A framework for the classification of Could Computing Business Models

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ABSTRACT

Cloud computing is a modern style of innovation in network environment which takes the advantage of multi-technologies as distributed systems, wireless communication, parallel processing in term of providing service architecture. The main services are concerned about sharing communication and resources. Cloud computing offers scalable access, elastic and shared computing capabilities anytime and anywhere, and thereby requires minimum management and interaction with service providers. It promises efficiency gains and potential cost savings, which makes cloud solutions attractive to businesses and organizations. This, in turn, creates new directions, ideas and challenges in software markets and new cloud computing business models implementations. This paper aims at the creation of a holistic cloud computing business model framework that explicitly defines its structural elements and their relationships. Based on structured case methodology, currently existing and upcoming cloud services are integrated into the framework and categorized according to their service type. The business model framework constitutes a useful tool for managers and decision makers in implementing their strategies towards cloud markets.

Categories and Subject Descriptors

K.6.1 [**Management of computing and information systems**]: Project and people management - *life cycle, management techniques, strategic information systems planning*

General Terms

Management.

Keywords

Cloud computing, business models, structured case methodology

1. INTRODUCTION

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [1]. Although cloud is widely recognized as a technology game changer, its potential for driving business innovation remains virtually untapped. Indeed, cloud has the power to fundamentally shift competitive landscapes by providing a new platform for creating and delivering business value. To take advantage of cloud's potential to transform internal operations, customer relationships and industry value chains, organizations need to determine how best to employ cloud-enabled business models that promote sustainable competitive advantage. This, in turn, requires thoroughly defined business models as well as the tools to represent and compare business models. Yet, existing research in cloud computing has focused on specific business models characteristics [2], like taxonomies of the technical layers [3] and the revenue model [4], or considered specific cloud market segments [5-6]. In addition, the cloud business model (CBM) domain knowledge is fragmented and the concept is rarely clarified explicitly. Such clarification is therefore required to unify the different points of view into one comprehensive framework providing a common understanding, language, and labeling, so as to leverage our communication in this context and our utilization of the concept.

The objective of this paper is to provide with a comprehensive and generic CBM framework, that explicitly defines its structural elements and their relationships. The study focuses on knowledge and theory building by providing answers to critical research questions regarding the critical constructs and common characteristics of CBMs, as a linkage between empirical data collected and literature review. The paper reports on the findings of the use of the structured-case approach and proposes a holistic conceptual framework composed of two models; the ontology-based CBM and the CBM classification. The second model is derived as a vertical decomposition of the 'Value offered' structural element and is based on service type offered.

The rest of the paper is organized as follows: Firstly, the theoretical background and the research methodological approach are described. The next two sections report on the main findings of the two conducted research cycles. The final section discusses the results and concluding remarks obtained from the study.

2. THEORY AND METHODS

The business model concept (BM) has been widely discussed and analyzed in the literature. Chesbrough and Rosenbloom [7] emphasize on the connections between technical potential and the realization of economic value, Amit and Zott [8] describe the design of the transactions of a firm in creating value, while,

PCI 2015, October 01-03, 2015, Athens, Greece
© 2015 ACM. ISBN 978-1-4503-3551-5/15/10…$15.00
DOI: http://dx.doi.org/10.1145/2801948.2802028

Gordijn [9] and Morris et al. [10] emphasize on the model aspect following an ontology- based approach. For instance, Osterwalder [11] defines BM as a conceptual tool containing a set of objects, concepts and their relationships with the objective to express the business logic of a specific firm. Therefore, concepts and relationships allow a simplified description and representation of what value is provided to customers, how this is done and what are their according financial consequences

Osterwalder et al. [12] classified business models' researchers into three main categories: (i) those that study the business model as an "overarching concept" of all businesses (i.e. the structural elements of a business model); (ii) those that describe a number of different abstract types of business models with common characteristics (i.e. taxonomies); and (iii) those presenting aspects of a particular real world business model (i.e. case studies). Recently, Osterwalder and Pigneur [13] presented an upated ontological approach for business models. The model consists of nine basic building blocks and specific relations between those blocks. The study uses this BM framework [13], as a theoretical lens for the identification of the structural parts of CBM and the formation of an "overarching" ontological CBM. In addition, the building block of 'value offered' is further decomposed and serves as a basis for the classification of the different CBMs according to their service types.

