vom Brocke, J., Debortoli, S., Müller, O., & Uhl, A. (2013). In-Memory Database Business Value. *360° - The Business Transformation Journal, 3*(7), 16-26.

Abstract

With in-memory database management systems, such as SAP HANA, all data and applications are kept in the computer's main memory to avoid expensive mechanical hard-drive access, reducing latency times and increasing the ability to process large data volumes. This approach promises to enable new possibilities of action in various industries and application areas. In this article, we report on a recent explorative study among Chief Information Officers and technology experts from leading European retailers. The study elaborates on the business value creation in general and identifies five specific scenarios how to leverage in-memory technology in retail business, namely: dynamic pricing, ad-hoc couponing, personalized promotions, real-time on-shelf-availability management, and intraday forecasting and replenishment. Based on these findings we discuss five general principles and challenges which need to be considered in order to leverage business value through in-memory databases. These principles also apply to a wider audience in diverse areas of business.

IN-MEMORY DATABASE BUSINESS VALUE

Results from a Study on Retail Innovation

Clearly, in-memory technology offers increased information processing capabilities, and expectations are rising. What role can it play in terms of business value, and what does it mean for the retail industry in particular? Learn about 5 scenarios that might transform the retail business.

by Jan vom Brocke, Stefan Debortoli, Oliver Müller, and Axel Uhl

Recent technological developments in the IT sector enable new possibilities for business process management, service innovation, and product innovation. Two examples are ubiquitous computing and in-memory technology.

Ubiquitous computing aims at leveraging real-time technologies to collect real-world data for capturing the status and environment of a process. The vision is to "use real-time information from sensors, radio frequency identification, and other identifying devices to understand their business environments at a more granular level, to create new products and services, and to respond to changes in usage patterns as they occur" (Davenport et al. 2012, p. 43). As a result, great amounts of rich data can be captured in nearly real time. Today, not only structured but many sources of unstructured data – such as images, audio, and video – also contain valuable information for better decision making (vom Brocke et al. 2011). Researchers and practitioners have labeled this approach of harvesting vast amounts of structured and unstructured data in an integrated fashion as "Big Data" (Davenport et al. 2012).

Another recent innovation is in-memory technology. It offers an increased information processing capability. For example, in-memory Database Management Systems (subsequently abbreviated with "DBMS") may enable a performance increase by a factor of 100,000 (SAP 2012) compared to traditional relational DBMS. With in-memory technology, data and applications are kept completely in the computer's main memory to avoid expensive mechanical hard drive access (Plattner and Zeier 2011). This approach allows for an analysis of Big Data in a timely manner, enables real-time monitoring and control of business processes, and provides an opportunity for new applications to be developed. Plattner and Zeier (2011, p. xxxii) claim that in-memory technology "marks an inflection point for enterprise applications" and that this innovation "will lead to fundamentally improved business processes, better decision making, and new performance standards for enterprise applications".

Today, while the new technologies for enabling real-time and high-performance computing are available, the business value they create has not been analyzed in detail yet. To fill this research gap, the University of Liechtenstein established an In-Memory-Technology Competence Center. In a joint research study with

