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In-Memory Computing technology
The holy grail of analytics?

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In-Memory Computing in a nutshell

The latest industry perception clearly indicates a strong trend towards the adoption of In-Memory Computing (IMC). Results from a recent Deloitte survey among German CIOs and IT executives show that the concept of IMC is well known but productive use is still limited to innovators. The early majority of industry players are at the stage of running a pilot scheme or close to running a pilot scheme. However, most industry players have not yet decided whether IMC is hype or not and are taking a wait-and-see approach. The study provides evidence that especially those organizations that do not already utilize IMC tend to underestimate the implementation effort, after technological choice and integration. Likewise these organizations seem to have not yet grasped the full potential of IMC.

The study results support the Deloitte view on In-Memory Computing: IMC amalgamates innovative technology with innovative business processes and applications. Therefore, In-Memory Computing is the future of computing and consequently will make its way into businesses to help utilizing sustainable competitive advantages with its performance, process innovation, IT architecture simplification, and flexibility.

In-Memory Computing in a nutshell

From a hardware-based point of view, data analysis consists of three components: the processor to perform the calculations, the storage to store the (manipulated) data and a system that transfers data between the two. Naturally, the slowest of these components is the bottleneck for the performance of IT-based data analysis. The current bottleneck is the latency of storage. More specifically, it is not the latency of random-access memory but the latency of hard disks. Processing power is not used to full capacity because the data to be processed is not retrieved fast enough from hard disks.

IMC, in a nutshell, is moving data which has traditionally been stored on hard discs into memory. By focusing on pure hardware characteristics latency is dramatically reduced. Considering, for example, tests with Intel's Nehalem architecture, the latency of storage is reduced from one million CPU cycles to an average of 250 CPU cycles. Consequently, the process of data analysis is subject to a tremendous speed-up.

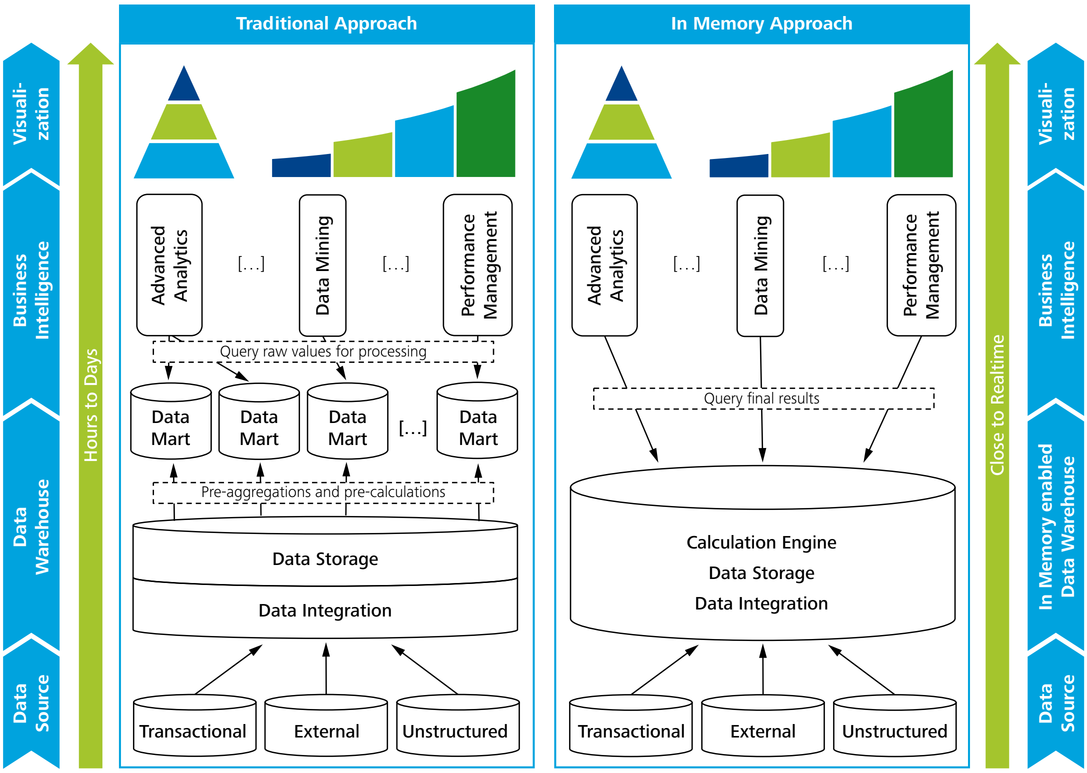
Specialized databases are required in order to move data into memory. An example is the SAP HANA IMC database, which was recently launched by SAP. In comparison to traditional offerings, IMC databases are not limited to the exploitation of pure hardware advantages. Intelligent data processing, data compression, and a built-in calculation engine which delivers close to real time results to complex data queries enable major additional performance gains. Furthermore, these features allow for the processing of both transactional as well as analytical data. At last it becomes possible to run operational applications and data analysis in close to real time on a single database. The case of a pilot customer for SAP HANA illustrates the potential for performance gains. The pilot customer managed to reduce the time it took to run a report from one hour to one second. That is 3,600 times faster than before. In comparison, a flight from London to New York which currently takes about 8.25 hours would be reduced to 8.42 seconds.