2.1 The Structured- Case Approach

The identification of the critical elements that form CBMs is supported by the structured-case research method [14]. The structured-case approach provides a focused but flexible methodology to the field research process, through outcomes integration allowing theory, knowledge and practice to emerge from the data collected; researchers' guidance to follow and ensure accuracy; ability to record the processes of knowledge and theory-building.

The method attempts to explain, predict and provide understanding, by determining the relationships between concepts, with the aim to build a knowledge guide with respect to various issues of cloud modeling. The development of conceptual frameworks namely, CF1, CF2… CFn is used to present the process of obtaining knowledge and theory building where CFn is the latest version of the theory built. Each Research Cycle (RC) can lead to updates of the existing CF. As part of the hermeneutic circle each new CF expresses the pre-understanding for the next cycle [15] following the natural human action of interpretation and world understanding [14]. Essentially, a spiral towards understanding is enacted as current knowledge and theory foundations for yet another research cycle, which will enhance, revise or evaluate the research understanding. This is particularly appropriate for clouds, as it is an area distinguished by rapid changes.

2.2 Methodology

In order to identify the structural parts of a CBM, two research cycles were applied. /At the first cycle, thorough literature review in the field of cloud BM was conducted for the identification of clouds' characteristics that can be critical for value and revenue creation. A variety of secondary data sources, such as business reports and technical reports for standards and specifications, were used to collect data. These characteristics served as 'pilots', in order to explore the different possible BM cases. The second RC aims to validate, evaluate and further improve the initial findings. The overall methodological procedure is summarized in Figure 1. A collection of 50 case studies of cloud oriented businesses were explored and analyzed, in terms of their strategies and business models. The cases are firms creating value out of cloud in terms of services and were selected so as to reflect all three aspects of cloud computing services as identified in the first RC. That is, Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS).

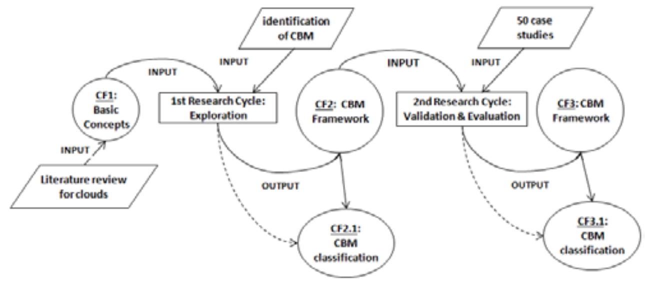

Figure 1. Overview of the methodological approach

They were also chosen according to their popularity in portals devoted to innovative technologies, such as Forbes, PCWorld, eWeek, CIOInsight and InfoWorld. The firms are listed in Appendix A. The 1st RC involves the exploration of the relevant literature and leads to the reformation of the initial conceptual framework (CF1) to the conceptual framework CF2. A part of CF2 is CF2.1, in which the different revenue models and value added categories are identified. The findings of the second research cycle are determined by the 50 case studies. These results are used to compare, evaluate and validate the results of the first research cycle.

3. FIRST RESEARCH CYCLE

The findings of the first RC were based on literature review [2-6-16-19]. They indicated the key attributes that enable business model innovation, as well as the critical elements of the structural model CF2. Following the business model structure as defined by Osterwalder [13], the proposed business model framework CF2 for CBM is described in the following paragraphs.

Key Activities. The different cloud services can be classified in three broader categories, according to the technical layer they are build, as follows [2-20].

Cloud Software as a Service (SaaS), that is the capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through a thin client interface such as a web browser (e.g., web-based email). The consumer does not manage or control the underlying cloud infrastructure, with the possible exception of limited user-specific application configuration settings. The aim of a SaaS provider is understanding customer behavior and requirements, translating these into new functionality and delivering this to customers. Developers and product managers are empowered to push features to production. Tests are all automated and the focus of operational staff is not so much into bringing features in production, but to maintain the assets and operational fabric that allow the developers to do that themselves.

Cloud Platform as a Service (PaaS), that is, the capability provided to the consumer to deploy applications that are created using programming languages and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure, but has control over the deployed applications and possibly application hosting environment configurations. PaaS can be based on interfaces to the IaaS layer and can therefore provide a flexible and programmable link to the infrastructure and a development environment, on which components are developed and can run.

Cloud Infrastructure as a Service (IaaS), that is the capability provided to the consumer to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The key activity of IaaS is highly automated delivery, oversight and resources planning. Optimizing assets versus utilization is very essential in the IaaS BM.

Key Resources. These are the assets required to offer and deliver the previously mentioned elements. All three layers (IaaS, PaaS and SaaS) rely heavily on software and developers assets. However for IaaS large-scale hardware is also necessary.

