Class Notes: BPM Research and Education

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In-Memory Value Creation, or now that we found love, what are we gonna do with it?

I decided to start this Column with a hot topic: in-memory value creation. It often reminds me of the the song “Now that we found love” written by Kenneth Gamble and Leon Huff and originally released on The O'Jays’ (1973) album *Ship Ahoy*.

In-memory technology—as considered by Gartner (2011) and Dutta & Bilbao-Osorio, (2012), for example, and discussed on *BPTrends* by Frankel (2012), among others—enables a remarkable increase in the information-processing capacity of organizations’ application systems. For example, SAP reports increases in transaction speed by factors up to 100,000 for its in-memory computing appliance, HANA (High-performance ANalytic Appliance). This increase in speed is comparable to improving the flight time from New York to Paris to 0.28 seconds or that of circling the world to 1.5 seconds (SAP, 2012a). Truly, such acceleration goes beyond our imagination on what we can achieve through process improvement. “Imagine this speed increase: How would you plan your weekend with your spouse?” Martin Petry, CIO of the Hilti Corporation, asked. “You might actually consider visiting two or three continents as opposed to going shopping in the village close by.”

Appliances of in-memory technology, such as QlikView (released by QlikTech in 1997) and products from IBM, Oracle, SAP, and TIBCO (Howarth, 2011; vom Brocke et al. 2013a), are available in the market. But companies are challenged by the question, “How can we create value out of this?” Ironically, the question is not easy to answer. Martin Petry observed that “we used to provide sales reports in the morning at 7 a.m., and now we would be able to provide them at 3 a.m. or much earlier. But who would care? No sales representative would wake up four hours earlier just to see these reports. Clearly pure acceleration of some operations is not delivering the expected value.”

There is excitement about a technological innovation that makes possible scenarios we did not even think of before, but these possibilities exceed our imagination in such a way that we aren’t sure how to benefit from it. In other words, “what are we gonna do with it?”

In our BPM group at the University of Liechtenstein, we conducted a number of research projects on in-memory value creation (www.uni.li/bpm) and had the chance to study one of the early adopters, the Hilti Corporation, which served as a ramp-up partner for SAP Hana (vom Brocke et al., 2013a). We were also among the first to talk to thought leaders, such as those in retail (vom Brocke et al., 2013b). This note shares the first findings of this work. It presents some specific application scenarios, as well as first general principles about leveraging the potential of in-memory technology that we identified in our projects. The findings show the important role of BPM in creating business value through in-memory technology. I look forward to discussing these results with readers!

Fundamentals of In-Memory Technology

Previous studies have covered the fundamentals of in-memory technology in detail (e.g., Plattner & Zeier, 2011, Word, 2012, Berg & Silvia, 2012), so I'll limit this section to brief summary of some fundamentals.

The technological foundations of in-memory computing were developed in the mid-1980s, but it is recent developments in the area of computer hardware —primarily increases in the size of main memory and in computing power at affordable prices—that have made the use of these technologies economically feasible for many companies.

In-memory database management systems (IMDBMS) can be described in terms of five primary technical characteristics (vom Brocke et al. 2013a):

1. The whole operational and/or analytical database is stored entirely in RAM, avoiding the expensive performance penalty of disk I/O (Word, 2012).
2. Multiple multi-core CPUs can process parallel requests, thereby using the available computing resources fully (Word, 2012).
3. A mixed row- and column-oriented storage approach is applied in IMDBMS instead of the row- only approach that is implemented in traditional relational database management systems (RDBMS) (Plattner & Zeier, 2011).
4. IMDBMS offer compression techniques like dictionary-encoding and run-length-encoding that significantly reduce data size (Plattner & Zeier, 2011).
5. IMDBMS implement an insert-only approach (Berg & Silvia, 2012), so the database does not allow applications to perform updates or deletions on physically stored tuples of data.

These five characteristics are key to a significant increase in information processing capability. Now, how could this create business value?

Value creation through In-Memory Technology: Additional fundamentals not to be forgotten

When seeking for value creation, one must consider that technology alone does not generate positive business value (Bakos, 1987), and in-memory technology is no exception. Instead, in-memory technology may enable changes in business process that ultimately lead to business value (cf. Figure 1).

