Abstract
Marketing hype claims that cloud computing can help any enterprise meet most IT service needs at a lower total cost of ownership (TCO) and higher return on investment (ROI). However, the promise of the cloud requiring minimal capital investment and the subjectivity of some cloud benefits have created some confusion among IT professionals trying to determine the benefits of adopting cloud services. Calculating ROI for cloud services requires some up-front work to understand business requirements, organizational maturity, control considerations and regulatory requirements and to quantify benefits and costs associated with the cloud model that the enterprise has selected. Strategic benefits could be more subjective and may require additional analysis to measure their financial impact over the investment. To determine whether the cloud is a viable option, it is necessary to separate the hype from reality. Calculating ROI does not need to be complex because it is only an estimate to support investment decisions; however, it must be accurate and based on realistic expectations.
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Calculating Cloud ROI: From the Customer Perspective
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Introduction

With the evolution of managed services, outsourcing, virtualization and broadband connectivity, cloud computing was inevitable. The acceptance at lightning speed may be attributed to its appeal as a low cost-of-entry and rapid return on investment (ROI) solution. This view, however, may only consider the immediate costs of contracting and migrating to the cloud and fails to consider the long-term costs of operating in the cloud and, worse, the hidden costs that could minimize the expected return. To add to the complexity, cloud computing encompasses a variety of service delivery and deployment models, ranging from public and community to hybrid and private clouds. These services are offered by a variety of providers, each with different solutions and pricing models.

One of the most difficult tasks for IT leadership is weighing the total cost of an IT service against its potential return. This challenge holds true (perhaps even more so) for cloud computing. A meaningful assessment of the benefits of cloud computing must encompass the short-, medium- and long-term views as well as termination costs. In addition, tangible and intangible benefits must be properly quantified and considered in the equation.

ROI calculation is important for any new or existing investment. It is critical for answering the questions, “Are we doing the right things?” and “Are we doing them in the right way?” Cloud computing’s perceived low up-front cash outflow may make it easy to overlook its associated investment. However, it stands to reason that any service that plays a critical role in supporting and driving the business will require investment, if not in the form of up-front expenditures, then certainly in terms of time, resources, organizational readiness and forgone opportunities. Just as any major investment, cloud computing requires thought and analysis around ROI—both up-front and continuously throughout its life span.

Because ROI is calculated using return and investment cost, it is important to quantify the value of the return as much as possible and identify all potential costs (expected and unexpected) when weighing a decision whether to proceed with a cloud solution. Quantifying return will vary considerably from one organization to another, yet a generally accepted base must be found and used consistently—at a minimum, within the enterprise. This can best be accomplished by engaging different business functions during the requirements definition and the financial analysis phase. Most finance organizations have well-defined rules and rates for calculating ROI and other financial indicators.

ROI calculation for cloud computing entails many issues and can be highly complex due to its abstract nature; nevertheless, it is important to focus on finding the right information to make meaningful and accurate estimates. Otherwise, the results may be useless or, worse, misleading.

Proposal and Organization

This white paper lays out a framework that IT and business decision makers can use to analyze components that should be considered in calculating ROI. To address these issues, the white paper:
• Provides a high-level definition of cloud computing and ROI calculation
• Describes the most common benefits, costs and business challenges related to cloud computing
• Provides a framework for evaluating ROI for cloud computing projects
Cloud Computing Service Delivery and Deployment Models

The US National Institute of Standards and Technology (NIST) defines cloud computing as “a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.”

The NIST cloud computing model has the following dimensions: five essential characteristics, three service models, and four deployment models (figure 1).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Broad Network Access</th>
<th>Rapid Elasticity</th>
<th>Resource Pooling</th>
<th>Measured Service</th>
<th>On-demand Self-service</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Service Models</th>
<th>Infrastructure as a Service (IaaS)</th>
<th>Platform as a Service (PaaS)</th>
<th>Software as a Service (SaaS)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Deployment Models</th>
<th>Private</th>
<th>Community</th>
<th>Public</th>
<th>Hybrid</th>
</tr>
</thead>
</table>


Calculating ROI

ROI is one of several financial metrics available to estimate the financial outcome of business investments. This calculation considers both the costs of an investment and its expected gains, and yields an estimate of how favorable the investment will be. To calculate ROI (simple ROI), the result of subtracting the cost of an investment from the gain (return) of the investment is divided by the cost of the investment and the result is expressed as a percentage or ratio (figure 2). In most cases, a ratio greater than 0 means the return is greater than the cost, so the investment may be considered beneficial (how beneficial depends on the enterprise’s investment objectives or its corporate standards).

