Oracle® Practitioner Guide

Creating a Roadmap to Cloud Computing

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Creating a Roadmap to Cloud Computing, Release 3.0

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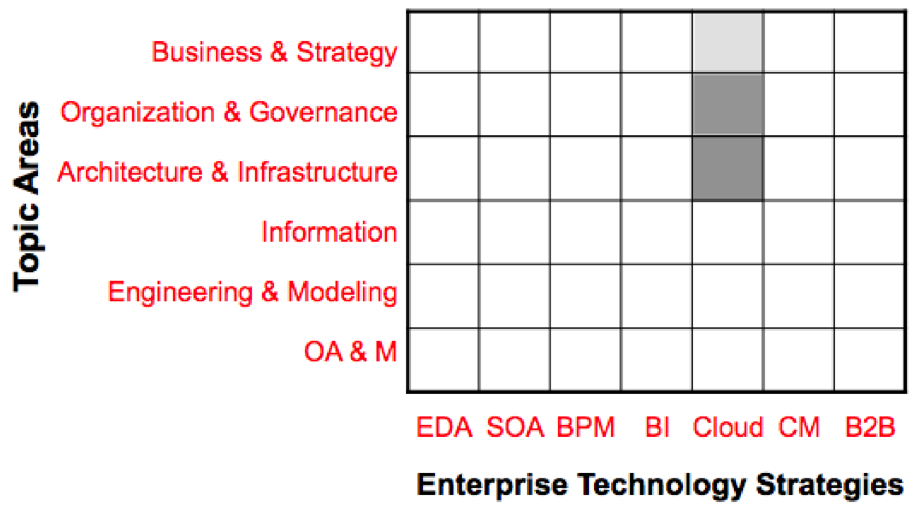
Preface

A Cloud Roadmap provides clear guidance for successful adoption of a Cloud Computing approach to delivering IT services in support of business. A well defined Cloud Roadmap defines program level and project level activities to deliver business value with Cloud capabilities, while steering clear of the associated common risks. To create such a roadmap requires a clear understanding of the current state of related capabilities, a well defined vision for Cloud adoption, and a structured methodology for defining the projects that make up the Roadmap.

This document is part of a series of documents that describe IT Strategies from Oracle (ITSO) Cloud strategy. Please consult the ITSO web site for documents pertaining to Cloud and other technologies.

Document Purpose

This document describes a robust process for creating a Roadmap for adoption of Cloud Computing within an enterprise. This process sets a Cloud initiative on a path for success by defining a vision and assessing current state. We describe these activities collectively as Envision activities. Once a roadmap has been created, the next focus is to implement the defined vision through an iterative approach, collectively described as Implement activities. Finally, activities involved in operating are collected in a focus area called Operate. This document details the Envision focus area. Implement and Operate focus areas are covered in separate documents. This document also describes program level activities necessary to manage the overall effort and provide essential governance for the defined activities across all three focus areas: Envision, Implement, Operate.



The figure above shows where this document fits relative to Enterprise Technology Strategies and Topic Areas.

Audience

This document is intended for enterprise architects, application architects, and project managers. The material is designed for an IT professional audience that is interested in preparing to adopt cloud computing within an enterprise.

Document Structure

This document is organized into chapters that build upon each other to describe program level methods for Cloud adoption. The chapters are organized as follows:

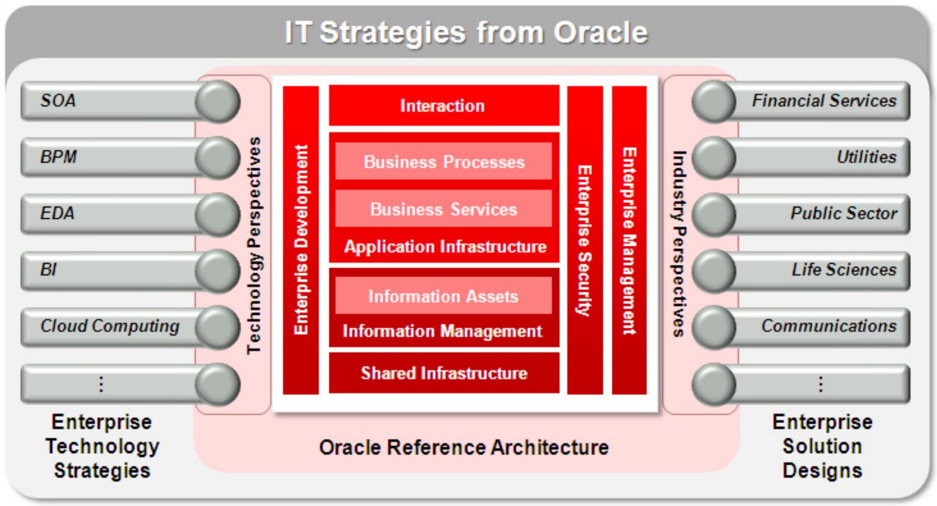
- Chapter 1 introduces the subject of a Cloud roadmap and describes the scope of program level and project level activities. Oracle's approach and the overall method structure involving three focus areas - Envision, Implement, Operate - is explained.
- Chapter 2 describes the Envision area of focus - Creating a Cloud Roadmap, which consists of a method and activities for initiating a cloud adoption effort, establishing a vision and specific goals, assessing current cloud computing capabilities, and evolving the approach to cloud adoption over time.
- Appendices provide a high level map of Cloud adoption activities across the three focus areas, and describe the Cloud ETS tools involved in developing the roadmap, specifically the Cloud Maturity Assessment Tool and the Cloud Candidate Selection Tool.
- **Summary** provides the conclusion for this document.

How to Use This Document

This document is intended to be a reference and a guide. As a guide it should be read from beginning to end. Certain sections within the document may be used referenced independently for discrete program level planning and decision making.

Related Documents

IT Strategies from Oracle (ITSO) is a series of documentation and supporting material designed to enable organizations to develop an architecture-centric approach to enterprise-class IT initiatives. ITSO presents successful technology strategies and solution designs by defining universally adopted architecture concepts, principles, guidelines, standards, and patterns.



ITSO is made up of three primary elements:

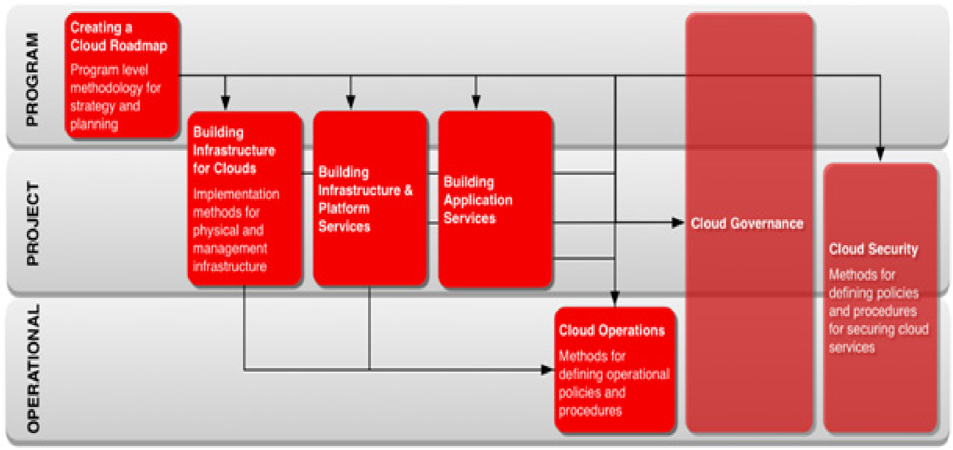
Oracle Reference Architecture (ORA) defines a detailed and consistent architecture for developing and integrating solutions based on Oracle technologies. The reference architecture offers architecture principles and guidance based on recommendations from technical experts across Oracle. It covers a broad spectrum of concerns pertaining to technology architecture, including middleware, database, hardware, processes, and services.

Enterprise Technology Strategies (ETS) offer valuable guidance on the adoption of horizontal technologies for the enterprise. They explain how to successfully execute a strategy by addressing concerns pertaining to architecture, technology, engineering, strategy, and governance. An organization can use this material to measure their maturity, develop their strategy, and achieve greater levels of adoption and success. In addition, each ETS extends the Oracle Reference Architecture by adding the unique capabilities and components provided by that particular technology. It offers a horizontal technology-based perspective of ORA.

Enterprise Solution Designs (ESD) are industry specific solution perspectives based on ORA. They define the high level business processes and functions, and the software capabilities in an underlying technology infrastructure that are required to build enterprise-wide industry solutions. ESDs also map the relevant application and technology products against solutions to illustrate how capabilities in Oracle's complete integrated stack can best meet the business, technical, and quality of service requirements within a particular industry.

Document Map

The Oracle Practitioner Guides for Cloud Computing are seven documents that describe a method that spans program level, project level, and operational concerns from envisioning the solution, through implementation of the solution, to operating the solution. The seven documents, as shown below, are:



- Creating a Roadmap for Cloud (*this document*) - program level methodology for strategy and planning Cloud adoption.
- Building Cloud Infrastructure - project implementation methods for physical and management Cloud infrastructure.
- Building Application Services - project level implementation methods for SaaS and applications services in the Cloud
- Building Infrastructure and Platform Cloud Services - project level implementation methods for Cloud infrastructure and platform services.
- Cloud Operations - methods for defining operational policies and procedures to run Cloud infrastructure and services.
- Cloud Security - project level and operational methods for securing cloud infrastructure and services

The practitioner guides listed above are part of the IT Strategies from Oracle (ITSO) series of documentation.

Please consult the ITSO web site for a complete listing of ORA documents as well as other materials in the ITSO series.

Conventions

The following text conventions are used in this document:

Convention	Meaning
boldface	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
italic	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
`monospace`	Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.

1 Creating a Roadmap to Cloud

This section gives an overview of the Cloud Roadmap creation process. It begins with a definition of what is encompassed within a Cloud Roadmap, and then describes the structure and organization of methods involved. The specific methods for Roadmap creation are described in detail in section 2.

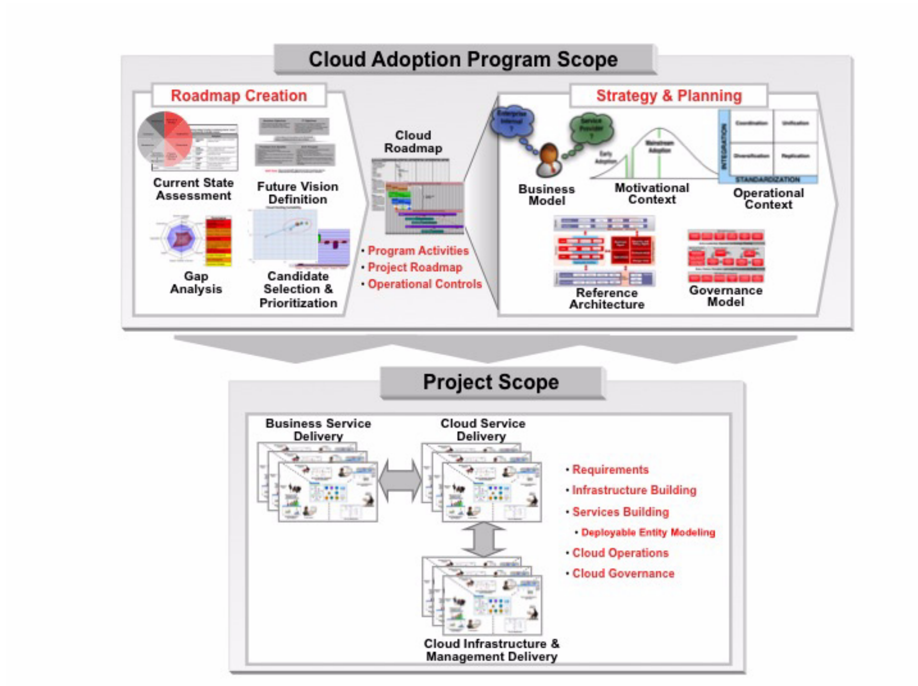
1.1 Cloud Roadmap Purpose

A Cloud Roadmap guides the strategic direction for Cloud adoption within an organization. The roadmap is the framework within which any single project can contribute to the overall goal, safeguarding against deviation from the plan. It provides guidance to the Cloud adoption efforts, allowing multiple projects to progress in parallel yet remain coordinated in pursuit of a common target that provides value greater than the sum of the individual projects. The Cloud Roadmap consists of two fundamental scopes of activity:

- Program-level efforts to establish a framework and guidance to achieve a common goal
- Projects that build specific cloud capabilities, unified by the program level assets

The relationships between these two fundamental scopes are illustrated in Figure 1–1.

Figure 1–1 Components of a Cloud Roadmap and their relationships



The program-level efforts define the overall approach and create the unifying assets that are leveraged across all of the individual projects. Examples include the evaluation of Motivational and Operational Contexts for the Cloud initiative, the Cloud Reference Architecture, governance policies, standards, engineering methods, and the roadmap itself. The program level efforts provide and enforce the necessary consistency required to succeed at Cloud adoption.

Specific individual projects form the route to realizing the desired Cloud capabilities and Cloud Architecture, and delivering measurable business benefit. The projects are chosen according to expected business benefit and risk. Initial projects drive the Cloud infrastructure build-out and identify the important cloud capabilities to deliver first. Follow-on projects leverage the Cloud infrastructure and early capabilities. Business value should be increasingly apparent as individual projects are completed.

