commodities, the start and end points are fixed. The intended route could already be monitored for hazards using the existing system. In an emergency, however, additional parameters would have to be taken into account when selecting safe alternative routes, due for example to the regulations governing the transport of dangerous goods.

sd-kama – Smart Data Disaster Management

Despite technological progress, flooding cannot be prevented – be it due to the thaw after a snowy winter 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.

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. The teams are thus better able to assess risks, make the right decisions and coordinate forces and resources efficiently.

This is made possible by the two information categories “space” and “people”. First, sd-kama creates a current picture of the affected area. To do this, information such as water level data is collected from various separate systems and linked. The analysis is also based on satellite imagery that provides information about the condition of buildings and infrastructure. Furthermore, the system uses dynamic data streams of photos and videos submitted by volunteers or the emergency services. This is where the second information category, “people”, comes into play. sd-kama monitors the psychological and physiological state of the emergency personnel with wearables. This means that the team leader knows where each helper is available and who is under too much mental or physical stress so that urgent backup or relief can be organised.

Another advantage is that sd-kama looks into the near future. “Our 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 was possible before. This enables team leaders to make decisions based on more accurate forecasts and enables them to prepare earlier and better,” says Dr. Stefan Jäger of geomer GmbH, who leads the project.

The project partners are working meticulously on an information platform that will revolutionise disaster management with precision based on the user-oriented evaluation of comprehensive data.

Further information: www.sd-kama.de

Project partners: geomer GmbH (consortium leader), the German Aerospace Center (DLR), Fraunhofer Heinrich Hertz Institute, Software AG, Stadtentwässerungsbetriebe Köln

Interview with Dr. Stefan Jäger, consortium leader, sd-kama

Dr. Stefan Jäger leads the smart data project "sd-kama – Smart Data Disaster Management" and is managing director of geomer GmbH

You are planning an app that allows precise disaster management in real time. What benefits does sd-kama offer emergency response teams?

In an ideal situation, the threatening scenarios are all pre-calculated. The data analysis of complex event processing identifies precisely the information in the data streams that is relevant or could become important for the crisis management. In doing this, sd-kama only considers the practical benefits. This enables the emergency response team to prepare both earlier and better. We are also arming the helpers: Firstly, we equip them with wearables such as armbands that send their vital signs to the response team's management. If the helpers are overstrained, support can be ordered. If they become exhausted, the team leader is informed early on and can organise relief. A further advantage is that the response teams are close to the action. The sd-kama app enables them not only to describe the situation to the team's management, but to simply show them with videos or photos using their smartphones. Overall, sd-kama improves the informational basis and helps detect any mistakes or the failure of protective systems early on. In this way we avoid an escalation of the situation.

What makes sd-kama so special?

sd-kama collects, links and then analyses all of the information from very diverse sources systematically using an algorithm. Previously, the sources were all separate from each other. Putting the information together took time. We are automating that process. sd-kama then evaluates all of the data according to the only truly important question: What is important for the management of the crisis? We focus exclusively on added value for the emergency response managers.

What challenges do you face?

The special feature is also the challenge. The existing information systems are very heterogeneous so linking them technically is a major challenge. Additionally, sd-kama looks at new dynamic data streams of photo and video files and merges them with information we obtain from satellite imagery. However, the most difficult aspect is that, despite all of the analyses, calculations and forecasts, there will be other unforeseeable events that can dramatically escalate a crisis. They always pose a risk to successful disaster management. But we are on the right track: we are currently finalising our system architecture and have developed a prototype that we will test in an initial exercise.

What other applications or areas of development do you aspire to?

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.

SD4M – Smart Data for Mobility

Smart Data for Mobility

By tram to the train station, then a train to the next city, then by car-sharing to the final destination and by plane and taxi to get back: numerous means of transport are available to travellers for today's mobility needs.

The ambition of ensuring a continuous transport chain presents the mobility sector with various challenges. 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.

Furthermore, with its many different providers, the mobility sector is highly fragmented. Modern urban spaces are highly complex systems in which many individual transport systems are closely linked. Because a typical journey involves multiple systems (eg. a taxi to the airport), it is necessary to consider the performance of the overall system, such as a large city, in its entirety. However, the data systems used by transport companies are often unable to process external data from other operators and therefore cannot use this to optimise their own services.

