Cooperative Hybrid Cloud Intermediaries — Making Cloud Sourcing Feasible for Small and Medium-sized Enterprises

Till Haselmann[A], Gottfried Vossen[B,C], Stuart Dillon[C]

[A] items GmbH, Hafenweg 7, 48155 Münster, Germany, t.haselmann@itemsnet.de
[B] ERCIS, University of Münster, Leonardo-Campus 3, 48149 Münster, Germany, vossen@uni-muenster.de
[C] University of Waikato Management School, Private Bag 3105, Hamilton, New Zealand, {vossen, stuart}@waikato.ac.nz

ABSTRACT

"The cloud" is widely advertised as a silver bullet for many IT-related challenges of small and medium-sized enterprises (SMEs). While it can potentially have a number of attractive benefits, many SMEs refrain from using cloud sourcing and cloud services because of high upfront costs for building the appropriate knowledge in the enterprise, for searching and screening of possible cloud service providers, and for mastering the intricate legal issues related to outsourcing sensitive data. This paper presents the concept of hybrid cloud intermediaries, *an approach that can address many of the prevailing issues. With the aid of empirical findings from a cross-nation study of cloud adoption in SMEs for context, we describe the concept in detail and show conceivable variants, including a comprehensive cross-perspective consolidated model of cloud intermediary value-creation. Subsequently, we analyze the benefits of such a hybrid cloud intermediary for addressing cloud adoption issues in SMEs, and suggest suitable governance structures based on the cooperative paradigm. The resulting entity — a cooperative hybrid cloud intermediary or, more concisely,* co-op cloud *— is discussed in detail showing both feasible scenarios and limitations for SMEs that would like to engage in a cloud-sourcing.*

TYPE OF PAPER AND KEYWORDS

Visionary paper: *Cloud Intermediary, Cloud Service, IT-Outsourcing, small enterprises, medium-sized enterprises*

1 INTRODUCTION

"The cloud" is widely hailed as a silver bullet for many IT-related challenges and troubles of small and medium-sized enterprises (SMEs). Apart from the principal argument of notable cost savings, the promised benefits include access to flexible pricing and payment models, reduced administrative overhead, and access to state-of-the-art technology. Nevertheless, many SMEs refrain from using cloud services because of high setup costs for building the appropriate knowledge in the enterprise,

for searching and screening of possible cloud service providers (CSPs), and for mastering the intricate legal issues related to outsourcing sensitive data, see [13, 40, 11] amongst others. A solution to this dilemma is presented in this paper.

Most SMEs, in particular those for which IT is not their core business, are poorly equipped to properly evaluate their options for cloud sourcing. A survey by two of the authors [7] of 88 SMEs in Germany and New Zealand provides motivation for the concept presented in this pa-

per. A key finding of this recent study was that the vast majority of German and New Zealand SMEs are influenced in their clouding sourcing decisions by external parties – especially "experts". It was also observed that many SMEs were adopting cloud services from existing IT providers or providers that were large and well-known. Only around 20% would follow a formal selection process, as is indicated in Figure 1, which is taken from [7]. Most concerning was a widespread lack of concern around the security and privacy risks associated with the cloud. It was concluded from this that the so-called experts the SMEs were using were either limited in their SME-relevant expertise, or were perhaps providing an intermediary-type service, but one in which they were more supplier orientated.

We see two major problems in this context: Firstly, decision processes have to be adequately designed, matching the specific situation of both project and enterprise in question with the plethora of available cloud services. Thus, in order to be successful, a cloud sourcing decision has to be supported by an adequate *decision process*, an adequate *assessment method* and an adequate *choice of factors* to consider, which comes together in a *cloud strategy*. Secondly, most SMEs cannot even compare the benefits of cloud sourcing to an in-house solution, since current costs are not quantifiable in detail; instead they are faced with one big "chunk" of IT cost. As a result, this demands a significant effort on the part of the enterprise — an effort which many SMEs eschew due to lack of resources. Before building a full-blown business case it is, therefore, helpful to have easy-to-verify criteria that can identify those projects that are likely to be good candidates for cloud sourcing. SMEs would hence greatly benefit from a "filter" that can help them sieve out unfit projects easily and let them focus on promising cloud sourcing undertakings. In [15], we present such a filter in the form of a method we term EVACS (short for *Economic Value Assessment of Cloud Sourcing*). In the current paper, we introduce and describe an entirely different solution which assumes that an SME has decided in favor of the cloud, but entrusts all the issues related to its implementation and ongoing operation to an intermediary.

Specifically, we present the notion of a *hybrid cloud intermediary* that can address many of the prevailing issues in cloud adoption in SMEs. We do this by first providing an appropriate theoretical background and an overview of related work in Section 2. Besides general cloud fundamentals, this includes a motivation for the research by way of the particular problems SMEs face in contrast to larger enterprises, an overview of previous work on intermediaries in electronic markets ("cybermediaries") as well as an overview of the cooperative paradigm, which we will apply to this case later. Sec-

tion 3 then introduces the notion of cloud intermediaries and analyzes their prominent traits. Subsequently, Section 4 provides a detailed view of the benefits a cloud intermediary can offer SMEs as well as a detailed characterization of a special intermediary variant. Turning from a market structure perspective to a governance perspective, Section 5 outlines a possible organizational form for a cloud intermediary based on the cooperative paradigm. We provide empirical validation of the approach utilizing the findings of an international empirical study of cloud computing adoption in SMEs. A discussion of the potential adoption of the approach and a consideration of limitations is provided in Section 6, followed by conclusions in Section 7. We note that the present paper is a revised and considerably augmented version of [14].

2 THEORETICAL BACKGROUND AND RELATED WORK

2.1 Cloud Sourcing

The term "cloud computing" is widely used to describe a diffuse field based on the use of IT resources via the Internet. The interpretations of the term range from the strict sense that designates only processing power ("compute") to the lenient interpretation that includes basically any remote procedure or service call. As a first step to narrow this broad set of definitions, we provide a concise definition based on the definition by the US NIST[1] [24]:

> *Cloud sourcing* is the utilization of IT capabilities from a *cloud service provider* (CSP) based on the cloud paradigm. The *cloud paradigm* implies five characteristics:[2] resource pooling, rapid elasticity, on-demand self-service, broad network access, and measured service.

NIST defines three service models: Software-, Platform- and Infrastructure-as-a-Service, abbreviated as SaaS, PaaS, and IaaS, respectively. The different service models represent different types of services and, in a sense, different levels of abstraction from the underlying physical IT infrastructure.

