# Cloud Strategies for Software Providers: Strategic Choices for SMEs in the Context of the Cloud Platform Landscape

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Abstract: Within this paper, the fundamental question of the hosting challenge for software providers starting with the cloud business, becoming Software-as-a-Service (SaaS) providers, is discussed. Selecting a hosting provider and consuming Infrastructure-as-a-Service (IaaS) is a common and viable solution. Some cooperation-based strategic choices are presented as alternative solutions and compared to the more common approaches. These can hold great potential, especially for Small and Medium-sized Enterprises (SME) when applied meaningfully. For that, the relevant terms Platform-as-a-Service (PaaS) and Cloud Ecosystem are discussed, differentiated and defined with regards to existing definitions and their ambiguities. Following, the outset and challenges are described focussing on the case of SME providers. Last but not least, different strategic choices are presented with their advantages, disadvantages and challenges. These choices are presented in an overview matrix roughly weighted with relative responsibilities as well as ecological and strategic aspects.



## 1 INTRODUCTION

Cloud Computing has the potential to transform capital expenditure to operational expenditure and facilitates flexibility in developing. It may allow a stronger focus on the core competences and can create value relevant for competitiveness and corporate growth (Mitra et al., 2018). Whereas the advantages of cloud computing involve huge potentials, there is also a shift in the challenges and IT related tasks for the enterprises accompanied. Challenges arise especially in the business process management and on the technical side in the areas of IT security, data migration, interface definition, customizing, and mobile application development (Nieuwenhuis et al., 2018). It is also considered as a value adding (trend) technology transforming value chains to complex value ecosystems (Rafique et al., 2012).

With an enterprise adoption of over 90 percent (RightScale, 2018) even for public clouds, Cloud Computing has exceeded the trend technology status and has become a fundamental part of the technology landscape for many enterprises, the everyday life and work processes. Even in more cautious countries such as Germany, the public cloud adoption has drastically increased from roughly six percent in 2011 (Pierre Audoin Consultants, 2012) to 29 percent in 2016 (KPMG AG Wirtschaftsprüfungsgesellschaft and Bitkom Research GmbH, 2017).

There is plenty of literature about the challenges, advantages and potentials of the use of cloud computing for consumers. In addition to the beforementioned references, Marston et al. list entry cost for compute-intensive business analytics, almost immediate access to hardware resources, lowering of IT barriers to innovation, service scaling for enterprises and enabling of new applications as the five main advantages of cloud computing (Marston et al., 2011). On the other hand, Avram lists security and privacy, connectivity and open access, reliability, interoperability, economic value, changes in the IT organisation and political issues due to global boundaries as barriers (Avram, 2014). In contrast, publications making the strategic view of cloud software providers the subject of discussion, are rare to find. The trend of switching offerings from on-premises solutions to web-based cloud solutions with a focus on pricing models and advertisements in that context as well as the impact on users and the pricing models is evaluated in (Jhang-Li and Chiang, 2015).

In (Carvalho et al., 2017), capacity planning for Infrastructure-as-a-Service (IaaS) provider respecting



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service level agreements is evaluated. In addition, a planning method is proposed for optimising the CPU utilisation.

Regarding the strategic view, in (Wang and He, 2014) SMEs in Taiwan were investigated with the focus on late entrants to the cloud service provider market. Main challenges with a focus on business models are discussed and strategy alternatives are summarised in a strategy matrix to bolster the competitiveness of SME cloud service providers.

Strategic alliances for the case of SMEs are discussed in (O'Dwyer and Gilmore, 2018). The significance, especially for expanding capabilities and value optimisation is emphasized in addition to the strong customer focus of SMEs. The research is focused on the success of alliances and longevity, especially by providing help for partner selection.

When talking about SMEs in this paper, the definition of the European Commission meant, i.e. a staff less than 250, the turnover less or equal to 50 million euros and the balance sheet less or equal to 43 million euros (European Commission, 2005).

