

# Cloud Computing and its Leveling Impact between Developed and Emerging Economies

Easwar Krishna Iyer, Widya Cholil and Tapan Panda

## ABSTRACT

*This paper looks at Cloud Computing as a new wave technology option and the leveling impact that it has got between developed and emerging economies. The paper analyses the four vectors of threat for cloud computing adoption using the tetra-threat framework, a structure that analyses the sustainability of competitive advantage. In the context of emerging economies, the paper explains the cloud acceptance patterns of predominantly 'new customer' emerging markets with two countries in perspective – India a BRIC nation and Indonesia a MIST nation.*

**Key words:** *Cloud Computing, Emerging Economies, Sustainable Advantage, Tetra-Threat Framework*

## 1. Introduction

Technology in general and mass-adoption technologies in particular has always leveled the playing field across businesses, economies, individuals and nations. The arrival of the Personal Computer in the 1980s and the ubiquitous acceptance of the Internet in the 1990s reduced information arbitrage between the developed world and the new age developing world. The computer-internet duo eliminated the advantages of size, scale and scope hitherto held by a smaller and privileged eco-system and created an equal opportunity platform for all firms to reach out to global markets – be it to raise capital, or to source raw material or to finally sell their end produce. The explosion of the dot com business at the turn of the millennium was a definitive expression of this new found reach. The bubble bursting later is only a manifestation of Darwinism playing out in the digital landscape.

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Today, Cloud Computing is at the threshold of creating another level playing field – reducing investment arbitrage. ICT investment is today a prime driver in the success of any industry / firm. Gathering, storing, retrieving, analyzing and interpreting information is the key to understanding environment dynamics, thereby improving business advantage. Platforms like ERP, CRM, SCM, DWBI and the likes are all key engines created with the technology backbone to levitate businesses to the next levels of performance. Yet, the acquisition and effective usage of these tools require a significant upfront capital investment. This again gives an undue advantage to players having the capacity to go for investments. Scale rules the game. Thus, though the information is ubiquitous, thanks to the internet, its effective assimilation, storage, processing and usage is not on a level ground till the arrival of cloud. Cloud significantly reduces upfront CAPEX investment and simultaneously offers a lesser OPEX environment. One can think of cloud as the enabler of democratization in data processing. The value-add possibilities are immense.

Several studies have been conducted and documented on the economic impact of the

acceptance of cloud as a business offering. The section on literature survey will list them in fair detail. Most of these studies are survey driven and user perception driven. This paper tries to fit in the sustenance of Cloud Computing as a business offering in the tetra-threat framework proposed by Pankaj Ghemawat [1]. The analysis is done using the same framework at two different levels. At level one, the industry which is analyzed is the entire ICT industry itself. In the context of ICT, Cloud Computing comes across as a substitution offering. As will be seen later, substitution – be it in technology or any other realm - offers optimality for new customers while being a sub-optimal option for existing customers. Since the growing markets of BRIC and MIST nations will have significantly more ‘new’ customers - given the currently low technology penetration – any new wave and cost effective technology will have a higher acceptance in the emerging world than in the developed world. The argument is applicable for the entire emerging markets and the two countries in mention – India and Indonesia are only illustrative examples.

At a second level, the same tetra-threat framework is imposed upon cloud, treating it as a stand-alone fledgling industry. The sustenance of the cloud offering is studied in the context of the framework’s four possible threats – imitation, substitution, holdup and slack. This second level analysis tries to understand the reasons for the inhibition in cloud adoption today despite a fairly clear appreciation of the gains. The structural analysis is supported by some survey data from Indian as well as Indonesian SME respondents who are on the threshold of a possible cloud adoption.

