Through the application of mature technology platforms, bank steering can be brought to its next higher level. Top-tier investment banks have leveraged recent technology advances, such as parallel computing, in-memory storage, and smart algorithms, to capitalize on the advantages of speed in trading. As these technologies are becoming increasingly available to second movers, their application to additional areas of bank steering is essential, providing a competitive edge needed to stay ahead in what some call a mature market.

**High performance bank steering combines technology with business processes**

High performance bank steering (HPBS) goes beyond the simple “faster, higher, and further” of more efficient and smarter technology. The real potential lies in the massive improvement regarding a more rapid responsiveness of banks to even marginal changes in market conditions by adapting two factors in accordance with each other: technology and business/risk processes.

**High performance bank steering leverages technology to boost profitability**

HPBS does not only provide efficiency gains but also model-based analytics with a much higher degree of sophistication. In consequence, analytic resources and capabilities often being in scarce supply become available to enhance processes on strategic, tactical, and operational level.

**Introducing high performance bank steering is a journey rather than a big bang**

Moving towards HPBS means substantial changes to business and steering processes as well as to the supporting technical infrastructure. Consequently implemented, this will lead to a significant organizational change. A phased approach with carefully selected pilot implementations driven by a viable business case is suggested. This will set the adequate frame for the institution to move along the organizational learning curve in applying HPBS and will serve as a seed for evolutionary implementation of further HPBS cases in the institution.
Over the past several years, more leading investment banks have begun to use a combination of supercomputer grade hardware, operational research, and statistics to improve the speed and quality of their decision-making. First introduced as custom-built systems by a few early adopter banks around the turn of the millennium, these capabilities are now available to the general banking industry. And if the impact of high frequency trading on the investment market is any indication, applying this high performance technology (HPT) in combination with accordingly adapted bank steering processes—a High Performance Bank steering (HPBS)—is likely to be game-changing, not only to the trading floor, but across the entire bank.

That’s because HPBS gives bank leaders the ability to simulate potential market changes and act accordingly. In addition to being a powerful innovation lever, it also provides management with greater insight into where to direct their financial resources. The combined cost and performance benefits can create competitive advantages for HPBS-enabled banks, helping them ratchet up the quality and speed of their decision-making. While no panacea, HPBS adds more octane to big data analytics in the form of greater parallel processing muscle and analytical algorithms designed to work in parallel with them—effectively letting bank managers process multiple streams of information across a function or the bank as a whole in near time. Where banks used to have to wait 24 hours or more for detailed forecasts to be generated, HPT crunches through the numbers within fractions of a second. It also makes it easier for managers to tweak the variables and run a host of different scenarios right from their own desk. That mix of flexibility, speed, and accuracy has the potential to alter the competitive playing field dramatically, creating winners and losers between banks that are HPBS-enabled and those that are not.

This report examines the potential of HPBS applied across the bank and the organizational, governance, and technological requirements banks required to make that possible.

Notes
1. See sidebar “Defining high performance technology” for more details.
Why high performance bank steering (HPBS) is the next big thing

**Until recently, high performance technology (HPT) was limited to a handful of banks**

HPT was introduced at the beginning of the century with the arrival of high-frequency trading (HFT). That was the first area in which fast analytics and reaction times contributed directly to banking profit or loss. The high performance technology behind it—state-of-the-art IT and smart algorithms—offered banks the ability to convert large amounts of market data (like price quotes) into buy or sell recommendations. A 2011 Deutsche Bank report observed, these "[...] substantial developments in information technology (IT) have spurred an electronic revolution [...], which ultimately led to an ‘arms race’ for the most effective deployment of IT."  

Those developments revolutionized trading, because "Programs running on high-speed computers analyze massive amounts of market data, using sophisticated algorithms to exploit trading opportunities that may open up for milliseconds or seconds."  

That speed and computing muscle meant that in operational practice high-frequency traders could process stock and market information, calculate different reaction strategies, and execute the ones with the highest expected profit faster than any human trader. Such deftness gave early adopters, such as Goldman Sachs, a distinct earnings advantage. Those gains came not through a few big transactions but from the cumulative sum of marginal arbitrage opportunities gained over large volumes of single deals. At the peak of the financial crisis in 2009, for instance, the
New York Times commented, "Nearly everyone on Wall Street is wondering how hedge funds and large banks like Goldman Sachs are making so much money so soon after the financial system nearly collapsed. High-frequency trading is one answer." More notably, as of 2011 [...] around 73% of the trading volume on the U.S. equity market [was] due to HFT but only 2% of 20,000 firms trade using HFT.

