Mastering hybrid IT landscapes – challenges and solutions

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April 2019

INTRODUCTION

Since the advent of cloud computing, the demands placed on IT departments have shifted in terms of the cost, speed, and flexibility of IT services delivered. On the one hand, IT managers have to meet the requirements of their internal customers regarding agility and flexibility, which are growing significantly given the increasing digitalization of all business units. On the other hand, however, they also have to keep an eye on the costs of IT operations, while ensuring that continuity and stability are guaranteed, and that security and compliance requirements are met at all times. Thus, PAC’s "CxO study", a survey of more than 2,300 executives worldwide, revealed that, after "Cost pressure" (87%), companies consider "Agility and innovative strength in the face of a rapidly changing market environment" (85%) to be the biggest challenge from a business point of view. Accordingly, from the perspective of IT decision-makers, "Changing requirements due to digitalization" (84%) is one of the top challenges, after "Cost pressure" (86%) and "Stable and secure IT operations" (85%).

For years, flexibility, agility, scalability, and cost-effectiveness have been the main reasons for using cloud computing across all surveys. Accordingly, cloud computing reached the status of operational implementation a long time ago in most companies. Cloud services are used for IT infrastructures (IaaS), development and operation platforms (PaaS), as well as applications (SaaS), in combination or as a supplement to established IT landscapes. The result: a hybrid IT architecture. That is, a juxtaposition of traditional IT, private and public cloud models, as well as internal and external IT resources, is currently the norm in companies. This coexistence of different IT operating models allows companies to benefit from the respective advantages of the individual architectures, and thus find a balance between innovation and stability. However, this
means that they are also confronted with numerous new challenges, such as increasing complexity, difficulty in ensuring transparency and control, as well as additional security and compliance issues.

Against this background, T-Systems commissioned the market analysis and consulting firm Pierre Audoin Consultants (PAC) to write this white paper. It is based on current PAC studies and 14 expert interviews with IT decision-makers from major European companies in different sectors such as industry, life sciences, electrical engineering, financial services, agriculture, services, transportation and logistics, and public institutions. The expert interviews conducted in August and September 2018 included discussions regarding the challenges of hybrid IT infrastructures as well as the solutions selected by companies.
THE KEY IMPORTANT POINTS AT A GLANCE

Cloud computing as a sourcing alternative and platform for innovation. Cloud computing, in its various forms, changed from being the dominant topic of information technology to an important pillar of digitalization a long time ago. The model is being used to make corporate IT more agile, scalable, and cost-efficient. At the same time, cloud computing also serves as a platform for innovation around topics such as big data analytics, the Internet of Things, or artificial intelligence. However, cloud computing stands for “simplicity”, as so often proclaimed on the marketing side, only to a very limited degree in the enterprise environment. On the contrary, in most companies it means the introduction of another platform that needs to be managed in addition to existing IT.

Hybrid IT is already the norm in companies. There have already been several massive paradigm shifts in information technology. Central mainframes were followed by distributed client-server architectures, with repeated waves of outsourcing and insourcing. Today’s current cloud computing model also combines architectural change with various sourcing strategies. Existing IT architectures and operating models are rarely the result of a complete replacement by newer technologies. Rather, large companies today are confronted with the simultaneous coexistence of a wide variety of architectures and operating models – a hybrid IT landscape.

Increasingly hybrid IT brings more challenges. Ensuring governance, transparency, and overall security and compliance is proving to be increasingly costly and difficult given the large number of technologies and service providers that need to be managed in parallel. At the same time, IT experts, especially for older, but also for very new technologies, are extremely rare, the key phrase here being the “war for talent”.

Different solutions support hybrid IT management. There are a variety of solutions out there today that are intended to facilitate the integration and management of hybrid IT, from software products to managed services concepts. However, given the often excessive complexity of the situation, companies that view the current challenge as solved are far and few between. The vision of a unified management approach across all existing architectures and operating models is not yet a reality. Moreover, moving applications and data between on-premises infrastructures and the cloud as well as between clouds is still not a trivial matter. The implementation strategies used by companies today are therefore manifold.
HYBRID IT LANDSCAPES – BACKGROUND AND EMERGENCE

Many companies have begun to migrate existing IT systems to the private cloud and use them productively there in recent years. However, this is often seen only as an intermediate step. The majority of companies assume that they will migrate to a public cloud infrastructure in the future – even though this is still often viewed with skepticism. They recognize the benefits of the public cloud model, such as virtually unlimited scalability, flexibility, and potential cost-effectiveness. Companies also increasingly assume that, given the “cloud-first” strategy of many software vendors, sooner or later they will hardly have any alternative to the public cloud SaaS model. However, in the face of this development, concerns are still frequently raised today, especially with regard to security, compliance, or vendor lock-in.