> "In-Memory Computing promises a massive gain in speed."

The shift from traditional, hard disk-enabled data warehouses to IMC-enabled data warehouses implies a reduction in layers on the way from raw data to the results of data analysis (Figure 1).

In a traditional data warehouse-based approach, raw data is stored in a data warehouse. Part of the data is extracted to data marts for the purpose of context and user specific pre-aggregations and pre-calculations. The results stored in a data mart are requested by business intelligence applications for the processing and visualization of final results. As in a traditional data warehouse, raw data is stored in an IMC-enabled data warehouse. However, business intelligence applications do not request partial results from data marts but final results from the IMC-enabled data warehouse. The results are computed in close to real time by querying the built-in calculation engine. The purpose of business intelligence applications is reduced to the proper visualization of the results queried. The layer of data marts becomes obsolete. Furthermore, IMC-enabled data warehouses allow for a frequent update of raw data so that e.g. transactional applications can directly feed data into an IMC-enabled data warehouse.

Fig. 1 – Traditional data warehouse approach vs. IMC-enabled data warehouse approach



Three common IMC misjudgments

Having described the major aspects of the IMC technology, the picture is not complete without outlining three common misjudgments concerning In-Memory Computing:

Misbelief #1: IMC provides competitive value out of the box

A simple speed up of current analytical and transactional processes is available but does not provide a sustainable competitive advantage. The utilization of IMC as a competitive tool needs talent to identify and serve the specific information needs of every single business. This requires effective management of data volumes and the respective analytical and transactional processes.

Misbelief #2: IMC solves current and future performance problems

It is reasonable to expect IMC to mitigate current performance challenges. However, the expected continuing exponential growth of data volumes could even out the performance gains in weeks rather than in years if the power of IMC is wasted to address data quality issues and if applications make inefficient use of IMC (e.g. by querying unnecessarily complex or repeated calculations and aggregations).

Misbelief #3: IMC allows for a reduction in IT Governance efforts

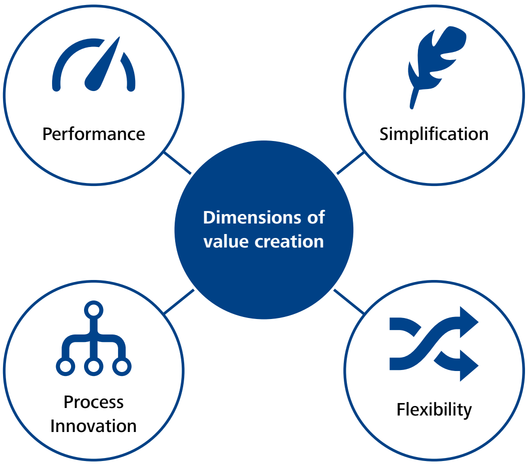
A reduced focus on IT Governance, pointing to performance gains, will result in a significant increase of process redundancies and complexity as well as in an increase of data volumes and maintenance effort. There is a major impact on the performance of IMC if the volume of data as well as the number of database queries is significantly increasing due to sloppy IT Governance.

