tei
The Language of Value

Total Economic Impact™ Analysis

Oracle9*i* Real Application Clusters on Compaq *TruCluster* Server Software

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Giga Information Group®
Technology advice.
Business results.

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Executive Summary

As a backdrop to this Total Economic Impact™ (TEI) report, Giga was asked to focus on those functionality underpinnings in *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems that have led to the cost improvements and/or reductions specific to high availability cluster computing infrastructures.

Giga defines a clustered-server architecture as essentially a group of computing nodes (multisystem configurations) that interconnect to work as a single, highly available and scalable system. As cluster nodes are added to multisystem configurations, IT managers must be able to operate and maintain these infrastructures as easily as managing single servers. In the past, clustering has always provided the highest levels of systems and applications availability for enterprise systems, but it has also been a technology plagued with increased management complexity as the clustered environment grew. With this in mind, Giga would always suggest that IT managers first weigh their selection criteria toward a cluster solution that can significantly ease the installation, administration and ongoing operations as the entire set of cluster resources is continually modified and/or added to. Essentially, the administration of a best-of-breed cluster should require no more skills or time investment than what is required to manage a single stand-alone. This is often referred to as achieving a "cluster single system image (SSI)."

Compaq's *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems design center maintains its technology-led brand as the best-of-breed cluster design center for the large-scale enterprise, founded on the long-term functionality advantages in *TruCluster*'s original design goal — namely, to provide a true single system image to all cluster resources, essentially allowing what was previously perceived to be complex to install, operate and modify to instead be managed as easily as a stand-alone single server resource.

Critical and, in some case, unique advantages of *TruCluster* Server V5.1A software are highlighted below, and they are the core technology-led reasons for the cost efficiencies and improvements discovered in the application of the Giga TEI model:

- The performance scalability benefits in an SSI cluster are that any and all nodes that have a direct connection to a shared storage pool may read/write data to it concurrently. In addition, even cluster nodes that do not have direct physical access (e.g., they are not on the same physical FC or SCSI bus connection) can still read/write data to devices they can't physically and directly connect to. In so doing, availability to data from this virtual shared pool is thereby substantially increased.
- In addition, and unique to Compaq's *TruCluster* Server software, is the Cluster File System (CFS) with shared root. While other cluster solutions offer a single clusterwide name space with *multiple* root disks, the CFS of *TruCluster* provides a single clusterwide name space with a *single* shared root disk, again preserving the system management discipline of always striving toward a single system image or view of cluster resources.
- Reports from cluster computing environments, as captured through Giga client inquiries, have demonstrated that the more efficient intersystem communications, stemming from Compaq's Memory Channel architecture, leads to significantly improved cluster performance scalability. Much of this improvement is tied to the higher transfer rates, coupled with the lower latency rates, of Compaq's switch-based Memory Channel architecture.
- The flexibility in making both CD-ROM and tape drives highly available across a single system cluster image has always been a critical (and unique) attribute of the *TruCluster* Server V5.1A software technology.

Introduction — Applying TEI to Compaq's Cluster Computing

Compaq Computer Corporation asked Giga Information Group to examine the economic impact of *Tru64* UNIX and *TruCluster* Server software on AlphaServer systems used in conjunction with Oracle9*i* Real Application Clusters technology. Estimates were obtained using Giga's Total Economic Impact™ (TEI) model. TEI is a way of quantifying the full impact of an investment in technology. TEI considers four elements of any initiative:

1. Benefits
2. Costs (sometimes referred to as total cost of ownership (TCO))
3. Flexibility
4. Risk

Giga's TEI has been used to examine the potential return on investment (ROI) from *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems, and its relationship with Oracle9*i* Real Application Clusters. Giga took a two-step process in examining the economic benefits surrounding the technology solution. Data was first obtained from four different organizations across several vertical industries using *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems. The majority of these organizations were currently using *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems and considering an additional investment in Oracle9*i* Real Application Clusters. The resulting data generated a potential ROI for IT systems based on the *Tru64* UNIX operating system, *TruCluster* Server software, *AlphaServer* systems, and Oracle software at each of the individual companies. The second part of the analysis centered on building a possible ROI for a "representative company" that would realize many of the same costs and benefit statements of the companies that were interviewed. The goal of this two-step approach was to first show the potential ROI across several different verticals and, secondly, to demonstrate how the common costs and benefits could be applied to a sample, or "representative," organization.

