Cloud Business Models and Sustainability: Impacts for businesses and e-Research

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1. Introduction

Cloud Computing provides added value for organisations; saving costs in operations, resources and staff – as well as new business opportunities for service-oriented models [2]. Achieving long-term sustainability is an important success factor for organisations, as failures to do so may result in Internet bubbles or crashes experienced in 2000s [3]. In this paper we review current cloud computing business models, and provide recommendations on how organisations can achieve sustainability by adopting appropriate models.

Extensive work has been done on investigating business models empowered by Cloud technologies. Several papers illustrate the importance of classifying the right business strategies and models for long-term sustainability [2,5,6]. There are two business models presented in this paper, and the first is Cloud Cube Model (CCM) from The Jericho Forum (JF), which we have added our classification and categorised into eight business models. The second is the Hexagon model, which is we propose based on a review of business literature [1,7] and essence from Sun Tzu's Art of War, which is rated as the "Bible of War" in the East, and lessons learned have been studied and used extensively in the business strategies. Apart from the qualitative approach, the quantitative approach we use is the Capital Asset Pricing Model (CAPM), which aim organisational sustainability and predicts how well firms perform. The case study of OMII-UK is presented with 3D visualisation computed by Mathematica. This leads to development of Cloud Sustainability Framework (CSF), which measures cloud business performance.

2. The Cloud Cube Model

The Cloud Cube Model (CCM) proposed by the Jericho Forum (JF) is used to enable secure collaboration in the appropriate cloud formations best suited to the business needs [8].

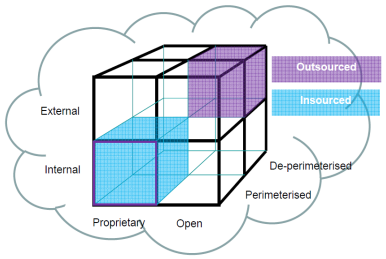


Figure 1: The Cloud Cube Model

The JF points out that many cloud service providers claim to be able to deliver solutions, so cloud customers need help in selecting the right formation within CCM suiting their needs. Within CCM, four distinct dimensions are identified. They are (a) External and Internal; (b) Proprietary and Open; (c) Perimeterised (Per) and De-Perimeterised (D-p), and (d) In-sourced and Outsourced. Refer to Figure 1 for the CCM [8].

3. Our Definition: Business Model Classifications and How Each Business Model Fits Into the CCM

In this Section, how each business model fits into the Cloud Cube Model is explained. Strengths and weaknesses for each business model are also presented at the left section. Dark purple is the joint area between outsource and in-house approaches. Based on previously literature [4,5,6,9], we categorise these models into eight types: (1) Service Provider and Service Orientation; (2) Support and Services Contracts; (3) In-House Private Clouds; (4) All-In-One Enterprise Cloud; (5) One-Stop Resources and Services; (6) Government funding; (7) Venture capitals and (8) Entertainment and Social Networking. These eight models are summed up as Table 1 on page 2 and 3.

4. The Hexagon Model

Sun Tzu's Art of War (STAW) has been extensively studied, researched and applied into business strategies, operations, negotiations, sales and leadership. There are scholarly publications [10], which are good in providing guidelines. They tend to set additional rules which may be interpreted as complication to original STAW. In our context, we aim to classify any business implications as an easy to understand approach, which our Hexagon Model fits well in, and can visually present a business or a project's strengths and weaknesses for decision-makers. The Hexagon model identifies six key elements for business sustainability and presents how a business or a cloud project performs in these six elements, which are consumers, investors, popularity, valuation, innovation and Get the job done (GTJD). Positions in these six elements reflect their relations to each other. Six elements can be divided into pairs: people (consumers and investors); business (popularity and valuation) and job done with job variance (get the job done, GTJD and innovation). Each pair is opposite to each other in the position of the hexagon. Figure 2 below is the presentation of our Hexagon Model. More case studies are presented in Table 2 on page 3.

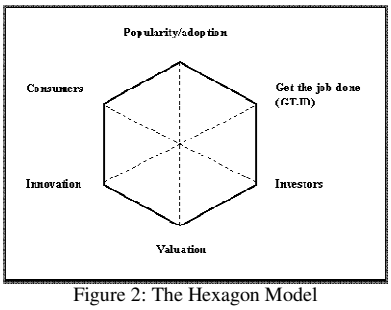


Figure 2: The Hexagon Model

5. Choices for sustainability modelling – CAPM and Cloud Sustainability Framework (CSF)

We review mathematical models and selectively study Monte Carlo, ARIMA, Black Scholes and CAPM, the later of which is the most appropriate for quantitative sustainability with two main reasons [4]. Based on our work on CAPM, the Cloud Sustainability Framework (CSF) has been established to provide a strcutured framework to measure business cloud performance. The proposed approach is to divide return and risk in three areas: Technical, Costs and Users before and after deploying cloud solutions or services. In some context, it can be defined as expected return and actual return. To demonstrate this, the OMII-UK's case study and other case studies are presented. Our CSF present growth in the OMII-UK's business case, and also explain how they relate to the Hexagon Model under the newly-proposed Cloud Computing Business Framework (CCBF).