## **2. India and Indonesia – A Comparison**

India and Indonesia have much more in common than a similar sounding currency. India, the fastest growing BRIC nation (the others being Russia, Brazil and China) and Indonesia the fastest growing MIST nation (the others being Mexico, South Korea and Turkey) have many common strengths and weaknesses. Indonesia started with a hyperinflation economy in the

1960s, but by using a series of price stabilizing measures achieved a sustained GDP growth of almost 7% for three consecutive decades before being temporarily set back by the sweeping East Asia Crisis in the late 1990s. The crisis caused the Indonesian economy to contract by an unprecedented 13% in 1998. But from the turn of the millennium, the country is back to the growth path and is registering a growth rate of around 6.5% in the new decade. Indonesia is now poised to join the trillion dollar economies with its current GDP hovering around the 900 billion USD mark.

India on the other hand had a flat and nominal growth rate of just about 3% till the economic liberalization was ushered in in the early 1990s. Since then the country has never looked back and is now one of the fastest growing economies in the Asian block lagging only behind China. Despite liberalization and considerable privatization and disinvestment, India still continues to be a dirigiste economy with its ruling class still having a neo-socialistic hangover of the Nehruvian era. In GDP terms, India is twice the size of the Indonesian economy and is expected to join the 2 Trillion GDP club by 2014.

On the positive front, both nations are attracting a lot of global investment, have stable democratic governments, are ICT friendly in terms of governmental regulations and have been insular to the most recent recession that has been holding the western world in a vice-like grip since 2008. Yet, on the flip side, both India and Indonesia have a lot to catch up in terms of power grid quality, internet penetration, broad band availability and data security management. As we shall see soon, a significant ramp up in these vectors will catapult both the countries to the top of the pile in the respective Goldman Sach groups to which they belong – BRIC and MIST.

## **3. Literature Survey**

As mentioned in both the abstract and the introduction, the cloud computing environment is analyzed using a framework called tetra-threat

framework which has been proposed by Pankaj Ghemawat [1]. The model will be explained in fair detail in the next section. Comparison between Indian and Indonesian economies has been mostly taken from the internet, blogs and consultancy reports. One of them is an economic cum historical perspective offered by Thee Kian Wie [2]. The state of cloud readiness in Asia is given in the Asia Cloud Computing Association Report [3]. The report analyses the cloud industry as a function of attributes like Government Regulations, Data Protection Policy, Business Efficiency Index, Risk Management, Broadband Quality and the likes. Another white paper on the State of Cloud Computing Security in Asia by Dave Asprey gives indications of why businesses are still hesitant to move towards the cloud [4].

Coming to the research world that has reviewed the emerging area of Cloud Computing and its potential impact on business, cloud has been defined as *'The illusion of infinite computing resources available on demand'* by Michael Armbrust et al in a marquee paper from Berkeley [5]. The paper by Vaquero et al provides a more complete definition of cloud and associates various systems and stakeholders involved with cloud [6]. Yashaswi Singh et al have come down from the strategic perspective to the tactical and explained the storage of data in cloud environment and its associated security issues [7]. Moving to the literature available on the Indian SME sector, Amit Singh Sisodiya talks about the challenges that the sector faces amidst deregulation, globalization and rapid technological disruption [8]. Monika Sharma et al talks specifically about the ERP cloud adoption by the SME diaspora and its associated cost savings [9]. The work done by Kaushalesh Lal takes one closer to the interdependence of SME and technology and explains the leveraging power of ICT in augmenting the existing labor productivity [10]. Incidentally consulting houses like KPMG, Gartner and Forrester have done extensive studies on global acceptance of cloud computing by small to medium size enterprises. The list is very long and hence the consulting house reports have not been given a specific citation.

Moving to some of the research work specifically done in the Indonesian cloud context, Charles Lim et al specifically evaluate the risk of cloud adoption with Indonesia in context [11]. Sinung Suakanto et al bring in some performance measurement matrices in the context of Cloud Computing Services [12]. Roland Tumbelaka et al compare the solution providers in the current Indonesian market and examine various business models in the realm of cloud computing [13]. Finally, Dedi Rianto Rahadi et al look at cloud computing implementation from the Indonesian SME perspective [14]. Many of the papers in the Indonesian context are analysis done on the service provider side.

