Migrating into a Cloud

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Introduction

- The promise of cloud computing has raised the IT expectations of small and medium enterprises (SME).

- There are certain key issues and associated doubts faced by _decision makers, architects, and systems managers_ in trying to understand and use cloud computing for their IT needs.

- The questions like
1. What part or component of IT application to migrate into cloud?
2. What not to migrate into cloud.?
3. When and how to migrate one's application into cloud?

And many more…

Promise of the Cloud

- Users of the cloud are least bothered about the complexities of the systems or their functioning.
- But they are most impressed by the simplicity, uniformity and ease of use of the cloud computing service.
- It has lead to economics savings
- This economics and associated   leveraging the cloud computing se   popularly known as "cloudonomics
- Cloudonomics:-Cloud + Economics
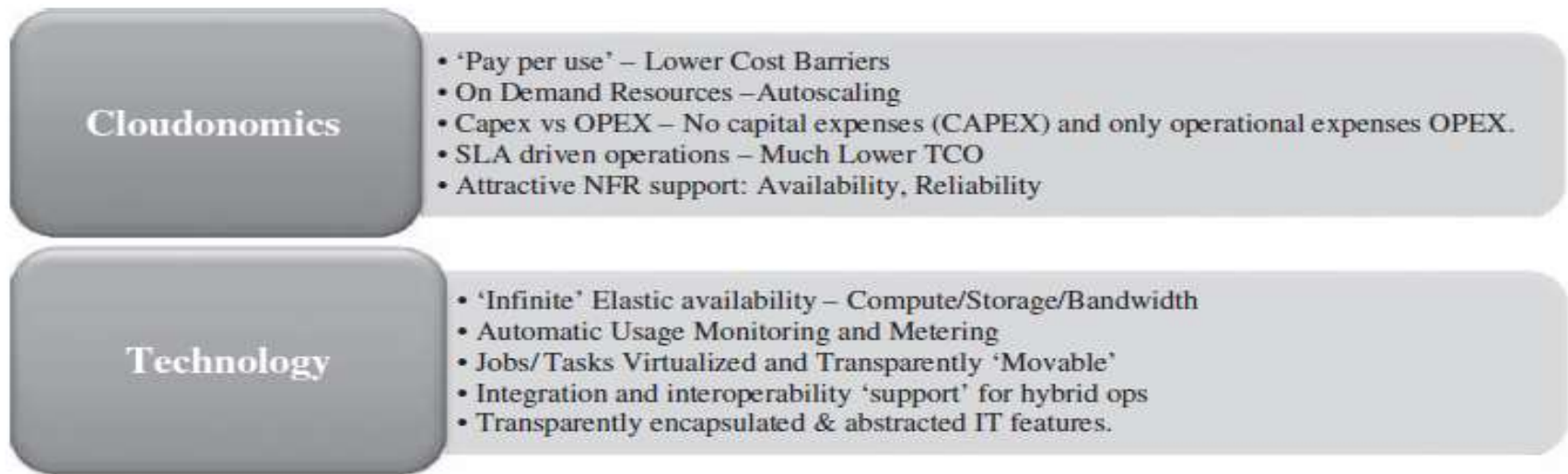
FIGURE 2.1. The promise of the cloud computing services.

✓ CAPEX:- Capital Expenditure
✓ OPEX:- Operating Expenditure
✓ TCO:-Total Cost of Ownership
✓ SLA:- Service Level Agreement
✓ NFR:- Non-Functional Requirement

Cloud service offerings and Deployment Models

- The cloud service offerings from different vendors can be broadly classified into three major streams:
- IaaS, PaaS, Saas.
- IT managers and system administrators preferred IaaS as offered by Amazon for many of their virtualized IT needs.
- The programmers prefered PaaS offerings like Google (Java/ Python programming) AppEngine, or Microsoft Azure (.Net programming)
- Users of large scale enterprise using specific software package on the cloud uses SaaS.

Cloud service offerings and Deployment Models

- ## Iaas , Paas & Saas
  - ### Public
  - ### Private

IaaS IT Folks	• Abstract Compute/Storage/Bandwidth Resources • Amazon Web Services[10,9] – EC2, S3, SDB, CDN, CloudWatch
PaaS Programmers	• Abstracted Programming Platform with encapsulated infrastructure • Google Apps Engine(Java/Python), Microsoft Azure, Aneka[13]
SaaS Architects & Users	• Application with encapsulated infrastructure & platform • Salesforce.com; Gmail; Yahoo Mail; Facebook; Twitter

Cloud Application Deployment & Consumption Models		
Public Clouds	Hybrid Clouds	Private Clouds

Challenges in the Cloud

- Promises of cloud seems very similar to the typical distributed system

Distributed System Fallacies and the Promise of the Cloud

- Full Network Reliability
- Zero Network Latency
- Infinite Bandwidth
- Secure Network
- No Topology changes
- Centralized Administration
- Zero Transport Costs
- Homogeneous Networks & Systems

Challenges in Cloud Technologies

- Security
- Performance Monitoring
- Consistent & Robust Service abstractions
- Meta Scheduling
- Energy efficient load balancing
- Scale management
- SLA & QoS Architectures
- Interoperability & Portability
- Green IT

Why Migrate?

