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## Major drivers for the rising dominance of the hyperscalers in the infrastructure as a service market segment

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**Abstract:** The rapidly growing worldwide market for infrastructure as a service (IaaS) is increasingly dominated by four hyperscalers. On the flip side, the market share and number of regional IaaS providers have been declining steadily over the past years. Astonishingly, this fight for market shares has been largely neglected by the research community. The goal of this study is to identify the major drivers for this market development. To this end, 18 exploratory expert interviews were conducted with high-ranking employees of various successful regional IaaS providers in Germany. The results indicate that the central driver is the significant lower price of the hyperscalers' offerings. Beyond that, eight additional important drivers have been identified. This study sheds light on the IaaS market and opens up future in-depth investigations. Regional IaaS providers can use these insights to develop strategies and business models for counteracting or at least decelerating the hyperscalers' growing dominance.

**Keywords:** cloud computing; infrastructure as a service; IaaS; business models; hyperscalers; regional IaaS providers; exploratory expert interviews; theory for explaining.

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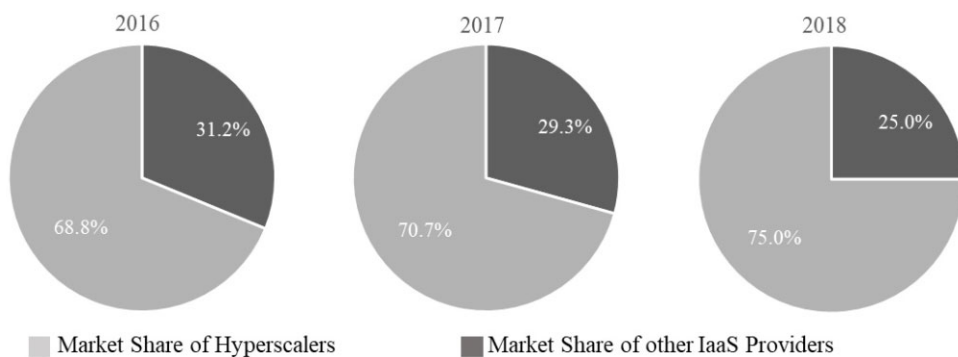
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## 1 Introduction

Infrastructure as a service (IaaS) is the fastest-growing cloud computing market segment worldwide. Gartner expects a market volume of around 74 billion USD in 2022, over a doubling compared to 2018 (Costello and Rimol, 2019). However, at the same time, it is the cloud service model with the least research attention from a business perspective (Floerecke and Lehner, 2018b). The small amount of research is surprising because the composition of the IaaS market is unique compared to the platform as a service (PaaS) and software as a service (SaaS) market: it has long been dominated by the four globally acting hyperscalers – Alibaba, Amazon Web Services (AWS), Google and Microsoft (Costello and Goasduff, 2019). In 2018, the hyperscalers' global market share was 75%, with increasing tendency (Figure 1) (Statista, 2019).

**Figure 1** Development of global market shares in the IaaS market segment between 2016 and 2018



Source: Statista (2019)

The remainder of the IaaS market consists of some large international, e.g., IBM and Oracle, and national IT companies, e.g., Bechtle and Deutsche Telekom in Germany, and a large number of small and medium-sized providers (Floerecke and Lehner, 2019a; ISG, 2018). The small and medium-sized IaaS providers commonly limit their offerings to one

country, one region within a country or even only one city (Floerecke and Lehner, 2018a). Particularly for this provider category it has increasingly become difficult to keep pace with the hyperscalers. This is reflected by a declining market share and number over the past years (Floerecke and Lehner, 2019b), despite the tremendous growth of the overall IaaS market (Costello and Goasduff, 2019).

While the cloud computing-specific literature on success-driving business model characteristics has generally grown over the recent years (Floerecke, 2018; Floerecke and Lehner, 2018a; Labes et al., 2015, 2017; Trenz et al., 2019), the specific competition between regional IaaS providers and the hyperscalers has been, with very few exceptions, neglected by the research community. Floerecke and Lehner (2018a, 2019a) identified in their exploratory studies several business model characteristics for regional IaaS providers for a successful differentiation from the hyperscalers. Beyond that, Floerecke and Lehner (2019b) revealed and analysed the dominant business model patterns of regional IaaS providers in Germany and compared them regarding the prospects for their long-term survival. However, very little is known about the key drivers causing the continuously growing gap between regional IaaS providers and hyperscalers. Aiming to reduce this gap, this paper addresses the following research question: *What are the major drivers for the ongoing growing market concentration among the hyperscalers in the IaaS segment?*

To answer this research question, 18 exploratory expert interviews are conducted with high-level representatives of regional IaaS providers in Germany. The perspective of regional IaaS providers is chosen as these are directly affected by the substantial market consolidation, whereby they are best placed to assess the past, current and possibly future market situation. To increase the validity of study's results, only experts from cloud providers are considered that have recorded profitable revenue growth over the past years, despite the precarious market situation.

