

A Case for Cooperative Cloud Intermediaries for Small and Medium-Sized Enterprises

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Veröffentlicht in:
Multikonferenz Wirtschaftsinformatik 2012
Tagungsband der MKWI 2012
Hrsg.: Dirk Christian Mattfeld; Susanne Robra-Bissantz



Braunschweig: Institut für Wirtschaftsinformatik, 2012

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Abstract

Cloud computing is a new and increasingly popular form of IT outsourcing. It implies that a cloud service provider offers very standardized abstract IT services which are accessed by a user over the Internet. While cloud services are supposed to be very beneficial for small and medium-sized enterprises, the adoption of such services has been low in this group, among other reasons because of high complexity of the cloud market and trust concerns. This paper motivates the notion of cooperative cloud intermediaries as a solution for these concerns by building on well-known concepts: transaction cost theory, agency theory, the notion of intermediaries in electronic markets and the cooperative paradigm. We derive our solution in detail and show its viability in theory.

1 Introduction

Cloud computing is a new variety of IT outsourcing that has been gaining much attention over the last few years. In this paradigm, a cloud service provider (CSP) offers very standardized abstract IT services which are accessed over a network, usually the Internet. These services comprise products on different levels of abstraction, ranging from software usable by the end-user to “virtual” IT hardware. CSPs provide a seemingly unlimited supply of resources and allow users to quickly make use of more or less resources depending on the current demand while users pay only for the resources that are actually used ([2], [17], [18]).

Whilst promising manifold benefits ([1], [2], [18], [21]), the cloud paradigm also means that end-users give up most of the control over implementation and operation of the systems, a fact that proves to be a significant obstacle for many companies, especially smaller ones ([10], [24]). In consequence, cloud computing is still “terra incognita” for most small and medium-sized enterprises (SMEs). According to recent studies ([10], [24]), the majority of SMEs is not yet using cloud services and has no plans of changing this in the foreseeable future. Major reasons for the

reluctant adoption are: lack of trust¹ in the security of the cloud services and the CSPs, lack of control over processes in the cloud, e. g., with regard to billing, but also with regard to data protection, as well as lack of certainty about the legal compliance of the CSP and the cloud services with respect to contract design, accountability, and warranty.

Various analyses of relevant information systems (IS) literature on IT outsourcing decisions show that transaction cost theory (TCT) is a widely-used explanation approach and it was shown to have yielded quite consistent results across a multitude of research studies ([4], [9], [27], [1]). We therefore draw on this theoretical framework and combine it with the concept of intermediaries to motivate our solution. In fact, we argue that a market-level approach is required to address these issues and suggest the concept of cooperative cloud intermediaries. In essence, these intermediaries are designed for SMEs to build trust into “their own cloud” and still benefit from (most of) the cost-efficiency of the cloud-computing paradigm. Our approach incorporates elements from the research on intermediaries in electronic markets, a community cloud approach as well as cooperative structures for the organization.

2 Cloud Services and SMEs

According to the widely accepted definition by the US NIST [18], cloud computing is characterized by five traits: (i) resource pooling, (ii) rapid elasticity, (iii) on-demand self-service, (iv) broad network access and (v) measured service. The term is generally used to refer not only to on-demand computing (i. e., CPU time) but to all kinds of cloud services, which can be classified by their service models as Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS) or Infrastructure-as-a-service (IaaS) [18].

Arguably the most important trait of the cloud paradigm is the stringent abstraction that conceals all internal details of the cloud from the end-user. This abstraction allows CSPs to provide their cloud services flexibly and in the most cost-efficient way possible. However, this abstraction also means that the end-user gives up control over most aspects of data processing and IT operations. In particular, many potential cloud users are concerned about the security and privacy of their data [24]. Due to the abstraction provided by the cloud, it is unclear where the data is physically stored, who effectively could gain access to it and what data protection regulations apply (i. e., what laws of which country are applicable).