One of the reasons for the small number of HFT players was the absence of any viable vendor or off-the-shelf solution. The early adopters, the top 10–15 first-tier banks with substantial proprietary positions, all built their IT infrastructure from scratch. These firms cobbled together the required software on their own or with contractors, assembled top-of-the-line hardware configurations, and pushed hardware providers to outperform previous generations. In addition, they hired experts who understood how to link hardware capabilities and software concepts and manage the computational complexity. While such purpose-built IT infrastructure came at an immense cost for first movers—putting it out of reach for most—the premiums generated from high-frequency trading more than made up for it.

NOTES
1. Massively parallel processing leveraging available CPU capacity fully plus in-memory data storage minimizing data access latency
4. Applying statistic and operation research techniques
6. Biais B, Woolley P. High frequency trading; 2011
7. E.g., global systemically important banks (G-SIBs) like Goldman Sachs, Deutsche Bank, etc.
Commoditization of high performance technology now makes it widely available

Fortunately, doing so no longer requires the same do-it-yourself investment that first-mover banks had to make. In fact, many big IT and software vendors have hit the market with big data application suites that banks can then layer with smart analytics. In addition, hardware frameworks for scalable and distributed computing\(^1\) and database techniques for in-memory application\(^2\) are available in the market and supported by nearly every important vendor\(^3\) for business intelligence software.

Using off-the-shelf HPT packaged solutions available in the market can reduce computing times significantly. For example, one bank reduced the amount of time it would normally take to calculate its asset-backed security (ABS) portfolio risk from eight hours to 12 minutes, accelerating the turnaround by a factor of 40. This could be achieved by combining standard hardware, such as blade or rack servers, with the bank’s proprietary valuation library and the HPT platform from SAS. The implementation of this specific solution took six months to deliver from design to production. In another case, a HPT solution from SAP was able to reduce the aggregation time of more than 200 million cash flows for liquidity risk management in a test environment from more than 60 min. on a standard system to less than 1 sec.

Notes
1. E.g., Apache, Hadoop
2. E.g., SAP HANA
3. E.g., IBM, SAS, SAP, Oracle, to name just a few

HPT can be applied to business challenges across the bank—implementing HPBS

Today every bank runs a sizable business intelligence (BI) operation, amalgamating data by applying standard descriptive analytics. While good, traditional BI tends to provide information after the fact, since the complex prospective analytics needed to forecast trends and related data are often limited by the amount of data the infrastructure can handle within reasonable cost and time parameters. With HPT, those technical limitations are gone, so banks can be far more forward-looking with their analytics, which, next to accordingly adapted steering processes, is one major pillar of HPBS. The time value of information, faster and cheaper processing speeds (efficiency), and increase in analytical precision (effectiveness) all support the HPBS business case.

That dexterity brings new ways to manage banking operations and optimize funding strategies across all areas of the bank (see Exhibit 1). For example, HPBS can give banks the quick reflexes needed to adjust their risk position when counterparties or countries are downgraded. The right algorithms backed with parallel processing can increase their ability to manage such events by simulating potential scenarios near-time at real scale with significantly fewer modeling assumptions.
HPBS can also improve the typical bank budgeting and planning cycle, a process that can take weeks to months and relies heavily on historical data. HPBS speeds this by reducing the turnaround times for developing, testing, and validating potential scenarios from weeks to hours or even minutes. In addition, where traditional forecasting processes allow at most one or two iterations, a HPBS analytic cycle gives banks greater flexibility by supporting multiple iterations and scenario testing. Likewise, where traditional profit and loss scenarios usually require an overnight to run and refresh, HPBS allows planners to create and review different models in close to real time.
From an organizational point of view, HPBS provides senior management with a more direct hand in shifting scenario parameters. Rather than being passive recipients of pre-set reporting, they can run scenarios then and there. That can shorten management decision cycles considerably. No longer do they have to wait a day for a new report to be run and another week for a new meeting to be convened. Instead of running a strict top-down bottom-up planning cycle, for instance, HPBS makes it easier for management to solicit input and from across the organization and test planning ideas iteratively. The same tools can be made available across the bank and down through different management tiers, spreading the reach of high-quality decision-making. The following graph illustrates how—with HPBS—the analytic management cycle could change.

