Pricing Model for Delivery of Cloud Computing Data Infrastructure Services

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***Abstract*--Cloud computing provides a means for developing economies to improve their global competitiveness. This is because it is a combination of infrastructure, technology innovation and technology readiness. Private organisations in the developing economy of context, believe there is a sizeable market to be served. The key challenge is to do this effectively at a price that is not only affordable but economically viable. This is because it is believed that providing cloud services in the developing economy would cost more that it would in developed economies. This paper takes a risk-neutral approach, based on cost-plus pricing strategy to develop a model to help cloud providers build a case in this regard. The resulting model was then applied to a number of services and revealed that indeed providing cloud services in a developing economy would not be competitive without a public-private partnership in the areas of power and broadband internet.**

I. INTRODUCTION

Competitiveness is defined as, 'the set of institutions, policies, and factors that determine the level of productivity of a country. The level of productivity, in turn, sets the level of prosperity that can be reached by an economy. The productivity level also determines the rates of return obtained by investments in an economy, which in turn are the fundamental drivers of its growth rates. In other words, a more competitive economy is one that is likely to grow faster over time.'[2]. The Global Competitiveness Index used in ranking economies was developed such that top-ranked economies today are so more because of their competitiveness despite their various stages of development[11]. This research focuses on three pillars of the index critical for developing and emerging economies to gain competitive advantage through technology. These are infrastructure (which includes transport and communication); technology readiness referred to as, 'the agility with which an economy adopts existing technologies to enhance the productivity of its industries, with specific emphasis on its capacity to fully leverage information and communication technologies (ICTs[1]) in daily activities and production processes for increased efficiency and enabling innovation for competitiveness'; and technological innovation[2]. Indeed these pillars are utilised invariably in a focused index called the Network Readiness Index (NRI), 'aims to measure the ability of countries to leverage information and communications technologies(ICTs) for improved competitiveness and well being.'[3]. Fig. 1 provides a comparison of advanced and emerging or developing economies relative to their network readiness.

Reference [3] further stated that, 'the higher the ICT readiness of a country is, the proportionally higher the economic and social impacts are.' Fig. 2 illustrates this point.

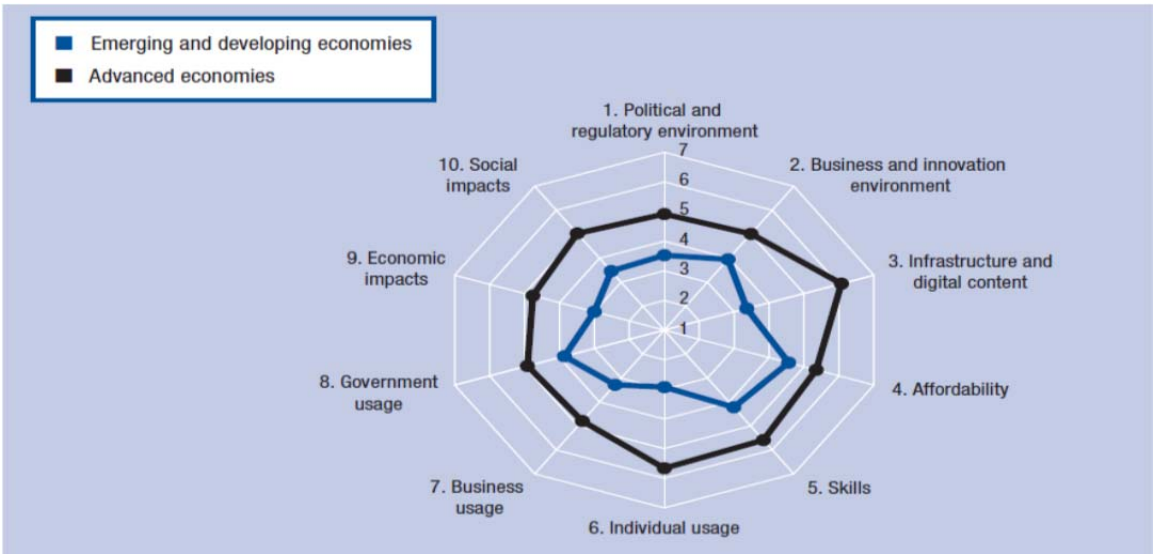

Fig. 1 NRI comparison (Advanced Vs Emerging and developing) Source: Beardsley et al [3, p.17]