For the representative company, Giga has examined the costs and benefits of the proposed solution both prior to**,** and following**,** risk adjustment. Financial estimates regarding costs and benefits were calculated as the change, either positive or negative, from the next-best alternative, i.e., a system from a competitive vendor. A summary of the findings appears in the table below. The table illustrates the three-year changes in costs and benefits relative to the next-best alternative:

- **TEI —** TEI is defined as net total benefits (cost savings + business benefits + flexibility – total costs) divided by total costs. It is a more comprehensive measure than ROI since it takes into account the value of flexibility inherent in the solution.
- **Payback —** Payback is the point at which there is a positive cash flow in the investment life cycle.
- **Total three-year costs —** The three-year deployment and operational costs of *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems.
- **Total three-year cost savings —** Internal IT efficiency savings resulting from the use of *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems compared to the next-best alternative.
- **Total three-year business benefits —** Considered overall improvements in business process. This can be seen either in terms of improving the efficiency of the end users or improvements directly related to the organization's bottom line.
- **Total flexibility benefits —** Measurement of the additional indirect benefits resulting from the use of *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems. Primary flexibility benefits resulted from the future addition of Oracle9*i* Real Application Clusters.

Financial Results	Unadjusted	Risk Adjusted
TEI	71%	50%
Payback	Within 12 Months	Within 12 months
Total three-year costs	(403,882) USD	(403,882) USD
Total three-year cost savings	469,730 USD	400,165 USD
Total three-year business benefits	134,009 USD	116,141 USD
Total flexibility benefits	103,600 USD	98,200 USD

Source: Giga Information Group

The table above illustrates the different financial metrics that were used to measure the economic performance of the Compaq and Oracle solution. For a more detailed explanation of the financial metrics used in this report, please see the Appendix.

Analysis showed that benefits accrue to both IT as well as the overall business. In addition, Giga identified part of the value of the *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems solution is in terms of its ability to support the Oracle9*i* Real Application Clusters technology.

The economic decision surrounding the use of server-based technology has historically been measured in terms of the impact to the IT organization. While cost efficiencies remain an important factor in the use of the technology solution, equal importance should be paid to the impact of the technology functionality itself on the overall business. More specifically, change on the business side, in terms of increasing overall business performance, must be taken into account if a comprehensive picture of the impact of the technology can be made. Giga's analysis focused on a three-year window at each company to measure the potential costs and benefits of the solution over time. It is important to note here, however, that companies should evaluate the expected cash flow in this report based on their own individual risk thresholds.

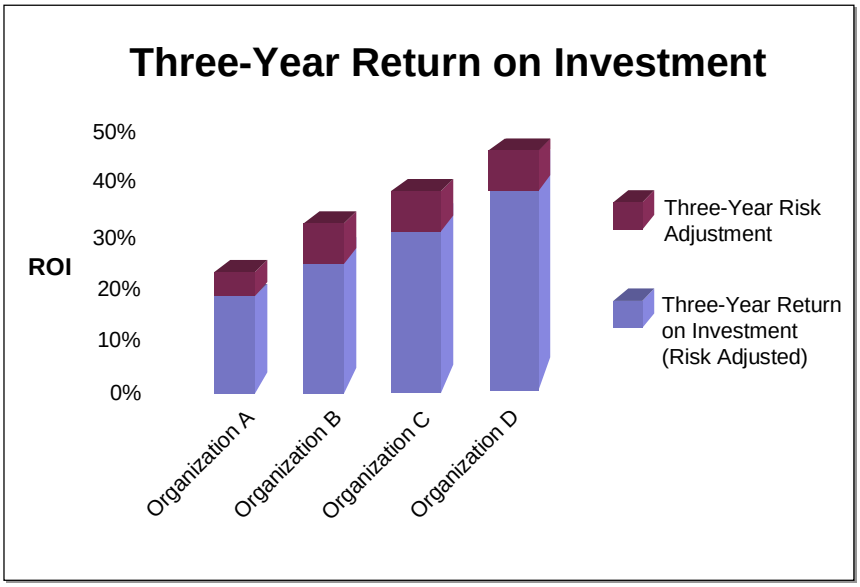
Giga makes no assumptions regarding the effect of *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems with Oracle9*i* Real Application Clusters at other companies. Nevertheless, this report examines the potential impact on the four organizations that participated in our examination and applies the common cost and benefit statements derived from these actual case interviews to a "representative company." The underlying objective of the document is to provide guidance to technology decision-makers seeking to identify areas where true business value can potentially be created based on a company's use of Compaq *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems in conjunction with the production deployment of Oracle9*i* Real Application Clusters in the near future.

