Guiding the cloud application decision with the IBM Cloud Transformation Advisor
Executive overview

Cloud computing helps enterprises become more agile and responsive while significantly reducing IT costs and complexity, through improved workload optimization and service delivery. Cloud-delivered applications provide many business benefits such as scalability based on business demand, the ability to maximize resource usage, expansion of services, maximization of software and hardware investment, and the standardization and ease of use of IT resources. When considering whether to move an application to the cloud, it is important to consider both the business purpose of the application and the role that application plays in supporting business and IT strategies. This context is important for considering whether to transition an application to a cloud environment, or whether to rearchitect or “transform” the application – and if so, how to do it. IBM has developed a methodology and tool for determining how to approach these decisions and optimize the benefits from applications being delivered from a cloud environment.

Cloud delivery drives business benefits

Cloud computing brings new opportunities for businesses, providing greater flexibility in terms of newer business solutions. These may include pay-as-you-go revenue models, elasticity to respond to changing demands, the potential to offer internal applications as services without having to worry about managing the infrastructure, and new business models for solution offerings. As a result, many enterprises are considering cloud not only for developing new applications, but also for extracting additional value from existing applications that have been developed for, and deployed on, traditional computing platforms.

Cloud adoption is driven by the need to provide a dynamic environment to drive change, innovation and efficiency, by making business services more widely available. Business services delivered via a cloud are essentially platform-agnostic and can be accessed by multiple devices. The cloud delivery model provides the ability to quickly scale IT resources without having to invest in expensive infrastructure; that is crucial to high-quality service delivery that meets both the enterprise’s and customer’s ever-changing business demands.

The three key motivators for moving applications to a cloud platform include:

- **Scalability** – the ability to accommodate business growth in a graceful manner
- **Agility** – the ability to rapidly adapt to change in a business environment in productive and cost-effective ways
- **High Performance** – the ability to process transactions faster and at a higher rate by better utilizing resources

Benefits of cloud delivery

**Value drivers: Improve flexibility, maximize investment**
- Faster speed to market—automated provisioning
- Self service and deeper user interaction—automated consumption
- New revenues and improved charge-backs—utility pricing
- Flexible financial model—shifting from capital expense to an operating expense
- Improved responsiveness to business fluctuation—built in elasticity
- Lower IT costs and operational efficiency—automation and standardization
- Faster innovation—access to emerging technologies and computing environments

**Outcomes: Innovate, reduce cost**
- Convergence and innovation—new and existing business offerings provisioned and delivered by cloud computing
- Revenue growth and flexibility—new customer segments, flexible pricing economics of scale, elastic scalability and self-service delivered by adapted applications and services
- Productivity and alignment—automated, standardized and streamlined delivery and consumption of computing services
- Cost reduction and operational efficiency—bringing of applications and services to a virtualized cloud infrastructure

Figure 1—Moving applications to a cloud can both drive business value and reduce risk.
The benefits from cloud are compelling. Early adopters of cloud computing, including IBM's own IT organization and IBM customers, have already realized significant benefits, including:

- Reducing IT labor cost by up to 50 percent in configuration, operations, management and monitoring
- Reducing server and application provisioning cycle times from weeks to minutes.
- Improving quality, eliminating up to 30 percent of software defects
- Lowering end-user IT support costs by up to 40 percent.

**Evaluating cloud applications**

A cloud application is an IT-delivered business process or custom-developed application capable of being deployed in a virtualized infrastructure and consumed as a service offering. The rationale for cloud-based application delivery stems from motivations such as providing business services to new or existing clients via new business models (e.g., a pay-as-you-go service), scaling resource usage across the enterprise, or moving to a pure service-based model.

When considering cloud delivery, one of the major challenges faced by enterprises is the lack of the right implementation plan for moving existing applications to the cloud. Adapting an application for cloud delivery requires upfront analysis and planning. Enterprises often limit cloud deployment to new applications without fully considering if, and if so how, existing applications can be transitioned.

