MIGRATING INTO A CLOUD

The promise of cloud computing has raised the IT expectations of small and medium enterprises beyond measure. Large companies are deeply debating it.

Cloud computing is a disruptive model of IT whose innovation is part technology and part business model—in short a "disruptive techno-commercial model" of IT.

key issues and associated dilemmas faced by decision makers, architects, and systems managers

when and how to, what part or component, what not to, what kind of customers really benefit

Google, Amazon, and Microsoft, who had started offering cloud computing services - demonstrated that cloud computing per se was for real and that the "techno-commerical disruptive business model" was indeed giving a greater return on investment (ROI) than traditional IT investment for a business.

If the enterprise is in a seasonal or cyclical business, then the load variation would be significant. Thus what is observed generally is that the provisioned capacity of IT resources is several times the average demand.

This is indicative of significant degree of idle capacity.

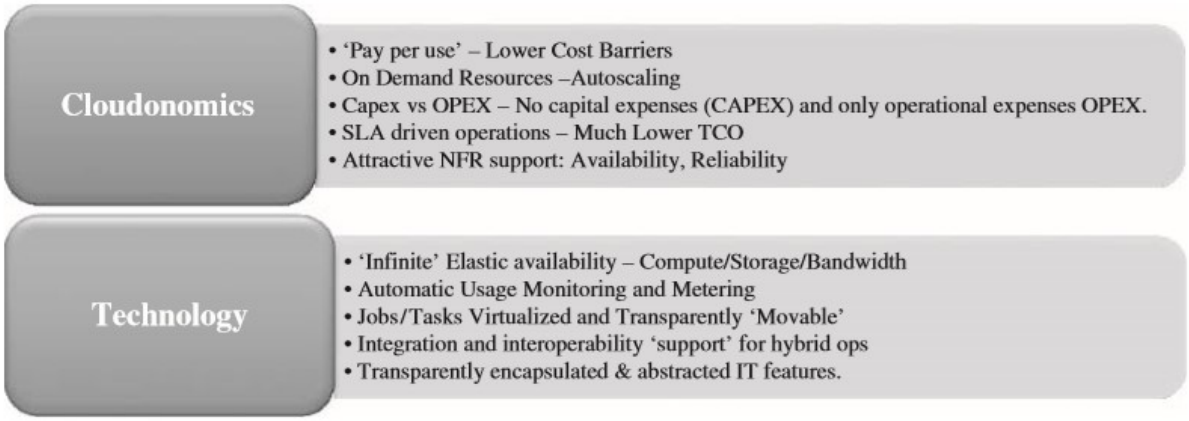
Many data center management teams have been continuously innovating their management practices and technologies deployed to possibly squeeze out the last possible usable computing resource cycle through appropriate programming, systems configurations, SLAs, and systems management.

The Promise of the Cloud

Most users are least bothered about the complexities of the underlying systems.

They were most impressed by the simplicity, uniformity, and ease of use of the Cloud Computing Service abstractions.

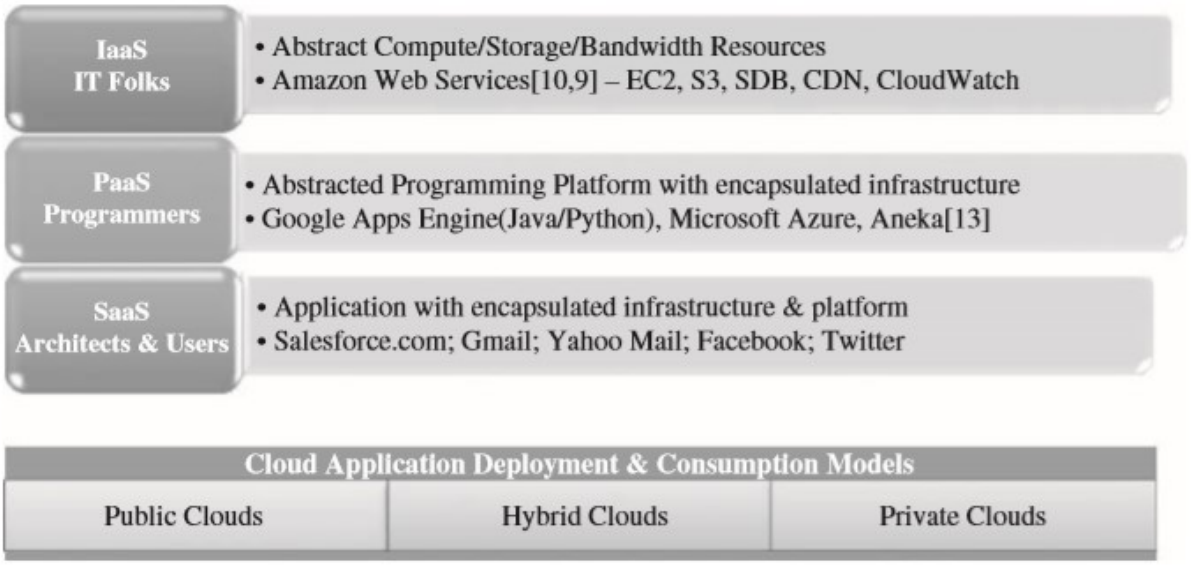
Small and medium enterprises, cloud computing usage for all additional cyclical IT needs has yielded substantial and significant economic savings -> economics and the associated trade-offs, of leveraging the cloud computing services, now popularly called "cloudonomics".