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1 Mell, Peter; Timothy Grance; US National Institute of Standards and Technology (NIST) Special Publication (SP) 800-145, The NIST Definition of Cloud Computing, NIST, USA, 2011
CALCULATING CLOUD ROI: FROM THE CUSTOMER PERSPECTIVE

Figure 2—Formula to Calculate Simple ROI

\[
ROI = \frac{\text{Gain From Investment} - \text{Cost of Investment}}{\text{Cost of Investment}}
\]

For example, the ROI for a new cloud-based application (SaaS) that is expected to have an investment of US $600,000 over a period of five years and provide benefits (cost savings and new revenue) of $900,000 over the same period of time will yield a return of 50 percent.

\[
ROI = \frac{$900,000 - $600,000}{$600,000} = 50\%
\]

ROI calculations used as the only financial measurement for decision making do not help predict the likelihood of realizing the return or the risk involved with a particular investment. Ideally, the enterprise will use multiple financial metrics (e.g., TCO, net present value [NPV], internal rate of return [IRR], payback period) in considering whether to adopt cloud computing services.

TCO is different from ROI because it accounts only for the cost associated with an acquisition for its entire life span or a period of time determined for the calculation. NPV compares anticipated benefits and costs over a predetermined time period using a rate that helps calculate the present value of future cash flow transactions. IRR is a variant of NPV used to find the discount rate that would make the NPV of the investment equal to zero. TCO, NPV and IRR are more significant and complex calculations; therefore, they require additional data and variables for their calculation. ROI’s simplicity makes it a more popular term to use in marketing materials and project analysis. Additional information about these financial terms and their formulas is found in Appendix A.

For investments that have clear and quantifiable benefits and costs that are easily known, the ROI calculation is simple. However, for more complex investments such as cloud computing services, the ROI calculation can be complex and misleading. Generating a meaningful result is dependent on accounting for all quantifiable variables and defining a clear and consistent time period. Intangible benefits and risk may not be included in the calculation unless the business is able to assign a value based on historical or statistical data. Investments based solely on business objectives may be better justified using a business case supported by multiple financial metrics.

Cloud Benefits

The cloud promises a range of benefits that include the ability to shift cost from capital to operational expenses, lower overall cost, greater agility and standardization, the ability to shift IT resources to higher-value-added activities, improve employee satisfaction and competitive advantage. Some of these benefits are quite subjective and, therefore, are difficult to include in financial (mathematical) calculations.
**Figure 3** describes the most common benefits promised by cloud computing supporters. The benefits are grouped into two categories: tangible (quantifiable) and intangible (strategic) benefits.

<table>
<thead>
<tr>
<th>Benefit Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tangible</strong></td>
<td></td>
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</tbody>
</table>
| Cost reduction      | Computing cost is shifted from a capital expenditure to an operational cost because the cloud provider supplies the underlying infrastructure as part of the service bundle. In addition, the cloud promises a cost reduction in the following areas:  
  - Labor—IT system administration hours/headcount  
  - Application software (SaaS only)  
  - Licensing purchase and maintenance  
  - Technical support and user support  
  - Maintenance (upgrades, updates, patches, etc.)  
  - Hosting (physical building, power, cooling, etc.) |
| Enhanced productivity| User mobility and ubiquitous access can increase productivity. Collaborative applications increase productivity and reduce rework. |
| Optimized resource utilization | Enterprises use only the computing resources they need, thus reducing system idle time waste. |
| Improved security/compliance | Cloud providers may offer robust security controls as a market differentiation. |
| Access to skills and capabilities | Customers benefit from top-notch skills and capabilities while avoiding employment costs (recruiting, salary, benefits, training, etc.). |
| Scalability | On-demand provisioning or computing resources eliminate the cost of capacity planning. |
| Agility | Agility contributes to cost reduction and productivity enhancement due to faster provisioning of systems:  
  - Faster application deployment (SaaS)  
  - Faster application development/testing (PaaS) |
| Customer satisfaction | Effective utilization of cloud applications can increase collaboration between the enterprise and its customers or reduce response time to customer inquiries. |
| Reliability | Cloud providers have redundant sites that can address business continuity and disaster recovery in a more efficient manner. |
| **Intangible**      |             |
| Avoidance of missed business opportunities | A cloud application (SaaS) may be the critical element to land a new business or expand into new markets. |
| Focus on core business | IT resources can be allocated to support core business functions. |
| Employee satisfaction/innovation | Mobility and faster performance can improve employee satisfaction and boost innovation. |
| Collaboration | Real-time collaboration can increase quality and innovation. |
| Risk transfer | Some risk can be transferred to the CSP (e.g., security breaches, data loss, disaster recovery); this could represent a tangible or intangible benefit. |
Cloud Costs

