

A Forrester Total Economic
Impact™ Study
Commissioned By
SAP

Project Director:
Shaheen Parks
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Projected Cost Analysis Of SAP HANA

Cost Savings Enabled By
Transitioning to HANA

Table Of Contents

Executive Summary	3
Disclosures	6
TEI Framework And Methodology	7
Analysis	8
Financial Summary	27
SAP HANA: Overview	29
Appendix A: Composite Organization Description	30
Appendix B: Total Economic Impact™ Overview.....	31
Appendix C: Glossary.....	32
Appendix D: Endnotes.....	33

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Executive Summary

In September 2013, SAP commissioned Forrester Consulting to conduct a cost-based analysis, utilizing the Total Economic Impact™ (TEI) methodology, and examine the potential cost savings and reduction in total cost of ownership (TCO) that enterprises may realize by deploying HANA. The purpose of this study is to provide readers with a framework to evaluate the potential financial impact of HANA on their organizations, purely from the perspective of IT costs and cost reductions.

SAP HANA is a distributed in-memory data platform that enterprises can use to support real-time analytics, predictive and text analytics, and extreme transaction volumes. The next-generation data platform demands looking at these new technologies to help deliver the speed, agility, and new insights critical to helping your business grow. For decades, organizations have built the transactional, operational, and analytical layers to support various applications, operational reporting, and analytics. However, with the growing need to support real-time data sharing driven by mobile enterprise, separate transactional, operational, and analytical layers are creating an obstacle in supporting such an initiative.

Distributed in-memory data platform offers a new approach to collapse the technology stack that can eliminate redundant hardware, software, and middleware components to save money and reduce complexity through automation and integrated systems that can help developers and DBAs become more productive.

SAP HANA TOTAL COST OF OWNERSHIP FRAMEWORK

To better understand the costs and risks associated with a HANA implementation, Forrester interviewed several customers with multiple years of experience using HANA and conducted a survey of 25 additional HANA users. Drawing on the experiences of these customers, as well as Forrester expertise in this area, we constructed a financial model to represent the potential savings associated with using HANA as a replacement for a traditional database platform in several different ways. While the customers had just begun to use HANA in this way, they were able to discuss the projected impact as they continued to expand their use of HANA as a replacement platform. In this financial analysis, we include the impact of using HANA in conjunction with the SAP Business Warehouse (BW) powered by SAP HANA, SAP Enterprise Resource Planning powered by SAP HANA, and a custom-developed application. For each case, we project the costs associated with using a traditional database platform, as well as with using HANA, and calculate the comparative TCO. We project a migration for BW in the first year of the analysis; in Year 2, the composite organization begins using HANA in conjunction with its current ERP deployment; in Year 3, the former ERP environment is retired and it is run on HANA; and, we project the costs and cost avoidance associated with developing a custom application on HANA (as compared with developing it on a traditional database platform) in the third year. The financial analysis is based on this scenario, as shown in Figure 1. The cost projections are based on information gathered through interviews and surveys, pricing information from SAP, and Forrester knowledge of database and application market rates.

SAP HANA changes the cost equation through simplification. It can help save costs on hardware and software, as well as reduce labor required for administration and development needs.

SAP HANA supports various use cases. Based on a composite cost model, HANA can save an organization 37% across hardware, software, and labor costs, depending on various factors.

- 70%+ on software
- 15%+ on hardware
- 20%+ on administration and development labor

In this case study, we project the reduction in total cost of ownership for an organization using HANA in conjunction with BW, ERP, and a custom-developed application. The cost saving projection is derived based on actual customer interviews conducted independently by Forrester.

FIGURE 1
Framework Summary

	Year 1	Year 2	Year 3	Year 4
BW	Moved to HANA; older system retired after 6 months	Savings calculated with avoided software, hardware, and labor costs		
ERP		Launched on HANA; run in parallel with older system	Older system retired; savings calculated with avoided software, hardware, and labor costs	
Custom application			Developed and launched on HANA in place of alternate solution	Savings calculated with avoided software, hardware, and labor costs

Source: Forrester Research, Inc.

Prior to HANA, customers were using traditional database platforms for their applications (both SAP and non-SAP), incurring costs associated with required hardware and software for processing and data storage, as well as the labor required for development and administration. By transitioning these applications to HANA, Forrester projects that customers are able to reduce the hardware and software required for these applications, as well as reduce the efforts for administration and development resources. This is due to the way that HANA eliminates or reduces the need for a variety of associated software and hardware, and adds efficiency to the development and system maintenance processes.

Many of the customers we interviewed stressed that HANA also provided significant benefit to the business. However, for the purposes of this analysis, we focus entirely on the IT impact.

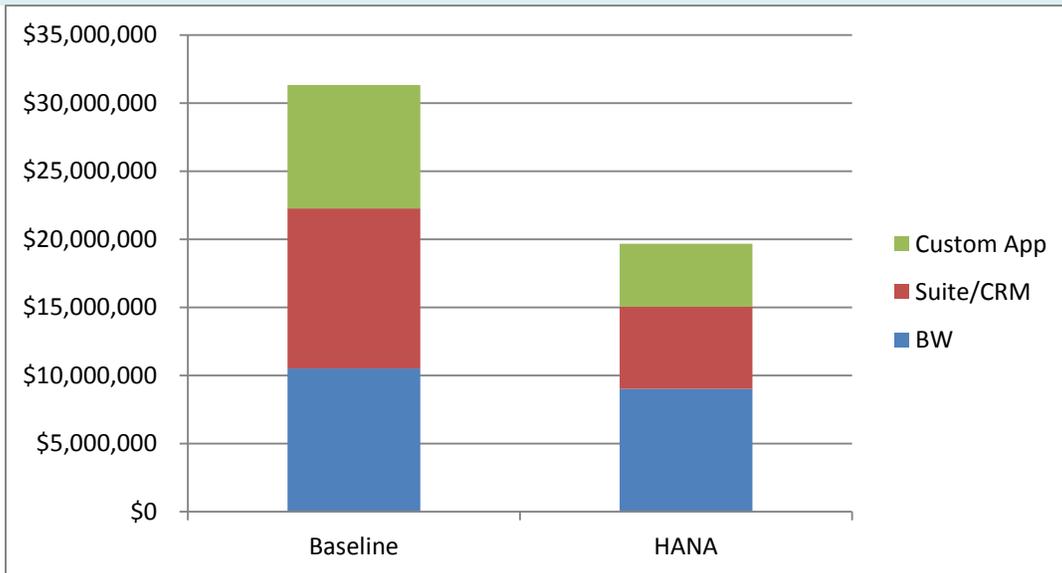
Our interviews with four existing customers, survey of 25 additional customers, and subsequent financial analysis found that a composite organization based on these interviewed organizations could expect to experience the risk-adjusted costs and costs savings shown in Figures 2 and 3 when utilizing HANA for this purpose.¹ (See Appendix A for a description of the composite organization.) As demonstrated by the total cost savings with HANA, there were significant reductions in the hardware, software, and labor required for each application.

FIGURE 2
Financial Summary Showing Three-Year Results



Source: Forrester Research, Inc.

FIGURE 3
HANA TCO Summary



Source: Forrester Research, Inc.