Some of the authors of this paper have done some previous work in similar lines. Easwar et al look at the drivers and inhibitors of cloud adoption with a specific SME sector perspective [15]. The data in this work is Indian SME data. Easwar et al have also done studies on the Net Present Value (NPV) behavior for full vs. fractional adoption of cloud [16]. The study looks at the unknown fears of cloud adoption which stretches across dimensions like security, privacy, variability, redundancy, down time, contract breach management and the likes and develops a mathematical model to monetize these risks. The Net Present Value studies done were converted into a cash flow model with variability analysis also built in by the same authors [17].

As can be seen, most of the work done so far has been survey driven and response analysis driven. This paper builds on the established knowledge framework that has already been gathered empirically and proceeds to build a conceptual analysis framework which can assess the sustainability of competitive advantage of the cloud computing platform using the Tetra-Threat Framework.

#### **4. The Tetra – Threat Framework**

The tetra-threat framework analyses the threats to sustainable performance for any business from two perspectives – nullification of added or scarcity value and difficulty in appropriability or

capture of the added value. Added value is the scarce and therefore highly utilitarian value originally created by the industry / firm. This scarcity can be diluted and the value proposition of the original added value can be negated by two threats - Imitation and Substitution. These are two of the four threats in the tetra-threat framework. Imitation represents the 'duplication' of the original added value and is a direct threat to sustainability. Imitative development of scarce resources is all-pervasive and undermines the value of scarcity. Substitution is an indirect way to weaken the added value and is a 'displacement' technique compared to the duplication route of imitation. Imitation expands the supply of added value (by duplication) whereas substitution reduces the demand for a given added value (by displacement) by bringing in a 'superior' added value.

The full realization, capture or appropriability of the value already brought to the table can be subverted by two more threats – Hold Up and Slack. Together, the foursome of threats is referred to as the tetra-threats for performance sustainability. Hold up is a measure of the inability of the firm / industry to appropriate the added value because the value tends to get 'diverted' to complementary players in the system. Hold up is an external threat to value appropriability. Slack on the other side is an internal threat to the full realization and capture of value. Slack indicates a tendency for persistent internal sub-optimization. Slack threatens to 'dissipate' the hard-earned added value.

Picking up the 4 Ds mentioned in the last two paragraphs, the four value annulling routes in business sustenance are *Duplication, Displacement, Diversion and Dissipation*. This paper analyzes the effect of the 4Ds in the context of Cloud Computing in two levels. At level 01, the entire ICT (Information and Communication Technology) industry is studied as a holistic ecosystem. Once the implications at that level are understood, at level 02 the sub-ecosystem called Cloud Computing is independently studied using the same framework.

## 5. Tetra-Threat Framework in the Context of ICT Industry [Level 01]

This paper proposes to do a two level Tetra-Threat Framework analysis of the Cloud Computing Industry. As mentioned earlier, at level one, the entire ICT industry is considered in its entirety. As far as the ICT landscape goes, Cloud Computing – as a business proposition is a Substitution entry. As explained below, the arrival of Cloud triggers the concept of displacement of added value. In this context, added value should be measured ex-ante to cloud arrival and compared ex-post after cloud arrival to get a sense of the displacement of value. The level 01 Tetra-Threat diagram is shown in Figure 01 [attached at the end of the paper as Appendix 1].

That Cloud Computing is a 'substitution' platform is highlighted by the following arguments. Cloud Computing moves the market from buying the product called computers to buying the underlying service called computing. Cloud Computing is a substitutional switch from asset ownership to asset utilization. Cloud Computing relieves the buyer from expensive upfront capital investment. Firms in a fund crunch would prefer to use up their precious high-cost initial seed capital to build assets that drive their revenue growth. In such a capital constrained scenario, any option of deferring capital investment will ease out the initial cash flow pressures. IT investment is a sunken cost for all firms except IT firms and hence firms – given an option like Cloud Computing – can choose the option of deferring upfront investment. Continuing on the 'substitution' pitch, Cloud Computing switches rigid fixed costs to flexible variable costs. Cloud converts current CAPEX (capital expenditure) to deferred OPEX (operating expenditure). Thus, from many perspectives, the Cloud offering is a substitute to the traditional in-house asset heavy computer usage model.

