TEI™
The language of value

The Total Economic Impact™ of Citrix MetaFrame Server-Based Computing Solutions

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Giga Information Group®

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Business results.

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Table of Contents

Executive Summary

Introduction

In early 2002, Giga Information Group commenced work on a research project commissioned by Citrix Systems Inc. focused on examining the potential return on investment (ROI) that enterprises might realize by adopting Citrix MetaFrame server-based computing (SBC) solutions. Giga defines server-based computing as the delivery of existing 32-bit client applications in time-shared mode. The applications run on a server and are shared by multiple users, with only the user I/O and display information transmitted between the client device and server. The entire client application executes on the server. Citrix is widely recognized as the leader in this market. *Note: Server-based computing is also commonly referred to as thin-client computing.*

Citrix selected Giga for the project because of the company's Total Economic Impact™ (TEI) analysis methodology, which not only measures costs and cost reduction, which are typically accounted for within IT, but also weighs the enabling value of a technology in increasing the effectiveness of overall business processes. Giga employed four fundamental elements of TEI (see Appendix A for TEI primer) in modeling the ROI of using Citrix MetaFrame: cost and cost reduction, benefits to the entire organization, flexibility and risk. While cost savings has certainly been a primary business driver for migrating computing environments to server-based computing and a thin client architecture, it is just one of several drivers in the overall equation. Given the increasing sophistication that enterprises have regarding cost analysis related to IT investments, Giga Information Group's TEI methodology serves an extremely useful purpose by providing a complete picture of the Total Economic Impact of purchase decisions.

This report highlights the benefits and costs of deploying Citrix MetaFrame solutions across the enterprise of a sample organization. The findings portrayed in this study are in large part based on interviews conducted with five different organizations that are currently using Citrix MetaFrame solutions (Versions 1.8 and MetaFrame XP) to deploy and manage applications. The report examines the estimated ROI for the sample organization, and represents the aggregate findings derived from the interview and analysis process as well as the independent research of Giga Information Group.

Key Findings

Giga Information Group research shows that server-based computing can provide tremendous benefits to organizations, but there are important considerations to keep in mind. SBC can provide benefits for many applications and users, but is not generally used to support all users within an organization. Deployed appropriately, SBC has significant benefits. ROI assessments should focus on specific applications and user constituencies to determine where SBC can be leveraged effectively.

Each of the five companies interviewed discovered the cost of deployment is fairly high — often higher than updating an existing full desktop client environment — though when considered in conjunction with long-term benefits and flexibility, our five interviewed companies agreed that server-based computing has tremendous potential value. However, identifying and quantifying the costs, benefits, flexibility options and associated risks can be a difficult task. Giga identified the following key cost savings associated with deploying SBC:

- Cost savings as a function of centralized management and support of applications
- Reduced labor costs associated with IT support of server-based solutions
- Extended desktop life cycle in environments where PCs are replaced by terminals
- Security — lower risk of data loss or theft and reduced risk of virus problems

While cost efficiencies within IT have traditionally created a sound business case for deploying Citrix MetaFrame, an examination of other positive benefits for the organization as a whole can also be measured. Included among these are:

- Rapid application deployment, accelerating user productivity and revenue benefits
- Secure remote access to rich 32-bit client functionality
- High levels of availability, reliability and security of the server-based applications
- Increased flexibility that can be achieved with a server-based computing environment

It is also important to evaluate SBC relative to other options. If applications are not deployed in this manner, they must be deployed in some other way (e.g., full desktop, Web client, etc.), so an impact analysis of SBC cannot occur in a vacuum since it is an *alternative* to other options under consideration. In this case study, it is compared to an existing distributed desktop environment. The companies Giga surveyed also had highly distributed desktop environments with minimal software distribution or desktop management tools. A campus LAN environment with on-site IT staff and robust software distribution tools would be unlikely to achieve the same benefits from SBC. The value of SBC to a particular organization may also change over time if other technologies emerge that are more suitable for deploying specific applications. For example, some software vendors now offer their software primarily on a Web-based platform. This kind of shift has potential implications for how MetaFrame is leveraged within an organization. However, because the vast majority of existing applications have a heavy client component, the organizations Giga interviewed did not consider this as an issue in the near term.

Risk-adjusted and non-risk adjusted ROI are both discussed in this study. The assessment of risks provides a range of possible outcomes, based on the risks associated with IT projects in general and specific risks relative to SBC. For example, companies should consider the increased risk posed by a network outage where dozens of users may suddenly lose their application sessions and their ability to work. A risk assessment can help IT managers understand where SBC can be deployed most effectively.

Based on the interviews and Giga's ongoing research, a sample organization was created (see Appendix B for comprehensive description of sample organization). A bank with 5,000 employees and 50 branches achieved a risk-adjusted ROI of 106 percent during a three-year period. The bank deployed MetaFrame XPe to deliver Microsoft Office and several line-of-business applications. Excluding risk adjustment, the ROI for MetaFrame XPe was 146 percent; three-year costs totaled $6.3 million; benefits (cost savings and productivity improvements) totaled $15.0 million (see Table 1). This organization is representative of the average company using SBC, but overall ROI is likely to vary significantly by industry, company size, location and many other factors. For the five companies interviewed, non-risk adjusted ROI ranged from 106 percent to 222 percent.