The rest of the paper is structured as follows: Section 2 presents the background and related work regarding cloud computing in general, the development of the IaaS market segment and the battle between hyperscalers and regional IaaS providers. In the third section, the research design – the exploratory expert interview approach – is justified and described in detail. The identified major drivers for the increasing dominance of the hyperscalers in the IaaS market segment are presented in Section 4 and discussed in Section 5. In addition, the competition among regional IaaS providers themselves and general strengths of regional IaaS providers in the battle with the hyperscalers are analysed and discussed. Section 6 concludes with a brief summary, contributions to research and practice, limitations and an outlook on future research.

## 2 Background and related work

### 2.1 Cloud computing

Scholars proposed numerous differing definitions of the term cloud computing since its market introduction by the IT giants Amazon and Microsoft in 2006, some of them with focus on business and others on technical aspects (Madhavaiah et al., 2012). Meanwhile, the rather technically orientated definition by the National Institute of Standards and Technology (NIST) has become the standard both in science and practice. According to their definition, “[c]loud computing is a model for enabling ubiquitous, convenient,

on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction” (Mell and Grance, 2011). Three fundamental cloud service models are distinguished: IaaS, PaaS and SaaS. IaaS supplies infrastructural resources (CPU, storage and network). PaaS facilitates the development and deployment of applications based on a software development environment with programming languages, libraries and tools. SaaS refers to direct usable software applications. These three cloud service models form layers that are interrelated and build upon each other (Armbrust et al., 2010; Mell and Grance, 2011). At each service layer, cloud services can be delivered via four main deployment models (public, private, hybrid and community). A deployment model defines where an application and data is stored and how customers can interact with them (Marston et al., 2011). Cloud services possess, by definition, specific characteristics that distinguish them from traditional on-premise IT solutions. These key characteristics are broad network access, on-demand self-service, rapid elasticity, resource pooling and service measurement (Zhang et al., 2010).

Instead of describing cloud computing relatively coarsely and technically oriented by distinguishing IaaS, PaaS and SaaS, a more fine-granular and business-oriented way of structuring cloud service offerings are role-based descriptions of the whole cloud computing ecosystem. In a role-based ecosystem model, an organisation can implement one or more of the roles at the same time (Floerecke and Lehner, 2016). Floerecke et al. (2020) have shown that there are many further activities and roles beyond IaaS, PaaS and SaaS, including aggregators, integrators, managed service providers and marketplace operators, and that the actual cloud computing business takes place in role clusters. A comprehensive model is the Passau cloud computing ecosystem (PaCE) model (Floerecke et al., 2020), which was developed based on a systematic analysis and synthesis of previously published models and evaluated regarding its structural equivalence and completeness according to the real cloud business by a quantitative cross-sectional analysis. It comprises 31 roles for market actors, which are grouped into five categories (client, vendor, hybrid role, support and environment), and the relationships between the roles.

## *2.2 Development of the IaaS market segment*

Cloud computing has been experiencing a boom for the last years. According to a current study by Gartner (Costello and Rimol, 2019), the worldwide cloud market is projected to grow from 227.8 billion USD in 2019 by 17% to 266.4 billion USD in 2020. Concerning the three cloud service models, SaaS will remain the largest segment at 116.0 billion USD, followed by IaaS at 50.0 billion USD and PaaS at 39.7 billion USD. For all three segments, substantial growth rates are predicted over the next years (overall nearly a doubling from 2018 to 2022). IaaS is the fastest-growing segment with an expected growth rate of 24% in 2020 (Costello and Rimol, 2019). This massive growth benefits above all the hyperscalers. Already in 2018, their global market share was 75%, with the trend clearly rising (Statista, 2019).