An attractive proposition both for the CFO and the CTO of an enterprise.

This has been achieved by large data center service vendors or now better known as cloud service vendors due to their scale of operations. Google, Amazon, Microsoft, have been the key players apart from open source Hadoop built around the Apache ecosystem.

The cloud service offerings from these vendors can broadly be classified into three major streams: the Infrastructure as a Service (IaaS), the Platform as a Service (PaaS), and the Software as a Service (SaaS)



Amazon offered many levels of abstracted elastic cloud compute (EC2) server power:

General purpose instances provide a balance of compute, memory and networking resources, and can be used for a variety of diverse workloads.

Compute Optimized instances are ideal for compute bound applications that benefit from high performance processors.

Memory optimized instances are designed to deliver fast performance for workloads that process large data sets in memory.

Accelerated computing instances use hardware accelerators, or co-processors, to perform functions, such as floating point number calculations, graphics processing, or data pattern matching, more efficiently than is possible in software running on CPUs.

Storage optimized instances are designed for workloads that require high, sequential read and write access to very large data sets on local storage. They are optimized to deliver tens of thousands of low-latency, random I/O operations per second (IOPS) to applications.

BROAD APPROACHES TO MIGRATING INTO THE CLOUD

At what IT costs—both short term and long term—would one want to migrate into the cloud?

While all capital expenses are eliminated and only operational expenses incurred by leveraging the cloud, does this satisfy all strategic parameters for enterprise IT?

Does the total cost of ownership (TCO) become significantly less as compared to that incurred when running one's own private data center?

Decision-makers, IT managers, and software architects are faced with several dilemmas when planning for new Enterprise IT initiatives.

Why Migrate?

Either the application is clean and independent, so it runs as is

or

perhaps some degree of code needs to be modified and adapted

or

the design (and therefore the code) needs to be first migrated into the cloud computing service environment

or

the core architecture being migrated for a cloud computing service setting, this resulting in a new architecture being developed, along with the accompanying design and code implementation.

Software design is about designing individual modules/components.	Software architecture is about the complete architecture of the overall system.
Software design defines the detailed properties.	Software architecture defines the fundamental properties.
It helps to implement the software.	It helps to define the high level infrastructure of the software.
In one word the level of software design is implementation.	In one word the level of software architecture is structure.

In brief, migration can happen at levels of application, code, design, architecture.

With due simplification, the migration of an enterprise application is best captured by the following:

$P \rightarrow P'_C + P'_I \rightarrow P'_{OFC} + P'_I$

where P is the application before migration running in captive data center,

P'_C is the application part after migration either into a (hybrid) cloud, P'_I is the part of application being run in the captive local data center.

P'_{OFC} is the application part optimized for cloud. If an enterprise application cannot be migrated fully, it could result in some parts being run on the captive local data center while the rest are being migrated into the cloud—essentially a case of a hybrid cloud usage.

However, when the entire application is migrated onto the cloud, then P'_I is null

Invariably, migrating into the cloud is driven by economic reasons of cost cutting in both the IT capital expenses (Capex) as well as operational expenses (Opex).

