EVACS: Economic Value Assessment of Cloud Sourcing by Small and Medium-sized Enterprises

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Abstract: While cloud computing is widely advertised as a "silver bullet" for many IT-related troubles of small and medium-sized enterprises (SMEs) because it can potentially lead to many attractive cost-savings, most enterprises struggle with creating appropriate business cases to support these claims. One major problem is that the effort – and, thus, cost – required to fairly evaluate a cloud sourcing solution is simply too high for a typical SME, partly due to the fact that even appropriate decision processes and assessment methods need to be developed. In this paper, we propose a generalized method to assess the economic value of cloud sourcing called EVACS, that facilitates the identification of valuable cloud sourcing projects for SMEs. We also present a cost-benefit framework that helps speeding up the process of building a detailed business case by outlining relevant decision factors.
Keywords: Cloud services, cloud usage, small and medium-sized enterprises (SMEs), economic value, cost and benefit analysis.

1 Introduction

"The cloud" is hailed pervasively as a silver bullet for many IT-related troubles of small and medium-sized enterprises (SMEs). While the benefits promised include access to flexible pricing and payment models, reduced administrative overhead and access to state-of-the-art technology, the principal argument for using the cloud typically is saving money. Although it is true that the cloud paradigm can offer significant cost savings to SMEs in some cases, it is unfit in others. Hence, a detailed business case is required for any cloud sourcing project in order to verify its economic benefit [Has12], as is a method to assess the economic value of cloud sourcing, which is presented in this paper.

Unfortunately, most SMEs are simply unable to evaluate all their options for cloud sourcing. 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. 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. Secondly, most SMEs cannot compare the benefits of cloud sourcing to an inhouse solution, since current costs are not quantifiable in detail; instead, there is only one big chunk of IT costs. As a result, this implies a rather 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 distill 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 this paper, we present such a filter in the form of a method we call EVACS (short for *Economic Value Assessment of Cloud Sourcing*). After providing the theoretical foundation and an overview of related literature (Sect. 2), we present our three-step approach in Sect. 3. Being an important foundation for a valid business case, we further present relevant cost-factors to consider in a cloud context (Sect. 4). We then discuss the approach critically (Sect. 5) and conclude with an outlook on future work (Sect. 6).

2 Theoretical Background and Related Work

2.1 Cloud Sourcing

The term "cloud computing" is widely used to describe a diffuse field of using 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 rectify this imprecision, we provide a concise definition (based on the definition by the US NIST [MG11]):

> *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:[1] 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, resp. The different service models represent different types of services and, in a sense, different levels of abstraction from the physical IT infrastructure.

2.2 Existing Approaches for Evaluating Cloud Sourcing Projects

In their survey of cloud computing literature from 2009, YANG AND TATE [YT09] could hardly identify any scientific publications on the business aspects for cloud sourcing users. Most work focused either on "technical" questions, such as optimal scheduling strategies for hybrid clouds [dAdCB09] or optimal service selection [ZZZ09], or on the business aspects for cloud service providers, e. g., [YVCB10], [PN09].

Since then, the number of relevant publications has significantly increased. Especially in the context of cloud infrastructure services, many authors investigate the effects of a

[1] For an in-depth discussion of these characteristics see [MG11] and [Has12].

pay-per-use pricing model, e. g., [SS10], [KHGS10], [CS11]; the majority of the analyses focus on operational costs of a cloud sourcing. However, as [KHGS10] notes, it is important to include all quantifiable effects of a cloud sourcing for the various stakeholders in a company and not constrain the analysis to mere operational expenses. Other authors try to include a time dimension into the cost analysis. For example, [Wal09] suggests a "depreciation" of processor power according to MOORE'S LAW. Similarly, cost for storage can be extrapolated based on historical developments [WBR10]. All these approaches represent valid *partial* models each capturing selected aspects of the complete problem. For a comprehensive view of the business value of a cloud sourcing endeavor, it is necessary to assemble them into a holistic method.

One attempt at assembling a comprehensive approach is described in [BNP11]. The authors try to capture the business value of a cloud sourcing in a so-called "savings index". However, due to the simple nature of the calculations, this index does not provide any significant information for business decisions.

Apart from the scientific community, many consulting companies and cloud providers offer white papers on the advantageous business effects of a migration to cloud services (e. g., [AM], [DE]) or supposedly helpful "ROI calculators" that ought to calculate the return on investment from a cloud sourcing project (e. g., the "Azure ROI Calculator"[2] or the "AppWare SaaS ROI Calculator"[3]). Despite their claims, all of these approaches are described on a very course-grained level of detail and consider too few input variables to be of any practical use.