For the sample company, risk-adjusted break-even occurred 11 months after the initial deployment. However, 35 percent of the overall ROI for the sample company is derived from "soft cost" savings, primarily improved user productivity (see Table 1). Although not all companies account for soft benefits in ROI assessments, Giga believes productivity benefits for both the IT staff and end users have significant value (see Figure 1). Even without the productivity benefits, three-year risk-adjusted ROI is 34 percent, with break-even occurring at 18 months.

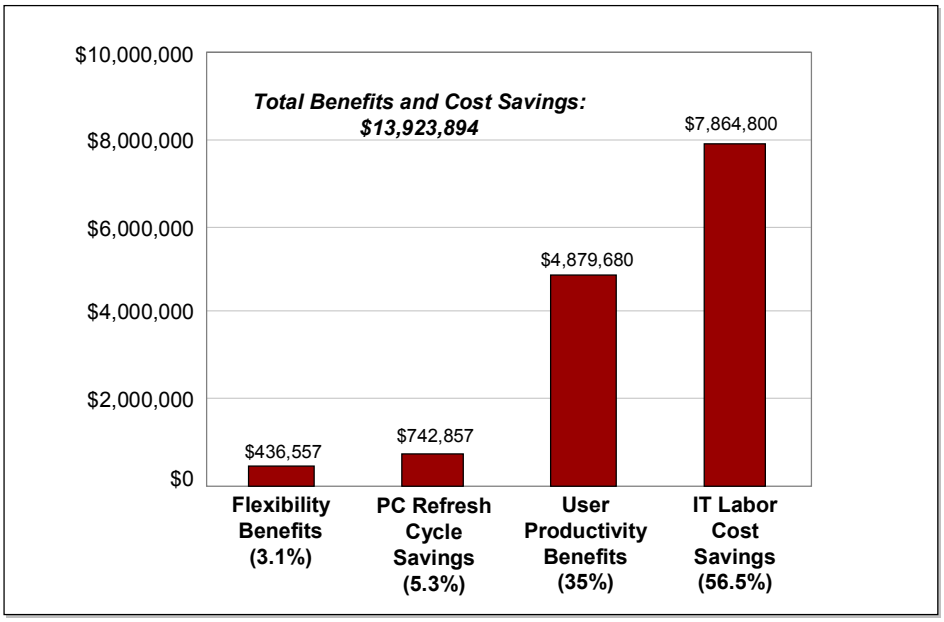
ROI will clearly vary significantly from one company to the next. It is important to evaluate groups of users and applications to determine where SBC can be leveraged within a company. It will almost always co-exist with other application platforms, such as thick-client PCs and browser-based applications. Organizations should use this research as a guide in their decision-making process when considering migrating applications to a server-based computing environment.

Table 1: Financial Results — Sample Organization

	Unadjusted	Risk-Adjusted
TEI (return on investment)	146%	106%
Payback	Within 9 months	Within 11 months
Total three-year costs	$6,285,000	$6,769,000
Total three-year cost savings	$9,416,143	$8,607,657
Total three-year productivity benefits	$5,630,400	$4,879,680
Total flexibility benefits	$641,995	$436,557

Source: Giga Information Group

Figure 1: Benefits and Cost Savings (Risk Adjusted)



Source: Giga Information Group

TEI Interview Highlights

As previously mentioned, Giga's TEI conclusions are derived in large part from information received in a series of interviews with various executives and personnel at five different organizations that currently have Citrix MetaFrame solutions (Versions 1.8 and MetaFrame XP) deployed. Industries represented by these five organizations include transportation, facilities management, travel and health care. A brief description of each organization follows:

A. Global transportation management company with more than 4,000 facilities

B. Regional automobile repair company with 100 service centers

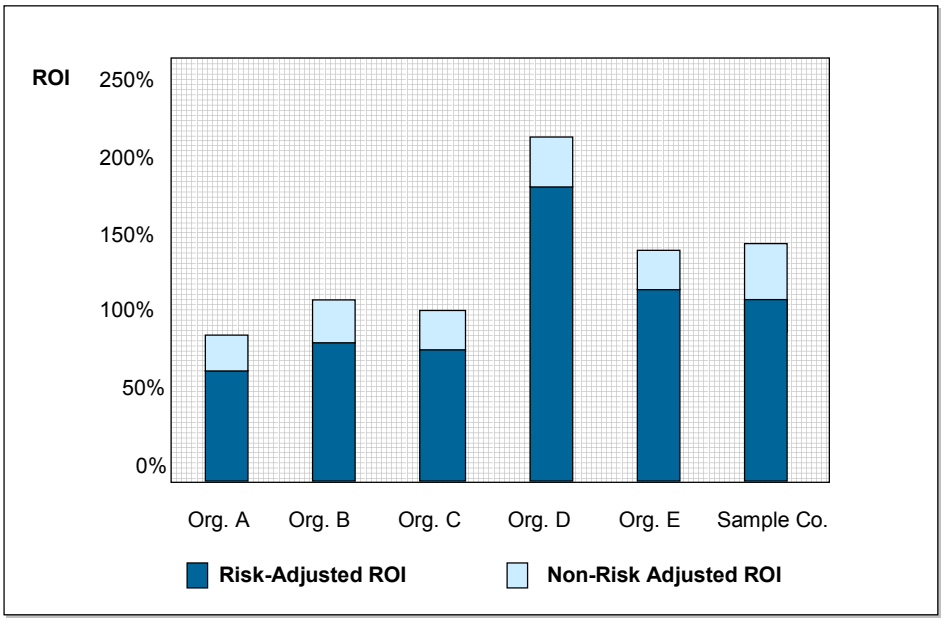
C. $2 billion global facilities services company with more than 50,000 employees