Nonetheless, European companies in the area of IT infrastructure and operations are currently investing almost as much in private and public clouds as in legacy systems. In 2014, this share was just 30%, but by 2020 it will rise to almost 70%. At the same time, spending on public cloud infrastructures will increase to more than 10%.
In the period up to 2020, the share of software as a service (SaaS) in relation to total software spending in Western Europe will increase from under 10% to over 30%. And this development will continue to accelerate, not least because of the stringent “cloud-first” strategy of the most important software providers.

Almost all major European companies are, in one form or another, undergoing a cloud migration or transformation. Moreover, there is hardly a company that does not use different IT operating models – cloud and non-cloud, sourcing and in-house operation – productively:

In what area do you already use cloud, plan to use it, or could you imagine using it?

<table>
<thead>
<tr>
<th></th>
<th>Already in use</th>
<th>Planned within the next 2 years</th>
<th>Neither in use, nor planned, but conceivable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage and/or back-up</td>
<td>55%</td>
<td>27%</td>
<td>13%</td>
</tr>
<tr>
<td>Server capacity</td>
<td>53%</td>
<td>29%</td>
<td>13%</td>
</tr>
<tr>
<td>Web hosting</td>
<td>50%</td>
<td>29%</td>
<td>15%</td>
</tr>
<tr>
<td>SaaS for specific solutions</td>
<td>41%</td>
<td>35%</td>
<td>16%</td>
</tr>
<tr>
<td>IaaS-based hosting of traditional enterprise applications</td>
<td>38%</td>
<td>33%</td>
<td>20%</td>
</tr>
<tr>
<td>SaaS as strategic software platform</td>
<td>36%</td>
<td>37%</td>
<td>19%</td>
</tr>
<tr>
<td>Platform for application development, testing, and/or operation (PaaS)</td>
<td>35%</td>
<td>40%</td>
<td>18%</td>
</tr>
<tr>
<td>IoT systems</td>
<td>35%</td>
<td>37%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Fig. 1. Development of spending on IT infrastructures 2014-2020

Fig. 2. Fields of application of cloud services
(source: CxO study from PAC on the use of cloud computing)
The IT architectures of most large companies today reflect the ever-changing IT demand and related architecture concepts of the past decades. In the late 1970s, most companies were simply focused on manufacturing products. Firms were organized into separate departments and divisions, while central applications running on mainframes supported the core business.

Some 15 years later, the picture had changed. The diversity of business models increased, services developed around product portfolios, and horizontal levels for sales, HR, and marketing were established in matrix organizations. In IT, mainframes were widely – though still not completely today – replaced by client-server architectures to provide more flexibility, and standard software products such as ERP became established.

With the Internet boom at the turn of the millennium, value chains became more flexible and more complex. The first Internet-based IT deployment models for software emerged (Application Service Providing – ASP).

Today, companies are demanding unprecedented agility in the face of globalized, rapidly changing and network-based business ecosystems. Cloud computing has already significantly raised the bar for IT departments in terms of cost, speed, and flexibility, and is at the cutting edge with distributed and service-oriented architectures.
The progressive use of IT in companies as well as the further development of, but also change in, IT architectures only very rarely led to the complete replacement of the previous technology. Due to the juxtaposition of the architectures described that often exists, this journey through time can be easily retraced in many data centers today.

**The Strategic Importance of IT is Changing**

The strategic importance of IT constantly fluctuated. While massive investments were made in supposedly differentiating information technology shortly before the turn of the millennium, many companies reevaluated the strategic importance of IT after the dotcom bubble burst: it was largely "demoted" to the role of supporting cost center. After that, the most important IT mantras—standardization and cost reduction—led to a veritable boom in IT outsourcing, culminating in the outsourcing of entire IT departments.

