

Organisational possibilities for a public administration community cloud

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Abstract: Starting with the concept of cloud computing, it is interesting to consider the various characteristics, structures and conceptual bases which community clouds may assume in public administration. This article structures organisational variants with different advantages and disadvantages. The variants are as follows: broker model, open community model, consortial cloud organisation, cloud masterprovider, standard-based cloud, non-community cloud, community cloud based on minimum regulations and shared service cloud. The article substantiates, on the basis of balanced arguments, advantages and disadvantages of the different types for public administration. The article also clarifies which types of community cloud are of special interest for public administration.

Keywords: community cloud, cloud organisation models, public administration, e-Government.

1 Introduction

1.1 Presentation of the problem

Swiss e-Government is facing important discussions around the issue of how e-Government solutions should be operated, and what new organisational forms are required by an e-Government that covers all federal levels (Fraefel et al. 2012). Such considerations are generally made by technophiles, and those working in administration find it particularly difficult to make rational decisions based on knowledge. It is therefore essential to have information in this context relating to considerations such as organisational forms of e-Government and IT sourcing. Where possible, these considerations should be made from the perspective of the actual business the administrations undertake. A concept that is currently being widely discussed, and that will be addressed in this context, is that of cloud computing, for which e-Government offers ideal cases for application. In Switzerland, for example, an identity and access management service is currently being operated from the cloud (Englert and Seeger 2011). Initial discussions around cloud computing in the area of administration, however, focus on areas of concern. Risks such as the loss of data sovereignty and provider independence are causing this new IT sourcing concept to be met with scepticism. Despite the various definitions of cloud computing, it is clear that a cloud solution is more than a web service or traditional type of outsourcing. According to the NIST definition (NIST 2011), it must be possible to call up a cloud solution via a network. The cloud solution must also enable resource pooling, be able to adapt flexibly to requirements, be offered as a measurable service and be billed according to usage. The objectives of cloud computing correspond to the current requirements of the business like cost savings, the ability to adapt quickly to the IT needs of the business, ongoing needs-oriented and flexible availability etc. The fact that there is a high level of interest within the IT industry concerning the commercialisation of cloud offerings cannot be completely dismissed. Considerations about the introduction of cloud solutions from an administrative perspective include the following: the IT is not agile enough; it cannot meet the constantly, ever faster changing business requirements on time or in a flexible enough manner. It is not only the risks of this still new technology that must be considered when using cloud computing. There must also be an assessment of the risks, opportunities, costs and benefits. This article contains an analysis from the perspective of cloud use by authorities. The organisational units included in the considerations exist at various federal levels: federal government, states / cantons and municipalities / parishes. The article deals with the following question: how is it possible to operate a cloud service with a community organisation that is based on the authorities' requirements? What are the specific features of a community cloud in the public sector? How and in what form (in terms of different cloud services) can (a) community cloud support public administration? Which reference and organisation models lend themselves to organising and operating a community cloud?

1.2 Objective

The community cloud concept is presented in this article. Which explains, in an organisational sense, how different cloud providers (service providers: (SP)) within a community cloud can organise themselves for their clients (administrative units and also third parties). Central from an organisational perspective is to establish who the "contact person" is within the community cloud for the external service recipient (SR), and the institutional framework that the community cloud must have in order to provide an effective and efficient service to the public administration.

1.3 Methodical procedure

The methodical procedure for compiling the findings from this article is based on a qualitative process for developing possible organisational variants of a community cloud for authorities / public administration.