**Considering transition vs. transformation approaches**

Moving business applications or services to a cloud is generally achieved either through transition or transformation. The difference lies in the extent to which the application is retooled for cloud delivery.

**Transition**

This option, commonly referred to as the “lift and shift model,” is applied to situations when the application runs as-is or with minimal changes to the architecture, design or delivery model necessary to accommodate cloud delivery. For example, an application with no duplication of functionality and that supports current performance and security requirements would be a good candidate to transition to a cloud. The transition of such an application typically includes:

- Selecting a private or public cloud environment to host the application.
- Provisioning and configuring the Infrastructure-as-a-Service and the Platform-as-a-Service needed to deploy the application.
- Provisioning the application to deliver built cloud characteristics such as monitoring, metering, scaling, etc.

When identifying enterprise applications for transition, there are a number of factors to consider. Assessment of the maturity level of these many factors is critical to help determine whether to transition applications to the cloud:

- **Business model** – Business services and capabilities should be separated from the underlying IT infrastructure on which they run. This enables the business to form partnerships and alliances and tap into partner business services without dramatic changes to the IT infrastructure.
- **Organization** – In a well-run cloud environment, enterprise IT governance is well established and fully functional. Service usage is tracked and the service owner and provider are able to reap paybacks for the services developed and exposed by them.
• **Methods and architecture** – The application architecture should support service-oriented principles and dynamically configurable services for consumption within the enterprise, its partners and throughout the services ecosystem. The application architecture of a good candidate application provides distinct separation of physical and logical layers, allowing for changes to infrastructure without impact to the consumers of services.

• **Applications** – The application portfolio should be structured so that key activities or steps of business processes are represented as services across the enterprise. With this kind of structure, business process changes can automatically trigger the new assembly of applications or composite business services. Business users and/or administrators may also perform dynamic service or application assembly, using the appropriate tools.

• **Information** – The application’s business data vocabulary – a collection of business concepts, terms, and data definitions – should provide expansion and enhancement as needed to support new services. This enables integration with external partners, as well as efficient business process reconfiguration.

• **IT infrastructure** – In a well thought-out cloud application, services can be virtualized such that any given instance may run on a different and/or shared set of resources. Services can be discovered and reused in new, dynamic ways without a negative impact on the infrastructure.

• **Operational management** – Service management incorporated into the application design addresses demand, performance, recoverability and availability. It also tracks and predicts changes to reduce costs and mitigate the impact on quality of service.

• **Security** – Good application and network security design supports both current and future enterprise security requirements.

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**Facilitating integration in a cloud environment**

![Diagram showing service components interacting in a cloud environment](image-url)

Figure 2 – The SOA reference model shows how service components interact in a cloud environment.
Transformation
In some cases, business and IT objectives and conditions warrant larger, more comprehensive changes to an application that is moving to the cloud than are possible under the transition approach. Transforming existing applications involves rearchitecting and redesigning the application to be deployed in either a private or public cloud environment. This path involves the application being redesigned to fit a more open computing model, for example to accommodate service-oriented architecture (SOA), exposed APIs or multi-tenancy. An SOA application model is valuable in that it allows for integration across custom and packaged applications as well as data stores, while being able to easily incorporate business support services that are needed for cloud deployment. The SOA reference model in Figure 2 shows how the layers of interoperability across services facilitate integration in a cloud environment.

Typically, transforming applications for a cloud environment includes the same set of criteria as transitioning applications to a cloud environment, but with different conditions. Often, applications targeted for transformation are tightly coupled with enterprise legacy systems and do not meet current security, availability and scalability requirements. The situational factors that support the transformation decision include:

- **Business model** – In an application that is a candidate for transformation, business services tend to be isolated with each line of business maintaining its own siloed applications. Also, there is minimal automated data interaction or process integration between the silos. By transforming the application for cloud delivery, the organization can extend the business value of the service or application to other lines of business (LOBs) and partners.