An additional challenge lies in incorporating sudden events into the process chain. Classical forecasting methods cannot take account of traffic jams, accidents or weather fronts for example. For this reason, structured historical data has been used almost exclusively to date. This means that unforeseen changes cannot be reacted to, as they are not yet reflected in the historical data.

The "SD4M – Smart Data for Mobility" project is therefore 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. The SD4M platform will merge data from different companies and structure and refine publicly available data.

In addition, forecasting and optimisation modules will be implemented on the SD4M platform to address the specific issues raised by the project partners from the mobility sector. The SD4M platform, as the centre of a data-ecosystem, has been designed to be accessible for data analysis service providers using standardised interfaces. By way of example, this could enable independent analysis specialists without their own historical databases to use the platform as an integration and data delivery system for their services. The project is set up as a partnership consortium with the intention of promoting acceptance and cooperation in the economy and industry. As an ecosystem for the cooperative and secure use of structured and unstructured data, the SD4M platform will help mobility operators optimise their forecasting, planning and capacity utilisation, and help make journeys easier for travellers.

Further information: www.sd4m.net

Project partners: DB Systel GmbH (consortium leader), German Research Center for Artificial Intelligence (DFKI), idalab GmbH,]init[AG für digitale Kommunikation, PS-Team Deutschland GmbH & Co. KG

Interview with Ingo Schwarzer, consortium leader, SD4M

Ingo Schwarzer leads the smart data project "SD4M – Smart Data for Mobility" and is the chief technology officer at DB Systel GmbH

The mobility sector is changing. What do you consider to be the most important trends?

Traditionally, most systems such as railway traffic, air traffic and so on, and the companies within these systems work exclusively for themselves. External data – even data that is freely available – is often not used to optimise transport routes. However, a journey usually involves several means of transport and this requires an integrated solution that considers all transport systems. At the same time we see that the service level is not benefitting from the data level. Complaints and information about accidents or similar events that are published for example in social media are rarely used to improve the service for passengers or to generate added value for businesses and service personnel. Customised technology is needed to ensure its comprehensive use that thereby improves the service for all travellers. This use of data is certainly one of the most influential current developments.

How does SD4M differ from other mobility concepts that are based on utilising user data?

Multimodality is the clear focus of the SD4M platform. The greatest challenge lies in merging different data sources from different companies with publicly available data and linking structured and unstructured data, in other words establishing semantic interoperability. By combining the information we can ultimately provide better and more comprehensive forecasts that, as dynamic feedback, are of real benefit for service providers and thus the service users. Translating textual expressions into valid data is an enormous challenge in the mobility sector. What do temporal terms such as "just" or "just now" or spatial descriptions such as "nearly at Tegel Airport" really mean? The task is to resolve temporal and spatial factors and to link them to each other.

What data sources does SD4M 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.

What are the advantages for mobility providers?

What really matters is the preparation of the data for the various stakeholders and value chains that are going to integrate the forecasts. 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.

Applications in energy

SmartEnergyHub – Data Hub for Smart Energy Use

The operators of key infrastructure such as airports, ports, industrial and chemical parks, factories, manufacturing plants, and office buildings are major consumers but also producers of large amounts of energy. Furthermore, major infrastructure systems have significant storage capacity and considerable load-shifting potential. For the infrastructure operators, providing reliable, stable and cost-effective technical infrastructure services and optimising them continuously is a major challenge. The increasing integration of renewable energy sources into the German power grid, changes in the cost structure of energy sources and technologies, and changes in legislation pose further challenges.

The SmartEnergyHub project is pursuing a platform-based approach that enables infrastructure managers and energy networks to deliver forecast- and market-based energy management with the aid of sensor data in order to cope adequately with these new conditions. New real-time energy management systems are able to map the dynamic developments created by the transition to renewable energy and enable new services and business models.