When multiple Cloud services are targeted, Cloud adoption efforts should be separated into distinct projects for implementation of Cloud physical infrastructure and management, and the development of Cloud services. Further, it is typically useful to separate the development of Cloud Application services from the development of supporting Infrastructure and Platform services. This allows the foundational infrastructure projects to focus on creating a robust cloud infrastructure and platforms that meets the needs of multiple application and business process Cloud services. Of course, projects for building these layers of services should not be taken on in isolation. In particular, projects for implementing cloud physical infrastructure should focus on selecting the most appropriate building blocks to support the targeted cloud services that are relevant and valuable to the organization. Therefore, program level efforts should consider key implementation projects holistically from the outset.

The methods described in this series assume that most enterprises will eventually operate in a hybrid cloud model, i.e., a combination of private and public cloud services will prove to be the best approach to meeting the changing needs of the business.

1.2 Oracle's Approach to Cloud Adoption

Cloud Computing is not a specific product or set of technologies. Cloud Computing manifests itself uniquely in every organization. The approach to achieving Cloud is unique for every enterprise. Consequently, a one-size-fits-all roadmap to Cloud is not possible. The guidance in this document, therefore, is not an end-to-end prescriptive process, but a flexible approach made up of useful steps that can be combined to suit the situation.

Oracle's approach to Cloud adoption is not a linear process. A stepwise prescription is not appropriate for the diverse goals, priorities, and constraints involved in Cloud adoption for most organizations. The approach described here is nonlinear and flexible, and intended to simplify the creation of a roadmap tailored to the needs of a specific organization. It employs tools and frameworks that are informed by and consistent with recognized IT models and business strategy frameworks. Its methods are compatible with and complementary to established methodologies such as Unified Process (UP) and The Open Group Architecture Framework (TOGAF®).

The approach assumes that Cloud adoption, in some form, is inevitable. I.e., under no circumstance does the roadmap lead to non-implementation of Cloud Computing. In order to be most effective, the approach also assumes that a thorough appraisal of the following questions takes place in the course of developing an appropriate roadmap:

- How does Cloud adoption improve my business? (Drivers and Benefits)
- How does Cloud adoption challenge my business? (Inhibitors)

Methods are described to facilitate answering these important questions, and then focus efforts accordingly. The priority and ordering of key architectural decisions, and the priority and scope of key organizational transformations are strongly influenced by the answers to these questions.

As described in section 1.1, Oracle's approach consists of Program Level and Project Level activities. The objective and structure of each of these levels is explained below.

1.3 Program Level

The scope of Program Level efforts for Cloud adoption spans three focus areas. These focus areas provide a framework for development, delivery, and operation of enterprise IT.

- **Envision** - deals with development and maintenance of enterprise level IT strategy, architecture, and governance. Envision activities assist in the transition from enterprise-level planning and strategy to the identification and initiation of specific projects. Envision activities are the focus of this document.
- **Implement** - contains project level activities for building Cloud infrastructure and Cloud services. The Implement focus area is aligned with the Cloud adoption program through artifacts produced in the Envision focus area, and is focused on delivering the capabilities defined in Envision. Implement activities are detailed in the related documents, *Building Cloud Infrastructure, Building Infrastructure and Platform Cloud Services*, and *Building Cloud Application Services*.
- **Operate** - describes the new and novel processes and procedures essential to the reliable operation of Cloud infrastructure and services. The Operate focus area is the culmination of the Cloud adoption program. Ongoing management and operation, as well as continuous improvement of the running Cloud environment is the objective of the Operate focus area. Operate activities are detailed in the *Cloud Operations* document.

The structure and content of these three focus areas are derived from the Oracle Unified Method (OUM), and share the same five core principles of that method, which are:

- Iterative and Incremental
- Business Process and Use Case-Driven
- Architecture-Centric
- Flexible and Scalable
- Risk-Focused

In addition to these principles common to robust technology initiatives, another principle, essential to any enterprise-wide shared service or consolidation program, is the synthesis and alignment of various requirements from across the enterprise for sharing resources. The methods described in the Implement focus area embody this principle, and are typical of a functioning Enterprise Architecture practice.

Creating a Cloud Roadmap involves Program Level activities contained within the Envision focus area, while Project Level activities occur primarily in the Implement focus area. An overview of the project level activities is provided in section 1.4.

1.4 Project Level

Cloud implementation is conducted through multiple projects. Oracle's approach to implementation involves three types of projects: building Cloud infrastructure, building infrastructure and platform Cloud services, and building business application Cloud services. Each of these project types follows the iterative phases described below.

1.4.1 Implementation Phases

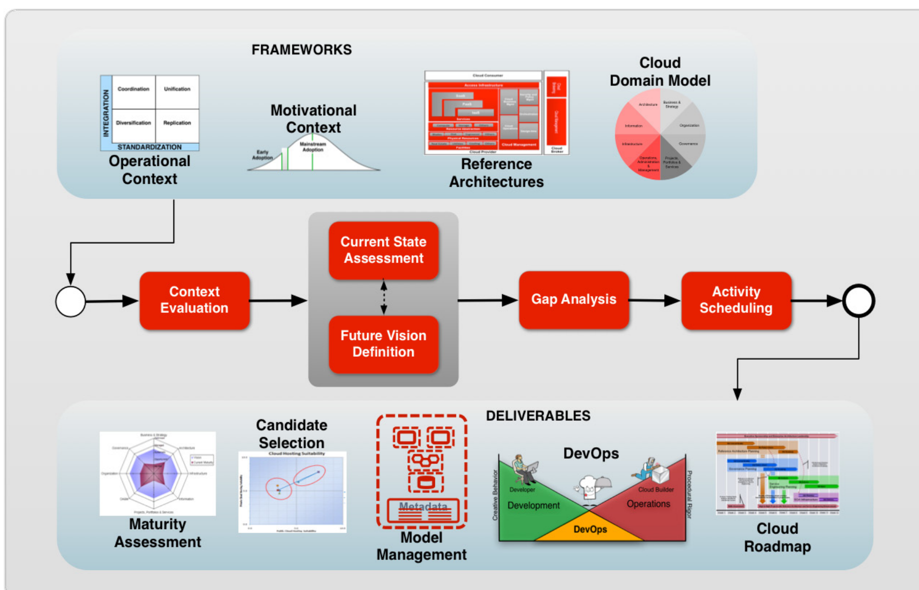
1. Inception - the goals of the Inception phase are to analyze the project requirements, define use cases related to the project, define the scope and boundary conditions for the project, define the initial project schedule and resource requirements, and produce a conceptual architecture that addresses the project requirements and use cases. The Inception phase must also identify which requirements are common and which are distinct from across the organization, and then align or reconcile these requirements according to the program level guidance and roadmap.
2. Elaboration - this phase elaborates the requirements and uses cases, and produces logical diagrams of the architecture. Elaboration includes activities to identify and address risks to the project.
3. Construction - the Construction phase produces a testable system that is expanded and refined through multiple iterations until a complete system that fulfills project requirements is ready for release to users of the system.
4. Transition - the Transition phase releases the system to its users and may include user training. Issues identified by the users are addressed through additional refinements, fixes and release iterations.

2

Roadmap Creation Process (Envision Focus Area)

The majority of effort in the Envision focus area is concentrated on creating a roadmap for Cloud adoption specific to a given organization. As shown in Figure 2–1, there are five main phases in the roadmap creation process: Context Evaluation, Current State Assessment, Future Vision Definition, Gap Analysis, and Activity Scheduling.

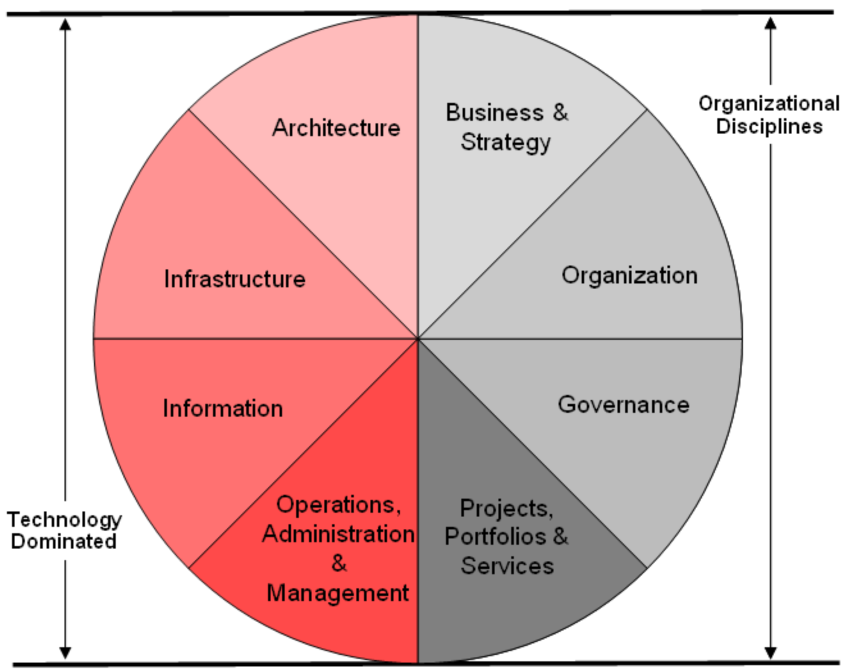
Figure 2–1 Highlights of the Roadmap Creation Process



A series of input frameworks and example deliverables are also depicted in Figure 2–1, each of which is critical to one or more of the five phases of the process. The purpose of the frameworks and deliverables, and how they are used and produced in each of the phases is described in the next section.

One of these frameworks is used throughout the roadmap creation process: Oracle's Capability Domain Model. It is a classification framework for organizing related IT capabilities. Each of the eight domains in the model represents a collection of capabilities essential to the discipline associated with the domain. See Appendix B, "Cloud Maturity Model" for a detailed description of the domain model and how it is used to assess maturity of IT capabilities. Figure 2–2 shows the eight domains in the model.

Figure 2–2 The Capability Domain Model



The process for creating a Cloud roadmap applies the domain model to focus effort on those capabilities that are most important for useful analysis and effective planning. Many of the planning activities described in the process contain guidance on which domains warrant primary focus or extra attention.

2.1 Context Evaluation

Organizations approach Cloud Computing in a variety of contexts. These contexts, together with the specific problems to solve with Cloud Computing, make up the forces driving Cloud adoption. Before defining architecture or prescribing solutions for a Cloud Computing initiative, it is important to evaluate the context - what are the organization's expectations from Cloud, and what drives the investment; what role will central IT play in the consumption and delivery of Cloud services; what are the operating model characteristics that must be reflected in the Cloud architecture? Another important question, often overlooked in the adoption of Cloud, is "What can Cloud offer to the business?" Evaluating the context for Cloud adoption, then, entails representing the range of viewpoints having a stake in the outcome of Cloud adoption. As the first step toward a vision that is realizable and aligned to the needs of the organization, we examine the motivational and operational contexts for the Cloud initiative.

2.1.1 Motivational Context

The motivational context for cloud adoption should be established early in the development of the Cloud roadmap. The vision and general goals for the Cloud effort are interpreted and refined in the context of the motivations leading to investment in Cloud. Core to the motivational context are four dimensions:

1. Business Model
2. Business Drivers
3. Project Control
4. Technology Adoption

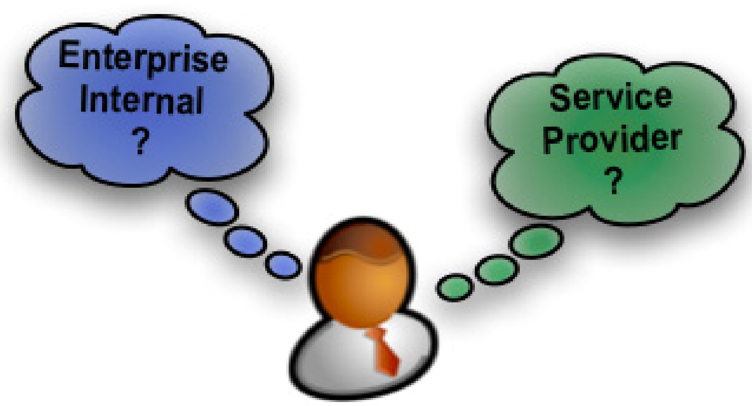
These dimensions and their impact on roadmap creation are described below.

2.1.1.1 Business Model

Is the Cloud for internal needs (Enterprise-Internal) or commercial offering (Commercial Cloud Service Provider), or both? These fundamental questions are answered categorically, i.e., yes or no for each the two business models. The answers infer certain critical objectives for the Cloud roadmap.

Most established organizations are focused on an Enterprise-Internal Cloud, but increasingly, Cloud adoption compels organizations to envision new business models for IT in which internal Cloud services make possible new revenue opportunities by providing the platform for external services. For example, if an enterprise possesses a market leading business process, it may find a new revenue stream in delivering this process by becoming a Commercial Cloud Service Provider (CCSP).

Figure 2–3 The Cloud Business Model - Commercial Cloud Service Provider or Enterprise-Internal Cloud?



Determination of the basic business model for the Cloud may require examination of certain distinguishing characteristics of the two models. Some of these characteristics, along with strategy and planning considerations, are described below for each of the models.

2.1.1.1.1 Enterprise-Internal Cloud

When evaluating the motivational context it is important to distinguish internal needs from internal capabilities. A Cloud business model focused on the internal needs of the enterprise may obtain certain essential capabilities from a separate CCSP. An

Enterprise-Internal Cloud business model may include the use of services from a CCSP, and therefore is not the same as a private Cloud.

When the motivation for obtaining Cloud Computing capabilities is primarily focused on improving internal operations, then the following strategy and planning considerations should be taken into account in the roadmap:

- Specify multi-tenancy for optimal efficiency.
- Set quality objectives and metrics
- Choose technology standards according to internal interoperability needs.
- Measure service for assessing value and allocating costs.
- Manage capacity according to needs of the business.
- Identify which internal IT systems to integrate with the Cloud environment.