Once Cloud Computing – as a business proposition – is understood to be a substitution move, it now needs to be established that such a move will be more beneficial to emerging markets like BRIC and MIST nations. Any

substitution is a suboptimal offering for the existing consumers and an optimal move for the new consumers. A few examples will drive home this point.

Take mobile telephony and its rate of growth in developing countries. Both China and India have a higher mobile usage than traditional land line usage. When mobiles first came to the market, the population who did not have any communication tool quickly went for the 'mobile only' option skipping land line. When electric cars come to the market in a big way, faster acceptance would be by those populations who are not saddled with an IC engine car. Those with an IC engine car will be slower to adopt the new age car since it is a suboptimal solution for them. Another example is the modular kitchen which is gaining a higher acceptance from those who are getting their flats and apartments currently ready. People who have an existing house with traditional kitchen will find that the switch to modularity requires heavy civil engineering reconstruction. One can similarly think of many lines of business where the new substitute product is an optimal solution for the new customer. Mobile telephony, electric cars and modular kitchens are all examples of substitution platforms. They all offer a suboptimum solution to the existing user biosphere.

Coming back to cloud, between switchers and new adopters, the diffusion of new technology will be more with new adopters (developing emerging countries) than switchers (developed countries). Both MIST nations & BRIC nations have low ICT penetration today. Hence the acceptance of this substitution technology will be higher in the emerging world. For developed countries, there is a clear sunk cost to be taken care of in terms of existing capital already invested in traditional non-cloud platforms. A case study in the Asian context is Japan which is more reluctant to go to cloud than its emerging economy neighbors. Scaling the argument down from countries to firms, the smaller and new adopter SME firms are globally more receptive to Cloud than the established IT asset-heavy firms.

## **6. Tetra-Threat Framework in the Context of Cloud Computing Industry [Level 02]**

At the second level, we analyze the sub-industry within the ICT – the nascent Cloud Industry. The level 02 Tetra-Threat diagram is shown in Figure 02 [attached at the end of the paper as Appendix 2].

When the tetra threat framework is considered specifically in the context of cloud computing, then several real as well as perceptual threats to its sustenance can be mapped. The eco-system now comprises of only cloud vendors and service providers. The inhibitors for the penetration of rapid cloud usage can now be understood from this framework. It can be shown that though adoption and usage potential is more for the emerging economies, on the flip side, the sustainability threats are also more for the same economies. This is particularly so in the context of value appropriability because of the threat of Hold up.

For improving penetration and user acceptance, the industry is advised to look at the level 02 diagram holistically and come up with integrated solutions rather than take a piecemeal approach. The tangible and measurable gains of cost, technology and convenience are getting obscured by latent, real and perceived risks associated with security, efficiency and vendor reliability. Each of the four tetra-threat vectors is now dealt with in some detail.

### **Imitation**

Imitation represents the duplication of the original added value and is an endemic risk across all industries. The drivers for this risk can be divided into two broad classes in the cloud context. Primarily imitation risk comes from the intermediary vendor who essentially is a multi-offer integrator. He is typically the SaaS provider at the last mile and integrates the infrastructure and platform support from other hardware vendors in the cloud space. In product analogy terms, he represents a value added reseller. By and large, these last mile SaaS

vendors go for pure third party hosting of their services. So for a market at the threshold of cloud adoption, the intermediary vendor is perceived to have a soft and easy exit route since he has got no sunken capital. Some of the exit stories of fly-by-night operators only tend to increase the 'reputation fate sharing' of other genuine value adding operators. The other class of players who contribute to the imitation threat are the IT majors who are essentially software service vendors, but migrating now to the cloud selling space. Though they will have no dearth of scale or scope, their sustained interest in the new cloud vending route can come under radar.