With focus on Germany, the following situation emerges: According to Information Services Group (ISG, 2018), German companies increased their investment into IaaS about 30% in 2019 compared to 2018, which equates around 1.4 billion Euro. The IaaS segment in Germany thus grows even faster than globally. The hyperscalers are

extending their market dominance also in Germany: the German IaaS revenue of Microsoft grew by 60% in 2019, AWS by 40% – considerably faster than the total market segment. Together with Google, the third largest IaaS provider, nearly two thirds of the German IaaS market are served by these three US companies. Alibaba is, at least presently, playing only a subordinate role. The remaining third is shared among particularly IBM, Deutsche Telekom and Oracle, and the large number of regional IaaS providers (ISG, 2018). In summary, the German IaaS market still has a comparatively high share and number of regional providers meaning that the outcome of this battle has not been ultimately decided yet (Floerecke and Lehner, 2019b). This circumstance makes the German IaaS market particularly interesting for this study.

To give a few examples for the IaaS market consolidation in Germany: United Internet acquired Profit Bricks with its 120 employees at the end of 2017, a medium-sized IaaS provider from Berlin focusing on the German market. Already in 2016, ADACOR Hosting, based in Essen and part of Thomas-Krenn, purchased the small hoster filoo. Another example in the regional environment is Dogado with its headquarters in Dortmund. Since its foundation in 2001, Dogado has taken over eleven providers of IaaS and related services, such as Alvorach, Hostingparadise and WebControl, and now has around 100 employees. But even international, popular IT firms, such as Cisco, Dell, Fujitsu and Hewlett Packard Enterprise, were already forced to shut down their own public IaaS offerings under the given market conditions.

### *2.3 Research on the battle between hyperscalers and regional IaaS providers*

Research on cloud computing has rather addressed technical aspects so far. Less consideration has been given to the major changes within the business perspective (Herzfeldt et al., 2019; Senyo et al., 2018). This technical focus is astonishing, because cloud services per se have a comparatively low degree of novelty in technological terms (Zhang et al., 2010), but have radically changed the way IT resources and applications are implemented, deployed, provided, managed and utilised (Marston et al., 2011). Several researchers (e.g., Floerecke and Lehner, 2018b; Iyer and Henderson, 2010; Leimeister et al., 2010) therefore consider cloud computing as a co-evolution of computing technology and business models. The characteristic of being an enabler for new, innovative business models both on the provider's and the customer's side was the main trigger for the rapidly growing distribution and success of the cloud computing phenomenon (Böhm et al., 2011; Iyer and Henderson, 2012). In the meantime, cloud computing is regarded as a foundational enabler for digital transformation initiatives currently taking place in many companies across all industries (Benlian et al., 2018).

Whereas the cloud computing-specific literature on success-driving business model characteristics has generally grown over the recent years (Floerecke, 2018; Floerecke and Lehner, 2018b; Labes et al., 2015, 2017; Trenz et al., 2019), research on the competition between regional IaaS providers and the hyperscalers is still at an early stage. Floerecke and Lehner (2018a, 2019a) identified several success-driving business model characteristics for regional IaaS providers for a successful differentiation from the hyperscalers. Beyond that, Floerecke and Lehner (2019b) revealed and analysed the dominant business model patterns of regional IaaS providers in Germany – customisers and superscalers – and compared them regarding the prospects for their long-term survival. However, very little is known about the key drivers causing the continuously growing gap between regional IaaS providers and hyperscalers. Already known is that

basic IaaS services (without extensions such as managed or platform services) have developed into a commodity (Floerecke and Lehner, 2018a, 2018b). Commodities are products and services that are highly standardised and to a large level equivalent with regard to functionality and quality, irrespective of the specific vendor (Bruhn, 2011). Not surprisingly, the price of basic IaaS services has therefore turned into the major decision criterion for customers – similar to other commodity markets, including the electricity and gas market (Floerecke and Lehner, 2018a, 2018b). But as regional IaaS providers do not possess the huge server farms, they are unable to achieve the economies of scale, which would be necessary to keep up in the price competition with the hyperscalers (Floerecke and Lehner, 2019a). Against this background, an absolute prerequisite for the long-term success of regional IaaS providers is a business model that differs from the hyperscalers (Floerecke and Lehner, 2019b) and thus a differentiation strategy (Porter, 1985). The question which remains is whether the lower price is the only reason or whether there are further major drivers for this market development.

Considering research from other domains only gives very limited insights which can be transferred to the cloud computing domain. A literature review by Poulis et al. (2012) shows that there are many studies available comparing multinationals with domestic companies along single general dimensions, such as financial strength or production capacity. However, there is a lack of research on the direct competition between both provider groups and in particular, from the viewpoint of local firms (Poulis et al., 2012). In general, local firms have been mostly seen as passive recipients and not as active competitors in a given market (Chang and Xu, 2008; Wright et al., 2005). Only the formation of joint ventures with multinational companies was suggested as a promising measurement (Un and Rodríguez, 2018).