Some first movers are already leveraging HPBS to boost the bottom line. The marketing department of a large Fortune 500 financial service company, for instance, wanted to improve customer loyalty and retention. They had a limited budget to allocate toward retention initiatives, enough to cover about 20% of their customer base, so they had to be careful in targeting the subset of customers most likely to jump to another competitor. Prior to HPBS, figuring out which customers fell into that camp was more of a guessing game, since the analytical models in use were trained on small data samples only and training/recalibration took about one week to run. That meant sales staff relied on models with a relatively high margin of error. Moving to HPBS gave modelers the ability to process ten model iterations per day using the entire raw data range. As result, marketers got models more precise and up-to-date allowing sales and marketing to hone in on at-risk customers...
and tailor outreach accordingly. The result was a 10% increase in customer retention, which translated into a net profit per customer of €100. Better targeting also led to a 50% higher conversion rate. The company was able to attract new and more profitable customers (with a net profit yield of €150 per customer).
Transitioning to HPBS

Migration requirements

To leverage the full capabilities of HPBS and realize its benefits, some prerequisites have to be met at the business, organizational, and IT level.

On the business level, it requires:

1. Governance around the use of analytical intelligence in the decision-making process with coordinated change in processes and algorithms

2. Focus on using HPBS, i.e., considering the highest and best use of HPBS in the business strategy and business model, focusing on those areas most likely to benefit from applying HPBS such as sales and marketing, risk management, treasury with capital management—in essence, all areas where the law of large number offers a good lever for analytics to be applied

3. Openness to experimentation: Since HPBS’ use beyond the trading desk is new and hence potentially unfamiliar, banks need to establish an appetite for "thinking outside the box" by piloting options.

4. Analytical maturity: To make best use of HPBS, banks must first align their business model and strategy with their analytical capabilities and operational decision-making processes. That’s because operating decisions (such as allocating resources) need to support strategic, measurable objectives and be consistent across functional areas (e.g., finance, risk, sales). Feedback mechanisms, such as reporting and review sessions, and a tolerance for a certain level of trial and error are also important, since rapid iteration is an integral part of HPBS’ success.

On an organizational level, HPBS is most successful when change management criteria are in place. That includes commitment from senior leadership, cross-functional working groups to agree and evangelize the proposed changes, frequent feedback and communication, and regular performance measurement. The organizational change component is key because HPBS brings the potential to cut across functions and minimize the need for such things as individual databases for different departments and business units. That break with current experience and processes can lead to some natural resistance. Departments may feel that data or needs are specialized and may be compromised if integrated with other functions or processes. A bank’s risk and finance functions, for instance, often base their information management processes upon the same detailed contract data, but run their analytics in silos from data gathering all the way up to reporting. Those numbers then need to be reconciled in what is usually an extensive and costly process because of inconsistencies in how the two functions tag and store data and in the variables used in their analyses. HPBS would eliminate much of that, bringing both better consistency and accuracy while also allowing managers to evaluate risk and finance positions based on their impact on both their own portfolios as well as that of the bank as a whole. But gaining the agreement to break with traditional ways of managing data can be difficult. To get the benefit of HPBS, such change must come with strong leadership backing and must have on-the-ground engagement from members of all affected business units or departments.
On the IT level, the following three areas form part of the HPBS roadmap:

1. **Data**: Banks considering a move to HPBS must have a data warehouse (DWH) to store data at the required level of granularity (e.g., cash flows for single deals/transaction level) and time horizons (e.g., current and historical). To ensure apples-to-apples comparisons, data has to be consistent across all functional areas. This means banks must also have a common data dictionary and quality assurance procedures. These elements are a necessary precondition for any HPBS program.