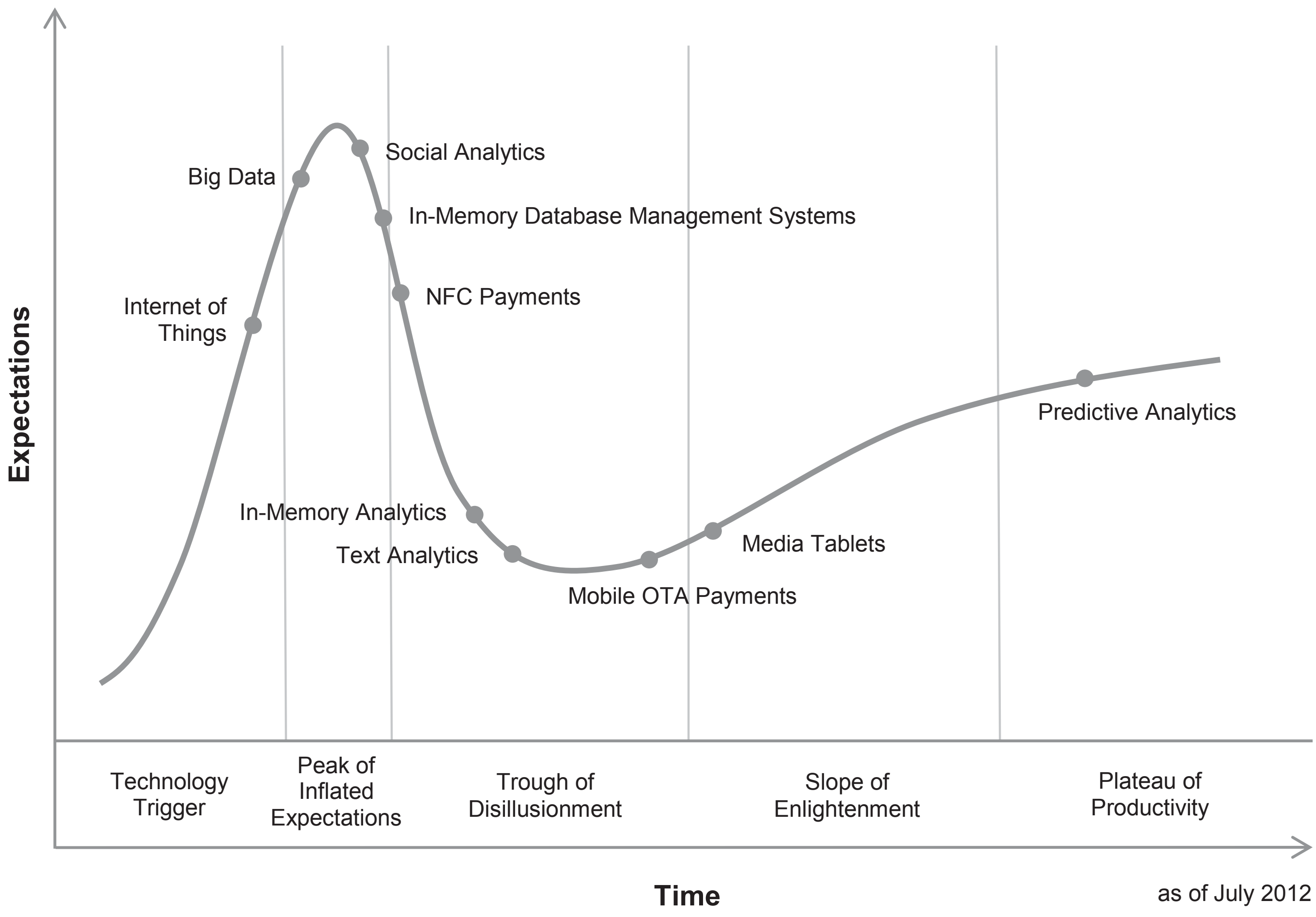

Fig. 1: Excerpt from the Hype Cycle for Emerging Technologies 2012 (adapted from Gartner 2012a)

the Business Transformation Academy (BTA), interviews with leading authorities of large European retailers, as well as executives of SAP Retail and the SAP Future Retail Center were conducted over a six-month period in 2012. In this article, application scenarios of in-memory value creation in retail industry which were derived from those interviews will be exemplified. In addition, principles and challenges will be indicated that may well be applied to other businesses.

Emerging Technologies

In order to understand how value can be created through in-memory-technology, a greater context of emerging technologies needs to be considered. In figure 1, the excerpt from the Gartner Hype Cycle for Emerging Technologies 2012 (Gartner 2012a) illustrates recent developments. This study has identified in-memory computing as one of the top ten strategic technologies for 2013. Gartner's definition of a strategic technology is "one with the potential for significant impact on the enterprise in the next three years" (Gartner 2012b). It can be observed that a vast amount of the emerging technologies can be clustered into four major technology types: (1) Mobile Devices, (2) Internet of Things, (3) Big Data, and (4) In-Memory Technology. These four technology types, which enable the capture, storage, and analysis of business events in real time, are explained briefly in table 1.