2.2 Characterizing SMEs

SMEs, in particular those for which IT is not their core business, have characteristics that are considerably different from that of large companies. Important traits in this context are the frequent lack of an explicit IT

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[1]National Institute for Standards and Technology

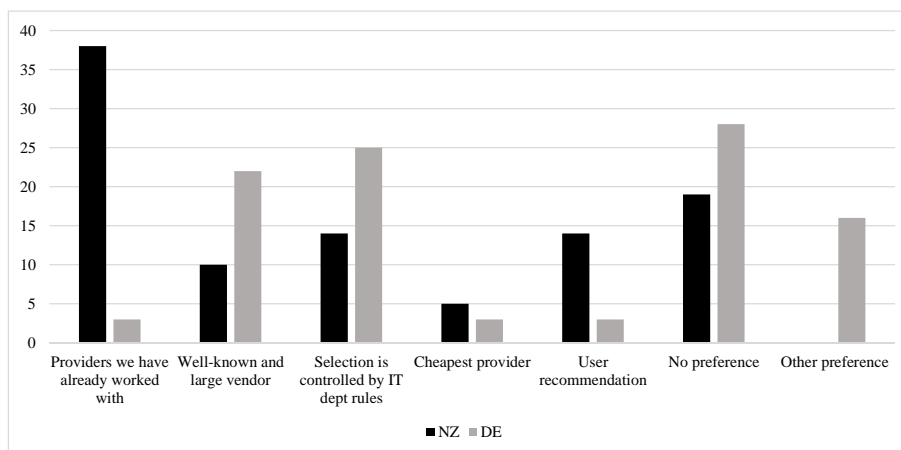[2]For an in-depth discussion of these characteristics see [24] and [11].

Figure 1: Approaches to cloud provider selection in DE vs. NZ SMEs.

strategy, limited financial resources, limited information skills, and often the presence of a solitary decision maker, i. e., the owner [5, 6].

The benefits of cloud services for SMEs are rather similar to those for any other type of company [3, 39]. However, they are more pronounced for SMEs in some respects because of their distinguishing features [13]. The main argument for cloud sourcing usually is that it cuts costs because expenditures for hardware, maintenance, and human resources can be reduced while cloud costs are distributed over the entire usage period [1, 3, 31, 39]. Both effects are desirable for SMEs, which are typically looking for ways to cut their IT spending. An approach to evaluating these effects has been described by the authors in [15]. As a side-effect, the pay-per-use notion allows SMEs access to software or infrastructure that would otherwise be too expensive to purchase. Additional benefits of cloud sourcing include access to professionally operated data centers [8, 23, 26], elasticity and short-term contracts [24], i. e., additional flexibility for SMEs [1].

Notwithstanding those benefits, SMEs also face some challenges with adoption. Compared to large companies, legal aspects and trust concerns of cloud sourcing contracts are often not adequately investigated by SMEs, an issue that has been accelerated by the infamous NSA spying scandal that unfolded in mid-2013[3]. On the one hand, this is concerned with data protection and data security issues, while on the other, this stems from uncertainties regarding the legal situation surrounding a cloud sourcing. The situation was recently aggravated when the European Court of Justice (ECJ) ruled the Safe Har-

bor treaty illegal[4]. This treaty was hitherto used by many companies to select IT providers abiding to a minimum level of data protection regulations. While it had always been debated whether the Safe Harbor was sufficient to satisfy, e.g., German data protection legislation, it was a relatively safe way for SMEs to choose providers that were legally acceptable. Further, SMEs typically do not have adequately trained staff to investigate new technologies. In conclusion, cloud services are a very attractive IT outsourcing approach for SMEs, but widespread adoption is hindered by the high required upfront effort and serious legal and security concerns of the enterprises.

2.3 Cybermediaries

In general, an *intermediary* is a third party that facilitates economic transactions between two other parties. For example, PayPal is an intermediary handling payments between two parties without revealing account details of the payer; such facilities have become very popular in the context of electronic business (and beyond). Indeed, the relevant literature provides an overwhelming number of terms to denote different varieties of intermediaries; Howells [17] provides a framework to organize the various facets of the term. In this paper, such a fine-grained differentiation is not required. Instead, we stick to the core idea of an intermediary as a middleman, broker, or facilitator of a transaction. If an intermediary operates in an electronic market and, thus, is heavily relying on information and communication technology (ICT) for its business, it is typically referred to as a *cybermediary* [32, 33].

In principle, an intermediary provides value by arbitrating between two or more other parties. This posi-

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[3]see, for example, `http://www.theguardian.com/world/the-nsa-files` or `http://www.spiegel.de/international/topic/nsa_spying_scandal/`

[4]http://www.irishtimes.com/business/technology/european-court-of-justice-calls-for-end-to-safe-harbour-1.2363741

tion empowers it to reduce the complexity of the relationship between buyers and sellers, in this context cloud users and cloud service providers (CSPs), and to have all relevant information available for the interacting parties [9, 4]. In effect, an intermediary can bundle supply and demand, match buyers and sellers, provide trust by reducing uncertainty, create new service bundles from different suppliers, appropriate collective goods, and – to some extent – mitigate the effects of moral hazard and adverse selection [27, 21, 17, 2, 34].

An important task of intermediaries is the collecting, editing, and providing of reliable information. Thus, they can act as catalysts for interactions and transactions between users and CSPs [17, 9]. As a consequence, intermediaries can act as "change agents" [17], accelerating decision processes in partner companies and facilitating the use of novel technologies especially for SMEs that would otherwise not be able to assess all alternatives fully [12].

Building on the business model concept by Osterwalder and Pigneur [25], Rensmann [29, 30] has developed a generic, consolidated, cross-perspective model of cybermediary value-creation that allows the specification of a cybermediary based on the following three characteristics:

1. its core value proposition, together with the specific buy-side and supply-side value propositions;

2. the key value creating activities of the cybermediary, which are based on the required key resources; and

3. relevant revenue streams.

In addition, the market environment needs to be specified by detailing the customer segments on both the supply and buy side as well as describing relevant competitors. The resulting model is shown in Figure 2. We present an adaption of this in Section 4.2 to specify a prototypical buy-side cloud intermediary, intended specifically for SMEs.

The application of the intermediary idea to the cloud domain has received little attention to date. Although there are many real-world examples of cloud intermediaries, e. g., business consultants that focus on cloud services, most studies regard intermediaries only as a subordinate phenomenon and not as the nexus of analysis [17]; this holds even more for the cloud domain. Only Marston et al. [22] sketch a rough vision of applying the intermediary notion to the cloud domain, albeit without going into detail.

2.4 The Cooperative Paradigm

As noted previously, SMEs are characterised by a series of resource-based limitations. These limitations can significantly hamper the adoption of cloud services, many of which have been specifically developed for infrastructure-rich large corporates. History provides numerous examples of how constraints associated with company sized have been overcome by the formation of cooperatives between them. Following Haselmann and Lipsky [12], a possible organizational form for an intermediary that internalizes information problems is the cooperative. We will introduce the reasons for this in a general sense below and then further elaborate on the role of the cooperation in Section 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 [20]. Even though these individuals act rationally and are self-seeking in terms of their financial returns, cooperative structures channel their actions so that these lead to a superior "collective" performance compared to an isolated approach. Although cooperatives are generally ascribed to traditional economic sectors such as agriculture or finance, a number of cooperatives have been founded in recent years in expanding, future-oriented industries such as IT [38]. Cooperatives can help realize synergies, compensate for competitive disadvantages, and allow the combination of decentralized knowledge without sacrificing any member's independence [37, 35].

Cooperatives are characterized by a high degree of institutionalization and a standardized scope for action. The applicable "rules of the game" are defined by legislature and in the statutory regulations of a cooperative [35]. These clear rules facilitate handling uncertainty and can thus foster credibility and trust among the members. This systemic trust is also created by the cooperative's special governance elements which are broken down into two main aspects: *mutualism* and *self-government*.