2. **Systems and applications**: All relevant operational applications need to be identified at the data source layer. For auditing and compliance purposes, such as traceability, the data delivery process should be highly automated without need for manual intervention. Such automation is one of the factors that allow HPBS to perform fast iterations on new data sets. Clear governance on the calculation methods is also key. In addition, simulation models must be defined at the bank level to ensure consistency and transparency in deriving risk and performance figures (see "Moving beyond compliance," BCG, Platinion, and SAS, October 2011).

3. **Roles and responsibilities**:
   - Data ownership—clear responsibilities for each data item
   - Data governance—escalation and decision processes in place
   - Data authorization—access and execution restrictions
   - Data recovery and emergency concepts—definition of roles
   - Clear definition of unique data ownerships

**TAKING A PHASED APPROACH**

Given the size and scope of the transition, an evolutionary migration to HPBS often works best. Start by creating a pilot in a high-profile business area. The business unit or function in question must be willing to lead or buy into the change, since the first pilot will be seen as a touchstone.

One large bank, for instance, began its pilot in the credit risk department. It met with the business managers, laid out the objectives, benefits, expectations, and required contributions, both budgetary and manpower. They then pulled together a working team comprising both business and IT professionals to map out the plan. The pilot took three months, and the results added 3% to the bottom line. The success allowed them to extend the pilot to other parts of the organization with the eventual goal of transforming the whole architecture into an enterprise HPBS.

The step-by-step approach also helps banks avoid technological obsolescence, since new technology can be brought on board incrementally, making the learning curve more manageable while maximizing the return on existing technology still in use.
INTEGRATING HPBS IN CURRENT ARCHITECTURES

In contrast to the organizational challenges, integrating HPBS, namely the high performance technology (HPT), into an existing architecture is easier than one might expect.

Exhibit 3 lists the steps necessary to make operational use of analytics in most business contexts. They include data preparation, model building, validation and deployment\(^1\), and model execution\(^2\) and performance measurement.

Notes
1. I.e., bringing the developed model code from model research into production system
2. I.e., running the deployed model code in production

Banks that have a sound bank steering process will already have the necessary architecture in place to cover the described functions. If that is the case, the only additional required changes for them are:

1. Data:
   For banks that have a formal data preparation process running on a massively parallelized DWH, HPBS requires only a fast network infrastructure (a commodity cluster is recommended) to host HPT on the appropriate DWH. That data preparation process might include an ETL\(^1\), a system like the one shown in

Exhibit 3 | These are the steps needed to make operational use of HPBS
Exhibit 4 that processes real-time data from front-office systems like trading and treasury systems. Whenever analytical functionality like risk calculations is required, HPT algorithms will fetch the required data from HPT system memory, perform fast multi-threaded\(^2\) (and multi-server) calculations, and write the results into the DWH or directly over to the front-office systems. That process does not put any substantial load onto the DWH. Effectively, the HPT becomes a “plug and play” architecture. The faster analytical engine aligns well with existing reporting processes and will not disturb other important bank processes on the DWH.

Problems arise if the data preparation process has not been implemented on a massively parallelized warehouse (MPP system). That would create a bottleneck since it would inhibit the concurrent processing that is a core feature of HPT. To avoid that, it is best to redesign the ETL to make it a parallel persistence layer. Either a parallel database appliance or a Hadoop-based system like Hive will work, the choice of which depends on the bank’s IT strategy, a discussion that lies outside the scope of this paper.

Alternatively, banks can take a greenfield approach in which they design the corresponding ETL process directly for real-time interaction with HPT systems (see Exhibit 4). To manage project complexity, narrow the scope of the newly added analytical processes so that alignment with current reporting only has to be ensured for a small range, thus granting a fast implementation time.

**EXHIBIT 4 | This is the ETL process for HPT**

**NOTES:**
1. ETL = extract, transform and load
2. I.e., increase utilization of a single core by using thread-level parallelism
2. Analytics:
   Similar to the preceding discussion on data preparation, the degree of architectural change needed depends on the maturity of the bank. In most cases an analytically mature bank is already using systems capable of automatically generating model execution code\(^1\). These systems provide powerful deployment mechanisms that guarantee fast batch model execution on different storage layers (in-memory or MPP DWH is recommended). That didn’t matter so much in a world without parallel processing in-memory potential since computation times took longer. But with high-speed processing working at many times the rate of human hands (and minds), the need to wait for manual guidance undermines the system’s potential. State-of-the-art systems support more automatic model performance monitoring. This supports efficient model risk management and therefore allows for a closed-loop analytic life cycle—the basis of any HPBS. For banks with a modern analytical system in place, the transition to HPBS mainly requires a review of their ETL processes, plugging in a stronger analytical engine, and use of model execution code which can run on parallel persistence layers.