Value Creation

Different dimensions of IMC value creation

A tight alignment of business and IT within an organization requires IT departments to make specific efforts to contribute effectively to the respective business goals. To justify the utilization of IMC for the purpose of data analysis the potential value created must be evaluated. Figure 2 shows the four major dimensions of value creation.

Fig. 2 – Dimensions of Value Creation



Consequently, the four dimensions can be identified as potential levers for organizations:

Performance

The duration of the process of data analysis, which includes all the steps from raw data to final analytical results, is reduced from hours to minutes or seconds. IMC allows leveraging the most recent data for the purpose of analysis and informed decisions.

Process Innovation

The performance gain offers the potential for innovative applications to differentiate sustainably from competitors. Examples include the finance industry considering the near real time analysis of the current risk exposure or the manufacturing industry considering complex scheduling on the most recent data.

Simplification

Due to the reduction in layers (data marts are obsolete) the complexity of data models can be reduced significantly. Simpler data models are providing the advantage of faster creation, less testing, less potential restart points as well as easier adaption. The reduction of complexity reduces the sources of potential errors.

Flexibility

The near real time calculation of analytical results from raw data adds flexibility in terms of two dimensions: integration of additional data sources and modification of the analysis. Analytical procedures making up an analysis can be changed without great effort as only a change to a query is required. New data sources can easily be plugged in as an additional source of information because every calculation is started from raw data.

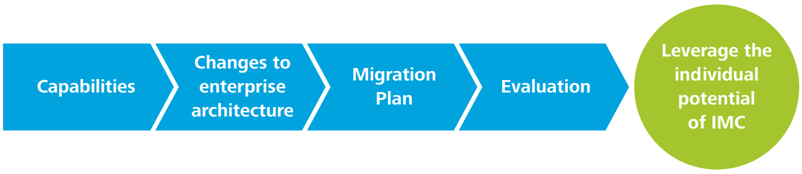
The dimensions of flexibility and simplification offer the potential for a significant reduction of the total cost of ownership (TCO): reduced efforts for the development of new data models as well as reduced efforts for the maintenance and development of existing data models.

Value Leverage

Four steps to leverage value creation

Enterprise architecture includes a detailed understanding of the way IT provides value for the business and how value creation translates to applications, data models, and information technology. To support value creation IMC needs to be properly fitted into the enterprise architecture. This is most straight forward if the enterprise architecture is already clearly set up. Figure 3 presents an overview of the four steps to leverage value creation by In-Memory Computing successfully.

Fig. 3 – Steps to applying IMC successfully



It is tempting to choose an easy target for the first application of IMC, but the selection of capabilities should be driven by business value.

Firstly, a clear process as well as a prioritization framework must be determined. In doing so, those capabilities with the highest priority according to business value have to be defined. However, it is advisable to discover the broader perspective beyond pure performance gains and consider changes in processes as well to leverage potentials that were not even thinkable before. The real competitive advantage will materialize as soon as fast analytics becomes a natural part of business processes and decision support.

Secondly, those changes to the enterprise architecture have to be identified which are needed to approach the selected fields of application. The changes break down into three categories: technology, data models, and processes. The technological choice sets the scope for the degree of adoption of IMC. Changes to data models and processes determine the degree of optimization towards leveraging the full potential of the technological choice. From a bottom-up perspective, the technological choice defines the scope of raw data to be integrated and as a result whether or not analytical and operational applications can be run on top of the IMC-enabled data. To capture the potentials of IMC fully, the applications have to be adapted to the infrastructure. Otherwise pure hardware-based performance gains can be realized, but leveraging advantages resulting from special software features like built-in calculation appear impossible. The same argument applies to processes and data models. IMC delivers its full potential the better processes and data models are adapted.

Thirdly, the migration to IMC must be well elaborated. Which quick wins to realize on the way to the envisioned enterprise architecture have to be defined. For example, quick performance gains can be achieved by replacing a traditional data warehouse with an IMC-based data warehouse. However, if the long-term goal is to reduce the TCO by simplification and to achieve maximum performance gains, data models as well as applications have to be optimized for IMC in a second step. In the end, the migration plan clearly defines whether to follow a big bang or a smooth transition that implies quick wins as defined in the migration plan.