Mutualism means that the members assist each other through collective self-help. It implies the voluntary cooperation of members (voluntary entry into and exit out of the cooperative) without any help from the outside. These structures are expatiated by the concept of membership that operationalizes another governance element, the consistent incentives. The special characteristic of a cooperative in comparison to other cooperation forms is the strategic alignment of all activities to the members' needs inside the cooperative. This finds its expression through the *MemberValue*, a special type of shareholder value. The MemberValue consists of the direct MemberValue (result of the members' function as service partners), the indirect MemberValue (result of the members' function as owners of the cooperative) and the sustain-
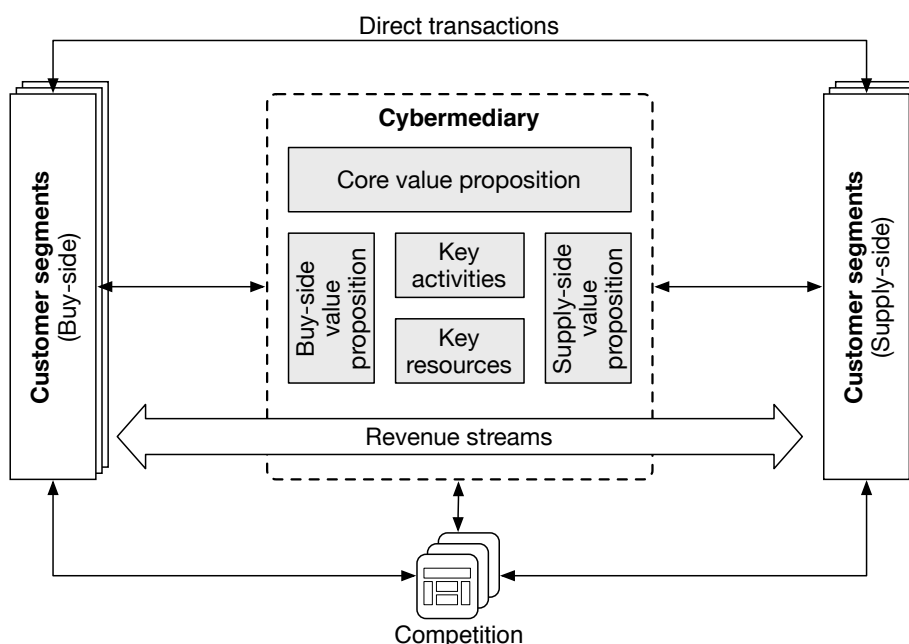
Figure 2: A cross-perspective consolidated model of cybermediary value-creation, showing the relevant characteristics of a cybermediary and its environment [28, based on].

able MemberValue (result of the members' function as owners with focus on their status as investors). It thus includes both short-term and long-term value components [36]. The creation of common values leads to mutual dependency among the members, i.e., they rely on each other. This fact and the establishment of a two-fold identity of the members as both customers and owners of the cooperative minimize uncertainty about a member's behavior leading to less opportunistic actions.

The second trait of cooperative governance is the self-government including self-responsibility of the members' actions with its democratic principles. An important particularity of a cooperative is that each member has exactly one vote[5] (*one-man-one-vote principle*). This favors smaller enterprises which are usually not in a position to negotiate with a larger business partner, such as a global CSP, due to size mismatch. This is combined with the principle of parity, which guarantees that members cannot exploit the inner mutual dependency to their own advantage. Beyond that, the membership management, which is self-responsible of its actions, ensures that anonymous vested interests are excluded from all strategic decisions.

While the general notion of a cooperative has been around for decades and is well understood, to our knowledge the specific application of the concept to the domain

of cloud computing has not been investigated before, except for the previous work of the authors: [16, 12, 11].

3 CLOUD INTERMEDIARIES

3.1 General Notion

If an intermediary focuses on the cloud domain, it is referred to as a *cloud intermediary*. In the sense of a traditional intermediary, a cloud intermediary arbitrates between supply (CSPs) and demand (potential cloud users) in order to facilitate cloud sourcing for SMEs by reducing the upfront effort of identifying, comparing, and screening the CSPs and their services. To do so, the intermediary propagates best practices and offers specific consultancy. Colloquially, a cloud intermediary helps cloud users "clear the service jungle" so that they can find a suitable match easier and, thus, cheaper. Evidently, a cloud intermediary is also a type of cybermediary.

Note that cloud sourcing is an external procurement of IT services. The generic service process can be structured into the three phases *information*, *agreement*, and *settlement* [19]. While in principle a cloud intermediary can participate in any of these phases, it is to be expected that its focus lies in the first two, because the nature of the business between buyer and seller thus remains largely untouched [9].

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[5]In a few cases, the general meeting can decide on exceptions from this rule.

3.2 Linkage Variants

Independent of the business model details, an intermediary has to position itself between buyers and suppliers. There are four conceivable linkage variants [11], which are based on the three generic cases from Klein and Teubner [18]; those three cases have been adapted to the cloud context and are all highly applicable to SMEs. While the original model does not distinguish between the cases of a neutral (unbiased) and a bilateral (mutual) intermediary, this distinction seems appropriate for the cloud situation; a detailed argumentation will follow in the remainder of this section. These new four linkage variants are:

- Neutral (unbiased) cloud intermediary

- Buy-side cloud intermediary

- Supply-side cloud intermediary

- Bilateral (mutual) cloud intermediary

These variants are explained in detail in the subsequent subsections. Figure 3 provides a graphical overview.
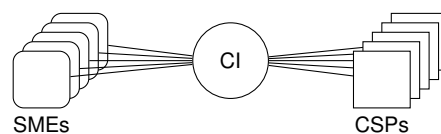
3.2.1 Neutral Cloud Intermediary

A *neutral* cloud intermediary is formed as an independent party between buyers and suppliers. It is, thus, biased neither towards CSPs nor towards cloud users. Such a cloud intermediary could be an independent consultancy or an operator of a cloud service market place. SPOTCLOUD[6] is an example of the latter category, being a marketplace for IaaS products. Registered users can offer their unused CPU capacity or storage space. Clients buy virtual resources "apiece" without knowing which user is acting as their CSP. SPOTCLOUD fulfills all duties connected with matching supply and demand as well as financial settlement.

Obviously, such a market place works best for highly standardized cloud services. Such services are typically found at the infrastructure level (in particular storage and CPU capacity). Distinctive attributes of such services are clearly delineated and the abstract services are not substantially different between different providers. For services with high specificity, such as most cloud platform services, matching of supply and demand becomes much harder.
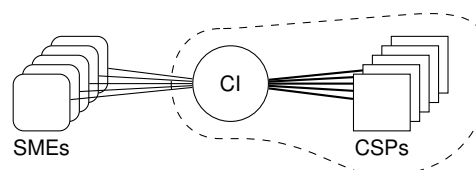
3.2.2 Buy-side Cloud Intermediary

A *buy-side* cloud intermediary is formed by a joint venture of potential cloud users that would like to bundle their cloud-related activities in order to realize synergies
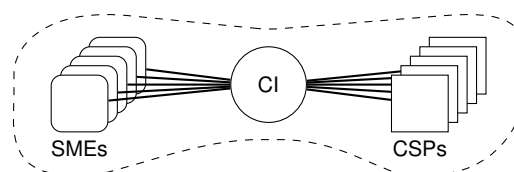

(a) Neutral cloud intermediary
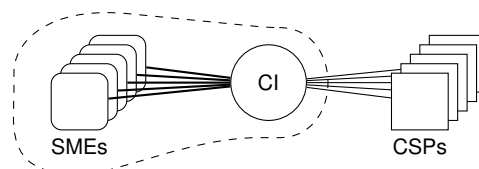
(b) Buy-side cloud intermediary

(c) Supply-side cloud intermediary

(d) Bilateral cloud intermediary

Figure 3: The four conceivable linkage variants for cloud intermediaries in which a cloud intermediary can be orientated towards buyers and/or suppliers.