Cloud solutions include many elements beyond the obvious hardware and software costs. There are three types of costs: start-up (up-front costs), operational (recurring costs) and one-time (change or termination costs). Figure 4 describes the most common of these cost types.

<table>
<thead>
<tr>
<th>Figure 4—Cloud Costs</th>
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</thead>
<tbody>
<tr>
<td><strong>Cost</strong></td>
</tr>
<tr>
<td><strong>Upfront costs</strong></td>
</tr>
<tr>
<td>Technical readiness</td>
</tr>
<tr>
<td>Implementation</td>
</tr>
<tr>
<td>Integration</td>
</tr>
<tr>
<td>Configuration/customization</td>
</tr>
<tr>
<td>Training</td>
</tr>
<tr>
<td>Organizational change</td>
</tr>
<tr>
<td><strong>Recurring costs</strong></td>
</tr>
<tr>
<td>Subscription fees</td>
</tr>
<tr>
<td>Change management</td>
</tr>
<tr>
<td>Vendor management</td>
</tr>
<tr>
<td>Cloud coordination</td>
</tr>
<tr>
<td>End-user support and administration</td>
</tr>
<tr>
<td>Risk mitigation</td>
</tr>
<tr>
<td>Downsize/upsiz</td>
</tr>
<tr>
<td><strong>Termination costs</strong></td>
</tr>
</tbody>
</table>
| Revert to on premises or transfer to a different provider | The enterprise may need to revert to an in-house model when/if new regulations or economic problems render the cloud impractical. Some of the possible costs are:  
  • Extracting data from the cloud and validating their accuracy and completeness  
  • Cost to sanitize or shred data from cloud storage and processing hardware  
  • Configuration and provisioning in-house systems to replace cloud services  
  • Penalties for early termination  
  • Reallocation or recruitment of IT resources to support services being reverted  
  • Reallocation or procurement of physical resources to host services being reverted |
**Business Challenges to Consider**

There are business challenges when using the cloud. Figure 5 describes common challenges that should be considered when evaluating cloud services.

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incompatibility</td>
<td>Cloud services may not be compatible with the existing IT infrastructure or specific systems that must be integrated.</td>
</tr>
<tr>
<td>Uptime</td>
<td>Cloud vendors may not be able to guarantee agreed-on uptime. In addition, uptime may be impacted by other factors, including the customer’s Internet service providers.</td>
</tr>
<tr>
<td>Performance</td>
<td>Multitenant models can degrade performance over time if capacity is not properly planned. Internet speed can also negatively impact performance.</td>
</tr>
<tr>
<td>Security</td>
<td>Cloud computing represents traditional and new risk that must be accounted for and mitigated accordingly (either by the CSP or the customer).</td>
</tr>
<tr>
<td>Compliance</td>
<td>The ubiquitous and abstract nature of the cloud can cause an enterprise’s transition from compliance to noncompliance without any notice.</td>
</tr>
<tr>
<td>Pay-as-you-go</td>
<td>The enterprise must implement controls to avoid overage charges incurred when systems stay connected after a demand spike is over.</td>
</tr>
<tr>
<td>Lock-in (hardware or vendor)</td>
<td>Customers may become locked into a specific technology or a specific cloud vendor, which can prevent portability.</td>
</tr>
<tr>
<td>Cloud consumerization</td>
<td>Business units may be able to procure cloud services without involving IT. To prevent this situation, the enterprise must adapt its governance framework to control cloud services procurement.</td>
</tr>
<tr>
<td>Limited customization</td>
<td>Cloud applications may not be customized every time the business process changes, making the business process a “Black Box” due to costs associated with each modification or application limitations.</td>
</tr>
</tbody>
</table>