5.1 The 3D sustainability modelling

We present OMII-UK's sustainability models in terms of statistical analysis in a paper [6]. Statistics still requires further analysis. To simplify complexity, 3D visualisation is introduced. Data is given into Mathematica, which computes sustainability modelling that corresponds to the OMII-UK's growth in the last three years. There are few or none of researchers getting into 3D visualisations. See Figure 3 below.

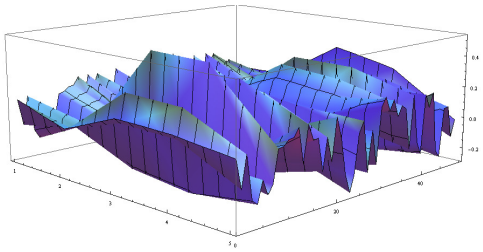
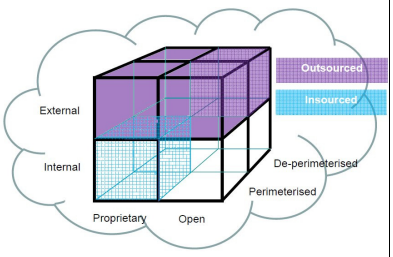
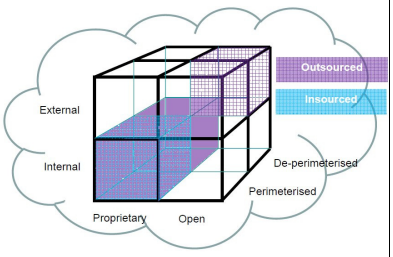
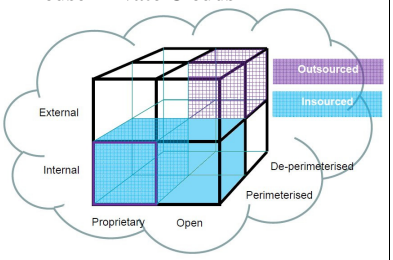
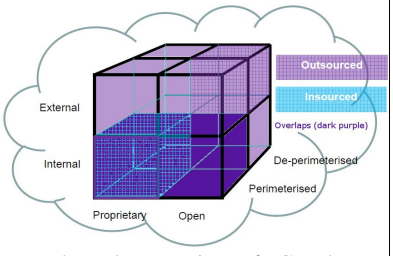


Figure 3: 3D sustainability modelling for the OMII-UK.

6. Conclusion

In this paper, we present the CCM and the Hexagon Model. The CCM is used to classify into eight business models, providing guidelines for how cloud businesses should operate and direction they strategically focus. The Hexagon Model is ideal to highlight strengths and weaknesses of cloud businesses at any time and provide awareness of areas they should focus, and a quick yet effective update on sustainability. Both models complement with each other under a newly-proposed CCBF, which accmmodates CSF, CCM and the Hexagon and explain their relations for sustainability. We present sustainability modelling and show how 3D visualisation can be illustrated. Understanding cloud and sustainability are essential for e-Research in a period of economic volatility, as problems faced by cloud industry will be faced by e-Research and lessons learned can provide us the edge for future work. More organisations are welcome to take part in this project.

A main stream business model - demands and requests are guaranteed. There are still unexploited areas for offering services and making profits. Data privacy is a concern for some clients. Stiff competitions are common.	**Service Provider / Service Orientation**  IaaS: Amazon EC2/S3 and Nimbus. PaaS: VMware Vsphere; Dropbox, Google Search, Microsoft Azure. SaaS: Salesforce CRM, Google Docs, Trend Micro, Facebook.
Suitable for small and medium enterprises who make extra profits and expand their businesses. Some firms may experience a period without contracts, and they must often change strategies.	**Support and Services Contracts**  Examples: Falconstor, Double Take and a few NHS and MRC contractors
Best suited for organisations developing their own private clouds which will not have data security and data loss concerns. Projects can be complicated and time consuming.	**In-House Private Clouds**  Examples: An anonymous NHS Trust and an anonymous University
The ultimate business model. It consolidates all business activities and strategies. S&M firms are unsuitable for it, unless they join part of an ecosystem.	**All-In-One Enterprise Cloud**  Examples: Ubuntu, Microsoft, Google