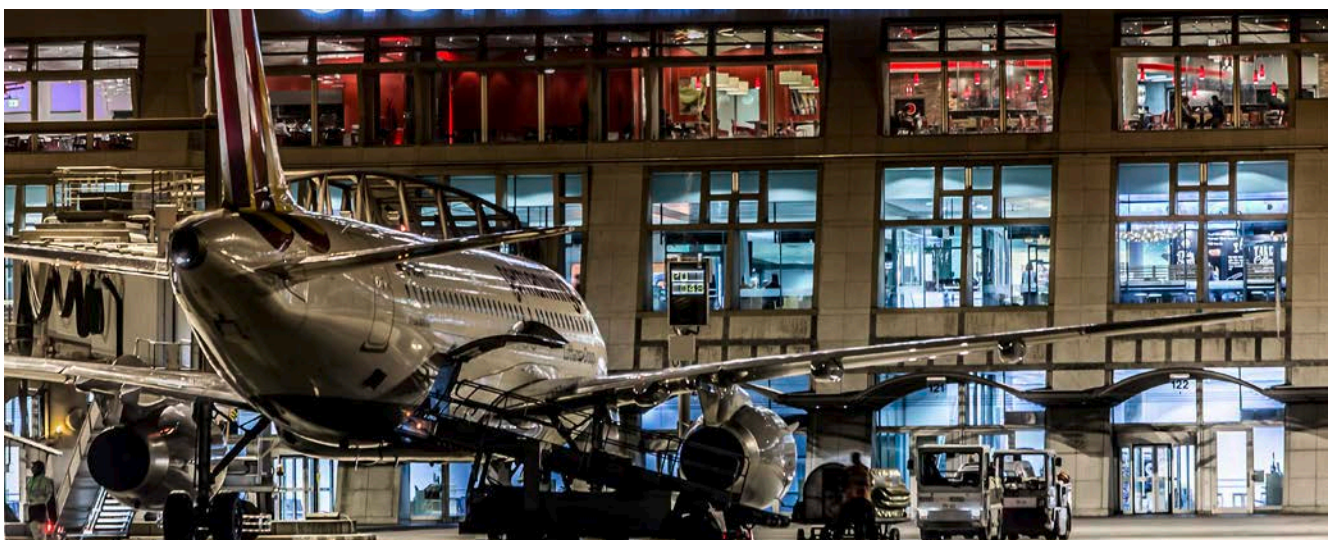
To achieve economic advantages, companies need to intelligently network and manage their own infrastructure. This requires a high-performance database (cloud-based in-memory technology) that can receive and process large amounts of data in a short time. The data storage can be done on-site or delivered as a service. On the other hand, software components must be installed that enable the simple and standardised connection of system elements, their management, and the visualisation of key information as a support for decision-making.

SmartEnergyHub aims to develop an IT toolkit for infrastructure operators. This is done with the objective of integrating the existing systems and the data already collected from the infrastructure operations. Merging and intelligently linking the data makes it possible to identify synergies and optimise the system as a whole. Users can use the new insights to implement additional energy-saving, cost-optimisation, or CO_2-reduction measures. Big data is turned into smart data and the IT toolkit will be the instrument for the transition to renewable energy.

The SmartEnergyHub project creates the necessary new solutions through the use of smart data technologies and platforms. Technical, structural, organisational and legal parameters are also considered and solutions are identified that overcome the current obstacles. Taking Stuttgart Airport as an example, SmartEnergyHub wants to show how concrete savings and added value can be realised in infrastructure operations.

Further information: www.smart-energy-hub.de

Project partners: Fichtner IT Consulting AG (consortium leader), Flughafen Stuttgart GmbH (Stuttgart Airport), Fraunhofer Institute for Industrial Engineering IAO, Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS, in-integrierte informationssysteme GmbH, Seven2one Informationssysteme GmbH



Interview with Dr. Albrecht Reuter, consortium leader, SmartEnergyHub

Dr. Albrecht Reuter leads the smart data project “SmartEnergyHub – Data Hub for Smart Energy Use” and is a board member at Fichtner IT Consulting AG

The energy market is in transition. What challenges are the changing conditions creating for large infrastructure operators such as airports and ports?