Key Partnerships. Some activities are outsourced, and some resources are acquired outside the enterprise. Cloud providers rely on other cloud providers, e.g. SaaS relies on PaaS and PaaS relies on IaaS so that there is a consumer/supplier relationship repeating through the technology stack (Figure 2). This, in turn, implies the relationship of customer and partners networks, as PaaS and SaaS serve both as consumers and suppliers to this network. By cooperating with IaaS or PaaS providers rather than owning the infrastructure, PaaS and SaaS costs shift from capital to operational. For IaaS data centers is also likely to be outsourced. Finally, strategic partnerships with open source (OSS) communities can provide valuable resources of code and support.

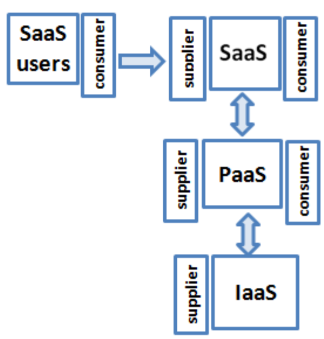

Figure 2. Customer and Partner relationships for clouds

Customer Relationships. Customer relations are established and maintained with each specific customer segment. Some ways of maintaining these relationships are through conferences (e.g. The 2013 reInvent developer conference attracted 9000 visitors), on-line communities and analytics. In addition, providers can have a much more direct relation with the customers with an on-premis solution. Technology enables providers to write down consumer's preferences and act accordingly.

Customer segments. They refer to the groups of customers that the company ultimately serves. As described in (Figure 2), customer segments for IaaS are mainly developers and PaaS, while customers for PaaS are mainly developers and SaaS. End users are the consumers of SaaS.

Value Offerings. The value propositions reflect the customer problems and needs. This is the central element that describes why the customer would ultimately pay for the product or service. The value proposition of cloud computing relate to its six special attributes that create competitive advantage to the traditional IT deployment. These are cost effectiveness, business scalability, market adaptability, masked complexity, context driven variability and ecosystem connectivity. The attributes are illustrated in Figure 3 and serve as a preliminary classification of CBM (CF2.1).

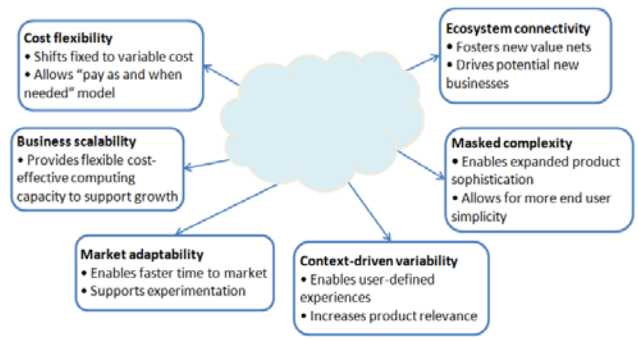

Figure 3. CF2.1 -Cloud's critical attributes

Channels. Value offerings are delivered to customers through communications, distribution and sales channels. IaaS primarily employs a self-service direct model, where the delivery is through APIs and a web user interface to those APIs. The model is enhanced by premium support. SaaS and PaaS, on the other hand, do not rely solely on self-service direct sales, but they develop extensive partner programs. The typical enterprise software solution is carefully planned and takes attention to change management and alignment on master data. Thus, value added re-sellers, and system integrators are also employed. Finally, SaaS solutions are often aggregated in broker portals, whose added value is in consolidated billing, self-service provisioning, identity management, and potentially some data integration.

Cost Structure. The main cost centers include the personnel for developing, maintenance and managing core software, assets such as servers and data centers and Partner costs (e.g. IaaS).

Revenue Streams. They refer to the money an organization generates from each customer segment. The revenue model is the blueprint that defines how the organization creates value for itself by defining the sources of the revenue and mechanisms to generate the revenue [13-21]. Software firms traditionally relied on licensing arrangements that were somewhat usage based, and could be hard to enforce technically as well as legally. Cloud computing services models by definition are usage based or by subscriptions.