[1] ICT – Information Communication Technology

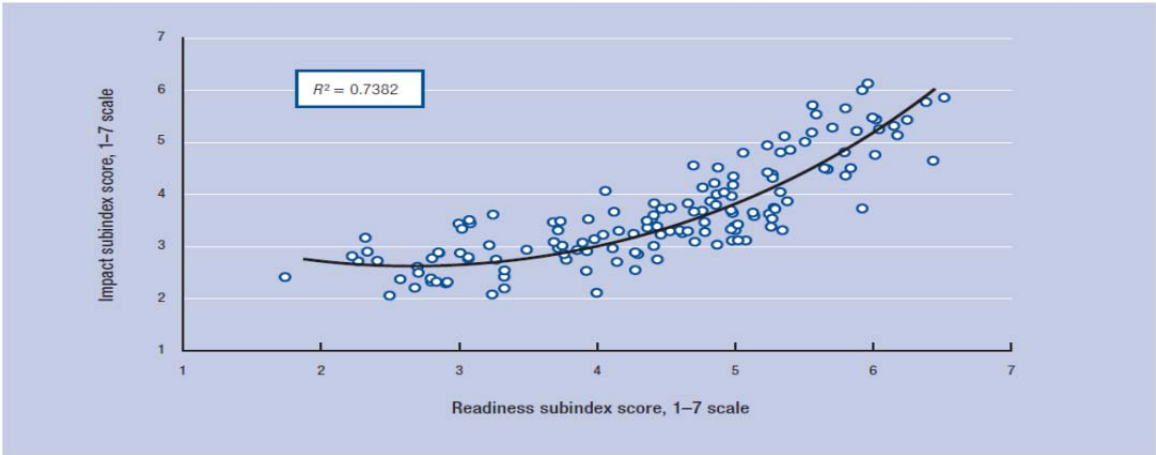

Fig. 2 Correlation between Readiness sub index Vs Impact sub index. Source: Beardsley et al [3]

Given Nigeria's ranking on the NRI for the past three years has been in the lowest quartile, areas of improvement do exist. The researchers believe that by applying cloud computing to public-private arrangements, significant gains can be achieved on the following pillars:

1. Infrastructure: government and private companies can provide ICTs to increase competitiveness and well being
2. Technology readiness: it allows for the faster adoption technologies that enable government, consumers and providers digitize operations and be more competitive
3. Innovation: it provides the ability to apply technology in ways peculiar to Nigeria for Nigeria's economic benefit

From Fig. 3, cloud computing achieves the integration of traditional networks and information technology; a consumer only needed a device as little as a mobile phone [1].

A cursory look reveals that putting up this infrastructure (i.e. cloud, pipe) requires financial investments upwards of NGN1billion. This cost excludes the operational costs around power, local skills to manage the infrastructure and the requisite favourable environment to make returns to investors or providers of such capabilities alike. Therefore, given the latest reports on Nigeria regarding market size, macroeconomic environment, financial market development and labour market efficiency relative to other factor driven economies, the researchers believe opportunities abound for such public-private partnership[3]. The key question therefore becomes what pricing model can be accommodated by government and cloud providers.