2.3 Effects of Elasticity and Pay-per-Use Pricing Models

Strictly speaking, elasticity and pay-per-use (PPU) pricing models represent two independent aspects. Having elasticity implies that the amount of allocated resources closely matches the actual resource demand – regardless of its current extent. This helps avoiding both over-provisioning of resources (i. e., unused, paid-for resources) and under-provisioning of resources (i. e., unserved demand and forfeited chances of generating revenue). In combination with a PPU pricing model, a company pays essentially for the average utilization. This is in contrast to a fixed-capacity infrastructure, which is usually planned (and paid for) according to the expected peak demand ([AFG+10], [BNT10]).

In the cloud context, only the combination of the two aspects – elasticity and PPU pricing models – offers the characteristic benefits. Using elastic PPU services, companies are able to satisfy even times of exceptionally high demand while being able to reduce the amount of allocated resources in times of low demand. As a general rule, the larger the variation of the demand is, the more attractive is a cloud sourcing for the IT product in question [Has12]. However, this benefit depends not only on the specific IT product in question but also on various other endogenous as well as exogenous factors, so that it is impossible to specify any ranges, let alone exact figures.

[2] `http://azureroi.cloudapp.net/`
[3] `http://www.saasroi.co.uk/static/saasroi/`

2.4 The Particular Situation of SMEs

SMEs are in a situation that is considerably different from that of large companies, due to several characteristics. Important traits in this context are the lack of an IT strategy, limited financial resources, limited information skills, and often the presence of a solitary decision maker, i. e., the owner ([BLP98], [CHP+03]).

The benefits of cloud services for SMEs are rather similar to those for any other type of company ([AFG+10], [VVE09]). However, they are more pronounced for SMEs in some respects because of their characteristic features ([HV11]). The main argument for cloud sourcing usually is that it cuts costs in the enterprise; because expenditures for hardware, maintenance and human resources can be reduced and at the same time converted into smaller payments distributed over the entire usage period (e. g., [AS10], [AFG+10], [RR09], [VVE09]). Both effects are very desirable for SMEs, which are typically looking for ways to cut their IT spending. 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 a cloud sourcing include access to professionally operated data centers ([DFJK04], [MKL09], [PS01]), elasticity and short-term contracts [MG11], i. e., additional flexibility for SMEs [AS10].

Notwithstanding those benefits, SMEs also face the downsides of the cloud approach as detailed above. Compared to large companies, they do not possess adequate means to address these concerns due to their small sizes. Specifically, legal aspects and trust concerns of cloud sourcing contracts cannot be adequately investigated by SMEs. They usually do not have enough staff to investigate new technologies, either. In conclusion, cloud services are a very attractive IT outsourcing approach for SMEs, but widespread adoption is hindered by serious concerns of the enterprises.

3 The EVACS Method

As argued above, a major problem for SMEs is to decide beforehand whether it is sensible to undertake the tedious work of creating a business case for a specific cloud sourcing project. Our approach applies the well-known principle of stepwise refinement: Project ideas are analyzed in three incremental steps so that most of the eventually unattractive projects are eliminated with comparatively little effort in the first two steps. We propose three steps, as shown in Fig. 1:

1. **Sanity check:** Ensure that the cloud paradigm is in principle adequate for the problem at hand and check that typical benefits of cloud sourcing are likely to be leveraged.
2. **Preparatory analysis:** Using rules of thumb (which will be detailed below), roughly estimate the business value of a cloud sourcing project.
3. **In-depth analysis:** If a project looks promising, build a detailed business case using the guidelines on cost factors and benefits presented in this paper.

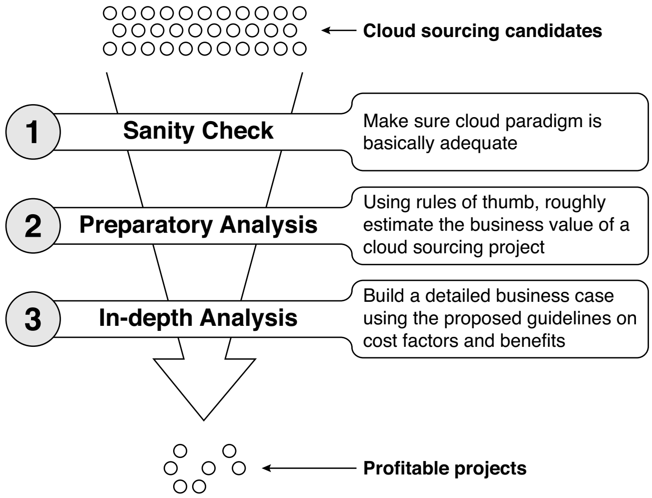

Figure 1: The three phases of the EVACS method.