In recent years, many companies became aware that all too often they had lost the close connection between IT and business departments necessary for innovation due to excessive outsourcing, and tried to counteract this through more selective and more flexible sourcing. The emerging cloud computing industry fueled this trend.

Today, due to extensive digitalization, we are once again having a rethink: IT is strategic once more and should not only support a company’s own business areas, but also open up new business models at the same time. Companies now think very carefully about which IT services they consider to be differentiating and which they can source in a standardized manner (off-the-shelf).

This change in philosophy has also led to a variety of operating models and sourcing options that are now well established. "Traditional" infrastructures (client-server, sometimes mainframe) can be found in almost all companies, alongside various cloud models operated in-house, via hosting, or with the help of managed services providers.
IT OPERATING MODELS AND MULTI-CLOUD SCENARIOS

The use of cloud services, such as infrastructure as a service and platform as a service, for the dynamic procurement of computing power as well as the development and operation of applications, is often driven by the IT department. However, “IT-oriented” business departments are also increasingly using IaaS and PaaS offerings to develop their own applications. PaaS is often given preference here, as there is direct access to available services such as machine learning.

Cloud-based application software, SaaS, normally directly addresses users in the company’s business departments, promising fast, cost-efficient, and flexible support for respective corporate processes. At the same time, users benefit from access (generally irrespective of the device, location, or time) to this software and the required data.

Since the majority of cloud solutions are still very new, most offerings also often provide a modern user interface and, associated with this, a high level of user-friendliness as well as a high degree of integration for the communication and cooperation between employees, customers, and partners. In addition to pure cloud providers such as Salesforce, Workday, or ServiceNow, leading suppliers of SaaS solutions now also include established software companies such as Microsoft, Oracle, or SAP.

The main operating models in use today can be classified in an abstract manner based on the aspects “degree of standardization” and/or “sourcing model”:

![Classification of typical operating models](image)

Fig. 4. Classification of typical operating models
• Public cloud: Central provision of a standardized IT service by a provider for a large number of customers. Due to standardization, this can often only be adjusted to individual/specific customer needs within specified limits.

The virtually unlimited scalability of public cloud providers is difficult for a corporate IT department to replicate, and only rarely will it be possible to achieve similar economies of scale when it comes to costs. This is especially true for particularly compute-intensive operations that are limited in time, or for rare peak loads, such as for annual financial statements, simulations, or marketing campaigns.

• Private cloud: To a certain degree, it is also possible to deploy an internal IT infrastructure dynamically using virtualization and automation technologies or open-source frameworks such as OpenStack. A "private cloud" of this type denotes the implementation of a dedicated cloud IT architecture that is only used by one customer. The company can implement it in its own data center and operate it internally ("in-house private cloud").

Alternatively, the company can hire an external service provider to run it in the customer’s own data center ("managed private cloud") or host it in the provider’s data center ("hosted private cloud"). Both concepts are similar to the established IT outsourcing model; the externally operated private cloud is often a further development of traditional application hosting, which has been transformed according to the cloud paradigm.

In summary, it can be said: the "more private" the architecture, the greater the control and the possibility for customization. In return, however, this also means foregoing the benefits of public cloud, such as fast, virtually unlimited scalability and flexibility.
**Fig. 5.** Comparison of advantages and disadvantages of different operating models

Internally operated systems offer companies the benefit of complete transparency over usage, operations, and spending. On the other hand, they require investments (CAPEX) and infrastructure maintenance.

Traditional hosting or a managed service for the conventional (non-cloud) infrastructure saves the customer hardware maintenance and promises access to external know-how. Being provided dedicated to a single customer, they allow greater control and customization. In other aspects, however, traditional IT – i.e., IT landscapes that are often monolithic, not very agile, and have usually grown over long periods of time – is inferior to modern cloud offerings.

"It is advisable to always carry out an initial check as to whether the migration of individual or multiple applications to the cloud brings financial, technical, or organizational benefits or whether the resulting challenges outweigh them."