For those banks without a modern analytical system in place, the pathway to HPBS will be highly dependent on their current operational setup. Any part of the analytic life cycle that does not support parallel computing will need to be revised.

\(1\) I.e. the programming source code translating the analytical model into an executable program

**Case studies—two flagship project examples**

The following cases illustrate the transition two banks made from traditional bank steering to HPBS.

**CASE STUDY I—MARKET RISK REPORT IN SYNC WITH MARKET DYNAMICS**

A global player in the capital markets was concerned about how long it took them to calculate consolidated market risk positions after the market closed, such that by the time they were ready, it was too late to react. The reasons were the usual suspects: late data delivery and the need (dictated by system constraints) to wait until all business segments and the trading desk delivered their numbers before they could start processing. The ability to calculate global value at risk (VaR) in near time would fix the problem, but this required to shorten the calculation time needed for consolidation and streamline data flows.

The bank had already made the decision to move toward HPBS, so the leadership buy-in and business unit commitment were in place. The remaining gap was technological. To solve it, they married big data analytics with event stream processing. Whenever a trading desk now completes its figures, the results are sent as an “event” and immediately picked up by the VaR engine. That means the bank no longer has to wait until all business segments report before getting started. To
speed processing times, the bank moved the VaR software engine onto a high performance in-memory\(^1\) analytic platform with all the regulator-approved VaR logic embedded into it. That allows the marginal global VaR position to be updated within minutes, giving top management a clear risk view in time to act. That helps lower the bank’s risk buffer and frees up capital that would otherwise be held up in reserve (see Exhibit 5).

**EXHIBIT 5 | Market risk reporting was improved using HPT**

- Risk engines
  - P&L pricing data supplied in continuous pulses throughout the day
  - Stress-testing based on sensitivities
- Book location A
- Book location B
- Book location C
- Other data
- Other dimensions data

**Persistence/recovery**

- SAS ESP
- HP risk
  - UI
  - Data surfaced immediately as cube join takes place
  - Stress-testing based on sensitivities
- HP risk
  - UI
  - Stress-testing based on sensitivities
- Web portal
  - reports
  - Data surfaced based on business requirements at regular intervals

**Frozen data and snapshot reporting**

**Monitoring and quality checks of data delivered**

- Reports about the data processing (e.g., are there data with anomalies)

**Consistent view across the bank** (e.g., front-office/risk management, etc.)

**Daily timeline:**
- Closing event: +5 min.
- +10 sec.
- +10 min.

**NOTES:**
1. I.e., all data are kept in memory, essentially eliminating data load time when executing the processing task at hand

With its initial objective met, the bank is now looking at additional ways to apply HPBS, such as marginal pricing (including complex credit value adjustment) or firm-wide instantaneous stress-testing with full revaluation.
CASE STUDY 2—BOOSTING LOAN BOOK PERFORMANCE

A large bank that relied on statistical models to assess and manage credit risk faced long time frames for developing new models and maintaining existing ones. While the quant team had plenty of capacity, they spent 70% of their time either compiling data samples small enough to be handled by the current system or waiting for the system to finish the model development run. In addition, accuracy was compromised because the existing technology only allowed them to process sample data and was limited to two iteration runs per model.

By switching the model development and deployment process to HPBS, this bank gained better model precision and the ability to access all data, not just samples. What's more, the euros saved more than made up for the cost of the system. These changes, combined with the quantitative excellence of the team, led to a sixfold increase in development cycles, which almost doubled the average model lift. In addition, by improving their ability to identify good clients and reject bad ones, the bank boosted loan book performance by nearly 15%, putting them ahead of non-HPBS-enabled peer banks in terms of financial performance.

NOTES:
1. Model lift is a measure of the model performance; it measures the improvement of a decision (e.g., granting a loan) when taken upon model recommendation over a random decision.
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