The development of the energy market is thoroughly indistinct because the change is taking place over a very long period of time. The federal government’s objectives in the transition to renewable energy extend into the coming decades. For infrastructure on the scale of an airport, market developments are difficult to predict as there are impacts on different levels. In particular, it is not clear how the integration with the energy market will take place. We must note that the airport itself is not a commercial establishment; it needs to learn first, for example through research projects. Until now it has only been concerned with processing passengers. In the future it will have to play its part in the transition to renewable energy as an energy cell. The fact that this also has to happen in real time is perhaps the biggest challenge that infrastructure operators currently face.

How can potentials be realised with smart data?

We need to consider three things. Firstly, we are aiming to optimise the energy market in real time. Previously we had – figuratively speaking – whole days to adjust. Now we have to be able to react by the second. That is not possible without intelligently using the data being created. Secondly, to date we have differentiated according to department. The electrical engineering department is concerned with the electrical power, the mechanical engineers are concerned with design and production etc. Today we are working towards interlacing different sectors, for example heating, electricity, air conditioning, passengers and so on. Thirdly, we must consider infrastructure as energy cells within a united cell structure. The airport interacts with other energy systems, it has to exchange data, and so it must also be able to provide data. The aim of using the data is ultimately to optimise the overall system.

Taking Stuttgart Airport as an example, you are demonstrating how infrastructure can employ smart data solutions. What distinguishes SmartEnergyHub from other solutions?

The novel thing about SmartEnergyHub is the holistic approach, while taking time and data volumes into account. We are designing the system architecture for Stuttgart Airport, ie. we define what data we receive from which sensors, how this data is processed and managed, how it is used, as well as how, for example, projections are integrated. The second step is an analysis of the current situation. Only after that will we start looking at individual business cases, for example the question of how maximum CO_2 savings can be made. The airport already has a large number of measuring points and the data obtained is processed in an internal system that we can use as a base. We then check for real-time capability and networking capability in order to connect the internally generated data with exogenous data sources, such as weather or stock information.

Are the results from the example of the airport transferable? To what extent can other infrastructure, such as industrial or chemical parks, benefit?

The aim is to make Stuttgart Airport a flagship energy infrastructure cell. The results from the project are certainly generalisable – if we manage to transform the airport into an autonomous cell. Whether a train station, a port or an industrial park – the cellular approach is the core and that is transferable to all infrastructure systems.

SmartRegio – Trend Analysis Based on Heterogeneous Mass Data

Trends and opinions among like-minded people often develop locally, within a region or a city. This manifests itself for example in public support or opposition to local construction projects or refugee accommodation, in the agreement with or rejection of energy policy, and in the general political mood of a particular region. These trends and opinions often come from people with much in common, such as age, educational background or social status. New services, technologies and issues are often met with very different reactions within such communities.

Small and medium-sized enterprises, public institutions and infrastructure operators usually have deep roots in their home region. It is therefore advantageous for them to take local socioeconomic and demographic trends into account in their business processes. 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. To determine the characteristics and trends in a region, data needs to be collected. Classical studies and surveys alone are not particularly suitable for this as in small areas they are usually not representative or are too time-consuming.

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. However, the data itself is widely dispersed and varies in type, size and accessibility. 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.

Further information: www.smartregio.org

Project partners: YellowMap AG (consortium leader), German Research Center for Artificial Intelligence (DFKI), DISY GmbH, Goethe University Frankfurt, USU Software AG

Interview with Richard Wacker, consortium leader, SmartRegio

Richard Wacker leads the smart data project "SmartRegio – Trend Analysis Based on Heterogeneous Mass Data" and is head of research at YellowMap AG

Why do companies need to address local trends?

Because the competition does. Almost all small and medium-sized businesses compete with large retailers that have been identifying regional trends in the conventional way for a long time. Relevant datasets are traded and offered as a service, for example via the Gesellschaft für Konsumforschung (GfK) or TNS Infratest. Companies can fall back on this, for example when opening a new branch. If Starbucks opens a branch in any location today, the local revenue can be predicted to within 15 to 20 percent accuracy – based solely on current market studies.

Why do the conventional approaches not extend to trend detection?