The previous tables are not all-inclusive. They list the best-known benefits, costs and challenges, and are meant to kick-start cloud ROI analysis. Users must include values relevant to the project under analysis and remove nonapplicable values.
Framework for Calculating Cloud ROI

Why Bother Calculating ROI for Cloud Computing?
To answer this question, it is necessary to separate hype from reality. According to hype, the cloud is an opportunity for users to self-service all their IT needs, with virtually no up-front investment, minimal pay-as-you-go operating costs and limitless scalability, while all the hassles of managing data centers are almost magically abstracted away. The marketing is slick and makes it seem effortless.

The reality varies somewhat. Users who have been in IT for a long time know that, no matter what new innovation comes along, the challenges of managing IT (e.g., security, cost, complexity) never go away—they just take on new (and sometimes dangerous) forms. Cloud computing is no different.

The benefits can be real. Cloud computing truly can offer enterprises whole new sets of options for building and delivering IT services rapidly, inexpensively and without major investment or technical skills. But the risk and potential costs are also very real. As in life, there is no reward without risk and investment. In cloud computing, the risk may not be obvious but is still there: security breaches, data loss, disasters, outages, vendor lock-in, data concentration, legal and jurisdictional issues, and so on. The ways to manage the risk can be very different from the approaches for traditional IT. For example, arguing with a public cloud provider about its service can be a bit like arguing with a vending machine: unless support was clearly defined and agreed to up front in the contract, there may be no response at all.

Decision making around use of cloud services can be complex and estimating the ROI is a critical part of ensuring that the path taken is the right one. Following are some key points to bear in mind:

- **Estimating ROI does not need to be complex.** After all, it is just an estimate. A simple, but effective, ROI calculation enables the enterprise to support an investment decision and measure whether the expected cost and benefits occur. An overly complex calculation can make it hard to understand why a decision was made and/or measure its effects, essentially defeating the purpose of doing one in the first place.

- **Cloud is not right for every organizational need.** The type of cloud service selected is critical, as is how it is managed. Thinking strategically about benefits, costs and risk is paramount and must be done up front, before any contract is signed.

- **There can be many hidden costs that are not obvious from the provider's fee schedule.** For example, while there may not be any up-front service provisioning costs from the provider, the time and effort in migrating existing systems into the cloud can be expensive. The same can be said of pulling systems or data back in-house or porting them to another provider. The lesson is that selecting the right cloud service can result in cost savings, but selecting the wrong one can be very expensive.

- **It is far easier and cheaper to change a decision (e.g., different service model or provider) when it is still on the drawing board or perhaps in the proof-of-concept stage.** It can be far more difficult and expensive when the service is up and running, interfacing with other systems and processes and using live customer data. With so many cloud service options available, the time that the enterprise spends considering the respective ROIs and selecting the best fit for its needs is time well spent.

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Cloud computing truly can offer enterprises whole new sets of options for building and delivering IT services rapidly, inexpensively and without major investment or technical skills.
Why Is it so Challenging to Do?

Those new to cloud computing may not realize how many service options exist and how confusing it can be to understand and evaluate them all. A multitude of service and deployment model variations are already out there, and more are emerging all the time. The NIST definitions are very helpful to understand and explore the options, but they are more like “big buckets” of options rather than definitive standards.

Complicating this challenge is the fact that every enterprise has a different set of needs (e.g., customer, functional, legal, compliance) and is in a different position regarding its current IT services and systems (e.g., start-up “green fields” enterprises vs. mature enterprises with various legacy systems).