### **3 Research design**

The intention behind this research is to generate a theory for explaining (Gregor, 2006). Theories for explaining elucidate primarily how and why a specific phenomenon occurs in a certain situation in the real world. A resulting theory needs to be new and interesting or explain something that was poorly or imperfectly understood beforehand (Gregor, 2006). This requirement corresponds to the goal of this paper: the identification of the major drivers causing the continuously growing gap between regional IaaS providers and hyperscalers within the IaaS market segment. To reach this research goal, 18 exploratory expert interviews (Myers and Newman, 2007) were carried out with high-ranking employees of various regional IaaS providers in Germany. The perspective of regional IaaS providers was chosen as these are directly affected by the strong market consolidation, whereby they are best placed to assess the past, current and possibly future market situation. Only regional IaaS providers have been considered that have recorded profitable revenue growth over the past years, despite the precarious market situation. All these cloud providers have at least one IaaS service in their portfolio. Since there is no ranking of regional IaaS providers and only few of them report business figures, the sales growth served as evidence of success. This is the most frequently applied proxy for success of small and medium-sized companies in the academic literature (Kim et al., 2004; Mendelson, 2000). The intention behind choosing only high-ranking employees from successful regional IaaS providers was to increase the validity of the interview

results and, overall, to follow the best-practice within the information systems research (Creeger, 2009; Iyer and Henderson, 2012).

To identify regional IaaS providers, an internet search based on Google was conducted. The keywords were 'infrastructure as a service' or 'IaaS' in combination with 'regional', 'local', 'Germany', several regions, such as 'Upper Bavaria', and several large cities, such as 'Munich'. This search resulted in 64 potential candidates. All these companies were subsequently contacted by contact form on their website, e-mail or private message on Xing, a German career-oriented social networking site. In this written interview request, the IaaS-specific turnover development over the past five years (the condition for participation) was asked. 19 of the 64 contacted providers answered and expressed their willingness to take part in this study. This corresponds to a ratio of 29.7%. As one of them reported only stagnant IaaS-specific sales, he was excluded. The very high proportion of IaaS providers with a positive sales trend might be explained by the fact that only those providers answered the interview request and demonstrated interest, which have been successful from their own viewpoint. This circumstance is in line with the experience of the first author from a previous study (Floerecke and Lehner, 2018b), where individual representatives from failed cloud providers were requested for an interview, but none of them agreed to participate.

The 18 companies of the final sample have between 10 and 400 employees (mean: 112) and are spread throughout nine of 16 federal states in Germany. Seven companies have exclusively IaaS, eight IaaS and SaaS and three IaaS, PaaS and SaaS offerings in place. The representatives of each company are responsible or at least co-responsible for the initial development and/or the continuous innovation of the IaaS business models and have profound knowledge of the whole IaaS market. This comprised eight managing directors and/or founders, three department managers, three product managers, three sales representatives and one business developer. They have been working for their company for about ten years on average.

Table 1 summarises the regional IaaS providers (anonymised with Greek letters) and the interview partners in the data collection.

All interviews were based on a pre-tested, semi-structured interview guide consisting of three main parts. In the first part, general information about the person (position within the company and date of employment) and the company (year of foundation, number of employees, offered cloud service models and own data centre yes/no) was collected. Second, the competitive situation between regional IaaS providers and the hyperscalers in Germany was analysed in-depth. Focus was placed on the specific challenges for IaaS regional providers as well as the decisive advantages and strengths of the hyperscalers. The concrete questions in the second part of the interviews were the following: *How do you perceive the competitive situation on the German IaaS market? What are the challenges for regional IaaS providers in the battle with the hyperscalers? What are the strengths and advantages of the hyperscalers leading to their ongoing increasing market share? How do you consciously differentiate yourself from the hyperscalers? What are things a hyperscaler could envy in smaller, regional IaaS providers in general and you in particular?* Third, the interviewees were asked regarding emerging market and technological trends that might influence this battle in future and how the ultimate outcome of this battle could look like.