- › **Savings.** Based on the composite total cost model, the sample organization experienced the following risk-adjusted benefits (that represent those experienced and projected by the interviewed companies):
 - **Reduced hardware cost (simpler data footprint/simpler landscape/simpler setup).** Moving to the HANA platform allows customers to reduce the volume of servers and storage required, due to the data compression, as well as efficiencies gained due to HANA's functionality.
 - **Lower software costs (simpler data footprint/simpler landscape/simpler setup).** HANA also allows for a reduction and elimination in many of the software products such as ETL, data replication, management, and other middleware software. Additionally, the HANA platform includes advanced analytics capabilities such as text, geospatial, and predictive analytics as part of its platform offering without additional license.
 - **Faster development time (simpler application development/simpler user experience).** All of the interviewees cited a faster, more efficient application development process through automation and minimizing complexity, which allowed for a reduction in resource time.
 - **Increased productivity for administrators (simpler processing and operations).** Due to the simplification of the environment with HANA, customers are able to reduce the amount of administration time required to tune, optimize, and manage databases and servers.
- › **Costs.** The sample organization experienced the following risk-adjusted costs:
 - **HANA appliance cost.** In this model, we have included the HANA appliance as the hardware for the deployment. However, we note that SAP also offers the SAP HANA tailored data center integration delivery approach, allowing customers to utilize enterprise hardware and potentially offering additional cost savings.
 - **Software licensing costs.** This includes the software cost associated with HANA, as well as the costs of the application software. We include initial costs as well as ongoing maintenance.
 - **Development cost.** This cost category includes the resource cost for development for the applications moved to HANA.
 - **Administration cost.** This cost category includes the resource cost for administration for the applications moved to HANA.

Disclosures

The reader should be aware of the following:

- › The study is commissioned by SAP and delivered by Forrester Consulting. It is not meant to be used as a competitive analysis.
- › Forrester makes no assumptions as to the potential cost savings that other organizations will receive. Forrester strongly advises that readers use their own estimates within the framework provided in the report to determine the appropriateness of an investment in SAP HANA.
- › SAP reviewed and provided feedback to Forrester, but Forrester maintains editorial control over the study and its findings and does not accept changes to the study that contradict Forrester's findings or obscure the meaning of the study.
- › SAP provided the customer names for the interviews but did not participate in the interviews.

TEI Framework And Methodology

INTRODUCTION

From the information provided in the interviews, Forrester has constructed a Total Economic Impact™ (TEI) framework for those organizations considering implementing SAP HANA. The objective of the framework is to identify the cost, benefit, flexibility, and risk factors that affect the investment decision.

APPROACH AND METHODOLOGY

Forrester took a multistep approach to evaluate the impact that SAP HANA can have on an organization (see Figure 4). Specifically, we:

- › Interviewed SAP marketing, sales, engineering, and information technology personnel, along with Forrester analysts, to gather data relative to HANA and the marketplace for HANA.
- › Interviewed four organizations currently using SAP HANA to obtain data with respect to costs, benefits, and risks and conducted a survey of 25 additional HANA users.
- › Designed a composite organization based on characteristics of the interviewed organizations (see Appendix A).
- › Constructed a financial model representative of the interviews using the TEI methodology. The financial model is populated with the cost data obtained from the interviews as applied to the composite organization, as well as Forrester projections based on industry standards.
- › Risk adjustment is a key part of the TEI methodology. While the interviewed organizations provided some of the cost estimates, some categories included a broad range of responses or had a number of outside forces that might have affected the results.

Forrester employed three fundamental elements of TEI in modeling SAP HANA's service: costs, flexibility, and risks.

Given the increasing sophistication that enterprises have regarding ROI analyses related to IT investments, Forrester's TEI methodology serves to provide a complete picture of the total economic impact of purchase decisions. Please see Appendix B for additional information on the TEI methodology.

FIGURE 4
TEI Approach



Source: Forrester Research, Inc.

Analysis

COMPOSITE ORGANIZATION

For this study, Forrester conducted a total of four interviews with representatives from the following companies, which are SAP customers based globally:

- › An electricity supply company for a large region of the western United States
- › An American global aerospace, defense, security, and advanced technology company
- › An Italian multinational manufacturing company with over 20 production sites and a network of 10,000 distributors and retailers
- › A German regional energy service provider for electricity and gas

All of the interviewees, and the majority of the survey respondents, were long-term SAP customers migrating from other databases to SAP HANA. IT-based goals for the move included simpler data management, simpler IT operations, and simplified code to write and manage, leading to improved business processes supported by IT. Based on the interviews, Forrester constructed a cost framework, a composite company, and an associated TCO analysis that illustrates the areas financially affected. The composite organization that Forrester synthesized from these results represents an organization with the following characteristics:

- › A US-based manufacturing company
- › 40,000 employees
- › Pre-HANA, the Company has:
 - 40 TB SAP BW database system
 - 10 TB SAP ERP (Business Suite)
 - 2 TB custom (homegrown) application

*“Over 10 years, we would spend
33% less with HANA.”*

~HANA user

The Company uses HANA as a replacement rather than refreshing the hardware for existing database platforms. For the purposes of this analysis, we assume that the Company begins by moving its BW implementation onto HANA, followed by ERP in the next year, and then a custom application in the following year. The custom application is developed on HANA, instead of using an alternate database platform. This financial analysis begins with the BW transition.

INTERVIEW HIGHLIGHTS

In order to illustrate the potential cost savings that companies may realize by utilizing HANA to eliminate intermediate layers of the stack and reduce complexity, Forrester has modeled a scenario for the composite organization representing a move to HANA for BW in the first year, ERP in the second year, and a custom application in the third year. In each of these scenarios, we model the HANA deployment initially, followed by the retirement of the existing deployment in the following six months to a year. This follows the behavior of the interviewed customers, many of whom choose to implement HANA initially as a sidecar, before considering a replacement of their existing systems.

The customers we interviewed all cited the business benefits of HANA as the initial draw, but identified the potential for TCO savings as an additional driver for the move to HANA. Although none had completed a move to HANA across their applications, most of the interviewees planned to gradually increase and expand their use of HANA as opportunity arose. Therefore, in this model, we have spaced out the deployment of each application over a four-year analysis, allowing ample time to implement and bring each HANA deployment up to speed before retiring older platforms.

The interviews revealed that:

- › **HANA was initially brought in for business needs.** All of the interviewees spoke about the business advantages of HANA's speed and reporting capabilities, and described the ways in which this had transformed the way decisions were made.
- › **Long term, HANA offers a compelling opportunity to reduce IT spend.** Although initially HANA was deployed as a sidecar to the current environment, all of the interviewees projected a move to HANA as they refreshed the hardware for their applications, and anticipated that this would ultimately lead to significant hardware and software cost savings.
- › **Data footprint reduction is key.** All of the interviewees cited large data compression ratio with HANA, ranging from 4 to 10 times. One interviewee stated, "Our data growth on BW has been 34% per year, but we've cut down to 12% with HANA." Additionally, data compression is only one of many factors that leads to overall data footprint reduction. Forrester's interviews with customers and app development teams have revealed these additional major factors: a simpler data model, the elimination of aggregates/indices, the elimination of redundant copies of data in ERP and BW, and columnar/dictionary-based data compression, all of which contribute to the data footprint reduction.
- › **HANA provides increased efficiency for development and administration.** Interviewees described HANA as "simple to use" with some initial learning curve but cited productivity savings of 20% to 40% on both development and administration. Specifically, one mentioned, "You reduce the amount of development you need to create reports and analysis. You're not rematerializing into a data warehouse — you can reach into the source system."
- › **Software license costs vary widely.** The majority of customers surveyed used full use licenses versus runtime licenses for their database software. This study has calculated savings based on runtime software license cost to better compare similar costs between HANA and potential alternatives. Using full use licenses will raise the software cost associated with the non-HANA scenarios for BW and ERP significantly; we encourage the reader to consider which type of license makes sense in the appropriate environment.

"The overhead is hugely reduced through automation, integrated appliance, and common data platform."