To put it in simple terms, the adopting market does not find a simple provider-user relationship in the complicated cloud market. Hence there is a perceived ambiguity of escalation point for the end user when he perceives trouble. As will be seen in the subsequent section, vendor related dilemma has been given the highest risk score by Indian respondents.

### **Substitution**

Cloud itself was a substitution move into the ICT market a few years back. So its substitution in the immediate future is not a high possibility. But technological advances combined with business model hybrids do pose a few substitutes to the cloud. When we talk about cloud as a business offering, we allude to the public cloud with its distributed revenue possibilities. Public cloud has two substitutes in the form of hybrid clouds and private clouds. High end customers who understand the value proposition of cloud can migrate to their own internally operated private clouds, thereby reducing the growth potential of the public cloud offering vendors. It is akin to firms developing their own versions of crude yet internally effective ERP systems thereby depriving the ERP vendor of a business opportunity.

Another business model substitute for the 'pay-as-you-use' cloud offering is the freemium offerings like Drop Box, Google Drive, Sky Drive and the likes. Unless the user wants premium upgrades, the basic no-frills offering comes as free. This can impact cloud penetration

in the typically low usage emerging markets where the free version would currently serve the purpose of a significant chunk of customers.

Social networking sites are today doubling up as cloud providers offering bare services. An example is Buddy Cloud which is a file / data saving and sharing platform. Customers can build many applications and uses intelligently built around such offerings.

Finally customized hardware options like FPGA [Field-Programmable Gate Arrays] offer speed and power consumption improvements of over two orders with respect to conventional processors. Hence for analyzing big data – an area where scalable cloud computing is a strong entrant – customized options like FPGA offer a substitutional possibility.

Many of these options are nascent and have not gained high end user penetration. But then, cloud computing itself is a new technology and it has peaked in the Gartner hype cycle only as late as 2009. It remains to be seen how the paid cloud subscription market will sustain its momentum in the face of competition from private / hybrid clouds, freemium models and social networking sites.

### **Holdup**

Inability to capture the full value potential of cloud offerings because of systemic Holdup driven by several external factors appears to be the most potent threat for high cloud acceptance. The most obvious threat – real as well as perceived – in the cloud ecosystem is the threat of data security. Potential buyers would be quite wary of the privacy and confidentiality of their data. The fear of data security stems from the threat of external abuse. Denial of Service attack (DoS), Distributed Denial of Service attack (DDoS) and its variants are examples of external abuse.

A holdup situation can also be driven by unfriendly government policies on ICT. Emerging economies like Philippines, Vietnam, Thailand and Indonesia have a relatively low score in Government prioritization of ICT (3.5

to 4.5 out of 10). Countries like Japan, Hong Kong and Singapore are high up in this list (8.0 to 9.5) with India having a better than average score of 6.6 [Asia Cloud Readiness Index Report, Ref. 3]. The government policies will combine with regulatory frameworks for licensing requirements and IP protection to make or mar the growth of the Cloud.

In addition, external support factors like internet connectivity, broad band availability, broadband quality, power grid quality etc will all add up to the Holdup perspective. In most of these parameters, the emerging economies score worse off than their developed counterparts. Sometimes select consumer groups can themselves double up as a Holdup factor. Banking sector and Government sector could be considered as two sectors that could impose their own constraints in how to run the cloud-based operations. Since cloud – as mentioned earlier – operates on a multi-vendor platform, performance accountability cannot be pinned down. This also creates a hold up.

## **Slack**

Slack is internal sub-optimization of any system. If DoS and DDoS represents external threats to data security, malicious insiders with access to client data can act as data security threats from inside. Poor hiring standards coupled with low moral / ethical quotient can lead to slack driven security threat. Also, vendors not keeping pace with technology, not ramping up resources, not investing at the right time all this is the slack element that threatens the sustenance of cloud. Though malicious intent would have no emerging market specificity, inability to ramp up and keep pace would definitely have.