Fourthly, having defined the benefits as well as the efforts to be made for the introduction of IMC, the respective utility must be compared to alternatives. Alternatives may offer fewer benefits but also cost less effort. Examples are the optimization of existing processes, data models and analytical procedures. Furthermore, the replacement of outdated standard hardware or the update to a more advanced software release of a data warehouse may be sufficient to realize the required benefits.

Reality Check

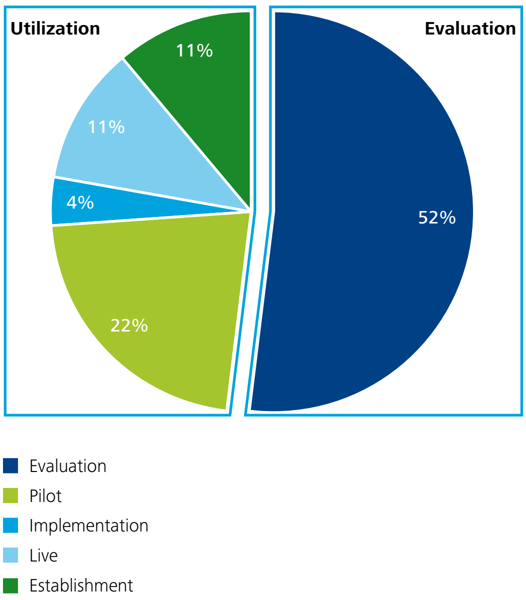
An IMC Reality Check: industry perception of In Memory Computing

We have seen the relevant value dimensions and the essential process steps to implement In-Memory Computing successfully. As a second substantial part of this study an IMC reality check should be made. Results of survey-based Deloitte research illustrate the recent industry perception of In-Memory Computing.

Within its scope, three hundred industry experts located in Germany were asked to contribute their point of view. The group was selected to cover a wide range of industry sectors including retail, energy, pharmacy, chemistry, finance, and aviation. To capture the potentially different views within an industry sector, major industry players as well as strong niche players were surveyed.

To determine the spread of IMC technology, the respondents were asked to assess their project according to one of the following maturity-states: established, live, implementation, pilot or evaluation. "Evaluation" is defined as the state of considering the application of IMC. The remaining phases indicate a status of actual adoption of In-Memory Computing. The respective phases decrease in degree of maturity from "established" to "pilot" (Figure 4).

Fig. 4 – Industry spread of IMC



"In-Memory Computing is not yet widely spread."

Overall, IMC is applied by nearly half of the respondents. The majority of organizations which adopted the technology to a certain degree are running a first pilot scheme (22%). For 11% of the organizations the application of IMC is already well-established. Half of the organizations (52%) assigned themselves to the state of "evaluation".

64% of the respondents plan to introduce IMC within the next three years. An additional 15% plan the introduction within the next four years. 21% have not yet decided when to adopt IMC. The results show that IMC is not yet wide-spread but innovators are taking advantage of it. The early adopters are at the stage of gaining initial experience while the early majority is running or is about to run a pilot scheme.