[Head of IT, service company]

These specific advantages and disadvantages of various cloud models and their different feasibility relative to specific applications are another reason for the currently prevailing hybrid architectures. Companies want...
to benefit from the respective benefits of the different models, combining private data storage with high scalability, for instance, and so a juxtaposition of internal and external services as well as cloud and non-cloud architectures is now part of the typical image of corporate IT.

**Fig. 6. Typical hybrid IT architecture in companies**

**MULTI-CLOUD SCENARIOS**

However, it is not only the combination of internal and external cloud and non-cloud architectures that leads to hybrid IT landscapes – their complexity is additionally increased by multi-cloud scenarios: the number of different public cloud platforms in companies is continuously growing, with different scenarios being distinguishable, each based on different strategies:

**IaaS/PaaS-SaaS:** This scenario is very common since IaaS and PaaS offerings are more likely to be used by internal IT, while initiatives to deploy a SaaS solution are more likely to come from the business departments. If part of the provider portfolio, IaaS, PaaS, and SaaS may be procured from the same vendor, but the sources differ in many cases.

**Multi-IaaS:** It is not uncommon for companies to use different IaaS or PaaS platforms for different applications. The offerings of current providers have various advantages, be it in terms of technological focus, service, or geographical presence. Customers therefore often rely on offers from different providers for different applications. Multi-IaaS architectures for the same application are also not unusual, however, particularly for back-up or business continuity purposes.

**Multi-SaaS:** Just as, at present, different business departments use different special software programs, possibly as a supplement to the central enterprise software, different business processes are also supported by different – sometimes highly specialized – SaaS solutions. Data integration is a challenge here, both in terms of maintaining uniformity of the pool of data from different sources within the company and, where necessary, ensuring a comprehensive analysis of this data.
EIGHT REASONS WHY COMPANIES CHANGE THEIR IT OPERATING MODEL

There are various reasons why a company decides to replace an existing operating model with another one or opts for a new one. The fact that these decisions are not usually made for the entire corporate IT, but rather for particular applications, also contributes to the emergence of hybrid architectures. The most important reasons for using cloud solutions, and thus the emergence of hybrid infrastructures, are:

Optimization of cost structures: The better the economic situation of a company, the less likely it is to change its IT operating model for cost reasons. New operating models may be considered for new applications (IoT, big data, etc.), but this is less probable for existing ones. However, if cost pressure increases, the willingness to weigh up alternatives often also rises.

"Any transition phase from one operating model to another – e.g. the migration to a private or public cloud – always means an initial increase in costs."

[Head of IT, financial services]

However, a tense cost situation can also speed up decisions to migrate to the cloud.

New digital business models and digitalization of corporate processes: Companies with a greater commitment to the digital transformation process usually have a higher affinity for cloud and thus a greater willingness to transfer existing applications to a different operating model. This trend is strengthened by DevOps approaches and the attractive services of many cloud platforms (microservices, analytics, machine learning, etc.), as companies are increasingly developing their own software programs and want to combine these with existing applications.

Globally distributed business units: The greater the degree of internationalization of a company, the greater the importance of central IT services as well as the connection and integration of international branches to the central IT processes with lower latencies. Collaboration with a global cloud provider can support this connectivity of geographically distributed business units.

Shortage of skilled IT professionals: If lacking skilled employees, companies are no longer able, at least in the long term, to maintain their current internal IT operating models and are reliant on external support or migration. A typical example is the lack of mainframe experts in companies, which can lead to the consideration of outsourcing or migration options. When making such a decision, companies must weigh up which tasks, and thus also which infrastructures, they want or need to outsource.
Growing need for collaboration: The greater the level of collaboration within a company and the more mobile the employees, the more important central data storage with decentralized access and cloud collaboration tools become. If not cloud-based, modern collaboration tools and infrastructures require continuous, usually intensive, support. Many collaboration tools are already only offered in the cloud model today.

Increasing standardization: With the growing number of software packages and the increasing availability of SaaS solutions, the migration of customer-specific solutions to software or SaaS is an important part of the standardization strategy of many companies. Such a shift is often accompanied by a change of the operating model. In view of the cloud strategy pursued by many large software vendors and due to the lack of alternatives in some cases, it will be difficult for customers to avoid a cloud migration in the future, unless they want to change the software.

Long-term/long-running outsourcing contracts: The scope and duration of existing IT outsourcing contracts may have a negative impact on flexibility when choosing an alternative operating model, unless the contract explicitly includes a transformation or migration.