A questionnaire with several classes of key questions that impact the IT due to the migration of the enterprise application is posed to a select audience chosen for their technology and business expertise.

Assume that there are M such classes. Each class of questions is assigned a certain relative weightage Bi in the context of the entire questionnaire.

Assume that in the M classes of questions, there was a class with a maximum of N questions. We can then model the weightage-based decision making as M x N weightage matrix as follows:

$$C_l \leq \sum_{i=1}^{M} B_i \left(\sum_{j=1}^{N} A_{ij} X_{ij} \right) \leq C_h$$

where Cl is the lower weightage threshold and Ch is the higher weightage threshold

while Aij is the specific constant assigned for a question and Xij is the fraction between 0 and 1 that represents the degree to which that answer to the question is relevant and applicable.

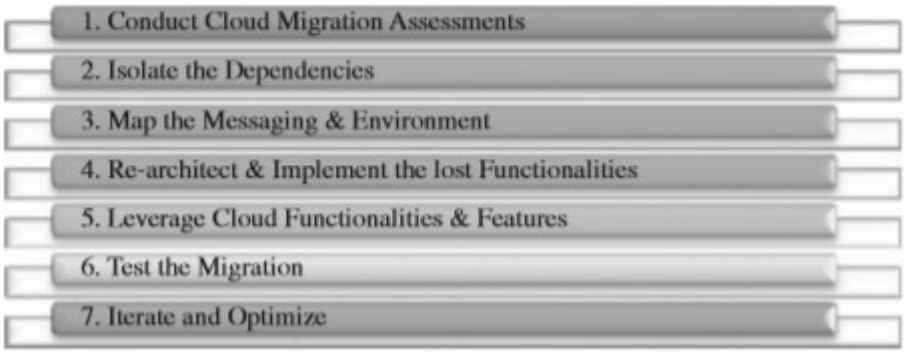
THE SEVEN-STEP MODEL OF MIGRATION INTO A CLOUD

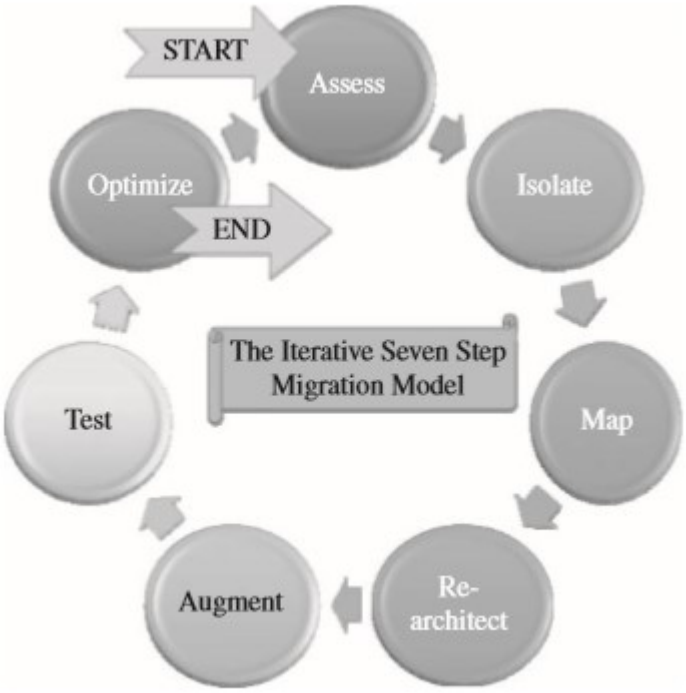
migration initiatives into the cloud are implemented in phases or in stages. structured and process-oriented approach.

migration assessments are done for the tools being used, the test cases as well as configurations, functionalities, and NFRs of the enterprise application.

This results in a meaningful formulation of a comprehensive migration strategy.

1. **assessment** of cost of migration as well as about the ROI.
2. **Isolating** all systemic and environmental dependencies of the enterprise application components within the captive data center.
3. **mapping** constructs between what shall possibly remain in the local captive data center and what goes onto the cloud.
4. a substantial part of the enterprise application needs to be **rearchitect**ed, **redesign**ed, and **reimplement**ed on the cloud. This gets in just about the functionality of the original enterprise application. Due to this migration, it is possible perhaps that some functionality is lost.
5. we **leverage** the intrinsic features of the cloud computing service to augment our enterprise application in its own small ways.
6. Having done the augmentation, we validate and **test** the new form of the enterprise application with an extensive test suite that comprises testing the components of the enterprise application on the cloud as well. These test results could be positive or mixed.
7. we **iterate and optimize** as appropriate. Our best practices indicate that it is best to iterate through this Seven-Step Model process for optimizing and ensuring that the migration into the cloud is both robust and comprehensive.