The benefits of cloud services are well known and have been frequently discussed ([2], [1], [21], [18]) and they have been found particularly suitable for SMEs (e. g., [11]). Notwithstanding those benefits, SMEs also face the downsides of the cloud approach as insinuated above. Compared to large companies, they do not possess adequate means to address these concerns due to their small size. Specifically, legal aspects of cloud-sourcing contracts and trust concerns regarding the misuse of company data by a CSP cannot be adequately addressed by SMEs. They usually do not have enough staff to investigate new technologies, either. All things considered, cloud services are a very attractive IT outsourcing approach for SMEs, but widespread adoption is hindered by serious concerns of the SMEs ([10], [24], [11]).

¹ In this paper, trust is the expectation of a reliable partner who is motivated to abstain from opportunistic behavior ([19]). The development of mutual trust in a partnership depends on each other's integrity ([22], [3]).

3 A Case for Cloud Intermediaries

In this section, we motivate the concept of *cloud intermediaries* (CIs). These intermediaries are a special type of middlemen who mediate the sourcing of cloud services between users (SMEs) and CSPs. Intermediaries have been shown to be advantageous in a variety of scenarios [10]. Our argument in favor of cloud intermediaries is two-fold. Firstly, we show that CIs are favorable in light of TCT². Secondly, we highlight the benefits of CIs as seen from an SME's perspective. In our analysis, we will focus on interactions initiated by potential cloud users, i. e., the SMEs, because this is the main direction for interactions in current cloud markets. Towards the end of this section, we highlight the limitations of the "plain CI" approach with regard to agency theory³. This shows that the concept of CIs requires further refinement, which is the topic of the subsequent Sections 4 and 5.

3.1 Argumentation in Light of TCT

TCT provides a framework for deciding whether a cloud intermediary (as a form of cooperation) is adequate or whether it is more suitable to purchase cloud services on the market. The decision is guided by Williamson's principal dimensions of transactions, mainly the asset specificity (see [28]). An insourcing of cloud services, i. e., a hierarchy solution, can be neglected because SMEs generally lack know-how and scale to provide cloud services comparable to those available from third parties. Therefore, the alternatives are a cloud market solution and a hybrid solution where CIs provide possibilities for cooperation.

Asset specificity is the most important and the most distinguished dimension in TCT. For an average cloud service, the asset specificity can be determined as medium high, which is one major indicator to organize these transactions in hybrid governance structures. This can be stated because no investments in stationary facilities are required (low site specificity), because some specific hardware devices potentially need to be purchased (medium physical asset specificity), and because the human resources have to be specialists in their field of business (high human specificity). With regard to a second dimension, uncertainty, SMEs have a need for reliable partners but also for stable governance structures that can support the development of trust, which indicates that a pure market is not an adequate coordination form. Hence, a cloud intermediary is most probably advantageous as a form of cooperation.

Besides this non-formal argumentation, we now investigate, similar to the argument of Sarkar et al. [21], the situation where a potential cloud user u has to choose whether it is better to directly interact with a provider p (which causes the transaction costs $T_1 = T_{u,p}$) or to engage an intermediary i that interacts with the provider on the user's behalf (which brings about the transaction costs $T_2 = T_{u,i} + T_{i,p}$) in a more formalized way. Unlike Sarkar et al. [21], however, our argument starts with a look at a group of N_u users that require a "similar" cloud service.

² In brevity, transaction cost theory (TCT) conceptualizes the outsourcing decisions as a search for the most cost-efficient alternatives, taking into account factors such as the strategic value of the IS in question (expressed as its "specificity") as well as its role in a company's processes [28].

³ The theory of agency relationships is closely related to TCT. Whereas the latter considers contractual relationships more generally with an economic emphasis, agency theory studies interactions between actors who act under asymmetrical information [13].

On the sellers' side, there is a group of N_p CSPs that offer suitable "similar" services. In order to find the optimal service and a CSP for their requirements, the SMEs will need to interact with each of the CSPs, e. g., to find out pricing details etc. From an economic perspective, the transaction costs for this alternative can thus be estimated as

$$T_1 = N_u \cdot N_p \cdot T'_{u,p}, \quad (1)$$

T' being the *average* transaction costs. Using an intermediary incurs transaction costs of approximately

$$T_2 = N_u \cdot N_i \cdot T'_{u,i} + N_i \cdot N_p \cdot T'_{i,p}. \quad (2)$$

For our argument, we make the assumption of a single intermediary, i. e., $N_i \equiv 1$ (**Assumption A1**). Furthermore, we suppose $N_u > 2$, $N_p > 2$ (**Assumption A2**) because the cloud services market would arguably be too simple to justify an intermediary otherwise. This is a rather weak assumption in light of actual cloud services markets with several hundreds or even thousands of participants. The situation, showing the interaction of a group of cloud users with a group of providers either with or without an intermediary, can, therefore, be depicted as shown in Figure 1. In order for intermediaries to be beneficial, we require $T_1 > T_2$.