- Due to Economic, Business and Technological reason an enterprise can be migrated into the cloud.

- Migration of an application into the cloud can happen in one of the several ways:
  - If the application is clean and independent **or**
  - some degree of code is to be modified and adapted **or**
  - the design first needs to be migrated **or**
  - may be the core architecture being migrated for cloud computing service setting.

- Migration can happen at one of the five levels of Application, Code, Design, Architecture, Usage
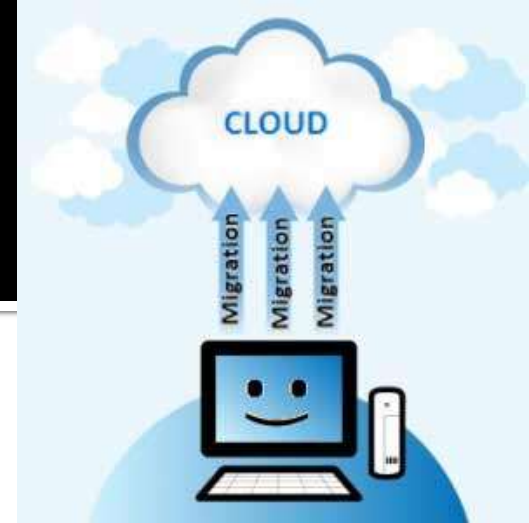
- The migration of an application is best captured by following
- $P \longrightarrow P'_c + P'_l \longrightarrow P'_{OFC} + P'_l$
- where P is the application before migration running in data center, P'_c is the application part after migration either into a (hybrid) cloud. P'_l Is the part of application being run in the captive local data center and 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 data center while rest are being migrated into the cloud.
- But if the entire application is migrated to cloud then P'_l is null.
- Hence P application can be migrated at five different levels.

Cloudonomics

- Cloud + Economics
- CAPEX vs. OPEX (IT capital expenses Vs Operational expenses)
- Migration can be economically feasible or tenable.
- Avg. cost of using an enterprise application on cloud is lower than cost using at one's data center and if migration doesn't burden on ROI then migration into cloud should be done.

Seven step model of migration into cloud

1. Conduct Cloud Migration Assessments

2. Isolate the Dependencies

3. Map the Messaging & Environment

4. Re-architect & Implement the lost Functionalities

5. Leverage Cloud Functionalities & Features

6. Test the Migration

7. Iterate and Optimize

Seven step model of migration into cloud

- Assess
    - Migration starts with an assessment of the issues relating to migration, at the application, code, design, and architecture levels. Moreover, assessments are also required for tools being used, functionality, test cases, and configuration of the application. The proof of concepts for migration and the corresponding pricing details will help to assess these issues properly.
- Isolate
    - The second step is the isolation of all the environmental and systemic dependencies of the enterprise application within the captive data center. These include library, application, and architectural dependencies. This step results in a better understanding of the complexity of the migration.
- Map
    - A mapping construct is generated to separate the components that should reside in the captive data center from the ones that will go into the cloud.

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- ## Re-architect
  - It is likely that a substantial part of the application has to be re-architected and implemented in the cloud. This can affect the functionalities of the application and some of these might be lost. It is possible to approximate lost functionality using cloud runtime support API.
- ## Augment
  - Greese cloud functionalities & features
  - Cloud computing service features are used to enhance the application.

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- Test
  - Once the augmentation is done, the application needs to be validated and tested. This is to be done using a test suite for the applications on the cloud. New test cases due to augmentation and proof-of-concepts are also tested at this stage.
- Optimize
  - The test results from the last step can be mixed and so require iteration and optimization. It may take several optimizing iterations for the migration to be successful.
  - It is best to iterate through this seven step model as this will ensure the migration to be robust and comprehensive.