Compliance regulations: In some industries and countries, specific compliance requirements must be met that go beyond general data protection requirements and the like (e.g. health care, financial, defense, etc.).

"From a compliance point of view, it is far easier to maintain a general overview of a private cloud, because fewer external factors need to be included in reporting."

[Head of IT, logistics]
TRENDS THAT ENCOURAGE THE EMERGENCE OF HYBRID INFRASTRUCTURES

In addition to the historical reasons for hybrid IT described at the start, there are numerous trends and factors that promote hybrid infrastructures:

**Digitalization:** Besides web hosting, public cloud is also currently particularly making its mark in the development of new, digital business models. This is hardly surprising, firstly, since digitalization strategies often go hand in hand with a stronger networking of the business ecosystem, for which the public cloud is predestined, and secondly, because these strategies are frequently based on newly developed software, the design, operation, and, above all, rapid scaling of which are also some of the benefits of a public cloud. Accordingly, cloud-based application development and/or enterprise software testing often take place on public cloud platforms.

**Analytics:** The increasingly important analysis of large amounts of data from different sources (big data) especially requires enormous IT resources and is thus ideally suited for a public cloud. However, data is usually evaluated at the location where it is held. This can be web or cloud data, but often also the ERP system – which still rarely lies in the public cloud. The situation regarding SaaS solutions is somewhat different. The analytics functionalities of the provider are often used here. That is, the data is also processed directly in the cloud.

**The Internet of Things (IoT):** In the area of IoT, companies use a combination of private and public cloud. This is no surprise since, on the one hand, all important IoT platforms, such as those from AWS, Bosch, GE Digital, or Microsoft, are public cloud-based, but, on the other hand, connectivity to back-end systems is an integral part of most IoT strategies. In addition, this business area and the data generated here are often considered to be particularly strategic. In short: the data often resides in the company’s own data center, but the IoT applications are kept in the cloud.

**Equipping smaller branches:** It is not uncommon for the central internal IT or central enterprise software to be supplemented by leaner, cloud-based or SaaS solutions in order to support smaller or international branches.

**Step-by-step cloud migration:** In the past, large companies usually preferred to transform internal or outsourced IT towards a private cloud model initially. In addition, existing IT landscapes in most companies still cannot or should not be replaced entirely by a public cloud – even though such a strategy is finding its way into more and more corporations, as is the case at Enel or Deutsche Bahn, for example.
"It is important to let your employees experience new topics such as infrastructure as a code or DevOps little by little, before daring to take the big step into the cloud."

[Director of IT Services, discrete manufacturing]

Traditional IT architectures are superior: The cloud concept per se does not add value. Rather, it promises certain benefits, such as scalability, cost efficiency, speed of implementation, etc., which, however, do not apply or are not necessary to the same extent for each application. Therefore, companies weigh up the given advantages and disadvantages of a conventional solution before carefully checking whether a cloud model is actually superior. A "traditional" solution, such as standard software, an in-house development, or the like, is often available as alternative, which may even offer advantages over the cloud model.

"All existing on-premises systems are being migrated to a private cloud – except for the mainframe, which is being kept within a separate area of responsibility".

[Head of IT, insurance]

Importance of legacy systems: Many existing applications are not suitable for the cloud. In some cases, tools enable the migration of legacy applications using the "Lift & Shift" method. Application modernization, which is often useful or necessary during a cloud migration, can be very complex and expensive, however, meaning that companies stick with existing architectures. These frequently include mainframe applications, which still map the core business in many industries and are not going be abandoned in the foreseeable future.

"It is not the infrastructure that dictates the whole thing, but rather the application and/or the service. If cloud-ready: OK; if not, it makes no sense to force something."

[Head of IT, discrete manufacturing]

Migration movements between operating models: There is little sense in switching back from a cloud model to a traditional operating model. However, even within cloud environments there are sometimes massive migration movements, for example from an internally operated cloud to externally provided solutions, from private to public cloud, or, when traditional applications are being replaced by SaaS, from IaaS-based hosting to SaaS. These movements are by no means observable in one direction only. The public cloud, for example, is often used for the rapid development and scaling of an offering as soon as a certain workload size is reached, before reverting back to internal or external private cloud models.
CHALLENGES OF HYBRID IT ARCHITECTURES

Many cloud platforms and solutions available can be introduced and used separately relatively quickly. Cloud-based solutions also usually have defined interfaces and thus allow integration (normally through application programming interfaces [APIs]). However, the integration of diverse cloud systems is anything but simple, especially if they originate from different providers or have a different technical structure.