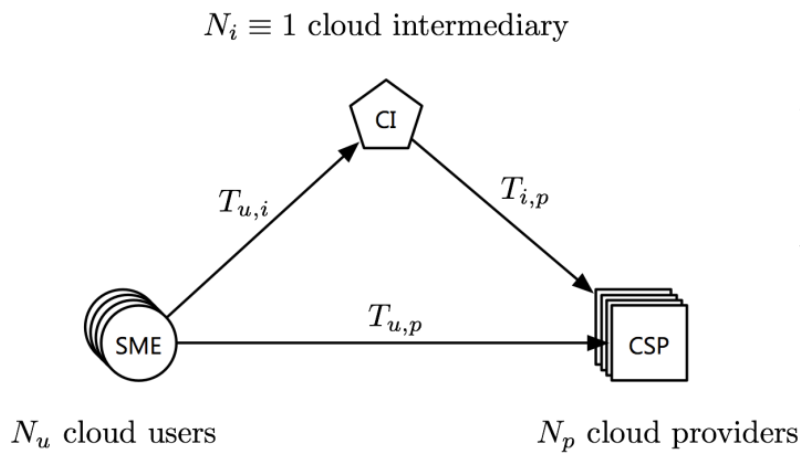


Figure 1: TCT alternatives adopted from Sarkar et al. [21]

The argument against intermediaries in electronic markets, also referred to as the disintermediation hypothesis (see [8]), is based on the assumption that electronic markets inherently reduce T' to a very low common level T^* (**Assumption A3**), which means that $T_1 = T_{u,p} = T^* < T_{u,i} + T_{i,p} = 2 T^* = T_2$ for a setting with $N_u = N_p = 1$, thus deducing that it is advantageous to drive intermediaries out of the market (see [21]). While Sarkar et al. argue that this is an unreasonably strong assumption (e. g., one would expect that $T_{u,i} < T_{u,p}$ and $T_{i,p} < T_{u,p}$, even if overall $T_{u,p} < T_{u,i} + T_{i,p}$), we accept **A3** for a first analysis, hence, $T_{u,p} = T_{u,i} = T_{i,p} = T^* > 0$. From (1), (2) and **A1**, it then follows that

$$T_1 = N_u \cdot N_p \cdot T^* \text{ as well as } T_2 = N_u \cdot T^* + N_p \cdot T^* = (N_u + N_p) T^*, \quad (3)$$

and hence also $T_1 > T_2$ because of **A2**, which implies $N_u \cdot N_p > N_u + N_p$. From an economic point of view, it is therefore beneficial to have the hybrid coordination form of a cloud intermediary, even under the strong assumption **A3**. Additional observations in the course of this section will make this result even more articulated.

3.2 Benefits of a Cloud Intermediary from an SME's Point of View

As a first step, outsourcing parts of the IT of an SME to the cloud requires finding the optimal cloud service and CSP. A CI would, of course, have to undertake a similarly tedious search and screening process, just like other cloud users. Nevertheless, a CI can realize considerable economies of scale because the results of the search and screening are – with only small changes – applicable for a large group of SMEs. The intermediary would then allow sharing the transaction costs for search and screening (plus a premium charge for the mediation services) between many SMEs. Similarly, the interactions between the SMEs and the intermediary benefit from economies of scale when users request a variety of services from the same CI. Instead of coordinating with a whole crowd of CSPs, SMEs can lower their transactions costs by interacting with one CI as their single point of contact. As a result, the transaction costs *for each individual SME* can be reduced by the introduction of a CI, too.