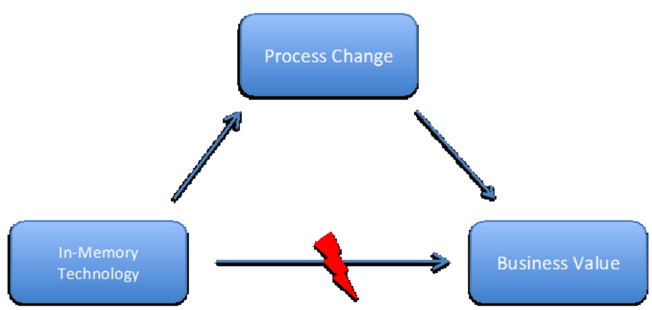

Figure 1 - Business Value Creation (cf. Bakos, 1987)

Based on this understanding, business application scenarios should be identified considering the specific use contexts in which in-memory technology can enable process change that ultimately delivers business value.

Some Examples of Value-Creating In-Memory Scenarios

We conducted interviews with experts from industry (vom Brocke et al., 2013a) and retail (vom Brocke et al., 2013b) in order to learn what scenarios they envisioned for in-memory value creation. We also involved students from our university in order to approach the task with a fresh perspective and stimulate out-of-the-box thinking. In all of these discussions, we applied a generic creative process (Lubart, 2001) of preparation, incubation, illumination, and verification. In what follows, I present examples of the scenarios identified. (For a more thorough description and for more scenarios, see vom Brocke et al., 2013a and 2013b).

Scenarios from Retail

Scenario	Description
Dynamic pricing	Adjusting prices dynamically depending on: - inventory levels - current demand - time of day - quality of perishable goods - individual purchase history - other customers' purchases
Ad-hoc couponing	Printing personal coupons on receipts depending on: - current shopping basket - other customers' purchases - individual purchase history
Personalized promotions	Pushing personalized promotions onto customers' smartphones while they are: - walking close by a specific shelf - driving/walking by a retail store

Scenarios from Industry

Scenario	Description
Track 'n' Aid	Capturing data from tools (or, more generally, products) in the field regarding position, status, and usage data in order to enhance customer service and improve product designs.
Instant Knowledge Finder	Managing knowledge in real time by: - extracting information from various unstructured data sources as it is created - crawling file systems constantly to extract concepts and relationships from textual data - recommending colleagues with whom to connect who show a similar expertise or interests
Sales Area App	Supporting salespeople in the field with customer-related information, such as - which customers are in the region - nearby construction sites - location and status of tools on these sites - social media posts from people nearby

The scenarios–and particularly the process of creating them–revealed some general principles for in-memory value creation that are discussed in the next section.

A Model for In-Memory Value Creation

Our model builds on the three levels of observation introduced in figure 1: technology, process change, and business value. This note focuses on the process-change-related effects in the center of the model. For further explanation, please refer to the original and full version of this research (vom Brocke et al., 2013a).

