The Paradox of Cloud Computing Adoption

Cloud Computing has been a major factor for companies of all sizes and types in determining their IT strategy. The compelling nature of the pay-as-you-go model that has minimized large capital outlays for technology projects, enhanced agility that enterprises derive with the ability to scale up/down at will, and reduced costs incurred due to sharing infrastructure established at large scales have made it highly attractive to executives. These factors also appear to make a solid case for Cloud adoption; however, the ground reality is quite different. For any enterprise, Cloud strategy is not a one-size-fits-all and depends upon the intrinsic complexities that define an organization, which in turn is based upon the nature of its operations.

Looking at various applications that exist within an organization from the outside, it appears simple to decide which applications can be moved to the Cloud and those that should be retained in-house. Yet, this is a simplistic view that ignores the context of these applications and the organization within which they exist. While the nature of any given application seems to be an obvious driver in the decision to move it to the cloud, a close look at the current landscape across various organizations reveal that the organization's size, maturity and integration with other applications are also significant drivers of the adoption. This paper attempts to take a closer look at the many complexities involved with matching any given enterprise to an appropriate Cloud strategy, and explores the drivers that explain such a disparity in adoption of Cloud services.

As a new startup, it is a simple proposition to use the Cloud for computing capacity. There are no large capital investments needed, or processes for acquisition and installation of equipment. A Cloud service to be used to provision capacity for a nominal cost. There is no need for expensive infrastructure that might be underutilized, or teams to manage the same. In case there is a need for more capacity, it can be obtained instantaneously. This increases the agility of a startup, while keeping down costs. As the startup grows, its infrastructure can also grow with it.

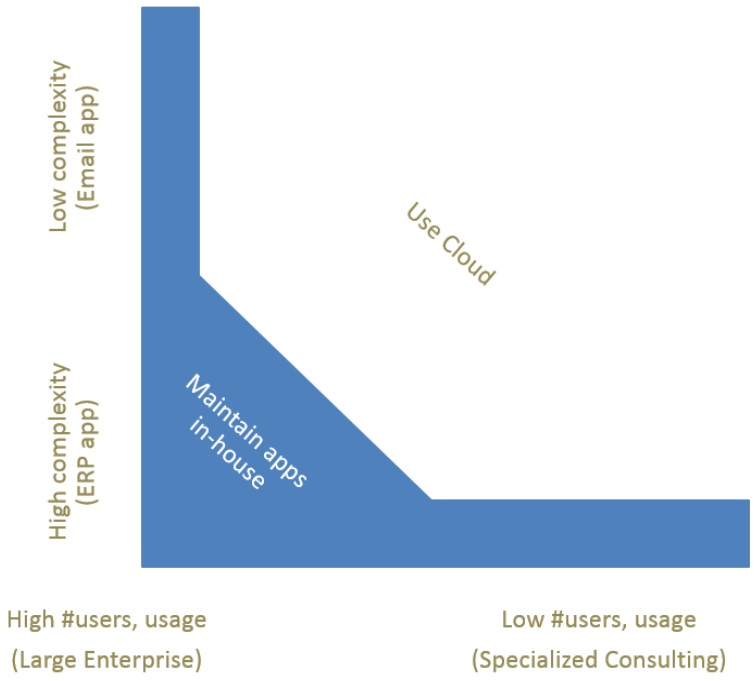
As organizations grow, the scale and scope of their IT needs/applications also increase. Large scales imply economies of scale from deploying applications in-house, reducing benefits resulting from migrating to the Cloud. With a large scope, multiple Cloud providers are needed to satisfy the organization's needs, which makes it preferable to retain these applications in-house. Although most of these workloads are unlikely to provide any economies of scale, the integration between them represents a large barrier to migration.

As with scale, the complexity of the applications used within organizations increases as they grow/mature. In the early stages most companies just need email and spreadsheets. As they grow they need tools such as Salesforce, Workday, etc. They might also use computing capacity from AWS or Google, and migrate their email to Office 365. They also begin to establish workflows that integrate these services to mirror their operational processes. While it makes sense to use XaaS services for most needs, other factors accompany growth – gradual acquisition of proprietary information, data

movement (between applications, organizational functions, and multiple sites), and regulatory mandates. These factors promote the establishment and usage of complex systems.