~HANA user

COST ANALYSIS

We now focus on the details of the comparative cost calculation, examining each of the three scenarios in detail. There are several assumptions underlying all of these calculations, as shown in the following tables. For the hardware calculations, we make certain assumptions both for the HANA and non-HANA scenarios in order to project the costs for each. These include estimating the hardware needs for both, in terms of processing and storage, and then assigning cost based on the number of sockets and volume of storage (for non-HANA machines) and the number of HANA appliances required (for the HANA scenarios). For software, we estimate prices for database, ETL, management, and data services software based again on the number of sockets, with variations for production and nonproduction licenses. Forrester notes that SAP HANA also includes capabilities such as OLAP and advanced analytics, which can contribute to a lower TCO, as these features might require additional licenses with alternate solutions. However, for the purposes of this analysis, we have not included this category of cost avoidance, as we did not have sufficient data about the comparative requirements. However, in the case of a custom application developed on HANA, we do include an estimate of the comparative cost for additional analytic capability, as it is particularly relevant in this scenario.

For both hardware and software, we include ongoing maintenance at a rate of 22%, based on industry average. For labor costs, we use a fully loaded rate for administrators and developers, as listed below. For implementation costs, we include both an internal and external (services) cost at the rates shown. The exact numbers for each scenario are detailed in the following sections; however, these assumptions are used in each calculation.

For the hardware assumptions, shown in Table 1, we list the average cost of sockets and storage, both production and non-production. In each of the three scenarios, we then estimate the number of servers and associated sockets required for that scenario, without HANA, and use these guidelines to estimate the cost of these machines. We then estimate the number of HANA appliances required for the same scenario, using the compression factor listed below, and project the total cost of the HANA appliances required. For all hardware, we use an ongoing maintenance rate of 22%. For each scenario, we detail the exact projections made, using these metrics.

TABLE 1
Cost Analysis Assumptions — Hardware

Description	Value
Average cost per CPU (baseline, production machine)	\$25,000
Average cost per CPU (baseline, nonproduction machine)	\$15,000
Average cost of storage (baseline, per TB, production)	\$8,000
Average cost of storage (baseline, per TB, nonproduction)	\$5,000
Number of cores per CPU	8
HANA appliance (sample pricing for calculation purposes)	\$150,000 - \$325,000
HANA data footprint reduction (conservative)	4x
Hardware maintenance rate	22%

Source: Forrester Research, Inc.

For the software requirements, we estimate these separately for each scenario and describe them in the following sections; however, for all software, we include a maintenance rate of 22%, as shown in Table 2. Much of the software pricing is per core; as stated above, we use an assumption of 8 cores per CPU.

TABLE 2
Cost Analysis Assumptions — Software

Description	Value
Software maintenance rate	22%

Source: Forrester Research, Inc.

In Table 3, we list the assumptions made for labor costs for administration and maintenance, development, and professional services. In each scenario, we list the required resources and use these metrics to project the associated cost.

TABLE 3
Cost Analysis Assumptions — Labor

Description	Value
Administrator salary (fully loaded)	\$150,000
Developer salary (fully loaded)	\$140,000
Professional services (hourly rate)	\$150

Source: Forrester Research, Inc.

✦ Scenario 1: Business Warehouse

In order to project the cost savings attributable to moving BW to HANA, we first project the likely costs of moving BW to HANA, and then forecast the costs avoided (which would be the costs incurred had the former environment been refreshed). In projecting the HANA costs, we assume that HANA is implemented in the first year of the analysis, so that all initial hardware, software, implementation, and labor costs are accrued upfront. Over the following three years of the analysis, we project the hardware and software maintenance costs, as well as the ongoing development and administration costs associated with BW on HANA. These costs are shown in Tables 4 (hardware), 5 (software), and 6 (labor).

Table 4 shows the hardware costs, which include the HANA appliances' and BW servers' production, high availability and disaster recovery, quality assurance, and development. Additionally, we include costs associated with high and low end storage. As outlined here, BW HANA configuration assumes 20% of hot data will persist in HANA, with cold data kept in near line storage. There is no additional software license for IQ as it is part of the 8% SAP HANA license. We include both the hardware for the HANA configuration as well as the additional hardware required for the remainder of the data. Forrester notes that the BW on SAP HANA configuration is an upgrade over original BW without HANA configuration to meet growing business needs.

TABLE 4
BW On HANA — Hardware Costs

Metric	Details	Calculation	Year 1	Ongoing
HANA appliance	9x 1TB scale-out appliances required based on assumption 2TB compressed (40 TB) datasize; Primary: 4production; 1 standby; high availability Secondary: 4disaster recover; test and development	9*\$150,000	\$ 1,350,000	\$297,000
SAP NetWeaver	Production: 4 CPU, 64GB memory, 5TB high-end storage Nonproduction: 2 CPU, 32GB memory, 5TB storage (2 needed)	$(4*\$25,000 + 5 *\$8,000) + ((2*\$15,000 + 5*\$5,000)*2)$	\$250,000	\$55,000
Additional hardware for cold (non-HANA) data	Production: 2 CPU, 1TB memory, 8TB high end storage; Nonproduction: disaster recovery (same as production); 1 development and QA machine: 2 CPU (at \$15,000), 8TB storage	$(2*(2*\$25,000+8*\$8,000)) + (2*\$15,000+8*\$5,000)$	\$298,000	\$65,560
Total			\$1,898,000	\$417,560

Source: Forrester Research, Inc.

For the software costs, we include the costs of the HANA runtime license on BW, which is based on the total current maintenance base for SAP applications. This base is made up of the total cost of SAP applications in the environment, which for this sample organization consists of the \$2,000,000 ERP license (more details on the ERP scenario are provided in the following section). This leads to an initial HANA license cost of \$160,000, with ongoing maintenance of 22% in the following years. Forrester notes that the BW license is included as part of the Business Suite/ERP purchase and therefore has no additional cost.

TABLE 5
BW On HANA — Software Costs

Metric	Details	SAP Application Value	Year 1	Ongoing
HANA license cost	Percentage of total SAP application cost	\$2,000,000	\$160,000	\$35,200

Source: Forrester Research, Inc.

For the implementation costs, we include the upfront costs associated with both internal and external labor, at 1,500 hours each (the rates for each are in the assumptions). We also include the administration and development resource costs, which demonstrate an increase in productivity over the pre-HANA environment. These costs continue to go down over the first three years, as efficiency in using the HANA platform increases within the organization. For administration, we include at the

initial deployment, 4 FTEs; for development, we include 8 FTEs. This represents an initial savings of 20% over the labor required in the non-HANA scenario, which ramps up to 25% and 30% in the subsequent years.

TABLE 6
BW On HANA — Labor Costs

Metric	Calculation	Year 1	Year 2	Year 3	Year 4
Implementation (internal)		\$108,173			
Implementation (professional services)		\$157,500			
Administration resources		\$600,000	\$562,500	\$525,000	\$525,000
Development resources		\$1,120,000	\$1,050,000	\$980,000	\$980,000
Total		\$1,985,673	\$1,612,500	\$1,505,000	\$1,505,000

Source: Forrester Research, Inc.

TABLE 7
BW On HANA — Total Costs

Metric	Year 1	Year 2	Year 3	Year 4	Total	Present Value
Total hardware costs	\$1,898,000	\$417,560	\$417,560	\$417,560	\$3,150,680	\$2,936,410
Total software costs	\$160,000	\$35,200	\$35,200	\$35,200	\$265,600	\$247,537
Total implementation costs	\$265,673	\$0	\$0	\$0	\$265,673	\$265,673
Total labor cost	\$1,720,000	\$1,612,500	\$1,505,000	\$1,505,000	\$6,342,500	\$5,560,440
Total BW on HANA cost	\$4,043,673	\$2,065,260	\$1,957,760	\$1,957,760	\$10,024,453	\$9,010,060

Source: Forrester Research, Inc.