**Table 1** Summary of regional IaaS providers and interview partners

<i>Firm label</i>	<i>Year of foundation</i>	<i>Number of employees</i>	<i>Cloud service models</i>	<i>Own data centre</i>	<i>Internal position of interviewee</i>	<i>Date of employment</i>	<i>Interview duration</i>
Alpha	1999	50	IaaS	X	Managing director	1999	33 min
Beta	1994	192	IaaS		Head of cloud/managed services	2011	60 min
Gamma	2003	100	IaaS, SaaS	X	Head of sales and consulting	2005	50 min
Delta	2002	16	IaaS	X	Managing director	2002	38 min
Epsilon	1968	30	IaaS, SaaS	X	Managing director	2018	61 min
Zeta	1993	50	IaaS, SaaS		Deputy managing director	2000	47 min
Eta	1990	70	IaaS	X	Product manager	2016	51 min
Theta	1996	400	IaaS, SaaS	X	Product manager	2017	58 min
Iota	2005	10	IaaS, SaaS	X	Managing director	2005	28 min
Kappa	2007	100	IaaS, PaaS, SaaS	X	Founder/head of customer success	2007	36 min
Lambda	2010	10	IaaS, SaaS		Managing director	2010	53 min
Mu	2002	50	IaaS	X	Managing director and founder	2002	42 min
Nu	1998	90	IaaS	X	Business development associate	2015	40 min
Xi	1993	300	IaaS, SaaS		Sales consultant managed service	2017	62 min
Omicron	1993	220	IaaS, PaaS, SaaS	X	System engineer/product manager	2011	39 min
Pi	2011	180	IaaS, SaaS		Managing director	2011	53 min
Rho	2005	130	IaaS, PaaS, SaaS	X	Lead sales/presales	2011	29 min
Sigma	1997	21	IaaS	X	Technical sales manager	2006	35 min

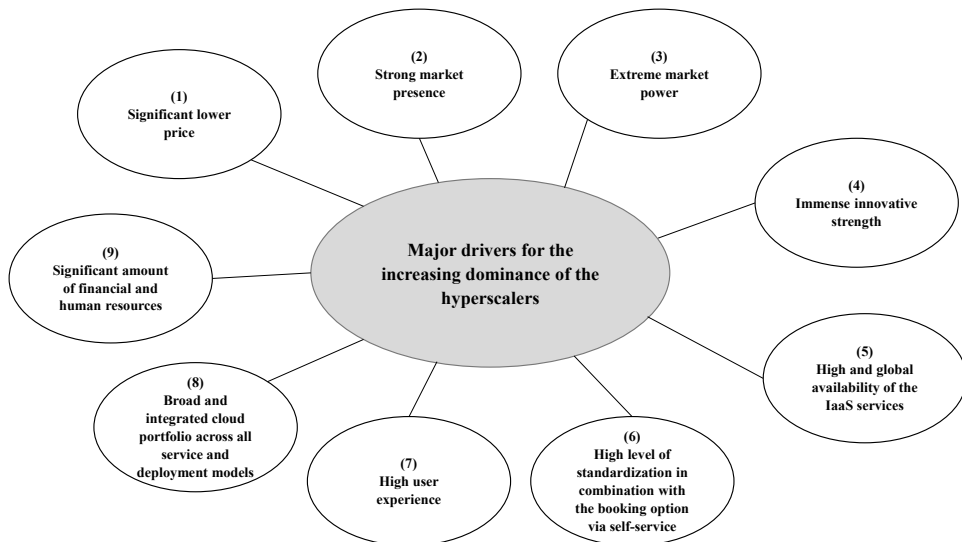
The 18 telephone interviews took place in the period between October and December 2018. The interview language was German. The interview duration ranged from 29 to 62 minutes, with a mean of 45 minutes. When conducting the interviews, the laddering technique (Corbridge et al., 1994) was applied whenever appropriate, whereby the interviews were guided conversations. During the course of this study, a theoretical saturation (Corbin and Strauss, 2008) became increasingly apparent: the answers of the interviewees were repeated several times, while no new aspects were added. Further data collection therefore would not have provided additional insights with high probability, indicating that the concepts of the generated theory for explaining were sufficiently well developed.

All interviews were recorded, transcribed, proof-read and anonymised. The data analysis was performed using qualitative content analysis by Mayring (2010) with the software tool MAXQDA. The assignments of interviewees' statements to generated categories were discussed iteratively among the authors until common agreement was reached. The challenge during the data analysis was to avoid overlapping (mutual exclusiveness) of the identified drivers, and, at the same time, to achieve a high degree of completeness. The data analysis was hence an iterative process of (re-)coding data, generating and dropping as well as splitting and combining categories.

#### 4 Major drivers for the increasing dominance of the hyperscalers

Nine major drivers for the increasing dominance of the hyperscalers were identified (Figure 2). These are described and explained one by one in the following, using representative expert statements (translated from German into English by the authors). To save space, pieces of comments of experts that are irrelevant for the paper's goal were removed and replaced by ellipses ([...]).