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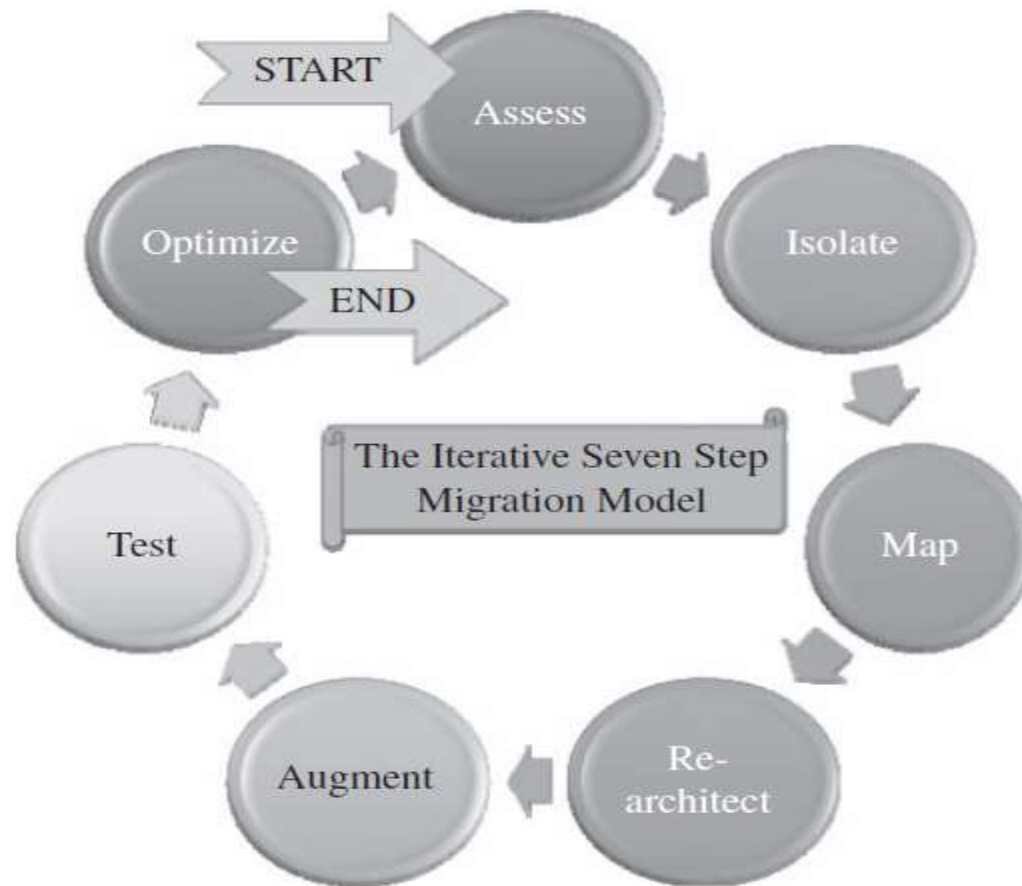
FIGURE 2.5. The iterative Seven-step Model of Migration into the Cloud. (*Source: Infosys Research.*)

Migration & Mitigation

- The biggest challenge to any cloud migration project is how effectively the migration risks are identified and mitigated.
- Migration risks for cloud fall under two categories:
  - General migration risks.
    - Several issues like performance monitoring & Tuning.
    - IPs & Licensing issues
    - Portability and inter operability issues
    - QoS and SLA Commitment issues
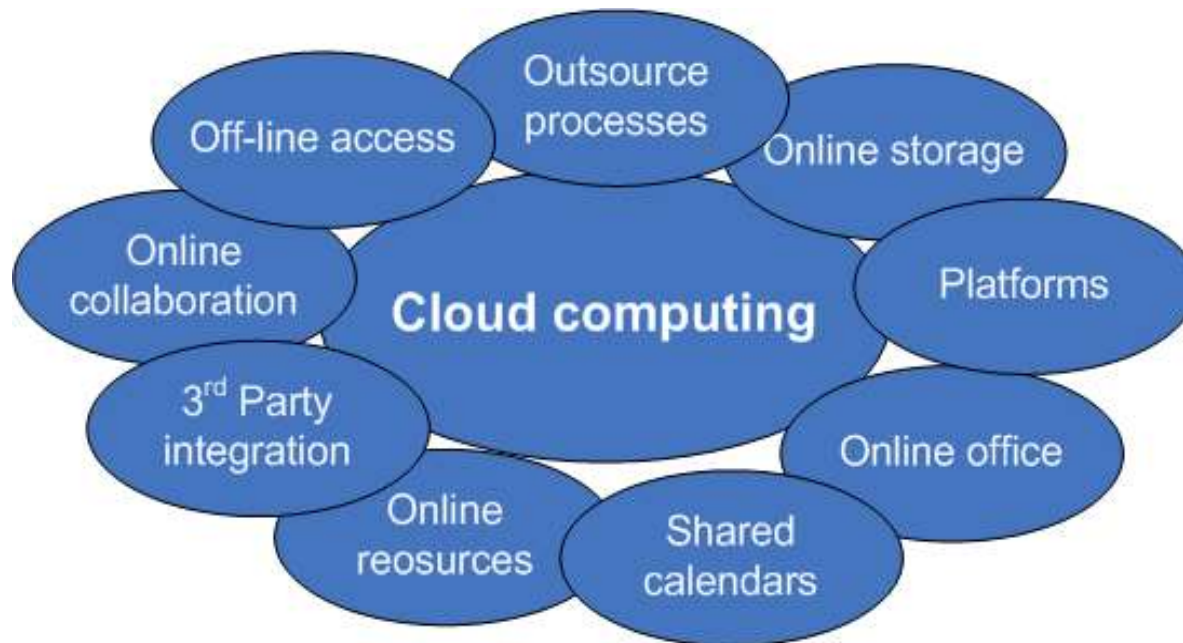   - ownership, transfer, and storage of data in the application