D. National travel company specializing in group/corporate travel with $2 billion in sales

E. Leading medical institution combining education, clinical care and research with 4,500 employees

While cost and cost savings were important factors for all of the companies that were interviewed, each also claimed a direct causal impact on quantifiable business benefits. A summary of the estimated risk-adjusted ROI for each organization appears in Figure 2. Organizations A through E experienced three-year, non-risk adjusted ROIs ranging from 106 percent to 222 percent, with an average 10-month break-even point. Corresponding risk-adjusted ROIs ranged from 70 percent to 191 percent and an average 12-month break-even. This indicates that SBC investments carry a low level of risk, a positive ROI and relatively short time to recoup the investment.

Figure 2: Citrix MetaFrame ROI Estimates



Source: Giga Information Group

Giga makes no assumptions regarding the success of a MetaFrame solution at other companies. This report focuses on the potential TEI attributable to the five organizations that participated in our examination and our sample organization. However, this document can provide guidance to technology decision-makers seeking to identify areas where value can potentially be created based on the procurement of Citrix MetaFrame solutions.

Costs

The following criteria should be used in evaluating the cost component of SBC:

Identifying Target Applications and Users

SBC represents a potentially significant shift from how desktop applications are deployed in most organizations, and will require some level of assessment and planning. This first assessment stage is absolutely critical. It will determine where SBC is most appropriately used and where it will prove to be of little value in the organization. One possible outcome of such an assessment may be a decision not to use SBC at all.

IT planners need to begin by identifying applications and user constituencies that will benefit from server-based computing. It is equally important to identify applications that cannot easily be deployed using SBC and user groups that either won't benefit from it or will resist the transition. In some cases, applications may not be compatible or an ISV may be withdrawing support for the 32-bit client platform. The costs of this planning phase will vary significantly depending on the complexity of the deployment. The number of applications, number of users and the diversity of the user population all impact the planning costs significantly.

Infrastructure Assessment and Planning

Once the decision to deploy specific applications on SBC has been made, organizations should conduct an infrastructure assessment to determine if the existing network and data centers need to be upgraded or changed at all. Initial benchmarking should be done at this stage to identify what new infrastructure — servers, software and network capacity — will be needed. This can and should be done in comparison to some other means of deploying the same application, which could include keeping it on the existing infrastructure (i.e., with the client applications deployed locally on each PC). Note that this is merely the assessment phase and does not include the actual costs of the deployment. The time and effort required for this assessment will depend on the complexity of the planned deployment. A pilot program should be implemented concurrent to this phase. Including the pilot phase, this can easily take four to seven months for a new deployment.

Acquisition and Deployment Costs

A number of relatively predictable costs are incurred during the deployment, including application servers, file servers, database servers, additional networking equipment or services, software licenses (see Appendix C for server and associated cost analysis for the sample organization) and the associated labor costs for internal IT staff or consultants. These costs are very high in most instances, particularly since each server supports a finite number of users. For example, in a Citrix-Microsoft Terminal Services deployment, servers support a range of 25 to 40 users per processor. However, the number of user sessions per processor will vary significantly based on both the applications being used and the types of users. At an average of 25 users per processor, the cost of the servers and software can add up quickly for large deployments, and the per-seat cost can easily reach $325 to $375, without including labor costs or server and software maintenance support costs.