In order to project the costs avoided without HANA, we consider what the costs would have been had the Company not moved BW to HANA. To do this, we include the costs of hardware, software, and labor for administration and development. To project the hardware cost, we rely on the metrics listed in the assumptions above to calculate a reasonable cost for the hardware required, as detailed in the table below. This hardware cost avoidance begins in Year 1, as we assume that the Company moves to HANA instead of refreshing its current environment. We note that the Company is able to eliminate both the database server (replaced by HANA) and the operational reporting server, as it is no longer needed with HANA.

TABLE 8
BW Hardware Costs (Without HANA)

Metric	Details	Calculation	Year 1	Ongoing
Database server	Production: 8 CPU, 64GB memory, 50TB high-end storage; nonproduction: 2 CPU, 32GB memory, 20TB storage (3 needed)	$(8 * \$25,000 + 50 * \$8,000) + ((2 * \$15,000 + 20 * \$5,000) * 3)$	\$990,000	\$217,800
SAP NetWeaver	Production: 4 CPU, 64GB memory, 5TB high-end storage Nonproduction: 2 CPU, 32GB memory, 5TB storage (2 needed)	$(4 * \$25,000 + 5 * \$8,000) + ((2 * \$15,000 + 5 * \$5,000) * 2)$	\$250,000	\$55,000
Operational reporting server (40 TB)	Production: 4 CPU, 64GB memory, 40TB high-end storage	$(4 * \$25,000) + (40 * \$8,000)$	\$420,000	\$92,400
Total			\$1,660,000	\$365,200

Source: Forrester Research, Inc.

For software, we consider the required software, including alternate database software, as well as ETL software. However, as these licenses are already purchased, we include only the cost associated with ongoing maintenance (22% of license cost). In the first year, we include 50% of the cost avoidance, assuming that for the first six months, the old software is still in use as HANA is deployed and ramped up (so these licenses are retired after the initial six months). The database software is priced as a percentage of the ERP license cost, the same as the HANA licenses; these are both prices for runtime licenses. Forrester notes that many customers choose full licenses for their database software, which would raise the cost of software in this alternate scenario. The details of these costs are shown in Table 9 below. As in the HANA scenario, the BW license is included with the ERP purchase, so there is no incremental license cost associated with BW.

TABLE 9
BW Software Costs (Without HANA)

Metric	Calculation	Year 1	Ongoing
Database license cost	percentage of ERP license (same as HANA scenario); runtime license	\$160,000	\$35,200
ETL license cost	\$11,500 per production core; \$5,750 per nonproduction core	\$212,520	\$425,040
Total		\$372,520	\$460,240

Source: Forrester Research, Inc.

We also include costs associated with ongoing administration and development, as shown in the table below. Similar to the software licenses, we assume that for the first six months, these resources are still needed before the move to HANA is complete, so we include this cost avoidance at 50% of the annual total saved in later years. For administration, we include 5 FTEs; for administration, we include 10 FTEs.

TABLE 10
BW Labor Costs (Without HANA)

Metric	Calculation	Year 1	Year 2	Year 3	Year 4
Administration resources		\$375,000	\$750,000	\$750,000	\$750,000
Development resources		\$700,000	\$1,400,000	\$1,400,000	\$1,400,000
Total		\$1,075,000	\$2,150,000	\$2,150,000	\$2,150,000

Source: Forrester Research, Inc.

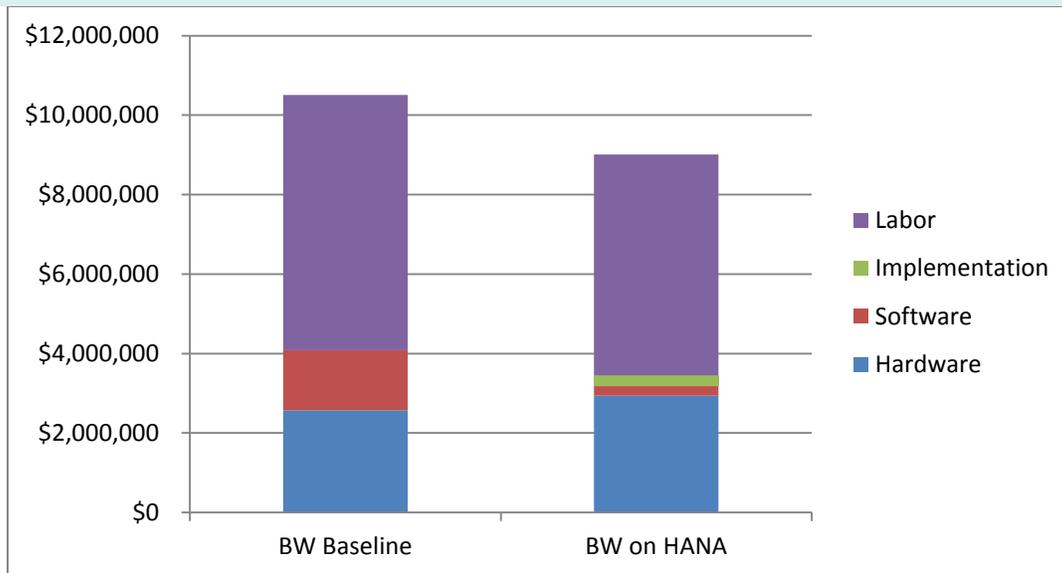
TABLE 11
BW Without HANA — Total Cost Avoidance

Metric	Year 1	Year 2	Year 3	Year 4	Total	Present Value
Total hardware costs	\$1,660,000	\$365,200	\$365,200	\$365,200	\$2,755,600	\$2,568,198
Total software costs	\$372,520	\$460,240	\$460,240	\$460,240	\$1,753,240	\$1,517,069
Total implementation costs (N/A)						
Total labor cost	\$1,075,000	\$2,150,000	\$2,150,000	\$2,150,000	\$7,525,000	\$6,421,732
Total BW cost avoidance	\$3,107,520	\$2,975,440	\$2,975,440	\$2,975,440	\$12,033,840	\$10,506,999

Source: Forrester Research, Inc.

The net difference between the two scenarios is shown in Figure 5 and Table 12, below.

FIGURE 5
BW TCO Summary



Source: Forrester Research, Inc.

TABLE 12
Net BW Savings With HANA

Metric	Year 1	Year 2	Year 3	Year 4	Total	Present Value
Total hardware costs	(\$238,000)	(\$52,360)	(\$52,360)	(\$52,360)	(\$395,080)	(\$368,212)
Total software costs	\$212,520	\$425,040	\$425,040	\$425,040	\$1,487,640	\$1,269,532
Total implementation costs (N/A)	(\$265,673)	\$0	\$0	\$0	(\$265,673)	(\$265,673)
Total labor cost	(\$645,000)	\$537,500	\$645,000	\$645,000	\$1,182,500	\$861,292
Total net BW savings with HANA	(\$936,153)	\$910,180	\$1,017,680	\$1,017,680	\$2,009,387	\$1,496,939

Source: Forrester Research, Inc.

★ Scenario 2: ERP

Similar to our projections for moving BW onto HANA, we have developed a model to forecast the costs of moving ERP to HANA, as compared with remaining on an alternate database platform. In this case, we project that the Company moves its ERP instance to HANA in the second year of the analysis, once the BW move is complete, and retires the existing environment in the following year (Year 3 of the analysis). Below, we show the costs of moving the existing ERP to HANA. As before, we show the hardware, software, and labor costs.

Table 13 shows the hardware costs associated with moving ERP onto HANA, for the HANA appliances, application servers, and additional storage.