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- Security-level migration risks.
    - Trust & Privacy issues
    - legal compliances
    - IT data leakage

3-The Enterprise Cloud Computing Paradigm

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Introduction

- Enterprise Cloud Computing Paradigm

Enterprise cloud computing is the alignment of a cloud computing model with an organization's business objectives (profit, return on investment, reduction of operations costs) and processes.

Essential Cloud Characteristics

1. ## On-demand self-service
   - Get computing capabilities as needed automatically
2. ## Broad network access
   - Services available over the net using desktop, laptop, PDA, mobile phone

Essential Cloud Characteristics

3. Resource pooling
    - Location independence
    - Provider resources pooled to server multiple clients
4. Rapid elasticity
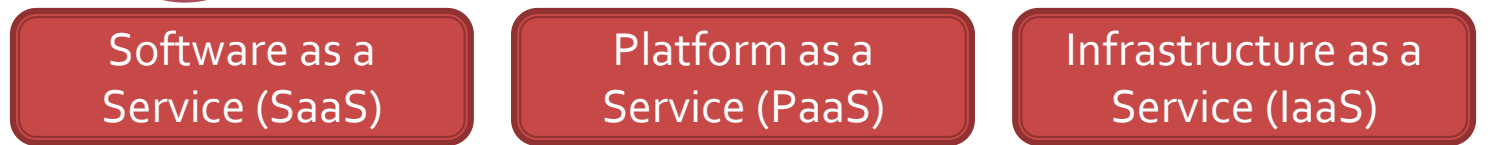   - Ability to quickly scale in/out service
5. Measured service
    - control, optimize services based on metering

The NIST Cloud Definition Framework

Hybrid Clouds

Deployment Models

Private Cloud

Community Cloud

Public Cloud

Service Models

Software as a Service (SaaS)	Platform as a Service (PaaS)	Infrastructure as a Service (IaaS)

Essential Characteristics

On Demand Self-Service

Broad Network Access	Rapid Elasticity
Resource Pooling	Measured Service

Common Characteristics

Massive Scale	Resilient Computing
Homogeneity	Geographic Distribution
Virtualization	Service Orientation
Low Cost Software	Advanced Security

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Adoption Strategy

Cloud Data Center(s) (CDC)

Scalability-driven: Use of cloud resources to support additional load or as back-up.

Availability-driven: Use of load-balanced and localised cloud resources to increase availability and reduce response time

Market-driven: Users and providers of cloud resources make decisions based on the potential saving and profit

Convenience-driven: Use cloud resources so that there is no need to maintain local resources.
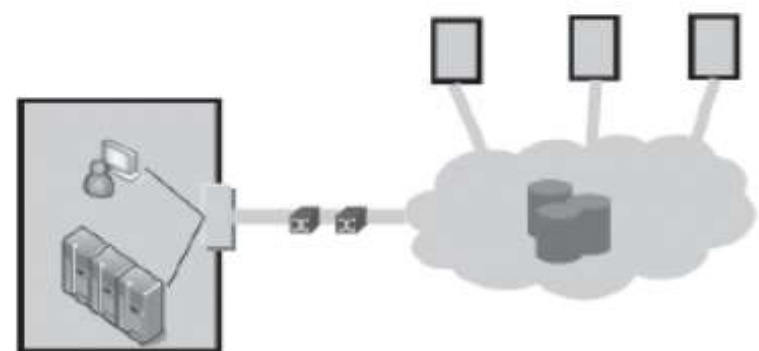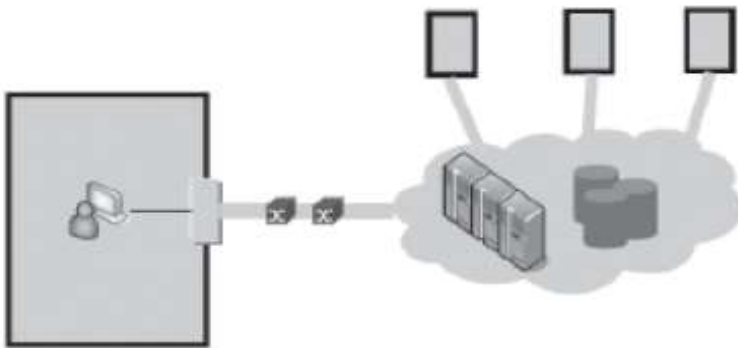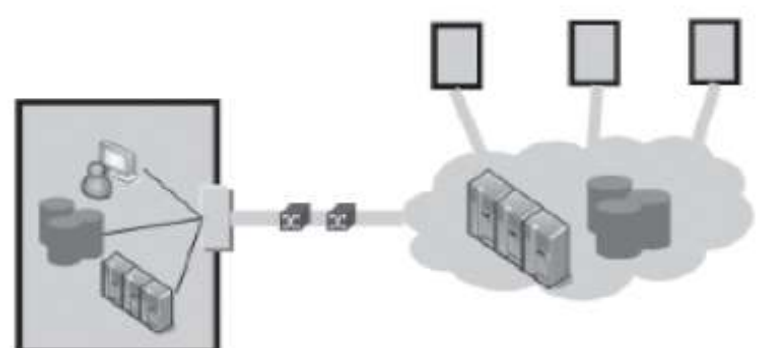
Consumption Strategy

