

Sociology View on Cloud Computing Value: Actor Network Theory Perspective

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Abstract—This article argues cloud computing value is generated through dynamic interactions of IT artifacts, services, organizations and their interests. From actor network theory, it illustrates Amazon, Google, and IBM, Microsoft cloud computing value networking and translation, inscription in their actor-network. Further implications such as cloud computing transactions types, standards, economics, and hybrid cloud trends are discussed.

Keywords-cloud computing; actor network theory; IT value

I. INTRODUCTION

Since Carr published “IT Doesn’t Matter” article in Harvard Business Review, causing scholars’ attention to reconsider information technology and its business value. Carr described that IT becomes a kind of commodity like water or electricity, IT is no longer valuable. Cloud computing transfers IT artifact into the service like water or electricity, realizes the Carr’s concepts. However, cloud computing is also considered as the strategic weapon helping enterprises to lower the cost, increase their competitiveness. Does cloud computing matter or not?

Past literature on IT and business value divided into the two kinds of causality inferences. One is called technology determination, considers that, IT as strategic resource, or innovative tool, the specific IT can create value of organizations [5][6][7]. Another, called organization determination, considers that IT aligned with organization strategy, can increase competitiveness [8][9][10].

But, as regards cloud computing, it seems brings the opportunities of technical innovation, but not all organization can all enjoy the interests immediately. It seems that IT and organization value generation are not for instance, the simple causality influence in this place [2].

In addition, cloud computing is not only the technology innovation but also service innovation. If not considering the service model but prosperities of IT artifact, neglected the important part of cloud computing.

In this article, we argue that cloud computing value is generated through dynamic interactions of IT artifacts, services, organizations and their interests. Using sociology theory, actor network theory (ANT) [14] as a lens, we illustrate Amazon, Google, IBM, and Microsoft cloud

computing development cases to demonstrate different business values generation processes. Finally, implications to future cloud computing technology and services development are proposed.

In the following section, we first review the literature of cloud computing and actor network theory. Second, we describe our methodology. Third, the four case stories are illustrated. Fourth, we present analysis and discussion and fifth, we identify contributions, limitations and suggestions for future research.

II. LITERATURE REVIEW

A. Cloud Computing

Cloud Computing refers to the applications or IT resources delivered as services over the internet; also, to the hardware and systems software in that datacenters that provides those services. Although it is popular, but definition of cloud computing is diversity [3][4]. Vaquero et al. give it more careful definition [4]:

Clouds are a large pool of easily usable and accessible virtualized resources (such as hardware, development platforms and/or services). These resources can be dynamically re-configured to adjust to a variable load (scale), allowing also for an optimum resource utilization. This pool of resources is typically exploited by a pay-per-use model in which guarantees are offered by the Infrastructure Provider by means of customized SLAs (p.51)

From this definition, it describes that cloud computing not only the enabled-technology but also the service model.

Retrospect to the evolution history of cloud computing, the cloud computing was the co-evolution from the service innovation and technology innovation (see Fig. 1). That is, while we consider cloud computing, it is not pure the technology artifact but service included.

That is, measuring cloud computing value cannot only derive from their IT characteristics but also its services or economic model. Cloud computing is a kind of techno-economic network (TEN) that Callon mentioned [13].

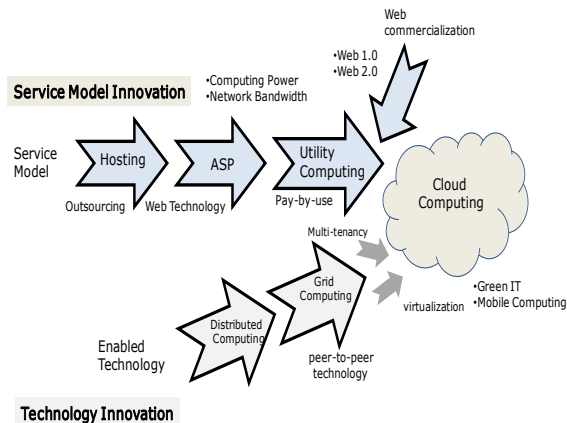


Figure 1. Evolution of cloud computing

Moreover, cloud services and cloud computing technology form a new ecosystem which allied with cloud services providers, cloud infrastructure operators, and cloud technology-enabled providers. Cloud computing includes technology, services, actors and their interests.