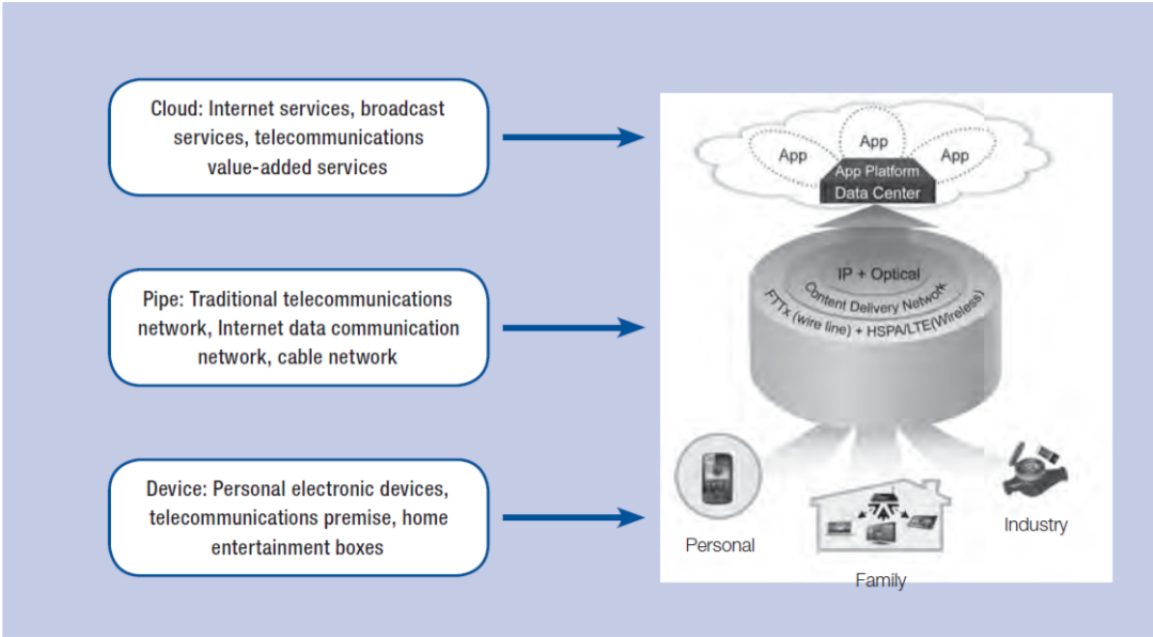

Fig. 3 Model for Cloud Computing Source: Huwaei Technologies

II. RESEARCH

The research includes work done with three ICT organisations. One holds a license to provide international submarine cable infrastructure and landing station services; the second is a holder of fixed wireless access services and the third is an information technology company entering the value added services space in the communications industry. Fig. 4 below shows the research methodology employed - based on four stages:

Fig. 4 Research Methodology

Realisation Lifecycle refers to the set of activities, contracts and organisations necessary to realise to goal of delivering cloud computing services via data centre infrastructure. The end result of the engagement was the delivery of a functioning Tier 3 data centre as defined by the Uptime Institute [14]. Also, to deliver this phase of work, the project contract type EPCIM[2] was used. This is because though the infrastructure is the physical data centre that would follow the EPC[3] model, the utility of the data centre comes from the installation and maintenance of computing equipment that would deliver cloud computing services. Table 1 identifies the major business functions with critical roles to play during each stage of the process.

With the **Business Model Realisation**, the researchers evolved an operating model fit-for use by the research subjects. Fig. 5 depicts the business model realisation template [10].

TABLE 1REALISATION MATRIX

	Engineering	Procurement	Construction	Installation	Management
Infrastructure (owner of data centre)	X		X	X	X
Services (owner of cloud computing services)	X		X	X	X
Finance (owner of revenue, pricing, cost)	X	X			
Legal (owner of contract legalese)		X			
Business Development (owner of commercialisation)	X				X