Moving to the cloud is not a stand-alone decision that can be made in isolation from everything else going on in the enterprise. Cloud computing can impact so many different elements (data centers, application software, IT support tools, personnel, IT processes, business processes) that each of these needs to be considered when performing an ROI analysis. For enterprises with existing systems, this also means looking at current IT costs and benefits; if they are not understood well, it makes the exercise that much more difficult.

Understandably, many enterprises skip the ROI step altogether. However, moving into the cloud can be a little like downhill skiing: It is advisable not to wait until the descent begins before thinking about how to get to the bottom safely. Being “bold, but controlled” is often good advice on the slopes, and the same can be said about moving to the cloud. Estimating ROI is an important part of the control.

A Practical Approach to Measuring Cloud ROI

There are many possible ways to estimate cloud ROI and no single approach will suit all situations. Selecting the best one for a particular case depends on several factors, including what the key business drivers are for moving to the cloud (increasing revenue vs. reducing costs), the enterprise’s approach to preparing and assessing business cases (focus on tangibles vs. intangibles), and where the enterprise is in the business growth/maturity cycle (start-up vs. mature business).

The three-phase approach outlined in this white paper is designed to suit an enterprise that has reasonably mature operations (i.e., existing systems and business processes) and is considering moving to the cloud primarily to achieve cost savings. The concepts described can also be applied to other scenarios; some steps may need more or less emphasis to suit the circumstances.

A few suggestions for maximizing this approach follow:

• **Focus quickly on the optimal cloud solution**—There are so many alternatives that sifting through them all could take forever. Starting with an initial/baseline model and then iteratively identifying the one best suited to the enterprise’s needs (cost, risk, compliance, etc.) can make the selection process faster and more effective.

• **Make an “apples to apples” comparison**—Evaluate a holistic and comparable set of costs for both the as-is and to-be alternatives addressing the common problem of not being able to make a fair comparison between two solutions that are potentially very different (either comparing two different cloud solutions or comparing cloud to traditional IT). Measuring monetary values in a consistent manner increases ROI accuracy and reliability.

• **Stay within the enterprise’s risk tolerance**—Perform a risk assessment of both the as-is and to-be options to help ensure that the solutions being compared are within the enterprise’s risk tolerance and the costs of mitigating unacceptable risk are factored into the calculations. Knowing the enterprise’s risk appetite before the calculations begin is a must.
Figure 6 outlines the three phases and suggested questions to address each step.

<table>
<thead>
<tr>
<th>Phase/Step</th>
<th>Guidance/Key Questions to Answer</th>
</tr>
</thead>
</table>
| Phase 1—Determine to-be Cloud Costs and Benefits | a. Define high-level business (functional) requirements.  
- What business functions need to be covered?  
- What are the business drivers for adopting cloud-based services?  
- How might cloud-based services support business processes?  
- What compliance requirements (e.g., US Sarbanes-Oxley Act, Health Insurance Portability and Accountability Act [HIPAA], Payment Card Industry Data Security Standards [PCI DSS]) are relevant?  

b. Define initial/baseline cloud service model.  
- What type of cloud service model (IaaS, PaaS, or SaaS) is needed?  
- What type of deployment model (public, private, community, or hybrid) is most appropriate? (figure 1)  
- Where would services be physically located (e.g., on premises, off premises, specific geographic location)?  
- Who would deliver the services (e.g., third party, in-house, mix, cloud broker)?  
- For this baseline, start with a model that is simple and low-cost (e.g., public SaaS), but rule out options that will not meet major compliance requirements (e.g., focus on in-country providers if use of foreign providers is prohibited).  
- The baseline solution may not be the optimal one or may fall outside the enterprise’s risk tolerance, but later steps should address these concerns.  