One problem is that the data packets are usually too expensive for small and medium-sized enterprises and their evaluation requires expert knowledge that is not generally available internally. This means that the companies must call on consulting services that are more expensive than the data itself – or get lots of contractors on board and disclose their own data. Market power is a clear advantage here. A second problem is that the data collected does not actually illustrate trends, rather it only represents a snapshot. It's not possible to read developments and trends out of the data packets. For example, if demand is currently high, that is a long way from saying whether demand will rise, fall or remain stable in the future.

What can big data achieve in this context?

The advantage of big data is that the data is collected for purposes other than those for which it is ultimately used. The data becomes a raw material and different things can be read from it, depending on individual needs. Big data is a data stream that enables predictions to be made about future trends and tendencies. In this context, information packets should be regarded as building blocks. In cities these would include public transport, construction sites, information about individual districts, waste management and so on. A lot of data is also publicly available, for example in social media. Placing the available blocks in relation to each other enables the demographics of the population and shifts to be identified. Intelligent interpretation yields information that can be decisive in competitive situations.

How does the SmartRegio project differ from previous approaches?

The main novelty is merging many different data formats in real time. The platform we are developing is extremely flexible, prepares data streams every second and makes them usable. For companies, this means that 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.

How are you proceeding with SmartRegio in practice?

Our usage case in the context of the smart data programme involves strategic consulting for typical municipal utilities. Their line of business faces technical challenges and increased competition due to market liberalisation 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? It is interesting that public utilities have a lot of data but rarely extract such information from it. SmartRegio combines this data with many other sources in order to create a stable basis for decision making.

Applications in healthcare

InnOPlan – Innovative, Data-driven Efficiency of Surgery-related Process Landscapes

There are many applications for smart data in hospitals, from patient data analysis and networking devices in operating theatres through to administrative processes. Data analysis can be used in the healthcare sector to better target individual treatment for patients. Moreover, harnessing smart data enables comprehensive analysis and evaluation of health-related data, which, in an ideal scenario, can lead to entirely new medical insights. The InnOPlan project aims to optimise processes in operating theatres and surgery processes in hospitals using big data.

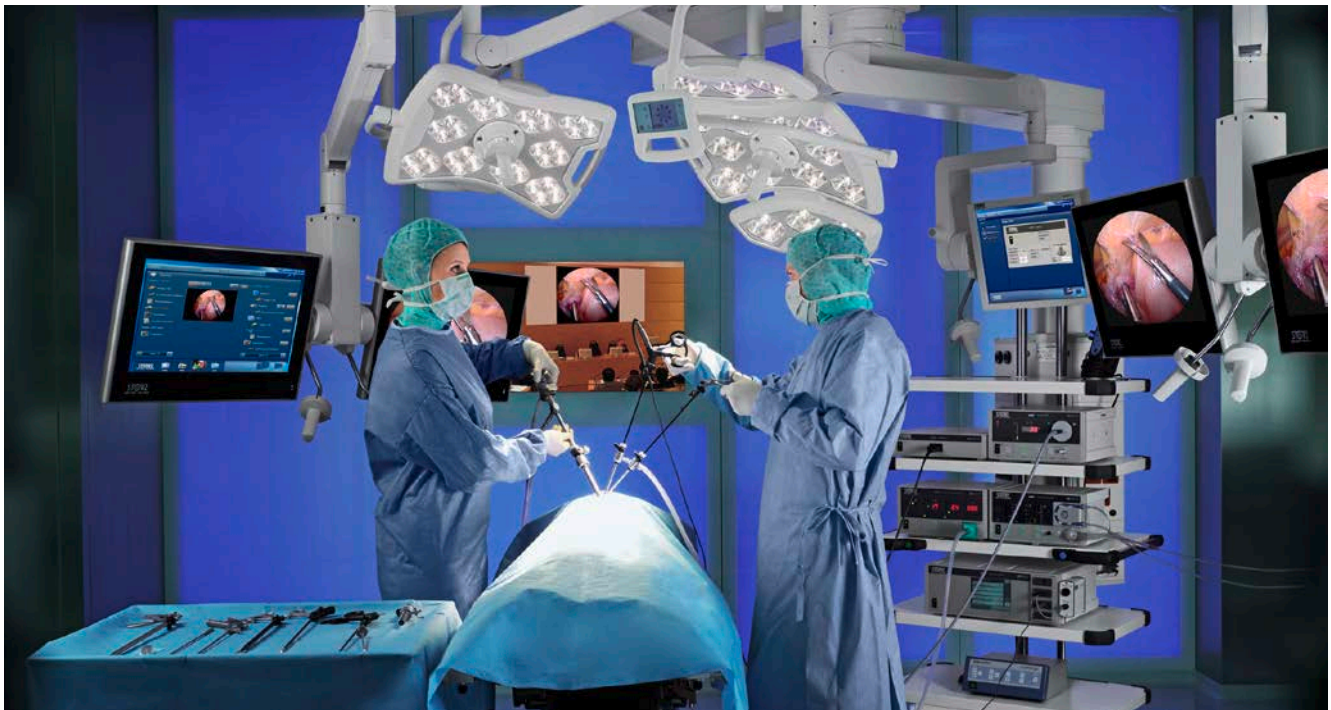
The operating theatre is the heart of a hospital. It is paramount that proceedings here run smoothly. However, many processes involve hurdles of various kinds. The individual process steps often do not complement each other optimally. The better individual devices are networked, the more trouble-free their interaction will be in critical moments. The aim of the project is therefore to enhance medical devices so that they fulfill their technical functions but also provide data intelligence that can be used to network clinical processes more closely and improve their efficiency.