Analysis of Implementation

The following four elements of TEI were employed in modeling the impact of Compaq's solution on each organization:

1. Cost and cost reduction
2. Benefits to the overall organization
3. Flexibility
4. Risk

As mentioned within the Executive Summary, data and the resulting analysis for this report were obtained from interviews with four different organizations across three different vertical industries. These included manufacturing, financial services and technology. While cost and cost savings were an important factor in all of the companies that were interviewed, several claimed a direct causal impact on quantifiable business benefits. A summary of the estimated risk-adjusted ROI for each organization appears below. Organizations A through D experienced three-year ROIs between 21 percent and 50 percent.



Source: Giga Information Group

Figure 1

Despite their different business drivers and objectives, Giga observed several common characteristics across the organizations interviewed. The following common characteristics provide the initial building blocks in applying the costs and benefits of the Compaq solution to a representative company:

- Technology-led features that impacted both cost and cost savings were the primary reasons for choosing Compaq *TruCluster* Server software technology.
- Customers thought the Compaq technology was "best of breed" in terms of performance and ease of use.
- The majority of the customers that were surveyed were confident in the current technology, but the impending merger between Compaq and Hewlett-Packard (HP) created questions as to whether, in a merged company, the continued investments, both in dollars and in human engineering costs, would remain unaffected, specific to the current road map currently committed to.

From these common value statements, Giga was able to extrapolate and generate a potential return on investment for a representative company that is currently using *Tru64* UNIX and *TruCluster* Server software on *AlphaServer*

systems with the future potential of deploying Oracle9*i* Real Application Clusters in a full production environment. The representative company was created to apply the common cost and benefit estimates that were obtained during the interview process of the four actual case studies. The objective is to illustrate how the common benefit and cost estimates can be applied to other organizations that might consider this technology.

1. Cost and Cost Reduction

Costs for *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems and Oracle9*i* Real Application Clusters were based on procurement, licensing and deployment costs for the two technologies. While costs for the *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems are captured in this section, costs for the integration of Oracle9*i* Real Application Clusters are captured later in this analysis (see Section 3 titled "Flexibility"). The reason for this breakdown is to provide a delineation between direct benefits and direct costs attributable to the *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems solution and the indirect benefits and costs for Oracle9*i* Real Application Clusters. For the purpose of this analysis, we assume that the majority of the costs stem from of the acquisition of the solution and are absorbed in the first year of deployment. In the case of the representative company, the following assumptions were made based on the data that was obtained and aggregated from the four actual case study interviews:

- Costs were divided between acquisition and licensing costs for the *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems solution. One-time implementation and acquisition costs amounted to an estimated $282,000 for a small-scale deployment. These costs include the costs to purchase the solution as well as the estimated costs to install the solution in an average-sized environment. This was based on the cost of the current customer system deployment and not necessarily the cost of a certified configuration.
- Annual licensing and maintenance costs are assumed to be a percentage of the original purchase price. These costs were estimated to be roughly $55,400 on a yearly basis.
- Cost savings are seen in several areas. Customers repeatedly emphasized the ease of use of the *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems solution in terms of overall management activities. In terms of system management efficiency gains, Giga estimates at least 30 percent to 50 percent efficiency gain for activities such as configuring the cluster, overall cluster management, and adding or removing nodes. The total efficiency gain is estimated to be $118,000 USD per year based on overall system management cost savings. These savings are compared to the next-best competitive offering to the *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems solution.
- In addition to system management, the company can expect additional efficiency gains in the area of event and volume management. Estimated efficiency gains are between 10 percent and 25 percent for various functions, including responding to and monitoring possible failovers, distributing event information, and increased efficiencies from being able to view as an integrated whole. Total efficiency gains are estimated to be roughly $179,166 USD per year for the representative organization.

The table below illustrates some of the representative efficiency gains possible as a result of switching to the *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems solution compared to the next-best alternative.

Area of Improvement	Efficiency Gain
System Management	30 % to 50% over the next-best alternative
Event Management	10% to 25% over the next-best alternative
Volume Management	10% to 25% over the next-best alternative

2. Benefit to the Business

While costs and costs reductions within IT continue to be a driving force behind any technology decision, measuring the impact of the technology on the overall business must also be a critical component. During the interviews, Giga found that some companies do measure the positive impact of technology on improving overall business process. This impact must be quantified and incorporated as part of the overall return on investment.

Based on the benefit statements uncovered during the interviews, a set of common benefits were applied to measure the return on investment for a representative firm. Particular business benefits were based in part on the following assumptions:

- The company was continuing to use the *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems for a significant portion of its internal applications. These applications needed to provide functionality to allow for high availability in reacting to changes by the external business.

- While improved availability directly benefits internal business processes, it is equally important to maintain high availability of external, customer-facing applications.