While each of the above-mentioned technologies is powerful on its own, a certain power lies in their combination. The increased information processing capacity provided by in-memory technology seems to serve as an enabler for more innovative application scenarios. In the next section, we will briefly outline the key technological characteristics of in-memory technology.

In-Memory Database Management Systems

The technological foundations of in-memory computing were developed in the mid-1980s, but it is recent developments in the area of computer hardware that have made the use of these technologies economically feasible for many companies, primarily by increasing the main memory sizes and the computing power at affordable prices. As a result of these developments, many enterprise software vendors have begun building in-memory technology into their application systems, for example SAP with their in-memory technology database appliance SAP HANA.

In-memory DBMS can be described in terms of five primary technical characteristics.

- The whole operational and/or analytical database is stored entirely in Random Access Memory (RAM), avoiding expensive performance loss of disk I/O (Word 2012). Accessing data in main memory is up to 100,000 times faster than accessing data on a traditional hard disk, resulting in increased information processing capabilities (Berg and Silvia 2012).
- Multiple multi-core CPUs can process parallel requests in order to fully use the available computing resources (Word 2012).
- Instead of the row-based-only, transaction-focused approach that is implemented in traditional relational DBMS, a hybrid row- and column-oriented storage approach is applied in SAP HANA. The column-oriented storage approach provides significant advantages for modern CPUs as it improves data compression and allows for massive parallel processing and efficient memory access, which is required for analytic purposes (Plattner 2009).
- Innovations in the hybrid row- and column-storage approach allow data

Table 1: Four types of emerging technologies

(1) Mobile Devices: The diffusion of mobile technologies, such as smart phones and tablet computers, has accelerated since the turn of the century (Ladd et al. 2010). Mobile computing has the potential to significantly alter the interactions of individuals, groups, organizations, and societies. Standalone applications or remotely-accessible thin clients enable on-demand and on-the-go access to various business applications of the enterprise system.
(2) Internet of Things (IoT): The IoT is a concept belonging to ubiquitous computing where each real-world object is equipped with sensor- and communication-devices, enabled by recent developments in technology: the physical size of wireless network enabled devices has drastically decreased and their computation power, memory, network speed, and throughput have increased. This progress has led to an almost infinite number of new applications in many business domains. The vision is to fully connect the real world with the digital world.
(3) Big Data: Recently, this term has been used to describe the data sets in applications that are so large (from terabytes to exabytes) and complex (from sensor to social media data) that the current data management technologies cannot cope with them anymore. They require advanced and unique data storage, management, analysis, and visualization technologies (Chen et al. 2012). New technologies, like in-memory DBMS, offer a solution for including large and complex data in the results of various queries.
(4) In-Memory Technology: This technology breaks away from the traditional architectural principles of relational Database Management Systems (DBMS) and stores data permanently in the main memory of the underlying system instead of the physical hard drives. Because of growing main memory capacities and affordable prices, it is possible to shift whole databases into the main memory of servers. Such systems are called "in-memory DBMS". The most profound implication of this change in storage is the performance gain of the database systems since the access time for main memory is orders of magnitude less than for disk storage.

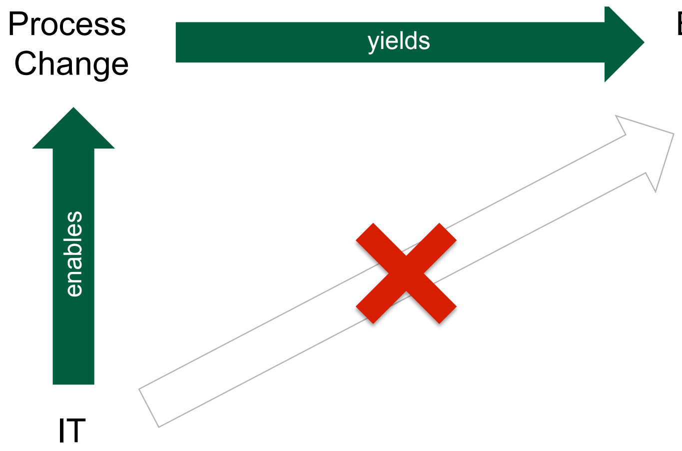

Fig. 2: Business value creation (adapted from Bakos 1987)

compression ratios between 5 and 10 on the raw data (Word 2012).