Examples of complex systems are ERP systems, MES systems, and Datawarehouses. They impact multiple or all functions within the organization, make extensive use of automated workflows, and generate reports at daily or hourly rests that are needed to make operational decisions. They communicate with many other applications, and interact with multiple organizational functions and impact core operations at various levels within the organization. They communicate with systems and applications that belong to their suppliers, partners, customers, and regulatory organizations. They are organization-aware and have been extensively customized to closely match the organization's operations. Losing these applications has critical impact upon an organization, bringing most operations to a halt.

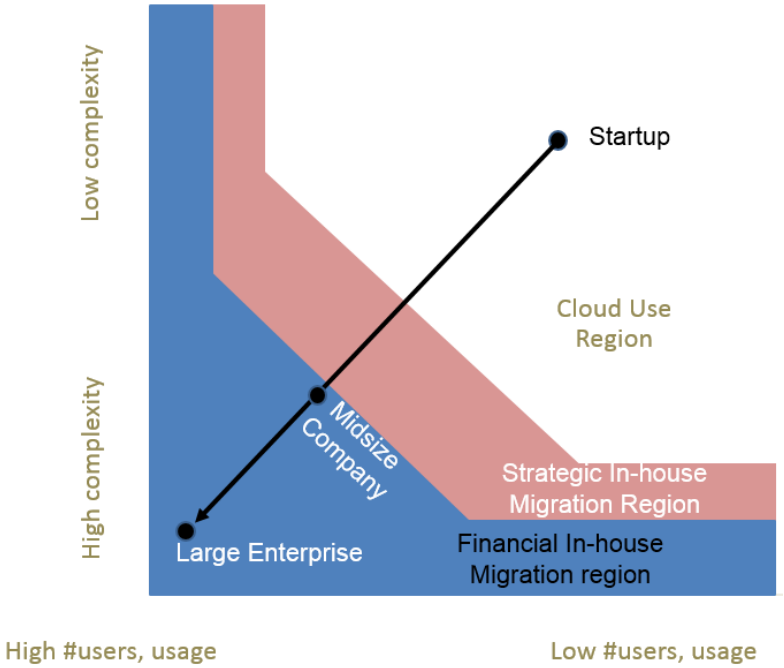
It is this combination of organizational and industry awareness, criticality of business impact, and extensive integration with other systems that makes complex systems hard to replicate within a Cloud environment. In case these systems already exist in-house, it is quite difficult to upgrade, replace, or migrate to the Cloud.



Based on the chart above, we see that organizations with large monolithic applications, or organizations with complex applications (even at low scales), should maintain these in-house. On the other hand, smaller companies with low complexity of applications are better served by using Cloud-based applications.

What would be the recommendations for an existing enterprise? Again, for an existing startup, this would be a no-brainer; in most cases, it would be to leverage the Cloud to improve agility while minimizing expenses. On the other hand, a large existing enterprise has the necessary scale to retain its infrastructure and systems in-house. It is quite easy to recommend that a new startup rent its infrastructure at AWS or build its applications upon the Azure platform. It is similarly easy to recommend that companies such as GE or Merck maintain their systems in-house. The recommendation is not so clear for medium-sized companies; they do not have a very large scale to justify in-house retention. At the same time, this is complicated by integration between applications.

How do these recommendations change with growth? When does Cloud Strategy dictate moving Cloud systems in-house or vice-versa? Let us take a look at Chart 2 to understand the impact.



Startups score low on both scale and scope of their applications, and hence are located at the top right of the above chart. As they grow, the scale and scope of their workloads increases, causing them to resemble mid-sized companies, and ultimately become large enterprises. This migration is also pictured above. At some point in the organizational lifecycle, it becomes economically imperative for applications to be migrated to in-house systems, as shown in the blue region. However, strategic considerations may pre-empt this move, within the brown region above.

What are other considerations that dictate Cloud strategy and have a bearing upon customer adoption? Some of these are listed below.

1. Variability of Workload

Workloads are assumed to be fixed or variable; in reality, they are almost always variable. They can vary at low or high rates, and this variability can be predictable or unpredictable (H&R Block during tax season vs. social media spikes during major events). It is difficult to accommodate a highly variable workload in-house or in a private cloud – the two available options are to either overbuild at a large cost or suffer degraded performance during workload spikes. A public Cloud capitalizes upon the fact that workload spikes between its customers are not correlated; if they were, the public Cloud could be susceptible to similar performance issues as well.

2. Data Intensity

Enterprises have different characteristics in terms of data generation, based primarily upon the nature of their business. Some organizations generate a large amount of data (Social Media, Insurance companies, Pharmaceutical companies, and Manufacturing companies). Others generate relatively lesser amounts of data (early-stage startups, mobile app companies). It is relatively easier to migrate low data intensity applications to Cloud providers, and such migrations are likely to involve lower operational costs as well.