(1) **Software Provision:** Cloud provides instances of software but data is maintained within user's data center

(2) **Storage Provision:** Cloud provides data management and software accesses data remotely from user's data center

(3) **Solution Provision:** Software and storage are maintained in cloud and the user does not maintain a data center

(4) **Redundancy Services:** Cloud is used as an alternative or extension of user's data center for software and storage

Issues for Enterprise Applications in cloud

- ERP
- However, as the market rapidly changes, organizations need new solutions for remaining competitive, such that they will constantly need to improve their business practices and procedures.
- For this reason the enterprise cloud computing paradigm is becoming attractive as a potential ERP execution environment.
- One of the first issues is that of infrastructure availability. adequate IT infrastructure, hardware and networking are crucial for an ERP system's success.
- Business Intelligence and analytical applications are relatively better suited to run in a cloud platform with a shared-nothing architecture and commodity hardware.

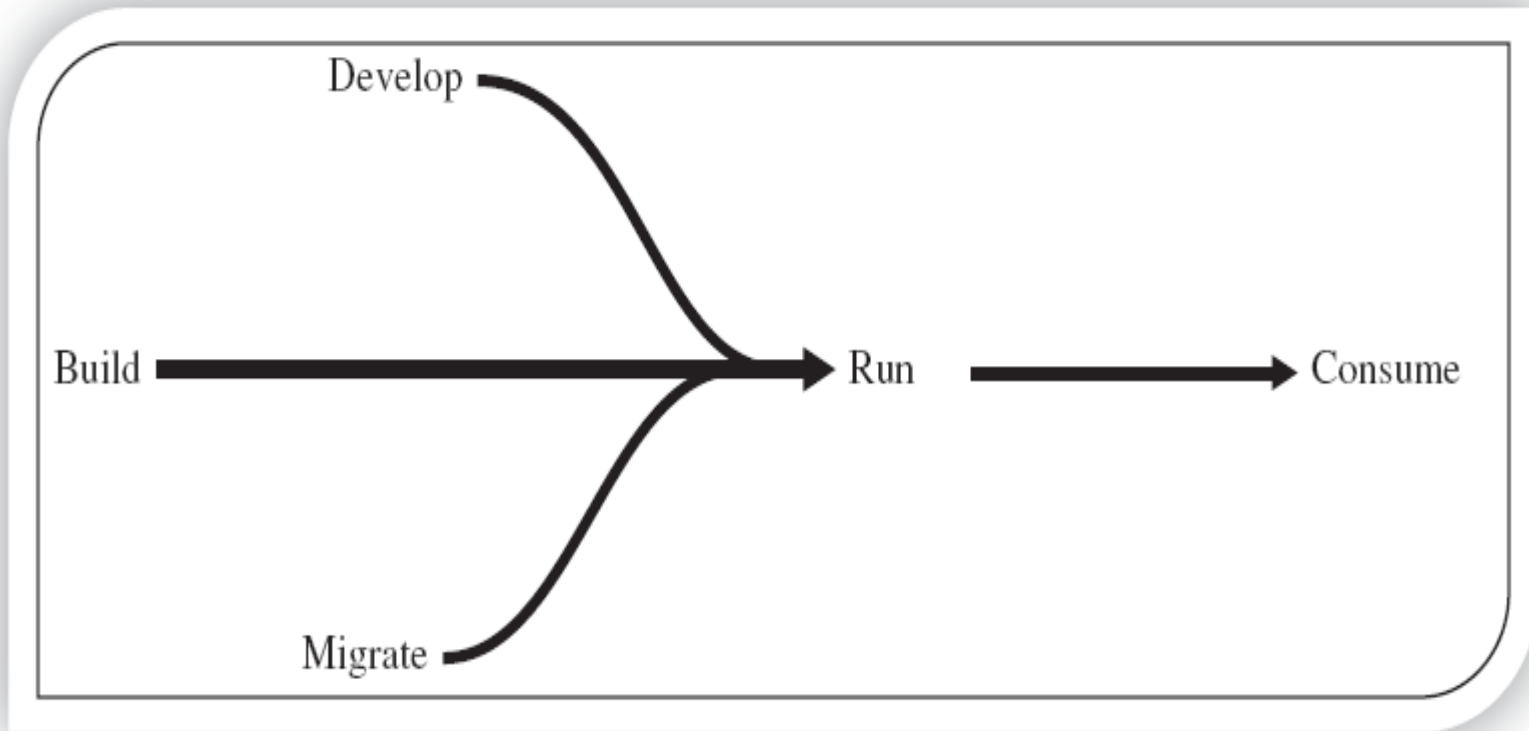# Issues for Enterprise Applications in cloud