B. Actor Network Theory

Actor Network Theory (ANT) was developed in the sociology of science and technology [14]. ANT helps to describe how actors form alliances and involve other actors and use non-human actors (artifacts) to strengthen such alliances and to secure their interests. ANT consists of two concepts: translation and inscription.

When an actor-network is created, consists of four processes of translation [15]:

- **Problematization:** The focal actors define interests that others may share, establishes itself as indispensable resources in the solution of the problems they have defined. They define the problems and solutions and also establish roles and identities for other actors in the network. As a consequence, focal actors establish an “obligatory passage point” for problem solution which all the actors in an actor-network must pass.
- **Interessement:** The focal actors convince other actors that the interests defined by the focal actors are in fact well in line with their own interests. Through interessement the developing network creates sufficient incitement to both lock actors into networks.
- **Enrollment:** Enrollment involves a definition of roles of each of the actors in the newly created actor-network. It also involves a set of strategies through which focal actors seek to convince other actors to embrace the underlying ideas of the growing actor-network and to be an active part of the whole project.
- **Mobilization:** The focal actors use a set of methods to ensure that the other actors act according to their

agreement and would not betray. With allies mobilized, an actor network achieves stability.

In addition to the four stages of translation, the process of inscription is critical to building networks, as most artifacts within a social system embody inscriptions of some interests. As ideas are inscribed in technology and as these technologies diffuse in contexts where they are assigned relevance, they help achieve socio-technical stability.

Through ANT, we can understand how the focal case companies generate values through networks and inscribe their interests into their cloud computing technology and services.

III. METHODOLOGY

In this paper, we use the case study methodology [11] to examine the cloud computing and its business value. We choose four firms, two are internet service firms (Amazon, Google), and two are technology vendors firms (IBM, Microsoft). These four firms are famous with their using cloud computing. We collected documentary data included their cloud computing development histories, news, company reports, successful cases and independent analysis reports such as IDC, Gartner, and Ovum [12]. We also interviewed with their high level managers to talk about their strategies and values of cloud computing. All interview manuscripts are recorded.

Further, we use the events analysis and ANT theory to understand cloud computing value generation processes.

IV. CASE STUDY

A. Amazon

Amazon was established in 1994, the headquarter is located in Seattle of U.S. Amazon relied mainly on engaging in the online bookstore's selling in early days, then flowers, software, electronic goods, toy and other and retailed goods later. Amazon becomes first 500 big online retail businesses in America. The profits generated by Amazon are about 24 billion dollars in 2009.

The development of cloud services of Amazon begins with 2003 and offers web services for its e-commerce partners first. For example, partners want sell music CD in Amazon’s online restores, listing the latest music purchase ranks and buyers’ comments in order to promote the marketing of its CD and sell. The partners use Amazon’s web services offered to develop the promotion web site.

Amazon gradually transfers their internal IT infrastructure to cloud service serve their partners. For example, storage (S3), server computing resources (EC2) and even business process of e-commerce, such as fulfillment process (FWS), payment process (FPS), the personnel matching process (Mechanical Turk).

Through the cloud computing development histories of Amazon, we understand that Amazon early is to offer website designing or developing tools to help its partners to sell on Amazon online store. After developing various kinds of services, Amazon strengthens the whole competitiveness of supply chain operation efficiency with her partners.

B. Google

Google was established in 1998, the headquarters located in California of U.S. Relying on searching engine to attract commercial advertisement, Google becomes the biggest search engine company in the world. The Google earns about 23.6 billion dollars in 2009.

The active one in recent years of Google carries on every tactics overall arrangement, including: merge YouTube, developing cell-phone operating system, Android, Google Chrome browser, Google Earth and cloud services etc., attracted attention by the market.

Google's clouds services raise from Google API development in 2005. The main purpose of Google API is to let consumers log in their websites frequently, in order to increase the web traffics, strive for the advertiser to put their advertisement on Google websites.

Later, Google begins to develop various types of cloud services, for instance: Google Docs, Google Finance, Google Spreadsheets, Google APE, etc., in order to offer consumers and website designers.