Even a separate cloud solution often means that different parties are involved in the “cloud value chain”. For example, in the case of a SaaS solution, think about the data center or various co-location sites, the infrastructure operation (plus corresponding technology suppliers), the network, the application development and corresponding management, the data storage, possibly also third-party software providers, the implementation and/or managed services partners, etc.

This complexity may also increase in a hybrid architecture, since interactions between the platforms must be taken into account at the same time. In large companies, it is not uncommon that hundreds of different applications need to be run on platforms from a wide range of manufacturers and service providers and also be supplemented by numerous SaaS solutions, again from different suppliers.

This results in challenges that can lead to considerable additional costs and also risks:
COMPLEXITY
The technical complexity of hybrid IT management, especially with regard to the interoperability and integration capability of different offerings, but also regarding data integration across different platforms, remains one of the major challenges from a corporate perspective. For cloud-based applications, for example, the data model, the functions and/or processes, the user interface, and the user administration can be different in each case.

And the need for integration is increasing, especially in the context of digitalization, with data flows needing to be controlled across departments and often even across company boundaries. Applications must be able to exchange data with each other to ensure a smooth and automatic process flow, even though the data relevant for the processes is distributed to different systems. This increase in complexity is also reflected in increased operational and administrative costs.

TRANSPARENCY
The complicated monitoring across different legacy systems and cloud models is not just a security or compliance-relevant risk. The monitoring of availability and performance as well as the tracking of transactions and resource usage – from infrastructures and databases to web and mobile applications – also represent an increased challenge.

In addition, high transaction costs, particularly for significant data transfers using a public cloud platform, can have a significant negative impact on the total cost calculation.

INTEGRATION WITH LEGACY APPLICATIONS
Companies often want to use cloud services in conjunction with in-house systems. However, the latter may be older software products that do not always have modern integration capabilities (APIs). Furthermore, existing integrations may also be subject to change.

SECURITY AND COMPLIANCE RISKS
Ensuring security and compliance, as with the topic of cloud usage in general, is not just a security or compliance-relevant risk. The monitoring of availability and performance as well as the tracking of transactions and resource usage – from infrastructures and databases to web and mobile applications – also represent an increased challenge.

"IT is increasingly becoming the focus of company audits."
[Head of IT, life sciences]
**IT SERVICE MANAGEMENT**

The more heterogeneous the system environment, the more complex IT service management becomes. If the landscape is made up of many different cloud systems and on-premises systems, it will be more difficult to find and eliminate causes of process interruptions, delays in processing, or latencies in cross-disciplinary software solutions.

**MULTI-VENDOR MANAGEMENT**

The use of different technologies and cloud solutions from different providers also means more complex vendor management, and thus not only increased technical but also growing commercial complexity, with each vendor having platform-specific purchasing and billing processes, user contracts, service catalogs, and support concepts. License management in particular can prove to be extremely complex in hybrid environments.

Just keeping up to date with the offers of the sometimes extremely fast innovating cloud providers places particular demands on many customers. Consequently, the cost of educating and training employees is also a major challenge - and relevant experts are scarce on the market.
IMPLEMENTATION STRATEGIES, SOLUTIONS, AND RECOMMENDED ACTIONS

There is an abundance of solutions on the provider side designed to facilitate hybrid IT management, from software products to managed services concepts. And strategies on the customer side are also manifold. However, given the often excessive complexity of the situation, companies that view the current challenge as solved are far and few between.

"Our vision is to be able to use a unified management approach and a portal that allows applications and data to be easily moved between on-premises infrastructures and the cloud as well as between clouds."