- The *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems functionality is easy to install, as well as to maintain, with the assumption that it can also be modified to accommodate a changing applications portfolio without disrupting the current production environment.

- Giga estimates that the impact of *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems to external business improvements to be between $50,000 and $60,000. This figure is based on improving the availability of applications that run on *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems and, as a result, increasing the speed of service to the overall marketplace.

3. Flexibility

Flexibility is the ability to take advantage of future downstream benefits. The intention of this report is to examine not only the direct benefits of the *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems solution, but also the future benefits of deploying *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems in conjunction with Oracle9*i* Real Application Clusters. Since all of the customers interviewed have yet to fully deploy the Oracle9*i* Real Application Clusters solution within their business production environment, there was not yet enough user experience with Oracle9*i* Real Application Clusters on *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems at the time of this report to determine immediate, direct benefits. Therefore, survey respondents estimated the future benefits (flexibility) of using Oracle9*i* Real Application Clusters on their current platform.

In most of the organizations that were interviewed, the anticipated use of the Oracle9*i* Real Application Clusters solution was for external-facing applications that directly impacted the external performance metrics of the company. These included such things as increasing customer satisfaction, maintaining or increasing market share, or reducing business process costs. For example, a manufacturing company indicated that it plans to use Oracle9*i* Real Application Clusters for external e-business applications, allowing for efficient data access and reduced transaction costs.

Most of the companies, however, did indicate that the long-term decision to move forward with Oracle9*i* Real Application Clusters was impacted significantly by the recent announcement of the potential merger between HP and Compaq. Several customers specifically stated that moving forward with the Oracle9*i* Real Application Clusters solution on Compaq increased the risks significantly, to the point where the long-term value of the solution was questionable. Since this is specifically a risk to the benefits of the Oracle solution, the risk to capturing the benefits is applied just to the flexibility benefits. Giga incorporates these concerns into the model by building in an appropriate level of risk both for the direct benefits as well as the long-term indirect benefits that may be achieved.

The value of flexibility is clearly unique to each organization and the willingness of each company to measure the value of flexibility varied considerably from company to company. For the purpose of this analysis, we have assumed that the representative company sees the value of flexibility in being able to scale to new potential revenue streams and reduced deployment times of the Oracle9*i* Real Application Clusters on *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems. We estimated that the company can achieve reduced deployment time as a result of the certified configuration that Oracle9*i* Real Application Clusters provides. In order to achieve this revenue target, the representative company needs to expend roughly $120,000 USD in additional cost to exercise the flexibility option. This cost is based in part on a small-scale deployment of the Oracle9*i* Real Application Clusters solution on its existing configuration. The underlying value of the option is estimated to be $103,600 USD based on the Black-Scholes Option Pricing formula.

4. Risk

Measurement of risk is a way of incorporating the level of confidence and uncertainty regarding the cost and benefit estimates of a given investment. Higher confidence that the costs and benefit estimates will be met implies that the level of risk is lower and the variation between the risk- and non-risk-adjusted outcomes would be minimal.

However, in most cases, the level of uncertainty surrounding the original estimates is significant, and its impact directly quantified. For the purpose of this analysis, there were two issues associated with the measurement of uncertainty of the original estimates. First is the likelihood that the costs and benefit estimates will be realized by each of the four companies that were interviewed. In all cases, Giga assumed an aggressive risk profile for each of the four companies in achieving the benefits predicted. The profile for each was based on several assumptions:

- All of the companies interviewed have limited experience with Oracle9*i* Real Application Clusters, and their initial benefits estimates may not ultimately be validated by actual internal data.
- In the case of benefit estimates, there is the potential that the benefit will not be measured and quantified down the road and, as a result, no TEI benefit calculation would result. High estimates were calculated as the value of the original unadjusted risk estimate in the case study. Using these assumptions as a starting point, the risk analysis was based on the level of confidence in the cost and benefit estimates and the level of specific information regarding the particular company. In some cases, the worst-case estimate for a particular benefit was 60 percent less than the original estimate, leading to a reduction in the risk-adjusted ROI.
- Risks to costs range from 90 percent of original cost estimate (suggesting a slight under run is possible) to a possible 10 percent increase in the cost over a three-year time frame.

Measurement of risks for each of the four customers was used as a basis for measurement of risk for the representative company.