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 optimise clinical and logistical operations, surgical planning and equipment availability. With this approach, 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.

This creates excellent opportunities for the key German medical technology industry to develop new, economically sustainable services and business models, and to develop new markets.

Further information: www.innoplan-project.de

Project partners: KARL STORZ GmbH & Co. KG (consortium leader), HB Technologies AG, Heidelberg University Hospital, University of Hohenheim, Leipzig University, SMARTIT® – Kawetzki, Sprung, Streng GbR



Interview with Dr. Norbert Hansen, consortium leader, InnOPlan

Dr. Norbert Hansen leads the smart data project "InnOPlan – Innovative, Data-driven Efficiency of Surgery-related Process Landscapes" and is senior project manager at KARL STORZ GmbH & Co. KG

What role does big data play in operating theatres?

A distinction must be drawn between the present state of development and the role that big data will play in operating theatres in the future. The InnOPlan project works exclusively with non-patient-specific data. This includes, for example, information about the length of an operation. In other words, with this project we are trying to highlight the potential of what can be achieved with non-patient-related data. This applies primarily to a hospital's administrative tasks such as surgical planning and coordination. In the long term we also envisage patient-related data being harnessed so that this valuable data can be used better in regard to diagnosis, the course of diseases and therapy. However, this can only become a reality once the issue of data protection has been clarified by the legislative process.

What added value do the new technologies create for hospitals?

Hospitals will function more efficiently with the new technologies and be able to optimise 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 optimised and process costs in the hospital can be reduced. The improved level of organisation and the resulting optimised capacity utilisation benefits the hospital in two respects: Firstly, all processes become even more focussed on medical tasks than they were before. Secondly, the improved level of organisation 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 for 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.

You mentioned providing smart-service platforms for medical technology providers. What does this involve and what advantages do the platforms offer clinical users?

The idea is to provide device data via a smart-service platform. Small and medium-sized software companies would have access, following proper authentication. These SMEs often have difficulty programming their medical applications to meet the needs of target groups and in testing their effectiveness as they often cannot get hold of such data easily. Complying with data protection rules is a challenge here since the information may not be passed on arbitrarily to other companies. SMEs could potentially enquire about cooperation opportunities with companies such as medical device manufacturers. By working with a company, SMEs can also take advantage of their data resources.

KDI – Clinical Data Intelligence

Breast cancer is the most common type of malignant tumour in women and the leading cause of death between the ages of 45 and 60. Various information from the patients is evaluated in order to predict the risk of breast cancer and to select appropriate treatment. The most important data is graphical information from mammograms, but also genetic factors and biomarkers. Generating information in a targeted way and connecting it is crucial. However, no link is currently made with the diverse range of information that could be extracted from comprehensive electronic patient records.

