Organizations and new IT paradigms: processes and organizational implications related to Cloud Computing projects

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Abstract Recently, the remarkable success of the Cloud Computing inspires reflections related to the introduction and the development of new technologies. The relevant turmoil around this phenomenon is not always supported by a complete understanding of its peculiarities, potentialities, opportunities offered to companies and of its consequent organizational implications. Actual market propositions of Cloud solutions include not only the supply of infrastructures and applications as a service, but also the availability of business platforms, to design business processes and to realize integrated inter-organizational processes. Managers can, in fact, improve their companies productivity and competitiveness through the implementation of Cloud and Business Process Management technologies. This work, through the methodology of multiple case study and the coherent analysis of some providers, is aimed to point out Cloud Computing peculiarities, and different organizational approaches that actually characterize projects' planning and implementation, to identify, apart from various offer typologies, standardized procedures for process management and to deduce and suggest a common, hoped organizational behaviour.

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

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[1] Although this work is the result of a common will, every paragraph has been written by a single author; particularly:

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and to process data items, thanks to the use of hardware and software resources, distributed and shared in a virtual platform on line[2].

This phenomenon represents the logical consequence of the nineties' technological progresses and of the succeeding technologies pervasiveness, thanks to which each final consumers can process data and pass information, even without having high technological competencies and understanding of computing contents of operations carried out. Related authors have, in fact, identified, the most relevant features of Cloud Computing, the prevalence of economic variables (Chellappa and Gupta, 2002) and of organizational implications and goals (Aymerich, Fenu and Surcis, 2008; Ahronovitz and al., 2010) over purely technological aspects[3].

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) (Avison and Pries-Heje, 2005), but also for its transversality toward different organizational research themes, typical features of studies about Information Systems' Organization. It is noteworthy to remark that Cloud technologies are strictly related to specific aspects, like: a) «management and organization of information systems», for what concerns the planning of infrastructures and applications, and the relationships between information system and organization, b) «development of information systems», with regard to the definition of technical and organizational requirements, and the management of project risks (Davis, 2000; Baskerville and Myers, 2002).

In the light of previous considerations, this paper's objective is to answer, through a multiple case study, the following research questions:

1) what are the main characteristics of Cloud market;

2) what are the organizational implications of project management, and particularly:

- is there a relative uniformity among providers concerning the projects management?

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[2] In short, from now on the term «Cloud» will be used as «Cloud Computing».

[3] Literature analysis has been realized on the abstracts of 837 paper, in the years from 2010 to 2011, of these publications: *European Journal of Information Systems*, *Information Systems Journal*, *Information Systems Research*, *Journal of AIS*, *Journal of MIS*, *MIS Quarterly* (first 6 excellence journal and review according to the ranking of Association for Information Systems (AIS)) and *Information & Management*, *Management Science* (class A review for «Organization» area according to the ranking 2011 of Accademia Italiana di Economia Aziendale (AIDEA)). The analysis has shown that only 9 paper are related to Cloud topics, and not focused on organizational aspects of ICT as a Service.

The same results has been produced by the analysis of the first 15 available *Google Books*, related to the keyword «Cloud Computing», and on the first 20 pages of *Google Scholar*, related to the same keyword.

- are there standardize procedures for processes related to projects management?
- if it is possible to identify and take up common organizational behaviours, what are the effects on the clients' organizations?

2. Characteristics of the Cloud market

Cloud Computing has had a strong impact on ICT market, with particular regard to the reconsideration of procedures, through which services are created, supplied, and, then, employed. In this connection the Cloud market can be analyzed under different perspectives. The main ones, according to the literature analysis, emphasize, both the goals of Cloud services, and technological components, through which services are provided.

According to the first perspective, the attention is drawn to the best conditions of use, in order to assure the greatest flexibility and effectiveness. For this matter, providers make use of a large pool of virtualized and easily accessible resources (such as hardware, development platforms and/or services), that can be dynamically reconfigured. This pool of resources is typically supplied by a *pay per use* model, fully respecting predetermined Service Level Agreements (SLA) (Vaquero and al., 2009; Catteddu e Hogben, 2009).