3. Externally generated data vs. internal

Companies also differ by where their data is generated. Social media companies experience externally generated data, whereas Pharmaceutical or Manufacturing companies generate their data in-house via test or manufacturing equipment. It is not easy to migrate these to the Cloud due to the data volumes involved, and if there are Compliance and IP considerations involved (see #5 below).

4. Interoperations between applications, and data movement within the enterprise

Companies could have several standalone applications with relatively limited interaction. For example, Twitter's Operations, internal email, and financial systems minimally interact with each other, if at all. On the other hand, an insurance company's Claims applications, Data Warehouse, Marketing applications, and email systems (workflow) are all linked with well-defined data flows. Here it would be a significant task to replace any of these components to a Cloud-based service.

Another hurdle with high interoperability of applications is large scale data movement within the organization. Various functions and locations within an organization access data created by each other;

internal network connections are created to implement and optimize these data flows, which is a complex task to accomplish across locations and service providers.

5. Legacy issues and IP considerations

Cloud service providers support most modern protocols, such as SOAP and REST within their PaaS offerings. However, they do not have support for legacy protocols that are in use at enterprises. This constitutes a significant hurdle that cannot be easily overcome. This is not an issue for new companies, but a rather significant issue for established companies that have been in business for many years. Organizations will continue to replace such applications with new services where feasible, but this is a slow process.

6. SLAs and OLAs required by the business

Corporations are increasingly required to provide SLAs and OLAs to their customers for all operational aspects of their business. These flow back to the Business Applications and IT Operations as corresponding SLAs/OLAs. In case an application or a set of applications are migrated to Cloud providers, corresponding SLAs/OLAs need to be established with the Cloud providers. This may or may not be possible based upon options that the provider offers, may be financially prohibitive, or difficult to enforce. Amazon offers a 99.9999% availability for its EC2 infrastructure, yet we have had several outages that violate such an SLA. However, the contract would have been written in the provider's favor, insulating them from serious financial impact, and usually limited to the amount paid for the service feature that failed. However, the damage to the customer's reputation and financials is immense.

For example, a provider that offers a 99.9% SLA would remain in compliance with a single 8 hour outage during an entire calendar year. Would EBay or Amazon tolerate this one week before Thanksgiving?

7. Regulatory and Compliance limitations

Regulatory and compliance issues are little understood by most players in the Cloud business; even industry experts can be misled by some of the provider certifications. The reality for companies is that they are responsible to their customers, shareholders, and to regulatory authorities for enforcement of privacy, security, and integrity of their customer data. Cloud provider certifications mean that these providers follow best practices; however, in case customer data is lost or compromised, it is hard to see that the Cloud provider would step up to take financial responsibility. Even worse, smaller providers might simply close their doors, leaving all their customers in an extremely difficult situation.

8. Impact of network costs

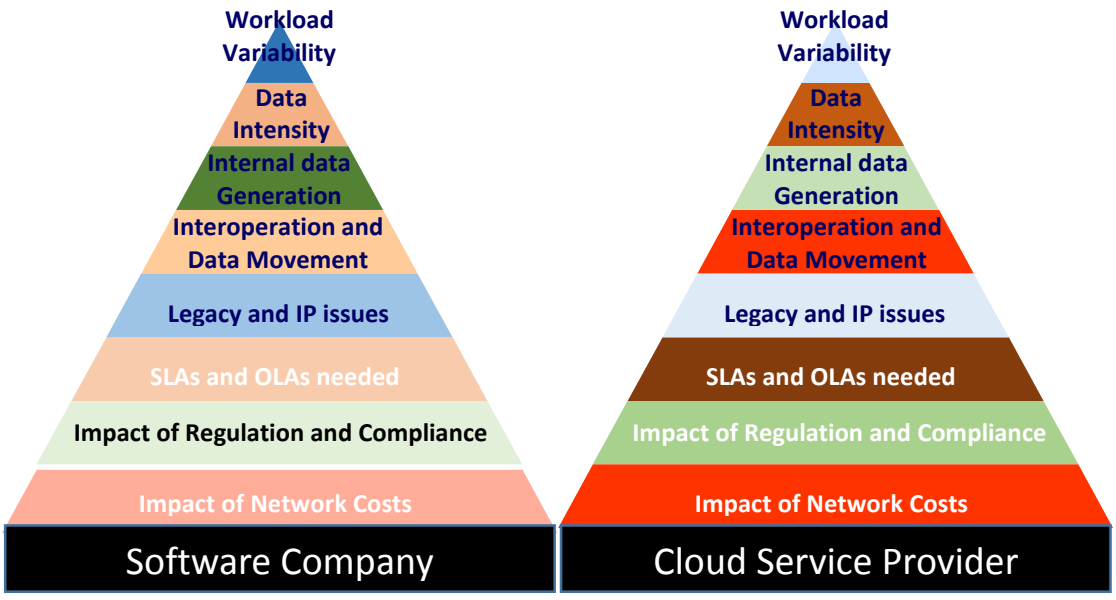
Network costs are a major source of expense for organizations in the present situation, representing significant chunks of IT/Telecom budgets for most. The reasons that these are exceedingly high are due to the nature of large capital projects for network capacity, and the small number of providers operating as an effective oligopoly.

