The Impact of Cloud Infrastructure on Business Value: A Qualitative Analysis

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Although this work is the result of a common will, every paragraph has been written by a single author, particularly:
– 1st and 2nd sections by Roberto Candiotto.
– 3rd and 4th sections by Silvia Gandini.

Abstract The interpretation of organizations like dynamic entities imposes some fundamental challenges for today's managers. Firms have not derived value simply by linking IT to their business processes: they have learned how to benefit from IT by developing a competency in creating and evolving an IT architecture, able to identify and implement the organization's strategic objectives. Cloud computing represents a possible answer to companies' needs of flexibility, giving them the chance to implement new services more quickly than the past and without expensive capital investments. The aim of this work is to analyze the impact of cloud (in short, from now on the term "Cloud" will be used as "Cloud Computing") on value creation opportunities for companies that decide to migrate their IT infrastructure toward the *on-demand* model. The assumption that similar choices, from a technological point of view, can imply various value expectations has been attested through the cross-analysis of two companies that both chose public cloud, but starting from deeply different motivations.

Keywords Cloud computing • IT infrastructure • IT value • IT management • IT business impact

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1 Introduction

Cloud computing can be defined as a set of technologies, typically in the shape of a service offered to a client by a provider, which enable to store, to file away, and to process data items, thanks to the use of hardware and software resources, distributed and shared online.[1] The vision of computing as a service focuses on the linkage between business processes and IT services so that the first can be seamlessly automated using the second; service computing has led to the development of software for millions to consume, rather than to run on their individual computers [1]. To deliver this vision, many computing paradigms have been proposed over the last few years,[2] but cloud represents an extension of them wherein the capabilities of business applications are exposed as sophisticated services that can be accessed over a network.

The study of cloud can be particularly interesting not only for its multidisciplinary character, determined by the involvement of different disciplines in data collection, data processing, and data storage operations, and for the use of *Information and Communication Technologies* (ICT) [2], but also for its transversality toward different organizational research themes, typical features of studies about information systems' organization. Many researchers focused their attention on this phenomenon, considering its potential to transform large parts of the IT industry [2, 3], and identifying its most relevant features such as the prevalence of economic variables [4] and of organizational implications and goals [5, 6] over purely technological aspects. But very few works have concretely analyzed what potentialities can emerge from the combination of the global availability of cloud infrastructure at a low cost and companies' capability to create business value [7]. When cloud is conceived as a public service, it can be interpreted as a virtual space where the infrastructure is provisioned for an open use by the general public, resources are shared, and dynamically allocated, according to customers' real needs and basing on a usage model focused on "pay as you grow."

Hence, it's reasonable to think that cloud could be used to optimize, transform, and create companies' value chain, basing on its capability to improve the following aspects:

- *Cost flexibility*, because cloud services can help an organization reduce fixed IT costs (software licenses, servers, and networking equipment) by enabling a shift from capital expenses (capex) to operational expenses (opex);
- *Business scalability*, since cloud enables a company to benefit from economies of scale by allowing for rapid provisioning of resources without scale limitations;

[1] http://www.nist.gov/

[2] Here are some paradigms promising to deliver IT as a service: web, data center, service-oriented architecture, grid computing, P2P computing, market-oriented computing.

– *Market adaptability*, because cloud in turn facilitates rapid innovation and helps speed time to market by enabling businesses to rapidly adjust processes, products, and services to meet changing needs.

Moreover, in order to evaluate the maturity and the adoption of technologies and applications, and to understand how they are potentially relevant to solving real business problems and exploiting new opportunities, the *Hype Cycle* model is often used.[3]

Actually cloud is still interpreted as a phase of the *commodization* process of IT investments,[4] but really this technology is looking for a specific identity over the ICT market and could represent a strategic evolution step in the use of the Internet.