## **7. Some Gain / Risk perception data from India and Indonesia**

Though this paper is primarily a conceptual research paper aimed at fitting the cloud computing environment into the tetra-threat framework, some preliminary data has been gathered on ex-ante consumer perception to cloud acceptance. The data has been collected from one BRIC nation India and one MIST

nation Indonesia. The sample space of 50 (India) and 30 (Indonesia) is chosen from a random diaspora of SME firms, fairly well divided between manufacturing and service sector. A respondent population that has not yet adopted cloud services in any significant way is consciously chosen and hence our responses are purely perceptual and do not reflect a post-buy usage driven feedback.

In gain perception study, three gain vectors have been identified – Cost Gain, Technology Gain and Convenience Gain. Deferred capital expenses [CAPEX] gain and reduced operating expenses [OPEX] gain together constitute the Cost Gain Vector. The speed and innovation that the cloud vendors can bring constitutes the second Technology Gain Vector. Dynamic innovation of cloud offerings is something that cannot be matched by the individual technology buyer. Scalability, flexibility, customization and mobility ushers in the third dimension of posited gain i.e. Convenience Gain Vector. In a traditional platform, capacity up-scaling is possible. Cloud offers the unique convenience of up-scaling and down-scaling.

As far as risk perception goes, any new technology comes in with a set of risks – real, latent or perceived. For sectors like SME which are fairly new to technology adoption, this perception of risk will only be heightened. Cloud adoption risks are again plotted along three vectors – Vendor Risk, Security Risk and Efficiency Risk. Fear of lock-in with an incompatible vendor, lack of guarantee of business continuity and service availability, reputation fate sharing with a vendor and unclear licensing issues come under the portfolio of Vendor Risk. Data security, data privacy, data confidentiality and loss of governance & control of IT delivery cover the second dimension of Security Risk. Latency, downtime management and data transfer bottlenecks sum up the last risk on Efficiency. The risks and gains enumerated have been arrived at after extensive literature review.

The Gain and Risk perceptions plots for India Vs. Indonesia is given in Figure 03 [attached at the end of the paper as Appendix 3].

As far as gain goes, convenience is the least perceivable one before real usage. The advantage of scalability and flexibility is probably difficult to perceive for the ex-ante user. Hence respondents from both countries have pushed convenience related gain to the third slot. On the contrary, both cost gains and technology gains are more easily understood even before adoption. India has voted heavily for the cost angle of the cloud gain which Indonesia has cast an even vote for cost and technology. On the Indian side, the cloud promotions are primarily driving the potential buyer to the attendant cost benefits. Indian Cloud vendors like Ramco focus their ads on slogans like 'No CAPEX', 'No Maintenance Cost' etc. This could have tilted the Indian scale in favor of cost.

Coming to risk, Indonesia, which is more recent into the cloud scene compared to India, has uniformly spread its risk profile across all the three vectors. The most obviously perceived risk of security risk gets the highest vote among fairly comparable votes. India has put vendor related risk at a higher plane compared to the other two risks. It only indicates a heightened perception of the Imitation and Holdup scenarios that was explained in the previous sections and its effect on vendor credibility. Satisfactory consumption of technology never gets highlighted in the social and blog pages. But any minor dissatisfaction immediately gets mileage. Since it is still early days, the vendor risk perception will continue to be high.

The aim of this study is in helping cloud vendors to understand the sustenance threats for their offering in the backdrop of the tetra-threat framework. The authors feel that the vendor biosphere should try to understand the entire environment in which they are operating. Both threats to added value and threats to appropriability should be effectively addressed for enhancing cloud adoption. Some of these problems have an added dimension in the emerging economy markets – particularly those related to Holdup.

## **8. Conclusion**

Cloud as an alternative is here to stay and the business gains of cloud adoption in terms of better Net Present Value is measurable. Across industries, there is a clear tendency to at least partially move towards the cloud to gain the advantages of lower CAPEX as well as lower OPEX. The paradigm change from ownership of technology to utilization of technology should come in as a big boost to emerging markets where capital is scarce and current IT asset build up is not very high. Available literature as well as consultancy reports clearly indicates this tendency for higher cloud adoption amongst less-IT asset intensive emerging markets wrt to their developed market counterparts.