Amazon:

The first phase is the cloud migration assessment phase wherein dependencies are isolated and strategies worked out to handle these dependencies.

The next phase is in trying out proof of concepts to build a reference migration architecture.

The third phase is the data migration phase wherein database data segmentation and cleansing is completed. This phase also tries to leverage the various cloud storage options as best suited.

The fourth phase comprises the application migration wherein either a "**forklift strategy**" (The forklift migration strategy consists of moving an application to the cloud all at once.) of migrating the key enterprise application along with its dependencies (other applications) into the cloud is pursued. Or

perhaps using the "**hybrid migration strategy**," the critical parts of the enterprise application are retained in the local captive data center while noncritical parts are moved into the cloud.

The fifth phase comprises leveraging the various Amazon AWS features like elasticity, autoscaling, cloud storage, and so on.

Finally in the sixth phase, the migration is optimized for the cloud.

These phases are representative of how typical IT staff would like to migrate an enterprise application without touching its innards but only perhaps at the level of configurations—this perfectly matches with the typical IaaS cloud computing offerings. However, this is **specific and proprietary** to **Amazon** cloud offering.

CISCO :

Planning your migration

Choosing your cloud environment

Migrating your apps and data

Validating post-move success

Six R's of migration (**types of cloud migration strategies)**

Rehosting ("lift and shift")

This involves lifting your stack and shifting it from on-premises hosting to the cloud. You transport an exact copy of your current environment without making extensive changes for the quickest ROI.

Replatforming

It involves making a few further adjustments to optimize your landscape for the cloud. Again, the core architecture of applications stays the same.

Repurchasing

This means moving your applications to a new, cloud-native product, most commonly a SaaS platform. The challenge is losing the familiarity of existing code and training your team on the new platform.

Refactoring

Refactoring (or rearchitecting) means rebuilding your applications from scratch. This is usually driven by a business need to leverage cloud capabilities that are not available in your existing environment, such as cloud auto-scaling

Retiring

Once you have assessed your application portfolio for cloud readiness, you might find some applications are no longer useful. In this case, simply turn them off.

Retaining

Unable to take data off premises for compliance reasons. Not ready to prioritize an app that was recently upgraded. In this case, plan to revisit cloud computing at a later date. Only migrate what makes sense for the business.

Benefits of migrating to the cloud (CISCO)

Decreased hosting costs

Agility and scalability

Decreased footprint

Disaster recovery

Security

Challenges of cloud migration (CISCO)

Downtime

Data loss

Resource management

Interoperability

Migration Risks and Mitigation

The biggest challenge to any cloud migration project is how effectively the migration risks are identified and mitigated.

The process step of testing and validating includes efforts to **identify** the key migration risks.

In the optimization step, we address various approaches to **mitigate** the identified migration risks.

Migration risks :

1. the general migration risks

    - performance monitoring and tuning—essentially identifying all possible production level deviants
    - the business continuity and disaster recovery in the world of cloud computing service;
    - the compliance with standards and governance issues; the IP and licensing issues;
    - the quality of service (QoS) parameters as well as the corresponding SLAs committed to;
    - the ownership, transfer, and storage of data in the application;
    - the portability and interoperability issues which could help mitigate potential vendor lock-ins;
    - the issues that result in trivializing and noncomprehending the complexities of migration that results in migration failure and loss of senior management's business confidence in these efforts.

2. the security-related migration risks

    - several legal compliances that a migration strategy and implementation has to fulfill, including obtaining the right execution logs as well as retaining the rights to all audit trails at a detailed level—which currently may not be fully available.
    - On matters of governance, there are several shortcomings in the current cloud computing service vendors.
    - Matters of multi-tenancy and the impact of IT data leakage in the cloud computing environments is acknowledged; however, the robustness of the solutions to prevent it is not fully validated.
    - Key aspects of vulnerability management and incident responses quality are yet to be supported in a substantial way by the cloud service vendors.