In the light of previous considerations, this work is aimed to analyze if cloud services can have a positive impact not only on companies' IT costs but also over their capability to improve business value through innovation. To answer this question, it's been assumed that the adoption of similar cloud services can be influenced by multiple motivations, leading implementation projects to have different degrees of strategic impact.

The assumption has been tested through a qualitative cross-analysis of two companies that both implemented a cloud infrastructure. The analysis has regarded the projects' phases and characteristics (assessment of actual criticalities, provider selection, role of the IT management), and the improvements expected/already perceived from the new context, leading to find some analogies but also substantial differences in companies' behavior.

2 Research Project Description

Analyzed companies:

1. Multinational of the fashion sector (company A)
2. Consortium for the *Waste of Electric and Electronic Equipment*—WEEE disposal (company B)

Research methodology: qualitative cross-analysis through direct interviews [8]
Period: June–October 2014
Interviewed person:

[3] Basing on this model, each hype cycle drills down into the five key phases of a technology's life cycle: the evolution starts from a breakthrough moment (*Technology Trigger*), goes through a period of extreme excitement (*Peak of Inflated Expectations*), then of disillusionment (*Trough of Disillusionment*), and can finally arrive to a true understanding of the technology's applicability, risks, and benefits (*Slope of Enlightenment*), before the rapid growth phase of adoption begins (*Plateau of Productivity*). Cfr.: http://www.gartner.com/

[4] According to Gartner, in 2014 cloud was at the end of the third phase (*Trough of Disillusionment*).

– Global IT Coordinator (company A)
– IT manager (company B)

Goals:

– What are the main differences between analyzed companies about strategy, organization, and IT architecture.
– What are the reasons underlying the migration of the IT infrastructure to cloud.
– How cloud projects were structured and realized.
– What is the projects' strategic impact.

2.1 Analyzed Companies

Company A is a multinational of the fashion sector structured in the following business units: (1) *BU Italy*, which covers Italy market and is also the operative headquarter; (2) *BU International Business*, which manages commercial relations with distributors in 100 countries worldwide; (3) *BU France*, which covers France and Benelux markets; (4) *BU Deutschland*, which covers Germany and Austria markets; and (5) *BU North America*, which covers USA market and was founded in 2012 as a start-up.

The IT management of the group is composed of local IT manager (except for BU North America) and, at a central level, of a *Global IT Coordinator* who is responsible for the company's IT investments and for the monitoring of BU behavior about the use of IT. Strategy and cultural values are deeply oriented to internationalization, and the main goal is to develop the brand worldwide but respecting local markets' peculiarities through excellent industrial design, specialized know-how, and a global strategic approach.

The technical architecture is managed at local level and coordinated at central level, and each BU is provided with the following applications:

– *ERP*, which supports financial and distribution operations and is locally deployed at BU level;
– *PLM*, which supports the processes underlying the collections' design and the product development and is implemented at central level;
– *BI*, whcih supports the processes underlying the corporate reporting and is implemented at both central and BU levels;
– *Local enterprise applications*, integrated with the ERP and managed at local level (sales force automation, retail, and B2B).

In 2012, the incorporation of BU North America as a start-up required a way to rationalize the IT investment for the new reality. Management decided to provide the BU with the same set of applications of others, but externalizing the IT infrastructure and deciding at first for an outsourcing solution. However, after a careful evaluation of the main international provider over the market, in January 2014 the infrastructure of the North America area migrated to a public cloud. As of

now, assessment of actual criticalities has been done for all other BUs, in order to migrate the whole infrastructure of the group.

Company B is a consortium for the WEEE disposal that operates on the Italian market and is composed of appliances, consumer electronics, and computer equipment producers. The main activities involve (1) the recall from some certified collection points, (2) the transportation to selected treatment plants, and (3) the recycling and the retrieval of materials.

A *WEEE Coordination Centre* is responsible for the control of all national consortium, in order to assure high service levels, to correct behaviors, and to protect municipalities that decide to equip collection points for their citizens. In the last few years, a substantial decrease of disposal requirements has characterized the WEEE market, implying a need for major flexibility in the consortium production processes. Efficiency and business continuity are therefore the main critical success factors to respect national regulations and manage irregular workloads at the same time.