- **Organization** – When each business unit owns its own siloed applications, it defines its own approach, standards and guidelines for implementing, consuming and maintaining application-delivered services. These may not align well with the need of the organization as a whole.

- **Methods and architecture** – In siloed applications there is no consistent approach for developing components or services. LOBs tend to throw requirements “over the fence” to the IT organization, which then develops solutions without feedback from the business. The application architecture is typically monolithic and tightly coupled, with minimal separation between presentation, business logic and the database tiers. Often there is mostly – or in some cases only – point-to-point integration.

- **Applications** – Usually, portfolios of discrete applications take minimal advantage of service-oriented architecture concepts, and business processes are locked in application silos.

- **Information** – Information sharing tends to be limited across separated applications. Data formats are often application-specific and the relatively inefficient extract-transform-load process is the primary means for information sharing between applications.

- **IT infrastructure** – Platform-specific infrastructures are maintained for each application and infrastructure changes have had to be put in place to accommodate service orientation, where it exists.

- **Operational management** – In environments that would benefit from transformation, service management functionalities such as monitoring and metering to manage enterprise business applications and/or services are either not supported at all, or only to a limited extent.

- **Security** – Enterprise application and network security enhancements are required in transformation candidate applications to meet current and future security requirements.
Choosing between transition and transformation

<table>
<thead>
<tr>
<th>Domains</th>
<th>Transition</th>
<th>Transformation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>Virtualized and dynamically reconfigurable business processes and services</td>
<td>Isolated business line driven with minimal interaction or process integration</td>
</tr>
<tr>
<td>Organization</td>
<td>Enterprise / IT governance aligned</td>
<td>Ad hoc IT strategy and governance</td>
</tr>
<tr>
<td>Methods</td>
<td>Service-oriented modeling</td>
<td>Structured analysis and design</td>
</tr>
<tr>
<td>Architecture</td>
<td>Dynamically reconfigurable SOA-based architecture</td>
<td>Monolithic / tightly-coupled architecture</td>
</tr>
<tr>
<td>Application</td>
<td>Based on service-oriented principles, supports processes, dynamic application assembly, and context-aware invocation</td>
<td>Modules-based interconnected applications</td>
</tr>
<tr>
<td>Information</td>
<td>Virtualized information services, non-redundant data, and semantic data vocabularies</td>
<td>Application specific</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Service-oriented infrastructure, resources can be virtualized</td>
<td>Platform specific</td>
</tr>
<tr>
<td>Operational management</td>
<td>Service management addresses demand, performance, recoverability, scalability and availability in the infrastructure</td>
<td>Does not support the performance, recoverable, scalable and available requirements</td>
</tr>
<tr>
<td>Security</td>
<td>Supports enterprise current and future security requirements</td>
<td>Security enhancements required</td>
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Figure 3 – An application’s attributes determine how it should be moved to a cloud.

After selecting the appropriate cloud delivery model (private or public), the decision to transition or transform an existing enterprise application is important in order to help ensure a successful move to cloud. When resources are limited, it is possible for an enterprise to choose to run the transformation in parallel with transition to meet short-term needs, while planning for longer-term, best-in-class performance through application transformation.

Guiding the transformation decision: the IBM Cloud Transformation Advisor

For existing applications that are being transformed to truly take advantage of the specific nature of a cloud environment, cloud platform providers will, in many cases, need to provide automation to help ease the cost and effort required to move applications onto new platforms. For clients who have made the decision to transform an application, IBM has developed a comprehensive methodology to help inform and guide the migration process. This methodology is encapsulated in the IBM Cloud Transformation Advisor. This tool is used to evaluate transformation alternatives based on unique enterprise data that spans both business and technical considerations.
Transformation needs will vary depending upon the application and objective for moving to a cloud model. The approach to transformation of a particular application will be unique in some respects. Although it is not possible to apply a single approach for all scenarios, the Advisor model can help influence the application transformation process and improve the odds of success.