2.1.1.1.2 Commercial Cloud Service Provider

If investment in Cloud is motivated by the expectation of direct revenue from IT services made available to external users then the roadmap should address:

- Design multi-tenancy to optimize for tenant security and isolation; for high-volume and narrow margin services, design may also include a model for oversubscription.
- Choose technology standards according to interoperability needs of the market served.
- Measure service for billing purposes - transparent and auditable; for pay-for-use model accurate metering of actual resource usage is likely necessary.
- Identify requirements for integration with back office systems and business operations.
- Manage capacity according to market demand.
- Analyze potential need for federation of identity management.

2.1.1.2 Business Drivers

The business drivers leading to IT investments are as varied as the organizations making the investments. Typically, these drivers spring from a motivation to either save costs or to increase business agility. Understanding what an organization expects from the Cloud initiative broadly in terms of efficiency and business agility is an important consideration in making design tradeoffs and in constructing a roadmap for Cloud adoption.

Cloud Computing projects motivated by potential cost savings and increased efficiency are generally more tactical in nature and may have a return on investment target expressed as expense reductions. In this case, a common approach is to increase asset utilization through consolidation of workloads onto less costly infrastructure. In contrast, business agility improvements, such as acceleration of product development and faster response to market conditions, are the kinds of strategic motivations typical of strategic investments in Cloud Computing. Whether efficiency or business agility is the primary motivation for the Cloud project will affect the approach. For example, Cloud projects focused on efficiency may initially plan to consolidate applications onto shared infrastructure, whereas an agility-focused plan is more likely to introduce higher levels of automation early in the project.

Is the goal cutting costs or gaining agility? The answer to this question is rarely categorical. Most organizations expect to achieve both in some measure. In order to determine where the priority for a given organization is placed on this spectrum, certain distinguishing characteristics should be considered. These characteristics, along with strategy and planning implications, are described below for the two ends of this spectrum.

2.1.1.2.1 Cost Savings

Cloud initiatives focused on resource efficiency, increased asset utilization, and reduced IT expenses should address the following in the roadmap:

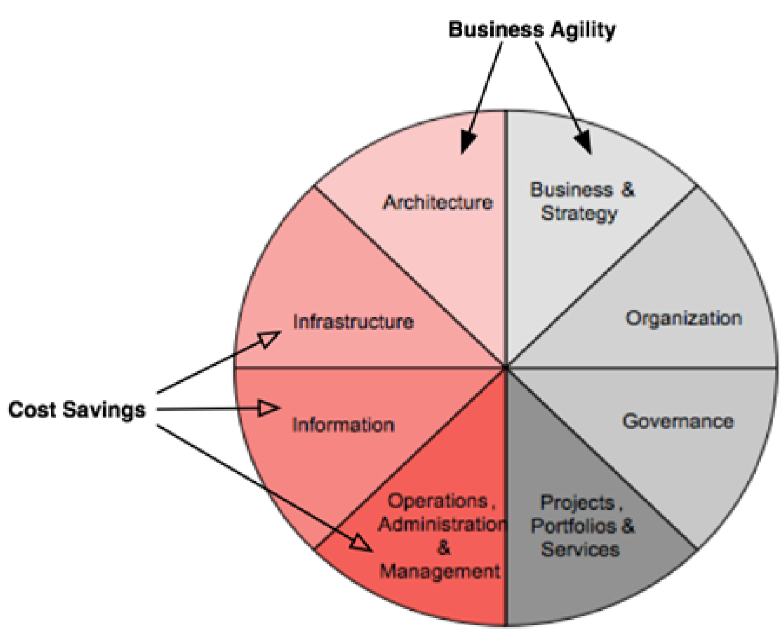
- Understand the real costs connected to the environments and applications that will be replaced or improved by the Cloud initiative. Use these costs to help drive the business case for Cloud, and to measure progress toward the cost savings goal.
- Early focus on resource pooling and consolidation to enable shared infrastructure and shared services.
- Evaluation of public Cloud services for replacement of inefficient or costly internal services.
- Initial focus on Infrastructure, Information, and Operations, Administration and Management domains.

2.1.1.2.2 Business Agility and Innovation

Cloud investment focused on agility and enabling innovation through accelerated product development and better responsiveness to changing market conditions should address the following in the roadmap:

- Focus early on higher levels of automation.
- Initial focus on Business Strategy and Architecture domains.

Figure 2–4 Business Drivers help determine where to focus efforts



2.1.1.3 Project Control

Control and responsibility for IT projects most often lies with the IT department today. However, this orientation is shifting toward more control in the hands of lines of business and enterprises' operating units. This shift reflects a 'consumerization' of IT, and Cloud Computing's self-service, ubiquitous access, and pay-for-use features enable that shift. Frequently, IT's overt position of control has not been adjusted to reflect the business reality of simple and direct access to public Cloud services by business units and workers. This commonly leads to 'shadow' IT, which carries potential security risks and unnecessary expenditures.

Where the actual authority and control for a Cloud project lies within an organization affects many aspects of the approach to the project. Questions such as how resources are shared, how data protection policies are enforced, and how expenses are controlled, are answered differently depending on whether a central IT department controls projects, or control is distributed among the business consumers of IT. The balance of Cloud project control is a critical dimension that figures prominently in the Cloud roadmap.

A related question arises in the case of business controlled Cloud projects: what level of the business is responsible for the project? The IT departments' traditional responsibilities of ensuring security, managing service levels, controlling costs, and vetting technology providers, etc. still need to be carried out. Are these duties conducted centrally or distributed to the parts of the business that control Cloud projects?

Who controls cloud projects? The answer may be categorical, i.e., Lines of Business, or Central IT, but often is a matrix of influences involving multiple levels of decision-making and funding sources. The makeup of this matrix can be understood through examination of certain characteristics. These characteristics, along with strategy and planning implications, are described below for the two common control scenarios.

2.1.1.3.1 IT Controlled

If project control and responsibility for Cloud adoption lie with IT, and IT has decision authority for budget, and resource allocation, then the roadmap should address:

- Project prioritization to deal with competing demands for limited IT resources.
- Mechanisms by which business will adopt Cloud services provided by (or brokered by) the IT organization, and whether a commercial relationship between IT and the business is called for.

2.1.1.3.2 Business Controlled

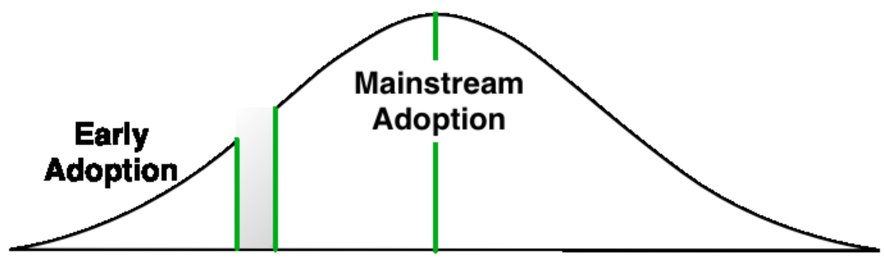
If the budget and priorities for Cloud adoption are controlled by the business and the business unit has decision authority for budget, and resource allocation, then the roadmap should address:

- Clear delineation of which project responsibilities lay with the business and which lay with IT.
- Determination of what level of business has project authority (e.g., CFO / enterprise-wide authority, business unit leaders / line of business authority)

2.1.1.4 Technology Adoption

Technology adoption practices reflect an organization's tolerance for risk as well as its expectations of technological leverage to be gained in the market. Innovators and early adopters will routinely accept a higher degree of risk in terms of the viability or reliability of a given technology in order to gain first mover advantage. Mainstream adopters wait until a technology goes mainstream before introducing it into their own environment so as to avoid the kinds of risks assumed by early adopters. While early adoption has the potential to produce real market advantage, success with this strategy is not assured. In fact, many innovative technologies fail to reach mainstream adoption, which may expose early adopters to problems of reliability as well as a negative return on investment.

Figure 2–5 Technology Adoption Curve (adapted from Geoffrey Moore's Crossing the Chasm)



Whether an organization leans toward early adoption or mainstream adoption can be gauged simply by reviewing the existing technology portfolio. A portfolio dominated by mainstream products and technologies indicates a mainstream adoption bias. A portfolio that includes many products from new companies or unproven technologies indicates a bias toward early adoption. Mainstream adoption practices affect the approach to Cloud projects by following another organization's or industry's lead, and involves minimal levels of innovation. A strong preference for early adoption leads to an approach that accepts certain significant risks and accounts for the prospect of failure.

What is the appetite for adoption of specific advanced cloud features such as Virtual Data Centers (VDC's) and model driven deployments? The answer sometimes depends on which part of the organization you're asking, but generally organizations are innovating with information technology or they're not. Some of the characteristics and implications of the technology adoption profile are described below.

2.1.1.4.1 Early Adoption

When an organization moves to adopt advanced Cloud technologies and services before the rest of its industry and most peers in order to gain competitive advantage then the roadmap should address:

- Increased need for contingency plans and risk mitigation.
- Training for users and/or operators on related new technologies.
- Business Strategy and Architecture domains first.

2.1.1.4.2 Mainstream Adoption

When an organization waits for its industry and peers to adopt cloud first in order to avoid risks associated with technology viability and reliability, then the roadmap should address:

- Sourcing efforts to obtain Cloud technologies and services from trusted suppliers with established installed bases.
- Leveraging the lessons and know-how from experienced Cloud practitioners.

- Governance, Organization, and Project, Portfolios and Services domains first.

2.1.2 Operational Context

The operational context for cloud adoption should also be established early in the development of the Cloud roadmap. The parameters and constraints of the existing operation must be accounted for in the roadmap. Adjustments to operational structure and processes may be necessary in order to successfully adopt a Cloud model.

Determination of the operational context is supported by a framework consisting of three dimensions: (1) Business Process Integration and (2) Business Process Standardization, which together determine the organization's Operating Model, and (3) the Operational Role of IT. These dimensions and their impact on the roadmap are described below.

2.1.2.1 Operating Model

Enterprises are differentiated by, and often defined by, their business processes; an enterprise's operating model is a reflection of its business processes. The operating model is comprised of two dimensions: The level of standardization and level of integration found in an enterprise's core business processes[1].

2.1.2.1.1 Business Process Standardization

Standardization of process can produce significant efficiencies and improve predictability for an operation, but may limit business units in their ability to operate autonomously. High levels of standardization tightly constrain processes and leave little room for diversity between departments, business units, and geographic regions. However, common standards reflect an ability to leverage innovations across business units, and typically affords a consistent customer experience globally Low levels of standardization allow for diversity and supports adaptation to local business conditions, but are also accompanied by redundancies, which carry overhead expense.

Enterprises that support diverse processes with minimal standards across the businesses may find it difficult to introduce Cloud Computing as a shared service across the enterprise. In this case, a Cloud environment tailored to the needs of a specific operating unit may be more tenable. Enterprises that employ common processes across operating units may be able to parlay the high level of standardization into widely adopted Cloud services that support these processes.

2.1.2.1.2 Business Process Integration

Process integration can accelerate operations and help organizations capitalize on synergies among its operating units. An enterprise that relies on highly integrated processes can coordinate complex operations reliably and efficiently, yet affords relatively autonomous operations across business units. Low levels of process integration hinder coordination across business units, but independently operated business units and centralized operations are not necessarily held back by lack of process integration.

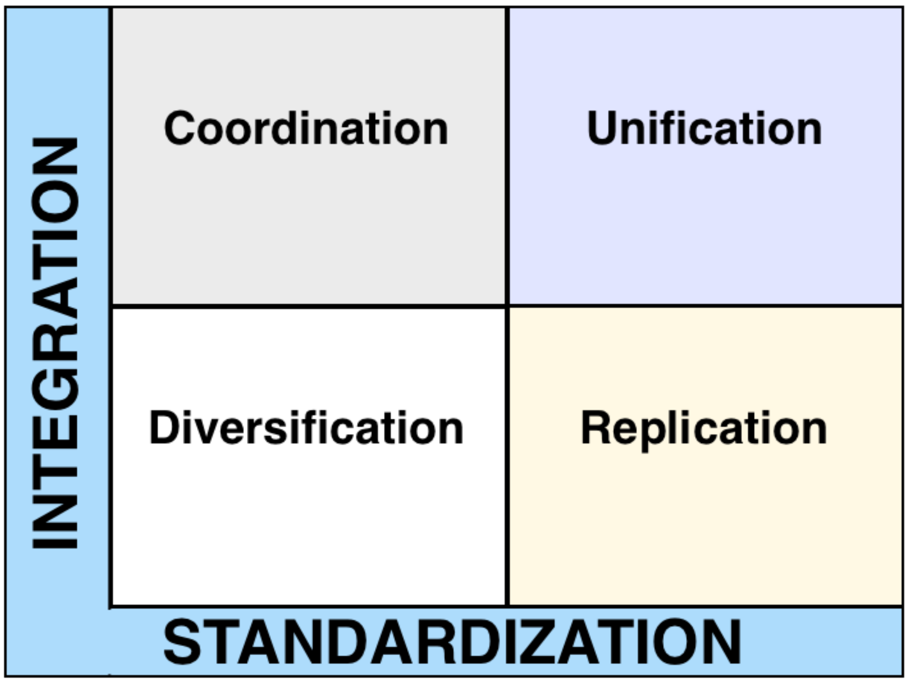
The level of process integration is fundamental to how an enterprise operates. The approach to Cloud adoption should reflect this. For example, highly integrated processes may benefit from running on highly integrated platforms. A Platform-as-a-Service (PaaS) model, which can facilitate data sharing across processes,

[1] *Enterprise Architecture as Strategy: Creating a Foundation for Business Execution*, Jeanne W. Ross, Peter Weill, David C. Robertson

may be advisable in this case. Low levels of integration may indicate reduced emphasis on infrastructure sharing and programmatic control in the Cloud in favor of robust self-service capabilities.