In the sequel, each step is described in its own subsection. As a general assumption, we target our approach at inexperienced companies (which currently make up the vast majority of SMEs [HV11]) and exclude those with cloud sourcing experience. In addition, it seems reasonable that a company will perform the first two steps on their own, but will contact a knowledgeable IT consultancy for a detailed business case in step 3.

Phase 1: Sanity Check. Cloud sourcing can be an attractive solution, but it is hardly the silver bullet for any given IT project. Indeed, it is rather clearly delineated what types of projects are likely to benefit from the cloud paradigm and what types are not. Therefore, the first step for a company should be to look for *indicators* that promise attractive results from a cloud sourcing and *contra-indicators* signaling that a cloud sourcing is likely to be a suboptimal choice.[4]

Sample Indicators The more of the following indicators apply, the more promising a cloud sourcing is for the project in question. As a rule of thumb, at least two indicators should apply in order to justify further investigation.

The load of the IT product is subject to significant variation: Are there, for instance, periods with very high usage (spikes) or periods where there is hardly any usage? In this case, the product will most likely benefit from elasticity and pay-per-use pricing models that are available for typical cloud services.

The project possibly has a short lifespan or might need to be aborted: In contrast to a solution requiring long-term infrastructure investments, a cloud sourcing allows all resources to be deallocated and decommissioned quickly. This can be very beneficial especially for

[4]The following lists of indicators and contra-indicators are not exhaustive. SMEs are encouraged to extend them as noted in Sect. 5.

smaller companies that cannot re-purpose their IT infrastructure easily and would otherwise be burdened with unused hardware. This applies especially for one-time efforts.

The workload of the IT product can be partitioned in a "natural" way: This is a prerequisite for leveraging horizontal scalability, one of the main pillars for the elasticity of cloud services.

The data of the IT product can be partitioned in a "natural" way:[5] This is a prerequisite for leveraging a distributed cloud storage.

The last two indicators do not apply to SaaS: In that service model, those tasks are the responsibility of the elected CSP.

Sample Counter-Indicators A cloud sourcing is most likely not a good choice if any of the following contra-indicators are present:

Sensitive data involved: If either sensitive business data or sensitive "personal data" (aka personally identifying information, PII) is involved, the project should not be realized using a cloud sourcing. Especially European SMEs need to obey strict privacy regulations and, as of time of writing, these are considered not satisfied when using cloud services [VHH12].

Criticality of the project: If the project is mission-critical, a cloud sourcing is not a good choice. On the one hand, it should be questioned whether outsourcing a mission-critical project makes sense at all. On the other hand, cloud services and SaaS are still rather young and evolving so that they are most likely not a suitable choice for a mission-critical undertaking.

Lack of experience: As with the previous aspect, a cloud sourcing is not advisable if the project is planned to be a long-term strategic effort and the SME has still little experience with cloud sourcing.

Phase 2: Preparatory Analysis. When an analysis has shown that a cloud sourcing is in principle viable, an SME can use more detailed rules of thumb to investigate its attractiveness. These rules require more detailed input and, thus, usually require a finer grain for all planning associated with the project. For example, it should be clear whether an SME will source SaaS or IaaS because both models exhibit specific features. There is a vast array of conceivable rules of thumb that can be applied on various levels of detail. It is recommended that any enterprise experiment with different rules until they find a set that works particularly well for their individual situation.

For the approach as presented in this paper, we provide twenty rules of thumb as a starting point. We will not explain the rules in detail, but instead give a brief overview of the general ideas, which should suffice to understand the approach per se. The interested reader is referred to [Has12]. The proposed rules are listed in Table 1. They are structured into three groups:

1. Rules concerning the existing IT resources, such as the total number of servers or the geographic distribution of the IT: These rules are a proxy to determine – among other

[5] This indicator only applies if the IT product handles large amounts of data that are beyond the scope of a typical single-node relational database system.

aspects – the "professionalism" of an SME's IT department. The more professional and the larger an IT department is, the less beneficial are cloud services because the scale of an in-house production becomes more attractive.