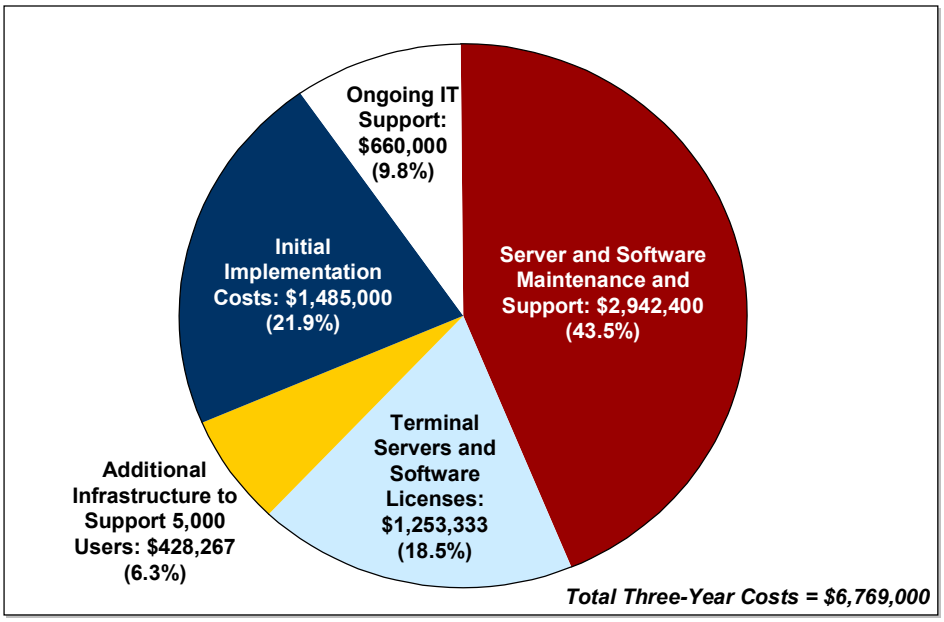
Deploying server-based computing can be an expensive undertaking, particularly because of the substantial requirement for server resources. Furthermore, labor costs for IT staff time and subcontracts are likely to be significant. Each application must be tested and tuned to run in a server-based computing environment, and in some cases, custom or legacy 16-bit applications will require significant configuration and ongoing maintenance. Some of these applications will also need to be isolated on separate servers to prevent server crashes, though this will also incur additional licensing and hardware costs. However, the upfront hardware and software acquisition costs can be amortized over time, typically at least three years. Nonetheless, IT managers need to plan carefully to be certain that the investment will not become obsolete and lose its value in a shorter time frame.

Support and Training Costs

Regardless of how applications are deployed, ongoing support, maintenance and management costs need to be evaluated in comparison to the existing or alternative environments. For example, our sample organization, a 5,000-seat deployment, would require 25 four-processor Citrix/Terminal Servers, with hardware and software licenses running about $47,000 each. However, this represents only 25 percent to 30 percent of the total lifetime cost of each server. Ongoing support costs for the SBC deployment for our sample organization are $200,000 annually for two full-time equivalent (FTE) system administrators, and $919,500 annually for infrastructure support and maintenance

(including floor space, power requirements, networking equipment and cables), hardware and software maintenance, and IT support overhead related to maintaining the servers (see Figure 3).

Figure 3: Costs Associated With MetaFrame Implementation (Risk Adjusted)



Source: Giga Information Group

Benefits

Increased Productivity

A significant "soft" benefit to the organization stemming from SBC is increased user productivity. In our sample organization, this productivity benefit was valued at $4.9 million (risk-adjusted), representing about one-third of the total benefits and cost savings of $13.9 million (risk adjusted) over three years. Users can be more productive, benefiting from decreased downtime, faster access to new or upgraded applications, and access to applications from remote sites. These benefits can equate to either increased revenue (if the application directly impacts revenue) or lower labor costs through increased user productivity. In our sample organization, we concluded that 20 percent of the employee population (1,000 users) would see a 3 percent increase in their productivity (15 minutes of incremental productive time each day). Four of the companies we interviewed cited accelerated user productivity enhancements. Two of the companies reported increased salesperson productivity (resulting in increased revenues) by being able to roll out new revenue applications over one to two weekends vs. several weeks with a thick client environment.

IT organizations using Citrix MetaFrame are also more productive because server-based applications can be deployed or upgraded with less effort than with full desktop client applications. These "hard" benefits in our sample organization included IT labor cost savings valued at $7.9 million (risk adjusted) over three years (see Figure 4). Each of the five companies we interviewed reported similar savings. These benefits are achieved in several ways:

Increased Application Stability

Particularly with Windows 2000 Server, applications are likely to be two to five times more reliable than identical applications running on a Windows 98 or 2000 desktop. This is not entirely a function of the platform. Part of the benefit is attributable to the centralized server environment since IT can manage the application centrally, creating a more stable computing environment. Each of the companies interviewed by Giga Information Group emphasized reliable application stability as a significant benefit of Citrix MetaFrame solutions.

Reduced Time to Deploy or Update Applications

As discussed earlier, applications can be deployed or upgraded with less effort than with full desktop-client applications. Additionally, end users have access to the applications sooner than they otherwise would. If the application has a measurable impact on productivity, it will be realized much sooner if the application is run in server-based computing mode. (The same benefits would apply to Web-based applications that are managed centrally, and to an extent, this would be true for well-managed thick-client environments with ESD tools).

In our sample company's new SBC environment, the upgrade of 5,000 employees from Office 97 and 2000 to Office XP could be rolled out over the course of a few days or perhaps two weekends vs. one to three months in a thick client environment. (An SBC best practice involves rolling out the new application on half the servers and letting it run in full production before deploying it to the rest of the servers.) Any productivity gains are realized sooner — at the end of week one, 2,500 users have access to the updated application; at the end of week two, all 5,000 users have benefited. Effectively, application upgrades or even new deployments within a thin-client environment have either direct revenue benefits or improve productivity (and reduce labor costs) — which will be realized about 90 percent sooner than in unmanaged thick-client environments.

Our five interviewed companies all achieved significant IT-related cost savings when they deployed upgrades and new software across their organizations.

Giga Information Group believes there is significant and quantifiable value in having the future flexibility and agility to upgrade software in a more cost-effective and productive manner. All five companies indicated that their computing environments were more flexible and agile relative to their ability to quickly deploy future new software or upgrades. In our sample organization, we valued these future flexibility options at a risk-adjusted $436,557 (see Flexibility Section below for further explanation).