TABLE 13
ERP On HANA — Hardware Costs

Metric	Details	Calculation	Year 1	Ongoing
HANA appliance	3x 4TB (4TB sufficient as not that high analytical workload) appliances required based on assumption 2,5TB compressed (10TB) database size; Primary: 1 production; 1-standby: high availability; secondary: 1 disaster recovery; test and development	3*\$325,000	\$975,000	\$214,500
SAP NetWeaver	Production: 4 CPU, 64GB memory, 5TB high-end storage Nonproduction: 2 CPU, 32GB Memory, 5TB storage (3 needed)	$(4*\$25,000 + 5 *\$8,000) + ((2*\$15,000 + 5*\$5,000)*3)$	\$305,000	\$67,100
Total			\$1,280,000	\$281,600

Source: Forrester Research, Inc.

For the software costs, we include the maintenance costs of the ERP license, as well as the HANA license cost. We assume that the ERP license cost has been acquired prior to the move to HANA, and therefore is a sunk cost for the purposes of this analysis.

TABLE 14
ERP On HANA — Software Costs

Metric	Details	SAP Application Value	Year 1	Ongoing
ERP cost (on HANA)	Depends on the numbers of users	$\$2,000,000 * 22\%$ maintenance	\$440,000	\$440,000
HANA license cost	Derived as % of the SAP application cost		\$300,000	\$66,000
Total			\$740,000	\$506,000

Source: Forrester Research, Inc.

For the implementation costs, we include the upfront costs associated with both internal and external labor, at 1,500 hours each (the rates for each are in the assumptions). We also include the administration and development resource costs, which demonstrate an increase in productivity over the pre-HANA environment. These costs continue to go down over the first three years, as efficiency in using the HANA platform increases within the organization. For administration, we include at the initial deployment, 4 FTEs; for administration, we include 4 FTEs. This represents an initial savings of 20% over the labor required in the non-HANA scenario, which ramps up to 25% and 30% in the subsequent years.

TABLE 15
ERP On HANA — Labor Costs

Metric	Calculation	Year 1	Year 2	Year 3	Year 4
Implementation (internal)			\$108,173		
Implementation (professional services)			\$157,500		
Administration resources			\$600,000	\$562,500	\$525,000
Development resources			\$560,000	\$525,000	\$490,000
Total			\$1,425,673	\$1,087,500	\$1,015,000

Source: Forrester Research, Inc.

Table 16 shows the total costs associated with moving ERP onto HANA.

TABLE 16
ERP On HANA — Total Costs

Metric	Year 1	Year 2	Year 3	Year 4	Total	Present Value
Total hardware costs	\$0	\$1,280,000	\$281,600	\$281,600	\$1,843,200	\$1,607,934
Total software costs	\$0	\$740,000	\$506,000	\$506,000	\$1,752,000	\$1,471,074
Total implementation costs	\$0	\$265,673	\$0	\$0	\$265,673	\$241,521
Total labor cost	\$0	\$1,160,000	\$1,087,500	\$1,015,000	\$3,262,500	\$2,715,890
Total ERP on HANA cost	\$0	\$3,445,673	\$1,875,100	\$1,802,600	\$7,123,373	\$6,036,420

Source: Forrester Research, Inc.

As with BW, in order to project the costs avoided without HANA, we consider what the costs would have been had the Company not moved ERP to HANA. To do this, we include the costs of hardware, software, and labor for administration and development that are avoided, beginning in Year 3 of the analysis (when the former ERP environment is retired). To project the hardware cost, we rely on the metrics listed in the assumptions above to calculate a reasonable cost for the hardware required, as detailed in the table below. This hardware cost avoidance begins in Year 3, when we assume that the Company is able to avoid refreshing its current environment. We note that the Company is able to eliminate both the database server (replaced by HANA) and the operational reporting server, as it is no longer needed with HANA.

TABLE 17
ERP Hardware Costs (Without HANA)

Metric	Details	Calculation	Year 1	Ongoing
Database server (20 TB)	Production: 8 CPU, 128GB memory, 30TB	$((8 * \$25,000 + 30 * \$8,000) * 2) +$	\$1,840,000	\$404,800

	high-end storage; nonproduction (2 needed): 4 CPU, 64GB memory, 20TB storage (6 needed)	$((4 * \$15,000 + 20 * \$5,000) * 6)$		
Application server	Production: 4 CPU, 64GB memory, 5TB high-end storage; nonproduction: 2 CPU, 32GB memory, 5TB storage (3 needed)	$(4 * \$25,000 + 5 * \$8,000) + ((2 * \$15,000 + 5 * \$5,000) * 3)$	\$305,000	\$67,100
Operational reporting server (20 TB)	Production: 4 CPU, 64GB memory, 20TB high-end storage	$(4 * \$25,000) + (20 * \$8,000)$	\$260,000	\$92,400
Total			\$2,405,000	\$564,300

Source: Forrester Research, Inc.

For software, we consider the required software, including alternate database software, ETL software, data services software, and management tools. As in the previous scenario, we note that the database software is priced for full use licenses, as compared with the HANA prices for runtime licenses. However, as these licenses are already purchased, we include only the cost associated with ongoing maintenance (22% of license cost), starting in the third year when this software is no longer required. Similar to the previous use-case, the database software cost is calculated in the same way that the HANA license is calculated, as a percentage of the ERP license cost; this represents the cost of a runtime license. Again, Forrester recognizes that many customers choose to purchase full licenses for their database software, which would raise the software cost in the non-HANA scenario.

TABLE 18
ERP Software Costs (Without HANA)

Metric	Calculation	Ongoing
ERP license cost	Maintenance fee based on license cost of \$2,000,000	\$440,000
Database license cost	Percentage of ERP license; runtime license	\$66,000
ETL license cost	\$11,500 per production core; \$5,750 per nonproduction core	\$769,120
Data services license cost	\$25,000 per production core; \$12,500 per nonproduction core	\$1,672,000
Management tools license cost	\$10,000 per production core; \$5,000 per nonproduction core	\$668,800
Total		\$3,615,920

Source: Forrester Research, Inc.

We also include costs associated with ongoing administration and development, as shown in the table below. For both administration and development, we include 5 FTEs each.

TABLE 19
ERP Labor Costs (Without HANA)

Metric	Calculation	Year 1	Year 2	Year 3	Year 4
Administration resources	5*\$150,000			\$750,000	\$750,000
Development resources	5*\$140,000			\$700,000	\$700,000
Total				\$1,450,000	\$1,450,000

Source: Forrester Research, Inc.

The total costs eliminated, beginning in Year 3, are shown in Table 20.

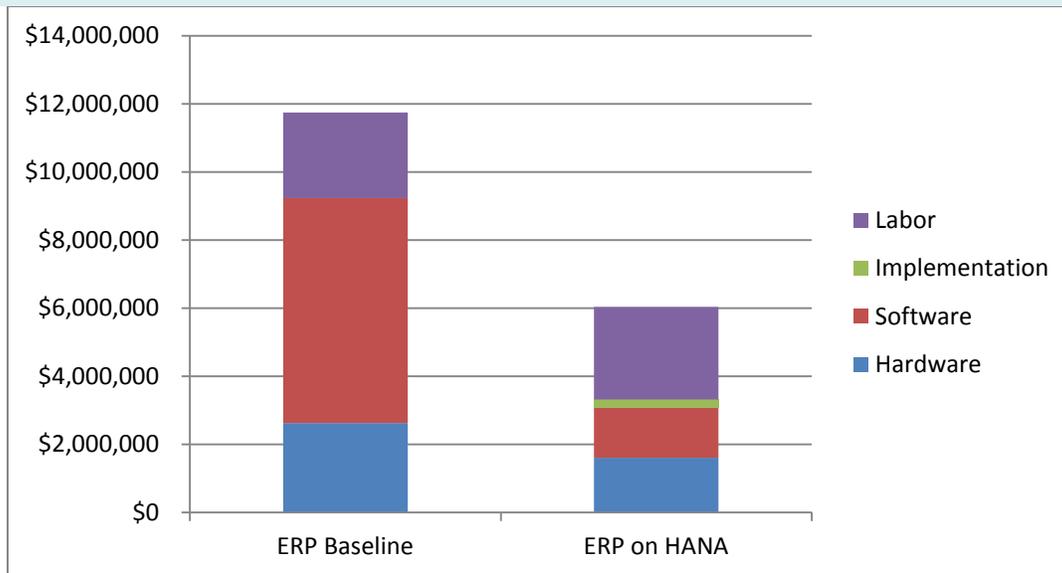
TABLE 20
ERP Without HANA — Total Cost Avoidance