According to the second perspective, instead, providers' infrastructures consist of Internet-connected servers, located either in a single area or distributed across several locations, which host applications and data in order to obtain efficiency and innovation. Those infrastructures are virtualized and they include different types of software, they use interfaces and communication tools with final users, and lastly they are based on monitoring mechanisms for SLA (Armbrust and al., 2009; Leavitt, 2009).

A third perspective, developed by *American National Institute of Standards and Technology* (NIST), reconciles the two previous mentioned ones, by defining Cloud Computing as «a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction[4]».

NIST has also offered important contributions to the determination of the cloud computing concept:

- *essential characteristics of Cloud*; according to standards, it's possible to talk about Cloud when: a) the service is offered through *self-service* and *on-demand* modality; b) services are available on line and the distribution occurs through mechanisms of standards supply c) the provider's physical and virtual resources are gathered to serve multiple consumers using a *multi-tenant* model; d) the supply of resources and services can be elastically provisioned and released, in

[4] Source: http://www.nist.gov/

order to assure timeliness of supplying; e) resources usage can be monitored, controlled, and reported, guaranteeing transparency for both provider and consumer.

- *service model*; the consumer can buy: a) provider's applications running on a Cloud infrastructure (*Software as a Service – SaaS*); processing, storage, networks, and other fundamental computing resources (*Infrastructure as a Service – IaaS*); c) applications created using programming languages, libraries, services, and tools supported by the provider (*Platform as a Service – Paas*);
- *deployment models*; it's possible to distinguish between: a) a *public Cloud*, when the infrastructure is provisioned for an open use by the general public, resources are shared, and dynamically allocated, according to customers' real needs; b) *private Cloud*, when the infrastructure is offered to the exclusive use of a single organization; c) *community Cloud*, when the infrastructure is shared by several organizations associated with some common interests (for instance, mission values, security requirements, policy, and compliance considerations); d) *hybrid Cloud*, when infrastructure is a composition of two or more distinct Cloud deployment models (private, community, or public).

3. Organizational peculiarities in cloud project management

The analysis of some Cloud providers has enabled us to identify some guidelines, that characterized the service offers which reflect the strong diversity within the organizational approaches used by supplier companies.

Analyzed companies[5]**:** Altea, Asystel, Cosmic Blue Team, Eid, Gruppo Zenit, IBM, Kelyan

Research methodology: multiple case study

Goals:

- the provider positioning in the Cloud market;
- phases and activities of Cloud projects;
- constraints/opportunities related to projects;
- the impact of projects on business opportunities of clients companies.

The analysis showed how the market is currently characterized by a great number of providers, aware that some changes are taking place in the ICT market, and

[5] We thank all companies' managers that have allowed the realization of this work with their willingness, professionalism, attention, and sensitivity. Particularly: for Altea Gian Carlo Pera and Giovanni Rota, for Asystel Danilo Formaggini and Paolo Sito, for Cosmic Blue Team Manuela Branz and Paolo Zanolini, for EID Giuseppe Volta, for Gruppo Zenit Alessandro Barbero and Roberto Pagano, for IBM Mariano Ammirabile and Mario Moccia, for Kelyan Andrea Bouchard and Luca Ferraris.

The interviews has been planned by defining a specific scheme, predisposed through preliminary conversations (May-July 2011), and then realized (October 2011-January 2012).

prepared to transform themselves from licence producer to supplier of applicative services (SaaS), present in their own infrastructure. Other vendors have began as an IaaS provider, by placing infrastructures composed of servers and storage tools, and supplying traditional programming services. This strategy has also been afterwards adopted by some national telecommunication operators, which provided their relevant technical infrastructures, in order to deliver ICT services to big companies, however limiting themselves to hardware infrastructures, or at least, environments traditionally development-oriented.

The current and wide differentiation of the Cloud offer in the market is also showed in different organizational behaviours by providers, who variously configure the phases of the project based on different experiences and strategies, although they share the belief that Cloud can have success only through the offer of integrable applications, directly configurable by the final consumer.