- ERP
- Capabilities of ERP
  - Transactional Capabilities
    - OLTP (Online Transaction Processing)
    - manage transaction oriented applications(relational databases)
    - ACID properties, write/update-intensive
    - CRM (Customer Relationship Management)
  - Analytical Capabilities
    - OLAP (Online Analytical Processing)
    - Analysis, reporting, decision support
    - Read only
    - Data-intensive
    - BI (Business Intelligence)

- The challenges can be classified in five different categories, which are the five aspects of the enterprise cloud stages: build, develop, migrate, run and consume.
- The first immediate challenge of the transition is understanding of the state of their own IT assets and what is already, can and cannot be transited.
- They need to audit and evaluate what can be done from the existing infrastructure.
- If the unplanned cloud spreads throughout the organization, then it becomes coherent which is a big challenge.

- Five stage of the cloud

- The second challenge is migration of existing or legacy applications to the cloud.
- An applications migration is not a straightforward process. It is risky, and doesn't always guarantee a better service delivery.
- If the processes are made automated still the companies will face the same amount of planning, negotiation and testing.
- Not all applications will be able to handle such migration without a tedious and costly overall reengineering.

ERP Transition Challenges

- Challenges for cloud operations can be divided into running the enterprise cloud and running applications on the enterprise cloud.
- In running the enterprise cloud, companies face the difficulties in terms of the changing IT operations of their day today operations.
- It requires updating and upgrading all the IT departments components.
- Need to train the staff so they speed up.
- Once IT organizations has done these, they face the difficulty of maintaining the services in the cloud and applications on the cloud.
- monitoring, troubleshooting, and comprehensive capacity planning are actually missing in most offers.

Cloud pricing models

- Today there are two major cloud pricing models :

  - Allocation based and usage based.
- Allocation based is provided by the Amazon. It allocates the resources for a fixed amount of time.
- Usage based does not require any reservation of resource, and the cloud would simply allocate them as per need basis.
- Several variations can be done in the pricing models, like utility (pay per use) and subscription (fixed per duration charge) can be combined.
- Finding the right combination of billing and consumption model for a service is a tedious task.

Enterprise Cloud Technology & Market Evolution

- As the increasing number of organizations and enterprise are going for cloud adoption strategies and execution plans, requirements of open, interoperable standards for cloud management interfaces and protocols, data formats and so on is emerging.

- There have been so many number initiatives like Standards, Brokerage and SLA are emerging in this space :

Enterprise Cloud Technology & Market Evolution

- Standards
  - Vendor lock-in
  - OGF (for Google) OCCI for compute clouds
  - SNIA CDMI for storage and data management
  - DMTF Virtualization Management (VMAN)
  - DMTF Cloud Incubator
  - Drives adoption, Drives the market, Third party vendor
- SLA
  - Lack of control
  - Primitive vs. Sophisticated
- Cloud Service Brokerage (CSB)
  - Cloud Service Intermediation
  - Aggregation
  - Cloud service Arbitrage

Enterprise Cloud Technology & Market Evolution

- ## Technology Drivers for Enterprise Cloud Computing Evolution
  - ### Vendor lock-in
    - Barriers of interfaces, formats ,program languages and protocols.
    - Big cloud vendors like amazon,google who currently do not active in participation.
  - ### Maintenance
    - Underperforming resources lead to business and financial loss,reputation,reduced business credibility.
    - SLA can prove to be useful.
    - Currently cloud solution come with non existing SLAs or Primitives.

Cloud service brokerages(CSB)

- Sometimes, services are very complex to handle directly by the consumers.
- Enhance service delivery and service value.
- Types of CSB:-
    - Cloud service intermediation
    - Aggregation
    - Cloud service arbitrage

Cloud service brokerages(CSB)

- Widespread participation in these initiatives is still lacking especially amongst the big cloud vendors like Amazon, Google, and Microsoft, who currently do not actively participate in these efforts.
- Third party vendors will be able to develop and offer value added management capabilities in the form of independent cloud management tools

Cloud service brokerages(CSB)

- In the face of lack of control over the environment Service level agreements (SLA) can prove to be a useful instrument in facilitating enterprises' trust in cloud-based services.
- Services would become complex to be handled directly by the consumers.
- To cope with these scenarios, meta-services or cloud brokerage services will emerge. These brokerages will use several types of brokers and platforms to enhance service delivery and, ultimately service value.