In addition, a CI can even provide ancillary benefits that outweigh parts of the transaction costs [12]. Notably, the search for information is facilitated by CIs providing reliable and processed information on eligible CSPs and services. They may, e. g., already have tested certain undocumented aspects of the service and can thus easily answer common concerns for a group of SMEs. In consequence, cloud intermediaries lower the entry barrier particularly for first-time and small-scale cloud users like SMEs.

3.3 Linkage Alternatives for Cloud Intermediaries

Based on the three general cases described by Klein and Teubner [14], we identify four conceivable settings for the linkage between cloud intermediary, customers and providers, differentiating linkage types 0 and III, which were originally treated as a single case [14].

- 0 Neutral cloud intermediary** – The intermediary is formed as a completely independent company without any affiliation to CSPs or cloud users and acts as an independent consultancy or a marketplace for cloud services.
- I Buy-side cloud intermediary** – The intermediary is the cloud users' agent and is, thus, biased towards the cloud users' interests. In this case, potential cloud users form a joint venture to bundle their cloud-related activities. Hence, the intermediary focuses on addressing the cloud users' problems, such as the identification of suitable services, the selection of reliable and trustworthy CSPs, as well as many other aspects concerning questions of future provider changes etc.
- II Sell-side cloud intermediary** – The intermediary is the CSPs' agent, leading to an intermediary that represents the providers' interests.
- III Joint cloud intermediary** – The intermediary is equally linked to both cloud users and providers. It is a mixed group of small partners that would like to engage in close interaction on a medium to long-term basis. They jointly form a cloud intermediary around a common goal.

It is clear that not all linkage variants are equally suitable to address the issues identified in the previous sections. Obviously, neither type 0 nor type II render the CI an agent of the cloud users, making these variants inadequate for ameliorating the identified issues. The joint cloud intermediary (type III) does act to some extent as the cloud users' agent, but is only applicable for a very limited set of scenarios. This leaves linkage type I, the buy-side intermediary. Indeed,

this variant seems to be suited well to address both trust issues of the SMEs as well as issues concerning their positions in the cloud market. Since the main focus of our research is to address the concerns of small and medium-sized cloud users, variant I is the type of intermediary that will be examined more closely in the remainder of this paper.

3.4 Conclusions from and Limitations of the “Plain CI” Approach

SMEs face several selection problems when they want to engage in cloud-sourcing. An intermediary can reduce up-front costs and thus facilitate the cloud use for smaller enterprises. It also offers the benefits outlined in Section 3.2, such as providing virtual size and economies of scale, skill and scope. A cloud intermediary can therefore strengthen the market position of SMEs and provide valuable services or consultancy to them. Our results are in accordance with two “premises” made by Giaglis et al. [8] who propose (i) that intermediaries are likely to emerge in situations where market or product knowledge is important or products can be bundled as well as (ii) that intermediaries can add value by simplifying information search in scenarios where buying decisions are complex. Both apply for the cloud services domain and reinforce our argument.

A widely acknowledged fact about cloud services, especially those on higher levels of abstraction (PaaS, SaaS), is the problem of vendor lock-in [6]. Due to a lack of standardized interfaces, the time and effort invested into integrating a particular cloud service into the IT landscape of an enterprise is very transaction-specific, leaving cloud users dependent on CSPs. In TCT, this phenomenon of transforming *ex-ante* unspecific services into *ex-post* specific ones is known as *fundamental transformation*. If the independent partner behaves opportunistically and cancels the transaction relationship, e. g., by discontinuing the service, the dependent partner would lose the transaction-specific quasi-rent⁴, which is high for specific commons and lower for generic goods. Successful cooperations, thus, require credible commitments by all parties involved. Commitments, however, easily lack credibility if the cooperation is organized by non-binding contracts only.

As a first conclusion, a cloud intermediary can indeed minimize the transaction costs on both sides by matching buyers and sellers, by eliminating asymmetrical information distribution, by boosting transparency and by creating trust. Besides, a cloud intermediary aggregates the demands of many different SMEs. However, this subsection also presented some limitations of the CI approach that need to be addressed by applicative governance structures. In Section 4, apart from purely economic aspects, we will show possible implementation variants of a CI, moving closer to the technological level and further motivating the requirement of additional governance structures. A possible solution will then be presented in Section 5.