What level of business process integration and standardization? It is useful to address this question as an intersection of the two dimensions. Ross, et al, have devised a convenient quadrant system representing the categories of operating models that compose this intersection, as depicted in Figure 2–6.

Figure 2–6 Four Categories of Operating Models



The characteristics and roadmap implications for each of the four operating models are described below.

2.1.2.1.3 Diversification

Business units within companies operating in a Diversification model share few, if any, customers or suppliers; they conduct mostly independent transactions, and manage their business autonomously. In this operating model few data standards between business units exist, and IT functions are frequently replicated within each business unit. The roadmap for Cloud adoption in these organizations should address:

- Determination of which, if any, Cloud services will be shared across business units.
- Optimization for business process efficiency.
- Projects, Portfolios and Services, and Business and Strategy domains first.

2.1.2.1.4 Replication

Companies operating in a Replication model also have few, if any, shared customers; transactions are aggregated at a high level, and business units manage operations mostly autonomously within the constraints of standardized business processes. IT services in a Replication operating model are centrally defined, but many of the services may be operated autonomously. The roadmap for organizations with this operating model should address:

- Robust standards for services and service interfaces, data definitions, and operational controls.
- Aggregation of autonomous processes.
- Governance and Architecture domains first.

2.1.2.1.5 Coordination

A Coordination operating model is characterized by shared customers and products or suppliers across business units that are operationally unique. Business units maintain control over business process design. The roadmap for organization with this operating model should address:

- Systems for sharing customer, product and supplier data.
- Consensus building across business units for designing Cloud services.
- Information and Architecture domains first.

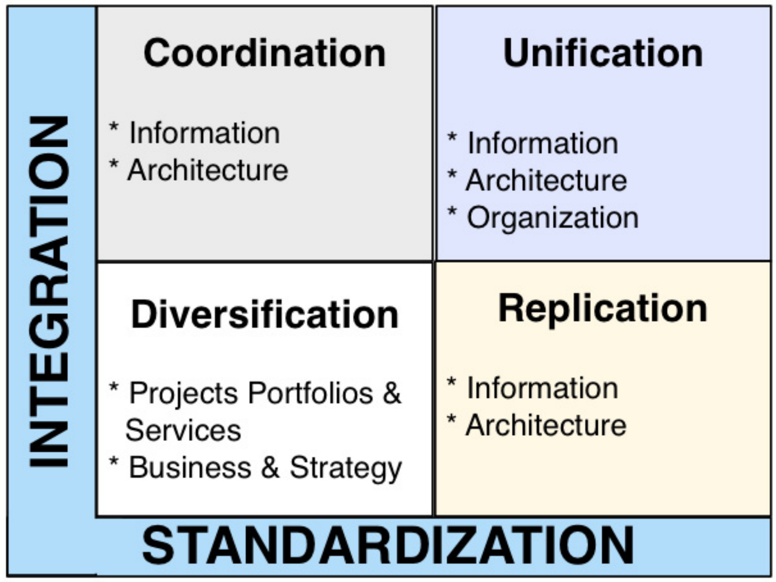
2.1.2.1.6 Unification

Organizations operating in a Unification model have globally integrated business processes and centralized IT services. For this operating model, the roadmap should address:

- Centralized design process with balanced stakeholder representation.
- Processes for defining technology and services standards.
- Process for identifying and addressing integration needs.
- Architecture, Information, and Organization domains first.

Figure 2–7 summarizes the domain model focus areas for creating a roadmap suited to each of the four operating models.

Figure 2–7 Domain focus for each of the four operating models



2.1.2.2 IT's Role

Most IT departments are organized as a cost center to support business operations. Functioning as a cost center necessitates cost allocation schemes and processes for liaising with the internal business consumers of IT. In cases where IT capabilities are core to the organization's products and services, however, much of the IT department's traditional function merges with the business. As IT becomes more integral to a functioning enterprise, the business model for IT may shift away from operating as a separate support function and toward an integrated model where IT and business are organizationally indistinguishable. The implications of the business model for IT affect multiple aspects of the approach to Cloud Computing. Take pricing and service level management, for example: In organizations where IT exists strictly as a support function, pricing of Cloud services are more likely to be set on a cost recovery basis and service levels are managed according to business need. When IT is integrated with business units and its services are delivered directly to customers, pricing of services may be set on a gross margin basis or according to market rates, and service levels are more likely to be managed according to contractual obligations.

Does IT exist merely to support the business or is it moving toward IT as Business? This question is the operational complement to the business model question that informs the motivational context. IT always functions in a support role within a modern enterprise. The important question to address is whether IT will also generate revenue directly from the services planned for Cloud deployment. Characteristics for making this determination, as well as strategy and planning implications for the two categories of IT's role, are described below.

2.1.2.2.1 IT as Support

In enterprises that rely on IT only to support internal processes and internal customers, IT is typically run as a cost center and organizationally responsible to the CFO. For organizations where IT's role is limited to such a support function, the roadmap should address:

- Measuring service at level of precision for cost allocation
- Liaison with internal customers and users; supporting users according to business priorities
- Establishment of public Cloud service brokering capability
- Projects, Portfolios and Services, Operations, Administration and Management, and Infrastructure domains first

2.1.2.2.2 IT as Business

In organizations that rely on IT for its core products and services, revenue is produced directly by IT services delivered to customers. The Cloud roadmap for these organizations should address:

- Measuring service at level of accuracy and precision for billing purposes
- Service pricing according to market rates and margin expectations
- Supporting customers according to contractual commitments
- Integration with back office systems for billing, entitlement, and sales administration
- Business and Strategy, Architecture, and Operations, Administration and Management domains first

2.2 Current State Assessment

The Current State Assessment phase is focused on the existing IT environment that supports the platforms, applications, and business processes under consideration for migration to a Cloud Computing model. The goal is not to capture all the details of an IT environment's current state; rather it is to evaluate the current state relative to the capabilities that are required to successfully adopt Cloud.

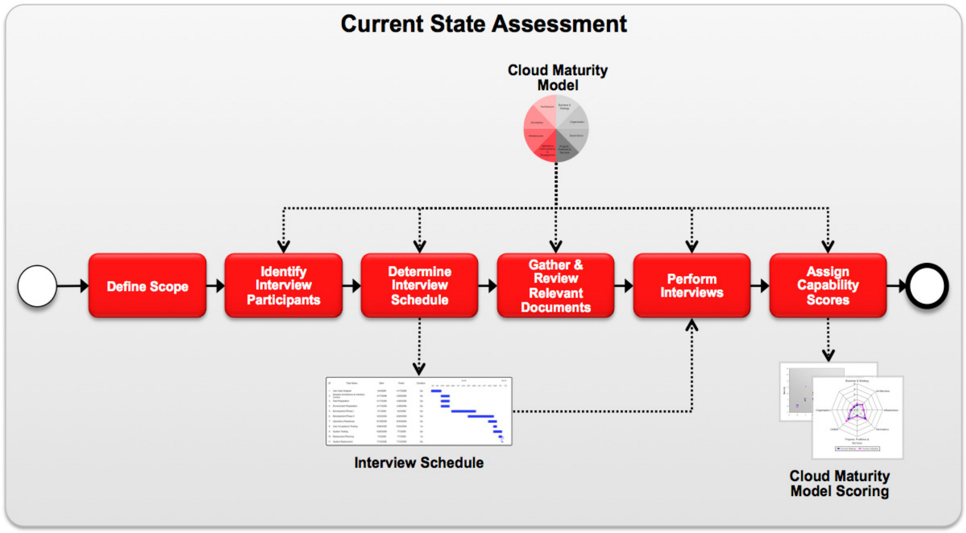
2.2.1 Overview

The current state assessment is based on the Oracle Cloud Maturity Model. (See Appendix B for a description of the Cloud Maturity Model.) The Cloud Maturity Model includes 60 capabilities that capture the best practices that Oracle has collected through the course of working with a variety of companies adopting Cloud and Cloud-related technologies. These capabilities provide the detail necessary to accurately measure and guide the progress of a Cloud initiative. Focusing the current state assessment on these specific capabilities ensures a focused scope for the assessment.

Further, the current state assessment should be tightly time-boxed to ensure timely completion of this phase. The size and complexity of an organization determines the actual amount of time that must be allocated to the assessment. Nominally, two weeks is the amount of time required.

An overview of the current state assessment process is shown in Figure 2–8.

Figure 2–8 Current State Assessment Process



2.2.1.1 Define Scope

Before beginning the actual assessment, it is vital that the scope of the assessment is determined and that all involved parties agree to the defined scope. For example, the scope could be limited to a single division or line-of-business within a larger enterprise. Or the scope could be limited to a single application being considered for cloud deployment. The scope defines both the scope of the assessment and, ultimately, the scope of the roadmap.

2.2.1.2 Identify Interview Participants

Once the scope has been determined, the participants in the assessment should be identified. The participants are chosen to ensure that all capabilities within the Cloud Maturity Model can be accurately scored. The following table describes the typical areas of interest and interview participants:

Table 2–1 Typical Interview Participants

Area of Interest	Typical Participant
Business Objectives	VP of Business Unit(s)
	LOB IT
IT Objectives	CIO
	VP of Application Development
	VP of IT Infrastructure
Enterprise Architecture	Infrastructure Architect(s)
	Enterprise Architect(s)
Program Management	PMO Manager
	Project Manager(s)

Table 2–1 (Cont.) Typical Interview Participants

Area of Interest	Typical Participant
Development Process	Application Architect(s)
	Business Analyst(s)
	Development Lead(s)
	QA Manager
Operations	Director of Operations
	Administrator(s)
	Change Managers
	Systems Administration Manager(s)
Security	Chief Security Architect
	Security Specialist(s)

2.2.1.3 Determine Interview Schedule

Once the interview participants have been identified, the next step is to create a schedule for when each participant will be interviewed. The duration of the assessment phase should be constrained; otherwise there is a tendency for the assessment, and interviews in particular, to be put off due to intervening priorities.

2.2.1.4 Gather and Review Relevant Documents

Before beginning the interview process, the assessment team should gather and review all the existing documents that describe various aspects of the current IT environment and Cloud initiative. This allows the assessment team to ask more focused questions in the interviews and also provides the opportunity to ask questions about the written material for clarification or to resolve conflicting information. The following list gives some examples of the types of documents that should be gathered and reviewed:

- Strategy Map (or similar business strategy/goals document)
- Enterprise Architecture Document(s)
- Project Management Handbook(s)
- Software Development Process Document(s)
- Operational Process and Procedures Document(s)
- Corporate Security Policies
- Organizational Structure Document
- Governance Policies and Procedures Document

2.2.1.5 Perform Interviews

Before each interview the assessment team should review the Cloud Maturity Model to identify capabilities that are particularly relevant for the person being interviewed. It is NOT recommended that the assessment team simply ask a question for each of the capabilities. Rather the interview team should ask open-ended questions that allow the interviewee to describe how things are currently done and to identify any problems that currently exists. Remember, the interviewees are the experts on what goes on within the organization being evaluated, so encourage them to explain the current situation.

2.2.1.6 Assign Capability Scores

Once the interviews have been completed and the documents have been reviewed, each of the capabilities in the Cloud Maturity Matrix should be scored for both maturity and adoption. These scores provide the raw data that can then be analyzed in the gap analysis phase of the roadmap creation process.

The Cloud Maturity Model includes a description for each level of maturity and each level of adoption for each capability. When scoring a capability, the scores selected should be the scores where the descriptions of maturity level and adoption level most accurately match the current situation based on the information collected in interviews and from the documents reviewed. Although there is always some level of subjectivity when measuring capability, the goal is to provide an objective measure. This allows future measurements to be performed by a different assessment team, yet still provide results that can be used to accurately measure progress.

Frequently when the assessment results are presented there are questions and even disagreements about the score that was assigned. Therefore, it is also important that in addition to the score, the assessment team also record the rational for assigning the maturity and adoption scores. This rational could include quotes from interviews or specific sections from the documents that were reviewed.

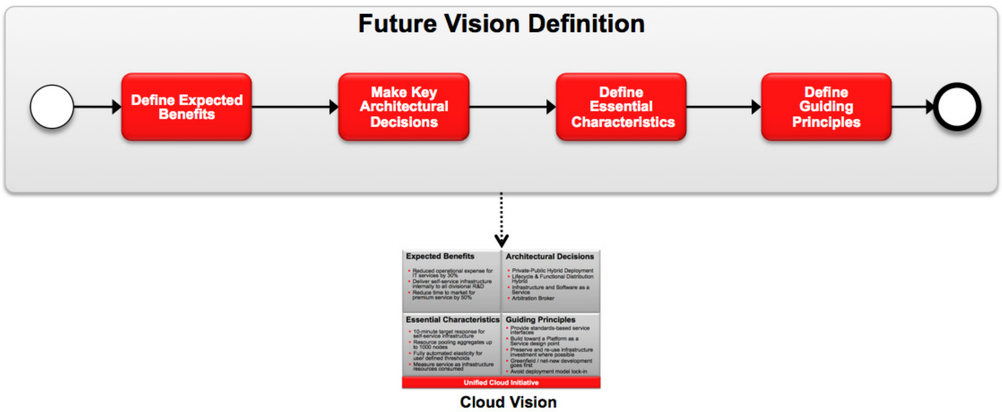
2.2.2 Output

The output of the current state assessment is the maturity and adoption score for each of the capabilities in the Cloud Maturity Model, along with charts to display the scores in relation to the domains in the model and to the dimensions of maturity and adoption. Additionally, the assessment team will have an understanding of the current state and should have collected known issues and problems that were identified and discussed during the interview process

2.3 Future Vision Definition

The Future Vision for a Cloud initiative consists of expected benefits, scope of benefits, target maturity level, key architectural decisions, essential characteristics, and guiding principles. Defining a vision for the future Cloud implementation requires a thorough understanding of the motivational and operational context for the Cloud initiative, as established in the first phase of the process for creating a Cloud roadmap described in Section 2.1, "Context Evaluation". The Future Definition phase does not attempt to define a comprehensive blueprint for the future state. Instead, it focuses on the expected benefits and key elements affecting the architecture that will be used to guide the Cloud initiative. The flow of the process for defining the Future Vision for Cloud is shown in Figure 2–9.