4. THE CBM FRAMEWORK

In the second RC, the case studies listed in Apendix A were analyzed in order to compare, evaluate and enhance findings of the previous RC. Findings verified the initial conceptual framework CF2. However, the analysis of the case studies provided with more specific and detailed information for the building blocks of 'Value Offerings' and 'Revenue streams'. Thus, in the second RC, these two blocks were refined to better illustrate different approaches taken by firms. The following paragraphs describe the findings concerning these two blocks. Taking into account the new information, the final CBM

Framework, with its nine building blocks is presented in Figure 4. In addition, a classification of the different value offerings in CBM is illustrated in CF3.1 (Figure 5). Value offerings are classified analogously to the technical layers in Cloud realizations, that is, the infrastructure layer, the platform-as-a-service layer and the application layer on top.

4.1 Infrastructure layer

It comprehends business models that focus on providing enabler technologies as basic components for cloud computing ecosystems. Offerings usually concern provision of ***storage capabilities*** and the provisioning of ***computing power***. For example, Amazon offers services based on their infrastructure as a computing service and a storage service. In most cases, Cloud Computing infrastructures are organized in a cluster-like structure facilitating virtualization technologies. Among providing pure resource services, providers such as RightScale often enrich their offerings through value-added services for ***managing the underlying hardware***.

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Offered</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="3">• IaaS
• PaaS
• OSS</td><td>IaaS, PaaS and SaaS activities</td><td rowspan="3">As in CF3.1</td><td>• On-line communities
• Analytics
• Conferences
• Customer feedback</td><td rowspan="3">• Developers
• End-users
• SaaS/ PaaS</td></tr>
<tr><th>Key Resources</th><th>Channels</th></tr>
<tr><td>• Hardware assets
• Developers
• Infrastructure</td><td>• Direct self-service sales
• APIs
• App stores
• System integrators
• Cloud brokers</td></tr>
<tr><th colspan="3">Cost Structure</th><th colspan="2">Revenue model</th></tr>
<tr><td colspan="3">• Personnel for developing, maintenance and managing core software
• assets such as servers and data centers
• Partner costs (e.g. IaaS)</td><td colspan="2">• Pay-per-use
• Subscription
• Dynamic pricing
• Revenue Sharing
• Admission fees
• Service level agreement (SLA) compensations.</td></tr>
</table>

Figure 4. Cloud Business Model Framework (CBM) CF3

Application domains offering. Servers with high performance capabilities are necessary across nearly all industry sectors. Amazon, for instance, offers different kinds of operating systems with preconfigured settings (so called Amazon Machine Instance or AMI) for instant usage on the IaaS level. The Havard Medical School runs an AMI with a customized Oracle Database for genetic testing purposes. Beyond this, using IaaS for running tests of huge information systems such as (modules of) ERP-Systems or other complex planning systems is very effective. Instead of maintaining the capacities for all different testing purposes in a company, the dynamic purchase/procurement of resources obviously is much more cost effective and technically flexible. Another important application area are all interactive web applications for a growing number of customers, particularly if the number might increase at any (unpredictable) point of time – IaaS provides a scalable technology for supporting all kinds of these scenarios. ***Rapid self-service provisioning of virtual machines (VM).*** The virtualization technology enables Amazon to preconfigure a huge amount of specific VMs. Amazon benefits from offering these preconfigured machines to a wide range of customers to satisfy different needs.

4.2 Platform layer

At this layer value-added services (platform-as-a-service) are offered on top of a cloud infrastructure from a technical and a business perspective. The key asset of PaaS provider is that it adds a layer of abstraction over actual infrastructure. ***Development platforms*** enable developers to write their applications and upload their code into the cloud where the application is accessible and can be run in a web-based manner. Developers do not have to care about issues like system scalability as the usage of their applications grows. Apart from development, PaaS providers can extend their offerings to ***testing*** and ***managing*** of the derived applications. Prominent examples are Morph Labsand Google App Engine, which provide platforms for the deployment and management of Grails, Ruby on Rails and Java applications in the cloud. A further example is BungeeLabs, which provides a platform that offers functionality for managing the whole web application lifecycle from development to productive provisioning.

Focus on distribution channel is the most important value offered. Facebook Developers, Apple iOS, and Zoho Creators offer distribution channels, over which developers find their potential users.

Business platforms enable the development, deployment and management of tailored business applications in the cloud and have gained strong attention. For instance, Salesforce, with the Apex programming language.

Application-based integration: the main value proposition is the integration of the developed applications into an existing SaaS solution, using the already build datacenters and infrastructure For example, SAP Business ByDesign, Force.com and Suiteflex allow applications development, which can be integrated into their existing SaaS solutions (ByDesign, salesforce.com, and Netsuite respectively).