c. Risk-assess initial/baseline cloud model.  
- Identify the risk areas to be considered (e.g., multitenancy, network dependency, abstraction, data usage limitations, security, privacy, up-front migration cost, cross-border data location, vendor lock-in, hardware lock-in, data ownership, in-house skills required to manage the cloud).  
- Determine countermeasures to mitigate the areas of risk outside of the enterprise’s risk tolerance.  
- Examples of risk mitigation measures may include:  
  - Data encryption/tokenization managed by the customer to protect against unauthorized data access by cloud provider staff  
  - A revert-back strategy to protect against potential failure of the cloud provider’s business  
  - Backups/audit trailing housed on customer premises to protect against loss of access to cloud services  
  - Clear and comprehensive SLAs that include the right to audit clause  
  - Implementation of in-house disaster recovery plan (DRP)  

d. Estimate costs.  
- The costs may include:  
  - Cost of migrating from the current model to a cloud-based model (e.g., rewriting applications to operate in a virtualized environment, reformattting data to suit SaaS provider formats, setting up federated identity and access management, implementing processes to manage the cloud)  
  - Cost of operating the cloud-based model (e.g., cloud provider fees, software licensing and support fees, data communication fees, cloud system administration)  
  - Cost of implementing and operating countermeasures to mitigate risk (e.g., data encryption tools, planning and testing revert-back strategies, maintenance of backups and audit logs offline from provider)  
  
  The calculations must include other factors as well:  
  - Estimate tangible benefits (e.g., increased sales due to improved availability, scalability of systems, increased revenue from sales representatives having better access to information while traveling, reduced head count supporting traditional IT systems).  
  - Assess intangible costs/benefits. These may include such considerations as:  
    - Ability to react quickly to changing markets through rapid product release and/or scaling  
    - Potential that cloud providers will be able to support introduction of new technical innovations faster than can a traditional IT function  
    - Risk that tightening of regulations (e.g., privacy) may make cloud services nonviable in the future, forcing systems to return in-house  
    - Loss of internal IT skills/knowledge that can otherwise be a strategic differentiator  
    - Risk of being locked in to particular cloud providers/proprietary service models, potentially impeding future adoption of open standards based services as they emerge  

e. Consider other cloud models.  
- Would it be more cost-effective to change the cloud service/deployment models? For example:  
  - Instead of a public cloud, would private, community or hybrid clouds remove the need for some of the security controls required for a public cloud?  
  - Instead of SaaS, would PaaS or IaaS make it more cost-effective to mitigate some of the lock-in risk?  
- Test each of the key alternatives available against the baseline model to determine whether there is a more optimal cloud model for the circumstances.  

f. Reevaluate costs/benefits to align to optimal model.  
- Once an optimal model is determined, update the costs and benefits (migration costs, operating costs, risk mitigation costs, intangible costs/benefits) to reflect this model.
### Phase 2—Evaluate as-is Costs and Benefits

#### a. Estimate as-is costs and benefits.
- Using the same definition of business requirements as utilized in phase 1, define the current service model to meet the same functional and compliance requirements.

#### b. Perform (or review if one already exists) a risk assessment of the current service model.
- Are there any risk areas that fall outside the enterprise’s risk tolerance that need to be mitigated? For example:
  - The current system is locked in to a particular technology or provider, and moving to the cloud may require considerable time, effort and money.
  - The current system contains intellectual property that requires high levels of security and compartmentalization.
  - The cloud provider may not meet current service levels, leading to degradation in service to customers and loss of business.
- Determine countermeasures/mitigations required to bring risk to an acceptable level (e.g., use a private cloud to avoid multitenancy, assess vendor performance, assess vendor certifications and compliance profile).
- To ensure an “apples to apples” comparison, review the risk areas considered in the to-be assessment to ensure that they have all been considered in the as-is assessment, and vice versa.

#### c. Estimate costs/benefits.
These may include:
- Ongoing operation/maintenance costs (TCO)
- Risk mitigation cost
- Intangible costs/benefits

### Phase 3—Estimate ROI

#### a. Compare as-is and to-be costs and benefits.
- The simplest way to do this is to prepare a table comparing the quantified costs and benefits for the as-is and to-be options over a period of up to five years. A longer period is not recommended due to the speed with which the IT industry changes.
- For each year, calculate the net incremental cost/benefit of moving to the to-be cloud solution.

#### b. Calculate ROI.
- Several methods can be used. Engage the enterprise’s finance team and apply the organizational standard.
- If the enterprise does not have a standard, the simplest approach is to use the simple ROI calculation, supported by a simple NPV calculation. To calculate NVP, take the net cost-benefit for each year and discount it back to the present using an approved interest rate (i.e., the rate at which the organization borrows). This should result in the total cost-benefit in present-day value.