2. Anticipated usage patterns for the IT resources, such as variation in system load and integration with other systems: These rules capture especially the attractiveness of elastic PPU resources for the given project.

3. Additional factors, such as the requirements on IT security and existing company knowledge: These rules capture further "soft" factors that influence the attractiveness of a cloud sourcing.

Rules are annotated with "$\langle + \rangle$" to indicate a positive correlation to the attractiveness of a cloud sourcing ("larger is better"), "$\langle - \rangle$" indicates the contrary ("smaller is better"). "$\langle \downarrow\uparrow \rangle$" indicates that a variable with nominal scale influences the attractiveness, a "$\langle ? \rangle$" marks rules with no clear influence[6].

Phase 3: In-depth Analysis. When a project proposal has passed the tests of the first two steps, it is likely but still not certain that the project is economically attractive. Therefore, a detailed business case has to be developed that considers all cost factors and possible benefits and compares them to the conceivable alternatives. In particular, the in-house alternative is often relevant, but hard to assess. This is due to the fact that in-house costs are typically not known in detail [Has12]. As a result of this and the limited expertise of typical SMEs, we expect this step to be supported by a knowledgeable IT consultancy. Due to the very specific nature of each IT project, we do not outline any particular procedure for this step. However, we give a detailed overview of the relevant costs and benefits that need to be considered in this step in the next section.

4 Relevant Cost Factors

We investigate relevant cost factors of cloud sourcing by first looking at the case where a new IT product, such as a new SaaS application, is introduced. Subsequently, we will point out additional aspects that need to be considered if an existing IT product is migrated into the cloud. We conclude this section with a consideration of positive effects on utility that may result from cloud sourcing.

4.1 Cost Factors for Introducing a New IT Product

The description of cost factors is structured according to the points in time in which the costs can occur. Fig. 2 gives an overview of the structure. In the following we explain all five categories in detail.

[6] This applies to rule no. 3, which was included to show a sample factor that does not influence the attractiveness of a cloud sourcing even though one is tempted to think so. See [Has12] for details.

Table 1: Rules of Thumb about Factors and their Basic Effects.

No.	Factor	Effect
Scope and target of existing IT resources		
1	Number of servers in a company	⟨−⟩
2	Number of users of an IT product	⟨−⟩
3	Geographic distribution of the users	⟨ ? ⟩
4	Yearly turnover generated by an IT product	⟨−⟩
5	Number of countries with IT department	⟨−⟩
Usage patterns for the IT resources in quesion		
6	Usage intensity: average demand	⟨−⟩
7	Variance of demand: peak-to-average ratio	⟨+⟩
8	Variance of demand: coefficient of variation	⟨+⟩
9	Duration and predictability of demand spikes	⟨+⟩
10	Amount of data to be processed (data in the cloud)	⟨+⟩
11	Ratio of data to processing time	⟨−⟩
12	Degree of integration with other systems	⟨−⟩
13	Horizontal scalability of the computations	⟨+⟩
Additional factors		
14	Required level of IT security	⟨−⟩
15	Efficiency of in-house IT operations	⟨−⟩
16	Degree of service orientation of an existing IT infrastructure	⟨+⟩
17	Past experiences with outsourcing of IT products	⟨+⟩
18	Elected service and delivery models	⟨↓↑⟩
19	Specificity of an IT product	⟨−⟩
20	Uncertainty associated with cloud sourcing	⟨−⟩

4.1.1 Preparatory Costs

This category comprises all costs that occur before a cloud sourcing project is started, i. e., the cost for preparing the decision on undertaking a project. As with any IT project, this category contains costs for a (coarse) planning of a future IT architecture; for analyzing and possibly transforming business processes; for conducting a feasibility analysis or a pilot study; and for documentation of these preparatory efforts.