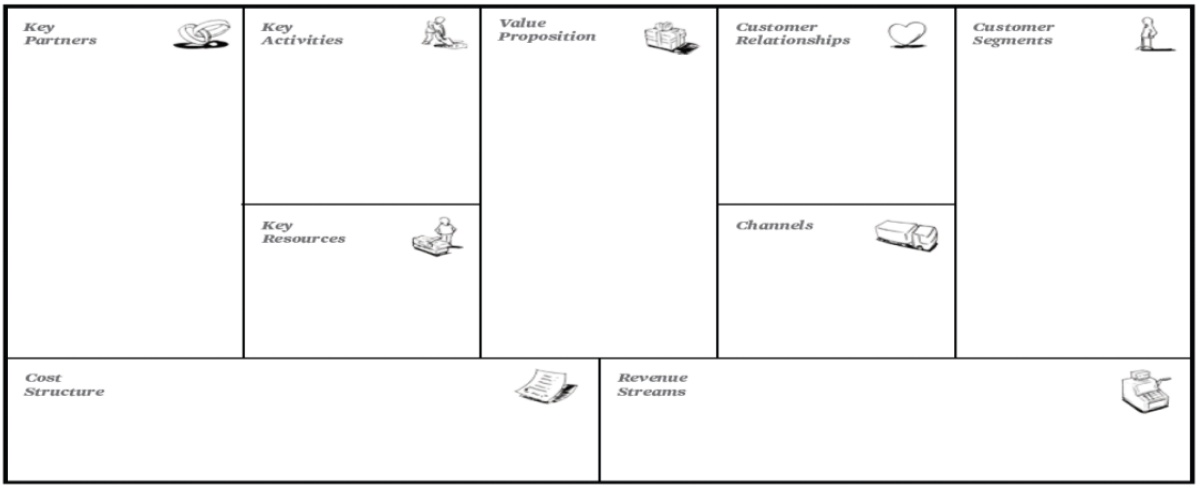

Fig. 5 Business Model Canvas

[2] EPCIM – Engineering, Procurement, Construction, Installation, Management
[3] EPC – Engineering, Procurement, Construction

For the research subjects, the responses were generalised as follows:

1) Customer segments – their focus would be non-consumer markets i.e. SMEs[4]; Corporates[5] as defined by SMEDAN[6][12]. Chenomics International Inc as quoted by the NPC[7] puts the addressable market as 1.72million customers[9].
2) Value Propositions – PAAS & IAAS[8] offerings. They eliminate the need for these customers of providing ICT infrastructure and personnel to stay competitive technologically.
3) Channels –subjects agreed to use electronic/ internet channels as a secondary option to having and actual field sales force.
4) Customer Relationships – the types agreed upon were personal for those requiring at extra cost a dedicated service account manager; and non-personal for those who believe relationship over the internet would suffice.
5) Revenue Streams – money will be based on annuity-begin financial model using subscription fees
6) Key Resources – refers to the data centre computing infrastructure and broad network access.
7) Key Activities – the researchers adopted ITSM[9] activities of service strategy, service design, service construction, service operations& maintenance, service continual improvement[4].
8) Key Partnerships – the network of suppliers and partners that make the business model work
9) Cost Structure – all costs incurred to operate the business model

Pricing Strategy Selection refers to the basis used for the price to end customers. The actual factors and issues to consider in arriving at a price are not trivial[8]. Fig 6 shows a schematic highlighting this.

1. Demand factors: it was agreed by the subjects that the value to the target market was the offering of a service that was required in an outsourced fashion as against having to provide themselves
2. Trade Factors: by leveraging technology customers and providers could improve their respective distribution channels effectiveness and efficiency.
3. Legal Factors: Given the rise of information security challenges globally, the environment was increasingly favourable to housing digital information within customer locale (i.e. country)

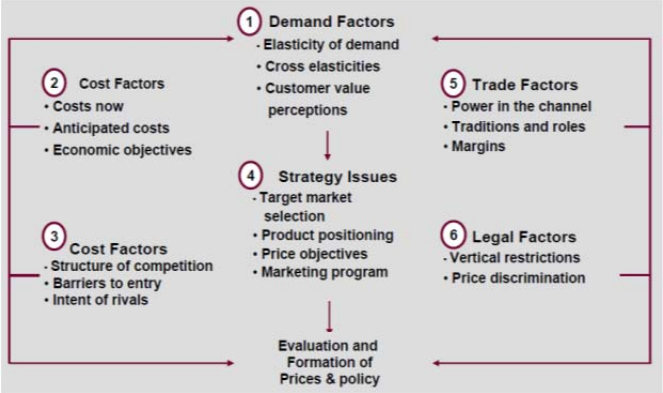

Figure 6 Factors determining price

4. Cost factors: considering this was basically the introduction of a new sub-market with its own products and services, the subjects were keen on knowing the cost structures for delivering cloud services. They also understood that the sheer size of providing the facilities/ assets (i.e. data centre) was enough of a barrier to entry, especially since very few companies had access to such credit.
5. Strategy Issues: of most important common to all subjects was the fact that they need to break-even in the shortest possible time. All subjects also agreed that given that cloud services were only novel in Nigeria it would be favourable to a penetration pricing stance and hopefully keep this price constant as demand increases.