**Figure 2** Major drivers for the increasing dominance of the hyperscalers



The central driver, which has already been revealed by previous studies (Floerecke and Lehner, 2018a, 2018b), was confirmed:

- 1 *The price:* IaaS providers simply operate at similar locations, use similar hardware and operating systems and offer similar basic IaaS services. However, as regional IaaS providers cannot afford the huge server farms, they are unable to realise the needed economies of scale in order to keep up in the price competition with the hyperscalers: “No one can offer computing power cheaper than the hyperscalers. This means that I automatically have a commercial disadvantage in this aspect, which is difficult to compensate” (Omicron). The hyperscalers seem fully aware of their powerful position: they have been cutting their prices continuously over the past years aiming to force their local competitors out of the market. Expert Iota spoke in this regard even of dumping prices: “What we notice is that Microsoft and particularly AWS charges very low dumping prices with respect to the pure infrastructure rental fees” (Iota).

Beside the predominant price aspect, the following additional major drivers were unveiled by the expert interviews. The order of the enumeration does not represent an evaluation of the individual drivers.

- 2 *The strong market presence of the hyperscalers compared to the low awareness level of the regional IaaS providers.* “Many do not even know that there are also smaller providers, because the name cloud is only associated with the big hyperscalers” (Alpha). It would therefore be of fundamental importance to “[...] drive the brand awareness continuously to establish oneself with customers, who already have years of contracts with a larger one” (Tau). However, this is a difficult endeavour, as expert Beta reported from his experience: “[...] you must have references to prove that your IaaS service is well used by some customers. This is not self-evident in the IaaS environment” (Beta). In sum, the regional providers are in a niche market and will presumably never reach a nationwide or even worldwide awareness level.
- 3 *The extreme market power:* Regional IaaS providers are directly dependent of Microsoft as customers demand their operating systems (Windows) or applications (e.g., Office 365). Therefore, Microsoft possesses an extreme market power: “From Microsoft you always remain a plaything of emotions [...] because we always have to deliver software environments, not just a pure IaaS infrastructure [...]” (Zeta). Expert Iota illustrated the following example: “In a Microsoft Exchange Server, where next year is end-of-support, where then the new one is actually operated only from the cloud. This means, they have things or opportunities because they have that market power to enforce what a small provider simply cannot do” (Iota).
- 4 *The immense innovative strength:* The hyperscalers continuously expand and enhance their cloud service portfolio and use the latest technologies: “The hyperscalers bring out annually a multiplicity of innovations and additional features. [...] [The small providers] [...] do not have so much advancement, it takes longer to deal with new technologies and functions” (Pi). This means, the “[hyperscalers] are just very ‘early adopting’” (Epsilon). According to expert Beta, “[...] it would be very difficult for a small and medium-sized company to reach even only rudimentarily comparable achievements in terms of services and technology” (Beta).

- 5 *The high and global availability of the IaaS services:* “We have certain availability restrictions compared to a hyperscaler. With one data center we logically cannot offer geo-redundancy” (Theta). Expert Omicron added: “When I think about globally distributed infrastructure, I have a massive disadvantage anyway. Because I simply cannot provide a global infrastructure” (Omicron). This is a key reason why regional providers are commonly not chosen by large corporations. These prefer to use the same IaaS service with the same mask and APIs in all their corporate locations. In the case of hyperscalers, customers can select one or more availability zones of the IaaS service during the order process. Therefore, regional providers have no other choice than to concentrate on small and medium-sized companies and partly private customers.
- 6 *The high level of standardisation in combination with the booking option via self-service:* By contrast, most regional IaaS providers sell their services personally. “Everything is highly automated and thus bookable via self-service. So, if I have a need for a service, then I go to a web portal, book that service and get it right away. For the smaller providers this is difficult to reproduce” (Pi). On demand self-service implies cost savings as fewer sales employees are needed and standardised contracts with standard discounts can be used. Moreover, the entry barrier of ordering a cloud service and the duration of the process of bringing a customer on the platform is significantly reduced. The mandatory prerequisite is, of course, that the cloud service portfolio is depicted on the website in detail, but in simple terms using the language of the target market.
- 7 *The high user experience of hyperscalers’ IaaS services:* The topic of user experience is according to the interviewed experts highly important in the cloud computing domain. The handling of IaaS services must be self-explanatory and simple, without the necessity of attending a training session prior to its usage. Traditional user experience concepts that have been applied in large on-premise software systems, structured as monolithic block, are inappropriate. In this respect, regional IaaS providers have considerable difficulties, as, for instance, expert Xi stated: “The hyperscalers’ systems [...] are really [...] very user-friendly and easy to use without much effort. In this point, we are clearly differently positioned” (Xi).
- 8 *The broad and integrated cloud portfolio across all service and deployment models:* “They have, of course, a very wide range of services that they are offering, in particular, for young companies and very modern companies. Everyone else is more casual and does not have the same bandwidth that the big ones have” (Epsilon). A broad service portfolio brings, inter alia, the following advantages according to the interviewees: First, it achieves increased attractiveness of a provider as customers feel more prepared for the future. Second, customers always search for a solution for their specific requirements and problems. By a broad portfolio, a provider can significantly better address that demand. Third, a provider having all three cloud layers in-house has full control over all aspects of the service provision and can hence offer higher security and service quality.
- 9 *The significant amount of financial and human resources for the development and operation of the IaaS services:* “The hyperscalers have invested a great amount of money and resources [...] in the development of the systems” (Xi). Expert Delta added: The success of the hyperscalers “[...] just depends on a lot of money right