Figure 2–9 Process for defining Future Vision



2.3.1 Expected Benefits

When an organization has followed its Cloud roadmap to completion, certain benefits to the organization should be evident. What benefits are expected? The answers should readily derive from the motivational and operational contexts established in the Context Evaluation phase. For the purposes of creating a Cloud roadmap, expected benefits should be few in number (between two and four) and limited to the primary benefits being sought, and should be described unambiguously. Table 2–2 lists example expected benefits associated with Cloud Computing.

Table 2–2 Example Cloud Benefits

Reduced time to provision (applications, infrastructure, etc.) to less than one day
Reduced capital expense for IT systems by 50%
Reduced operational expense for IT services by 30%
Increased responsiveness to changes in market conditions by 50%
Reduced time to develop and release new services by 80%
Gain ability to deliver pay-for-use commercial Cloud services
Gain ability to deliver self-service infrastructure internally

Once the primary expected benefits are identified, the scope for these benefits should be defined. The scope can be stated in a variety of ways, such as organizationally, e.g., Media Campaigns Marketing Department, or Distribution Division; location specific, e.g., Northern Virginia Data Center; application classification, e.g., Business Essential Applications. The final scope might be an intersection of multiple scopes, e.g., Employee Portal Applications used by North American employees. Ideally one statement of scope will apply to the aggregate of expected benefits. Differences in scope between different expected benefits will complicate the planning and implementation efforts.

2.3.2 Key Architectural Decisions

This section describes the key architectural decisions typically made in Cloud adoption planning before implementation begins. Guidance on how to apply the findings from the Context Evaluation phase to the decisions is given.

2.3.2.1 Deployment Model

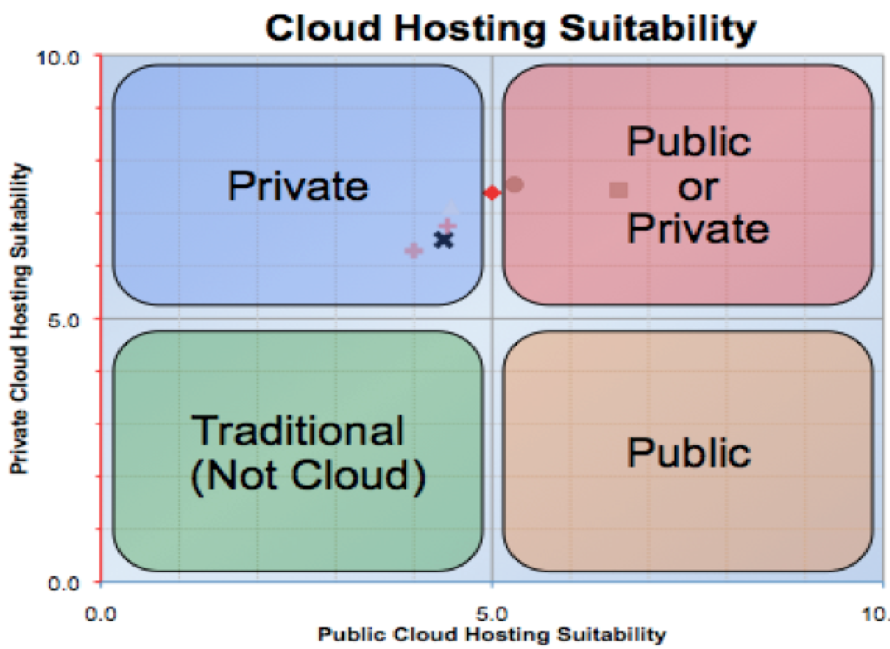
NIST defines four Cloud deployment models, each of which is found in operation broadly in different industry sectors.

- Private Cloud - Operated solely for a single organization.
- Public Cloud - Infrastructure, platforms or applications operated as Cloud service is offered to the general public or industry on a subscription or pay-for-use basis.
- Community Cloud - Shared by several organizations in a related 'community', e.g., academic research or industry.
- Hybrid Cloud - The Cloud is a composition of two or more Clouds (private, community, or public) bound together by data and application interoperability.

A successful approach to Cloud adoption needs to make a distinction between software components that are well suited to run in one of these Cloud deployment models and those that are not suited for Cloud. Candidate applications for cloud deployment should be analyzed in this context.

For established enterprise IT environments, it would be unrealistic to expect wholesale migration to any Cloud deployment model. Certain assets in the environment will lend themselves to migration better than others. Determination of what IT assets should be considered for a Cloud Computing environment, and then which deployment model is best suited for the asset, are critical considerations in the development of a roadmap to Cloud. Oracle has developed an evaluation framework, called the Cloud Candidate Selection Tool (CCST), to help IT organizations with this task. The framework computes Cloud suitability of candidate components by evaluating each against architecturally significant criteria, in the context of target usage patterns. Availability requirements, latency requirements, and statefulness of components are among the criteria considered in the evaluation. Figure 2–10 shows a chart from this framework, which is used to indicate which potential deployment model is most suitable for a given software component. Analysis with the CCST plots each of the components from an application, or application portfolio, into one of the four deployment models shown.

Figure 2–10 Cloud Candidate Selection Tool helps determine 'fit' at component level



Furnished with such an analysis, IT architects will likely identify clusters of components with corresponding patterns of criteria influencing the position and clustering relative to public or private Cloud deployment models. The framework also provides a basic indication of dependencies between components. IT architects can use this to identify potential areas of focus to mitigate those dependencies that may be hindering the (conceptual) deployment of an application to a target deployment model. See Appendix C for a description of the CCST and where to download the white paper, Cloud Candidate Selection Tool: Guiding Cloud Adoption on oracle.com.

This component-level analysis of the candidate workloads will help to paint a picture of which components should be targeted for Cloud deployment and in what order. The analysis will also identify which criteria most affect the architecture and which dependencies between components might prevent the desired usage pattern and deployment model for a given workload. Activities in the Implement focus area then specify strategies to account for the criteria in the architecture and to potentially address the offending dependencies between components.

2.3.2.2 Hybrid Model

A Hybrid Cloud is a composition of two or more distinct clouds (private, community, or public) bound together by standards for portability and consistency that enable service interoperability. Enterprise adoption of Cloud Computing typically involves some form of hybrid Cloud involving integration or interoperability between internal functions and public Cloud providers. The types of hybrid integration that occur generally fall into one of the following three hybrid models: Functional Distribution, Lifecycle Distribution, or Workload Distribution. In the following sections, each of the three models is described in terms of relevant Use Cases, typical Architectures, and Interoperability strategies.

2.3.2.2.1 Functional Distribution

The Functional Distribution hybrid model separates components of a business process into distinct deployment environments. Customer facing applications, back office applications, and fulfillment processes might each be run in a different cloud, optimized for performance, security, scalability, and cost. Separation may occur at varying levels of component granularity.

Figure 2–11 Functional Distribution hybrid model - Which applications and components go where?

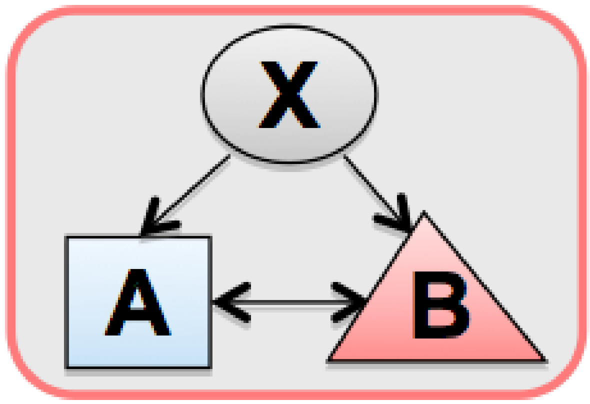


Table 2–3 Functional Distribution hybrid model

Uses Cases	Different components of a single business process or application in separate clouds (e.g., CRM, HR)
	Leverage best of breed services with private cloud needs
Architectures	Loosely coupled (e.g., CRM, HR)
	Tightly coupled (e.g., CRM / Billing and Revenue Mgmt.)
Interoperability	Business process coordinated through distributed applications
	Key interoperability strategy: Standardization

2.3.2.2.2 Lifecycle Distribution

The Lifecycle Distribution hybrid model separates stages of the software lifecycle into distinct deployment environments. Development, test, and production might each be run in a different cloud, optimized for release process efficiency and resource utilization efficiency.

Figure 2–12 Lifecycle Distribution hybrid model - Which stages of SDLC go where?

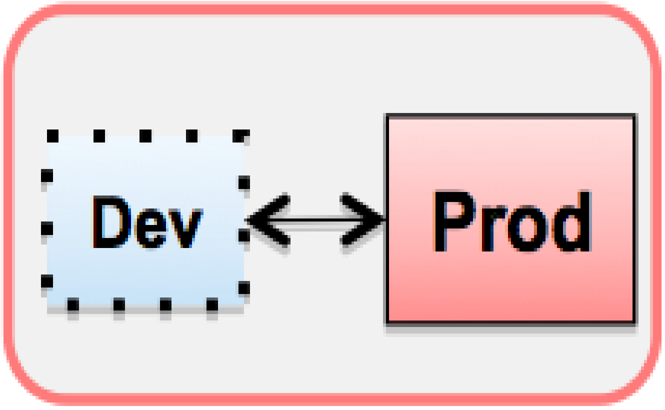


Table 2–4 Lifecycle Distribution hybrid model

Uses Cases	Ephemeral development and functional test workloads are deployed to a public cloud, while production workloads are deployed in a private cloud model.
Architectures	Occasional release (e.g., Once a Year / Quarter)
	Frequent release (e.g., Once a Week / Day)
Interoperability	Promotion from one stage of SDLC to the next is facilitated by common tools and interfaces for packaging and provisioning.
	Key interoperability strategy: Portability

2.3.2.2.3 Workload Distribution

The Workload Distribution hybrid model separates baseline workload from excess workload during peak demand periods and routes the excess workload to temporary pay-for-use cloud services. Demand patterns characterized by infrequent, short lived, and unpredictable peaks might be candidates for distribution of baseline and excess workloads to different clouds.

Figure 2–13 Workload Distribution - Which workloads / demand patterns go where?

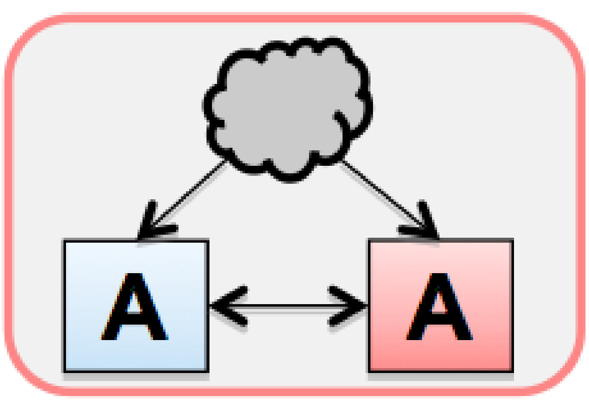


Table 2–5 Workload Distribution hybrid model

Uses Cases	"Cloudbursting"
	More challenging for complex enterprise transactions
Architectures	Explicit offload to single cloud
	Brokered offload with arbitrage across multiple clouds (see Section 2.3.2.4, "Broker Type")
Interoperability	Identical processing spread over multiple clouds.
	Key interoperability strategy: Synchronization / Consistency

2.3.2.3 Service Model

The NIST grouping of Cloud Computing service models into three layers - Software as a Service, Platform as a Service, Infrastructure as a Service - is a widely accepted representation of the predominant implementations of Cloud Computing today. The concept of layered service types is not rigid, but the distinction between the three service models is unambiguous. Simple definitions of the three models are:

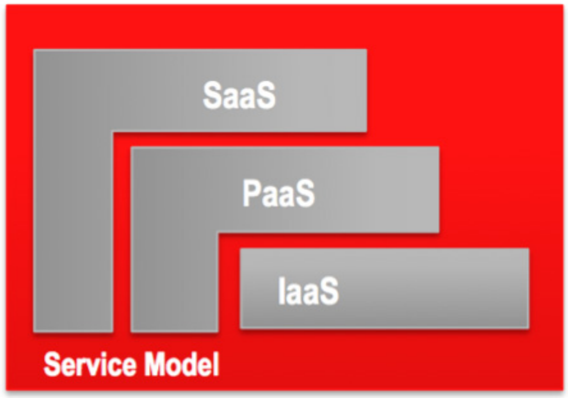
Software as a Service (SaaS): Consumers use applications running on a Cloud infrastructure. The SaaS provider manages or controls the underlying software and infrastructure. Relative to the other lower layer service models, functionality of SaaS offerings is less flexible by design, but what it lacks in flexibility it aims to make up in direct value to its users.