Expert interviews, based on key words / results, were conducted and some of them were held with the same people several times. Interviews were conducted with the organisation that commissioned the work that underlies this article (IT steering unit at the Federal Department of Finance, Architecture Division) and with organisational and e-Government experts. The interviews for this study are based on a very widely supported cloud strategy for Switzerland which is currently in the consultation process (ISB 2011). This research shows possible organisational measures for implementation that complement (ISB 2011). The intention is to use the results presented here as the starting point for a possible pilot project for a community cloud for the Swiss authorities. From the commissioning entity's perspective and based on a definition of the concept, the method aimed to gather the requirements for creating a community cloud, and then use these to define organisational models for implementing the community cloud for public authorities. Further research investigated the question of how the community organises itself. This was based, among other things, on the results from a research project that looked at sourcing options from Swiss parishes (Csoka 2006), which were partially used as the basis for this development of proprietary community cloud models. Additional considerations were based on Carr's publication which describes how infrastructures can be used to generate and distribute electricity. (Cloud models from other domains: electricity, transport infrastructures etc. (Carr 2008)). The corresponding broker model is based on an idea of a spin-off from the ETH Zurich (cloud force). The aforementioned bases were used to define models that, in interviews with the commissioning entity, were tested and validated in terms of their completeness and usability for public authorities. This showed that the results were valid and reliable. The effective implementation / use of the relevant models for public authorities was also tested. For reasons of space, this will be discussed in a subsequent article.

2 Introduction to the subject matter

2.1 Definition of cloud computing

This article is based on the NIST Cloud definition:

"Cloud computing is a model for enabling ubiquitous, 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. This cloud model is composed of five essential characteristics, three service models, and four deployment models." (NIST 2011)

This definition comes closest to the concept of cloud computing and is often cited in literature and in practice. Cloud computing can thus be described as a special form of outsourcing (Motahari-Nezhad et al. 2009). It has specific features and characteristics that each have their own advantages and disadvantages. Only when a service exhibits all of the properties listed in the following table can it be referred to as an integrated cloud offering as per the NIST definition.

Table 1: characteristics of cloud computing.

Characteristics	Description
On-demand self-service	IT is used as a service and be called up easily without any form of manual interaction.
Broad network access	The service is available via a network, independent from the end device. The connection must be available and high-performing as per the service.
Resource pooling	The required resources are made available by the provider for different clients. This is made possible by technologies such as virtualisation and multi-client capability (multi-tenancy).
Rapid elasticity	The resources required are made spontaneously available as needed and, in the event of non-use, released without any manual intervention.
Measured service	The service used must be commensurable with the resources required. This enables usage-based billing.

2.2 Cloud service models

The following section deals with different cloud service models and their respective advantages and disadvantages.

Table 2: advantages and disadvantages of different cloud service models.

Type / Brief description	Advantages	Disadvantages
<p>Infrastructure as a Service (IaaS):</p> <p>The client is offered computing, storage and network capacity. Using this infrastructure, the client operates its own platform, software and operating systems.</p>	<p>High scalability of the required systems, as per the need; redundant data storage; physical separation of stored and used data; no maintenance costs for setting up and operating the infrastructure. OPEX instead of CAPEX; Pay-as-you-Go.</p> <p>OPEX stands for OPERational EXpenditure. This covers expenses for the operational business.</p> <p>CAPEX stands for CAPital EXpenditure. This covers investment expenditure for longer-term assets.</p>	<p>Location of the data for public and private clouds not always evident; strongly dependent on availability of infrastructure and networks; lack of or deficient demarcation / isolation of data manipulation; possible unauthorised access to data due to incorrect configuration; warranty and liability in the event of breach of confidentiality, security and data integrity.</p>
<p>Platform as a Service (PaaS):</p> <p>Includes a complete platform with development tools. Such solutions are used for proprietary developments or for a special software that runs on the platform. The underlying infrastructure is made available and administered by the provider.</p>	<p>Low administrative expense, as user does not have to provide or implement the necessary infrastructure; development in the team (also geographically distributed). One single platform with minimal costs (standardisation); no maintenance costs for setting up and operating the platform and its tools; no maintenance costs for setting up and operating the platform and its tools; OPEX instead of CAPEX; Pay-as-you-Go</p>	<p>Vendor-lock-in; lack of portability; lack of interoperability; no standardised technologies; lack of flexibility; requirements of proprietary applications or development environments.</p>

Type / Brief description	Advantages	Disadvantages
Software as a Service (SaaS); , complete applications are made available, generally via a web interface. The client has no influence on the platform and the underlying infrastructure.	Separability / multi-client capability of the applications; quickly ready for use / faster project initiation (time to market); no maintenance costs for operating the business functionalities; OPEX instead of CAPEX; Pay-as-you-Go; lower total costs (TCO); mobility / location independence.	Selection of the right provider; lack of portability; lower ease of integration into existing application landscapes; fewer adaptation options, due to inherent standardisation; poss. longer response times; impact of security gaps when using joint SaaS solutions; no use without internet access.