Any new technology comes with imitative platforms which duplicate the original impact as well as with substitutive platforms which displace the original impact. In addition, diversion and / or dissipation of the original created value happen through hold up and slack. For sustaining, growing and consolidating as an effective technology, cloud vendors are well advised to keep in mind the effects of the four value annulling routes (as given in tetra-threat framework).

## **9. Future Directions of Research**

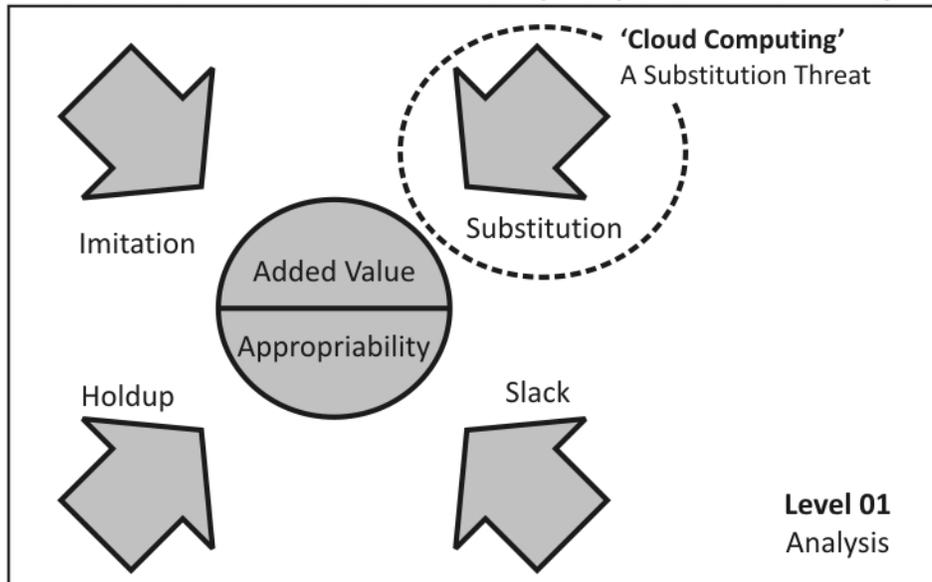
A detailed multi-parameter driven regression analysis can be done on a country by country basis to establish the weighted drivers that inhibit higher cloud adoption. Parameters like connectivity, regulations, licensing, broadband quality, power grid quality, data portability problems, freemium offers, security threats – external as well as internal, vendor diversity and the likes can drive a cause-effect mapping to better understand cloud adoption, cloud pricing and depth of cloud engagement. The authors would recommend an Asian consortium to be formed to look into all these aspects and would be willing to collaborate and create such a multi-country research platform.