Platform as a Service (PaaS): Consumers use programming languages and tools supported by the PaaS provider and then control the deployed application. PaaS is designed to provide the necessary capabilities to allow developers to focus on the higher value activities of building and delivering applications while leaving the configuration and management associated with the underlying platform to the provider.

Infrastructure as a Service (IaaS): Consumers deploy and run arbitrary software, and requisition from the IaaS provider the needed compute, storage, and networks to do so. IaaS is designed to allow consumers choice of technology for the entire stack above the hardware, while eliminating the complexity of management of the physical infrastructure.

Figure 2–14 depicts the three service models in relation to each other. The layering in this depiction indicates that higher-level service models can be implemented upon lower level service models, e.g., PaaS on top of IaaS. Layering of service models is not essential, however, e.g., SaaS can be implemented without an underlying PaaS or IaaS model.

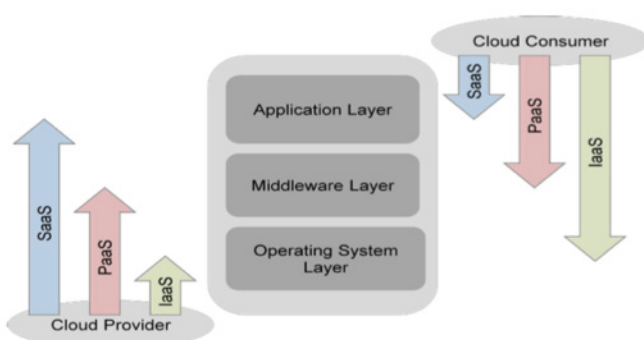
Figure 2–14 Predominant Cloud Computing Service Models



However, even in the case of SaaS, multiple service models may be involved. The delivery of a single software service may be built upon a PaaS environment that is shared by other SaaS offerings, which in turn may be built upon an IaaS environment that is shared by other PaaS and SaaS offerings.

For most enterprises, the choice of service model will derive primarily from business goals; particularly in the case of IT services to be provided commercially. If a business wishes to deliver a consumer application to mobile devices then their choice of service models would certainly include SaaS. SaaS may also be the right choice for a business that wants to consume a specific business application, such as CRM, from a service provider rather than deliver the service itself. In any case, the needs of both the Cloud service provider and consumer must be considered (as represented in Figure 2–15), and both must realize some benefit in order for adoption of Cloud to proceed as expected.

Figure 2–15 Service Models - What are the provider's and consumer's needs?



In addition to the business goals, and provider and consumer needs, other factors influencing choice of service model include:

Investment in virtualization - virtualized IT infrastructure established through the use of hypervisor technologies provides a starting point for incremental adoption of Cloud Computing. This approach conforms to an investment protection strategy and should enable quick implementation of hardware resource pooling, which is a fundamental IaaS capability. This approach also potentially represents less disruption to existing processes - it perpetuates the status quo for the development, release, and management of applications. Because this approach alone does little to eliminate complexity and delivers no new shared services other than pools of hardware, it often falls short of the transformational benefits represented by higher-level service models.

Commitment to technology standards - as described earlier in section 2.1.2.1.1, the level of process standardization has important implications for approaching Cloud Computing. The same is true for technology standardization. Organizations committed to a standard based on highly integrated technologies that comprise a 'complete stack' may not need the flexibility to support a diverse array of alternative technologies. In this case, the higher value capabilities of PaaS may be more readily attained. Conversely, flexibility to support diverse technologies may be necessary in environments where standards are difficult to establish and enforce. IaaS may be a more realistic goal for service model in this case.

2.3.2.4 Broker Type

Another key decision that ultimately affects the Cloud architecture is the type of broker capability needed to manage the demand for public cloud services. Most enterprises are finding that a growing number of services available from public cloud providers can meet many of their IT needs. The three types of Cloud service brokers are described below, along with the conditions and example scenarios where they are appropriate.

2.3.2.4.1 Intermediation

An Intermediation broker provides higher-level service by integrating specific capabilities with lower-level services consumed from a public Cloud provider. An Intermediation broker might build SaaS service on public IaaS. Organizations with strong software development capabilities and service delivery experience are in a position to broker service through Intermediation.

2.3.2.4.2 Aggregation

An Aggregation broker provides a unified management interface to multiple Cloud providers. An Aggregation broker might provide a common API for provisioning Java applications to cloud platforms from three different providers. Companies that want portability across multiple cloud providers may want to develop or use Aggregation broker capability.

2.3.2.4.3 Arbitration

Arbitrage of Cloud services involves continuous comparison of price for specific equivalent services available from multiple providers. An Arbitration broker can add value only when there is a market for the services being brokered, and as such is practical for only a narrow set of services today, primarily available in the IaaS service model. Companies that consume a large volume of commodity Cloud services such as compute and storage may benefit from Arbitration capability.

Implicit in the choice of broker type is another decision, related to the business model question from the Context Evaluation phase of the roadmap creation process, which is the choice of publicly provided service versus privately provided service. This decision is dealt with in the Implementation phase, and is not addressed directly in the roadmap creation process. However, minimal criteria for this decision will need to be defined in order to identify the broker capabilities to develop.

2.3.3 Scale, Velocity and Essential Characteristics

What characteristics are essential to the specific Cloud implementation? There are five characteristics described as essential for Cloud Computing by NIST (see Section 2.3.3.3, "Essential Characteristics"), but a pragmatic approach may place emphasis on certain of these characteristics and deemphasize others. Further, these characteristics must be interpreted in the context established earlier in the roadmap creation process and defined in a specific and measureable way. Scale and velocity are two key dimensions that should be used to add specificity and measurability to the definitions of these characteristics.

2.3.3.1 Scale

Scale refers to the magnitude or size of the Cloud under consideration, as well as the potential reach of the services it provides. Scale limitations are among the constraints imposed by specific technologies common to Cloud environments. For example, systems management tools that are designed to control and monitor 500 nodes from a central master may not be appropriate, or may require complex hierarchical architecture, for a 10,000 node Cloud environment. Technological constraints are best addressed early in the planning process. An Enterprise-Internal Cloud comprised of both private and public Cloud services for one autonomous division using mainstream technology may deem that a systems management limitation of 500 nodes is within the scale goal of their Cloud initiative. A larger Cloud may call for systems management technology that has greater horizontal scalability.

2.3.3.2 Velocity

Velocity refers to the rate of change and the rate of data processing in the Cloud environment. The frequency of service versioning, the polling rate of service levels, the latency between request and response, are all velocity considerations that must be factored into the specification of Cloud services.

2.3.3.3 Essential Characteristics

Specific scale and velocity factors should be used to define the NIST essential characteristics in a specific and measurable way that supports the vision for Cloud adoption.

- On-demand self-service - What does it mean to be "on-demand" and "self-service"? Is a sub-five-minute turnaround required for every request, or is it acceptable for a request form to be processed by a human who then initiates a review and, upon approval, commits the resources to provide the requested service within one week?
- Resource pooling - What is the size of a pool? I.e., how many resources can be aggregated in a single pool? Several factors must be considered when determining pool size, including the demand profile for the resource, the degree of resource transparency to the user, availability of technology to administer pools, etc.
- Rapid elasticity - How fast is "rapid"? Does the same velocity definition for on-demand self-service apply to elasticity? Further, what are the scale limitations for increasing capacity on a temporary basis? Are there policy limitations as well as technical limitations to the scale and velocity of elasticity?
- Measured service - Are both volume and duration of service measured? Once the units of measurement are defined, the frequency of measurement will need to be defined for certain metrics, and how are those metrics are used in cost allocation or billing must be defined.

- Broad network access - How broadly accessible do the services need to be? Are internal networks capable of providing access for all users in all regions to a given Cloud service?

2.3.4 Guiding Principles

The guiding principles are derived from the primary expected benefits and provide enforceable guidance to the Cloud initiative. The following table provides some example guiding principles.

Principle	Prefer Public Cloud
Statement	Only those services that cannot be consumed from a public Cloud provider will be deployed in private environments.
Rationale	For "commodity" and standard business services, commercial Cloud service providers can deliver greater efficiency and reliability due to their scale and experience.
Typical Context	IT as Support function, emerging Broker

Principle	Start green field
Statement	Avoid legacy systems and focus only on new services for Cloud deployment..
Rationale	Migration of legacy systems to Cloud are likely to take longer and involve more risk than building new services, which are not core to current operations and will help to build competence in Cloud Computing with minimal risk.
Typical Context	Agility focused, emerging Intermediary Broker

Principle	Preserve investment
Statement	Where possible, reuse existing capital and skills in the implementation of Cloud.
Rationale	Substantial and recent investments in IT systems and staffing are applicable to Cloud and should not be wasted.
Typical Context	Cost Savings focused

Principle	Opportunistic refresh
Statement	Preference for migration to Cloud is given to those applications or services that are due for upgrade, rearchitecture or other disruptive intervention.
Rationale	If changes or disruption to applications are already planned for upgrades, etc., then combining those planned changes with Cloud migration efforts, which likely also involve changes and disruption, will minimize total effort and disruption for the planned changes.
Typical Context	Coordination or Unification Operating Model

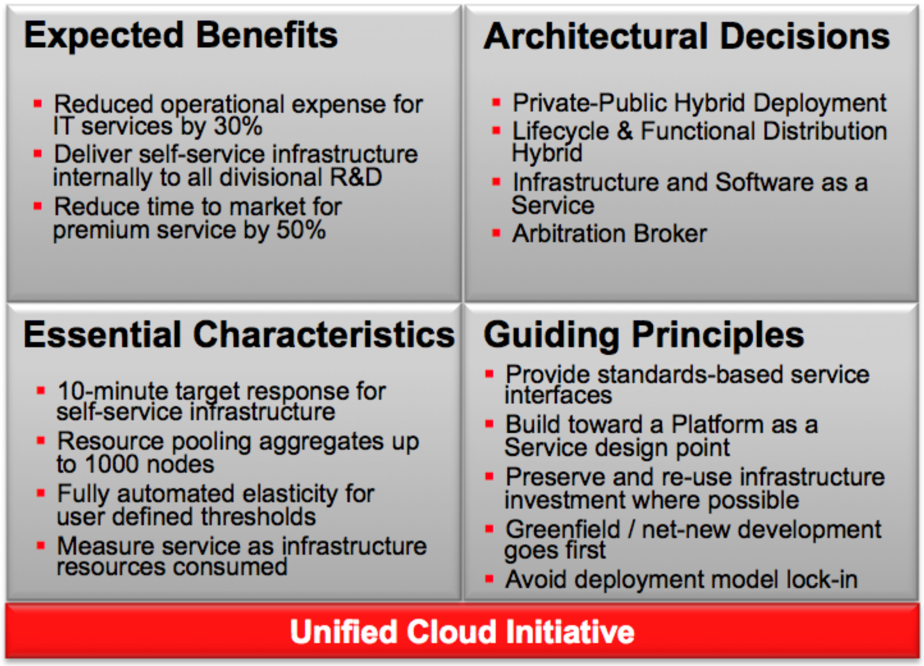
Principle	Avoid deployment model lock in
Statement	Design for interoperability and portability, and plan for reoccurring migration between service providers and deployment models.
Rationale	In order to take advantage of the best price and functionality available at any given time, the ability to redeploy applications into a different model is essential.
Typical Context	Early Technology Adoption, emerging Arbitration Broker

Principle	Accept no new risks
Statement	Adoption of Cloud services should not expose the business to new risks. Services with reliability and security requirements beyond the known limits of a particular Cloud will not be considered for deployment in that Cloud.
Rationale	The potential costs associated with new risks due to deployment in a Cloud model outweigh the potential benefits.
Typical Context	Mainstream Technology Adoption

The guiding principles should be sufficiently clear and detailed such that the principles can be enforced across the entire scope of the Cloud initiative and on specific projects that fall within the purview of the initiative. The principles should also serve as a foundation to make more specific decisions in the future.

Figure 2–16 shows an example vision statement that captures the Expected Benefits, Key Architectural Choices, Essential Characteristics, and Guiding Principles for an organization's Cloud initiative.

Figure 2–16 Example Unified Cloud Initiative Vision Statement

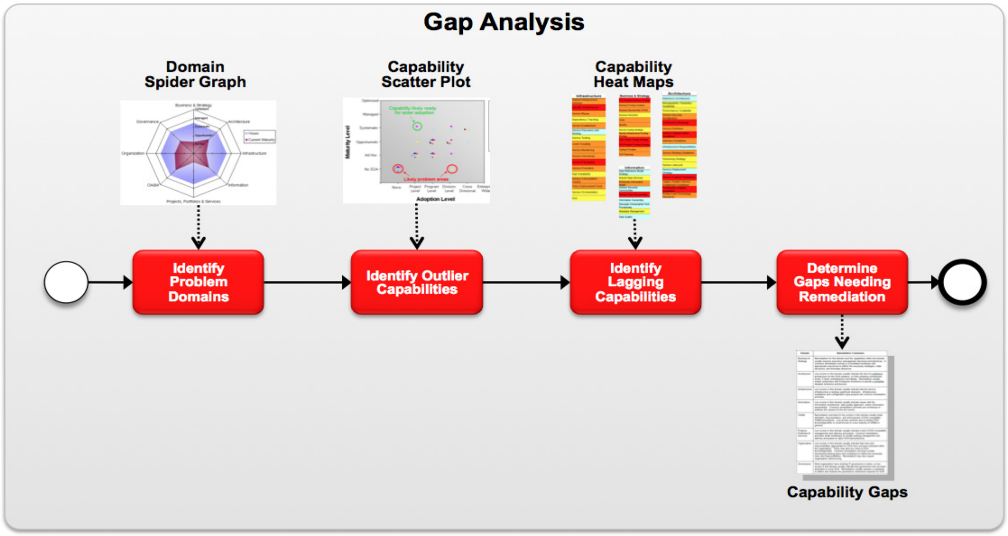


2.4 Gap Analysis and Key Transformations

The gap analysis phase compares the current state of the Cloud capabilities (as measured in the Current Assessment phase) with the vision for the initiative (defined in the Future Vision phase). The gap between these two is then analyzed to determine the causes and remediation approaches are identified.