## 2 THE CLOUD PLATFORM LANDSCAPE

This section provides an overview over the relevant platform types and terms, highlights ambiguities and gives a suggestion for the terminology.

The terms Platform as well as Platform-as-a-Service (PaaS) are used in many different contexts with several definitions. The ambiguities even persist when only talking about cloud Platforms. For some authors, PaaS refers to cloud based integrated development environments (IDE) such as in (Lawton, 2008). PaaS is also defined and used as managed IaaS which is the case in (Jadeja and Modi, 2012). For the PaaS definition, some others include middleware services such as billing, authentication and authorisation (Boniface et al., 2010). This also matches the definition of the National Institute of Standards and Technology (NIST) (Mell and Grance, 2011). Even in the cloud context, PaaS is not always referred to as a cloud service model including cloud technologies, but also supporting technologies such as in (Li et al., 2017). In this case, PaaS is used as a synonym for a DevOps environment.

Detached from the as-a-Service, the term (cloud) Platform is also often used for any kind of PaaS. It is also used for cloud infrastructure and therefore also in combination with or synonym for IaaS such as in (Han, 2013). Last but not least, Platform refers to all kinds of cloud marketplaces. These marketplaces may or may not include any kind of PaaS such as in (ComputeNext Team, 2016). An overview over the identified differences and ambiguities of the explicit definitions can be seen in Figure 1. The characteristics are described in the following:

- **IaaS directly sold** means, that infrastructure such as storage, network or computation power is one of the main components sold.
- **IaaS implicitly sold** means, that infrastructure as mentioned above, is a part which is used by the service sold, but not the main component.
- **Developer Tools and environment** covers fully integrated IDEs as well as Application Programming Interfaces (APIs) and other tools bolstering the development and deployment process.
- **Middleware Services** in this context are as described above, more complex software tools and services such as invoice and billing systems. Such middleware services reduce the required efforts to provide a sound SaaS solution enabling a focus on the core features of the solution.

When writing about PaaS in this paper, a cloud based developing and deployment environment with infrastructure included is meant. To differentiate, the term Basic PaaS is used for a variant which does not include more complex middleware such as services for billing, authentication or single sign on. In addition, Extended PaaS is used when more complex middleware as mentioned before is included. An overview over the responsibilities for the operation and providing of the most central components of cloud services can be seen in Figure 2.

When taking a more holistic view, the term Cloud Ecosystem becomes relevant. A cloud ecosystem can be defined as a complex system of interdependent components that all work together to enable cloud services (Rouse et al., 2018). Sometimes the term Cloud Ecosystem is used for spanning everything related to cloud computing as one big ecosystem such as in (Marinescu, 2018). In this paper, the first definition is used with a Platform, provider or a solution as the center of the Cloud Ecosystem. In addition, every related physical component as well as every stakeholder and their connections are parts of the ecosystem. Cloud providers can purposeful cultivate their ecosystem to add value for the stakeholders and especially their customers. For example, this can be done by maintaining communities, events and information exchange such as best practises between the stakeholders.

| Usage / Characteristics | PaaS as Cloud IDE | PaaS as managed IaaS | PaaS with Middleware | PaaS as DevOps |
|---|---|---|---|---|
| Source | (Lawton, 2008) | (Jadeja and Modi, 2012) | (Boniface et al., 2010) and (Mell and Grance, 2011) | (Li et al., 2017) |
| IaaS directly sold | | ✓ | ✓ | |
| IaaS implicitly sold | ✓ | ✓ | ✓ | |
| Developer Tools and Environment | ✓ | ✓ | ✓ | ✓ |
| Middleware Services | | | ✓ | |

Figure 1: Overview over the differentiation of diverse usages of the term PaaS.