Fig. 5 – Short-term IMC value dimensions to be leveraged

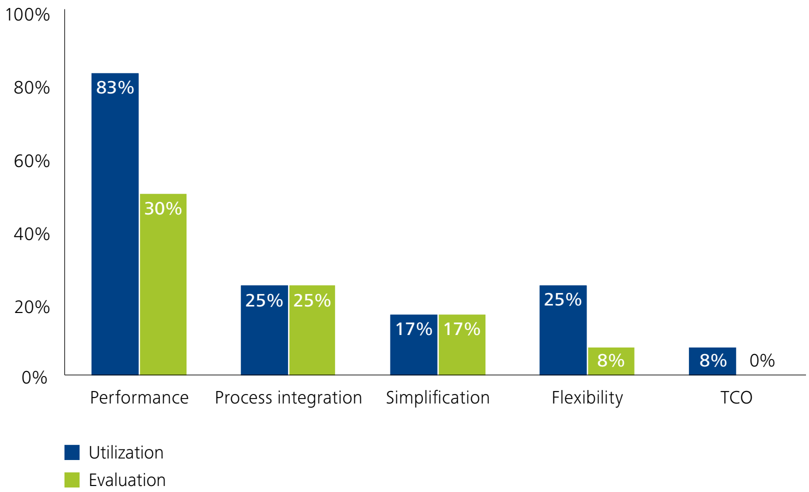
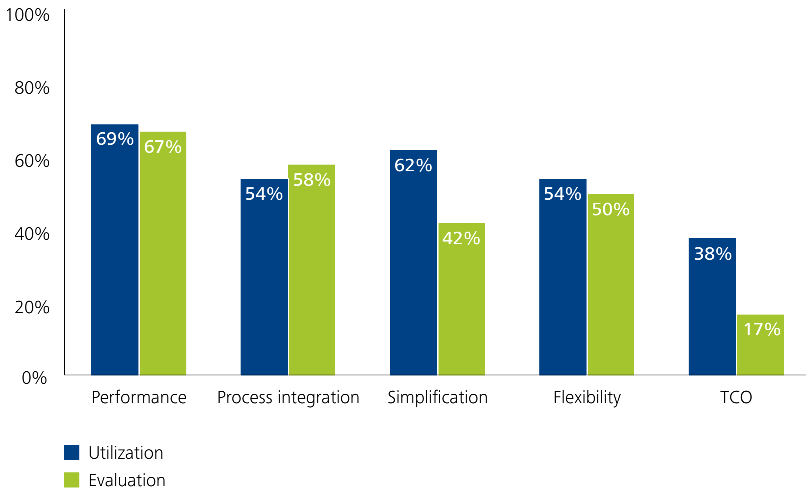


Fig. 6 – Long-term IMC value dimensions to be leveraged



"Before implementation the potential of IMC is often underestimated."

Differentiated consideration of value dimensions

The different value dimensions are the key influencing factors when evaluating the utilization of In-Memory Computing. Figures 5 and 6 illustrate the particular value dimensions the organizations plan to address. Within the analysis, the short-term view is compared to the long-term view. The comparison was made to prove the hypothesis that performance is the key driver for short-term gains (lift and shift approach) whereas process integration, simplification and flexibility tend to need more preparation and have a much wider impact on the business and on the existing technology landscape. Consequently, the group of those organizations which already adopted IMC is separated from those which are still at the stage of evaluation.

The results for the short-term perspective clearly indicate a strong preference for the value dimension of performance.

By contrast, the analysis of the long-term perspective shows a much broader spectrum of preferences (Figure 6). The differences between the long-term and the short-term views signify that most organizations adopt IMC step by step rather than in a big bang.

This finding emphasizes the need for a well-established migration plan that is optimized for value delivery while IMC is implemented. Interestingly, the organizations that already utilize In-Memory Computing plan to realize a broader set of value dimensions in the long run. This indicates that the potential of IMC tends to be underestimated prior to implementation.

The reduction of the TCO is mostly considered as a long-term potential. This is not surprising for the short-term perspective because IMC and non-IMC applications, hardware and processes will in the beginning run in parallel.

Implementation timeline underestimated

Another relevant aspect when evaluating the state of the current In-Memory Computing landscape is the respondents` appraisal of the expected timeline to leverage their respective IMC goals fully. Not surprisingly, those organizations that have not yet introduced IMC estimate that they will require more time to achieve the short-term goals. Figure 7 provides an overview of the estimates of organizations for the timeline to leverage the respective short-term goals fully, considering the value dimensions of IMC. The time horizon for the short term was defined from 0 to about 3 years.

Interestingly, the observation does not hold for the long-term perspective which was defined from 0 to 6 years and beyond as outlined in Figure 8. The time horizon also starts in year 0 to cover also companies that have already embarked on their journey but focus right from the beginning on their long-term goal.

Obviously, those organizations which have not yet introduced IMC tend to underestimate the effort needed to realize their objectives. As outlined above, the adoption of IMC and the realization of the value dimensions are not straight-forward. The survey participants who already utilize IMC reported for example challenges in the fields of data quality, the integration of different data sources, the integration of applications and the infrastructure, or in the sizing of the underlying hardware.

In-Memory Computing does not deliver durable value if it is not implemented mindfully. Talent is required to manage data volumes and the respective analytical evaluation processes effectively. An unfocused collection and analytical evaluation of data is not likely to provide insights that offer a competitive advantage.