Results from the Cloud Maturity Assessment and the Cloud Candidate Selection process are critical inputs to the gap analysis. In addition, the results from Context Evaluation must be considered in the gap analysis. In particular, certain transformations are implied by these contexts, and must be identified and addressed in the roadmap. Typical transformations implied by most Cloud adoption efforts are described in the next section.

Figure 2–17 Gap Analysis Process



2.4.1 Transformations

There are several important transformations that most organizations will have to go through in the course of adopting Cloud. These transformations are described in the following sections, Role Shifts, and Automation and Model Management and Late Binding.

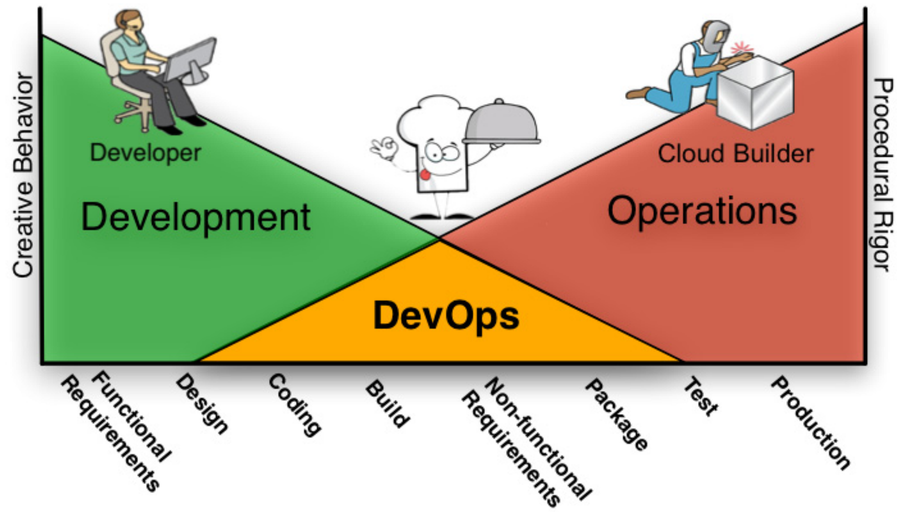
2.4.1.1 Role Shifts and Automation

Traditional IT operations are typically responsible for operating the IT infrastructure, platforms, and applications that run the business. This includes the monitoring and management of service levels to the end users of business services. In this traditional model, operations may call upon application developers to assist with resolution of production problems, but the developers' primary role is to add features to the applications.

New capabilities introduced with Cloud Computing, such as automated provisioning / deprovisioning, elasticity, and self service lead to an increased pace of change. This creates a challenge for IT organizations that are structured to directly manage all changes to any part of the running environment and may even discourage or impede change in the interest of maintaining stability in the environment. Dealing with this challenge involves shifts in roles and increased automation of operational tasks to effectively manage the pace of change.

For services running in a cloud, the traditional line between IT operations and application developer roles is often replaced by a practical division of responsibilities that is more situational and less rigid. A "DevOps" approach integrates development and operations into a single role or shared responsibility between two or more roles. This merging of responsibilities from development and operations is bolstered by the use of common tool sets across the disciplines. One tool to manage both application configuration and infrastructure configuration promotes integration of "Dev" and "Ops". A shared version control system that contains system provisioning scripts as well as application code is typical of a well functioning DevOps approach. Common methods and tools for testing and quality assurance are also shared in a DevOps approach. A simple delineation of responsibilities typical of traditional roles and DevOps roles is show in Figure 2–18.

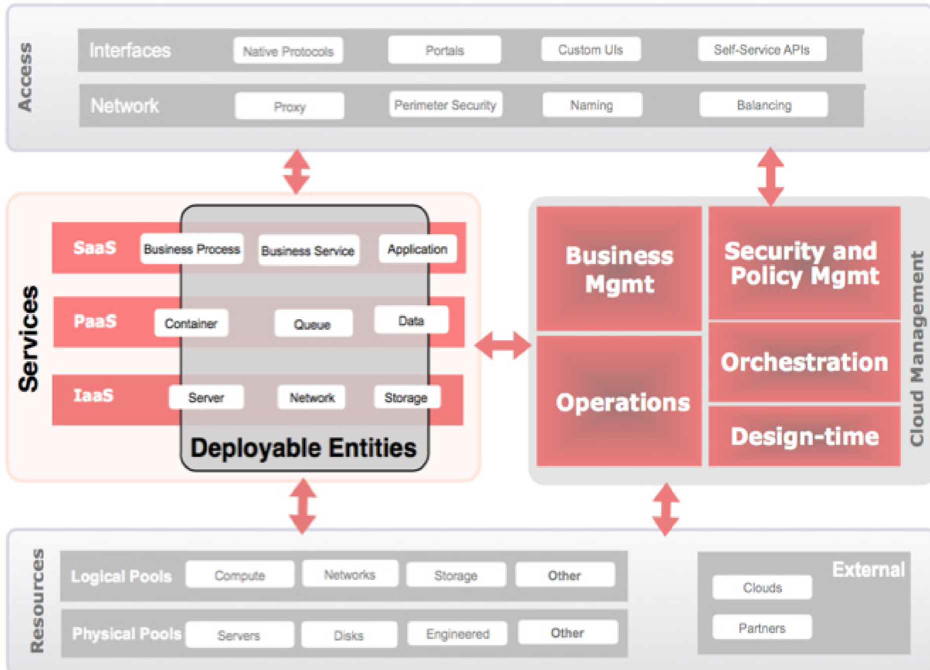
Figure 2–18 'DevOps' Convergence of Development & Operations



The transformation to a DevOps approach involves skills development and possible restructuring of organizational boundaries, as well as retooling to a common set of tools. Adaptation of the governance model for IT will also be necessary. The transition to DevOps is a multi-phase effort. It begins in the Current State Assessment phase by identifying affected roles and processes, and continues in the Implementation phases with refactoring of existing roles and processes or creating new ones. Improvements to the associated processes are ongoing in the Operate phases. The roadmap should account for activities to handle the mechanics as well as the cultural impacts of this transformation.

Automation is not new to IT operations, but Cloud services demand higher levels of automation than traditional IT customarily provides. Operating applications in the Cloud involves management of services as semi-autonomous entities, comprised of multiple elements (binaries, scripts, configuration, dependencies), whose deployment is treated as a single idempotent transaction. That is, complete services are managed as deployable entities that are provisioned uniformly as a single payload to a baseline platform common to other deployable entities. The platform is not modified by a deployment, and changes to the entity are applied not incrementally to the running system, but as part of the entity that is redeployed. This notion of deployable entities, where configuration and code for multiple subcomponents are encapsulated in a template or assembly is a critical underpinning of Cloud scale automation. Figure 2–19 illustrates the concept of deployable entities in the context of an overall logical view of Cloud architecture.

Figure 2–19 Deployable Entities within a Logical View of Cloud Architecture



Deployable entities vastly simplify operations and serve as logical abstractions of the underlying detail involved in delivering Cloud services.

2.4.1.2 Model Management and Late Binding

Abstraction involves a normalized method of either aggregating underlying subsystems into larger systems or disaggregating systems into smaller subsystems. Server pooling abstracts individual servers into an addressable collection of server capacity. Server virtualization abstracts the physical hardware by dividing the processing and I/O capacity of a server into smaller virtual machines. Higher levels of abstraction require complete representations, or models, of the underlying subsystems along with the policies, configurations, and relationships that describe the system. In complex environments such as Clouds, model management becomes an essential capability and is the basis for maintaining deployable entities, among other core building blocks of the Cloud architecture. For Cloud service developers model management is the main point of interaction with the Cloud environment.

Systems that support high velocity of change across a large number of subsystems rely on model management to define up front those elements of a service that are fixed or expected to change infrequently ("early binding"), while allowing the dynamic elements of the service to be defined later when the service is launched. This "late binding" of components enables rapid release of new features and quick correction of defects. This, in turn, reduces the risk of releasing new code and removes barriers to continuous service improvement.

The creation of models representing Cloud services and major subsystems is an Implementation activity, as is the specification for model management infrastructure, which includes some form of model repository. Creation of models can be greatly simplified through the use of introspection, which captures a metadata description of a running reference system to be brought under model management. The roadmap should address which models are needed, how they will be created, and whether introspection would be possible and useful in the model management function.

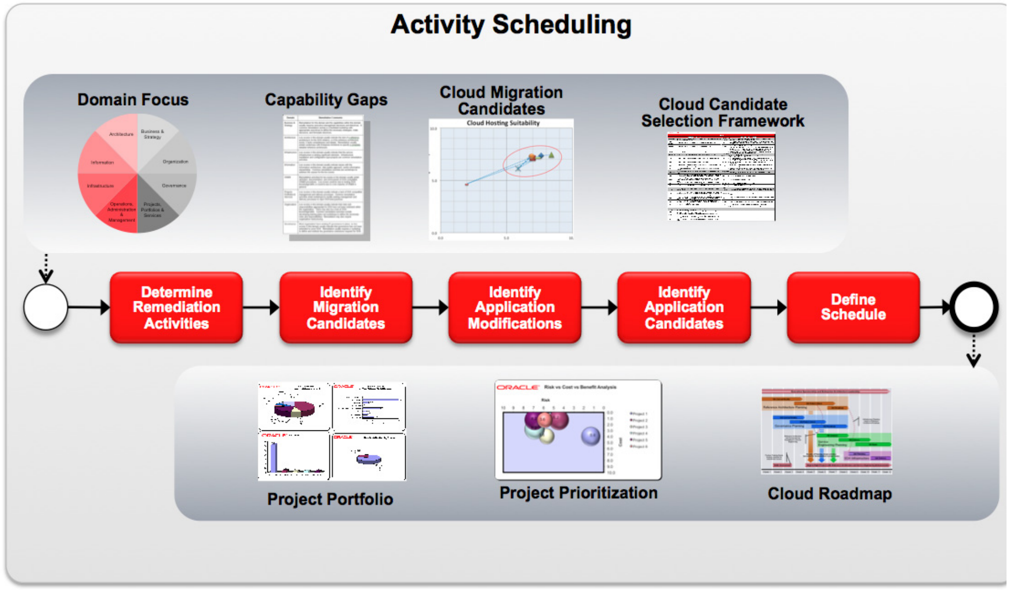
As discussed earlier, the upfront "early binding" activities are concerned with building the Cloud infrastructure, and occur infrequently. These build-time efforts implement the operational capabilities of a Cloud such as resource pooling, rapid elasticity, and self-service. The "late binding" of service components is concerned with applications running in the environment and occur on shorter intervals, as frequently as, say, once an hour. These run-time activities include application deployment, dynamic provisioning and deprovisioning of capacity, and responding to problems in the running service.

Management of the overall system - infrastructure and applications - is typically separated into multiple control planes. One for management of the Cloud infrastructure, which serves the needs of the Cloud operator, and one or more for managing the applications running in the Cloud, which serve the needs of the application owner.

2.5 Activity Scheduling

Much of the guidance derived from earlier phases in the roadmap creation process is directed at specific domains in the Capability Domain Model. It is convenient to group remediation activities into these domains for project selection and scheduling. The remediation activities identified in the Gap Analysis phase are grouped into projects according to domain. Additional projects are defined for building Cloud services, and migration of applications identified for Cloud deployment with the CCST. Still more projects are defined for private Cloud initiatives to build Cloud infrastructure. These building, migration and domain-focused remediation projects are then prioritized according to dependencies, benefit, cost, and risk. In the case where budget or timeline limits the scope of the plan to fewer projects than were identified, then a priority threshold for project selection will need to be set. Projects with priority exceeding the threshold are then compiled in a plan, which is the core deliverable of the roadmap creation process. Figure 2–20 shows the steps involved in the Activity Selection phase of the Cloud roadmap creation process. This is the final step of the process, after which a complete roadmap for the Cloud adoption initiative is ready for execution.

Figure 2–20 Activity Scheduling Process



To aid in the cost-benefit-risk analysis of projects, the Project Selection Framework for Cloud can be used to evaluate a portfolio of projects and set project priorities. See Appendix D for a description of the Cloud Project Selection Framework.

3 Summary

Cloud Computing can produce transformational benefits over the course of long-range strategic plans, or incremental improvements through tactical implementation of discrete capabilities. Whether an organization seeks to reduce the cost of delivering IT services or to increase business agility, Cloud Computing can provide a foundation for achieving these goals. Organizations should take a pragmatic approach to Cloud adoption designed to deliver their specific desired benefits. Cloud Computing is not a one-size-fits-all solution. The value of adopting Cloud Computing is strongly linked to the degree to which the approach accounts for the organization's motivational and operational contexts for Cloud adoption. Likewise, the ROI and transformational effects of Cloud Computing depend on rationalized architectural choices informed by the context leading to Cloud adoption.

Essential steps for creation of a tailored roadmap to Cloud were presented. These include an evaluation of the context for Cloud adoption, assessment of the current state of Cloud capabilities, definition of a future state vision, conducting gap analysis, and the identification of key transformations to the operation and management of IT. These activities must be accounted for in the roadmap. Roadmap development should leverage available methods, such as the one presented here, along with effective tools such as the Oracle Cloud Maturity Model, and the Oracle Cloud Candidate Selection Tool. A roadmap developed with the benefit of this guidance provides a solid foundation for a successful Cloud initiative.