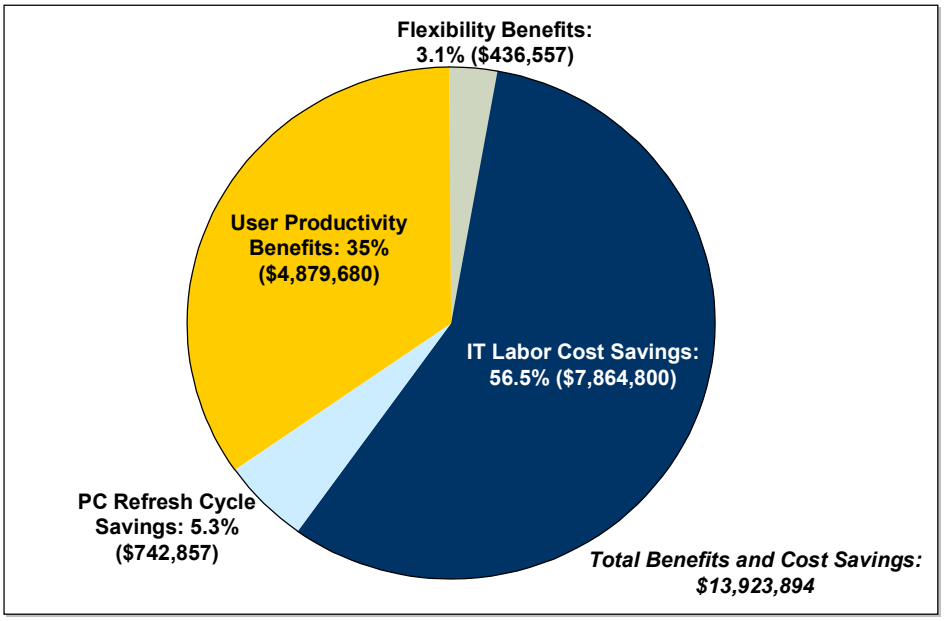
Extended Desktop Life Cycle

Although studies have reported that the total cost of ownership for thin clients can be as much as 70 percent lower than for unmanaged desktop PCs, Giga Information Group research concludes that this is a potentially misleading metric. A portion of these cost savings are based on the assumption that the desktop life cycle can be extended by a period of 18 to 36 months. However, this benefit is usually fairly minimal. In most instances, users will still have PCs with some applications running locally. Giga Information Group estimates that less than 20 percent of Terminal Services client licenses are deployed to Windows terminals, with most of those replacing existing legacy terminals. Three of the five interviewed companies were able to artificially extend the useful life of desktops by using Terminal Services. However, their savings were partially offset by the increased cost of managing and maintaining their legacy desktop hardware. In our sample organization, we concluded that SBC would extend the useful life of an average PC from three years to 3.5 years, saving a risk-adjusted $247,619 each year in deferred PC replacement costs.

Security — Lower Risk of Data Loss, Theft or Virus Problems

Compared to full desktop client environments, each of the five interviewed companies emphasized the lower risk of data loss, theft and virus problems with applications and data centralized on servers. All agreed that a data center is easier to secure than a desktop or mobile laptop. Several indicated that Citrix ICA (Independent Computing Architecture) traffic traversing the Internet between client devices and the server can be encrypted, reducing the chance of a security breach. However, each of our interviewed companies had difficulty quantifying the value of this benefit; therefore, Giga Information Group has chosen not to quantify these "soft" benefits in our analysis.

Figure 4: Benefits and Cost Savings (Risk Adjusted)



Source: Giga Information Group

Flexibility

Flexibility, as defined by TEI, represents investing in additional capacity or agility that can, for some *future* additional investment, be turned into business benefit. Giga Information Group believes that organizations that invest in SBC MetaFrame Solutions create the additional capacity and agility to allow for more cost-effective future software upgrades and new application deployments. This flexibility does not promise benefit during the initial implementation phase of the project and must be captured later, incorporating additional investment most likely in the form of software licenses and user training. However, the existence of the option to capture these savings has a present value that can be estimated. The flexibility component of TEI captures that value using the industry-standard Black-Scholes options valuation formula.

Each of the five organizations interviewed by Giga Information Group indicated they had future plans to switch some enterprise applications, or add new applications to the MetaFrame platform. Four of the organizations indicated they had definite plans to use MetaFrame to deploy applications to support future expansion and/or acquisitions.