The survey data supports this point of view, showing that 67% of the organizations utilize only up to 40% of the data collected for the purpose of analysis. Furthermore, 81% of the organizations estimate that only a share of up to 40% of the overall analytical processes directly benefit from a speed-up due to IMC. Consequently, the majority (74%) of the organizations does not expect IMC to replace traditional data warehouse systems completely. IMC is viewed as a technology to be applied to specific analytical processes.

“IMC will not completely replace traditional data warehouse systems.”

Fig. 7 – Timeline for leveraging IMC value dimensions – short-term perspective

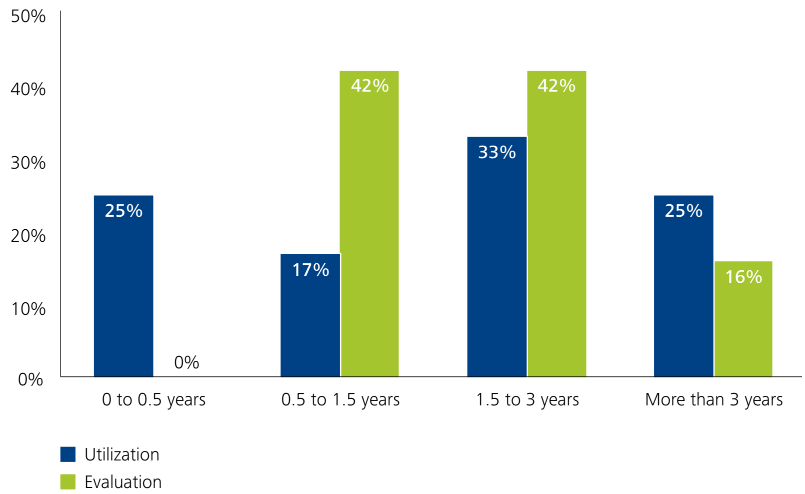
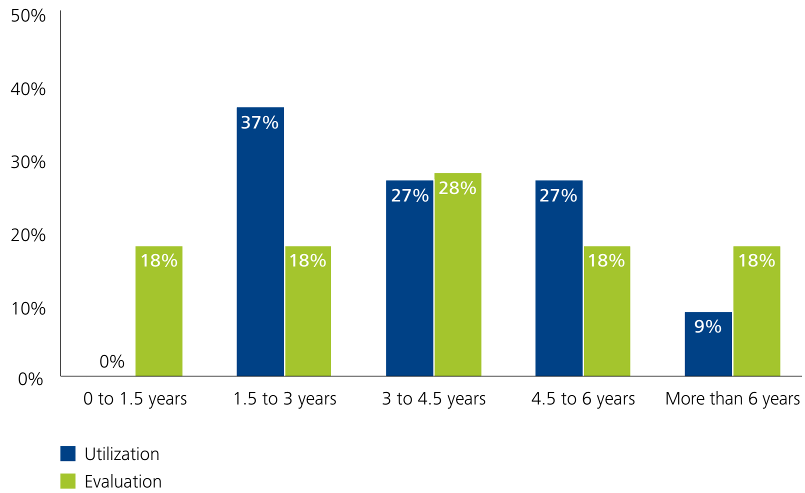


Fig. 8 – Timeline for leveraging IMC value dimensions – long-term perspective



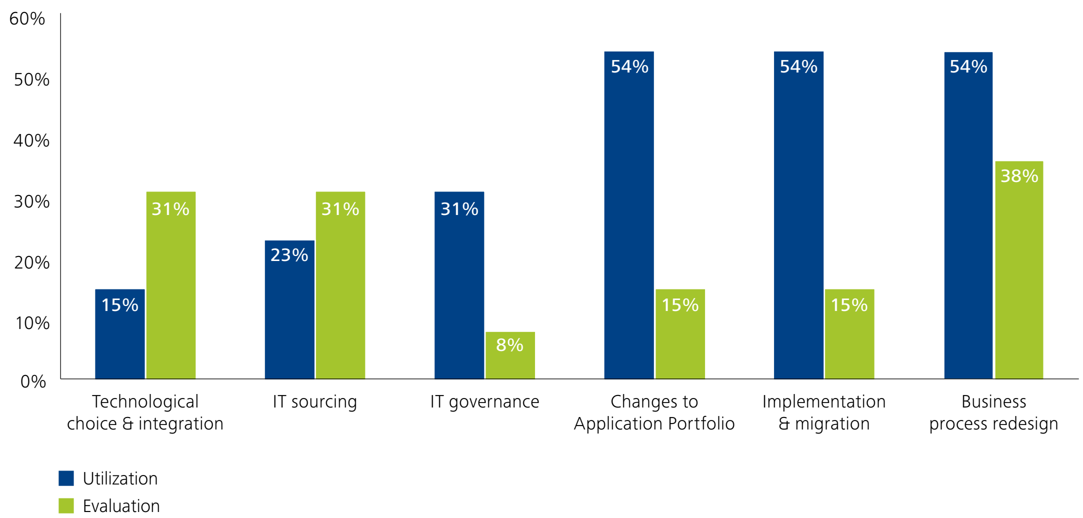
Need for action depends on adoption phase