In case of cloud sourcing, there are some specific costs that need to be considered in this phase of a project:

- Costs for preparing/updating a company's *cloud strategy*
- Significant search and information costs for market analysis as well as for finding eligible providers and suitable cloud integration and monitoring solutions
- Costs for transforming business processes so that they are "compatible to the cloud paradigm", which is typically a long-term, expensive effort [BNP11]

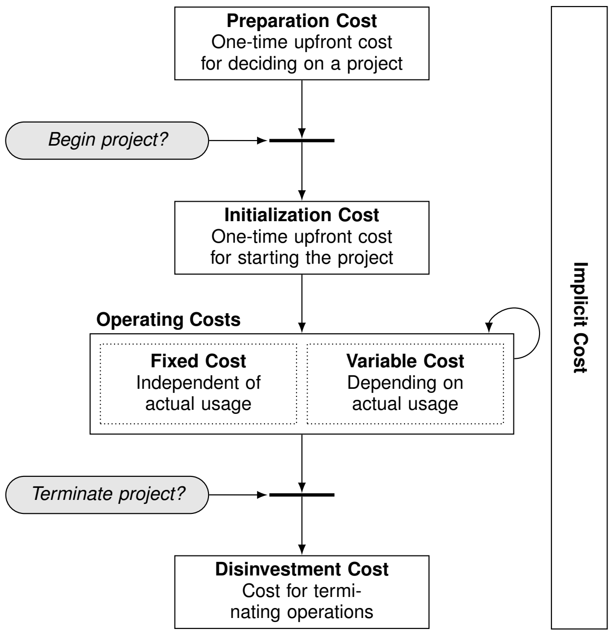

Figure 2: Different points in time at which different types of costs can occur in a cloud sourcing project.

4.1.2 Initialization Costs

This category comprises all costs that occur when a cloud sourcing project is actually started (and which can be avoided by not undertaking the project). Typically, these are costs for more detailed planning, contract negotiation, training, tests and documentation as well as possibly investments in new hardware or software. For a cloud-sourcing, these also include expenses for extending the net and IT infrastructure of a company to cope with new requirements. This means, e. g., buying a new firewall, intrusion detection system (IDS), intrusion prevention system (IPS) or new VPN routers, or upgrading existing server rooms or data centers with regard to disaster recovery and business continuity. In this context, costs for the integration of a cloud solution into an existing IT landscape either by resorting to a cloud integration platform or by developing a custom integration layer are also significant.

4.1.3 Operating Costs

This category subsumes all costs that occur during the productive use of a cloud solution. They can be further distinguished as *fixed cost*, i. e., costs that are invariant with regard to the actual usage of the cloud solution,[7] and *variable cost*, i. e., costs that vary directly with

[7]This is not a sharp distinction: When the temporal unit of analysis is chosen large enough, all fixed costs will at some point become variable.

the actual usage.

Variable costs mainly consist of PPU fees for the cloud services or SaaS, bandwidth fees and possibly PPU fees for cloud integration platforms or supporting software. Whilst there are only few categories of variable costs, their aggregated amount will typically be one of the most significant factors when using a cloud solution.

In contrast, the list of various types of fixed cost is longer. Apart from non-PPU usage fees (e. g., classic license fees), there are maintenance cost for the upkeep of operations (including software updates, hardware upgrades, maintenance contracts etc.); prorated cost for IT infrastructure and server rooms or data centers (including depreciation, cooling, power); as well as cost for data management and data integration. All these fixed costs are highly dependent on the chosen sourcing model. For instance, in a SaaS scenario, the first two categories (maintenance and infrastructure costs) are typically negligible. When sourcing cloud services, however, these categories are usually a significant factor to consider.

Other types of fixed cost that should be considered, even though they are probably of less significance than the aforementioned are: bandwidth costs that cannot be attributed directly to an IT product; prorated depreciation of facilities, hardware and software; costs for data, system and service management; cost for training; costs for planning; costs for analyzing, optimizing and executing processes; costs for service desk and end-user support; costs for cloud controlling, e. g., by a "Chief Cloud Officer (CCO)" [VHH12]; "indirect costs" from the TCO paradigm, such as down-times, informal peer support, development of personal utilities (e. g., macros or scripts).

4.1.4 Disinvestment Costs

When a cloud sourcing is to be terminated, additional costs will probably occur for shutting down the system in an orderly manner. All cost related to this are called disinvestment costs. They consist mainly of costs for retrieving data from the cloud, checking it, transforming it into a standardized data format and archiving it; of costs for long-term archiving of data; of bandwidth costs and provider charges for retrieving data; and of depreciation of now redundant hardware and software.

4.2 Additional Costs for Migrating Existing IT Products

So far, the analysis has assumed the introduction of a new IT product. In case an existing product is migrated into a cloud solution, there are four additional challenges that need to be faced.