- In-memory DBMS implement an insert-only approach (Berg and Silvia 2012). This means that the database does not allow applications to execute low-performing updates or deletions on physically stored tuples of data.

As we will see in the following paragraphs, these five technical characteristics of in-memory DBMS are the keys to a significant performance increase of data management, enabling improved business processes, better decision making, and new performance standards for enterprise applications.

Value Creation through In-Memory Technology

In-memory-based application systems are increasingly gaining relevance for decision makers in the field of enterprise information systems. Still, their specific benefits in terms of economic value creation are not yet well understood. Chief Information Officers are not sure to what extent their organization's information systems may benefit from an investment in in-memory technology. The same holds true for software vendors.
Considering value creation, one has to be aware that, put simply, technology alone does not generate business value. The same applies to in-memory technology. Rather it may enable changes in business processes, which ultimately lead to business value (see fig. 2).

Based on this understanding, business application scenarios, in which in-memory technology can enable process change, need to be identified. Drawing from our investigation into emerging technologies, we also tried to envision combinations of in-memory technology with Big Data, Internet of Things, and mobile computing that might offer particular potential for process innovation. To learn about such potentials, we conducted interviews with four leading experts in the field of retail and retail information systems.
The purpose of this joint research project is to provide exemplary value-generating application scenarios through process and service innovation in the retail sector and then to derive general principles for leveraging the potential of in-memory technology in an enterprise context.
Based on a series of in-depth interviews with retail industry experts, five promising in-memory technology based application scenarios were identified. In this section, we will present the five exemplary scenarios in depth; discuss the technical and organizational prerequisites, as well as the need for in-memory technology. A summary of the application scenarios will be presented in table 2.

Scenario 1: Dynamic Pricing

The benefits of dynamic pricing models have long been known in service industries, such as airlines, hotels, and utilities, where the product or service capacity is perishable and fixed in short-term (Elmaghraby and Keskinocak 2003). The increased availability of demand data led to an increasing adoption of this policy in other sectors as well (e.g., Sport Tickets, Online Shops, etc.). The idea behind dynamic pricing in retail is to regularly adjust the prices of goods depending on various factors, such as real-time inventory levels, current demand, time of the day, quality of perishable goods, individual purchase history, as well as purchases of other customers.
In-memory technology facilitates this scenario with its ability to capture and store large amounts of data in a timely

manner, e.g., inventory levels, current demand, or quality of perishable goods. The analysis of these data must be performed close to real time in order to provide information on a product's current value.

From a technical perspective, various prerequisites need to be fulfilled. On the one hand, qualitative and quantitative data on the goods must be available. Evaluating the quality of perishable goods requires new technologies, e.g., sensor networks as an integrated part of the Internet of Things, measuring environmental parameters, such as temperature, humidity, and luminance. In order to monitor current inventory levels and demand, all transactions need to be processed and analyzed in real time. On the other hand, the collected data must be processed accordingly. The constantly changing prices must be visible to the customer. In the case of a supermarket, this means that printed price labels must be replaced by electronic price tags to cope with this first challenge. Regularly recalculating the prices requires real-time communication between the point of sales (POS) and the corresponding in-memory back-end system (e.g., SAP HANA) to guarantee that the correct up-to-date prices are displayed.

However, beyond the technical prerequisites, the organizational prerequisites also need to be addressed, and those are more crucial for the success of dynamic pricing. On the one hand, dynamic pricing policies must be in line with the business strategy meaning that the company needs to be willing to start price discrimination. On the other hand, it is very important that the customer trust is preserved. If there are no discernible strategies for price transparency, the risk of putting customers off is very high.

