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Coordinating the Relationship between IT Services Providers and Clients: The Case of Cloud Computing

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Abstract
The focus of this research is on the IT service relationships that exist between clients and providers in cloud computing. Cloud computing is an important context in IT services management since it has become an increasingly popular delivery model. We use coordination theory and a case study of a cloud computing-based company to investigate how cloud service relationships are managed. Evidence of both the standardized and customized relationships is based on a case study of SiteWit, a new startup company that is both a user and provider of cloud services. This company is an interesting case to study, given the real-time, intensive nature of the technical demands, the multiple service relationships that must be managed, while at the same time minimizing costs.

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Abstract

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Introduction

In the past we referred to information technologies (IT) in terms of application code and databases, along with the physical servers, printers, and networks that provided the computing infrastructure – essentially hardware and software products. Now we speak of technologies as services increasingly available from the virtualized world of cloud computing, built on a flexible foundation of value-added services and "mash ups" of external services. Cloud computing has created a shift for businesses from traditional IT business models to an Internet delivery model, a phenomenon that is steadily gaining momentum. For IT providers, this shift facilitates "a move toward managing IT 'like a business'", [1]. It involves a shift from acquisition of software through traditional licensing agreements to software acquired as a service (SaaS), and a shift from the tradition of purchasing and maintaining infrastructure components and facilities to infrastructure acquired as a service (IaaS), both accessed via the Internet.

Cloud computing is an exemplar of what Malone [2, p. 13] describes as a *third order* effect of IT: an enabler of a shift toward more "coordination-intensive" structures. As they note, "IT can facilitate adhocracies - very flexible organizations - highly decentralized networks of communication among relatively autonomous entrepreneurial groups". Organizational strategy research identifies the complex network problem that arises when work is designed as webs of organizations, enabled by information technology, in which the organizations have specialized knowledge, are geographically dispersed, and require frequent and in depth interactions [3]. A key "disadvantage of adhocracies is that they require large amounts of unplanned communication and coordination" [4, p. 22]. When services are provided and coordinated via a market, as in cloud computing, market forces lower the costs of those services, but at the same time coordination costs ("all the information processing necessary to coordinate the work and people and machines that perform the primary processes") are higher [5, p. 485]. Williamson (1980) notes that this tradeoff between the cost economies of products and services provided in the market and the costs of coordination must be recognized in order to understand the best way to organize economic activity [6].

The massive managerial and technical interdependencies between cloud services providers and clients create many difficulties and costs. Large scale standardization a common coordination mechanism in information technology) [3, 5, 6, 7, 8, 9] is leveraged by cloud computing providers to minimize these costs and challenges. However, there are limits to the standardized

cloud computing relationship, which, when reached, require "punching a hole in the cloud", i.e., customizing the relationship. Such customization results in additional coordination costs and challenges. Our study uses coordination theory to understand the financial, managerial and technical implications of customized versus standardized cloud computing service relationships. Such knowledge will inform IT services management of this tension between standardized and customized cloud services [5, p. 328]

Background

Cloud computing can be viewed as a business service network (BSN) that is "challenging from both a technical and an economic perspective. … They raise many new questions about how to foster collaboration and orchestrate processes among partners. BSNs must provide end-to-end quality of service, including throughput, availability, transactional integrity, and reliability across multiple partners". [10, p.99] Coordination theory is used to understand what people do to coordinate their actions when they work together on common goals, and thus is an appropriate basis to understand the cloud computing network relationships. While the theory could be criticized as not being a fully developed theory [11], it does however, provide guidance about how to study the interactions between organizations in cloud computing. This includes identifying the kind of coordination mechanisms that are appropriate for the type of inter-dependencies between the different tasks, the tasks and sub-tasks, and the tasks and objects in the world. In particular, the theory notes that where interdependencies exist, alternative coordination mechanisms can be sought, some of which will lead to better outcomes than others [3, 4].

Coordination mechanisms such as trust, pricing, communication, standardization and authority have been discussed in the literature [2, 3, 4]. Trust and authority however, are more commonly used in single-firm supply chains. In these situations, the familiarity brought about by people working together in or among units facilitates trust. Also, the existence of hierarchies within these firms establishes authority and respect. This authority "serves as the basic organizing principle for coordinating and controlling work across levels within an organization", [3].