The IT manager is responsible for the technical architecture, which is provided with a production system, an ERP system, and a service for market information collection. Up to 2010, the IT infrastructure has been managed in hosting with some problems related to server maintenance, power availability, and long provisioning time. For these matters, IT direction decided to migrate the whole infrastructure to a public cloud.

2.2 Projects' Analysis

A clear comprehension of how a company IT services can be similar to available cloud services and the ability to implement cloud in the most coherent way allow us to reduce risks related to migration projects and so to obtain a major value from investments. Cloud implementation requires a wide-ranging strategy and new responsibilities for the IT management, in order to realize a structured governance system and to assure alignment between the cloud and the company's strategy. From a technical point of view, since the IT management could lose control and vision over the IT architecture it is necessary to develop the capacity to orchestrate internal and external services and to evaluate the trade-off between the costs and benefits of the migration. Another important aspect of public cloud projects is data sharing outside the company limits so that management have to know all controls and security policies of provider's offering.

In the light of previous consideration, cloud projects have been analyzed considering the following aspects: (a) *strategic goals and resources assessment*, (b) *provider selection*, and (c) *impact on IT costs*.

(a) *Strategic goals and resources assessment*
The great availability of cloud services and the large number of provider on the cloud market imply the necessity to consider carefully a cloud migration. IT

management should create integration between IT investments and business. For this matter, it is important to structure migration projects starting from an assessment of actual resources, to analyze criticalities and needs, and to understand what kind of benefits cloud could generate.
In this section, interviews have been structured as follows:

– What are the main motivations for the migration to cloud?
– How this passage can support strategic goals?
– Who has/have the responsibility to decide for IT investments?
– Was the assessment of pre-cloud situation a formalized process?
– Has the assessment required external competencies?
– What criticalities/opportunities of improvement arose from the assessment?
– How cloud can solve criticalities and support opportunities?

(b) *Provider selection*
Before implementing cloud services, companies should evaluate the amount and typology of the data they want to externalize. This kind of analysis is important to understand not only the project's feasibility but also the economic and organizational consequences of an eventual loss of data. The *Italian Data Protection Authority*[5] suggests companies to test providers' reliability considering the following aspects: (1) references and guarantees offered to preserve the confidentiality and security of data; (2) measures adopted to assure business continuity; (3) quality of services and degree of responsibility if problems occur; (4) location, in order to understand if there is a normative gap; and (5) characteristics of the contractual terms.
In this section, interviews have been structured as follows:

– What are the main assessment benchmark used to evaluate providers?
– How the reliability of selected provider was tested?
– Does the selected provider give information about the location of externalized data?
– Are the contractual terms clear and comprehensible?

(c) *Impact on IT costs*
In the last few years, companies' continuous expansion to meet business goals has in some cases led to a congestion of their data center. Under this perspective, cloud represents a solution for a more "ecological" way to manage data center, giving companies the possibility to (1) take advantage of shared and dynamic infrastructures; (2) reduce the number of servers in-house; (3) automatize a lot of maintenance activities; and (4) cut maintenance, license, upgrading, storage, security, and energy costs.
In this section, interviews have been structured as follows:

– What are the cost elements to consider in the migration project?

[5] http://www.garanteprivacy.it

– How can pre-cloud and cloud costs be compared?
– What kinds of cost benefits have already been obtained and what are expected?
– Could the cost benefits have a strategic impact?

3 Results of the Analysis

3.1 Strategic Goals and Resources Assessment

In the case of company A, strategy is oriented to develop the brand worldwide and to improve the international development but respecting local markets' peculiarities. Moreover, the introduction of the Global IT Coordinator has allowed to better promote organizational changes besides all the BUs and to assure alignment between IT choices and business goals for all the reference markets.