Metric	Year 1	Year 2	Year 3	Year 4	Total	Present Value
Total hardware costs	\$0	\$0	\$2,405,000	\$529,100	\$2,934,100	\$2,623,636
Total software costs	\$0	\$0	\$3,615,920	\$3,615,920	\$7,671,840	\$6,606,142
Total implementation costs (N/A)						
Total labor cost	\$0	\$0	\$1,450,000	\$1,450,000	\$2,900,000	\$2,516,529
Total ERP cost avoidance	\$0	\$0	\$7,470,920	\$5,595,020	\$13,505,940	\$11,746,307

Source: Forrester Research, Inc.

The net difference between the two scenarios is shown in Figure 6 and Table 21, below.

FIGURE 6
ERP TCO Summary



Source: Forrester Research, Inc.

TABLE 21
Net ERP Savings With HANA

Metric	Year 1	Year 2	Year 3	Year 4	Total	Present Value
Total hardware costs	\$0	(\$1,280,000)	\$2,123,400	\$247,500	\$1,090,900	\$1,015,702
Total software costs	\$0	(\$740,000)	\$3,109,920	\$3,109,920	\$5,919,840	\$5,135,068
Total implementation costs (N/A)	\$0	(\$265,673)	\$0	\$0	(\$265,673)	(\$241,521)
Total labor cost	\$0	(\$1,160,000)	\$362,500	\$435,000	(\$362,500)	(\$199,361)
Total net ERP savings with HANA	\$0	(\$3,445,673)	\$5,595,820	\$3,792,420	\$6,382,567	\$5,709,888

Source: Forrester Research, Inc.

★ Scenario 3: Custom Application

For the final scenario, we project the costs of developing a custom application to HANA, as compared with developing this application on the previous platform. Some of the interviewees mentioned this kind of application, which was extremely

business specific. In both cases, the applications involved tracking and analyzing large amounts of data and using the results to make decisions and improve customer service.

We begin with the hardware costs associated with using HANA for this work. As shown in Table 22, we include two HANA appliances at a cost of \$150,000 each.

TABLE 22
Custom Application Developed On HANA — Hardware Costs

Metric	Details	Calculation	Year 1	Ongoing
HANA appliance	2 x 1TB appliances required based on assumption 512GB compressed database size; disaster recovery runs on primary; test and development run on secondary	2*\$150,000	\$300,000	\$66,000

Source: Forrester Research, Inc.

For the software costs, we include only the HANA license cost, which is based on the amount of memory required. For this custom application, approximately 1 TB of HANA is needed. This leads to a total software cost of \$1,920,000, and an ongoing cost of 22% of this, or \$422,400, as shown in Table 23.

TABLE 23
Custom Application Developed On HANA — Software Costs

Metric	Details	Calculation	Initial	Ongoing
HANA license cost	1TB required		\$1,920,000	\$422,400

Source: Forrester Research, Inc.

For the implementation costs, we include the upfront costs associated with both internal and external labor, at 1,500 hours each (the rates for each are in the assumptions). We also include the administration and development resource costs, which demonstrate an increase in productivity over the pre-HANA environment. These costs continue to go down over the first three years, as efficiency in using the HANA platform increases within the organization. For administration, we include at the initial deployment, 4 FTEs; for administration, we include 4 FTEs, both of which are 20% lower than the comparable labor totals without HANA.

TABLE 24
Custom Application Developed On HANA — Labor Costs

Metric	Calculation	Year 1	Year 2	Year 3	Year 4
Implementation (internal)				\$108,173	
Implementation (professional services)				\$157,500	
Administration resources				\$600,000	\$562,500

Development resources	\$560,000	\$525,000
Total	\$1,425,673	\$1,087,500

Source: Forrester Research, Inc.

Table 25 shows the total costs associated with developing the custom application on HANA.

TABLE 25
Custom Application Developed On HANA — Total Costs

Metric	Year 1	Year 2	Year 3	Year 4	Total	Present Value
Total hardware costs	\$0	\$0	\$300,000	\$66,000	\$366,000	\$327,273
Total software costs	\$0	\$0	\$1,920,000	\$422,400	\$2,342,400	\$2,094,545
Total implementation costs	\$0	\$0	\$265,673	\$0	\$265,673	\$241,521
Total labor cost	\$0	\$0	\$1,160,000	\$1,087,500	\$2,247,500	\$1,953,306
Total custom application on HANA cost	\$0	\$0	\$3,645,673	\$1,575,900	\$5,221,573	\$4,616,645

Source: Forrester Research, Inc.

As in the prior two cases, in order to project the costs avoided without HANA, we consider what the costs would have been had the Company developed this application on its prior platform. To do this, we include the costs of hardware, software, and labor for administration and development that are avoided, beginning in Year 3 of the analysis (when the application is developed). To project the hardware cost, we rely on the metrics listed in the assumptions above to calculate a reasonable cost for the hardware required, as detailed in the table below. This hardware cost avoidance begins in Year 3, when we assume that the Company is able to avoid acquiring this hardware.

TABLE 26
Custom Application Hardware (Without HANA)

Metric	Details	Calculation	Year 3	Year 4
Database server (2 TB data)	Production: 4 CPU, 128GB memory, 6TB high-end storage; nonproduction: 2 CPU, 64GB memory, 8TB storage (2 needed)	$(4 * \$25,000 + 20 * \$8,000) + ((2 * \$15,000 + 20 * \$5,000) * 2)$	\$288,000	\$63,360
Application server	Production: 2 CPU, 64GB memory, 5TB high-end storage; nonproduction: 2 CPU, 32GB memory, 5TB storage (2 needed)	$(2 * \$25,000 + 5 * \$8,000) + ((2 * \$15,000 + 5 * \$5,000) * 2)$	\$200,000	\$44,000
Total			\$488,000	\$107,360

Source: Forrester Research, Inc.

For software, we consider the required software for developing this application. These costs start in the third year when this software was not required (since the application is developed on HANA, these costs are never incurred). Therefore, in Year 3, we include the initial license cost, and in Year 4, the ongoing maintenance cost. To estimate the database cost, we use the license rate of \$25,000 per core for production and \$12,500 for nonproduction, as in the previous scenarios; however, we then add an additional \$25,000 per core (\$12,500 for nonproduction) for analytics and text capabilities. This provides a more complete comparison to the HANA license, which includes these capabilities. Forrester notes that these costs can vary widely based on the pricing and discounts offered by various vendors; we use these values as representative but encourage the reader to consider the most realistic pricing for this technology, based on the intended use and existing environment.

TABLE 27
Custom Application Software (Without HANA)

Metric	Calculation	Year 3	Year 4
Homegrown app written in Java/.NET	No incremental cost		
Database software license cost	\$50,000 per production core; \$25,000 per non-production core	\$5,600,000	\$1,232,000
Application Server software: WebLogic/WebSphere	Estimated as 15% of database cost	\$840,000	\$184,800
Total		\$6,440,000	\$1,416,800

Source: Forrester Research, Inc.

We also include costs associated with ongoing administration and development, as shown in the table below. For both administration and development, we include 5 FTEs each.