Dynamic Business Model

- Business models will consider various fields, including e-business, strategy, supply chain management and information systems but will now need to emphasize the value of ICT-driven innovations for organizations and users

- For dynamic business models for ICT, it is important to incorporate general phases of a product development.

- Phasing models help to understand how innovation and change affect the evolution of the markets, and its consequences for company strategies and business models .

- The three main phases are R&D, implementation/roll-out, and market phase, which include the sub phases of market offerings, maturity, and decline
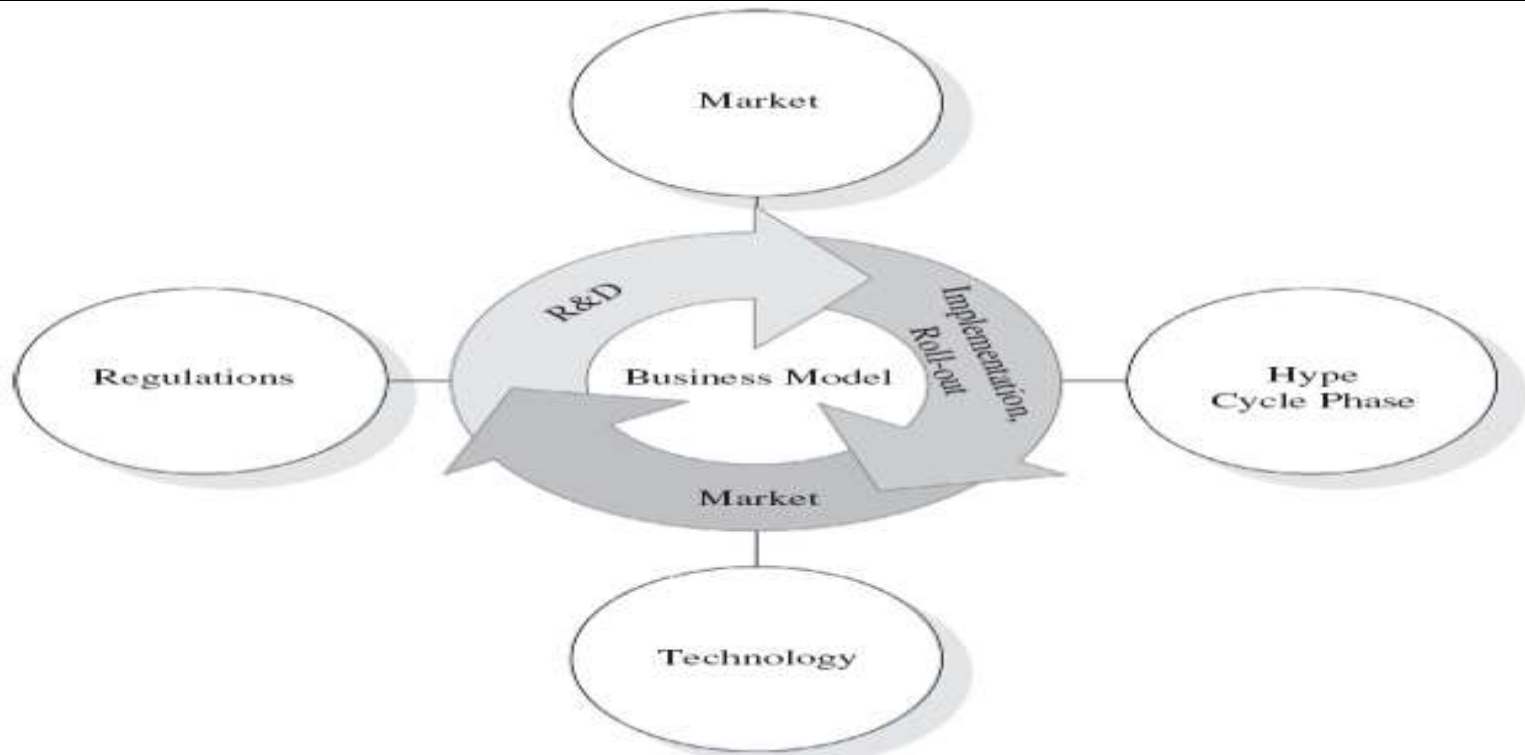
Dynamic Business Model

Figure also outlines which external drivers are expected to play a dominant role throughout the phases.
market developments and regulation can also trigger opportunities for the development of new products and services in this paradigm

Cloud Supply Chain

- The idea of C-SCM represents the management of a network of interconnected businesses involved in the end-to-end provision of product and service packages required by customers.
- The established understanding of a supply chain is two or more parties linked by a flow of goods, information, and funds .A specific definition for a C-SC is hence: "two or more parties linked by the provision of cloud services, related information and funds."
- The figure shows the flow of products along different organizations such as hardware suppliers, software components suppliers , data center operators, distributors and the customer.