The researchers realised that the subjects had taken these factors into consideration in varying degrees. For example, demand elasticity analyses was yet to be done; product mix, trade discounts and seasonality factors, and industry peculiarities were still areas where more value could be obtained from customers. For some factors the subjects were unwilling to divulge information as it amounted to giving away information on competitive advantage. Based on this understanding, the cost-plus approach was taken[5].

Revenue Model realisation refers to the price the providers were going to charge customers for the cloud computing services. The formula was given as:

$P(d_i) = R(Z_i) \cdot \{M(Y_i) + C(X_i)\}$.....A

Where

$P(d_i)$ = price for each cloud computing service i on offer

R(Zi) = to risk calculation Z attached to providing the cloud computing service i

M(Yi) = the margin Y expected from the sale of each new cloud computing service i

C(Xi) = the cost X for delivering cloud computing service i per customer

The researchers realised that the risk appetite for each subject were not the same. For one it meant entering a new

[4] SMEs – Small and medium enterprises; business organization with assets valued above NGN5million but less than NGN500 million and number of employees totaling between 10and 199

[5] Corporates – Business organisations with assets valued more than NGN500million and number of employees over 199

[6] SMEDAN – Small and Medium Enterprises Development Agency of Nigeria

[7] NPC - National Planning Commission of Nigeria

[8] PAAS & IAAS – Platform-as-a-service & Infrastructure-as-a-service

[9] ITSM – Information Technology Service Management

market, for another it was about gaining market share and for the third about changing the business model. These three business objectives necessitated different appetites for risk that were confidential. Hence to normalise the situation R(Zi) was resolved to 1. Secondly, though each subject had different ways of determining their target margin (either from revenue, operation or net) an average margin of twenty percent was fair to arrive at a price from their various individual market feasibility studies. Substituting in equation (A) we have:

$P(d_i) = (1.2) \,.\, C(X_i)\}$.....B

The common cloud computing service the subjects were all delivering to the market was Database-as-a-service (DBaaS). Curino et al [6] while introducing relational cloud specified the importance of DBaaS thus, 'Relational database management systems (DBMSs) are an integral and indispensable component in most computing environments today, and their importance is unlikely to diminish. With the advent of hosted cloud computing and storage, the opportunity to offer a DBMS as an outsourced service is gaining momentum... Such a database-as-a-service (DBaaS) is attractive for two reasons. First, due to economies of scale, the hardware and energy costs incurred by users are likely to be much lower when they are paying for a share of a service rather than running everything themselves. Second, the costs incurred in a well-designed DBaaS will be proportional to actual usage ("pay-per-use")—this applies to both software licensing and administrative costs. The latter are often a significant expense because of the specialized expertise required to extract good performance from commodity DBMSs. By centralizing and automating many database management tasks, a DBaaS can substantially reduce operational costs and perform well'.

Fig. 7 provides the costing model derived by applying principles of the composition pattern [13].

Customers of the subjects had the option of taking one of three possible options of a DBaaS bouquet namely:

1. Database One: an entry level database running within a virtualised compute node with some storage for data
2. Database two: a mid-level database with certain security features added having more computational power and storage.
3. Database three: an enterprise level database complete with security features, dedicated management and the most computational power and storage

The typical offering for the service thus became as in table 2.