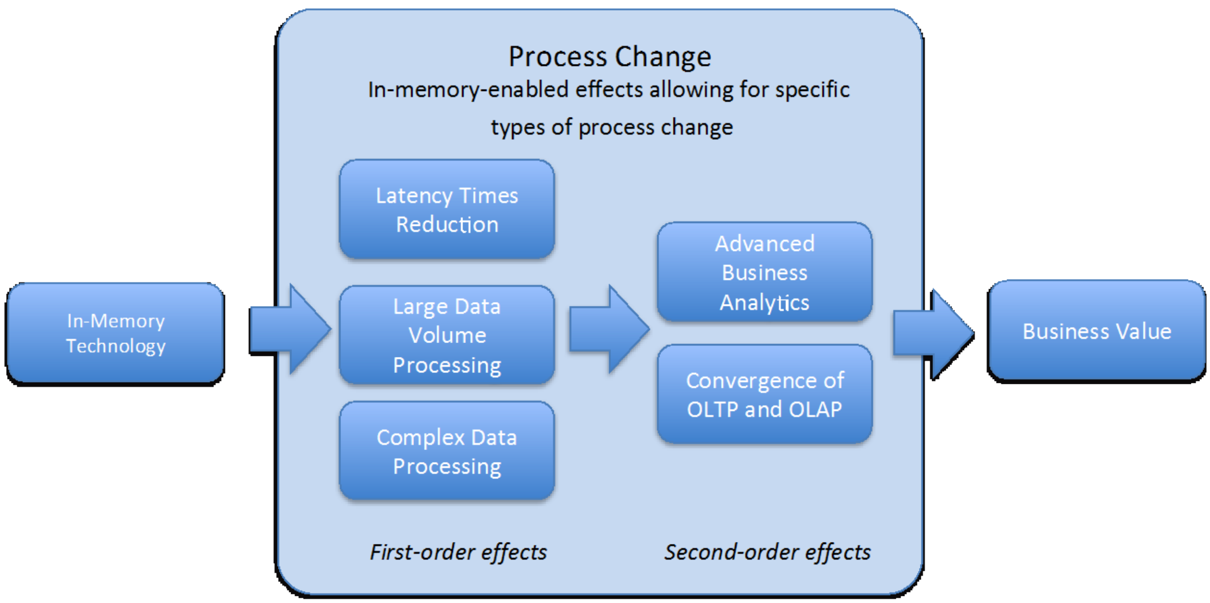

Fig. 2: Model for Generating Business Value through In-Memory Technology (cf. vom Brocke et al., 2013a)

Based on the model shown in figure 2, we can derive four essential principles of in-memory technology value creation, as described in vom Brocke et al., 2013a:

1. **The technical characteristics of in-memory technology provide first-order and second-order effects.** From in-memory technology we observe an increase in the information-processing capability, such as increased speed of single calculations or transactions. However, in order to investigate organizational performance effects more deeply, we have to focus on what possibilities arise *from* this increase in information-processing capacity—that is, second-order effects.

2. **The second-order effects of in-memory technology manifest in advanced business analytics and the convergence of online transaction processing (OLTP) and online analytical processing (OLAP).** Through increased information-processing capacity, in-memory technology facilitates the creation of statistical models that can consider an unprecedented number of inputs and that allow analyses to be performed in a timely manner (see *Advanced business*

analytics). In-memory technology also allows OLAP and OLTP systems to be converged by eliminating the information latency of conventional ETL (extract, transfer, load) processes and enables analyses of “historical” data at the time a transaction is performed (see: *Convergence of OLTP and OLAP*). These capabilities enable embedded analytics (Nijkamp & Oberhofer, 2009), operational business intelligence (Marjanovic, 2007), real-time business intelligence (Chaudhuri et al., 2011), and context-aware business process management (Rosemann et al., 2010).

3. **The second-order effects of in-memory technology are driven by reduced latency times and the ability to process large volumes of complex data.** In-memory technology shrinks latency times (see *Latency times reduction*) and reduces the value lost related to latency through real-time computing (reducing data latency) and high-performance computing (reducing analysis latency). We like to use the latency types presented by (zur Mühlen & Shapiro, 2010) to illustrate this effect (figure 3). In addition, because of the technical characteristics of in-memory technology, larger and more complex data sets can be processed in a given amount of time (see *large data volume processing* and *complex data processing*), so data can be taken into account that has not been considered before.

4. **The value creation through in-memory technology is limited by the capabilities of the overall socio-technical structures and processes.** Discussions with industry experts showed that, in many cases, a mature IT landscape—including high-quality data, harmonization of diverse internal data sources, and information-sharing along the supply chain—is required in order to realize the full potential of in-memory technology. In that sense, the increase in automated information-processing must be supported by the structures and processes (including people) throughout the entire value chain. Establishing this level of support often requires substantial business transformation work, for which BPM can provide important solutions (vom Brocke et al., 2012).