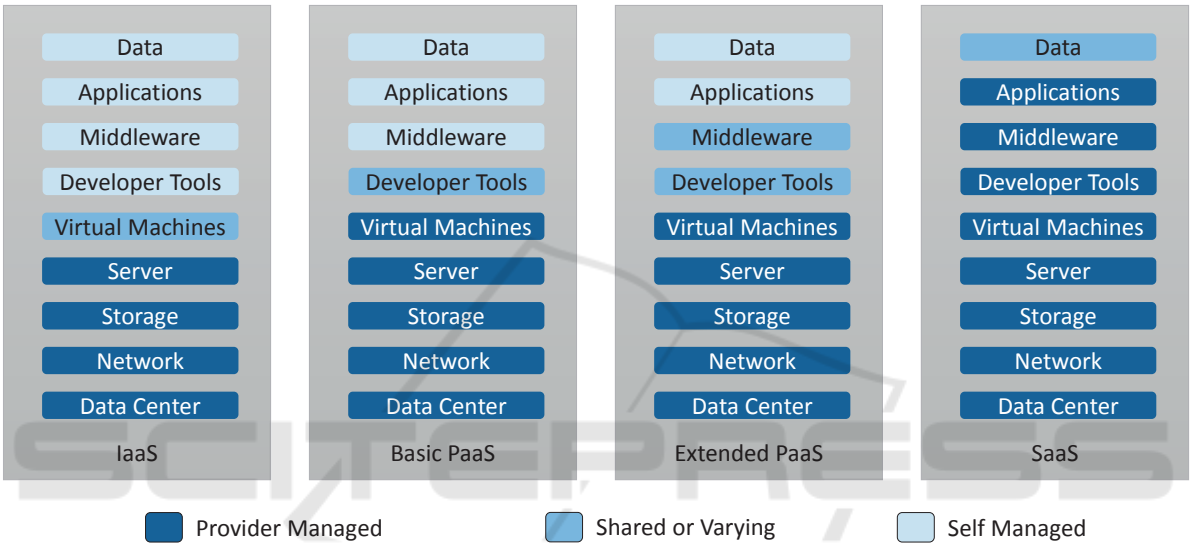


Figure 2: Suggestions for the PaaS differentiation and usage in the context of other cloud service models in a graphical representation adapted from Gartner (Cancila et al., 2016).

# 3 OUTSET AND CLOUD RELATED CHALLENGES

## 3.1 Overview and Challenges

The cloud adoption has drastically increased over the last years. Most recent surveys show that a majority of enterprises is using cloud computing. A survey of RightScale in January 2018 is pointing out, that 92 percent of the enterprises are using public clouds. This increases to 96 percent when private clouds are included (RightScale, 2018). In contrast to the high adoption and acceptance, there is still much potential for cloud solutions left. According to Capgemini, the share of used IT-systems was only 10.2 percent for public clouds and 36.6 percent for private clouds (Scheid et al., 2017), making the offering of cloud solutions a reasonable and maybe even required decision for software providers.

Following the cloud definition of the National Institute of Standards and Technology (NIST), two of the essential characteristics of cloud computing are on-demand self-service and rapid elasticity (Mell and Grance, 2011). The first means that a consumer can get the services and their resources without human interaction. The latter stands for the availability of practically unlimited resources for the consumers.

When established providers of conventional software start offering Software-as-a-Service (SaaS), many important decisions have to be made in order to handle the above mentioned two characteristics. Especially for SME the choices are often crucial due to limited resources and expertise, in particular when it comes to the data centre maintenance and tasks. Some of the main challenges regarding this crucial area are:

- **Rapid Elasticity:** to guarantee the practically unlimited amount of resources, huge reserves of hardware are necessary
- **Reliability:** a standard requirement for prevent-

ing data loss and to ensure high availability of service for cloud computing is to maintain geographically separated redundancies resulting in even higher investment costs.

- **Security:** Compared to dedicated servers, data centres need professional business operation because of the multi-tenancy requirements.