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[6]http://www.spotcloud.com/

and scale effects.[7] The cloud intermediary is, hence, an agent of the cloud users and strongly biased to enforce these users' interests towards CSPs. The intermediary focuses on the users' problems, such as service identification, provider selection or migration from one CSP to another. A typical example of a buy-side intermediary is EURONICS[8]; ICT-enabled versions are typically group buying websites such as GROUPON MYCITYDEALS[9].

The main advantage of this type of intermediaries lies in the bundling of its users' demands and needs. This allows many small enterprises to aggregate their market power and act with the virtual size of a much larger enterprise. As a consequence, the intermediary has increased bargaining power for negotiating contracts and prices. In addition, buy-side cloud intermediaries can help introduce new technologies or exchange best practices among its users. Established principles of intermediation can be transfered from "older" industries to cloud sourcing. Real-world examples of such buy-side cloud intermediaries do not yet exist to the authors' knowledge.

3.2.3 Supply-side Cloud Intermediary

If a group of CSPs that share a common goal forms a joint venture, it is called a *supply-side* cloud intermediary.[10] The intermediary then acts an agent of the suppliers and is, thus, focused on enhancing their interests. The formation of such a cloud intermediary is attractive mainly for small players in the cloud market that offer complementary services. Using a supply-side cloud intermediary, these companies can offer a more comprehensive coherent portfolio. Thus, they address a larger group of target customers because they can also reach customers who are looking for a one-stop solution instead of a "service jigsaw". An example of a supply-side cloud intermediary is the APPEXCHANGE platform by SALESFORCE that provides a single unified platform for offering and finding extensions to the SALESFORCE CRM system.

3.2.4 Bilateral Cloud Intermediary

The final conceivable case is that of a *bilateral* cloud intermediary. Such an intermediary arbitrates between cloud users and CSPs while being tied to both sides. This is particularly relevant when there is a group of

enterprises that plan a close cooperation based on a mid- to long-term horizon. In this scenario, a bilateral cloud intermediary can reduce the coordination overhead between the partners and allow for the realization of economies of scale, scope and skill.

This solution, however, is only suitable for a very limited number of scenarios. In particular, it is only viable if various partners would like to create a closely linked ecosystem around a common goal, a common product or a common problem. For example, the OPEN SOURCE AUTOMATION DEVELOPMENT LAB (www.osadl.org) brings together software developers and users with the common goal of fostering the development of open-source software. Without this intermediary, most participants would not publish their enhancements of open-source software ("why pay for the result and then give it away for free?") or prefer a solution with proprietary vendor-specific software to an open-source solution. Notice that the bilateral case might address the challenge of data privacy.

It is necessary to point out that the distinction between a neutral and a bilateral cloud intermediary is subtle, but important. A neutral cloud intermediary will always align its strategy with the demands of its target customers, which may change in the course of time. An enterprise that is in the group of target customers might not stay a member in the long run. Besides, a neutral cloud intermediary will base its strategy on the *intersection* of the customers' various demands and disregard the specific demands of smaller subsets. A bilateral cloud intermediary, on the contrary, has two fixed groups of target customers. It will, therefore, align its strategy with their exact needs and adjust the strategy in case the demands change over time.

3.2.5 Comparison and Evaluation of the Four Variants

It is obvious that not all linkage variants are equally well suited to address the issues of SMEs as outlined in Section 2.2. Clearly, neither a neutral cloud intermediary nor a supply-side cloud intermediary can address the interests of the cloud *users*. A bilateral cloud intermediary acts – at least to some extend – as an agent of cloud users; however, it must always consider the demands of the suppliers as well and is only appropriate for a very limited number of scenarios. In contrast, a buy-side cloud intermediary (Figure 3b) is well positioned to address both the interests of the cloud users and the trust issues that SMEs potentially have with cloud sourcing. Subsequently, we will therefore focus our attention on this variant.

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[7]In rare cases, there are singular enterprises on the buyer side that have such an importance in the market that they can form their own buy-side cloud intermediary.

[8]https://www.euronics.de

[9]http://www.groupon.co.uk/

[10]In this case there is the possibility of a very large provider forming a supply-side cloud intermediary on its own. A real-world example is the APPEXCHANGE platform, see https://appexchange.salesforce.com/.

3.3 Business Models

3.3.1 True Intermediary Business Models

Two general business models can be distinguished depending on how comprehensively the cloud intermediary acts as a middleman between two parties: cloud brokers and cloud traders.

A *cloud broker* is limited to the negotiation of contracts between a cloud user and a CSP. With the CSP it mainly performs a screening and assessment; with the cloud user, it provides consultancy and curated information on various market aspects. Thus, it supports the initiation and negotiation phases of the service process. The actual contract is still closed directly between the cloud user and the CSP, without the involvement of the intermediary.

In contrast, a *cloud trader* acts as a distributor and reseller of cloud services by establishing contracts with various cloud users and satisfying the demands by closing matching contracts with CSPs. The services of CSPs can be made available to users either transparently (i. e., it is clear that a certain third-party CSP is providing the service) or relabeled as a proper service (i. e., the cloud trader appears as service provider). The same is true for the payment of service fees, which can be paid either to the cloud intermediary or to the original CSP (which, in turn, pays the cloud trader a commission). These two business models are shown schematically in Figure 4.

Both business models offer essentially the same advantages and disadvantages for customers.[11] A notable difference is that a cloud trader cannot only support the negotiation phase by providing consultancy, but it can even enhance the market position of its customers. To do so, it bundles the users' demands thus gaining *virtual size* and a better position for negotiating rebates. Typically, this also implies that a cloud trader has to bear the planning risk for the congruence of supply and demand (e. g., because there are upper and lower bounds on the amounts of contracted resources).

3.3.2 Hybrid Business Models

Since a genuine cloud *intermediary* does not offer any cloud services of its own (cf. Figure 4), there are no requirements for costly investments in IT infrastructure. Also, it is easy for the founders to liquidate a cloud intermediary and return to unmediated transactions in case it turns out that a solution with a broker is unsuitable or not financially viable. The principal advantage of a cloud intermediary lies in the rather objective

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[11] We abstract from the differences between various business models on the side of the cloud intermediary because the analysis is performed from a user's point of view.
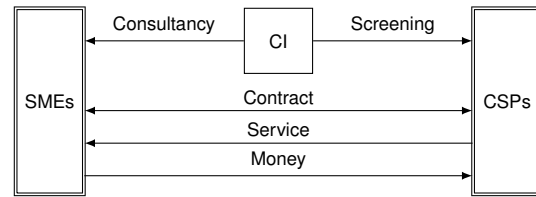
(a) Cloud broker as a facilitator of contracts.
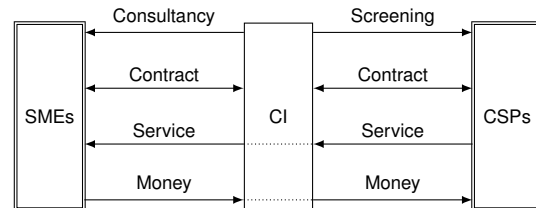
(b) Cloud trader as intermediate agent and independent contract partner.