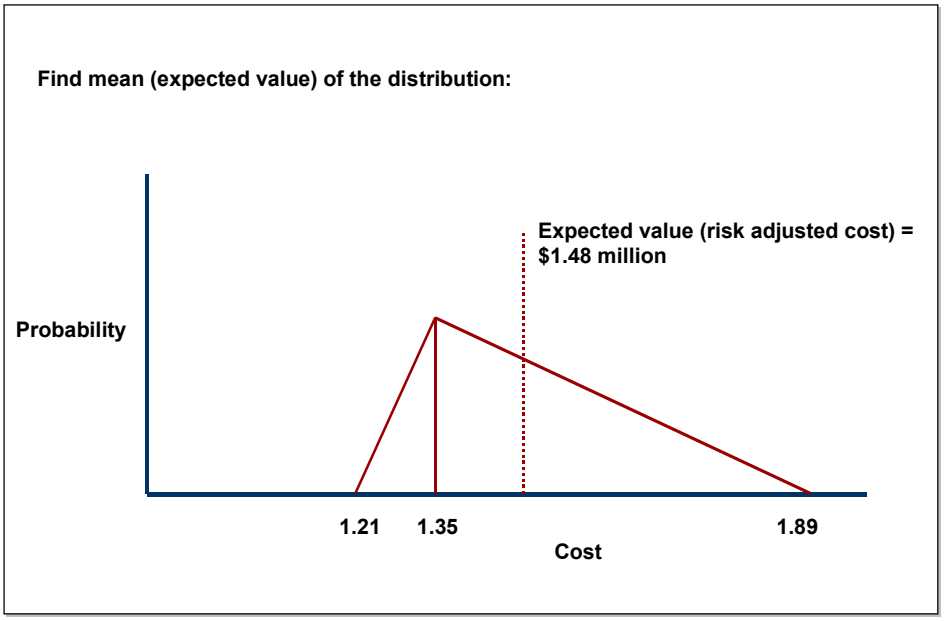
Our sample organization will deploy a variety of existing applications across its new MetaFrame environment in the next two months to include: accounts payable, customer and account tracking, human resources and other functions. It has further plans to acquire a smaller bank within four months and will deploy the above applications to the new bank later this year. The company also plans to upgrade to Microsoft Office XP in eight months, deploying the new software on MetaFrame to all 5,000 users. MetaFrame offers the flexibility and agility to deploy the above applications in a more cost-effective manner. Using our TEI methodology and the industry-standard Black-Scholes options valuation formula, Giga Information Group values these future flexibility options at a risk-adjusted $436,557.

Risk

Risk factors are used in TEI to widen the possible outcomes of the costs and benefits (and resulting savings) associated with a 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 considers all possible risks to each possible benefit. Likewise, risks-to-costs considers all possible risks to each possible cost. Using probability density functions, we create a triangular distribution range of three values, including a low estimate, a most likely estimate and a high estimate. For example, in our sample organization, we included MetaFrame project startup costs of $1.35 million (non-risk adjusted). For this cost category, the risks-to-costs ranged from a low of 90 percent of the $1.35 million ($1.21 million), suggesting a slight under run is possible, to a high of 140 percent ($1.89 million), indicating a possible moderate overrun in costs. The 140 percent risk estimate considered the possibility of larger-than-expected volatility in the initial implementation and the complexity of pilot testing new server-based applications. Using triangular distribution, we sum the three possibilities of low, most likely and high and divide by three to get the mean (or risk-adjusted cost) of $1.48 million. ($1.21M + $1.35M + $1.89M = $4.45 / 3 = $1.48M). Figure 5 illustrates the concept of triangular distribution, and the vertical line in the center represents the expected value of $1.48 million. In our sample organization, all costs and benefits were adjusted for risk.

Figure 5: Risk Adjusting Startup Cost Estimates — Example



Source: Giga Information Group

The following *general* risks were considered in this report:

- Lack of corporate discipline, resulting in poor requirements specification, scope creep and rework
- Poor execution of the employee communications plan, causing resistance to the approach and resulting in slow adoption and/or project cancellation, including a business willingness to adopt new expectations
- Failure to reduce or transfer IT help desk and support headcount made redundant by deploying a thin client environment
- Poor specification and vendor management, which can threaten the ability to reduce cycle times, potentially lengthening cycle times
- Internal inertia, conflicting priorities and turnover, which causes overrun

The following *server-based computing* risks were considered in this report:

- Internet provider risk associated with dependence on external party for connectivity
- Employee satisfaction — productivity issues and lack of control over their PC

- Vendor applications that do not run, or do not run well on Terminal Services
- Loss of functionality – certain features within applications may not work properly
- Reliance on the network is much greater — no longer able to operate locally if network is down
- Single/fewer points of failure with server-based computing

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.

Project Summary

Table 2 illustrates the potential return on investment and savings for our sample company. The data in this table is representative of data obtained from interviews with five companies in five industries. The objective of this study is not to illustrate a common return on investment that companies can obtain by using Citrix MetaFrame solutions, 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 MetaFrame solution for their particular environment.

Table 2: Financial Results — Sample Organization

	Unadjusted	Risk-Adjusted
TEI (return on investment)	146%	106%
Payback	Within 9 months	Within 11 months
Total three-year costs	$6,285,000	$6,769,000
Total three-year cost savings	$9,416,143	$8,607,657
Total three-year productivity benefits	$5,630,400	$4,879,680
Total flexibility benefits	$641,995	$436,557

Source: Giga Information Group

As the data indicates, Citrix MetaFrame has the potential to provide a significant return on investment. In addition, the risk-adjusted ROI of 106 percent, along with an 11-month break-even, raises confidence that the investment is likely to succeed since the risks that may threaten the project have been taken into consideration and quantified. The significant cost savings and productivity benefits will accrue to both IT and the entire organization. In addition, the study found a significant value associated with the amount of flexibility that is inherent in the MetaFrame solution. In particular, it can be leveraged in M&A activity, and to lower the cost of adding new users or applications in the future. For most organizations, SBC investments carry a low level of risk, a positive ROI and relatively short time to recoup the investment.