Cloud migration started in 2014 for the BU North America in order to provide it with a flexible and scalable infrastructure. The success of this project led the IT management to evaluate the same choice for all the other BUs. In this case, the main purpose was an improvement in flexibility and efficiency of the actual infrastructure at economic conditions, to free resources for the following more strategic IT investments: (a) the strengthening of the Business Intelligence system, to increase the value of available data; (b) the development of a new Product Lifecycle Management and 3D system, to reduce time to market; and (c) the introduction of new Global Supply Chain functionalities, to increase customer satisfaction and to reduce the working capital at the same time.

Assessment has been realized in different sessions. For the BU North America, the preliminary analysis was focused on a comparison between all the possible options (*on premise*, *cloud*, and *hosting*) to understand strength and weaknesses of each of them. For the European BU, the analysis was based on a double perspective and regarded:

1. The actual *application portfolio*, to evaluate what are the most critical applications that have a direct impact on the company's business;
2. The *system catalogue*, to discover infrastructural problems of single BU and to make a general evaluation of the whole company's IT infrastructure.

The results of this last analysis were then shared with local IT departments, in order to define a general plan of action and to compare strengths and weaknesses of the possible options (upgrading of actual infrastructure or migration to cloud). Both for BU North America and for European BU, the assessment and the implementation plans have been structured in a standardized way and followed by a cloud broker, which previously was the company's IT consultant.

In the case of company B, strategy is oriented to manage the WEEE in an excellent and efficient way, because performances are controlled and monitored

	COMPANY A	COMPANY B
Strategy	International development	Process efficiency
Organizational complexity	High (5 business units WW)	Low
Motivations of the change		
- Obsolete IT infrastructure	●	●
- Problems about systems security	●	●
Expected benefits from the change		
- improved business continuity	●	●
- increased infrastructure scalability	●	●
- Improved corporate image (more innovation for investitors)	●	
- IT investments reduction	More resources for the future strategic development of applicaton portfolio	More resources for an eventual infrastructure development
Responsibility of IT investments	Centralized unit Strategic Functions (Global IT Coordinator)	IT Direction
Structured process for the assessment of actual resources	●	
Involment of external actors in the change process	Cloud broker (previous IT consultant), from assessment activities	System integrator (applications provider), after the infrastructure migration

Fig. 1 Strategic goals and resources assessment: a comparison of results

by the Coordination Center, but they are also strictly related to the workloads trend. In this context, it is necessary to dispose of a solid and secure IT infrastructure, able to assure business continuity and to avoid penalties. Moreover, the same infrastructure must be scalable because workloads could exceed production capacity. The passage to a cloud infrastructure was determined by previous considerations and also by some problems related to server maintenance, power availability, and provisioning time for additional resources. In fact, when compared with the upgrading of existing infrastructure in hosting cloud represents the only solution able to assure a rapid scalability. The assessment process was not formalized and did not involve external competencies, but it was very useful to understand the most important criticalities of the pre-cloud situation. Cloud migration required a collaboration between the company's IT management and an external system integrator, but only in the last phases of the process (Fig. 1).

Hence, the analysis realized for the area *strategic goals and resources assessment* has allowed to make the following considerations:

– Motivations at the base of cloud adoption are firstly economic.
– When strategy is more oriented to market development, the passage to cloud could represent an input for innovation, leaving to the IT management major resources for applications' strategic improvement.
– Complex organization requires a structured assessment process, supported by external specialists.

– Complex projects require a greater involvement of the cloud broker since the assessment activities, to assure a major alignment between IT systems and business.

3.2 Provider Selection

In order to accomplish to the *Italian Data Protection Authority* guidelines, companies decided to focus on international players, although they had different motivations and goals. For company A, the choice was imposed by the desire to improve corporate reputation worldwide, while company B related the success of provider to its capacity to assure a high degree of business continuity.