Figure 4: Two business models for a CI that a acts as a cloud broker or b as a cloud trader.

and customer-specific consultancy that can highlight reliable CSPs, propagate best practices and architectural approaches etc. A cloud intermediary can, thus, be of significant help for SMEs that have no cloud experience worth mentioning – which is the majority of SMEs as of time of writing.

The fact that a cloud intermediary does not provide any cloud services of its own is, nevertheless, also a limitation. A genuine cloud intermediary cannot easily provide services that are tailored specifically to the users' needs or compound services that provide added value based on a composition of other (probably third-party) cloud services. In essence, a cloud intermediary provides a "selective public cloud" due to the careful selection of publicly available and pre-existing cloud services. Thus, it can guarantee, e. g., a minimum service level but it cannot address the basic concerns, as outlined earlier, that many SMEs have with a public cloud.

A well-known workaround for many such issues of the public cloud model is the so-called *community cloud* model, in which a provider offers a cloud to a clearly defined group of clients, essentially making it a "joint private cloud". A community cloud does not offer a physical separation of clients as it is provided by a private cloud, nor does it feature a far-reaching logical separation as a virtual private cloud offers. It does, however, offer a physical separation of its members from non-members, making it suitable to address many privacy and information security concerns of a public cloud.

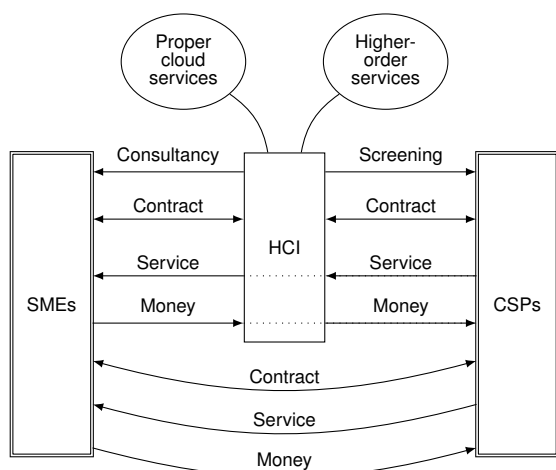An attractive proposition is that of a cloud intermedi-

Figure 5: Typical complex scenario involving a hybrid cloud intermediary.

ary that is also a community cloud provider. In this case, all benefits of a cloud intermediary are combined with the possibility to offer custom services that are tailored towards the needs of the members of the cloud intermediary. These services can comprise both completely self-provided functionality and compound services, created from a combination of third-party cloud services (providing some kind of added value); they are also referred to as *higher-order services*. A cloud intermediary that also acts as a CSP is called *hybrid cloud intermediary* (HCI).

While it is beneficial for SMEs in many cases to contract services through a cloud intermediary, it is not the only solution. Instead, they can contract directly with trusted CSPs or other intermediaries. The complete scenario around a hybrid cloud intermediary is shown in Figure 5.

4 BUY-SIDE HYBRID CLOUD INTERMEDIARIES

4.1 Examining Transaction Costs and Production Costs

In order to analyze whether intermediation offers a viable alternative to direct interactions with CSPs, we consider a scenario in which several SMEs would like to procure a cloud service that is offered simultaneously in a similar manner by multiple CSPs. Two relevant dimensions for this analysis are the *degree of in-house production* in the SMEs and the *scope of cooperation* with the intermediary. The first dimension is divided into three levels:

1. *None* – There is no in-house production, the cloud

service is used directly ("as-is").

2. *Partial* – The cloud service is enriched by additional (minor) features, making it a higher-order service and requiring some in-house production.

3. *Complete* – The service is not procured from a third party and is, therefore, completely provided in-house.

Independently, the cooperation dimension can also be divided into three levels:

1. *No cooperation* – All SMEs directly interact with the CSPs.

2. *Preparatory phases* – The SMEs cooperate in the preparatory phases of the service process, i. e., mainly in the initiation phase and possibly to some extent in the negotiation phase; cooperation is handled by a cloud intermediary.

3. *Entire service process* – The SMEs cooperate throughout the entire service process; cooperation is handled by a cloud intermediary.

This results in a total of nine scenarios, which are depicted in Figure 6. In order to show that a solution based on cooperation with a cloud intermediary is preferable to a solution without cooperation, we analyze the transitions from the left column to the middle and right columns. We do this row by row, i. e., we assume a fixed level for the degree of in-house production. Thus, we show that the transitions depicted as solid arrows in Figure 7 are actually beneficial for the involved SMEs. In order to do so, we perform a differential analysis of both transaction costs and production costs for each transition in question. As the analysis follows a very similar argument for all transitions, we present our argument in general and leave the application to each individual transition to the reader.

Looking at the transitions from the left column (no cooperation) to the middle column (cooperation in preparatory phases of the service process),[12] it can be observed that a cloud intermediary can support SMEs in the initiation and (partially) negotiation phases. It does so by providing filtered and aggregated information, i. e., specific consultancy to the SMEs. While the benefit is not immediately apparent in the case of a single enterprise, it becomes obvious when a group of SMEs with shared goals is considered . In that case, transaction costs for finding and negotiating a cloud sourcing contract are significantly reduced due to economies of scale through the use of the cloud intermediary. In cases where there is in-house production, the cloud intermediary can also foster