Table 3 gives an overview of service models, together with a brief description of these and an explanation of the advantages and disadvantages of the different models (EuroCloud Swiss 2012).

Table 3: possible organisational models for cloud offerings.

Organisational model	Brief description
Private cloud	The solution user is explicitly an organisation or an organisational unit. A private cloud can be operated both internally and by an external provider. The benefits of the private cloud approach can only be partially exploited, but it is possible to make extensive customisations.
Community cloud	In contrast to private cloud architecture, the service is used by several groups. These are defined. This service can, however, also be offered by a community i.e. by several solution providers.
Public cloud	The service offered is available to the public and is generally only offered by only one provider. The benefits of scalability and resource pooling can be best exploited.
Hybrid cloud	The hybrid cloud offers a combination of the different organisational forms described and their advantages and disadvantages. For example, data can be stored internally in a private cloud, whereas the application is run in a public cloud.

2.3 Community cloud approach

In this section, the theoretical approach for a community cloud is explained in more detail. This special type of cloud brings with it additional problems and questions that need to be addressed. Possible forms for the organisation with their advantages and disadvantages are reviewed. The provision of cloud services within a community depends on the type of service model (IaaS, PaaS, SaaS). A distinction between public clouds and private clouds is made in cloud literature. In between, there are various mixed forms (hybrids) which combine the advantages and disadvantages of public and private clouds. A community cloud requires the following parameters (IDABC. 2004): defined number of SRs or SPs, number must be greater than two; shared vision and strategy; legal basis; harmonised processes and organisation; semantic agreement for collaboration; compatible technology. A central issue for the community cloud is that of the legal body responsible for the governance and management of the cloud solution (Johannsen and Goeken 2011). A legal body may be necessary to enable contracts and service level agreements for the relevant services to be concluded. Transferring the services into a community cloud is a type of outsourcing with special challenges (Johannsen and Goeken 2011). The involvement of several stakeholders with different interests complicates the organisation. There is also a technical dependency between the providers. An SaaS provider is thus dependent on the platform and infrastructure, even though it can obtain these as an isolated service. If the service is provided in geographically different locations, this requires a correspondingly high-performing network connection between the data centres and the SR, to guarantee the availability of the data on the one hand and the desired performance of the service on the other. The advantage of using several providers is a greater availability of the overall system, whereby the individual providers do not have to offer any maximum availability. Each provider contributes towards to the overall high level of availability (Chakravartin 2010). The pooling effect can also be better exploited which may lead to cost savings for the providers. However, there are also difficulties associated with sharing the service between several providers. Duties, competencies and responsibilities must be clearly agreed

between the providers, as circumstances may arise where there is no longer an individual contact person (if no institutional cloak is created for the community cloud). To create the community and ensure that it survives, specific rules for collaboration must be defined, together with objectives in and for the community. Policies and principles of governance for the cloud must be defined by all parties involved. Guidelines within the community prevent one service provider from taking over the entire service and obtaining a monopoly. However, if the demands and requirements of the community towards the service providers are too high or not lucrative enough, there will no longer be any providers willing to work with the community. For an organisation, whether it be a company or a public authority, to be able to run a cloud solution successfully, it is essential to define roles with corresponding duties, competencies and responsibilities (governance). An appropriate concept for governance and roles is particularly vital in the cloud environment, where transparency is veiled by the cloud (Retarus 2012). Alongside the SR that uses the services delivered by the SP, two further roles are also described. A broker can assume a mediating role within a community acting as an intermediary between the SR and the SP. A consortium consists of representatives from the SR and the SP. This committee provides a platform for the exchange of information and decisions that have to be made throughout the entire community. In order to shape an organisation successfully, the following is required from all parties involved (Rüter 2010): co-operative behaviour – interest in a long-term business relationship, and the willingness to invest in this beyond the actual terms of the contract; mutual trust – the expectation that the business partner will act with good intent and fulfil the agreed arrangements as far as possible; flexibility – the willingness to adapt the agreed arrangements if circumstances change; open and honest communication – inform the business partner in a proactive, proper and timely manner.