[Director of IT Services, discrete manufacturing]

To cope with the increasing complexity of hybrid IT environments, many companies rely on external support. However, which strategies are specifically pursued depends very much on the internal capacities of the company and the individual sourcing strategy.
OFFERINGS ON THE PROVIDER SIDE

Technology vendors and service providers have recognized the problems of hybrid IT environments, addressing these issues with a variety of offers:

Cloud ecosystems: A number of cloud providers are constantly expanding their range of IaaS, PaaS, and SaaS solutions and technologies to form an ecosystem, in order to provide customers with an IT infrastructure that is as comprehensive as possible from a single source. These compatible and combinable cloud services are often an attractive offer as they allow customers to move within a technological world to a large extent and to use pre-integrated solutions. Considering the IT services required across an entire company, however, there is hardly a technology provider that would be able to cover all customer needs alone.

Management of cloud services: Some providers use defined toolsets and, based thereon, self-developed management frameworks to reduce the complexity of parts of hybrid IT management for customers via managed services, often in conjunction with cloud brokerage services. Last but not least, this approach promises to keep pace with rapidly advancing technological developments and the associated skills requirements on a sustained basis.

iPaaS for networking different cloud applications: Cloud solutions usually have interfaces for integration with other solutions. There are also numerous middleware offerings addressing the integration of specific cloud solutions. However, solutions can only be integrated with one another selectively in this manner. This is remedied by iPaaS (integration platform as a service) solutions.

There are a number of iPaaS vendors represented on the market whose solutions differ in terms of functional range. What we are talking about here is middleware for comprehensive cloud integration, which mediates between different cloud systems and on-premises systems. This is an alternative to point-to-point connections. iPaaS offers can connect different cloud applications to one another and provide the ability to integrate in-house software such as ERP systems with cloud-based software or implement the orchestration of cloud services. Thus, the customer receives pre-integrated cloud services with any integration issues having already been resolved.
IMPLEMENTATION STRATEGIES ON THE COMPANY SIDE

The IT decision-makers of major European companies consulted for this white paper confirm the challenge of hybrid IT management, but they take on the topic in different ways, pursue different strategies, and have different expectations of technology and service partners.

Fig. 7. Implementation strategies on the company side in view of the challenges of hybrid IT landscapes

Some of the approaches, best practices, and experiences frequently cited in the expert interviews and particularly pointed out by those interviewed are highlighted below.

Avoidance of complexity: Above all else, the avoidance of (further) complexity is given high priority:

"With any new software, we first check if a SaaS model is available. The ideal scenario is for everything to be provided "out of the box". Standards, simplicity, and avoidance of unnecessary complexity is the ultimate goal."

[Head of IT, financial services]

SaaS solutions promise direct support for respective corporate processes. They are largely standardized, requiring little IT know-how and no own infrastructure operation. Therefore, the use of a separate SaaS solution is usually far superior to the introduction of traditional software in terms of complexity of implementation and operation. The huge demand for SaaS products such as Microsoft Office 365, Salesforce, or SAP SuccessFactors confirms these benefits. The growing number of different...
SaaS solutions in a company brings, in turn, greater complexity, however. Data integration for maintaining uniformity of the pool of data from different sources is a particular challenge.

**Integration via standalone solutions:** In many cases, companies do not pursue the complete integration of new platforms intensively for compliance reasons, sometimes also simply due to a lack of options. Rather, for example, public cloud offerings are used separately and managed with dedicated tools:

> "Our public cloud usage is largely detached from the core business."
> [Head of IT, insurance]

Where SaaS and/or software solutions are to be integrated within a corporation, companies often use data integration software and/or iPaaS solutions, based on offerings from Informatica, Dell, Microsoft, Salesforce/MuleSoft, or IBM, for example. Such products are normally used to integrated two or more SaaS solutions.

Users often access a variety of different applications from different sources, directly from mobile devices. Central documentation and management of the various mobile applications distributed within the company as well as secure access to cloud solutions are supported by mobile device management solutions, from providers such as MobileIron, SAP, or VMware.