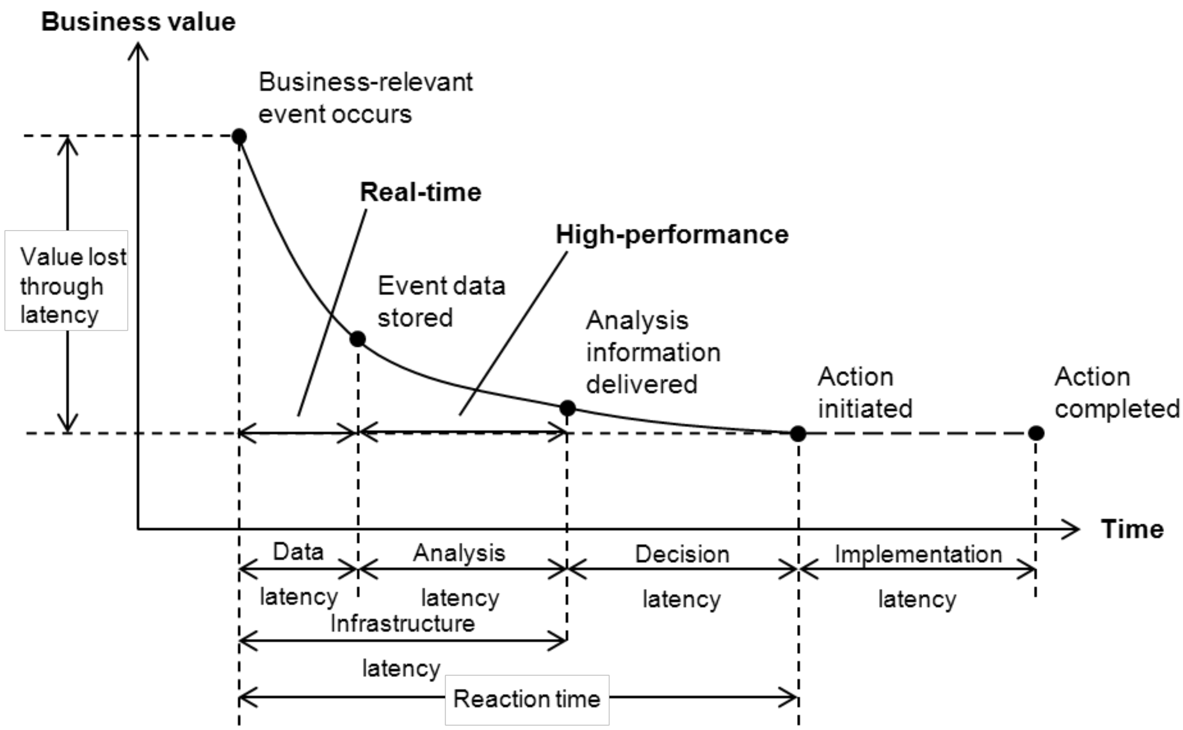

Figure 3. Latency Types (cf. zur Mühlen & Shapiro, 2010)

Summing Up – Lessons Learned

Summing up, there is clearly value potential in in-memory technology, but this potential must be identified and realized via process change. The key technical characteristic of in-memory technology is an increase in information-processing capacity, which enables first-order effects for process change, such as reductions in latency time, large volume data processing, and complex data processing. In combination, these effects drive second-order effects, such as advanced business analytics and the conversion of OLTP and OLAP. The scenarios that we identified for the use of in-memory technology in industry and retail indicate the potential for significant value creation if structures and processes are properly aligned.

A Call to Share Your Opinions

At this stage, we would like to invite readers to share their experiences in in-memory value creation. Do you see similar effects related to in-memory technology? Do you disagree with our findings? Can you think of other effects? Are you embarking on in-memory projects? We are eager to hear from you!

Acknowledgements

Many people and institutions contributed to the findings presented in this note. First and foremost, I thank my colleagues Oliver Müller, Stefan Debortoli, and Nadine Reuter, with whom I conducted this research. Special thanks also go to the Hilti Corporation and the SAP Business Transformation Academy, which were instrumental in conducting the first studies.

I also thank Jan Recker for getting me involved in this exciting role of writing this Column. Jan has been a valued colleague and good friend over the years, and it is a pleasure for me to continue his work. It has been fun writing this note, and I look forward feedback from the community.

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