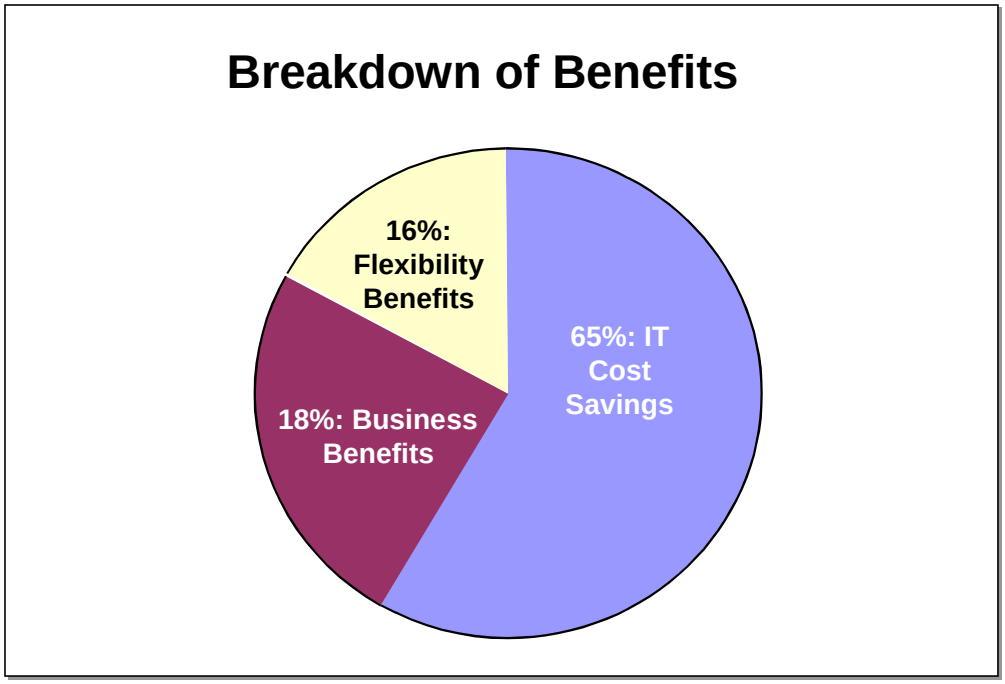
Project Summary

The following table and figure illustrate potential return on investment for a representative company based on data obtained from interviews with companies in different vertical industries. The objective here is not to illustrate a common return on investment that companies can obtain if using *Tru64* UNIX and *TruCluster* Server software on *AlphaServer* systems with Oracle9*i* Real Application Clusters, but rather to show the process of identifying common cost and benefit estimates and applying them to similar organizations. The results should be used as a guide that would allow organizations to determine the appropriate ROI of the Compaq/Oracle solution for their particular environment.

Financial Results	Unadjusted	Risk Adjusted
TEI	71%	50%
Payback	Within 12 Months	Within 12 months
Total three-year costs	(403,882) USD	(403,882) USD
Total three-year cost savings	469,730 USD	400,165 USD
Total three-year business benefits	134,009 USD	116,141 USD
Total flexibility benefits	103,600 USD	98,200 USD

Source: Giga Information Group

As the data indicates, *Tru64* UNIX with *TruCluster* Server software on *AlphaServer* systems has the potential to provide a significant positive return on investment, even with risk factored into the model. The ROI is composed of benefits that will accrue to both IT and the entire organization. Giga also found significant value associated with the amount of flexibility that is inherent in the same platform with Oracle9*i* Real Application Clusters (see Figure 2).



Source: Giga Information Group

Figure 2

Appendix A: Interpretation of the Financial Figures

The summary of the report is divided into two sections —standard ROI and risk-adjusted ROI. At the top of each section is a listing of the defined parameters used to calculate and display the results. Parameter definitions are as follows:

- Figures in the tables — The currency used in the report, e.g., USD = US dollars.
- Annual cost escalation factor — TEI can automatically increase cost year to year. If this parameter is a number other than zero, then the costs have been escalated each year by this percentage.
- NPV discount rate — As time moves forward, the purchasing power of money diminishes. The NPV discount rate attempts to capture the rate of decay of the purchasing power of money. This allows ROI calculations to be stated in present-day monetary units. The discount rate shown is the annual rate.
- Volatility factor — When calculating flexibility, TEI uses the industry-standard Black-Scholes options pricing formula. One of the inputs to the TEI formula is the volatility of the underlying asset. If flexibility has not been modeled, this factor is not used.
- Risk-free interest rate — This is another input to the Black-Scholes options pricing formula. If flexibility has not been modeled, this factor is not used. Otherwise, this factor represents the interest money can earn with little or no risk.