TABLE 28
Custom Application Labor (Without HANA)

Metric	Calculation	Year 1	Year 2	Year 3	Year 4
Administration resources				\$750,000	\$750,000
Development resources				\$700,000	\$700,000
Total				\$1,450,000	\$1,450,000

Source: Forrester Research, Inc.

The total costs eliminated, beginning in year 3, are shown in Table 29.

TABLE 29
Custom Application — Total Cost Avoidance

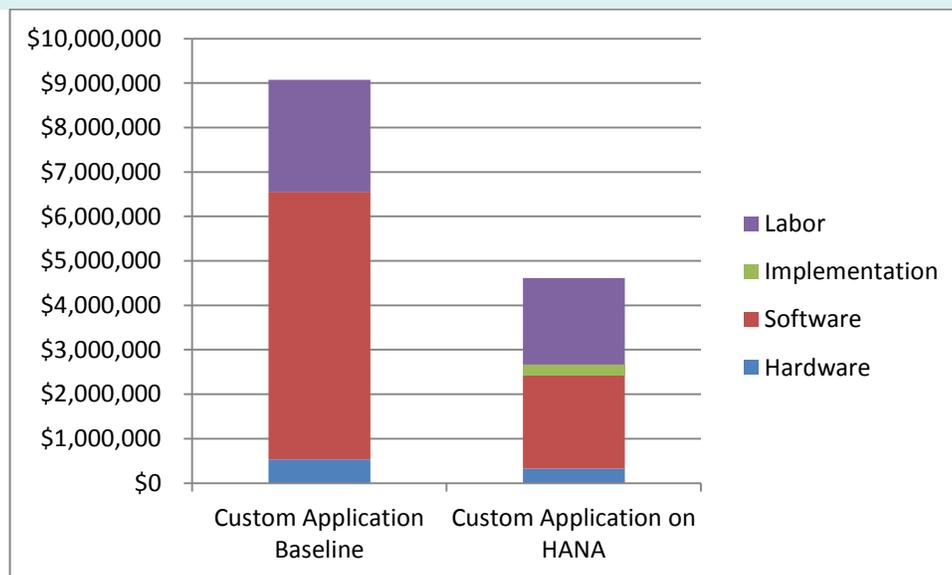
Metric	Year 1	Year 2	Year 3	Year 4	Total	Present Value
Total hardware costs	\$0	\$0	\$488,000	\$107,360	\$595,360	\$532,364

Total software costs	\$0	\$0	\$5,520,000	\$1,214,400	\$6,734,400	\$6,021,818
Total implementation costs (N/A)						
Total labor cost	\$0	\$0	\$1,450,000	\$1,450,000	\$2,900,000	\$2,516,529
Total custom application cost avoidance	\$0	\$0	\$7,458,000	\$2,771,760	\$10,229,760	\$9,070,711

Source: Forrester Research, Inc.

The net difference between the two scenarios is shown in Figure 7 and Table 30, below.

FIGURE 7
Custom Application TCO Summary



Source: Forrester Research, Inc.

TABLE 30
Net Custom Application Savings With HANA

Metric	Year 1	Year 2	Year 3	Year 4	Total	Present Value
Total hardware costs	\$0	\$0	\$300,000	\$66,000	\$366,000	\$327,273
Total software costs	\$0	\$0	\$1,920,000	\$422,400	\$2,342,400	\$2,094,545
Total implementation costs (N/A)	\$0	\$0	\$265,673	\$0	\$265,673	\$241,521

Total labor cost	\$0	\$0	\$1,160,000	\$1,087,500	\$2,247,500	\$1,953,306
Total net custom application savings with HANA	\$0	\$0	\$3,645,673	\$1,575,900	\$5,221,573	\$4,616,645

Source: Forrester Research, Inc.

FLEXIBILITY

Flexibility, as defined by TEI, represents an investment in additional capacity or capability that could be turned into business benefit for some future additional investment. This provides an organization with the “right” or the ability to engage in future initiatives but not the obligation to do so. There are multiple scenarios in which a customer might choose to implement HANA and later realize additional uses and business opportunities. Flexibility would also be quantified when evaluated as part of a specific project (described in more detail in Appendix B).

For the purposes of this study, we have not quantified the impact of flexibility, as it would add additional complexity to this already lengthy projection. However, all of the interviewees cited the future value of HANA as an underlying platform, and planned to expand their use of HANA to other workloads including transactional and custom applications. The interviewees agreed that the potential benefit was exponential, as they were able to reap benefits in terms of efficiency gains and hardware and software savings across various applications once they were on a common platform.

RISKS

Forrester defines two types of risk associated with this analysis: “implementation risk” and “impact risk.” “Implementation risk” is the risk that a proposed investment in HANA may deviate from the original or expected requirements, resulting in higher costs than anticipated. “Impact risk” refers to the risk that the business or technology needs of the organization may not be met by the investment in HANA, resulting in lower overall total benefits. The greater the uncertainty, the wider the potential range of outcomes for cost and benefit estimates.

Quantitatively capturing investment risk and impact risk by directly adjusting the financial estimates results provides more meaningful and accurate estimates and a more accurate projection of the ROI. In general, risks affect costs by raising the original estimates, and they affect benefits by reducing the original estimates. The risk-adjusted numbers should be taken as “realistic” expectations since they represent the expected values considering risk.

The following impact risk (that affects cost savings) is identified as part of the analysis:

- › In order to realize this type of TCO savings, the costs associated with the pre-HANA environment must either be eliminated or redeployed to recapture the value. We have projected savings associated with avoiding refreshed hardware, eliminating software and reducing labor. However, there is a risk that software licenses will not be terminated or that developers or administrators may not efficiently use the time gained.

The following implementation risk (that affects costs) is identified as part of this analysis:

- › The projected costs associated with HANA and the complementary hardware, software, and labor needs, are made based on estimated data and industry metrics. These may vary widely in any particular deployment.

The risk factors are not quantified in the financial framework due to the complexity of the model. However, Forrester recommends that readers apply risk adjustments (to raise costs and lower cost savings) when applying the model to their own situation. For more information about risk calculations, see Appendix B.

Financial Summary

The following three tables show the total cost savings of all three use cases listed above, as well as present values (PVs) discounted at 10%.

TABLE 31
Total Costs Incurred With HANA

Benefit	Year 1	Year 2	Year 3	Year 4	Total	Present Value
Total BW on HANA cost	\$4,043,673	\$2,065,260	\$1,957,760	\$1,957,760	\$10,024,453	\$9,010,060
Total suite/ERP on HANA Cost	\$0	\$3,445,673	\$1,875,100	\$1,802,600	\$7,123,373	\$6,036,420
Total custom app on HANA cost	\$0	\$0	\$3,645,673	\$1,575,900	\$5,221,573	\$4,616,645
Total HANA cost	\$4,043,673	\$5,510,933	\$7,478,533	\$5,336,260	\$22,369,399	\$19,663,124

Source: Forrester Research, Inc.

TABLE 32
Total Costs Avoided

Benefit	Year 1	Year 2	Year 3	Year 4	Total	Present Value
Total BW cost	\$3,107,520	\$2,975,440	\$2,975,440	\$2,975,440	\$12,033,840	\$10,506,999
Total suite/ERP cost	\$0	\$0	\$7,470,920	\$5,595,020	\$13,505,940	\$11,746,307
Total custom application cost	\$0	\$0	\$7,458,000	\$2,771,760	\$10,229,760	\$9,070,711
Total baseline cost	\$3,107,520	\$2,975,440	\$17,904,360	\$11,342,220	\$35,769,540	\$31,324,017

Source: Forrester Research, Inc.