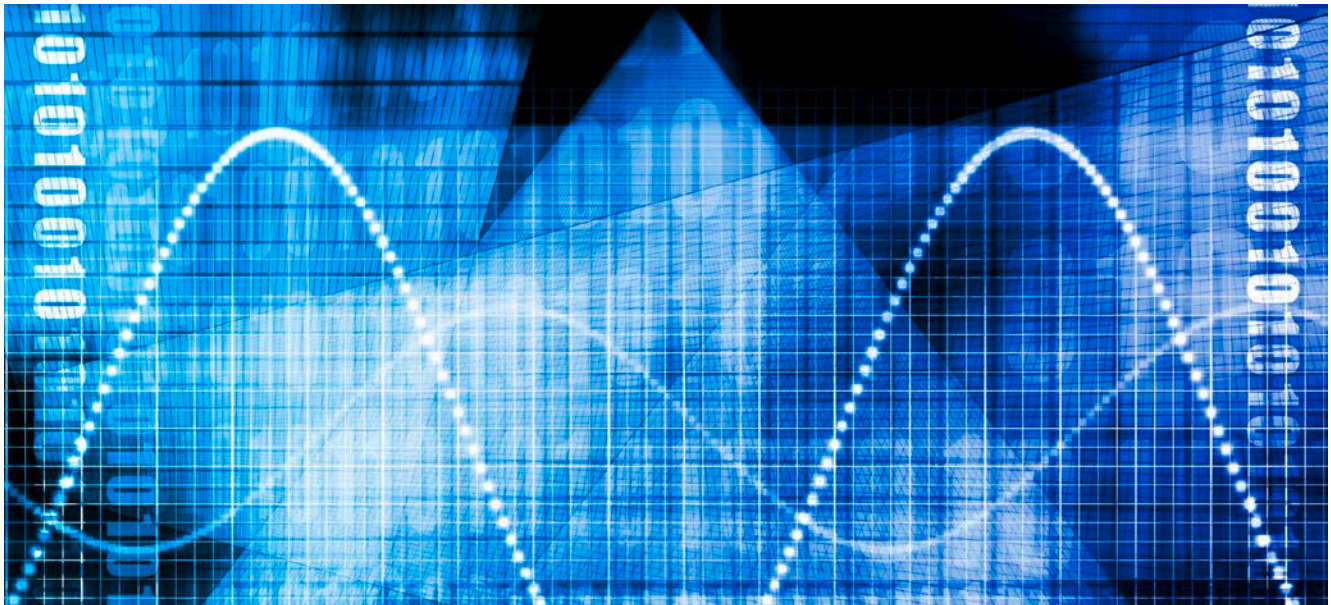
Patient data in today's clinical environment comes from a variety of sources. Information about the patient, disease progression, medication and treatment is collated and stored. There is also genome data, diagnostic data from ECG readings, CT and MRI scans, text, audio and graphical data. If new digital tools are also used, such as health apps on smartphones, smartwatches or data glasses, even more relevant data can be generated. In most cases this data is not crosslinked and the doctors providing treatment sometimes do not have access to all of the different datasets.

The main task and challenge is to collect the heterogeneous datasets from the databases and make them usable. This raises the question of how such diverse data, such as information from medical records, genomic data and radiology and pathology reports, can be analysed together. The "KDI – Clinical Data Intelligence" project wants to automate the evaluation of extensive and complex patient data, thereby simplifying the process drastically. To achieve this, all of the patient-related data from various sources will be combined to form a patient data model. Integrating the data creates the basis for further innovative services in patient care and medical research. An important result is integrated clinical decision-making based on the evaluation of all the available data sources.

The solution can be applied to any disease pattern and is being demonstrated by KDI in two situations: breast cancer and kidney transplantation. This will improve care and clinical doctors will be unburdened as medical decisions will be made easier. A significant advantage of the smart-data approach is that all of the available patient data can be evaluated and the patient is viewed holistically. An app infrastructure will enable more providers – SMEs in particular – to contribute with their solutions.