The report consists of five possible value/cost categories vs. periods of the analysis. Definitions for categories are as follows:

- IT costs — All costs that must be funded out of the IT budget for this investment.
- IT cost savings — The cost savings created as a result of the investment that will accrue to the IT budget.
- BU costs — All costs that must be funded out of the business unit budget for this investment.
- BU benefits — Business benefits that accrue to the business unit budget as a result of this investment.
- Flexibility — The real options value created by this investment. This is calculated using the Black-Scholes formula. The real options value is present-day value and is only present in the current period.

After the value/cost categories, the report shows several results. Those results are defined as follows:

- Direct benefits ROI — This is the ROI due to all cost/value elements except flexibility.
- Total ROI — This is the ROI due to all cost/value elements, including flexibility.
- Payback — The time period required for cumulative benefit to equal cumulative cost.
- Hurdle rate — The minimum ROI, usually specific for each company, that must be met in order for the project to be considered for funding.
- Risk/reward ratio — This is the ratio of the amount of risk, quantified in monetary units, to the total amount of reward (value-cost). It is a measure of the amount of risk being assumed on the project.
- Risk/reward target — This is preset as a target for the risk-to-reward ratio depending on the type of investment. The report will print an alert if the actual calculated risk-to-reward ratio is too far from the target.

The risk-adjusted section of this report uses the original outputs, adjusted for risk. Numbers are adjusted for risk by individually applying a triangle distribution to each element of cost, benefit and flexibility. The triangle distribution is applied by considering a low, most likely and high outcome for each element after reviewing the potential risks to each one. The risk-adjusted numbers are the total sum of the means of the individual triangle distributions. Due to the application of risk, cost elements tend to be higher while the flexibility and benefit elements tend to be lower. The result is that risk-adjusted ROIs tend to be lower. Therefore, if a risk-adjusted ROI still demonstrates a compelling business case, it raises confidence that the investment is likely to succeed, since the risks that threaten the

project have been taken into consideration and quantified. The risk-adjusted numbers should be taken as "realistic" expectations, since they represent the expected value considering risk. Assuming normal success at mitigating all risk, the risk-adjusted numbers should more closely reflect the expected outcome of the investment.

Appendix B: Total Economic Impact™ (TEI) Primer

Giga's Total Economic Impact™ (TEI) model is comprised of four separate elements: benefit, cost, flexibility and risk.

Benefits

Benefits represent the *value* delivered to the business by the proposed project. Oftentimes, IT project justification exercises focus on cost (e.g., TCO) and cost reductions. Among industry leaders, IT is deployed as an offensive weapon, with value expectations that exceed mere cost reduction. TEI captures the value proposition of the proposed project by measuring the benefits against the incurred costs.

All benefits captured by TEI must be traceable back to one or more critical success factors (CSFs). These CSFs are directly linked to a higher-level business strategy. If a proposed technology investment generates benefits that cannot be satisfactorily linked to a CSF, then it will not be included as a benefit for the organization in the model. In these cases, TEI requires that the benefit be discarded.

Under TEI, benefits may only accrue to the business units. "Benefits" derived through cost reductions within IT accrue as negative TCO to the IT budget, thereby showing a reduced TCO (TCO is considered by TEI to be a single-dimension, cost-centric focus on the IT budget).

The TEI process begins with a discovery of potential benefit areas. A representative, with the ability to capture the benefit in question, from the organization under examination must validate each benefit captured during discovery. In other words, values cannot arbitrarily be assigned to a benefit if that person is not in a position to deliver that benefit should the project be approved. Additionally, projects that are expected to deliver business value require some effort on the part of the business to realize that value. That effort may be in the form of training, organizational change or a modification of extant business processes. Therefore, TEI requires dialog with the actual business leaders who are responsible for making the necessary changes in order to capture the proposed benefit during the justification phase. TEI captures this dialog in the form of the name of the individuals, who validated the value calculation of each benefit.

Within TEI, each benefit entered has a specific capture date. Although the benefit may be captured over time, TEI requires the specification of a date when most of the benefit has been captured. TEI will then place the value delivered in the appropriate time frame within the project.

Costs

Costs represent the investment necessary to capture the *value*, or benefits, of the proposed project. IT or the business units may incur costs. These may be in the form of fully burdened labor, subcontractors or materials. Additionally, costs consider all the investment and expenses necessary to deliver the value proposed.

Flexibility

Flexibility, as defined by TEI, represents investing in additional capacity that can, for some future additional investment, be turned into business benefit. For instance, an investment in an enterprisewide upgrade of the desktop word processor application where the primary driver may be standardization (to increase efficiency) and licensing (to decrease IT costs). However, a collaborative workgroup feature may translate into greater worker productivity when the organization is ready to absorb the discipline necessary to capture that benefit. The collaboration feature does not promise benefit during this phase of the project and must be captured later, incorporating additional investment, most likely in the form of training. However, the existence of the option has a present value that can be estimated. The flexibility component of TEI captures that value.