now” (Delta). They have invested a lot of their money in strategic acquisitions over the past years and thus strengthened their market position und service portfolio. By contrast, the representatives of the regional IaaS providers lamed the difficulty to find skilled IT professionals in the view of the rising shortage of skilled labour in Germany. The hyperscalers have clear advantages in the recruitment of employees due to their recognition, their focus on employee development and in particularly, their higher salary level, as expert Epsilon reported: “I cannot compete with the salary because we are not a multi-billion group” (Epsilon).

## 5 Discussion

The identified drivers for the increasing dominance of the hyperscalers in the IaaS market segment are quite different in nature. They relate to various business model components (Osterwalder and Pigneur, 2010), including value propositions (5, 7, 8), key resources (2, 3, 4, 9), revenue streams (1) and channels (6). The central driver is the significant lower price of the hyperscalers. Thereby, this research confirms recent studies (Floerecke and Lehner, 2018a, 2018b). From the customer’s point of view, one unit CPU, one unit memory and one unit storage are the same, irrespective of whether they are obtained by a hyperscaler or a regional IaaS provider. Both provider categories have simply similar suppliers for software (e.g., operating systems and virtualisation software) and hardware components. Beyond this background, the market for basic IaaS services is similar to other utility markets, such as the gas and electricity market, where the only important factors for customers are price and amount.

After having exclusively considered the competition between regional IaaS providers and the hyperscalers, the question arises how the competition among regional IaaS providers can be characterised. The interview results clearly show that the competition between regional IaaS providers is perceived as significantly lower. The reason for this is obvious: they mostly restrict their offerings to a relatively small region, whereby their markets do not overlap to a high degree – despite their large number. Expert Epsilon summed up the overall competitive situation in the IaaS market segment representatively this way: “Of course, there is rivalry and competition [among regional IaaS providers] in some ways. However, it is not the case that we perceive that other smaller providers are permanently taking away projects. [...] the core competition is actually against [...] [the hyperscalers]” (Epsilon).

But are there also strengths of the regional IaaS providers in the battle with the hyperscalers? Central is their significantly greater flexibility, whereby they can address customer-specific requirements more easily: “With a large provider, such as AWS, you can just book your stuff and nothing individual around it. And we just build what the customer wants. And if the servers are supposed to be green, they are green” (Tau). The second strength, stated by the interviewees, is the proximity to the customers and the personal relationship: “The smaller ones, like us, do not have a call center and our customer is not just a number, but we actually know our customers personally. And that is not the case with a hyperscaler” (Tau). The guaranteed exclusive data storage in Germany was mentioned as third strength: “Our data is stored in Germany in compliance with the German or now European data protection principles. To put it bluntly, when I use our cloud, I know where my data is. If I go to the Amazon cloud, I also know who reads it all” (Alpha). The background to this is the Cloud Act, which obliges US

providers to provide requested data stored on servers to US authorities, regardless of whether it is stored in the USA or abroad. However, it probably is just a matter of time until the hyperscalers find ways, e.g., by defining specific cooperation forms, to bypass the Cloud Act. To conclude, the most powerful weapons of regional IaaS providers in the duel are a high degree of customisation, a highly personal customer service with firmly assigned contact persons and a solely domestic data storage.