The Cloud Transformation Advisor is based on an extensible knowledge base of transformation best practices that address specific needs in a cloud environment. The tool assists architects and developers in selecting the “best” set of enablement patterns for transforming a particular application. It also describes a set of alternatives using well-known optimization techniques across three different phases, as depicted in Figure 4.

Each step in the approach has a structured representation that indicates dependencies along several dimensions and the activities required to apply the desired transformation pattern, as well as a rating of the pattern against a set of relevant quality attributes. The alternatives are measured and presented against scalability, security, extensibility, accuracy and effort. To help reflect changing enterprise transformation patterns, the knowledge base in the tool grows over time based on usage and data capture from client situations.
Phase 1 – Data collection
The purpose of the data collection phase is to gather information needed to determine how best to transform an application for the cloud. This step includes building a common application profile that has details about the current application architecture, design and implementation. The information is collected through a questionnaire tailored for specific contexts. Figure 5 displays an example of the Common Application Profile portion of the questionnaire.

Figure 6 shows the Business Motivation and Desired Cloud Capabilities part of the questionnaire. This input provided is used by the Advisor to determine the set of transformation patterns that should be considered. If the user is uncertain about the specific capabilities needed in the transformed application, the Advisor provides functionality for identifying the business motivations for the transformation and mapping those to a set of potential capabilities which can be further refined.
**Phase 2 – Alternative generation and assessment**

In this phase, multiple transformation alternatives are generated and assessed using the Advisor tool. Based on the desired cloud capabilities and common application profile information, an algorithm identifies and examines the relevant transformation patterns in the Advisor knowledge base and generates alternatives. These contain sets of patterns that provide the desired application capabilities. A given application is likely to require many capabilities, and the knowledge base can contain multiple transformation patterns for each capability, each with differing requirements for usage. To make the best match, the Advisor can evaluate and propose the alternatives that are most compatible with requirements. If the proposed alternatives are not deemed sufficient, the user can modify or create new alternatives using the Advisor. Figure 7 shows an example of the Transformation Alternatives composition view.

Once alternatives have been generated, the Advisor steps the user through a feasibility check of each one. This step examines the requirements and dependencies of each transformation pattern against the as-is state of the application, as shown in Figure 8.

The dependencies can include platform- or application-level needs, as well as architectural or implementation technology-related requirements. Information about the as-is application state provided in the initial data collection phase is reflected in this view. Where required information has not been provided, the Advisor collects the additional information it needs to evaluate alternatives during this phase.
Based on the fitness status of each dependency (where a match indicates that the dependency is met by the as-is application state), the Advisor determines any additional activities and effort needed prior to transforming the application. This effort is then added to the scope of work required for each alternative. Figure 9 shows an example of transformation activities.

For each activity, the Advisor notes the required skills and relevant tools, if any. The knowledge base also provides an estimate of the effort required, as measured by “person-days,” which can help guide the development of the implementation plan.

Phase 3 – Evaluation and selection
In this phase, the alternatives are presented for evaluation according to a user-selectable set of criteria. These criteria can include transformation effort and cost, along with quality attributes such as scalability, security and extensibility. Figure 10 shows how representative alternatives are displayed relative to one another.

Based on the selected criteria, the user then selects the desired alternative and generates an Advisor Report. The report details the specific activities needed to apply the transformation patterns in the selected alternative (e.g., building a logging service, creating an LDAP sub-tree structure for each tenant, etc.), as well as the criteria and information used in the evaluation and selection processes.

Figure 11 summarizes how the IBM Cloud Transformation Advisor is applied to help guide the application transformation planning process.

Moving ahead with cloud transformation
When it comes to moving applications to a cloud environment, IBM understands the importance of analyzing the relevant factors that go into the application transformation or transition decision. Only when applying a methodical approach based on not only IT factors but also business, organization and information criteria, can you optimize your investment in cloud applications.
The Cloud Transformation Advisor provides a systematic consulting method and knowledge base for facilitating the transformation of enterprise applications for cloud environments. Through a systematic evaluation of key criteria, the methodology embedded in the tool can help improve the productivity of business analysts and enterprise/solution architects. This is accomplished by applying standardized, repeatable and reusable processes and work products, thereby saving time and money. The approach behind the Cloud Transformation Advisor ensures that desired cloud capabilities are based on enterprise business motivations and realistic business scenarios, ensuring that the application functions in the way it was intended to do so. The tool enables informed decision-making based on quantitative analyses with well-documented rationales, and provides a mechanism that helps to ensure accurate decisions are made.