Giga Information Group research shows that server-based computing can provide tremendous benefits to organizations, but there are important considerations to keep in mind. The cost of deployment is fairly high — often higher than updating an existing full desktop client environment — though when considered in conjunction with long-term benefits and flexibility, server-based computing has tremendous potential value. SBC can provide benefits for many applications and users, but is not generally used to support all users within an organization. Deployed appropriately, SBC has significant benefits. ROI assessments should focus on specific applications and user constituencies to determine where SBC can be leveraged effectively.

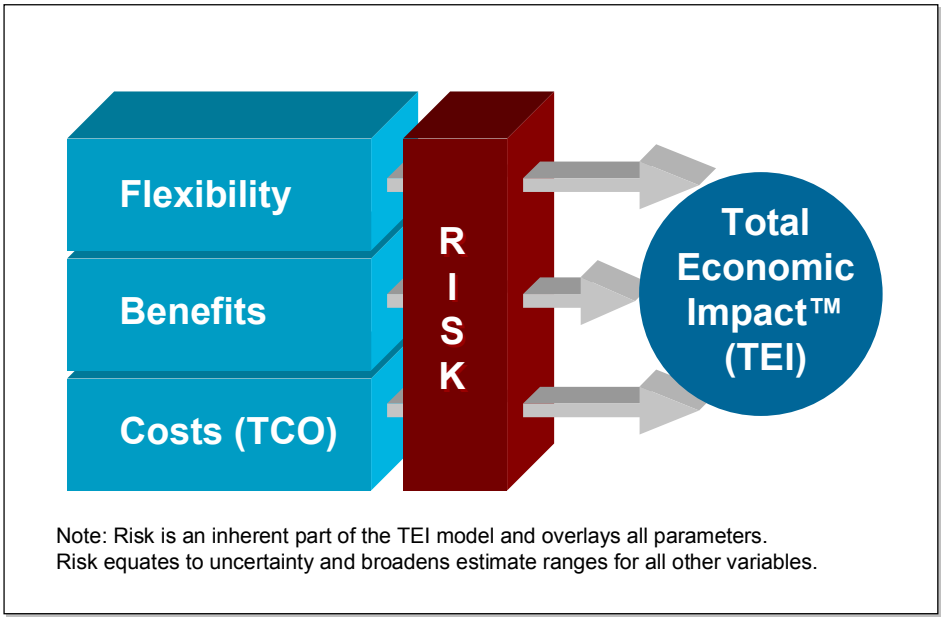
Appendix A: Total Economic Impact™ (TEI) Primer

Total Economic Impact is primarily a common language tool, designed to capture and properly communicate the value of IT initiatives in a common business language. In so doing, TEI considers four elements of any initiative:

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

Figure 5 shows the TEI methodology conceptually. Benefits, flexibility and costs are considered, through the filter of risk assessment, in determining an expected ROI for any given initiative.

Figure 6: TEI Conceptual Diagram



Source: Giga Information Group

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 greater value expectations than simple cost reduction, especially when those cost reductions tend to focus within IT. 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, who has 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 names of the individuals, which validates 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:

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 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 considers all possible risks to each possible benefit. Likewise, risks-to-costs considers 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 B — Description of Sample Organization

Description of Sample Organization — Nationwide Bank

In this study, we have created a sample organization in order to illustrate the quantifiable costs and benefits of a national bank intended to represent a typical midsize enterprise or division of a larger firm. The bank currently has 4,000 users located throughout 50 national branches (although the bank also plans to acquire a smaller bank within four months, adding a net of 1,000 new users at 20 sites). The users are primarily task-oriented, secondarily knowledge workers and 15 percent of the work force is classified as "management." Many of these users have requested access to corporate systems from home. The fully burdened cost per employee ranges from $60,000 to $80,000, with managers averaging $100,000.

In this sample organization, the current desktop environment is partially managed using a mix of hardware management and software distribution tools. The bank is using Microsoft Office 2000 and Windows 2000 on the desktop. The company plans to upgrade to Microsoft Office XP in eight months. Desktops are currently on a three-year refresh cycle, with one-third of the systems replaced each year. The other bank is using Office 97. Our sample bank is encouraged by the prospects of future yet-to-be named mergers that will be made easier (via flexibility options) using SBC technology. Additionally, a number of other packages exist within each organization for accounts payable, customer and account tracking, human resources and other functions, and these will all be deployed using MetaFrame in the next one to two months.

The time frame for this sample organization's TEI analysis is three years, with a significant level of risk surrounding the given estimates accounted for in this analysis. Companies should evaluate the expected ROI and savings in this report based on their own individual circumstances and risk thresholds.