Our overall objective for a stream of research is to arrive at the major coordination strategies used by both cloud service providers and clients in ensuring successful design and performance of the supply chain. This is especially difficult given both have to make their services available to multiple, and a wide cross-section of, clients. In this particular study, we use coordination theory to analyze the relationship between IT services providers and clients in the cloud, and focus on the coordination mechanism of ***standardization.*** We seek to answer the following research questions:

1. How and why is standardization used as a coordination mechanism to ensure successful design and performance in service supply chains in the cloud?
2. In the event that the standardization mechanism fails to ensure successful delivery of cloud computing services, what alternatives are used?
3. What is the impact of both the standardization and alternative coordination mechanisms on the costs of coordinating the cloud computing interdependencies?

Method

We used case research method to pursue our investigation. Case research is ideal because it allows us to (1) study information systems in a natural setting, learn about the state of the art, and generate theories from practice"; (2) "answer how" and "why" questions, that is, to understand the nature and complexity of the processes taking place" and finally; (3) "research an area in which few previous studies have been carried out" [12]. Our study has the need for all these three. This is a theory-based case study, in that coordination theory informs what constructs and relationships are extracted from the rich, case study description.

Study Setting

SiteWit is a leader in online predictive analytics and paid search optimization software with offices in Tampa (headquarters) and Silicon Valley. SiteWit.com provides an online marketing optimization and predictive analytics platform that allows online marketers to optimize their Google AdWords campaigns, with Bing, and Facebook soon to follow. Pay per click campaign management is available within the SiteWit software as a service (SaaS) platform, along with predictive analytics that segment and score website traffic. SiteWit offers a "freemium" model, with all website monitoring, traffic reports, and predictive analytics available at no cost. Website traffic monitoring relies on a comprehensive revenue attribution model that uses first click, last click, and multi-click attribution to better understand how multiple visitor sessions affect purchasing and other e-commerce actions. Active campaign management is offered at a flat fee per campaign (no charges are based on a percentage of add spend).

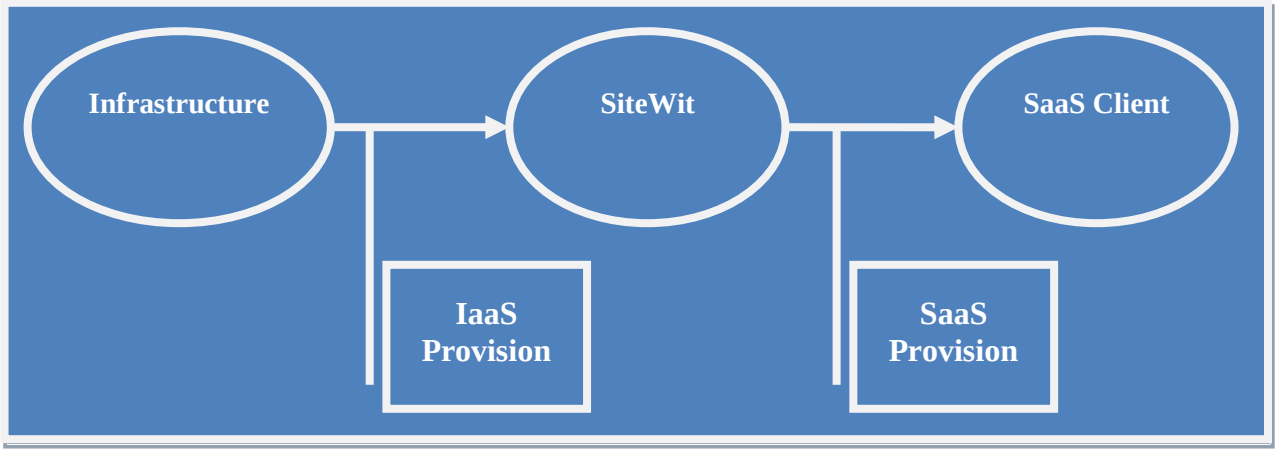
Ricardo Lasa, CEO of SiteWit, notes that the three key goals are to "measure, optimize, and predict" website visitor activities and improve the overall performance of online advertising campaigns.