The most common solution for the data centre problem is consuming IaaS, Basic PaaS or Extended PaaS from a data centre provider. In the role of a consumer of cloud services, SaaS-provider have to carefully choose the data centre provider. Some of the main challenges and criteria are listed and described in the following:

- **Vendor-Lock-in:** Depending on the needs of the SaaS-provider as well as the modality of the data centre resource provision, data formats and Service Level Agreements (SLA), there is a risk of strong dependencies from the data centre provider.
- **Hosting Location:** The geographical locations of the data centres of the provider. The relevance comes from performance when providing real time services as well as huge amounts of data, the applicable law and customer needs and preferences.
- **Customer Contact:** Some of the more complex solutions, especially the Extended PaaS Solutions sometimes offer or automatically include a sales channel. This can be a great advantage for finding new customers, but usually also includes a share of the revenue as additional fees and should therefore be considered carefully.

Depending on the end-consumer needs, some of these criteria might be of less importance. As an example, the hosting location might be subordinated to the other criteria depending on the country and the field of application. In some countries, such as Germany, it is often required, that the hosting location is in the same country or at least in the same continent due to legal reasons or customer demands. If the application itself has no crucial contents such as personal or medical data to handle, the mentality of the end-consumers often demands proximity of the data centres. To be convinced of a cloud provider or solution, the trustworthiness, especially when subcontractors are involved has to be backed for some customers, e.g. by certificates. Depending on the legal area, certificates might even be mandatory or at least necessary to prevent legal liability for the services of the data centre provider.

### 3.2 Business Sector Differences

A lot of surveys and papers investigate the cloud adoption and the impact of cloud usage to the performance of enterprises. Many of these surveys provide an overview of enterprises without a specific focus of the business section or application field such as (RightScale, 2018) or (Scheid et al., 2017). Some others take the business section into account, usually discovering notable differences such as (Pierre Audoin Consultants, 2012). Regarding to the cloud adoption, enterprises of the information and communications technology (ICT) business section are generally more advanced than enterprises from the retail or manufacturing section, whereby the retail section is outpacing the manufacturing section. Regarding the core competences, manufacturing enterprises are more advanced in using and planning with cloud solutions such as big data analytics and industry 4.0 (Falkner et al., 2018).

Accodring to (ClearTechnologies, 2018), choosing the right cloud solution is a tough decision and there are endless numbers of solutions. ClearTechnology also states that industry specialisation should be considered while searching the right solutions. With the varying requirements in mind, cloud Platform provider can add value by maintaining business sector focus on the Platform level, e.g. by providing search/categorisation support and clear separations as well as maintaining communities.

## 4 STRATEGIC CHOICES AND POTENTIALS

Instead of just using IaaS or basic PaaS from a data centre provider, there are different alternatives Software providers without own data centres when becoming SaaS providers. Two such alternatives are presented in the following, namely integration to extended PaaS or ecosystems and strategic cooperation.

### 4.1 Platform Integration

When choosing Extended PaaS or even an ecosystem including Extended PaaS, many of the technical and organisational challenges can be solved by the Platform provider. This usually comes at the cost of higher integration expenditures and therefore an increased vendor-lock-in. The following characteristics of Extended PaaS may be considered for the selection of a provider. The focus is on strategic components and fundamental characteristics such as service level

agreements (SLAs), costs, certifications and vendor lock-in:

- **Strong Ecosystem:** A strong and cultivated ecosystem with the Platform as the center and a strong community and knowledge transfer system build around it can be of great value for customers, e.g. by providing best practises and use cases to them. In addition, it can be an environment for finding strategic partners, gaining an overview over the market or knowledge exchange.
- **Middleware Extent:** Middleware services exceeding the necessary extent can save much effort when developing and providing cloud services. Common examples for such middleware in the context of extended PaaS range from common services such as billing, support assistance (e.g. ticket systems), single sign on, user management and monitoring to more specific ones such as device management or integration by standards and interfaces.
- **Existence of a Marketplace Component:** Some PaaS ecosystems also contain a marketplace as a sales channel for their customers. Usually, a share of the revenue has to be paid to the Platform in exchange for the marketing gained.
- **Business Sector Focus:** Especially for marketplaces, but not restricted to them, business sector focus can be of relevance. When containing many different solutions a selection and search taking the business sectors into account can be of value. In addition, the provided middleware can have a business sector focus by providing specific services such as device and sensor management for the Internet of Things (IoT) or manufacturing in the context of Industry 4.0.
- **Focus on Customer Needs:** Depending on the business sector or generally the customer group, the Platform may be designed for the needs of the customers or even contain interactive parts to achieve this such as crowd sourcing.

While having huge potential of saving efforts, some of the characteristics or services can also turn a drawback, e.g. when they rise the overall costs of the extended PaaS solution for enterprises which do not need them because of already existing own solutions.

## 4.2 Strategic Cooperation

As an alternative to consume IaaS or Basic/Extended PaaS for SaaS market entrants in the customer role, another possibility for them is to find partners for strategic cooperation. Two different ways of such strategic cooperation, namely joint ventures and SaaS cooperation are described in the following.

### 4.2.1 Joint Ventures: New Product

When the establishment of own data centres is not feasible for one enterprise, it may be in a joint venture. On the one hand, usually many organisational, legal and technical challenges have to be faced. On the other hand, the advantages include independency, needs-based design and in the long term potentially lesser costs or a resulting Extended PaaS which can be offered as a standalone service yielding revenue itself. An example for a strategic cooperation with a business sector focus as mentioned in the previous section is ADAMOS (ADAptive Manufacturing Open Solutions). ADAMOS is a strategic alliance and joint venture of several enterprises creating solutions for Industry 4.0 and the Industrial Internet of Things (IIoT) with the two main focuses of 1. IIoT-Plattform and 2. App Factory (ADAMOS GmbH, 2017).

### 4.2.2 SaaS Cooperation: Bundle Offers

Another alternative is a strategic cooperation of two or more enterprises, where at least one can provide the infrastructure or Platform environment. In this case, there are also organisational, legal and technical challenges to be faced, but without the foundation of a new enterprise. This might increase the legal but also reduce the technical expenditure. The different enterprises have no customer relationship in between them but are strategic partners offering one or more solution bundles and have their shares and responsibilities for the offered solutions.

## 4.3 Overview and Distinction

An overview over the choices and alternatives with a rough classification of technical responsibilities and ecological ratings can be seen in Figure 3. The overview has the perspective of software providers starting with the SaaS business, i.e. providers without own cloud-ready data centres. Responsibilities for the main technical challenges are listed in the upper part of the table. Ecological and strategic aspects are listed in the lower half focusing on resource invest and risk. The alternatives are described in the following:

- **Do it Yourself:** This alternative means building and maintaining cloud-ready data centres and caring for all technical challenges. Therefore there is no vendor lock-in, but the investment is high as well as the implementation overhead. There are

High Costs or Complexity of own Solution → High Complexity of the Network / Cooperation

| | Challenge \ Approach | Classic Approaches | | | Strategic Cooperations | |
|---|---|---|---|---|---|---|
| | | Do it Yourself | Consume IaaS or Basic PaaS | Consuming Extended PaaS | Cooperation by Contracts: Bundle Offerings | Cooperation: Joint Venture (new Product) |
| Technical | Rapid Elasticity | Self | Provider | Provider | Partner | Shared |
| | Reliability | Self | Provider | Provider | Partner | Partner |
| | Security | Self | Provider | Provider | Partner | Partner |
| | Hosting Location | Self | Provider | Provider | Partner | Shared |
| | Middleware Implementation | Self | Self | Provider | Partner | Partner |
| Ecologic / Strategic | Vendor Lock-in Risk | - | Medium | High | High | High |
| | Investment Amount | High | Medium | Small | Medium | High |
| | Implementation Overhead | High | Medium | Small | Small | Small |
| | Organisational Overhead | Medium | Small | Small | Medium | High |

Figure 3: Strategic choices from the perspective of software providers in the role of entrants to the SaaS market without own data centres: the complexity, technical responsibilities and ecological/strategic ratings in a rough overview. Responsibilities are illustrated in blue with darker colours meaning more responsibility for the software provider. Ecological and strategic values are illustrated in brown whereat darker colour means higher expenditure or risk for the software provider.

also many organisational challenges to solve, but limited to one enterprise and its processes.