Further information: www.klinische-datenintelligenz.de

Project partners: Siemens AG (consortium leader), Averbis GmbH, Charité – Universitätsmedizin Berlin, German Research Center for Artificial Intelligence (DFKI), Fraunhofer Institute for Integrated Circuits IIS, IFG Institut für Frauengesundheit GmbH, FAU Friedrich-Alexander University Erlangen-Nürnberg (Department of Medical Informatics), Universitätsklinikum Erlangen



Interview with Prof. Volker Tresp, consortium leader, KDI

Prof. Volker Tresp leads the smart data project "KDI – Clinical Data Intelligence" and is a principal research scientist at Siemens AG

A lot could still be done with data in the healthcare sector. Which fields do you consider relevant for smart data?

Clinical data analysis already has a long tradition because the analytical evaluation of data in clinical studies and epidemiology has always been an important part of medicine. What is new is the sheer volume of data. Medical facilities are experiencing a veritable explosion of data due to molecular data from genome and protein analyses and metabolic profiles. In the medium term, the volume of data will swamp the doctors and nurses providing treatment. This will demand a response from the entire healthcare industry to the question of how to deal with the flood of data in the future. At the same time, demographic change is having an effect: People are getting older and therefore, unfortunately, they suffer more often from diseases. Meaningful data evaluation can help to control the looming cost explosion.

How can the healthcare sector make good use of the data collected?

One example would be the treatment of rheumatism for which around 50 to 100 medications are available, depending on the case. Often, doctors keep trying medications until they find the right one. If this process can be accelerated through the analysis of large amounts of case-based data, the benefit is clear: The patient will recover faster and the cost of treatment will decrease. The situation is similar in the treatment of patients following kidney transplantation, where the objective is to find the best medication for the patient and to find a dose that avoids organ rejection but that at the same time minimises side effects. This is the application scenario our project is looking at. We need data from many patients in order to identify the correlations and we need detailed knowledge about the patient being treated in order to prescribe the right medication at the right dosage.

What advantages will data collection have for patients in the future?

We distinguish between four areas where significant benefits can be achieved. Firstly, prevention. Any doctor will tell you that a healthy lifestyle is crucial for the prevention of illness. In this respect, apps can help people to think about a healthy lifestyle and warn them in advance if things are going in the wrong direction. The effect is not to be underestimated in the overall social context. Secondly, screening. In mammography, for example, data acquisition can lead to pathologies being identified before the onset of any symptoms. Furthermore, smart data can be used during treatment, when the aim is to restore health, and of course during follow-up care to ensure that the disease does not recur.

Smart Analysis – Health Research Access (SAHRA)

SAHRA
Smart Analysis Health Research Access

Large volumes of data are created in the German healthcare system, for example when hospitals and medical practices invoice health insurance providers for various services. This data comes from various sources. To date it has not been used sufficiently for research into, and the improvement of, patient care. In Germany, unlike other European countries, findings from healthcare research have until now rarely been usable in treatment consultations between patients and doctors.

The "SAHRA – Smart Analysis – Health Research Access" project is set to change that. It will make it possible to combine billing, 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 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 needs, the development of chronic diseases and the effectiveness of therapies and treatment models.

Dr. Thomas P. Zahn, CEO of AOK Nordost's Gesundheitswissenschaftliches Institut Nordost (GeWINO) – a scientific institute run by a health insurance provider: "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 healthcare needs for all of the municipalities in northeastern Germany, in cooperation with the specialist unit "Aging and care in the community". An initial SAHRA research project will look into the preventability of total renal failure in patients with chronic kidney disease. The project is a cooperation between AOK Nordost and the University of Rostock, Fraunhofer IESE and a network of practicing doctors.

Healthcare data is particularly sensitive. The protection of commercial secrets and strict compliance with data protection regulations and their technical, legal and organisational implementation therefore constitute a key focus of the SAHRA project.

Further information: http://www.digitale-technologien.de/DT/Redaktion/DE/Standardartikel/SmartDataProjekte/smart_data_projekt-gesundheit_sahra.html

Project partners: GeWINO – Gesundheitswissenschaftliches Institut Nordost (consortium leader), data experts GmbH, the Hasso Plattner Institute at the University of Potsdam, TMF – Technologie- und Methodenplattform für die vernetzte medizinische Forschung e.V.

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