For more information
To learn more about the benefits of moving your enterprise applications to a cloud environment and the most effective ways to accomplish the task, contact your IBM representative.

Visit us at ibm.com/services/cloud

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**Cloud Transformation Advisor walk-through**

**Purpose**
- Understand motivation for cloud transformation
- Collect data for the transformation including customer profile, business motivation, application profile and project profile
- Identify desired capabilities from the transformation
- Define how the transformation can be realized by a set of alternatives
- Ensure alternatives feasible at a high level of design
- Understand the “how well” of each alternative from quantitative and qualitative perspectives

**Actions**
- Select a set of pre-defined questions from the repository and generate the structured questionnaire for interview
- Answer key questions
- Select business motivations and/or business scenarios that enable cloud capabilities
- Verify and adjust the selected capabilities
- The patterns to enable selected capabilities have been recommended from the knowledge base
- Faceted classification can be used to allocate a set of patterns and save them as an alternative
- Select one alternative and the corresponding feasibility check list are automatically generated on the pre-defined patterns selected in the alternatives
- Generate a list of required activities in the alternative
- Select evaluation criteria from pre-defined criteria list assisted with the relations with business motivations
- Evaluate each alternative based on benchmark suggested by patterns or via other estimation tools
- Select optimal transformation alternative recommended by the Advisor

**Final evaluation report**
Appendix A – IBM Cloud Reference Architecture

Cloud computing can potentially bring substantial changes to the way an enterprise’s IT services are delivered. The IBM Cloud Reference Architecture is a comprehensive implementation model for the building of cloud services. The same reference architecture is reflected in the design of IBM Cloud Appliances, which bundle hardware and software for cloud implementation. Solutions that utilize the reference architecture help to ensure consistency and quality in cloud-based delivery of services and applications.

The IBM Cloud Reference Architecture:

- Is based on open standards
- Delivers robust security, governance, compliance and privacy capabilities
- Combines powerful automation and services management with rich business management functions for fully integrated, top-to-bottom low-touch management of cloud infrastructure and cloud services
- Supports the full spectrum of cloud service models, including infrastructure as a service (IaaS), platform as a service (PaaS), software as a service (SaaS) and business process as a service (BPaaS)
- Enables the flexible scaling and resiliency required for variable cloud economics and business ROI
- Facilitates seamless integration with existing IT environments
- Is based on industry-leading IBM expertise in building services and service-oriented architectures.

As shown in Figure 12, the IBM Cloud Reference Architecture addresses the needs of three major stakeholders in any cloud computing environment: cloud service provider, cloud service creator and cloud service consumer.

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**Figure 12 – The cloud reference architecture provides a proven framework for cloud deployment.**
With well-defined components, the architecture helps organizations understand the business requirements, expectations and value propositions placed upon the system, and the supporting capabilities necessary to fulfill those requirements.

The component parts of the IBM Cloud Reference Architecture include:

**Infrastructure cloud services** – The provisioning of computation, storage, networks and other fundamental IT resources, where the cloud service consumer is able to deploy and run an arbitrary software workload. The consumer does not manage or control the underlying cloud infrastructure, but has control over operating systems, storage, deployed applications, and possibly limited control of select networking components (e.g., host firewalls). In some situations the most commonly used operating system (OS) software may be installed on the virtualized infrastructure with Bring Your Own License (BYOL), Pay As You Go (PAY) and Development Use Only (DUO) licensing of the OS.