2.4 Roles

Starting from the development of the organisational models for the community cloud presented in the next chapter, the following roles, which helped to structure the models, can be derived. The **SR** receives the service to the desired extent and with the appropriate quality from the SP. In most cases, the SR pays the SP for the service consumed. The SR can also present itself as an SP towards third parties with the related services. The **SP** produces the desired service and can perform them in the market for one or more SRs. How the SP delivers the performance and which service it generates is dependent on its product portfolio and strategy. The SP can also obtain services from third parties in order to perform its own service. For an SP to become involved within a community, there must be an incentive that could also bring it added value. Synonyms for SP are provider and supplier. **Brokers** mediate the provision of services of a specific quality between the SP and the SR. Depending on the characteristics, they are organisational and / or technical mediators. The **consortium** can consist of representatives of the SR and the SP. It can develop and specify necessary standards and guidelines.

2.5 Community cloud organisational models

Various models with different operational and organisational structures can be used for organising a community cloud. The design options are described below by means of ideal types including advantages and disadvantages. Depending on the scenario, a combination of organisational forms may also be selected. Successful control, communication and co-ordination between the stakeholders are critical for the correct organisational form. These activities will turn out differently depending on the model used.

Analysis has shown that the characteristics of the IT service providing can be described as follows: "Characteristics of the IT service providing: here it is about analysing whether outsourcing parts of the IT belongs to an existing strategic scenario in an administration. The following can be asked here: is the IT outsourced completely or in parts? Yes or no? An investigation of the institutional form of the service provider to which the IT is outsourced: here it is essentially about clarifying the institutional form i.e. whether the service provider was institutionalised as having internal, overall or external administration and the nature of possible current or future developments" (Walser and Breidung 2010).

ITIL (Bon et al. 2009) distinguishes three different types of service providers. Type I is described as functionally integrated SP, Type II is defined as a shared service center, and Type III means total outsourcing.

Starting from these three different service providers, possible ideal community cloud organisational forms are described in table 4 (Brian 2012). These are ideal solutions that only reveal the relationship between the SP and the SR. A combination of the different organisational forms is possible and partly even necessary.

Table 4: ideal community cloud organisational forms.