#### c. Factor in intangibles.
- Cloud computing initiatives can involve significant intangible benefits (e.g., increased ability to release new products rapidly) and costs (e.g., potential loss of internal IT technical skills).
- If these intangibles cannot be quantified reliably, they need to be described as clearly as possible and included in the ROI assessment to ensure that the final decision is based on a holistic set of factors.

### ROI Framework in Practice

- **Determine the period of time to use** (5 years is a common standard)
- **Calculate the benefits of moving to the cloud (tangible)**
- **Calculate the cost of moving to the cloud**
- **Identify any intangible benefits and risk and try to quantify them**
- **Determine the interest rate that applies to the enterprise when it borrows money**
- **Plug the numbers in the formulas**

**TCO** = Upfront cost + Recurring cost + Termination cost

**ROI** = \[
\frac{(Tangible\ benefits + Intangible\ benefits) - (Upfront\ cost + Recurring\ cost + Termination\ cost)}{(Upfront\ cost + Recurring\ cost + Termination\ cost)}
\]

**NPV** = - Upfront cost + \[
\frac{Recurring\ cost\ year\ 1}{(1 + \text{borrowing\ rate})} + \frac{Recurring\ cost\ year\ 2}{(1 + \text{borrowing\ rate})^2} + \frac{Recurring\ cost\ year\ 3}{(1 + \text{borrowing\ rate})^3} + \frac{Recurring\ cost\ year\ 4}{(1 + \text{borrowing\ rate})^4} + \frac{Recurring\ cost\ year\ 5}{(1 + \text{borrowing\ rate})^5}
\]
Following are some points to consider when applying this approach:

• Phase 1:
  – A good reason to start by evaluating a baseline cloud model that is simple and cost-effective is to facilitate conducting a proof of concept to better understand the model’s features, benefits and risk. With low sign-up and operating costs, many public cloud solutions can be very helpful for this purpose.
  – If the enterprise is sure that it has already identified its optimal cloud option, it may be possible to skip the steps in phase 1 related to evaluating an initial/baseline model. However, if the ROI of the optimal model has not yet been estimated, the question may be raised as to how it was determined that it is the optimal model (“the chicken or the egg” problem).
  – Gaining a firm understanding of the risk related to cloud services can be challenging due to the wide variety of services offered, the lack of transparency around controls and the difficulties in comparing across providers. While original investigation and research is effective, the following tools and references may be helpful in the process:
    - ISACA’s IT Control Objectives for Cloud Computing: Controls and Assurance in the Cloud—Guidance on governance of cloud computing, the relationship between service providers and customers, and specific control issues
    - ISACA’s Security Considerations for Cloud Computing—Practical guide to assess cloud risk and assists in determining which cloud model is most propitious to satisfy enterprise needs
    - Cloud Security Alliance’s (CSA) Security Guidance for Critical Areas of Focus for Cloud Computing—Detailed guidance on principles and practices for cloud computing security
    - NIST SP 800-146 Cloud Computing Synopsis and Recommendations
    - CSA’s Security, Trust & Assurance Registry (STAR)—A free public registry of security controls provided by various cloud computing offerings
  – Phase 2—This phase may be relatively straightforward, depending on how much documentation and analysis exists for the current service model and associated costs. But much depends on whether a full assessment of the current model has been completed. If not, and there are unknown areas of risk, the enterprise could be significantly underestimating as-is costs and/or to-be benefits.
  – Phase 3—Many enterprises moving to the cloud are redirecting a significant portion of IT operating cost savings toward managing cloud-related risk and management. This is because the cloud is introducing new types of risk, and the methods to manage that risk can be quite different from the approaches used for traditional IT (e.g., vendor management, change management, usage management). This may be reflected in as-is and to-be costs.

Key Takeaways

The ROI for cloud computing investments is not straightforward. In some cases, the cost savings are evident, e.g., when replacing costly servers with software-based virtual machines or when replacing licensed software for a cloud application that does not require license maintenance and administration. However, there can be unexpected costs, e.g., costs resulting from improper application management or contract termination that must be accounted for to calculate a meaningful estimate. ROI estimates must factor in short-, medium- and long-term costs; tangible and intangible benefits; and the cost to mitigate any new risk raised by the cloud.