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[12]that is, $S_1 \rightarrow S_2$, $S_4 \rightarrow S_5$ and $S_7 \rightarrow S_8$.
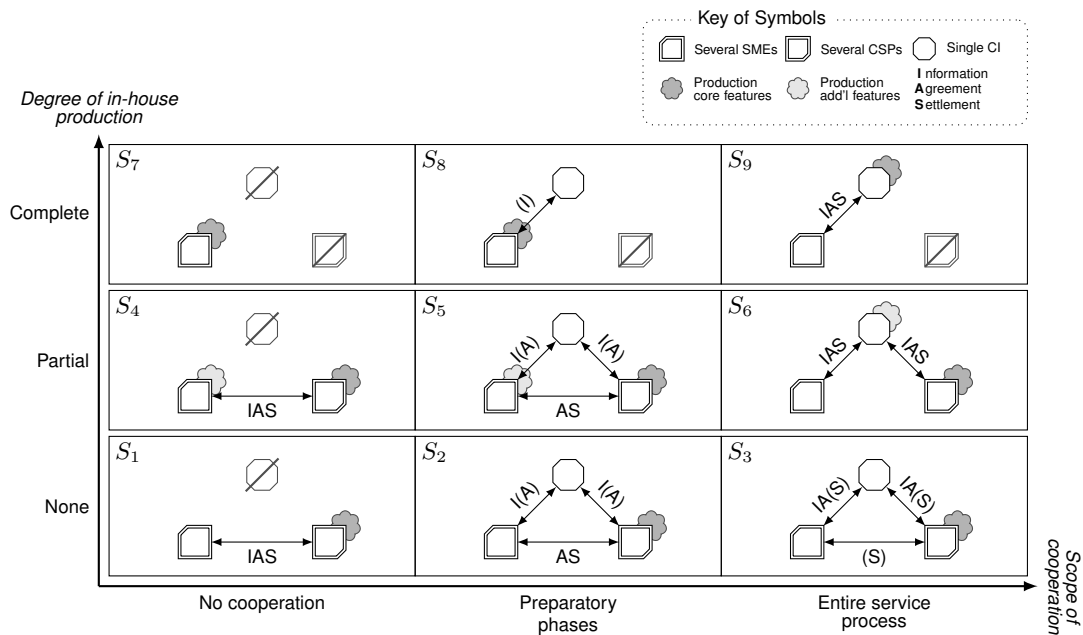
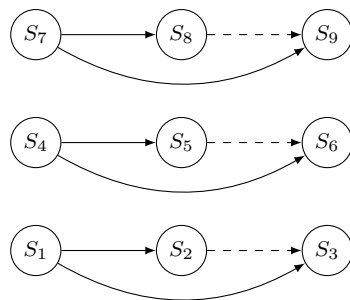**Figure 6: Graphical overview of the nine scenarios.**

Figure 7: Analyzed transitions between scenarios, distinguishing certainly beneficial transitions (solid arrows) and probably beneficial transitions (dashed arrows).

the exchange of knowledge and best practices among the SMEs.

Similarly, when analyzing the transitions from the left column to the right column (cooperation during the complete service process),[13] a cloud intermediary can provide the same advantages as outlined for the previous case. In addition, it can realize further economies of scale, skill, and scope. For instance, it can aggregate the demand of all SMEs and negotiate quantity rebates. Being involved during the entire service process, it can also provide more comprehensive support for all enterprises at a higher efficiency than the individual SMEs could. It is, thus, likely that even the transitions from the middle

to the right column are beneficial (indicated by dashed arrows in Figure 7).

Having established that the relevant transitions are beneficial considering transaction costs, we will now take a look at production costs as well, where the third row from Figure 6, i.e., the one containing scenarios without in-house production, is not considered because transitions in that row obviously do not imply any change in production cost. With increasing cooperation, SMEs are able to realize significant economies of scale if they have a mutual cloud intermediary handle the service production. Even if not cooperating, the production cost are not influenced by the presence of a cloud intermediary. Therefore, the relevant transitions are not detrimental (in the worst case), but rather expected to be quite advantageous (in the likely case).

In conclusion, it can be shown across all identified scenarios that a cooperative solution based on a cloud intermediary is indeed beneficial for a group of SMEs that are willing to cooperate on their cloud sourcing activities. Regarding transaction costs, it is always beneficial to engage a cloud intermediary (given the assumptions for a "typical" SME from Section 2.2). While this is not always the case for production costs, it is clear at least that production costs never increase when engaging a cloud intermediary; for the average case, SMEs can even expect decreases in production costs as well. Figure 7 summarizes these results graphically.

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[13]that is, $S_1 \rightarrow S_3$, $S_4 \rightarrow S_6$ and $S_7 \rightarrow S_9$.

4.2 Specifying the Notion of a Hybrid Buy-side Cloud Intermediary

As introduced in Section 2.3, a cybermediary can be characterized by specifying its value propositions, key activities, and key resources (cf. Figure 2). For a cloud intermediary, the services that are offered are of particular relevance. Therefore, the model is adapted to explicitly depict four different "types" of IT services: "pass-through" services that are made available without change; proper services that the cloud intermediary is providing, acting as a genuine CSP; "atomic" services that serve as building blocks for more elaborate compound services; and compound services[14] offered by the cloud intermediary that are composed of other services and provide some kind of added value over the "raw" services. The adapted model is depicted in Figure 8. It permits characterization any type of cloud intermediary.

We characterize the model presented in Figure 8 as a prototypical hybrid buy-side cloud intermediary, i.e., an intermediary that is founded by (or at least strongly biased towards) a group of SMEs that would like to engage in a cloud sourcing. While the services may be very different for each hybrid buy-side cloud intermediary depending on its customers' requirements, the market environment and so on, the core features – value proposition, key activities, and resources – can be characterized quite generically. In the following subsections, we focus on the shaded boxes of Figure 8.

Core value proposition: As argued so far, the core value proposition of a hybrid buy-side cloud intermediary is the significant reduction of transaction costs for all participants in cloud markets, thus overall providing more attractive transactions for buyers and sellers. It does so based on the "traditional" intermediary functions of matching suitable transaction partners (i.e., mainly finding adequate CSPs for the customer SMEs) and providing aggregated information about suppliers to buyers and vice versa. Being in between both sides of the cloud market, it can provide stability of business relations and technical interfaces (even if CSPs or SMEs change). Under certain circumstances, it can even take on the role of a trusted third party, thus possibly acting as a *trust anchor* (particularly for the comparatively small SMEs facing global cloud providers).

Buy-side value proposition: Being a buy-side intermediary, it is clear that the most important part of the value proposition targets the customer, i.e., the cloud procuring SMEs. For these enterprises, the cloud intermediary can assist with the (typically) tedious ven-

dor selection and screening process that precedes any cloud service procurement. In this phase it can also provide guidance on architectural, technological and implemention-related choices. It can even ensure stability of technical interfaces in cases where CSPs do not guarantee it. In addition, the cloud intermediary can provide complementary IT services that are not available on the market. Last, but not least, it can put SMEs into a better position for negotiations with CSPs (by providing a larger virtual size). Due to the fact that a cloud intermediary can reduce the transaction costs related to cloud sourcing to a degree that cloud services become a viable alternative for SMEs, a cloud intermediary can assume the role of a *cloud enabler*.

Supply-side value proposition: On the supply-side, the value proposition is given mainly by the core value proposition. Nevertheless, some specific benefits of a cloud intermediary can be identified. Firstly, a cloud intermediary acts as a single point of contact for CSPs which hence can reach all associated SMEs through a single channel. This implies less administrative overhead for a CSP and an opportunity for increased sales. Secondly, dealing with a cloud intermediary means that a CSP deals with an experienced partner that encapsulates all required domain knowledge about its customers (the SMEs) and relieves a CSP of translating their needs into technological requirements.

Key activities: The cloud intermediary provides the benefits described above by performing several key activities. First of all, it performs a market analysis, identifying and screening relevant CSPs. The intermediary then negotiates contracts on behalf of the associated SMEs. In doing so, it can benefit from having consolidated and standardized its customers' requirements, thus developing a concise portfolio of required services and achieving better economies of scale. It then helps with the procurement and integration of the services into the individual IT landscapes. If desired, the cloud intermediary can also take care of the settlement of PPU fees and other service charges. When the intermediary also acts as a proper CSP, it needs to operate selected cloud services and provide relevant compound services based on either in-house or cloud infrastructure.