Migration services and open APIs. A number of researchers have stressed the absence of [16-17] suitable *Application Program Interfaces (APIs)* that can allow interaction across organizations or easy migration to new providers. This problem can affect some industries more than others. For instance, industries that are heavily dependent upon supply chain or inter-organizational interaction and consequently they will be less inclined to move to the cloud. While open APIs, standards and protocols would be an effective solution, few actions towards this direction are taken. Thus migration services and open APIs constitute a prospective business model.

4.3 Application layer

It is what most people get to know from Cloud Computing as it represents the actual interface for the customer. Applications are delivered through the Cloud facilitating the platform and infrastructure layer below which are opaque for the user. We distinguish between ***Software-as-a-Service (SaaS) applications*** and the provisioning of rudimentary ***Web services on-demand***. Most prominent examples in the SaaS area are Google Apps with their broad catalogue of office applications such as word and spreadsheet processing as well as mail and calendar applications that are entirely accessible through a web browser.

Web service on-demand provisioning has well-established examples, such as Xignite and StrikeIron. Currently, there is a rising number of offerings of *internet services on demand.* Application services include types of *Business Process Management* (e.g. Appian Anywhere), *email* (e.g. Gmail), *Marketplace* (e.g. Zimory.com), *Billing* (e.g. DevPay) *office* *applications* (e.g. Google), *Data sharing, finance* (e.g. FPS), *Web services* (StrikeIron) *video, audio and data processing* (e.g. MuxCloud).

Long Tail strategy. Services built on top of cloud infrastructures enable software providers to offer products at lower cost and simultaneously with a higher degree of customization. This so-called "Long Tail" departs from the mass market and focuses on many niche markets [22]. Cloud Computing enables the access to large data centers enterprises, which they can use to provide unique services on large-scale resources. However, the selling of few unique services requires a thorough understanding of portfolio management. Unlike mass management, the model needs a continuous improvement and change of the currently offered products.

Tailored, industry specific cloud services. Prevailing cloud solutions do not fully address the specific needs of particular industrial sectors. The idea of putting all one's data in one place might not seem ideal and furthermore concerns about the appropriateness of the functionality provided can stop some users adopting SaaS solutions. Industry specific, or vertical cloud strategy, offers services tailored specifically for the customer and its industry. The differences among industries can occur at various levels from infrastructure needs, growth patterns, software functionality, privacy and security to the requirement to interoperate with third parties. SAP, has recently launched an Industry Cloud unit to address arising industry-specific concerns with cloud-based solutions. Deployable across public, private, or hybrid clouds, the provision will include intuitive interfaces and processes to simplify business. It will also include accessible big data. VMWare has launched virtualized desktop solutions for education, government, financial services, healthcare and manufacturing clients [23].

Information as a Service. This concept revolves around the idea of services that will efficiently integrate available information about a particular entity. For example, Ma, Li and Zhou [19] have proposed a dedicated creditworthiness service which collects online and professional comments about products and calculates credentials for ability or quality. In the era of big data the collection, integration and analytical services tailored to particular business and industry needs is of great value and the area offers good opportunity for development by industry-specific cloud providers.

Finally, there are CBM that apply to *all cloud layers*. That is, security and privacy services and cloud brokers.

Security and privacy services. Safety of critical data, both in transfer as in storage, remains a crucial point.. Large enterprises will not be willing to support the Cloud concept as long as there is not more transparency available at which geographical location the data is stored and how it is protected [24].

Cloud Brokers. A cloud broker is a third-party individual or business that acts as an intermediary between the purchaser of a cloud computing service and the sellers of that service. Cloud service brokerage has recently emerged as a promising concept to offer enhanced service delivery over large scale cloud environment. The future of cloud computing will be permeated with the emergence of Cloud Brokers acting as an intermediary between cloud providers and customers to negotiate and allocate resources among multiple data centers. The integration of cloud services can be too complex for cloud consumers to manage, and a Cloud Broker eases this and plays a unique dual role. It behaves as a provider when interacting with a consumer or as a consumer when interacting with a cloud provider. It has three predominant activities [1]. *Service Intermediation* occurs when the Cloud Broker enhances a service by improving an existing one, or providing other value-added services to consumers. *Service Aggregation* is accomplished by improving an existing service or combining multiple services together to produce a new service. *Service Arbitrage* is similar to Service Aggregation except that the services being aggregated are not fixed.