Scenario 2: Ad-hoc Couponing

Ad-hoc couponing relates to printing personal coupons on receipts depending on individual factors such as the customer's current shopping basket and the respective individual purchase history, as well as the purchases of other customers. Thus each customer receives highly individual up- and cross-selling offers. Since the coupon is printed on the receipt, the customer has to return to the retail store in order to cash the voucher. This allows for better customer retention.

Implementing ad-hoc couponing requires capturing and analyzing huge amounts of data in a timely manner, and in-memory technology provides the necessary capacity and speed.

Real-time information flow between the POS and the back-end system is based on a two-way communication. First, information about the current shopping basket needs to be transmitted to the "coupon calculation engine". Second, the calculated offer has to be transmitted back to the POS for printing the receipt. This requires constant up-to-date sales data availability in the back-end system as well as some means of customer identification in order to access the personal purchase history. The most common technique for customer identification is the distribution of loyalty cards, which need to be presented for each purchase.

As in the dynamic pricing application scenario, ad-hoc couponing also requires the company's willingness to give away coupons. Depending on the firm's strategy, such a price-based instrument might not fit the marketing concept, which then could make this scenario not applicable.

Scenario 3: Personalized Promotions

In this scenario, personalized promotions are pushed onto a customer's smartphone when he or she is, e.g., near a specific shelf or even driving or walking by a retail store. This enables customer-specific up- and cross-selling possibilities, and may lead to an increased customer retention, which in turn leads to increased sales volumes.

The continuous collection and storage of user location data as well as quick analyses of these records and of correlations with historical sales data require information processing capabilities which only in-memory technology can offer.

Locating, identifying, and reaching one's customer is a crucial prerequisite in this scenario. Today's smartphones already offer all required functionalities and the current smartphone penetration is rapidly rising. In addition to the data of one specific customer, information about the buying behavior of other customers is of equal importance for recommending possibly relevant items. As it is with all cross- and up-selling activities, the organization's strategy must include the willingness to do such promotions.

Scenario 4: Real-Time On-Shelf-Availability Management

Real-time on-shelf-availability management enables an instantaneous detection of out-of-shelf situations based on time series analysis. The sales data are collected at every POS and directly transmitted to the corresponding back-end system in real time. When an out-of-shelf situation is detected, a replenishment notification trigger gets sent to the employee in charge (e.g., pop-up in the enterprise system, e-mail, text message, etc.). In contrast to the previously introduced scenarios, this application scenario does not require any additional hardware solution and, thus, enables great benefits for little costs.

In this scenario, having the sales data available in one central database in a timely manner is a crucial factor for being able to quickly react to dropping sales volume caused by an out-of-shelf situation. However, there is an even more time-critical part of this application: the constantly running analysis of the data and the recognition of out-of-shelf situations based on distinctive sales patterns. In-memory databases fulfill both prerequisites for implementing this application scenario.

Besides the important real-time communication between the POS and the corresponding back-end system, the identification of relevant sales patterns constitutes the most challenging technical prerequisite in this scenario. However, various data mining techniques already exist which can serve as a basis for further developments. From an organizational point of view, the only prerequisite for this application scenario is the in-stock availability at the warehouse of the goods to be replenished. In some cases, the scenario which is described next might support this accomplishment.

Scenario 5: Intraday Forecasting and Replenishment

Intraday forecasting and replenishment means predicting out-of-stock situations and re-supplying stores with the needed goods multiple times a day. This does not only include the supply from a central warehouse to various branches, but also the transfer between the stores. As a result, the amount of inventory and, therefore, idle capital can be reduced dramatically.

The constant gathering of sales data from the POS and the continuous monitoring of inventory data require a database optimized for inserting large amounts of records. Additionally, the continuous analyses of data to detect out-of-stock patterns as well as the route-planning for the next delivery of supplies are predestinated tasks for in-memory databases.

While real-time communication between the POS and the back-end system, as well as up-to-date inventory data are essential technical requirements, the organizational prerequisites pose a bigger challenge, including agile supply chains and sufficient margins on the goods. Therefore, this scenario is not feasible for all types of merchandise since the additional transportation costs must be covered by higher margins. This scenario is a balancing act between having enough inventory and the occurring costs for the required extended logistics network, i.e., an agile supply chain.