**Platform cloud services** – Cloud infrastructure deployment of consumer-created or acquired applications built using programming languages and tools supported by the cloud service provider. The cloud service consumer does not manage or control the underlying cloud infrastructure (network, servers, operating systems and storage), but has control over the deployed applications and possibly the application hosting environment and firewall configurations.

**Application cloud services** – Delivery of the cloud service provider's applications, running on a cloud infrastructure. The applications are accessible from various channels and client devices through a thin client interface such as a web browser (e.g., web-based email). The cloud service consumer neither manages nor controls the underlying cloud infrastructure including network, virtual machines, operating systems, storage or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.

**Business process cloud services** – Business process services are any business process (horizontal or vertical) delivered through the cloud service model (multitenant, self-service provisioning, elastic scaling and usage metering or pricing) via the Internet with access via web-centric interfaces and exploiting web-oriented cloud architecture. The BPaaS provider is responsible for the related business function(s).

**Cloud Management Services** is comprised of two modules: Operational Support Services (OSS) and Business Support Services (BSS):

- **Operation Support Services** – The OSS module defines the set of systems management services that may be exploited by cloud service developers. The management services components include monitoring, event management, provisioning, incident and problem management, along with other functions.
- **Business Support Services** – The BSS module defines the capabilities required to enable the business management of one or more specific managed cloud services. For example, the billing service component of the BSS must be capable of performing billing for the consumption of virtual machine resources (IaaS), multi-tenancy-capable middleware platforms (PaaS) and multi-tenancy applications such as collaboration or customer relationship management (SaaS) as required by the business service deployed on the cloud.
Appendix B – Cloud implementations

Over the past several years, IBM has gained valuable experience implementing cloud solutions, both within client environments and within IBM itself. To show where and how cloud computing is being used and to understand the benefits it provides, the IBM Academy of Technology conducted a survey of 110 case studies that dealt with cloud computing implementations. The survey findings are based on client status regarding cloud computing, the challenges they faced, how they are benefiting from the existing implementations where they expect to be in two year's time. Figure 13 shows the industries covered in this survey, including banking, government, telecom, insurance and financial markets.

How cloud is used

Based on the survey, cloud computing is mainly applied to loosely coupled workloads along with content-centric workloads, with a focus on internal IT infrastructure, application development and test scenarios, and web infrastructure. Figure 14 shows cloud deployments by workload. The usage is split between public and private cloud engagements.

Benefits of cloud computing

Cloud computing offers a wide range of benefits, from high resource utilization and flexibility to increased responsiveness. Almost 80 percent of clients are realizing significant sharing...
of IT resources through a highly virtualized infrastructure, and over 60 percent are achieving ease-of-use through self-service with rapid delivery, as shown in Figure 15.

After evaluating the analysis of 110 implementation projects, it is understood that:

- Clients are finding value today by either implementing characteristics of cloud or finding workloads that are best suited for cloud delivery. In the process, they are gaining knowledge of what’s needed for the future.
- Clients have found that standardization and integration is important for the successful and rapid adoption of cloud computing.
- Clients have also learned they will need to make organizational and process changes and reach a higher maturity level of integrated service management to get the full value of cloud computing.
- Clients plan to dramatically increase their use of cloud computing, both to incorporate more mission-critical applications and to expand their use of public cloud services.

Cloud deployment across workloads

**Workload today**
- Application development and test
- Web infrastructure
- IT infrastructure
- Collaborative computing
- Business apps
- High performance computing
- Decision support and analytics
- Transaction processing

**Workload two years from now**
- Application development and test
- Web infrastructure
- IT infrastructure
- Collaborative computing
- Business apps
- High performance computing
- Decision support and analytics
- Transaction processing

**Figure 14** – Cloud development is expected to increase markedly in the next two years.

Benefits realized

- Highly virtualized infrastructure
- Pay-as-you-go charging model
- Consumer ease of use, self service, with rapid delivery
- Internet/Web based
- Highly scalable
- Other

**Figure 15** – Cloud implementation complements the benefits of virtualized infrastructures.
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