A

Major Activities by Focus Area

The table below lists the major activities for each of the three focus areas.

Envision	Implement	Operate
Evaluate Context for Cloud	dentify target workloads	Run-time Monitoring
■ Motivational	Decomposition of candidate applications	Analysis & reporting of Service Levels and QoS
■ Operational	Sourcing of technology and service providers	Resource provisioning
Current State Assessment	Define Service Levels and QoS requirements	Service deployment
■ Interviews	Cloud Infrastructure implementation	Change management
■ Scoring	Cloud Service development	Incident management
Future Vision Definition	Resource pool creation	Problem management
■ Expected Benefits	Cloud service identification	Capacity management
■ Architectural Choices	Cloud service definition	Root cause analysis
■ Essential Characteristics	Cloud service design	User provisioning
■ Guiding Principles	Cloud service testing	Failed resources handling
Gap Analysis		
■ Domain focus		
■ Capability Gaps		
■ Transformations		
■ Migration Candidates		
Activity Scheduling		
■ Project Portfolio		
■ Project Prioritization		

B

Cloud Maturity Model

Oracle's Cloud Maturity Model covers the major tenants of a complete Cloud Computing strategy, including both technical and business focused capabilities. It is designed to be used as a diagnostic of the current environment, and can also be used in roadmap development to set measurable goals for the assessed capabilities. The model also serves as a framework for insight and discussion among various stakeholders in the Cloud initiative, leading to a shared understanding of current capabilities and the gaps to be addressed in the course of Cloud adoption.

The main elements of the Cloud Maturity Model are briefly described below. For a detailed description of the model download the white paper Cloud Maturity Model: Guiding Success with Cloud Capabilities here:
http://www.oracle.com/technetwork/topics/Cloud/articles/index.html

B.1 Capabilities

The Cloud Maturity Model includes approximately sixty capabilities that capture the best practices that Oracle has collected over years working with a wide variety of companies. These capabilities provide the detail necessary to truly measure and guide the progress of a Cloud initiative.

B.2 Domains

There are eight domains in the maturity model:

Business & Strategy - Contains capabilities that provide the high-level constructs that allow the Cloud initiative to proceed. This includes such things as business motivation, expected benefits, guiding principles, expected costs, funding model, etc. Capabilities such as service selection and service level agreements gain relevance in Cloud initiatives as well.

Architecture - Contains capabilities concerning the definitions of the overall architecture and guidelines for various practitioners to ensure adherence to the architecture. Capabilities fundamental to Cloud architectures, such as resource pooling, interoperability, and self service are considered in the model.

Infrastructure - Contains capabilities concerning the service infrastructure and tools that provide the technical foundation for the Cloud initiative. Shared services, provisioning, and model packaging are particularly important in Cloud infrastructure.

Information - Contains capabilities concerning the information aspects of Cloud, such as metadata management, as well as customer entitlements, and data durability.

Projects, Portfolios & Services - Contains capabilities concerning the planning and building of Cloud services, and management of the portfolio of services.

Operations, Administration & Management - Contains capabilities concerning the post deployment aspects of Cloud service i.e. the Operations, Administration, and Management aspects of the Cloud environment. This includes capabilities for the delivery of self-service functions and change management.

Organization - Contains capabilities concerning the development of organizational competency around Cloud Computing including the organizational structure and skills development, as well as executive sponsorship and organizational authority.

Governance - Contains capabilities concerning the governance structures and processes that support and guide the Cloud efforts. These include policy management, risk management, and auditing capabilities. Maturity and adoption of adequate governance is a leading indicator of the overall success of a Cloud Computing strategy.

B.3 Maturity

The six levels of maturity used in the Cloud Maturity Model from lowest to highest are:

None - There is no Cloud approach being taken. No elements of Cloud are being implemented.

Ad Hoc - Awareness of Cloud Computing is established and some groups are beginning to implement elements of Cloud Computing. There is no cohesive Cloud Computing plan being followed.

Opportunistic - An approach has been decided upon and is being opportunistically applied. The approach has not been widely accepted and redundant or overlapping approaches exist. It may be informally defined, or if documented, may exist primarily as "shelf ware".

Systematic - The approach has been reviewed and accepted by affected parties. There has been buy-in to the documented approach and the approach is always (or nearly always) followed.

Managed - The capability is being measured and quantitatively managed via some type of governance structure. Appropriate metrics are being gathered and reported.

Optimized - Metrics are being consistently gathered and are being used to incrementally improve the capability. Assets are proactively maintained to ensure relevancy and correctness. The potential for market mechanisms to be used to leverage inter-Cloud operations has been established.

B.4 Adoption

The levels of adoption used in the Cloud Maturity Model are:

No Implementation - There is no current implementation anywhere in the organization of the capability being measured.

Discrete Resources - The capability is established for a single resource (e.g., application, hardware system, discrete organizational workgroup [e.g., project]).

Across Collections - The capability is established consistently for a collection of resources, primarily defined by the resource affinity or coupling in relation to a higher level function (e.g., suite of related applications, an HA cluster of servers, or a composite engineered system).

Across Pools - The capability is established consistently throughout a pool of resources, primarily defined by a common administrative purview (e.g., JEE applications, shared servers or storage environments throughout a data center, or an organizational division).

Across Units - The capability is established consistently within an operating unit (e.g., applications, hardware environments across multiple data centers or resources across an independent operating unit or subsidiary).

Across Clouds - The capability is established consistently across an entire 'enterprise' and may span Cloud providers (i.e., all applications, all data centers or all organizational units, or multiple Clouds are using the same approach).

C

Cloud Candidate Selection Tool

The Cloud Candidate Selection Tool can be used both as a framework for insight and discussion toward developing a Cloud architecture, as well as a diagnostic for an existing environment and to what extent it is amenable to a Cloud architecture.

Download the whitepaper, Cloud Candidate Selection Tool: Guiding Cloud Adoption, here:

http://www.oracle.com/technetwork/topics/Cloud/articles/index.html

The basic elements of the tool are described below.

C.1 Evaluation Criteria

The CCST includes 23 initial criteria used in the evaluation of application components. Criteria can be removed and additional criteria can be added for any evaluation. Example criteria used in the tool are Availability Requirement, Latency Requirements, Government Regulation, and Statefulness.

C.2 Weighting

The CCST allows customization of the analysis by applying different weights to each of the evaluation criteria. By default, all criteria are weighted equally.

C.3 Component Scoring

Each component within the application being evaluated must be rated on a scale relative to each criterion. These resulting scores are used to estimate component level suitability for public or private Cloud deployment.

C.4 Affinity

In order to identify component dependencies, an affinity rating (none, low, medium, high) is assigned to each pair of components within an application.

C.5 Analysis

Once all of the above data is input, an analysis is automatically generated which includes charts illustrating the deployment models most suitable for each component along with the dependencies between components indicated.

D

Cloud Project Selection Framework

The Cloud Project Selection Framework is used to select projects to include in a Cloud roadmap. The framework is used to evaluate the costs, benefits, and risks associated with each project. The result of this evaluation is a numeric score for cost, benefit, and risk. These numeric scores are then analyzed to select projects that provide the most benefits as compared to the costs, and risks.

It is important to note that there are products that are specifically for project portfolio planning. The framework described in this section is not intended to replace such products. Rather, this is a simple framework that can be used when an organization does not have a project portfolio planning product already deployed.

The framework is Excel spreadsheet based. Each worksheet contained in the spreadsheet is described below.

D.1 Parameters

The parameters worksheet is used to define both the criteria used to score projects and the weights applied to the criteria. The weights for each of the criteria types (Costs, Benefits, and Risk) must add up to 100% for the spreadsheet to sum totals properly. The weights should be adjusted for each situation based on the relative importance of each criterion. For each evaluation criterion, there is a text score and an associated numeric score. Providing a separate text score makes the Projects worksheet more readable and allows projects to be evaluated without selecting actual numeric values. After the projects have been evaluated by selecting the appropriate text score, the numeric values can be adjusted (if necessary) without requiring revisiting the project evaluations.

D.2 Projects

The Projects worksheet is used to evaluate the projects by selecting a score for each of the criterion. A portion of the Projects worksheet is shown in Figure D–1.

Figure D–1 Projects Worksheet

ORACLE	Project 1	Project 2	Project 3	Project 4
Risks of Complexity Criteria	**1.30**	**4.50**	**5.70**	**6.90**
Deployment Model	Private	Hybrid	Hybrid	Hybrid
Hybrid Type	Lifecycle Distribution	Functional Distribution	Functional Distribution	Functional Distribution
Type of Migration	None	Rehost	Rehost	Rearchitecture
Broker Type	Arbitration	Arbitration	Arbitration	Arbitration
Location / Premise Type	Single Entrprise Owned	Single Entrprise Owned	Multiple Providers	Provider Owned
-	None	None	None	None
Costs Criteria	**4.00**	**1.25**	**4.00**	**2.80**
Number of Service Models	2	1	2	1
Number of Deployment Models	2	1	2	2
Number of Platforms	1	0	1	1
Number of Applications	1 - 3	1 - 3	1 - 3	1 - 3
Number of Cloud Services	4 - 9	1 - 3	4 - 9	4 - 9
-	None	None	None	None
Benefits Criteria	**5.60**	**6.20**	**3.60**	**6.20**
ROI	Medium	Medium	Medium	Medium
New Revenues	Low	Low	High	Low
Cost Savings	Medium	High	None	High
Product innovation gains	None	None	High	None
Business agility gains	Low	Low	Medium	Low
-	None	None	None	None

The selections available for each criterion are limited to the text scores provided in the Parameters worksheet. The project scores are calculated using the weights and numeric scores in the Parameters worksheet.

D.3 Risks

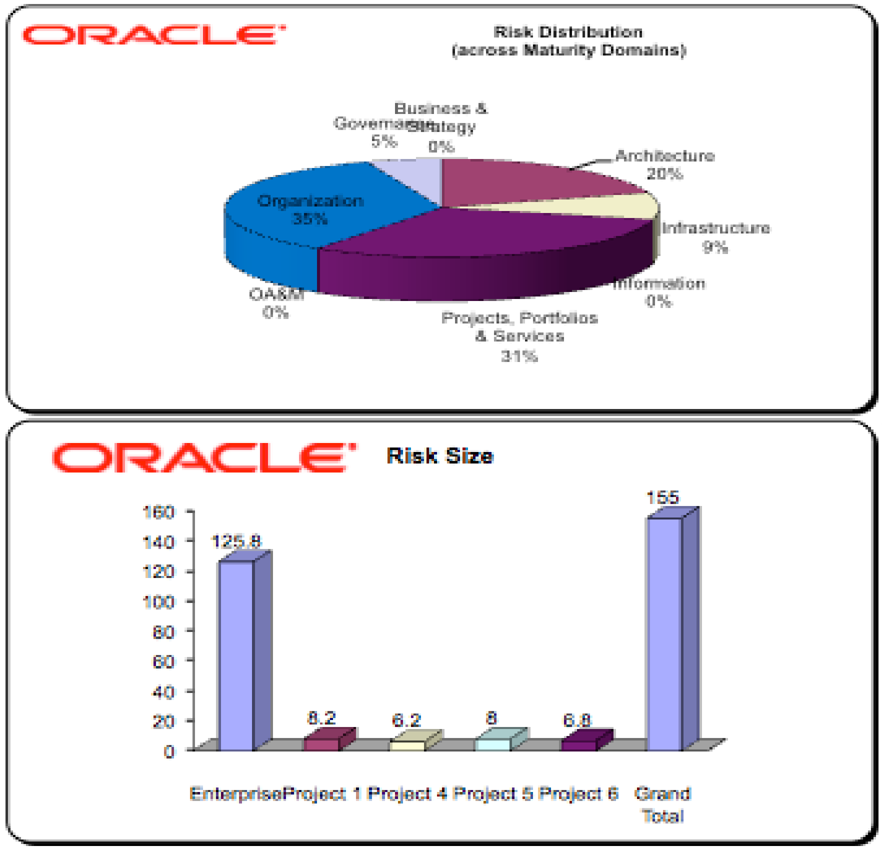
The Risks worksheet is used to evaluate the risks associate with each project. For each risk identified, the Cloud Maturity Model domain to which it applies is identified. This allows the risk to be categorized by the same domains as the Cloud Maturity Model capabilities.

For each risk, assign a value from 0 to 5 for the gravity, urgency, and trend. The gravity value measures how severe are the consequences of the risk, the urgency value measures how soon the risk will manifest, and the trend measures how much worse the risk will get with time.

The worksheet also allows for the identification of a product/process/approach/etc. that might remove the risk i.e. a risk mitigation strategy. If that risk mitigation is in place, then selecting 'Yes' in the 'Answer' column will zero out that risk.

The Risk Analysis worksheet provides summaries and graphics of the scores in the Risks worksheet. A sampling of the risk analysis provided by this worksheet is shown in Figure D–2.

Figure D–2 Risk Analysis Worksheet



In this example, the risk analysis shows that most of the risks are at enterprise scope and that the Cloud domain yielding the largest portion of the risk is the Architecture domain.

D.4 Project Portfolio Analysis

The final worksheet in the Cloud Project Selection Framework is the Cloud Project Portfolio Analysis worksheet. This worksheet combines the values from the Projects and Risks worksheets. The summary values are used to create charts that help to analyze the various projects. An example chart is shown in Figure D–3.

Figure D–3 Example Project Analysis Chart