4 Community Cloud Intermediaries

4.1 A Community Cloud Approach for Cloud Intermediaries

Broadly speaking, clouds can be distinguished by their delivery model into *private* and *public* clouds. In certain situations, it is beneficial for a defined group of organizations with a shared goal or concern to amalgamate the two models and form a so-called *community cloud*.

⁴The quasi-rent is the gap between the value of the current use of an asset and the value of its next best use. Highly specific assets have high quasi-rents because they cannot be repurposed easily [28].

Essentially, this is a “non-public” cloud for a restricted audience, offering many of the benefits of a true private cloud [18].

Members of a community cloud control all services within it. This allows for sensitive functionality to be delivered in a cloud-like manner while preserving a much higher level of confidentiality and control for the cloud users. Thus, SMEs can establish a certain baseline of trust into the cloud services. Additionally, a community cloud can provide tailored services that are not available on the market, e. g., services that address certain regional regulations, or services complementing existing services, e. g., a transparent encryption layer on top of a public storage service. A major benefit of a hybrid community cloud is, therefore, that its users can access trusted “private” services when needed and leverage cost-efficient “public” services when possible.

4.2 Implementation Variants for Community Cloud Intermediaries

Based on varying degrees of out- vs. insourcing, there are three different implementation variants for a community cloud intermediary. Figure 2 shows three alternatives where SMEs (small circles) form an intermediary (large circle) that possibly contracts services from third-party CSPs (small rectangles). At one end of the scale, the full-service CSP (variant A) represents a solution that completely insources all cloud activities. At the other extreme, the cloud broker (variant B) does not provide any proper services but only establishes the connections to third-party providers, thus completely outsourcing all cloud services. Between these two extremes, a hybrid cloud intermediary (variant C) combines aspects of both variants by striking a balance between sourcing external services and providing proper services. Of course, this can be done in varying degrees on the whole scale from no to full cloud-sourcing. The three types are now discussed in more detail.

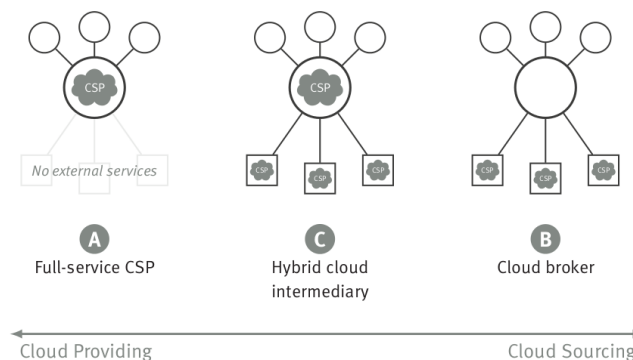


Figure 2: Implementation variants for community cloud intermediaries

Implementation Variant A: Full-service CSP

A full-service cloud provider provides all cloud-related services and required infrastructure for the associated SMEs. It also bundles much of the know-how that the enterprises have on using and operating cloud services. In effect, this variant can be regarded as a traditional data center that has evolved into a cloud data center by extending its portfolio of services and adapting the underlying infrastructure operations. Usually, however, such a data center will not reach the dimensions that are required for realizing attractive economies of scale. Also, one main point of using “the cloud” is to eliminate the need for own infrastructure. So the full-service CSP is generally not an attractive variant for SMEs unless they already have invested considerably in a suitable infrastructure.

Implementation Variant B: Cloud Broker

As an alternative to building one's own cloud data center, it is possible to leverage existing third-party services. To do so, a cloud intermediary can set up contracts with external CSPs in the name of the associated SMEs, thus acting as cloud broker. The cloud broker can facilitate the use of cloud services by effectively "clearing the service jungle" so that SMEs can choose suitable services more easily. This approach can be a good starting point for making a first contact with the cloud but is not expected to be a viable long-term solution that addresses the identified issues.