A first consideration, in the light of interviewed providers' contributions and of their main organizational variables, carries on the identification of:

- *utility provider*: generally equipped with relevant infrastructures and economic capabilities, they can be provider of applications, conceived as Cloud services, or provider of functions for the elaboration of data and for basic business processes. They are able to better standardize offered processes and services, thus assuring a greater flexibility, an easier pay per use services' quantification, and becoming more coherent with the above mentioned Cloud's peculiarities;
- *niche provider*: generally skilled in services for the support of specific functional activities, they use their specialization to offer personalized services and organizational behaviours closer to IT outsourcing logics.

This classification shows how, still today, Cloud is interpreted in different ways, as regards goals and project activities, and how providers can variously manage modular architectures, thus being able to integrate themselves with solutions from other providers.

The strong points of the package on offer by the utility providers are mainly represented by the efficiency, achievable through the complete services' availability[6], the recovery capability in case of damage, the celerity of the service's resetting of service capability, the data security, and lastly the chance to offer it at economic and favourable conditions.

The main strength of niche provider is, instead, the ability to project personalized services and applications, configurable in a rapid and secure way, in relation with final consumer's contexts, needs, and business goals. They are able to offer the most recent software releases, adapting them to clients' specific requirements, but often they are unable to include these applications as modular components in a wider solution.

However, the above analysis permits one to define a prevailing behaviour, particularly for the management of SaaS projects, articulated in the following phases:

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[6] The activation of Cloud solutions requires the availability of the broadband Internet connections, to assure high service levels, and particularly a reliability threshold closed to 99,999%.

A) *Definition of the solution* (*contracting phase*). In reference to the service chart, indicating service typologies and general service conditions, the commercial definition can involve three different professional resources: commercial figures for relations, the specialists (technical figures with commercial competencies for project propositions) and the planners (for the proper definition of the project); they are all coordinated by a Cloud manager. In this phase, the provider can use information systems to manage offer activities, which give a support to specialists in collecting consumer's bills, and plan for the involvement of adequate business resources, to assure the formulation of an optimal proposition. Concerning this, a direct interaction between resources of provider and client is pretty common, in order to better analyze management directives of existing information systems, expected levels for security and compliance, the required autonomy in the applications' development, and lastly the sought service level related to the business. This phase comprehends all negotiation activities that, although the existence of previously defined service conditions, can involve a legal consultant. The choice of managing differentiated requirements, through the adoption of unstandardized procedures, implies stronger constraints for the provider, particularly referring to the duration of contracts, normally not inferior to 36 months; moreover, the price payable by users is equivalent to a monthly rent, and can be established for each registered contractual user. At that moment, the provider's ability to define high security levels represents a critical success factor of the formulated offer.

B) *Activation of the service*. The order is received and processed into the informative system of the delivery unit (i.e. a team for the implementation of solutions, coordinated by a Data Center responsible), for the effective service supply, respecting pre-defined guidelines. Resources involved in the delivery structure are not only responsible for the implementation, but also for the integration of clients' different solutions, in order to coordinate internal applications and software/hardware managed as a Service. In this phase, people responsible for the monitoring have to assure a continuous assistance; in case of damage and malfunctioning they have to be ready to manage those problems, by involving their own specific competencies, both on damage related to the hardware and to applications.

The diffusion of the above mentioned project management procedures, is justified by the fact that a great number of niche providers, extremely professional in the sector of specific functional solutions, has capitalized their deep experience in the field of IT outsourcing, by finding an alternative way to be competitive in the Cloud market; in fact, even with limited investments, they are able to better analyze final markets, to satisfy peculiar requirements of the final consumer, and to offer personalization of components. For clients, advantages come not only from services cheapness (it is indeed sufficient to meet activation costs), but also from the consequent major accessibility to applications, previously not taken into consideration because it was either too expensive in the case of an internal development, or service potential was not known; under this point of view, actual and potential clients, aside from their dimensions, can avail themselves of the most

advanced technologies and they might exploit them to find new business opportunities.

On the other side, the same approach presents some incoherence with the main features of Cloud market, as defined by NIST. Particularly, personalization activities, both in the formulation of the offer and in the implementation of contracts, contrast with the idea that service has to be offered through *self-service* and *on-demand* modalities.

Explained opportunities and strengths, represent a solid base to verify what is the motivation for the definition of a general organizational approach shared by the providers, unrelated to their size, their resources, and typologies of service offered in the Cloud market.