Appendix C — Server Hardware and Associated Costs

Giga Information Group has determined that the costs associated with server hardware and associated costs for this sample organization total $5,254,500 over a four-year period. Giga's detailed assumptions are as follows:

The 5,000 users in our sample organization equate to about 2,100 concurrent users (roughly a 2.5:1 ratio). The users are primarily running Office 2000 and front-office or back-office applications relative to banking (e.g., teller applications, financial reporting, etc.). Most users are task workers, but use several applications at one time. At peak utilization, there are 2,100 users, or about 83 concurrent users on each server. This represents a conservative estimate, and is designed to withstand an outage of up to half the servers for a short period of time. Giga Information Group has based these capacity assumptions on planning white papers and on discussions with MetaFrame XP end users.

The following are the costs estimates for server hardware and associated costs:

Sample Organization Costs — 5,000-user implementation

***Hardware*:** (Pricing based on Dell servers as of March 13, 2002)
25 four-way application servers for redundancy

Four-way application server: **$20,000** each as configured below:

- Dell 6450, four processor 700Mhz Xeon/2MB Cache, 4GB RAM
- RAID 5, 4 36GB 10K RPM drives
- Remote management card
- Dell Bronze support level (standard three-year warranty NBD onsite)

Each server supports 83 concurrent users (one concurrent user = 2.5 seats) — running at about 40 percent to 50 percent capacity.

Total cost for 25 four-way application servers = **$500,000** for 25 applications servers (see additional costs for software licensing below).

***Software*:**

- Citrix licenses at $300 per MetaFrame XPe license with Subscription Advantage. 2,000 concurrent licenses: **$600,000** (including discounts of 25 percent) = $24,000/server ($120/seat). Each server supports 207 seats (83 concurrent users).
- Plus Windows 2000 server licenses**: $3,000** per server (including a discount of 25 percent). Total one-time cost of Windows 2000 server licenses = **$75,000.**
- The cost of Terminal Server CALs has not been included in this estimate since all of the client systems are running Windows 2000. However, users that have Windows 98, NT 4 Workstation or other non-Windows clients accessing the Citrix servers will also need to purchase Terminal Server CALs at approximately $80 per seat.
- Most organizations will have Windows 2000 Server CALs, so these have not been included in the estimate. However, companies that have a NetWare or other non-Windows LAN environment may need to purchase additional Windows Server CALs at approximately $30 per seat.

Total cost for software licenses: **$675,000**

***Additional infrastructure to support 5,000 users*:**

Additional servers (file, database servers):

- Clustered Database server for data store and management database (**$50,000**)
- Test environment — minimum of two servers (test & development) (**$100,000** total)
- Four clustered file servers: **$39,000** (total for four) including cluster software, configured as follows:
  - Single processor, 933Mhz, 512MB RAM
  - RAID 5, 5x36GB 10K drives
  - Remote management cards
  - Used to host user profiles and other critical data (all other user files stored locally, on NAS or on other file servers)
- 10 file servers ($20,000 each, **$200,000** total). These servers are used to store user files that might otherwise be stored on the desktop and share documents. The servers are included in this configuration as the bank is migrating user data off the desktop. However, many organizations are likely to have existing file servers or a SAN/NAS, and may not need to add any additional storage infrastructure.
- Application Packaging and Distribution Server**: $12,500** (total) configured as follows:
  - Single processor 933Mhz, 512MB RAM
  - RAID 5, 3x36GB 10K drives
  - Remote management card
  - MS and Citrix Software licenses included

Total cost for additional infrastructure**: $401,500**/5,000 users = $80/seat

Total hardware and software costs are **$1,576,500** or $315/seat.

Costs associated with a four-year server life cycle:

The following estimates are representative of a four-year server life cycle and are intended to reflect industry averages (as a percentage of total cost), based on extensive discussions with Giga's end user and vendor clients:

- Enterprise hardware — 10 percent to 15 percent (see above)
- Enterprise software — 15 percent to 20 percent (see above)
- Infrastructure, support and maintenance — 65 percent to 75 percent
  - Telecom costs — 10 percent to 15 percent
  - Networking (cables, routers, etc) — 15 percent to 20 percent
  - Power — 5 percent to 10 percent
  - Floor space — 3 percent to 5 percent
  - Support (see below) — 27 percent to 35 percent
  - Other — 5 percent to 10 percent

Support includes the costs of internal and external (outsourced) support staff, maintenance costs for the equipment, software maintenance agreements and training costs for IT staff and end users. Note that certain cost factors such as power, floor space and telecom charges tend to vary significantly by region. In California, power costs may exceed 10 percent of the total cost, while a data center in midtown Manhattan or central Hong Kong would have high floor space costs. The actual percentages should be fairly similar in NT and Unix environments, though mainframe environments tend to have lower per-user support costs and much higher software costs.

Therefore, the enterprise hardware and software costs are **$1,576,500** as outlined above. In addition, infrastructure, support and maintenance make up approximately 70 percent of the total cost, which equates to **$3,678,000** over four years. When you consider all the costs together, it totals **$5,254,500** over four years.

Table 3: Summary of Server Hardware and Associated Costs

Server Hardware and Associated Costs	Year 1	Year 2	Year 3	Year 4
Hardware	500,000			
Software	675,000			
Additional infrastructure to support 5,000 users	401,500			
Costs associated with a four-year server life cycle	919,500	919,500	919,500	919,500
Total annual costs	2,496,000	919,500	919,500	919,500

Source: Giga Information Group

Note: The shaded area above represents the costs included in the "sample organization" three-year TEI analysis