For Google, the search engine traffics equal to money (traffic=\$). That is, a series of services are developed and companies merge are to rely mainly on improving the traffics. For example, Google API, Gmail, Google Apps, Google APE, with attracting website designers or consumers in order to attract advertisers to carry on more advertisement. YouTube or Open Social API acquired and merged or linked social community websites in order to get popularity then increasing the traffics. Android operating system cell-phone, Google Chrome can hope for operating system and browser interface on new developing handheld devices of leading factor, ethnicity offering handheld devices to surf the net that has already made the service of Google can be more convenient, connect the flow fetched in order to increase its other equipment.

For Google, cloud services support Google's "traffic equals to money" strategy, that attract more net friends on her search engine, then get more profits from advertisers.

C. IBM

IBM was established in 1924, regard making enterprise information hardware, such as electronic calculator, large-scale mainframe, the first generation of personal computer, etc. Recently, she moves towards more service and software providers to big enterprises.

The development of cloud service was introduced by IBM to help her small independent software vendors (ISVs) partners located worldwide using IBM's server or storage through internet. These ISVs do not need invest hardware/software and can develop software through IBM's platform. Later, IBM developed their cloud computing technology into products that support their enterprise customers to build up the cloud services. Further, IBM provides online cloud services to realize their cloud computing technology.

IBM attempts to use the cloud computing technology products and leverage their consulting services and software implementation experiences in the large-scale enterprise's

market and then explores small and medium enterprises and on-line service companies market.

Take her cloud services implementation experiences in UPS for example, IBM combined cloud services with their software implemented in UPS. IBM supported their customers, UPS and also touched UPS's online partners. It is so-called two-sided market strategy includes the large-scale enterprise software service market that IBM has already deeply engaged and new developing medium and small-scale online service companies.

For IBM, cloud services and technology play a bridge role to explore on-line and small medium enterprise (SME) markets opportunities.

D. Microsoft

Microsoft was established in 1983, it is early in leading position which occupies operating system and suit software on the PC of MS-DOS operating system, MS-Office with successful series promptly.

It was about 58 billion dollars that Microsoft earns in 2009. Among them in the suit software / the commercial suit software, the camp of Office series accepts and accounts for all software camp to accept more than ninety percent.

Microsoft realizes that trends moving towards online services, PC or on-promise software is no longer the only choice. So, on one hand, Microsoft defends tenaciously and already has status of operating system, software on PC; on the other hand it can combine the various terminal devices and offer the software, on-line services.

This is the concept of "software plus services" or "3 screens and a cloud" that Microsoft announced her strategy in 2009. For Microsoft, the cloud services or cloud computing technology help her transit to the new "network operating system" smoothly from combing their traditional on-promise software.

V. ANALYSIS AND DISCUSSION

A. Cloud Computing Value Networking

Callon described techno-economic network (TEN) as "a coordinated set of heterogonous actors which interact more or less successfully to develop, produce, distribute and diffuse methods for generation goods and services." From Callon's point of view, the economic value is generated from actors, intermediaries (no-human), translation and their relationships [13].

From the four cases described above, we can understand that different companies interpret that different opportunities of cloud computing, and align their different strategies and try to generate their values.

For them, the cloud computing is not only the technology artifacts, but also services, service models and their customers and partners. It generates value through heterogonous actors with IT, services through networking activities. We call that they "networking IT/service value" (see Fig. 2). Followings are the explanations:

- Amazon: Cloud computing services are innovated from their internal IT, originally support their

business process. Then, Amazon enrolls their e-commerce partner's adopting their web services, and then cloud services embedded in their daily business process. Amazon strengthens their business values through the partners' networks formed by IT and cloud services.

- Google: Google's cloud services, IT products, tools all support their business strategy, the traffic equals to money. Moreover, these services, products leverage each other, and then intensify whole network values.
- IBM: Cloud services originally support IBM's small independent software vendor (ISV) partners to leverage IBM's software/hardware resources through internet. Then, IBM strengthens his technology products, then transfers to cloud services to support their secondary market, online/SME customers. The cloud services bridge a new market.
- Microsoft: Microsoft leverages cloud services to complement her on-promise software, and strength their device product's value. Microsoft tries to enroll her customers to their value network.

B. Translation and Inscription of Cloud Computing

Although these four case companies try to form their actor-network mentioned above, but they still on their different translation stages (see Table I). For example, Amazon enrolls her online store partners into the actor-network and stabilizes network by embedding supply chain processes into their technology. Amazon's online store partners are not easy to betray because of locked operation processes in cloud computing technology and services. Although Google enrolls their customers but still considers how to stabilize their customers using their services.