Flexibility can also be calculated by acknowledging that management has several decision points along the way for any given project. At each decision point, management can steer the project to a different outcome or cancel it altogether. Many net present value (NPV) evaluations fail to take this *management flexibility* into account. Since

TEI's flexibility component uses the industry standard Black-Scholes options formula, the management flexibility factor is taken into consideration.

TEI divides a project into multiple phases. The first phase is considered the "benefits" phase — it is the phase expected to deliver the primary benefits. The benefits phase is usually no more than one budget cycle long, and it is the primary reason the project is being considered. All other phases are "options" or "flexibility" phases. For additional investment at some point in the future, business benefit can be captured during these "options" phases. TEI applies the Black-Scholes options pricing equation to all phases other than the benefits phase. The Black-Scholes equation uses five inputs to calculate the present day value of flexibility or options. The five inputs are the following:

1. The value, or business benefit, that can be captured when the option is exercised; this value is expressed in present value terms.
2. The time to the date at which point the option or flexibility expires. Expiration could be due to business changes or technology obsolescence.
3. The cost of the investment to exercise the option and to capture the benefit.
4. The risk-free interest rate (typically the interest rate of government securities is used).
5. The volatility of the industry or sector; TEI uses the volatility of the stock prices within the market sector as this input.

Risk

Risks are used to widen the possible outcomes of the project. Since the future cannot be accurately predicted, there is risk inherent in any project. TEI captures risk in the form of risks-to-benefits and risks-to-costs.

Risks-to-benefits consider all possible risks to each possible benefit. Likewise, risks-to-costs consider all possible risks to each possible cost. Then, a range is chosen by applying best judgment for each cost and benefit, based on the set of risks assigned to each cost and benefit. The range is entered in the form of a low estimate, a most likely value, and a high estimate. For example, the risks to a cost may result in a range from the expected value as the low estimate to two times the expected value as the high for a particular cost (representing a potential two times cost overrun).

TEI applies a probability density function known as "triangular distribution" to the values entered. The expected value — the mean of the distribution— is used as the risk-adjusted cost or benefit number. The risk-adjusted costs and benefits are then summed to yield a complete risk-adjusted summary and ROI.

Typical project risk factors to consider include the following:

- Vendors — The risk that the vendor of a product or technology may need to be replaced at some point during the project duration
- Products — The risk that a product will not deliver the functionality expected
- Architecture — The risk that the current product architecture will not allow future infrastructure decisions and changes
- Culture — The risk that an organization will be unable to absorb the new technology or adapt to its implementation
- Delays — The impact on revenues of a project delay or cancellation
- Size — The direct correlation of project risk to the size of the project, as measured by application size or budget

Appendix C: Cost and Benefit Estimates, Sample Organization

Phase Information

Name	Type	Length	Time to Expire
Benefits	Benefits	36 month(s)	N/A
Flex 9i RAC Solution	Flexibility	24 Months	1 year(s)

Project Summary

Figures in **USD** (NPV discount rate = 8.00%)
(Volatility factor = 60.00%, Risk-free interest rate = 4.00%)

Item	2001	2002	2003
IT costs	(337,400)	(55,400)	(55,400)
IT cost savings	179,167	179,167	179,167
BU costs	0.00	0.00	0.00
BU benefits	52,000	52,000	52,000
Flexibility	103,600	0.00	0.00
Totals	(2,663)	175,767	175,767
Direct benefits ROI	48%		
Total ROI	71%		
Payback	Within 12 months		
Hurdle rate	20%		

Project Summary (Risk Adjusted)

Figures in **USD** (Annual cost escalation factor = 10.00%, NPV discount rate = 20.00%)
(Volatility factor = 60.00%, Risk-free interest rate = 4.00%)

Item	2001	2002	2003
IT costs	(337,400)	(55,400)	(55,400)
IT cost savings	155,278	155,278	155,278
BU costs	0.00	0.00	0.00
BU benefits	45,067	45,067	45,067
Flexibility	98,200	0.00	0.00
Totals	(38,855)	144,945	144,945
Direct benefits ROI	28%		
Total ROI	50%		
Payback	Within 12 months		
Hurdle rate	20%		