Anyway, in both cases the selection was deeply influenced by what the most important consulting companies said about the major cloud player on the market and it was realized considering strengths and weaknesses of two different offerings: (1) Amazon, for its positioning as a leader, and (2) Microsoft, for its development and worldwide recognized capabilities.

In the case of company A, the analysis was realized with the support of the external specialist, leading to the following considerations:

– Although Amazon Web Services enjoy a high reputation on the cloud market, they are too much standardized and not subject to discounts or special prices.
– Windows Azure is a quite recent solution, but, if compared with Amazon, it presents a greater economic flexibility and a major interoperability with existing applications.

In the case of company B, the analysis was realized independently by the IT manager, leading to the following considerations:

– The Amazon Web Services are numerous, growing (giving the possibility to improve economies of scale for all users), and characterized by high degrees of scalability and transparency;
– Windows Azure is quite recent and has a scarce experience in the management of those clients whose main needs are related to a rapid scalability.

Fig. 2 shows how in general providers can be evaluated based on three fundamental aspects: (1) *contractual characteristics*, to understand if it possible to obtain discounts or special prices; (2) *development and innovation degree*, as an index of acquired experience; and (3) *reputation over international markets*, as a measure of reliability and potential development.

Basing on the above said considerations, company A decided to migrate the IT infrastructure to the cloud of Microsoft, for its reputation and for the consequent possibility to better support the strategic value of the project. Instead, company B chose the cloud of Amazon, privileging so the provider with a major experience in the infrastructural field.

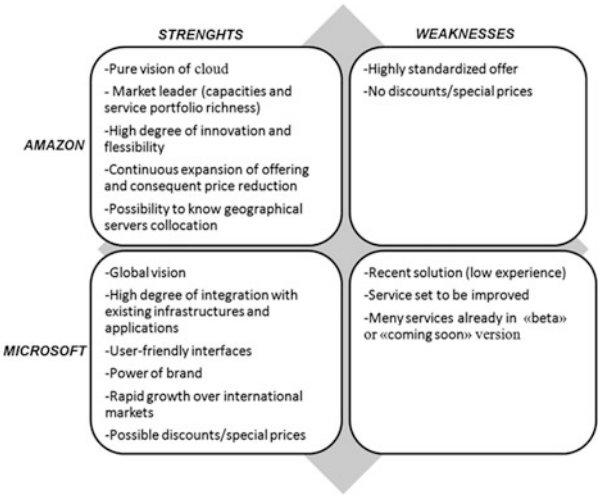

Fig. 2 Provider selection: a comparison of results

Hence, it is possible to say that the companies characterized by a global vision, whose strategy is mainly oriented to technological innovation and to the enforcement of the brand, tend to select provider for their international reputation, in order to legitimate organizational changes also for external stakeholders. Instead, companies whose strategy is more oriented to internal efficiency tend to select provider with a pure and standardized infrastructural offering.

3.3 Impact on IT Costs

In the case of company A, the economic evaluation started from the BU North America through a perspective comparison between on-premise and externalized solutions. Although the necessity to consider at the first year some capex related to the implementation of the set of applications, cloud remained however the most convenient solution.

The analysis for the European BU has been realized comparing the costs of infrastructural options for *to-be* situation (new on-premise or cloud) with those of *as-is* situation (old on premise). Only for cloud option, it was necessary to introduce at the first year some capex related to the migration of existing applications on the new virtualized infrastructure. Moreover, in the BU Italy it was decided to consider a hybrid cloud, in order to exploit a quite recent internal infrastructure for the *Production Data Management* system. This is the only case of minor convenience for cloud (but only for the first year because of the migration costs).