Key resources: The key resources of a cloud intermediary are two-fold: domain knowledge of the cloud market and the market participants as well as domain knowledge of cloud services, cloud operations, service provision, and service procurement. On the one hand, the intermediary relies on its specific knowledge of both its

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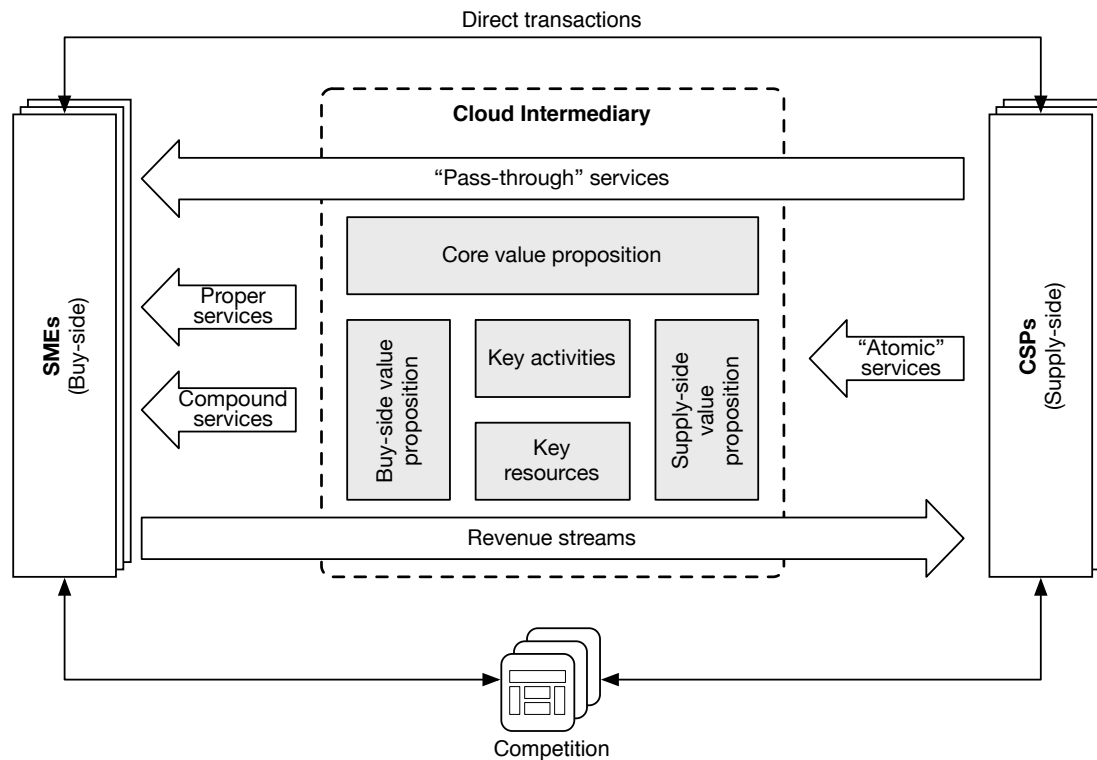[14]Also referred to as *mash-ups* in the Web 2.0 context.

Figure 8: A cross-perspective consolidated model of cloud intermediary value-creation, adapted from the generic model by Rensmann [28] (cf. Figure 2).

customers (the buy-side SMEs) and about relevant market players and appropriate selection and screening procedures. On the other hand, it needs to have appropriate knowledge about efficient infrastructure operations and service provision as well as about best practices that SMEs should follow when sourcing services from "the cloud".

5 COOPERATIVE GOVERNANCE FOR A CLOUD INTERMEDIARY

As the previous section has shown, resorting to a buy-side hybrid cloud intermediary is, in general, beneficial for SMEs. Since an appropriately designed cloud intermediary can reduce the upfront costs of using cloud services in SMEs to such a degree that it in fact enables SMEs to use cloud services at all; hence, a cloud intermediary can act as a *cloud enabler* (as argued in the previous section). However, there are some remaining issues that need to be addressed:

- The cloud intermediary does not protect buy-side SMEs from a hold-up[15] by the CSPs. Cloud users

are typically dependent on a single vendor because of various forms of *vendor lock-in*: proprietary data formats, proprietary scripts or macros, unique API calls etc. Migration to another vendor in such a scenario would incur significant costs.

- The described setup concentrates risk for the SMEs at a single point, namely at the cloud intermediary. This happens both consciously and unconsciously because of knowledge transfer or transfer of assets to the cloud intermediary. Over time, the cloud users may be deprived of the knowledge and assets that would be required to "backsource" the outsourced services into the enterprise.

- The described setup leads to a double principal-agent situation.[16] By introducing another party between buyers and sellers, there is a risk of increasing information asymmetries instead of ameliorating them. The cloud intermediary has to be designed appropriately so that its relations to the buy-side SMEs are close enough to bridge the information gap.

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[15]The term "hold-up" is a technical term from transaction cost theory; see, e. g., [27].

[16]For an introduction to the theory of agency see, e. g., [27].

These issues cannot be addressed simply by introducing an intermediary; rather, they require appropriate governance structures for the cloud intermediary. One particularly suitable governance form is the cooperative, which we now apply to the specific case of buy-side hybrid cloud intermediaries, showing its distinct advantages.

The combination of the general concept of a buy-side hybrid cloud intermediary with cooperative governance structures results in a cooperative that is formed 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 an effective means of handling opportunistic behavior and, thus, creating trust (see Section 2.4). The resulting entity is concisely referred to as a *co-op cloud*. Thus, a co-op cloud is schematically equivalent to Figure 3b, with the CI being organized as a cooperative.

The first effect of forming a co-op cloud 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 co-op cloud 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 venture. They now contract with the co-op cloud, a partner they are involved in and that is democratically managed by the "one-person-one-vote"-principle balancing all members' interests. Because of the fact that a cloud user is also co-owner of the co-op cloud, the user has full control and trust in the provided cloud services. The self-government element prevents external interests from influencing the cloud intermediary. On a side-note, the cooperative members are not required to purchase all of their cloud services through the co-op cloud. In fact, the set-up is flexible enough to allow some member's particular requirements that are out of the scope of the co-op cloud to be fulfilled externally. In general, however, it is expected that cooperative members will channel their cloud activities through the intermediary because of the described advantages.

This cooperative mutualism in the creation of identity among the members lowers the risk of opportunistic exploitation by CSPs. The operationalization of this mutualism is the creation of values, in a nutshell, the *MemberValue*, which is the total value of the members' entrepreneurship and consists of three facets (see Section 2.4). The direct MemberValue represents the value of having access to the co-op cloud'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 (divi-

dends) to the members. Finally, the sustainable Member-Value consolidates all values from investments to guarantee continuation and expansion of the co-op cloud, e. g., investments for developing new and innovative services for the community cloud and its members.

Another advantage of a co-op cloud is the creation of virtual economies of scale. Inside a cooperative — unlike most other governance forms —, the risk of selecting the wrong partner (adverse selection) is shared by all members. The search costs for new members, services or optimal solutions are shared as well. Still, all members maintain their identities and all SMEs remain self-dependent (so-called cooperative individualism). Although stability is generally ensured by the cooperative statutory regulations, the barrier to enter or exit the cooperative for a single member is rather low. Lock-in costs are relatively small because the members are entitled to a refunding of their deposit. However, it is problematic if a large portion of the members exits simultaneously because that can easily overstrain the financial capacity of the co-op cloud. In this case, the continuation of core services might not be sustainable.