Before deciding which cloud model to adopt, the enterprise must baseline the current cost to run the existing infrastructure or single system. This step is essential in deciding if cloud computing is suitable for the business and to calculate the economic and strategic return of the investment.
ROI is a good start, but other financial indicators must also be calculated to gauge return during the life span of the cloud investment. ROI coupled with IRR, TCO and NPV will provide a more accurate picture of the financial consequences of a particular solution. Nonetheless, if the primary driver for adopting cloud services is to meet business needs, it is advisable to build a solid business case and avoid relying on financial calculations alone.

Appendix A. Formulas

Total Cost of Ownership (TCO)
Cost of ownership analysis is intended to uncover the lifetime costs of acquiring, operating and maintaining something (services or assets). TCO is useful to determine the difference between the purchasing price and the long-term cost of investment.

\[
\text{TCO Formula} \\
\text{TCO} = \text{Purchase} + \text{Financing} + \text{Maintenance} + \text{Upgrade} + \text{Enhancements} + \text{Deployment} + \text{Security} + \text{Depreciation} + \text{Decommissioning} + \text{Disposal} + \text{Cost}_{\text{it}} \\
\]

The period of time used to calculate TCO depends on corporate standards which determine when ownership starts and ends. Three common life spans are:
- Depreciable life
- Economic life
- Service

Net Present Value (NPV)
Net present value is intended to calculate the present value of an investment by the discounted sum of cash flow disbursements over a period of time.

\[
\text{NPV Formula} \\
\text{NPV} = \text{Initial Investment} + \sum_{i=1}^{\text{Time}} \frac{\text{Cash Flow}_{i}}{(1 + \text{Discount Rate})^i} \\
\]

Example of NPV for an investment of US $500,000 and a rate of 10 percent over 3 years:

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash Flow</th>
<th>Present Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-$500,000</td>
<td>-$500,000</td>
</tr>
<tr>
<td>1</td>
<td>$200,000</td>
<td>$181,818</td>
</tr>
<tr>
<td>2</td>
<td>$300,000</td>
<td>$247,933</td>
</tr>
<tr>
<td>3</td>
<td>$200,000</td>
<td>$150,262</td>
</tr>
</tbody>
</table>

\[
\text{Investment NPV} = -$500,000 + \frac{$200,000}{1.10} + \frac{$300,000}{(1.10)^2} + \frac{$200,000}{(1.10)^3} \\
\]

NPV = -$500,000 + $181,818 + $247,933 + $150,262 = $80,015
**Internal Rate of Return (IRR)**

IRR is the interest rate that would make the initial investment NPV equal to zero. Usually a rate greater than the cost of borrowing money would be considered beneficial by most finance professionals or portfolio managers. Please note that IRR cannot be derived analytically, instead IRR must be found by using mathematical calculations to find the correct rate; however, most financial calculators or spreadsheet programs can be used to calculate IRR.

**IRR Formula**

\[
0 = \text{Initial Investment} + \frac{\text{Cash Flow}_1}{(1 + \text{IRR})} + \frac{\text{Cash Flow}_2}{(1 + \text{IRR})^2} + \frac{\text{Cash Flow}_n}{(1 + \text{IRR})^n}
\]

Example using the same investment of US $500,000 over 3 years and IRR of 19 percent (this is the rate that would make the initial investment zero).

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Flow</td>
<td>-$500,000</td>
<td>$200,000</td>
<td>$300,000</td>
<td>$200,000</td>
</tr>
</tbody>
</table>

\[0 = -500,000 + \frac{200,000}{(1.19)} + \frac{300,000}{(1.19)^2} + \frac{200,000}{(1.19)^3}\]

**Additional Resources and Feedback**

Visit [www.isaca.org/cloud-ROI](http://www.isaca.org/cloud-ROI) for additional resources and use the feedback function to provide your comments and suggestions on this document. Your feedback is a very important element in the development of ISACA guidance for its constituents and is greatly appreciated.