In the case of company B, evaluation was done comparing costs related to the upgrading of existing infrastructure in hosting, as noticed in the assessment phase,

		ANALIZED SCENARIOS		
		Hosting	On premise	Cloud
COMPANY A	ANAM	€ 97.517	€ 159.385	€ 54.112
	AFRA		€ 81.000	€ 56.250
	AGER		€ 79.750	€ 50.000
	AITA		€ 78.000	€ 104.000
COMPANY B		€ 13.298		€ 8.066

	COMPANY A				COMPANY B
	ANAM	AFRA	AGER	AITA	
Hosting	€ 97.517				€ 13.298
On premise	€ 159.385	€ 81.000	€ 79.750	€ 78.000	
Cloud	€ 54.112	€ 56.250	€ 50.000	€ 104.000	€ 8.066
	34% of on premise	69% of on premise	63% of on premise	133% of on premise	
	55% of hosting				61% of hosting

Fig. 3 Impact on IT costs: a comparison of results

with those of the passage in cloud. Also in this case, and only for cloud, it was necessary to consider some migration costs.

The analysis shows how, for both companies, cloud represents in general the most convenient solution among considered options (Fig. 3).

The saving ranks around:

- 55 % in the case IT infrastructure is directly realized in cloud, as for the BU North America, giving the advantage to cut capex and free resources for future business expansions through a rapid provisioning;
- 46 % (on average) in the case of a migration, with the possibility to dispose of major resources for a future strategic development of applications (company A) or for infrastructural expansions (company B).

4 Consideration About the Value of Cloud and Conclusions

Although today cloud is recognized as one of the most important technologies, a few companies use it to implement new business models and improve their capability to create innovation. A careful analysis of companies' value propositions and value chains at the same time is necessary to make a judgment about the impact of cloud projects on business value.

Enterprises can apply cloud to generate additional revenue streams by *enhancing*, *extending*, or *inventing* new customer value propositions. And cloud can be used to improve, transform, and create new organization and industry value chains (Fig. 4).

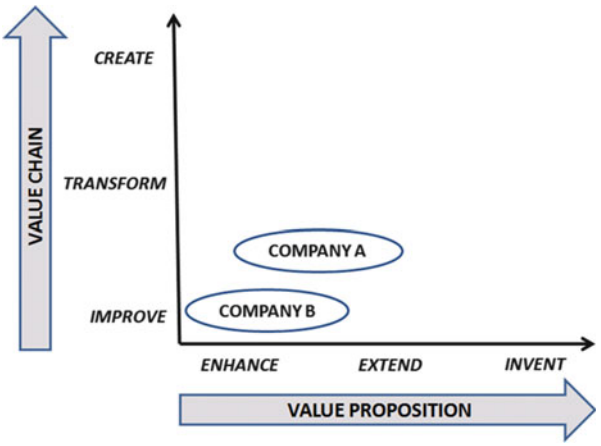

Fig. 4 The changing level of cloud (IBM realized this model basing on the classic Venkatraman model about the changing level of Ict.)

With regard to *value proposition*:

- As for company B, organizations can use cloud to improve current products and services to retain current and attract new customers, garnering incremental revenue (*enhance*).
- As for company A, cloud can support the creation of new products and services or the use of new channels to attract existing or adjacent customer segments to generate significant new revenues (*extend*);
- Companies can use cloud to create a new "need" and own a new market, attracting new customer segments and generating entirely new revenue streams (*invent*).

With regard to *value chain*:

- For both the analyzed companies, cloud adoption can help an organization maintain its place in an existing value chain through increased efficiency and an improved ability to partner, source, and collaborate (*improve*).
- By assisting in developing new operating capabilities, cloud can help a company change its role within its industry (as for the international expansion of company A) or enter a different industry (*transform*).
- Organizations can use cloud to build a new industry value chain or disintermediate an existing one, radically changing industry economics (*create*)

In conclusion, it is possible to say that similar projects, under a technical point of view, can lead companies to use cloud to incrementally enhance their customer value proposition while improving organizational efficiency or to significantly extend customer value propositions, resulting in new revenue streams. The rapid scalability of economic resources allows companies to focus on their business rather than on the supporting IT infrastructure. And this is true: more companies operate in a competitive environment and have market-oriented strategies, as this work has confirmed even if for only two cases.

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