Type / Description	Advantages	Disadvantages
<p>Broker model: SR obtains services via a central broker who coordinates with the SP. It could also be possible to have several brokers who offer different services.</p>	<p>The broker acts as a central contact point, which simplifies communication (reduction in transaction costs). All coordination is done via the broker. Simple to achieve a market overview through limited number of providers (brokers).</p>	<p>SR dependent on broker. Neutrality of the broker must be ensured. Clarification of broker's liability. Broker as intermediary. Limited number of brokers. Low level of competition within the community.</p>
<p>Open community model: Anyone who complies with the rules defined by the community can get involved. Rules are created by the community and can be influenced by the members.</p>	<p>Different providers can easily become involved in the community. Providers can enhance communities through their key competencies. Solutions are available to the whole community.</p>	<p>Communication / co-ordination complicated by loose organisation. Individual solution users have little influence on the community. Continuity dependent on members. Impact of innovative ideas complicated by community rules. From the members' perspective, the community may develop an unfamiliar momentum of its own. Legal form of the community not clarified.</p>
<p>Consortial cloud organisation: Consortium of providers / users makes a community cloud available. Synergies (e.g. redundant data centres) can be exploited. Services provided by the consortium are defined / offered.</p>	<p>Shareholdings in the consortium clearly defined. Wider support possible through involvement of different parties. Communication / co-ordination. Occurs within the consortium.</p>	<p>Decisions and advances must be made via the consortium or within the context of the rules agreed in the community. Disadvantageous for providers who do not belong to the consortium. Possible price fixing within the consortium. Parties involved represent wishes of their organisation, not very objective.</p>
<p>Cloud master provider: Consists of a main provider supported by other providers (sub-contractors); wide support / consideration of other providers. In contrast with brokers, the main provider can itself contribute certain functionalities to the service.</p>	<p>Clear contact person for communication / co-ordination / control. Main provider can pass on risk to sub-contractor. Additional offerings through sub-contractors that the main provider cannot provide.</p>	<p>Strong dependence on the main provider. Clarification of liability of main provider for sub-contractors. Main provider has an effective monopoly and can strongly influence the sub-contractors.</p>
<p>Cloud with standards and guidelines: SRs form a consortium that defines standards, guidelines and requirements for the community cloud. Providers must comply with the guidelines. Regulation by awarding lots. Regulation must be clear and easy to implement for commerce. Congruent products are offered due to clear norms and standards.</p>	<p>SR can freely select from the offering. Service provided is comparable. SP can decide how to structure service. Service delivery measured and compensated. Direct control and communication SR with SP.</p>	<p>Communication and co-ordination occur redundantly via relevant SP. Standards for SP complicated to define and can only be monitored with great effort.</p>

Type / Description	Advantages	Disadvantages
Standard-based cloud: Authorities define standards. Providers are entitled, if they comply with standards, to play a part and sell services. Analogy with grid computing.	Simple selection of SP by certificates or labels. Potential for computing power in the community. Open structure enables participation of many providers. No dependence on one provider.	No actual organisational form possible. Rather anarchistic organisation. Time-consuming to ensure traceability.
Non-community cloud: Cloud for authorities offered by individual providers. If cloud is used, provider must be preferred.	Defined contact person available for all issues. Contact person available in event of problems. Changes do not have to be made via the community. Central competencies: know-how can be gathered with provider. Internal process providers can be quickly and efficiently compiled.	Monopoly; substitute offering not possible. Pricing, innovation and market regulation completely in power of providers. Pooling effects; only limited exploitation of characteristic pooling effect. Too-big-to-fail problem: provider must be carried by the authority. Bankruptcy / failure to provide service with major consequences for authorities not acceptable. Vendor-lock-in: high dependency of providers. Deployed technology can be determined by provider. Change to another provider complicated and requires major effort.
Minimal regulation: Higher position prescribes minimal regulation standards that must be followed. May include selection procedure or categorisation of data. Each SR decides within minimal regulations how and where it deploys the cloud.	Fast adaptation of offerings to market. Slight restriction in autonomy of SR. Clear principles and guidelines.	Few synergy uses in cloud. Selection procedure and market analyses performed by all SRs themselves / redundantly. SR critical mass not achieved, act as small buyers in market.
Shared service centre: SR simultaneously acts as SP in the market or organisation. Shared services offered obtainable by several SRs. Core competence of the organisational unit can be made available to others.	Organisational units concentrate on core competencies. Clear responsibility of the SP. Direct billing for services between organisational units. Existing competencies are retained.	Role separation between SP and SR in the organisational unit. Role conflict within the organisational unit. Difficult to ensure an overview of offerings across different organisational units.

The different approaches shown in table 4 are assessed in view of their usability in public administration in the following chapter.