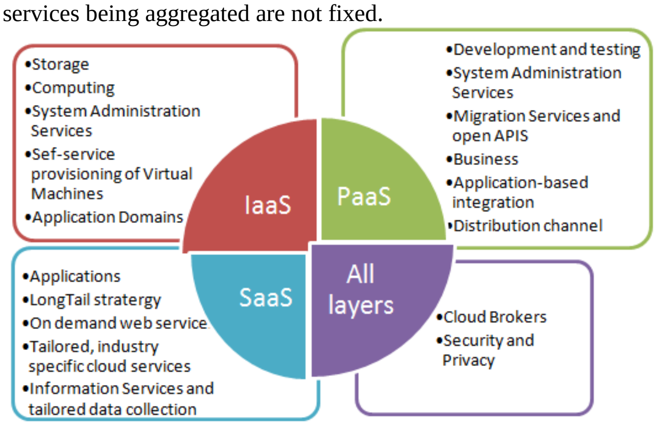

Figure 5. CF3.1 CBM classification (Value offerings)

Cloud computing revenue streams. The most frequently used pricing model of the case studies is *Pay-per-use*, in which the user pays a static price for a used unit, often per hour, GB, CPU-hour etc. According to Paleologo [25], this is normally a financial benefit for the consumer, since costs are charged proportional to the volume of the performed transactions. Also, it establishes ties between usage and payment. However, from a cloud provider's point of view, user-based transactions results in high costs for the administration of service billing and collection [26]. A similar but different pricing model is *Subscription*, where the user subscribes (signs a contract) for using a pre-selected combination of service units for a fixed price and longer time frame, usually monthly or yearly. The dominance of the above pricing models can be explained due to the fact, that users often prefer simple pricing models (like *Pay-per-use* or *Subscription*) with a static payment fee.

Dynamic pricing (also called variable pricing) is a pricing model, in which the target service price is established as a result of dynamic supply and demand, e.g. by means of auctions or negotiations. This pricing model is typically used for calculating the price of differentiated and high value items. Auctions are standard mechanisms for performing aggregations of supply and demand [27]. Another model is *Revenue Sharing*, where PaaS providers can request a commission or revenue share for placing and promoting an application that was developed by an individual software vendor. *Admission fees* can be charged to consumers, typically a one-time remuneration, in order to be granted access to the cloud-based platform or for cross-charging. Finally, customer charges must cover the risks of service disruption and possible *service level agreement (SLA)* compensations.

5. CONCLUSIONS

The paper proposes a generalized Cloud Business Model Framework (CF3) that identifies the critical structural elements and their relationships of a CBM. 50 Case studies of cloud providers were analyzed and categorized in the framework according to their value offerings and revenue models.

Findings suggest that security, privacy, control and interoperability remain concerns for industries as well as the need for more specialized services at application level. The implementations of these CBMs would offer valuable solutions to many firms in all market segments. This, in turn, would dramatically increase cloud adoption.

The research findings can become useful inputs for both researchers and practitioners. For researchers they can become the basis for building a common overarching CBM, clarifying and unifying the ambiguous constructs, elements and characteristics of the different CBM implementations. As cloud computing is an upcoming technology that continues to evolve, the proposed taxonomy is not meant to be exhaustive or definitive. New interesting variations are expected in the future. As there isn't a previous framework of the kind, this study aspires to create an efficient basis for future research in the field.

However, even in its current form, the framework can also become a useful tool for managers and decision makers that would anticipate to focus on a CBM strategy. The tool summarizes the architecture insights, structural elements and different implementations of already practiced CBM in the market. These issues leave ample room for both technical and economic future work.

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APPENDIX A

Table 1. List of case studies

IaaS	PaaS	SaaS
Amazon EC2, S3	4CaaSt	3M
DevPay	BungeLabs	Appian Anywhere
Flexiscale	CloudBees	Apple(Siri)
Google Apps Engine	DevPay	Box.Net
HearthHiway	FPS	BusinessByDesign
HP	Google Apps Engine	CloudTV
IBM	Microsoft Azure	Etsy
Joyent	Morph Labs	Facebook
Network.com	Network.com	Google Apps
Rackspace Cloud Servers	SalesForce.com	MS SkyDrive
RightScale	SimpleDB	MuxCloud
Sun Cloud Storage Services	SQS	Netflix
Xcalibre	WSO2	Nirvanix
Eucalyptus	Qrimp	Opsource
Vmware	OrangeScape	ProcessMaker
Techila Solutions		RedHat
		SalesForce.com
		SAP
		SmugMug
		StrikeIron
		SugarCRM
		Xdrive
		Xignite
		Zimory.com

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