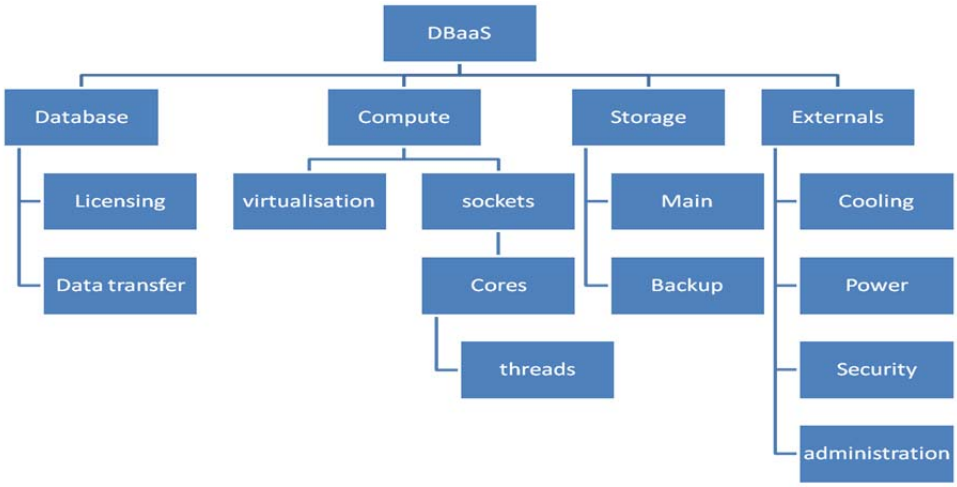

Fig. 7 Pricing Model DBaaS

TABLE 2 DBAAS OFFERINGS

DBaaS Bouquet	No of Processor	Unit Price per Processor (NGN[10])	Transfer (GB[11])	Unit Price for Transfer[12]	Storage Space (GB)	Unit Price/Storage Size (NGN)	Monthly Hosting Cost (NGN)
Database one	2	26,369.33[13]	30	3,532.80	5	123.00	10,000.00
Database two	4	64,433.33	120	3.532.80	20	123.00	10,000.00
Database three	4	206,033.33	300	3,532.80	50	123.00	10,000.00

[10] NGN – Nigerian Naira
[11] GB - Gigabit
[12] Refers to mobile bundle as provided by ITU exchange rate of USD1 to NGN160
[13] Prices here are based on offering the Oracle Database

III. FINDINGS

By focusing on database as-a-service alone, the research confirmed two facts:

1. Cost of Service - By assuming a constant currency conversion rate against the US dollar of NGN160 to US1 and also taking the average cost of providing database-as-a-service offering based on the Oracle database offerings from two international companies to serve as a benchmark (i.e. Rackspace, Oracle) , the researchers realised that the cost of providing this offering was significantly more than the reference providers; even after adjusting for use of the same broadband service available to all users. Fig. 8 below does a price comparison vis-a-vis the various comparable packages between the Nigerian providers and the benchmark.

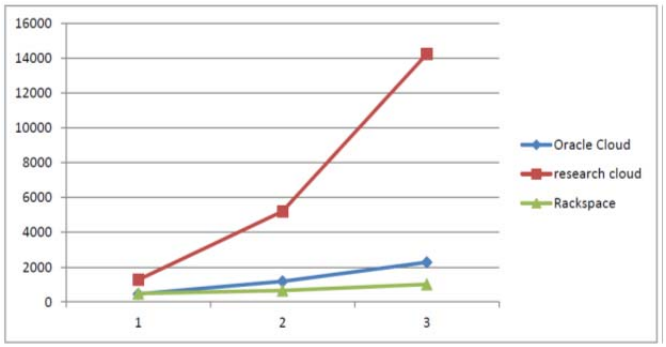

Fig. 8 Price comparison of Oracle database-as-a-service (research Vs competition)

2. Drivers of cost – for this case it was found out that power consumption and internet access provided a direct correspondence to the actual end price to the customer.
   a. Broadband Internet – researchers found that whereas in developed countries where broadband was typically a fixed rate over a period, for the developing country the amount of bandwidth increased as a direct correspondence to the amount of data transferred
   b. Power Consumption – for this cost driver, to meet the SLA[14]all providers decidedly are providing their own power. By assuming an average of NGN20 per KWH[15] the researchers found that the year power cost of an 18MW data centre would be at least NGN3.2million and this amount even though distributed amongst customers was such that each customer bill was expected to fluctuate in direct proportion to the amount of workload placed on the machine.

IV. CONCLUSION

The assumption that the provision of data centre services would be more expensive in a developing country context was thus proven to be true. So for developing nations to be competitive the options available are not limited but include:

1) Captive power arrangements using clusters - in this arrangement providers cite data centres in zones or power clusters created by government where power is generated, transmitted and distributed constantly
2) Subsidies by guaranteeing certain price levels for broadband internet or subsidies for internet. Here government and providers keep constant the cost of internet access to the consumer irrespective of the amount of data being transferred. This can be done via incentivising the use of internet, introducing freemium business models or tax credits for the amount of internet traffic that remains in-country.

[14] SLA – Service Level Agreements
[15] KWH – Kilo Watt Hour

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