Lastly, a secure legal framework is extremely important for the dissemination of cloud services among SMEs. With the establishment of a co-op cloud, 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. Having less legal leeway than other forms of cooperation, cooperative structures can provide such a setting as their narrow statutes create trust among its members and provide stability in the volatile cloud services domain.

In conclusion, the combination of a buy-side hybrid cloud intermediary with cooperative governance structures can indeed address the three identified issues. It can do so better than most other governances forms because of its characteristic traits. However, this still requires the cooperative be designed appropriately – a task that is facilitated by the fundamental ideas of a cooperative.

6 DISCUSSION AND LIMITATIONS

In this paper, we have systematically developed what we believe to be a theoretically sound and practically relevant approach to dealing with common cloud sourcing issues for small and medium enterprises. The concept of a hybrid cloud intermediary is intended to permit SMEs to take advantage of cloud computing in the lowering of entry barriers, in particular upfront (transaction) costs and address trust concerns. It has been shown that our solution is advantageous under a range of key assump-

tions as outlined in Sections 3 and 4. However, the co-op hybrid cloud intermediary is not a panacea for all cloud sourcing scenarios and, as such, the limitations of the approach need to be acknowledged.

Cooperative structures are designed and profitable for a long-term perspective. They are, therefore, unsuitable for SMEs that want to engage in a single cloud project or in very short-term cloud usage, nor for SMEs that want to retain utmost flexibility with regard to their operations. From our experience, however, most SMEs are looking for medium to long-term relationships with their business partners. Another open question in this context is the optimal size of a co-op cloud, because too few members may lead to an economically unsustainable situation, whilst too many members may render the cooperative inflexible.

Further, a cooperative cannot fulfill every special requirement of individual members. Depending on the fit of the members' requirements, it may be easier or harder (or even impossible) to find a solution that suits all members. Therefore, a co-op cloud may not be a viable solution if an enterprise has unique requirements with respect to data protection.

In our analysis, based on typical needs uncovered in our empirical study, we have focused on comparing costs for two scenarios: a setting with an established intermediary and a setting without one. This ignores the costs associated with the setup and launch of the intermediary and also the costs of forming a cooperative. The launch of a co-op cloud induces various obligations, e. g., costs for seeking out 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 and cost was not viewed as a significant issue in the findings of our empirical research (see Figure 1). 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 co-op clouds are established.

Finally, we have to highlight that cooperatives are most likely a country-specific construct, especially when it comes to its legal framework. Thus, it may not always be feasible to adapt it for a particular country. However, our solution can be considered as a reference model which suits European legislature as well as cooperatives in the USA and other Western nations. Therefore, a very large section of SME cloud users are able to benefit from a co-op cloud in principle. Some country-specific particularities will have to be respected, of course, and the cooperative governance structures have to be modeled adequately.

7 CONCLUSION AND FUTURE WORK

In this article, we have elaborated on the particular situation of SMEs in the cloud services domain and motivated the need for new governance structures with the aid of empirically founded SME cloud adoption issues. In order to address the identified issues, we have provided a 360-degree view of the concept of a hybrid cloud intermediary. This type of intermediary is particularly suited to enable SMEs to engage in cloud sourcing. Therefore, we have focused our analysis on buy-side intermediaries. Drawing on an existing framework for characterizing cybermediaries, we have detailed the value proposition and key activities of a cloud intermediary. In addition to the market-structural perspective, we have provided a proposal for specific governance structures based on the cooperative paradigm. The resulting entity is concisely named *co-op cloud*.

A hybrid cloud intermediary in general – and a co-op cloud in particular – can reduce the upfront costs associated with a cloud sourcing endeavor by significantly reducing transaction costs for the participating SMEs. A hybrid cloud intermediary thus acts as a cloud enabler for SMEs. Specifically, a cloud intermediary can support the initiation, provider selection and contract negotiation, i. e., the early phases of a cloud sourcing process. The intermediary then mainly provides domain-specific consultancy. If designed correctly, it can also address some of the prevailing trust concerns identified in our empirical study [7]. In conclusion, a co-op cloud can mitigate - to a certain degree - the lack of trust, control and certainty about legal issues as well as strengthen regional economic structures vis-à-vis global players.

Additional future research needs to be directed at investigating the current limitations identified in Section 6. On the other hand, co-operatives have proven to be highly successful in many countries and across many industries. For example, in New Zealand the largest company in terms of both revenue and employee numbers is the dairy co-operative Fonterra. Fonterra is the world's largest dairy exporter with revenue exceeding US$16 billion[17]. The co-operative structure of this company is seen as a key enabler of the significant international market penetration and resulting revenue growth it has experienced [10]. Similarly, in Germany DATEV is a co-operative body which primarily acts a technical information service provider for tax consultants and accountant and which provides relevant software to its customers. Moreover, various German banking group form co-operatives and, for example, share their data center as an intermediary for numerous IT services. Thus, the

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[17]see Fonterra Financial Statement 2014, available from http://www.fonterra.com

notion of a co-op cloud put forward in this paper could be seen as already in existence, however, the universality of this concept could still benefit from further empirical confirmation, e.g., through the channels we have already analyzed in [7].

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AUTHOR BIOGRAPHIES

Dr. Till Haselmann works as Service Level Manager for a full-service IT provider that specializes in providing IT services for utilities (gas and electricity providers) and public transportation companies. Before his move to private economy, he spent several years in academia researching the possibilities and adoption of cloud-based IT services in German businesses. The focus of his research are not only technical aspects, but also economical as well as organizational factors for successful use of cloud-based services in German businesses. Combining a sound academical background with ample experience from practice, he strives to provide meaningful insight for both practitioners and researchers alike. He received his master's and Ph.D. degrees from the Information Systems Department of the University of Muenster in Germany. He published his research in several articles and books.

Dr. Gottfried Vossen is a Professor of Computer Science in the Department of Information Systems at the University of Muenster in Germany. He is a Fellow of the German Computer Science Society and an Honorary Professor at the University of Waikato Management School in Hamilton, New Zealand. He received his master's and Ph.D. degrees as well as the German Habilitation from the Technical University of Aachen in Germany, and is the European Editor-in-Chief of Elsevier's Information Systems - An International Journal. His current research interests include conceptual as well as application-oriented challenges concerning databases, information systems, business process modeling, and Web 2.0 applications, cloud computing, and big data.

Dr. Stuart Dillon is an Associate Professor and Chairperson of the Department of Management Systems at the University of Waikato Management School in Hamilton, New Zealand. He is a member of the Professors and Heads of Information Systems New Zealand (PHISNZ). He has a PhD in Decision Science, however much of his research is in the area of electronic commerce. Past and current relevant research includes work on e-government, consumer perceptions on e-tailing, and data curation. He has published his research in academic journals such as MIS Quarterly, International Journal of Public Sector Management, and Journal of Global Information Management and is an active member of the European Center for Information Systems (ERCIS) of which the University of Waikato is the sole New Zealand institutional member.