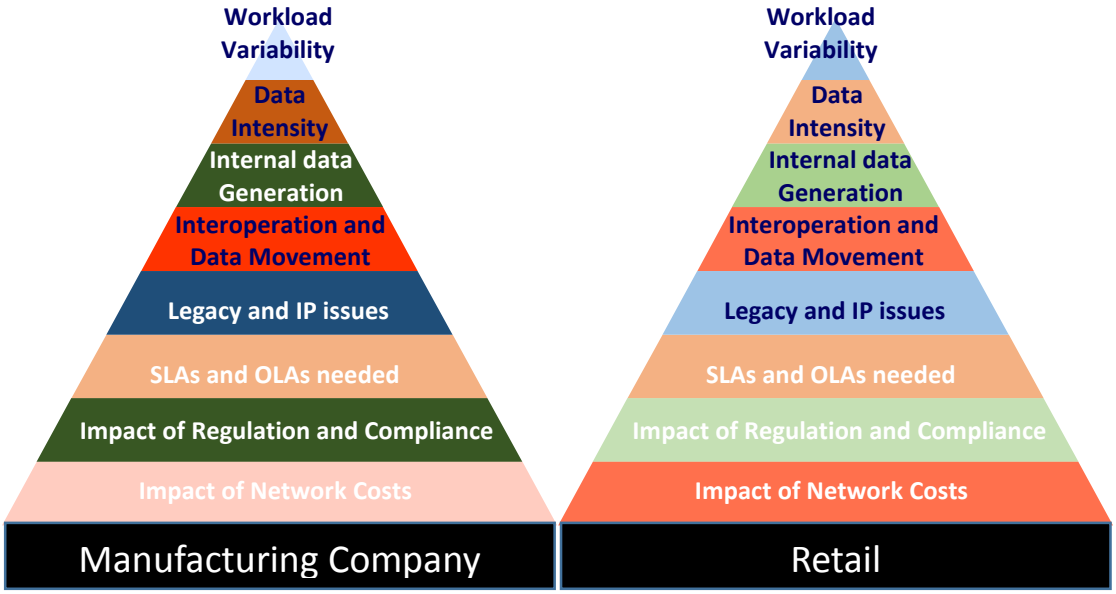
With migration to the Cloud, there is an increase in network traffic, and a corresponding increase in costs for companies on multiple accounts.

- All client access will move data to external providers.
- Movement of data occurs between multiple applications/providers
- Data communication to/from in-house legacy applications
- Movement of internally generated data to external providers

Each of the above items represents data that was being moved within the organization's Local Area Network (LAN), and will now be routed over the Wide Area Network (WAN) of a telecom provider. LAN costs are relatively very low, and provide a stable and high performance network path, whereas WAN costs are quite high, even at much lower bandwidths. In addition, usage of WANs introduces significant latencies that applications may or may not be able to tolerate. WANs are also more susceptible to failure than LANs as well. This represents a reduction in the reliability of network and application infrastructure.

Let us examine the impact of these factors on a few types of companies. Dark colors below indicate strong impact based on this dimension and lighter colors imply lesser impact due to any given factor.





It is clear that each of these types of companies have distinct profiles based upon the combination of these eight dimensions. Existing companies have operations and IT systems that reflect these profiles, and look for these requirements to be met by Cloud services. In case these requirements are not adequately met, it constitutes a barrier to migration. These profiles are likely to be similar for companies within a particular domain, irrespective of size.

In addition, there are a number of factors that inhibit rapid Cloud adoption by customers. We will explore these, and identify conditions that would speed up this process, and offer our recommendations for Cloud providers in the concluding part of this paper.