IBM coordinates with Amazon and Google to connect the online SME markets and interest her ISVs partners to join the actor-network. Microsoft is also on his way persuading her ISVs to join actor-network.

Through ANT lens, we also can understand these four focal companies inscribe their ideas and strategies into their cloud computing technology and services (see Table I). For example, Amazon inscribes efficient supply chain processes into their cloud commuting technology for their online store partners. In the future, Amazon will release more technology and services combined with supply chain processes. IBM inscribes their connection ideas into cloud computing technology and services. She tries to use cloud computing technology to connect online SME markets and traditional enterprise markets. Google inscribes everything online into their services and Microsoft tries to defense their on-promise software markets.

C. Implications to Cloud Computing Values and Technology/Services Development

Regarding our cases in this study, these companies' inscribes their ideas or strategies into cloud computing technology or services. Are the properties of technology or service model possible to provide to other actor-network? For examples, Amazon's cloud computing is for online commerce, short, stateless transactions, it will not be suitable for long, stateful traditional enterprise transactions. Moreover, these cloud computing services are easy to scale out to many servers. But the traditional enterprise business services are suitable to single virtualization machine. That is, the cloud computing technology will be more diversity and suitable for their services usage and contexts.

Second, it is not easy to have the de facto or open cloud computing standard, because these focal companies try to develop their own technology or services and generate their actor-network values. But they need expand their networks to enroll more members. That is, brokering services or middleware technology development prop sects well.

Third, it seems the cost down of IT resources the most popular considerations in cloud economics. But from our analysis above, business values are the key for actors to join the network. For example, Amazon's e-commerce partners get value from their operation process efficiency. UPS joins IBM's network, because of integrating her physical logistic process and online services.

Fourth, business values or business models are keys to enroll members to join cloud computing actor-network. That is, the focal companies will blur boundaries between on-line services and cloud computing services (pay-by-usage) model, on-promise software and services. It also means that will hybrid traditional enterprise technology and cloud computing technology as commerce solutions.

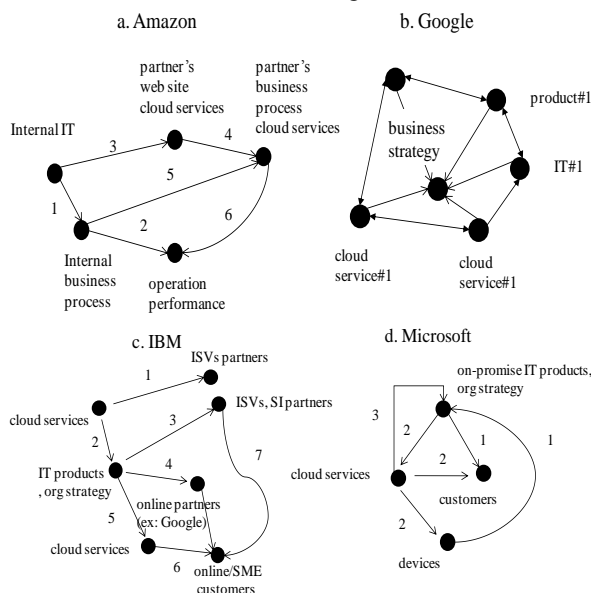


Figure 2. Value networking of case companies

TABLE I. TRANSLATION AND INSCRIPTION OF CLOUD COMPUTING

Focal Company	Translation	Inscription
Amazon	Problemaitziaion, Interessement, Envrollment Mobilization	Efficient supply chain process
Google	Problemaitziaion, Interessement, Envrollment	Services on line
IBM	Problemaitziaion, Interessement	Smart Services connection
Microsoft	Problemaitziaion, Interessement	Software plus Services

VI. CONCLUSION

In this article, we discuss the cloud computing value and future technology/service development through ANT theory. We argue that cloud computing values generated through networking of IT, services, organizations and their interests. We also implicate cloud computing technology and services will be more diversity, hybrid and suitable for their services usage and contexts.

This paper is limited to the four company cases analysis. Future research can conduct more companies’ cases, and analyze more detail activities and other actors’ responses and their inscriptions, translations in their actor-networks.

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