3 Cloud Computing in Swiss public administration

As part of qualitative research, the sourcing approaches of four Swiss cantons of different sizes and two Swiss cities (one large and one medium sized), were examined. It turned out that none of the cantons and neither of the cities use or have a community cloud. However, the degree of virtualization (private cloud) with differences is quite high, and tends to increase with the size of the IT department and the degree of virtualization. The majority of the cantons and cities which were investigated do not develop services themselves, assigning development to external companies. Most of the cantons and cities operate IT themselves. In one case, every request for a new service or application is checked, to ascertain whether it can be assigned externally or internally regarding development or operation. The construction or consolidation of their own data centers seems to be an issue. In one case, an external data center has been rented. In another case, one public administration rented out its own data center infrastructure for financial services. In a broader sense, the maturity of ICT service providers is too low for community clouds to have been realized until now. Generally cloud offerings are not considered systematically, but rather case by case. Based on one interview with a big city, the following reasons were mentioned for not taking outsourcing into account: the security argument, partly from ignorance, as well as data ownership, which is not the case with some providers.

4 Summary and outlook

The appropriateness of the selected community cloud organisational models in terms of their practicability for public administration is summarised: *Broker model*: this leads to lack of market transparency from SR perspective. *Broker model*: this leads to lack of market transparency from SR perspective. The SPs have no direct client contact. There is a danger that, due to non-transparent prices, the broker model will not lead to success. However, it does lead to a reduction in transaction costs for the SPs and SRs (depending on the number of SPs / SRs). *Open community model*: a disordered or uncontrolled organisation dominates. There is no pattern for order. The SPs organise themselves. Problems arise from the question of contact persons and clear governance from the SR's perspective. If need be, this model can be extended through a consortium. *Consortial community cloud*: the consortium ensures that all parties / stakeholders are represented. At most there is the danger that larger providers are disproportionately represented or have the decisive power. Smaller, less powerful providers may be excluded. However, the SPs and SRs can be well controlled due to the involvement of all involved parties. *Cloud master provider*: there is a monopoly with lock-in danger for the SR. However, there is better clarity with regard to the offering; sub-contractors may face pricing pressure through the cloud master. *Cloud with standards and guidelines*: this solution is linked to the SP. Quality pressure is exerted on the SP in this model. The SP is also required to set guidelines. Guidelines may be: cloud strategies, cloud policies, cloud standards etc. A lot has already been done in this area in Switzerland (EuroCloud Swiss 2012) (Fischer 2012) (ISB 2011) and the USA (Kundra 2011). *Standard based cloud*: this model is linked to the SR. This model gives rise to transparency of quality and performance. *Non-community cloud*: this organisational model gives rise to a kind of pseudo-monopoly and a problematic lock-in effect. The model creates an open market, but there is the danger that pricing models are not transparent (non-comparability of the offerings) and that the actual services delivered by the SP are obscured. However, it should result in a very clear service catalogue. It is also very difficult to exert control over the location where the data is stored (state interests, data protection etc.). The *minimal regulation organisational model* is a liberal type of model. Protecting state interests (data within the state) is (depending on the provider) rather difficult. The question is how effective relevant rules are and what role standards can play. *Shared service cloud*: the SPs act as owners. This may mean a reduction in the number of SRs involved in a community cloud (small SPs are sidelined, large SPs have supremacy). From an administrative perspective, the broker model (reduced transaction costs), consortial community cloud model (good pooling of offerings, clear governance, ideally suited for strong, federally organised, decentralised administrative organisations) and cloud master provider model (coherent offering, but with the issues of monopoly / lock-in / possibly difficult governance) are of particular interest for the reasons stated in brackets. Due to the federal structures, the cloud master provider model is only a realistic option if it involves an independent provider that doesn't already work for the administration. This raises the question of whether there are suitable providers and if possible sub-contractors would participate. From a governance perspective for the SP, models with clear contact persons from the SR are certainly an advantage.

The following can be concluded: the benefits promised by cloud computing meet the current IT requirements of business and also public administration as shown by a short survey. However, IT has yet to reach a state of maturity where it can fully exploit the promised benefits of the cloud. The expectations of IT are to save costs, be more efficient and simultaneously react more flexibly to constantly changing requirements. In view of the maturity level of the SR in the administrative environment in the areas of IT, business IT alignment and supplier management, these partly conflicting objectives are almost incompatible with the SR's current IT landscape. It will therefore be difficult to deploy cloud computing, regardless of the new community cloud solutions.

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