Lessons Learned

Based on our introduction chapter and learning from the five scenarios discussed above, we can derive five principles for value-creation through the in-memory database innovation.

Scenario	Description	Technical Prerequisites	Organizational Prerequisites
Dynamic Pricing	Adjusting prices dynamically depending on ▹ inventory levels ▹ current demand ▹ time of the day ▹ quality of perishable goods ▹ individual purchase history ▹ purchases of other customers	▹ Electronic price tags ▹ Real-time communication between POS and back-end system ▹ Up-to-date sales and inventory data ▹ Customer's purchase history (e.g., loyalty card) ▹ Internet of Things	▹ Willingness for price discrimination ▹ Customer trust must be preserved
Ad-hoc Couponing	Printing personal coupons on receipts depending on ▹ current shopping basket ▹ individual purchase history ▹ purchases of other customers	▹ Real-time communication between POS and back-end system ▹ Up-to-date sales data ▹ Customer's purchase history (e.g., loyalty card)	▹ Willingness to give away coupons
Personalized Promotions	Pushing personalized promotions onto customer's smartphone while ▹ walking close by a specific shelf ▹ driving/walking by a retail store	▹ Access to customer's smartphone (e.g., mobile app) ▹ Customer's exact geographic location ▹ Customer's purchase history (e.g., loyalty card) ▹ Purchase data of other customers	▹ Willingness to do promotions
Real-Time On-Shelf-Availability Management	Detecting out-of-shelf situations instantly via POS time series analysis	▹ Real-time communication between POS and back-end system ▹ Typical sales patterns	▹ Additional products must be on stock
Intraday Forecasting and Replenishment	Predicting out-of-stock situations and re-supplying stores multiple times a day (incl. stock transfers between stores)	▹ Real-time communication between POS and back-end system ▹ Up-to-date sales and inventory data	▹ Agile supply chain ▹ Sufficient margins

Table 2: Application scenarios

First, in-memory technology alone does not create business value per se.
Value creation does not come automatically by choosing in-memory DBMS. Rather it enables changes to business processes, which then may lead to substantial business value creation. Opportunities need to be identified and business transformations based on these opportunities need to be successfully managed. For example, all application scenarios presented in our study require

new processes and algorithms to be implemented in the enterprise system. None of them would work right away by swapping the enterprise system database with an in-memory DBMS.

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- Jörg Wagner, Global Head Trading Industries Consulting Services, SAP

Second, high value potential lies in the combination of in-memory technology with other supporting technologies.
Examples for such complementary technologies are mobile devices (e.g., smart phones, tablet computers) and sensing devices. These technologies are required as data sources and data sinks to incorporate contextual data. An example is the "personalized promotion" scenario in which location-based services are used extensively. Nevertheless, data privacy and security needs to be ensured at every point of the process in order to guarantee its wide acceptance among the users.

Third, a mature IT and process landscape is required in order to unfold the full potential of in-memory technology.
In this context, mature stands for (1) high data quality, (2) harmonization of diverse internal data sources, and (3) sharing information along the supply chain. Otherwise, in-memory technology can only be used to support existing processes or applications (e.g., reporting) without capitalizing its distinguished capabilities. For example, in the case of the "intraday forecasting and replenishment" scenario, information from outside the company's system boundaries (e.g., from a supplier) are required. If these three prerequisites are not fulfilled the increase in information processing capacity can only work locally in single transactions. The entire supply chain must be fit enough to leverage the performance increase by in-memory technology; otherwise bottlenecks might limit the value creation.

Fourth, existing planning and forecasting models have to be extended to incorporate the larger set of parameters that can be taken into account.
As more data can be included for generating the underlying mathematical model, in-memory technology promises to provide better prediction results. However, the challenge is to come up with an appropriate mathematical model based on the business requirements. For example, in the scenarios of "dynamic pricing" and "ad-hoc couponing", the core functionalities are the price/recommendation algorithms. The success of these scenarios heavily depends on the quality of the results of the implemented business logic.