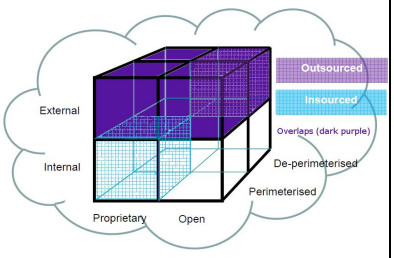
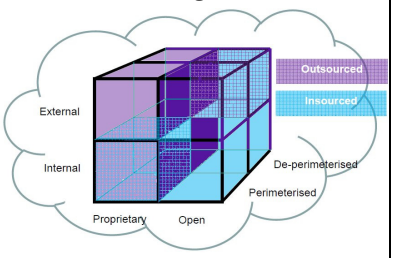
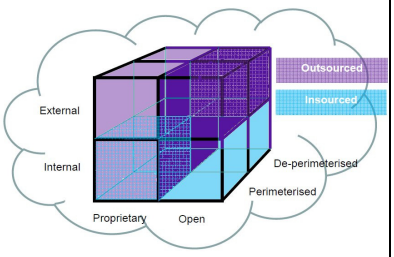
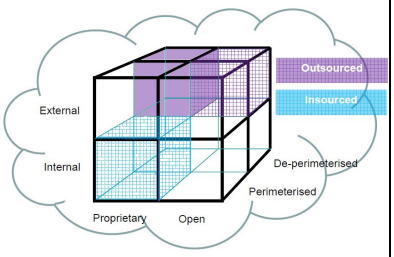
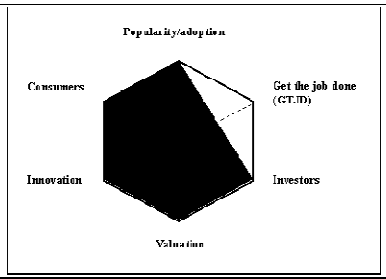
A suitable model for partnership and community. Can get mutual benefits through collaboration. All participating organisations or individuals need to contribute. Partnership will break apart if not managing well.	**One-Stop Resources and Services**  Examples: BT and National Grid Service, UK. Government Funding and Venture Capital can form into this model.
Government can invest a massive amount. This is beneficial for R&D projects with resources. Only affluent governments can afford that. Top-class firms and universities tend to be selected.	**Government Funding**  Examples: Governments of US, EU, UK, China and Taiwan.
It can receive a surplus essential for sustainability. Useful for start-ups, or firms nearly running out of cash. It can be a prolonged process without a guarantee to get anything.	**Venture Capitals**  Examples: Parascale, Ubuntu, Facebook and Double Clicks.
If successful, this model tends to dash into a storm of popularity and money in a short time. Teenage social problems and a few extreme cases seen in newspapers.	**Entertainment and Social Networking**  Examples: Apple, OnLive, Shanda Facebook, Twitter.

Table 1: Categorisation of eight business models

Apple and Facebook: They score very high for all areas except GTJD, since they are not just using clouds but whatever resources to boost rapid sales.	

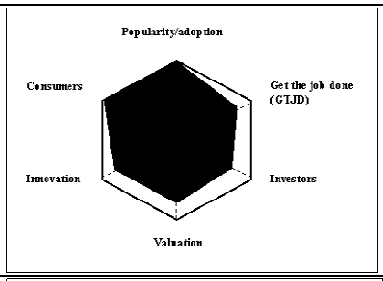
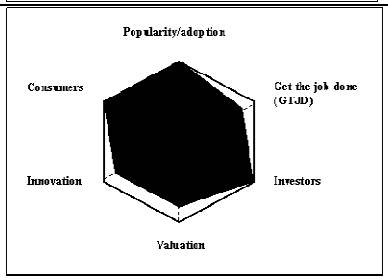
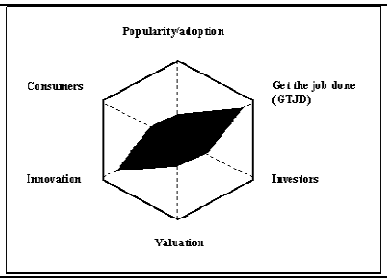
Amazon: The leader in IaaS. They score high in all areas. With ongoing small-scaled hacks and security concerns, they could score better in GTJD.	
Google: The leader in SaaS and All-in-One Enterprise Cloud. They score high in all, but can do better in GTJD, if focusing on private and hybrid clouds. There are security concerns.	
Private Cloud (two anonymous partners): GTJD and Innovation must be high at the beginning. But it needs to raise the other four areas soon to get more support.	

Table 2: List of case studies for the Hexagon Model

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