**Consolidation of providers:** Multi-vendor management is not a new problem. However, the topic receives special attention here due to the cloud trend with its many different technologies and parties:

> "Contracts with service providers are bundled. The same goes for application support."
> [Head of IT, logistics]

**Use of comprehensive (own) management tools:** Companies are trying to deal with the growing heterogeneity of systems and services as part of the cloud transformation with existing tools, also due to a lack of convincing, comprehensive solutions, in a rather reactive manner, step by step:

> "We use an open source-based API management framework for the orchestration. Our existing IT service management tool is still in use currently in the sense of a 'wait and see' philosophy."
> [Head of IT, financial services]

Frequently used IT service management solutions include products from HPE, IBM, BMC, or CA Technologies. However, the demand for cloud-
based offerings is also growing strongly in this environment; in particular, ServiceNow has secured a market-leading position here.

Some companies are working on their own hybrid IT management solutions – usually based on current toolsets – to master the complexity:

"We are working on developing our own portal, with ordering options, standardization, automated billing, etc. – but we still have some way to go."
[Director of IT Services, discrete manufacturing]

Integration still often involves a lot of manual implementation today, and many users are looking for a higher degree of automation:

"We already have a close integration of applications from individual business units. However, this is currently largely the result of moving files back and forth."
[Head of IT, financial services]

Development and expansion of own competences: Many companies see the danger of developing dependencies, whether this be on large cloud platforms or on service partners with specific competencies. Due to this, but also for security and compliance reasons, many companies, as shown above, still use private cloud concepts. In addition to the involvement of external specialists, organizations are also investing in the education and training of internal resources:

"Even if outsourcing, it is still recommended to continue investing in the education and training of internal IT employees, particularly in the area of cloud and other modern technologies."
[Head of IT, public sector]

Open-source and container technologies: In order to avoid developing a dependency on proprietary technologies or specific cloud platforms, many companies deploy open source-based cloud technologies, whether for the development and operation of internal cloud infrastructures or the use of external cloud offerings. OpenStack and Cloud Foundry are prominent examples of open source-based IaaS and PaaS platforms.

Also, the triumph of container technologies, such as those of Docker, is not least due to the desire of many companies for platform independence. The “containerization” of applications ensures the portability of software between different cloud providers and types, and also supports the migration and modernization of legacy applications.

Project-based support from external service providers: However, many companies do not have enough of the specific competences required to manage the variety of platforms completely independently. Consequently, many companies collaborate with external specialists. Service
providers are involved both on a project basis, to provide advice on architecture or to support the cloud transformation or migration, for example, as well as in the form of managed services.

"The growing complexity is increasingly becoming a problem. We are forced to work a lot more with external specialists in order to source their specific expertise."  
[Head of IT, life sciences]

As the survey results regarding preferred cloud operating models presented above show, many companies receive support when it comes to managing their internal private cloud infrastructure or have it hosted by an external service provider. Managed services for public cloud platforms are also used. Operational services delivered by external providers can help to embed special know-how and relieve internal IT resources, who are thus available for more differentiating tasks.

In addition, due to the increasing number of hybrid IT landscapes, cross-platform services are gaining importance, particularly for the orchestration, integration, automation, and protection of heterogeneous infrastructures.

"Our task as an IT department is to simplify processes – no longer managing hardware, but rather procuring services and ideally also the integration thereof."  
[Director of platform service, process manufacturing]
CONCLUSION: THE FOCUS IS ON BUSINESS, NOT TECHNOLOGY

Hybrid IT Management – Recommendations

- Consolidation, automation, and standardization
- Retention of know-how
- Use of managed services
- Integration of existing standalone solutions

The main concern of all IT decision-makers consulted is ultimately to keep the IT challenges of business users at bay as much as possible and to align any decisions strictly to business benefits. Even though almost every major company is pursuing a cloud strategy, each organization closely examines which operating model best meets the respective framework conditions and goals and what additional complexity it brings:
"It is recommended to always focus on your own business goals first and then make decisions regarding your own IT landscape as detached as possible from mainstream trends – especially when it comes to cloud usage."

[Director of IT, discrete manufacturing]

Solutions on the provider and user sides are therefore manifold when it comes to benefiting from new technologies and operating models while maintaining operation of existing ones. Hybrid IT landscapes will be with us for a long time, and their diversity is likely to increase even further.

However, mastering this complexity in order to pave the way for companies to digitalize is already the self-concept of corporate IT – even if the magic formula is yet to be found.

"We [the corporate IT department] are hopefully the oil and not the spanner in the works."

[Head of IT, logistics]
APPENDIX

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This study was commissioned by T-Systems.

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