Implementation Variant C: Hybrid Cloud Intermediary

Combining the merits of approaches A and B, a hybrid cloud intermediary can provide both proper (specialized, tailored) services as well as interfaces to third-party services in a public cloud. It allows SMEs to use proprietary "private" services for handling sensitive data, such as customers' credit card data. At the same time, cost-efficient services from the public cloud can be leveraged where appropriate. Other than that, it can also offer services with specialized functionality, e. g., for addressing particular industry requirements. Just like the other variants, it also does not include any mechanism to establish trust between the SMEs that form the intermediary. In conclusion, this variant C allows SMEs to strike a balance between cloud-sourcing of cost-efficient services and in-sourcing of mission-critical services. It can provide several benefits but still lacks the ability to establish trust between participating SMEs. Nonetheless, it is the best out of the three alternatives discussed. For this reason we will build on this variant when we add cooperative governance structures to address the trust issue in the next section.

5 Cooperative Structures for Cloud Intermediaries

The external interdependency between an SME and its CSPs in a market solution leads to two major problems (cf. Section 3.4). Firstly, there is the problem of agents' (i. e., CSPs') opportunistic behaviors trying to exploit the less-informed and dependent principals (SMEs). Secondly, related to the opportunism problem, there is still a lack of trust in the CI.

We suggest a solution based on cooperative paradigm⁵, thus forming *cooperative cloud intermediaries (CCIs)*. Building on the results from the previous sections, such CCIs extend the hybrid cloud intermediary notion by adding cooperative governance structures. Hence, the hybrid cloud intermediary is formed as a cooperative by a group of cloud users (SMEs) that have shared goals with regard to their cloud activities but do not necessarily come from the same industry or may even be competitors. The cooperative instruments are then an effective means of handling opportunistic behavior and, thus, creating trust.

The first effect of launching a cooperative is that the external interdependency between an SME and a CSP is replaced by an internal interdependency between the cooperative members. This internalization has to be advantageous for each CCI member to minimize the opportunistic behavior between the SMEs. Instead of contracting with an unknown external transaction partner, the SMEs help themselves by forming their own "meta-CSP" as a cooperative joint

⁵ A cooperative is a business organization owned and operated by a group of individuals (or companies) with a common goal and for their mutual benefit.

venture. They now contract with the CCI, a partner they are involved in and that is democratically managed by the “one-man-one-vote”-principle⁶ balancing all members’ interests. This effectively favors smaller enterprises, which are usually not in a position to negotiate with a global CSP due to size mismatch (cf. [8]). A cloud user being also co-owner of a CCI, it has full control and trust in the CCI’s cloud services. The cooperative self-government prevents external interests from influencing the CCI. On a side-note, the CCI members are not required to purchase their cloud services through the CCI. In fact, the set-up is flexible to allow some member’s particular requirements that are out of the scope of the CCI to be fulfilled externally. In general, however, we expect the CCI members to channel their cloud activities through the intermediary because of the described advantages.

The so-called cooperative mutualism is operationalized by the MemberValue, which is the total value of the members’ entrepreneurship and consists of three facets [23]. The direct MemberValue represents the value of having access to the CCI’s services, including both technical cloud services and non-technical services, such as consultancy. The indirect MemberValue stems from efficient value creation and payment flows (dividends) to the members. Finally, the sustainable MemberValue consolidates all values from investments to guarantee continuation and expansion of the CCI, e. g., investments for developing new and innovative services for the community cloud and its members.

A CCI also creates virtual economies of scale. Inside a cooperative, the risk of selecting a wrong partner (adverse selection) is shared by all members, as are search costs for new members, services or optimal solutions. In addition, the CCI subsumes all members under a single entity, pooling their demands and, thus, enhancing bargaining power. Still, all members keep their identity and all SMEs remain self-dependent (co-called cooperative individualism). Although stability is generally ensured by cooperative statutory regulations, the barrier to enter or exit a cooperative for a single member is rather low. Lock-in costs are relatively small because members are entitled to a refunding of their deposit. However, it is problematic if a large part of the members exits simultaneously because that can easily overstrain the capacity of the CCI. In that case, the upkeep of proper operations might not be feasible.

Lastly, a secure legal framework is extremely important for the dissemination of cloud services among the SMEs. With the establishment of a CCI, this can partly be guaranteed, particularly regarding critical aspects like privacy protection laws. It is also vital that members retain full access to their data and have the possibility to “withdraw” their data from the cloud whenever they want to.

6 Limitations of the Current Approach

Combining various economic approaches and theories we have demonstrated a solution for SMEs getting involved in cloud computing that can lower trust concerns. Our solution is advantageous under the assumptions mentioned. However, there are also some limitations to our approach.