4.2.1 Reengineering of existing systems

Existing systems need to be reengineered to make use of the cloud paradigm ("Cloudification"), e. g., they need to be optimized to take advantage of elasticity and scalable data storage, be converted to a service-oriented paradigm and be updated to support modern interfaces and technologies, such as AJAX, REST or XML.

4.2.2 Migration of existing data

Existing data needs to be migrated "into the Cloud", which can be trivial or highly complex. CSPs may provide help with batch import and data transformation. In any case, both staff and bandwidth costs need to be considered.

4.2.3 Integration of non-cloud systems

Existing in-house systems, including legacy systems, need to be integrated in the new IT architecture. A key area for problems in this context is data integration and data transfer between the various systems, both of which require thorough planning and may significantly increase the expenses for bandwidth.

4.2.4 Redundant operation of systems

Systems need to be operated redundantly, at least for mission-critical systems. Typically, an incremental migration is advisable (instead of a "Big Bang" approach) so that parallel operation of two systems is required for the migration phase. Also, it can be a good idea to have a local system as emergency fallback in case of unexpected problems with the cloud solution.

It has to be noted that migration costs are generally one-time initialization costs, which quickly decrease in the course of a project. Therefore it is necessary to choose the planning horizon appropriately because this choice influences the attractiveness of a migration.

4.3 Positive Effects on Utility to be Considered

Apart from a purely cost-based perspective, a cloud solution can be seen as an opportunity for additional *intangible value* in the enterprise. This value can stem from one of several aspects, which are depicted in Table 2.

Whilst these effects seem plausible, it is questionable whether an SME can actually realize any *tangible* effects. Their actual impact depends on the possibility of an SME to convert them into objective business effects, such as higher market share, reduced staff cost or less IT spending. This, in turn, depends on existing processes, personal capabilities of an SME's management, the degree of automation of the IT function and the general versatility of the enterprise. In addition, exogenous factors, such as market and competitors, can play a significant role. All things considered, an enterprise is less likely to profit from these intangible benefits if industry best-practices are already in place [BNP11].

Table 2: Intangible Benefits from a Cloud Sourcing.

Benefit	Effect
Higher flexibility or "business agility"	Innovative ideas and new business models can be implemented easier and faster; existing processes are re-usable thanks to the service-oriented paradigm
Better scalability from a technical point of view	Systems can cope with short-term variations in load; can grow/shrink easily with mid-term/long-term trends
Potentially shorter time-to-market	Faster break-even of new business ideas (due to the above effects)
Potentially higher customer satisfaction	More reliable, more powerful cloud infrastructure reduces waiting times and down times; higher performance improves customer experience
Potential cost-savings or improvements for disaster prevention and disaster recovery	Cloud data centers have higher standards than proprietary server rooms or data centers
Potentially reduced indirect cost	Less down times, less waiting times due to higher service levels of cloud solution

5 Discussion & Limitations

We do not see the EVACS method proposed in this paper as a replacement for existing methods, such as return on investment (ROI), net present value (NPV), or total cost of ownership (TCO). Instead, it complements these methods by providing two additional preparatory steps. The first two EVACS phases can filter out many cloud sourcing candidates with comparatively little effort that would be rejected anyway – but only after building a thorough business case for each of them. For the third EVACS phase, we actually recommend using a variety of proven methods for assessing IT outsourcing projects so that their business cases indeed reflect reality. The main advantage of using EVACS lies in the fact that our indicators and rules of thumb accelerate and facilitate decisions on cloud sourcing projects for inexperienced enterprises.

While we are convinced that our lists of indicators and rules of thumb are useful for SMEs evaluating a cloud sourcing, the lists are neither complete nor compulsory. In fact, we encourage SMEs to extend or adjust the lists to suit their needs because different factors may be more relevant for a particular enterprise. Furthermore, while all items were derived from scientific literature, they have not yet been tested empirically. However, the underlying studies are usually supported by empirical results.

6 Conclusion

In this paper we have presented a framework approach for SMEs to analyze the attractiveness of a cloud sourcing. The approach is named *Economic Value Assessment of Cloud Sourcing* (EVACS). It consists of three steps which incrementally refine the level of detail and provide helpful rules of thumb for determining attractive cloud sourcing projects easily. The suggested sets of rules are meant as a basis for further elaboration, so that an SME can fine-tune the filtering steps to its particular situation. As noted in the limitations, a next step will be the empirical verification of the rules. Still, we are convinced that many SMEs can already benefit from the presented approach.

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