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**Appendix 01**

**Tetra-Threat Framework for Sustainability Analysis of the 'ICT Industry'**



**Figure 1 : Level 01 of Tetra-Threat Framework - ICT Industry**

## Appendix 02

### Tetra-Threat Framework for Sustainability Analysis of the 'Cloud Computing Industry'

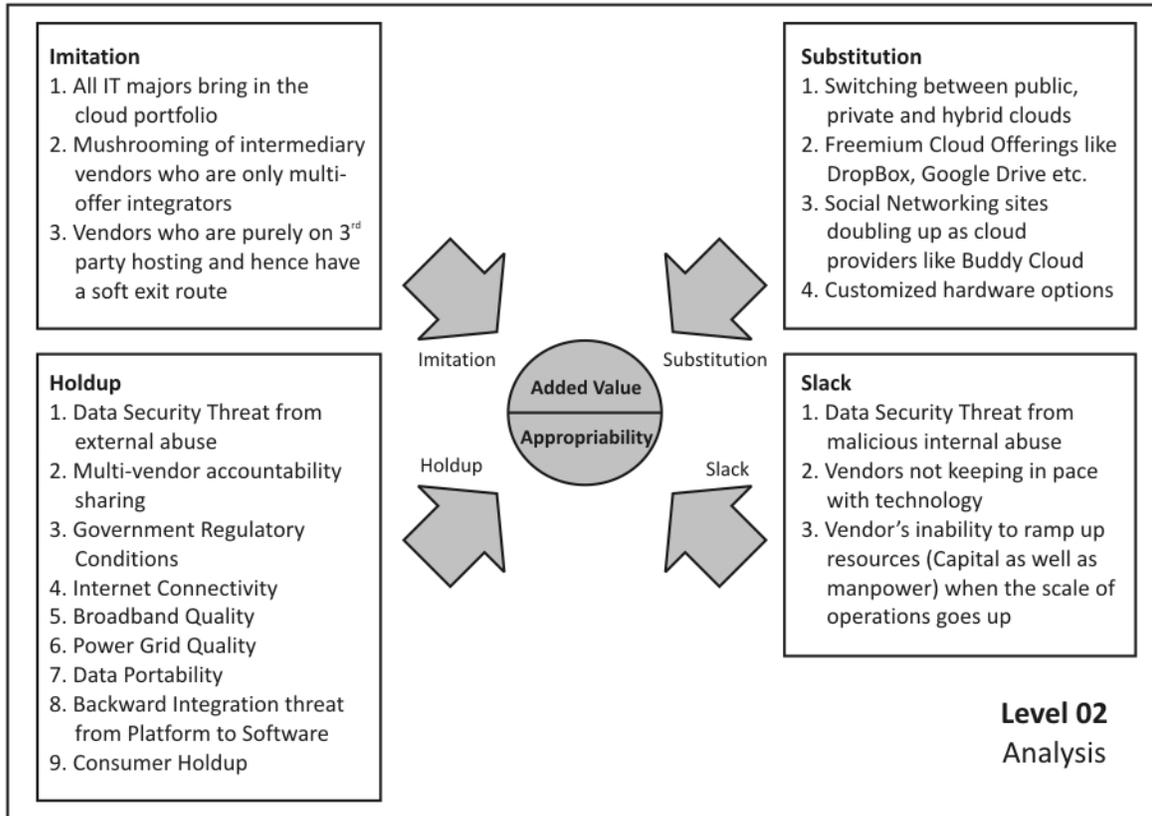


Figure 2: Level 02 of Tetra-Threat Framework – Cloud Computing Industry

### Appendix 03

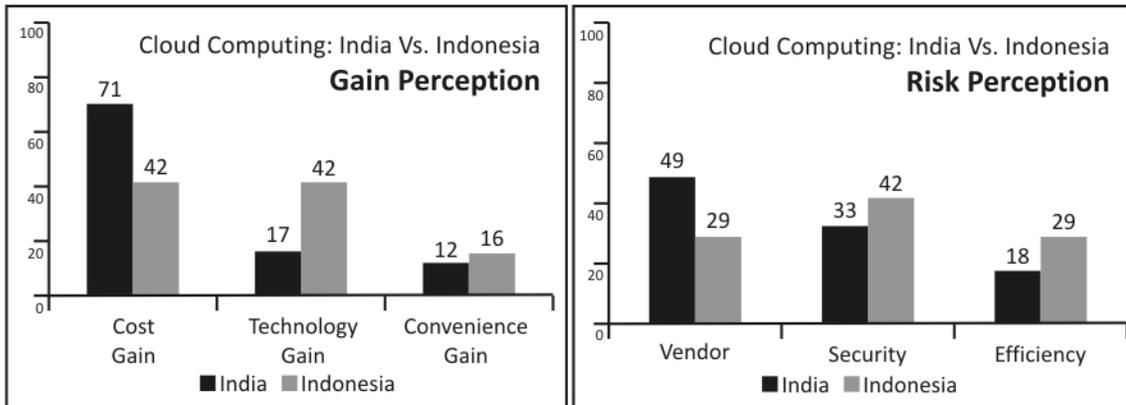


Figure 3: Gain and Risk Perception for Cloud Computing: An India-Indonesia Comparison