1. **Measurement** starts with detailed data collection at the individual page hit level. This low-level data is group into sessions for each visitor to the client website. These sessions are then threaded to give a historical picture of a visitor's behavior over time. For paid ad campaigns, each individual click is assigned a cost and any revenue generated from online purchases or other website goals is also allocated across a visitor's history. SiteWit uses three revenue attribution models to provide insights: first click, last click, and multi-click attribution. A first click perspective assigns the revenue to the first paid click and session for the particular visitor, crediting whatever events started the process of purchasing (or accomplishing any other goal). The more common last click model simply credits the last ad click before the purchase, assuming the most recent events are somehow more influential. Finally, multi-click attribution seeks to share revenue (and credit) across the whole chain events that led to a purchase.
2. **Optimization** is aimed at improving the overall performance of online advertising campaigns. The threaded session data is analyzed using a multidimensional approach that looks at many small traffic segments, identifying the most productive locations, times, and keywords for a particular ad campaign. A set of weekly recommendations are chosen from the many alternatives and upon approval, SiteWit automatically implements any actions need through the Google API (with no further human intervention). Since some policies may require constant attention, SiteWit takes actions on behalf of the campaign manager as

needed on a rolling schedule. In addition to campaign level recommendations, the optimization process also incorporates bid management and position targeting based on the ad locations on the search engine result page (SERP).

3. **Prediction** is focused on assigning a likelihood that a given website visitor will achieve a goal, such as making an online purchase. SiteWit automates a sophisticated data mining process that creates predictive models based on historical patterns in the threaded visitor session data. These models are used to make explicit predictions and segment visitors, as well as to generate visitor-specific quality scores.

While these three feature categories and brief descriptions provide only a high-level overview of the technology, the essential processes and overall aim of the SiteWit software as a service toolkit is hopefully captured. The whole SiteWit system is delivered using cloud computing, with everything from data collection to data mining hosted in a virtual computing environment.



The figure above illustrates the SaaS BSN.

Results

Comprehensive standardization is leveraged by IaaS providers to coordinate the large-scale delivery of their services. By standardizing, these providers minimize the costs and challenges of supplying their service on a large-scale and to a variety of clients. For instance, the need for communication is reduced as clients can easily discover what services are available, as well as the detailed technical specifications and prices of each service option. With Many IaaS providers, standardization goes beyond simply that of the service offerings; it also extends to service management. As a result there are standard service contracts, which are mainly to be found on the Internet.

Four areas where standardization was leveraged by cloud vendors for coordination with their clients were of importance in the design and performance of the SiteWit service. In two of these the services failed to satisfy SiteWit's needs. These were handled by introducing a level of customization at a higher cost to SiteWit (though still remaining in the cloud). The other two were considered successful; the first of them facilitated scalability, a critical factor for SiteWit in the cloud adoption decision, and the second facilitated ease of communication with other SaaS vendors for development of their design, yet another critical adoption factor for the company.

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1. **Standardization and Latency Issues – Customizing the Service.**

Severe latency issues within the transaction processing databases were experienced with use of standardized services. As the Chief Scientist at SiteWit explains:

> *"From the outset, the challenges of processing and tracking website traffic at the page level were expected to be demanding, so high-speed solutions for logging page hits and processing them outside the database, and then loading reasonably pre-digested data into the database engine were developed. The cloud-based server used for the database engine was the largest available with multiple processors and a lot of memory from the start. As the load increased during live beta testing with some fairly large clients, peak database loads climbed to unsustainable levels. Outright database failures were experienced. The levels of virtualization software introduce delays at several key points in input/output processing. So, the solution was to use a large, dedicated server without any virtualization. That is, essentially to puncture a hole in the cloud and rent a traditional hosted server co-located with the cloud servers (at a substantially higher cost)."*

2. **Standardization and Reliability and Recoverability Issues – Customizing the Service.**

Standardized services failed to provide the necessary reliability and data recoverability that SiteWit required. Again, the Chief Scientist at SiteWit explains:

> *"One unexpected aspect of moving to a cloud infrastructure was the dramatic and abrupt nature of crashes, essentially making failures discreet, i.e., either the system is running or not. This level of indirection makes the experience of cloud failures seem more abrupt or discreet. For instance, we experienced a "catastrophic" failure on one critical server, with a simple notification delivered via e-mail: the CEO was online at the time and noted that at one instant all was working and the next mouse click failed to deliver any data from the website.*
>
> *While there are certain services that are backed by replication in the cloud, they may simply meet uptime goals, not provide complete recovery in the face of catastrophic failure. We customized, restoring the old-fashioned way from a database backup and layering on top more traditional approaches for high availability systems. Perhaps the most important approach involved mirroring the core databases that handle website session processing, data warehousing for data-driven optimization, and predictive modeling. Here the cloud made some aspects easier, such as using different zones to ensure that the mirrors were located in separate physical areas (like the east and west coasts). In addition, fail over capabilities made the switch from one core database to the mirrored version fast and automatic. Mirroring was used to provide a safety net for all core database functions".*

3. **Standardization and Scalability – A Successful Coordination Mechanism**

The SiteWit architecture reflects a distributed processing approach with key activities located both within the database, as well as separate application code. Most of the initial prototyping was done within the database infrastructure to speed development, but as soon as the beta rollout began, so did the debates about what tasks were better suited to external application implementations. Among the earliest candidates for application code were all the demanding web page processing tasks. These were implemented as dedicated applications that are suited for execution on inexpensive cloud servers. So to meet escalating processing demands, it is simply a matter of adding to the collection of very basic cloud servers (available at very competitive prices). Currently, SiteWit relies on several of these infrastructure processors to keep up with the increasing number of individual page hits that come into the collection servers.

4. Standardization, APIs and Mashups – A Successful Coordination Mechanism

Again, from the Chief Scientist, comes final thoughts regarding standardization in cloud computing and flexible architectures via application programming interfaces (APIs) and mashups:

> *"SiteWit implements an API that allows others to build on the platform by requesting and reusing the detailed reports or predictive models. In turn, SiteWit also relies on other SaaS vendors to accomplish many tasks that are not deemed to be a core competency. Tasks from support ticket tracking and online form processing to customer surveys are implemented on top of other services. This has allowed SiteWit developers to focus on core development goals, while relying on best-of-breed solutions for other features. This strategy results in a very targeted development process and flexible architecture, quite well-suited to cloud computing".*

Discussion, Limitations, Conclusion

Cloud services are fairly new. We have attempted to find some of the major successes and issues focusing on the standardized services offered. Standardization is a well-known coordination mechanism. We used Coordination Theory to investigate the standardized features of infrastructure services offered using a case study of the relationship between SiteWit (a SaaS provider) and IaaS providers.

Three characteristics of cloud services appealed to the SiteWit team: Costs, scalability and the flexibility to experiment with the service design. Two of these are stated in the literature as adoption factors. As told by the Chief Scientist of SiteWit, "In addition to cost savings from the use of leased services as opposed to building infrastructure, scalability is a key factor in delivering the Web-scale measurement and optimization services offered by SiteWit. Perhaps most importantly, the flexibility to re-design and develop new features by using our modular infrastructure has allowed us to continually innovate. There is certainly a learning curve in building a company on top of a cloud computing platform, but overall it has been a definite competitive advantage".

We found that, in some cases, standardized and virtualized services were inadequate because of the volume of, and great computational burdens associated with transaction processing at SiteWit. We also found that standardized cloud services do not provide adequately for data recovery (critical in any case and even more when faced with reliability issues). In these cases a level of customization was required, increasing the costs of services for SiteWit. Where scalability is concerned, standardization was helpful in that it allowed replication of the design over new servers as required by SiteWit. Reliability was an issue compounded by the inability to recover from simple cloud snapshots. Here again customization was required. In all cases the cloud made available options that supported use of either standardized or customized services and so, according to the SiteWit team, despite the issues encountered, "we retained our commitment to the cloud".

This study has the limitation of being based on a single case study. There has been debate over number of cases used in case research, however as Eisenhart pointed out, "The concern is not whether two cases are better than one or four better than three. Rather, the appropriate number of cases depends upon how much is known and how much new information is likely to be learned from incremental cases [13]. One advantage with the case we studied is that it provides a realistic and evolving environment for analyzing the complex phenomena of cloud computing.

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