Benefits and Associated Risks

Benefit and Amount	Associated Risk(s) and Adjusted Amounts
Efficiency Gain – System Management **Start date:** 1/1/01 **End date:** 12/31/03 **Spread:** Even **Project phase:** Benefits **Benefactor:** IT **CSF:** IT cost avoidance (efficiency) In the interviews that Giga conducted, several customers that were surveyed cited system management savings of 30% overall. These included efficiency gains in the area of configuring the cluster (50% efficiency gain), synchronization and overall management (30% efficiency gain), and adding or removing additional nodes (50% efficiency gain). Configuring the cluster (50%) $44,000 savings per year Synch. and cluster management (30%) $30,000 savings per year Adding or removing nodes (50%) $44,000 savings per year **Non risk-adjusted amount:** 118,000 USD	Wider variance than anticipated **Low amount:** 47,200 USD **Most likely:** 118,000 USD **High amount:** 141,600 USD **Risk-adjusted amount:** 102,267 USD

Efficiency Gain – Event and Volume Management **Start date:** 1/1/01 **End date:** 12/31/03 **Spread:** Even **Project phase:** Benefits **Benefactor:** BU **CSF:** IT cost avoidance (efficiency) In the interviews that Giga conducted, several customers that were surveyed cited several areas of efficiency gain in the area of event and volume management. These included efficiency gains in the area of distributing event information (15% efficiency gain), failover monitoring (20% efficiency gain), and ability to view the cluster as a single system (25% efficiency gain). Distributing event information (15%) $4,500 savings per year Failover monitoring (20%) $23,333 savings per year Ability to view the entire cluster as a single system (25%) $33,333 savings per year **Non risk-adjusted amount:** 61,167 USD	Wider variance than anticipated **Low amount:** 24,467 USD **Most likely:** 61,167USD **High amount:** 73,400 USD **Risk-adjusted amount:** 53,011 USD
Improved IT Scalability Without Sacrificing Performance **Start date:** 1/1/01 **End date:** 12/31/03 **Spread:** Even **Project phase:** Benefit **Benefactor:** BU **CSF:** IT cost avoidance (efficiency) One of the key features of the *Tru64* Solution citied by customers is ability to ramp up internal critical applications. It is estimated that there is improved time savings internally within IT as a result of the *Tru64* Solution. These time savings equate to roughly 58,000 USD per year. **Non risk-adjusted amount:** 58,000 USD	Risk that the benefit estimate may not have equal variance **Low amount:** 20,800 USD **Most likely:** 58,000 USD **High amount:** 62,400 USD **Risk-adjusted amount:** 45,067 USD
Oracle9*i* Benefits **Start date:** 1/1/01 **End date:** 12/31/03 **Spread:** Even **Project phase:** Flex **Benefactor:** BU **CSF:** Downstream savings We estimated that the company can achieve reduced deployment time as a result of the certified configuration	Wider variance than anticipated **Low amount:** 20,000 USD **Most likely:** 103,600 USD **High amount:** 171,100 USD **Risk-adjusted amount:** 98,200 USD Factor applied: (none) (=1)

that 9iRAC provides. In order to achieve this revenue target, the representative company needs to expend roughly 120,000 USD in additional cost to exercise the flexibility option. The underlying value of the option is estimated to be 103,600 USD based on the Black-Scholes Option Pricing formula. **Non risk-adjusted amount:** 103,600 USD Factor applied: (none) (=1)	

Costs and Associated Risks

Cost and Amount	Associated Risk(s) and Adjusted Amounts
Cost to Exercise Flexible Benefits **Start date:** 1/1/01 **End date:** 12/31/02 **Spread:** Even **Project phase:** Flex **Impacted budget:** BU Cost to scale out to take advantage of Oracle9*i* RAC for an average-sized deployment **Non risk-adjusted amount:** 120,000 USD	Wider variance than anticipated **Low amount:** 100,000 USD **Most likely:** 120.000 USD **High amount:** 140,000 USD **Risk-adjusted amount:** 120,000 USD
Estimated Cost to Procure and Deploy **Start date:** 1/1/01 **End date:** 12/31/01 **Spread:** Even **Project Phase:** Benefits **Impacted budget:** IT 282,000 USD **Nonrisk-adjusted amount:** 282,000 USD	Wider variance than anticipated **Low amount:** 282,000 USD **Most likely:** 282,000 USD **High amount:** 282,000 USD **Risk-adjusted amount:** 282,000 USD
Annual Licensing Fees – *Tru64* **Start date:** 1/1/01 **End date:** 12/31/03 **Spread:** Even **Project phase:** Benefits **Impacted budget:** IT 55,400 USD per year **Non risk-adjusted amount:** 598,852 USD Factor applied: (none) (=1)	Wider variance than anticipated **Low amount:** 55,400 USD **Most likely:** 55,400 USD **High amount:** 55,400 USD **Risk-adjusted amount:** 55,400 USD Factor applied: (none) (=1)