Beyond that, this study revealed that the majority of regional IaaS providers do not provide IaaS services corresponding with their scientific, conceptual key characteristics: they mostly offer fixed prices (service measurement), sell their services personally (on-demand self-service) and are hardly able to offer a short-term scaling of IT resources (rapid elasticity). To formulate it critically, IaaS of regional providers is rather a traditional server hosting model that is labelled as cloud service for marketing reasons. This phenomenon is referred to as ‘cloud washing’ (Adamov and Erguvan, 2009). As expert Beta commented, “features as offered by, e.g., the Amazon or Microsoft public cloud, only very few can do that, only the bigger ones, but only to a limited extent. I would argue that the IaaS market in the medium-sized IT provider market is not quite as strong and is actually more of a server hosting that partly complies with the official rules of IaaS” (Beta). This implies that customers who attach importance to the fulfilment of the key characteristics of cloud computing have no other choice than to select one of the hyperscalers. The regional IaaS providers pursuing a business model that is at least partly in line with the key characteristics are named, due to the similarity to hyperscalers, but smaller company size, as superscalers by Floerecke and Lehner (2019b).

## **6 Conclusions**

Based on 18 exploratory expert interviews, the major drivers for the steadily increasing dominance of the hyperscalers in the IaaS market segment were explored and thus, a theory for explaining was generated. The study’s results show that the central driver is the significant lower price of the hyperscalers’ IaaS offerings. The background to this is that basic IaaS services have become a commodity. Beyond that, eight additional important drivers, such as market presence, innovative strength, amount of financial and human resources and high and global availability as well as high user experience of the IaaS services, have been identified. Overall, the revealed drivers are of heterogeneous character and refer to various business model components (channels, key resources, revenue streams and value propositions).

Moreover, three fundamental strengths of regional IaaS providers in the competition with the hyperscalers were identified: the greater flexibility and more customer-specific offerings, the proximity to customers and personal relationship, and the guaranteed solely domestic data storage.

Besides, this study uncovered that the competition between regional IaaS providers is significantly lower than the competition between regional IaaS providers and the hyperscalers because they mostly restrict their offerings to a relatively small region, so that their markets do not overlap to a high degree. Last, but not least, this study revealed that most regional IaaS providers do not offer IaaS services in line with the scientific, conceptual key characteristics of cloud computing. Specifically, they oftentimes contradict against the three characteristics self-service, rapid elasticity and service measurement.

This study is first to systematically explore the drivers for the significant dominance of the hyperscalers within the IaaS market segment and thus sheds light on the special and unique IaaS market conditions. Thereby, this work opens up and supports future in-depth investigations of this duel. As practical contribution, regional IaaS providers can use these insights to unravel the IaaS market conditions in general and to better understand the decisive strengths of the hyperscalers in particular. Based on this knowledge, regional IaaS providers are enabled to develop strategies and business models for counteracting or at least decelerating the hyperscalers' growing dominance in order to ensure their long-term survival in the cloud computing ecosystem.

This study is not free of limitations: A first limitation is the relatively small sample size, whereby this exploratory study cannot claim to have identified all decisive drivers for the increasing dominance of the hyperscalers. Second, the collected data and thus the findings are only as valid as the given answers of the interviewees. A final evidence for the validity of the identified drivers cannot be provided and they must therefore be evaluated in follow-up studies. Third, the geographic scope of IaaS providers and interviewees was limited to Germany, where there is still a comparatively high share and number of regional providers. It is necessary to investigate the regional IaaS market in other countries in order to address country-specific particularities.

Scholars should specifically explore and evaluate further drivers for the increasing dominance of the hyperscalers. In this regard, it might be very illuminating to conduct studies on the reasons for concrete failures of regional IaaS providers, e.g., by interviewing representatives of IaaS providers that already disappeared due to mergers, acquisitions, business model pivots or insolvencies. In addition, it might be useful to include representatives from consulting firms in order to benefit from their in-depth expertise concerning the whole cloud computing ecosystem. On this basis, it is important to develop strategies and business models as well as additional single business model characteristics for regional IaaS providers for at least decelerating the current rapid market development. In general, it appears interesting to investigate this duel from the hyperscalers' perspective. However, it should not be forgotten that the IaaS market also contains large international and national IT companies as third and fourth group, whose business models must be examined in detail as well.

To conclude, the current situation of regional IaaS providers is precarious and a continued worsening of it is expected. Decisive for the survival of regional IaaS providers will be that they concentrate on their own strengths and manage it to successfully differentiate themselves from the hyperscalers in order to at least partly compensate their clear disadvantages. One thing is certain: trying to imitate the business models of the hyperscalers and therefore to act in direct competition with them by particularly providing basic public IaaS services will be a desperate strategy in the long run. Acting in direct competition could only make sense if the regional IaaS providers share their resources and customers on a large scale (cloud federation) aiming to achieve greater economies of scale (Kim et al., 2014). This idea has, however, received only very little support by the regional IaaS providers so far.

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