- **Consume IaaS or Basic PaaS:** The challenges related to the infrastructure are the responsibility of the provider, but the middleware has to be implemented. There is a medium vendor lock-in risk due to customer contracts, the stored data and the system or API from the vendor. There is medium investment necessary due to the missing middleware which has to be bought or integrated. Since most crucial parts are the responsibility of the IaaS or Basic PaaS provider, there is only a relative small amount of organisational overhead.
- **Consuming Extended PaaS:** In addition to the infrastructure, also (most of) the middleware is bought as part of the Extended PaaS, leaving the technical challenges to the Extended PaaS provider. With this, many processes of the enterprises rely on the Extended PaaS provider, resulting in a hight vendor lock-in. The investment is small, since the costs are mainly operational and there is no huge implementation or organisation overhead.
- **Cooperation by Contracts: Bundle Offerings:** SaaS is offered by more than one enterprise in a partnership. Instead of a IaaS or PaaS provider, a strategic partner takes care of the technical challenges. Since there is at least one partner offering the SaaS bundle, the vendor lock-in (partner) usually is high. The medium investment comes from the adaptations with the partners and creating the necessary contracts. Whereas no hosting related implementation has to be done, the medium organisational overhead also comes from the partnership and bundle adaptations, especially the set-up of joint business processes.
- **Cooperation: Joint Venture (new Product):** A new enterprise is founded with joint resources and know-how. The challenges related to the infrastructure are initially solved by the resources of the founding partners. Rapid Elasticity and Hosting location are directly related to the resources of the founding partner, especially the investment amount. Whereas the infrastructure related implementation overhead is small for the software provider, vendor lock-in (partner), the investment amount and the organisational overhead are high.

At first glance, except for the implementation overhead, cooperation performs poorly in comparison with huge expenditure and high risk. But cooperation also comes with additional degrees of independence, since it is not a consumer relationship, but a partnership instead. Especially for the case of a joint venture, the solution can be needs-based to the own solution and there can be revenue from selling the Extended PaaS as a standalone solution bolstering the attractiveness from the ecological perspective.

## 5 CONCLUSIONS AND FUTURE WORK

The areas of Cloud Computing and Software-as-a-Service are still in motion. Some ambiguities

exist for the terminology, especially for the terms Platform and Platform-as-a-Service, where this paper has given an overview over the usage and suggested a differentiation by listing and describing common Platform characteristics with a mapping to the several existing definitions. In addition to that, strategic obstacles arise when starting as a cloud service provider. An overview over the outset and challenges was given, focusing on the core challenge of the hosting problem which arises when providing real cloud services regarding to rapid elasticity and on-demand-self-service. Some additional aspects such as possible business sector focus and the corresponding relevance were also discussed. Regarding possible solutions, joint ventures and contract-based cooperation are presented in the context of more familiar approaches such as consuming infrastructure from a data centre provider examining the advantages and disadvantages. For these alternatives, a rough overview over the responsibilities and resources is given.

Whereat this paper is focused on giving an overview and understanding the basics of strategic decisions for entrants to the SaaS market, future research could be more detailed investigations of the strategic sub-challenges and grant specific recommendations for action or decision-making aids. Especially for cooperation contracts many questions remain open such as legal responsibilities, shares and best practises. Also statistics to give more precise information about the necessary resources required for cooperation would add value to the topic of strategic alliances.

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