Cloud Supply Chain
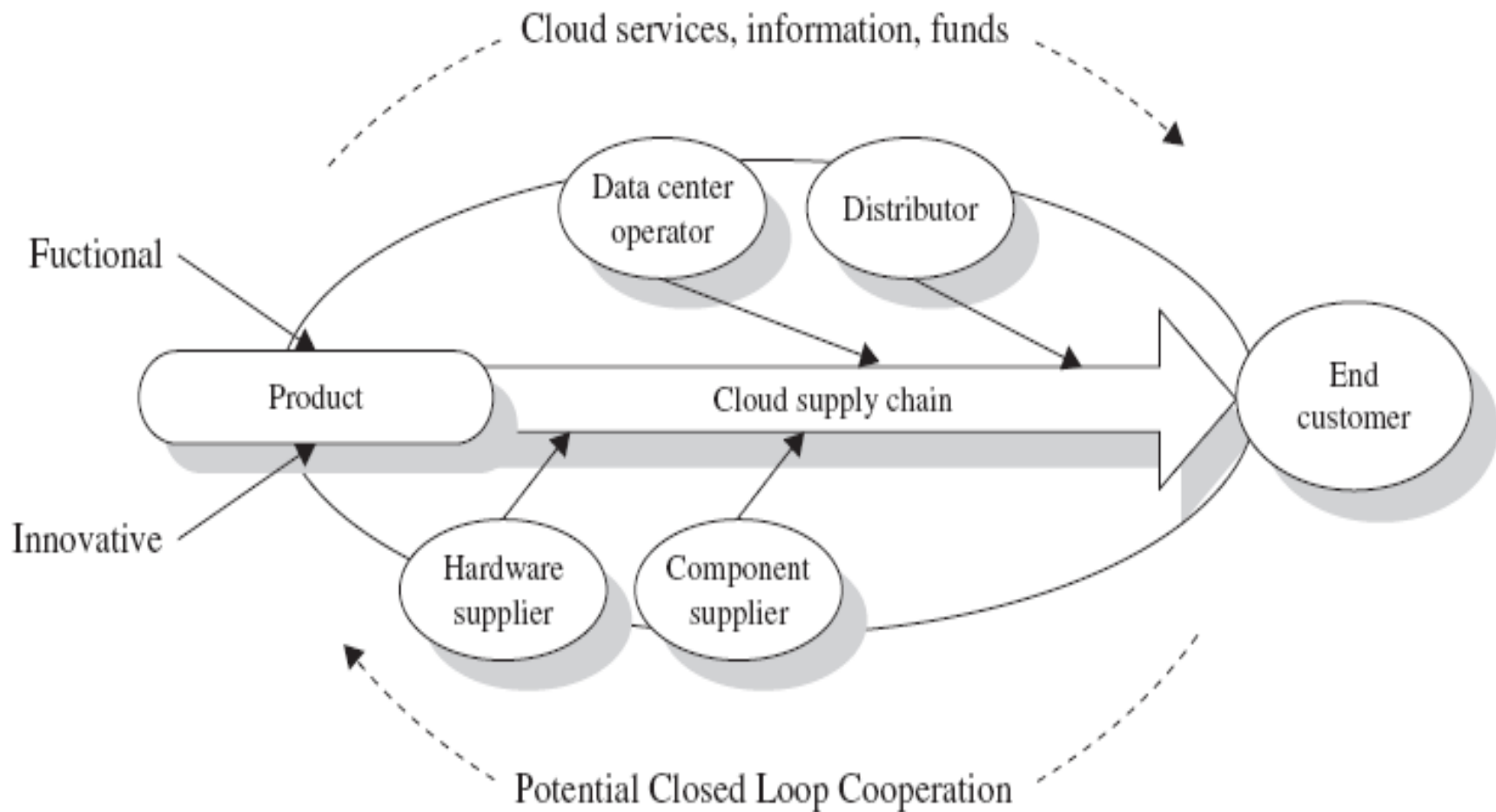
Cloud services stack for enterprise cloud

- SaaS
  - The most growth potential.
  - SaaS base applications need to be integrated to backend applications.
  - Cloud computing has given rise to alternative data storage technologies like Amazon Dynamo,Facebook Cassandra, Google BigTable etc.

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- PaaS
  - Is still in early phases.
  - Since the technologies are still evolving, providers are focus on innovation and compete nature.
  - As these technologies evolve into maturity, consolidate into a smaller number of service providers.
  - Software vendors will also join this kind of market.

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- IaaS
  - Attractive for small companies or startups.
  - Enterprises and large organizations are experiment with external cloud.
  - Cloud service providers will have to provide sophisticate monitoring and reporting for consumers.