4. Considerations about provider organizational reassessment

The comparison between market characteristics, as defined in paragraph 2, and those empirically verified through the multiple case study, has allowed us to deduce, for some of the providers interviewed, how the offer formulation should neither adapt itself to final consumers' requirements, nor provide conditions for negotiation activities, through an interaction between the client and the provider.

Currently, given the service models previously identified (SaaS, IaaS and PaaS), and the conditions of modularity and pay per use, Cloud Computing can be seen as a way of interaction between the *Business Process Management* (BPM) and the so called *Service Oriented Architectures* (SOA) [7]. This reflection implies that each provider must avail itself of infrastructures able to support both single applications and BPM platform, to facilitate clients in reaching their specific goals, but leaving them autonomous in the configuration/integration of their business processes.

The real challenge for the provider consists in the capability to project their own services in the most coherent way with regards to the more relevant market *business drivers*[8], and then to provide those services with standardized procedures. From an organizational point of view, the above mentioned approach requires the involvement of the following resources:

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[7] A *Service Oriented Architecture* (SOA) is a set of principles and methodologies for designing and developing software in the form of interoperable services; these services are well-defined business functionalities that are built as software components that can be reused for different purposes. SOA also generally provides a way for consumers of services, such as web-based applications, to be aware of available SOA-based services.

[8] For instance, reduction of development and activation costs, solutions' flexibility, quality of supplied services, new competencies development, etc.

- *service creation team*; it's the most innovative organizational unit, characterized both by technical and managerial competencies; particularly, if there is a high degree of interaction between:
a) a developer of the single service components, that uses specific tools for software design and development;
b) a compositor, responsible for the configuration of different solutions, by assembling various components;
c) an offer manager, for the offer planning;
- *service delivery team*; it's the operative organizational unit, integrated, through different portals, both to the service creation team and to the final consumers; it's composed of:
a) business supporters, responsible for the implementation of the offer, as planned by the offer manager, by defining, in a catalogue, the typologies and characteristics of supplied services, and the related contractual conditions;
b) operative supporters, responsible for the offer publication over the Internet, for the management of all operations required by the effective service activation and delivery, and for all consequent monitoring (mainly on service continuity and security levels) and help desk activities;
c) a service manager, responsible for the coordination of all resources involved in the team;
- *service promoters*[9]; they directly interact with final consumers (consolidated or potential) to present new solutions' opportunities, configuring themselves as consultants for a revising of existing strategies and of related processes, and activating Cloud solutions.

The defined organization can be effectively operative only if the provider possesses servers, storage tools, and networks, all implemented over a specific infrastructure, in order to enforce required services. Providers that cannot respect this condition, can find a secure infrastructures environment available in the offer of the so called *global provider*[10], which gives on-line the availability of Cloud applications and services. In this case the provider uses the global provider's infrastructures, delivering either its own services directly or becoming a pure indirect offer innovator.

In both cases, the on-line presence of BPM tools, comprehended in the global provider's offer and implemented in its infrastructure, lets final consumers autonomous in the design of their own business processes, or in the modification of pre-configured business processes, published on digital libraries. In the light of these considerations, it is possible to extend the previous classification, about the service models, by introducing the *Business Process as a Service* (BPaaS) modality; the latter, by positioning itself on various software components,

[9] These professional figures can be used in a first moment, mainly if final consumers aren't so ready to have an autonomous access to the provider's resources.

[10] For instance: Cordys, Pega, Appian, HumanWave, Longjump.

infrastructures, and platforms, leads to an interpretation of those items as instruments to investigate and to test new business opportunities, and lastly as tools to be used under a service perspective.

The limits of our research are shown in both a reference sample scarcely large and in the lack of a criticality analysis related to projects managed with an organizational behaviour well defined. For these reasons, future steps will consist in finding a confirmation of results achieved so far through the realization of further interviews and in carrying out, still with the support of the interviewed providers, an analysis process based on the model *Failure and Mode Effects* (FMEA) (Stamatis, 2003) which, due to the criticalities showed, might be able to identifiy consequences and appropriate corrective actions.

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