And finally, leveraging the potential of in-memory technology challenges, beyond technical and methodological challenges, also issues related to people, strategy, and compliance need to be considered.
The described application scenarios show that – apart from the application landscape – also diverse stakeholders involved in the business processes need to support the process changes facilitated by in-memory technology: Customers need to cope with the amount of new information which is being actively pushed to them. Retailers need to find the right amount of additional information (e.g., personalized promotion) for customers as an information overload might lead to a negative impact on the expected results. Since organizations are socio-technical systems, strategies of business transformation need to be selected and applied carefully.

In summary, this article aimed at giving an overview of the business value of in-memory technology in an enterprise context. We focused on the retail industry and, based on the conducted interviews, we identified five specific application scenarios. These findings allowed us to derive five more general principles to consider for leveraging business value through in-memory technology. Since we consider these principles relevant for a wider audience in diverse areas of business, we hope that these five scenarios will inspire others to apply the presented principles to their sector. At the same time it is clear that the application of in-memory technology in an enterprise context is still at an early stage. Our findings have a preliminary character and call for further investigation.

As one of our interviewees stated, we are just at the beginning of a new era of enterprise systems, which is comparable to the time when decision support systems were introduced a few decades ago. Our journey of studying the business value of in-memory technology will also continue intensively. Our further plans encompass comparing and contrasting the use of in-memory technology in several industries, in different parts of the value-chain, and in various types of applications. ◢

BIBLIOGRAPHY

- Bakos, J. Y. (1987). Dependent variables for the study of firm and industry-level impacts of information technology. Proceedings of the 8th International Conference on Information Systems Pittsburgh, 10-23.
- Berg, B. and Silvia, P. (2012). SAP HANA: An Introduction. Boston, MA: Galileo Press.
- Chen, H., Chiang, R. H. L., Storey, V. C. (2012). Business intelligence and analytics: From big data to big impact. MIS Quarterly, 36(4), 1165-1188.
- Davenport, T. H., Barth, P., Bean, R. (2012). How “Big Data” Is Different. MIT Sloan Management Review, 54(1), 43-46.
- Elmaghraby, W., Keskinocak, P. (2003). Dynamic Pricing in the Presence of Inventory Considerations: Research Overview, Current Practices, and Future Directions. Management Science, 49(10), 1287-1309.
- Gartner (2012a). Gartner’s 2012 Hype Cycle for Emerging Technologies Identifies “Tipping Point” Technologies That Will Unlock Long-Awaited Technology Scenarios. Available at: http://www.gartner.com/it/page.jsp?id=2124315 [Accessed on 26.02.2013]
- Gartner (2012b). Gartner Identifies the Top 10 Strategic Technology Trends for 2013. Available at: http://www.gartner.com/it/page.jsp?id=2209615 [Accessed on 26.02.2013]
- Ladd, D. A., Datta, A., Sarker, S., Yu, Y. (2010). Trends in mobile computing within the IS discipline: A ten-year retrospective. Communication of Association of Information Systems, 27, 285-306.
- Plattner, H. (2009). A common database approach for OLTP and OLAP using an in-memory column database. Proceedings of the 35th SIGMOD International Conference on Management of data - SIGMOD ’09, 1-2.
- Plattner, H. and Zeier, A. (2011). In-memory data management: an inflection point for enterprise applications. Heidelberg Dordrecht London New York: Springer Verlag.
- SAP (2012). The “One Hundred Thousand” Club. Available at: http://www.experiencesaphana.com/blogs/experts/2012/02/06/the-one-hundred-thousand-club [Accessed on 26.02.2013]
- vom Brocke, J., Derungs, R., Herbst, A., Novotny, S., Simons, A. (2011). The drivers behind enterprise content management: a process-oriented perspective. ECIS 2011 Proceedings. Helsinki, Finland.
- Word, J. (2012). SAP HANA Essentials (2nd ed.). Epistemy Press.

Service

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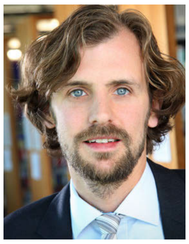

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