⁶ This is an important particularity of a cooperative where each member has exactly one vote, regardless of, e. g., financial size or any other measure of “importance”.

Cooperative structures are designed and profitable for a long-term perspective. They are, therefore, suitable neither for SMEs that want to engage in a single cloud project or very short-term cloud usage nor for SMEs that want to retain utmost flexibility with regard to their operations. From our research groups' experiences, however, most SMEs are looking for medium to long-term relationships with their business partners. In our analysis, we have focused on comparing costs for two scenarios: a setting with an established intermediary and a setting without one. This ignores costs associated with the setup and launch of an intermediary, in particular also the costs of forming a cooperative. The launch of a CCI occasions, e. g., costs for searching founding members, marketing costs for finding more potential members later on, costs for setting up a shared infrastructure etc. Our analysis is valid, nevertheless, because the setup cost is negligible in long-term considerations. Also, it represents the situation where an SME decides on whether to join an already existing intermediary organization. We expect this to be the more frequent case once first CCIs are established.

Finally, we have to highlight that cooperatives are a country-specific construct. Thus, it may not be feasible to adapt it for a particular country. However, our solution can be considered as a reference model that suits European legislature as well as cooperatives in the USA. Therefore, a very large part of cloud users are able to benefit from a CCI in principle. Some country-specific particularities will have to be respected, of course, and the cooperative governance structures have to be modeled adequately.

7 Related Work

The concept of intermediaries – also known as “middlemen”, “brokers” or “mediators” – is not new. In the context of grid computing, for instance, “resource brokers” are suggested to help grid users satisfy their exact resource needs across various providers using a homogeneous interface [5]. Those brokers, however, are mainly conceived as software artifacts. Similarly, in data integration the term “mediator” is used to denote a software artifact that helps integrate and harmonize data from various sources [26]. All aforementioned intermediaries are almost purely technological.

In the context of cloud computing, Gartner, Inc. has been researching the notion of “cloud service brokerages” since 2009.⁷ Whilst their primary focus is also rather technological (seeing brokers as integration platforms), they also make some remarks about organizational aspects of cloud service brokerages. Applying the general traits of the intermediary notion to the cloud market, they see three main areas for cloud brokers: cloud service intermediation (extending existing services), aggregation (providing services across several CSPs), cloud service arbitrage (allowing easier switch to the best-fitting cloud) [16]. A first viable implementation of these cloud brokers is provided by CloudSwitch⁸. While the technological side of this research closely resembles our suggestions regarding a community cloud for a CCI, our focus lies on the market participants and the role of intermediary organizations rather than technological artifacts. To our knowledge, our research is the first on this particular question in the cloud context.

⁷ <http://www.gartner.com/it/page.jsp?id=1064712>

⁸ <http://www.cloudswitch.com>

8 Conclusion and Future Work

One major reason for many SMEs not to use cloud services is the lack of trust. On the one hand, this concerns data protection and data security issues. On the other hand, this concerns uncertainties regarding the legal situation surrounding cloud computing. We elaborated on the particular situation of SMEs and motivated the need for adequate governance structures. To address this, we have introduced an intermediary that helps find the right matches for buyers and sellers as well as create trust by reducing uncertainty and providing several additional benefits. We have shown that such an intermediary can minimize transaction costs between SMEs and CSPs. Addressing remaining trust concerns, we have motivated the introduction of a *cooperative cloud intermediary* that is organized as a cooperative community cloud and that can mitigate the lack of trust, control and certainty about legal issues as well as strengthen regional economic structures vis-à-vis global players. While the general notion of a cooperative has been around for decades, to our knowledge the specific application of the concept to the domain of cloud computing has not been investigated before.

For the described approaches are still work in progress, they lack empirical confirmation. This is one of the major steps for our future work. In addition, we will have to identify the optimal size of a CCI that allows the cooperative to function in the most efficient way possible. Obviously, both having too few members in the CCI and having too many members is disadvantageous (because of lack of scale and too much coordination effort, respectively). Furthermore, the startup process of the CCI has to be explored in more detail, e. g., with regard to setup costs and optimal procedures.

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