Organizations must make an immediate initiative to exploit the potentials of IMC. Figure 9 shows the tangible needs for action that the respondents identified. Organizations at the stage of evaluation tend to underestimate the efforts to be made, next to technological choice. As the survey results indicate, these efforts include implementation efforts, the revaluation of the application portfolio as well as changes to IT-Governance and process redesign.

Bottom line: massive effort, massive potential

The study results are consistent with the knowledge and experience gathered from Deloitte's past IMC engagements. Before a project is implemented, only the performance gain is considered as relevant, other factors and results are neglected. When the IMC-engine is running, incredible performance can be seen and measured. During the implementation, however, other issues come to the fore. For example, the relevance of developing an integration scenario to integrate existing and future BI-systems. At this point, the TCO becomes more and more important. In most cases, In-Memory Computing results in a reduction of TCO. However, this happens usually because productivity rises faster than the costs increase. When systems and processes are integrated, experts start to reflect on the development of other potential benefits of IMC.

Fig. 9 – Identified needs for action to exploit the potentials of IMC technology

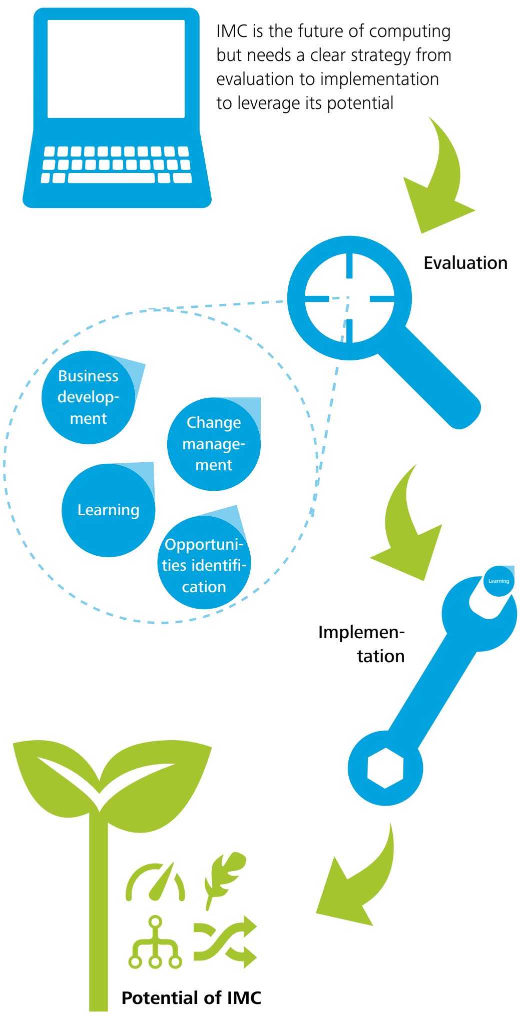


Conclusion

Overall, the survey results emphasize two key findings:

- Especially during the decision-making phase organizations tend to underestimate the effort that needs to be made after choosing the technology
- The potential for reducing TCO is largely underestimated.

Summing up, IMC is the future of computing but requires a clear strategy for all steps from evaluation to implementation. This includes, but is not limited to, the identification and evaluation of opportunities for the utilization of IMC, business case development, management of the implementation as well as learning and change management for pilot schemes and rollouts. If organizations keep this in mind and follow a clear and well worked-out strategy, In-Memory Computing offers a massive potential not only in TCO reduction but across all four value dimensions: performance, process innovation, simplification, and flexibility.



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