TABLE 33
Net Savings With HANA

Benefit	Year 1	Year 2	Year 3	Year 4	Total	Present Value	Percent savings with HANA
BW TCO savings with HANA	(\$936,153)	\$910,180	\$1,017,680	\$1,017,680	\$2,009,387	\$1,496,939	14%
ERP TCO savings with HANA	\$0	(\$3,445,673)	\$5,595,820	\$3,792,420	\$6,382,567	\$5,709,888	49%
Custom app TCO savings with HANA	\$0	\$0	\$3,812,327	\$1,195,860	\$5,008,187	\$4,454,066	49%
Total	(\$936,153)	(\$2,535,493)	\$10,425,827	\$6,005,960	\$13,400,141	\$11,660,893	37%

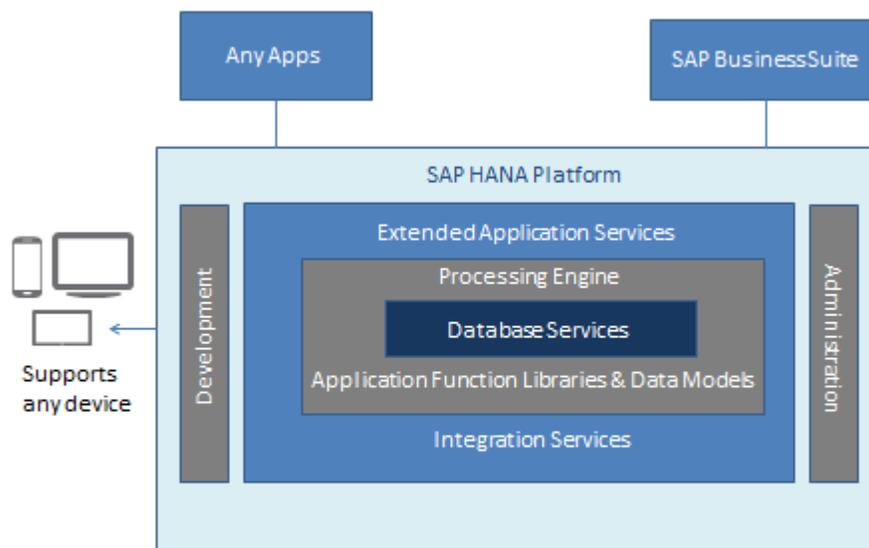
Source: Forrester Research, Inc.

SAP HANA: Overview

The following information is provided by SAP. Forrester has not validated any claims and does not endorse SAP or its offerings.

SAP HANA is a completely reimagined platform for real-time business. It converges database and application platform capabilities in-memory to transform transactions, analytics, text analysis, predictive, and spatial processing so businesses can operate in real time.

This new architecture enables converged OLTP and OLAP data processing within a single in-memory column-based data store with ACID compliance, while eliminating data redundancy and latency. By providing advanced capabilities, such as predictive text analytics, spatial processing, data and query federation, on the same architecture, it further simplifies application development and processing across big data sources and structures. This makes SAP HANA the most suitable platform for building and deploying next-generation, real-time applications and analytics.



Appendix A: Composite Organization Description

Based on the interviews, Forrester constructed a TEI framework, a composite company, and an associated ROI analysis that illustrates the areas financially affected. The composite organization that Forrester synthesized from these results represents an organization with the following characteristics:

- › A US-based manufacturing company
- › 40,000 employees
- › Pre-HANA, the Company has:
 - 40 TB SAP BW database system
 - 10 TB SAP ERP (Business Suite)
 - 2 TB custom (homegrown) application

The Company uses HANA as a replacement rather than refreshing the hardware for existing database platforms. For the purposes of this analysis, we assume that the Company begins by moving their BW implementation onto HANA, followed by ERP in the next year, and then a custom application in the following year. This financial analysis begins with the BW transition.

Appendix B: Total Economic Impact™ Overview

Total Economic Impact is a methodology developed by Forrester Research that enhances a company's technology decision-making processes and assists vendors in communicating the value proposition of their products and services to clients. The TEI methodology helps companies demonstrate, justify, and realize the tangible value of IT initiatives to both senior management and other key business stakeholders.

The TEI methodology consists of four components to evaluate investment value: benefits, costs, flexibility, and risks.

BENEFITS

Benefits represent the value delivered to the user organization — IT and/or business units — by the proposed product or project. Often, product or project justification exercises focus just on IT cost and cost reduction, leaving little room to analyze the effect of the technology on the entire organization. The TEI methodology and the resulting financial model place equal weight on the measure of benefits and the measure of costs, allowing for a full examination of the effect of the technology on the entire organization. Calculation of benefit estimates involves a clear dialogue with the user organization to understand the specific value that is created. In addition, Forrester also requires that there be a clear line of accountability established between the measurement and justification of benefit estimates after the project has been completed. This ensures that benefit estimates tie back directly to the bottom line.

COSTS

Costs represent the investment necessary to capture the value, or benefits, of the proposed project. IT or the business units may incur costs in the form of fully burdened labor, subcontractors, or materials. Costs consider all the investments and expenses necessary to deliver the proposed value. In addition, the cost category within TEI captures any incremental costs over the existing environment for ongoing costs associated with the solution. All costs must be tied to the benefits that are created.

FLEXIBILITY

Within the TEI methodology, direct benefits represent one part of the investment value. While direct benefits can typically be the primary way to justify a project, Forrester believes that organizations should be able to measure the strategic value of an investment. Flexibility represents the value that can be obtained for some future additional investment building on top of the initial investment already made. For instance, an investment in an enterprisewide upgrade of an office productivity suite can potentially increase standardization (to increase efficiency) and reduce licensing costs. However, an embedded collaboration feature may translate to greater worker productivity if activated. The collaboration can only be used with additional investment in training at some future point. However, having the ability to capture that benefit has a PV that can be estimated. The flexibility component of TEI captures that value.

RISKS

Risks measure the uncertainty of benefit and cost estimates contained within the investment. Uncertainty is measured in two ways: 1) the likelihood that the cost and benefit estimates will meet the original projections, and 2) the likelihood that the estimates will be measured and tracked over time. TEI applies a probability density function known as "triangular distribution" to the values entered. At a minimum, three values are calculated to estimate the underlying range around each cost and benefit.

Appendix C: Glossary

Discount rate: The interest rate used in cash flow analysis to take into account the time value of money. Companies set their own a discount rate based on their business and investment environment. Forrester assumes a yearly discount rate of 10% for this analysis. Organizations typically use discount rates between 8% and 16% based on their current environment. Readers are urged to consult their respective organizations to determine the most appropriate discount rate to use in their own environment.

Net present value (NPV): The present or current value of (discounted) future net cash flows given an interest rate (the discount rate). A positive project NPV normally indicates that the investment should be made, unless other projects have higher NPVs.

Present value (PV): The present or current value of (discounted) cost and benefit estimates given at an interest rate (the discount rate). The PV of costs and benefits feed into the total NPV of cash flows.

Payback period: The breakeven point for an investment. This is the point in time at which net benefits (benefits minus costs) equal initial investment or cost.

Return on investment (ROI): A measure of a project's expected return in percentage terms. ROI is calculated by dividing net benefits (benefits minus costs) by costs.

A NOTE ON CASH FLOW TABLES

The following is a note on the cash flow tables used in this study (see the example table below). The initial investment column contains costs incurred at "time 0" or at the beginning of Year 1. Those costs are not discounted. All other cash flows in years 1 through 3 are discounted using the discount rate at the end of the year. PV calculations are calculated for each total cost and benefit estimate. NPV calculations are not calculated until the summary tables are the sum of the initial investment and the discounted cash flows in each year.

TABLE [EXAMPLE]

Example Table

Ref.	Metric	Calculation	Year 1	Year 2	Year 3

Source: Forrester Research, Inc.

Appendix D: Endnotes

¹ Forrester risk-adjusts the summary financial metrics to take into account the potential uncertainty of the cost and benefit estimates. For more information see the section on Risks.