CLOUD STRATEGY

A Decision-Based Approach to Successful Cloud Migration

Gregor Hohpe

An Architect Elevator Guide

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Cloud computing changes the role technology plays in enterprises from "keeping the lights on" to boosting innovation through agility, frequent releases, and automation. It only seems appropriate to embrace the same principles when writing a book about this transformation. That's why this book started out as a Leanpub book, which supports early releases of in-progress ebooks using lightweight tools and iterations. You're reading the result of this iterative process, which elevates readers to become active participants through early feedback.

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I changed my cloud journey from wishful thinking to a decision-based strategy.

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About This Book

Strategy is the difference between making a wish and making it come true.

Cloud computing is an amazing resource that can provide fully managed platforms, instant scaling, auto-optimizing and even auto-healing operations, per-second billing, pre-trained machine learning models, and globally distributed transactional data stores. The cloud is also a critical enabler for organizations to compete in economies of speed. So, it's no wonder that most enterprises want to take advantage of such capabilities.

Migrating an entire enterprise to the cloud isn't as easy as pushing a button, though. Simply lifting and shifting legacy applications is unlikely to bring the anticipated benefits, whereas re-architecting applications to run optimally in the cloud can be cost prohibitive. In addition, organizations looking to reap the full rewards from cloud technology also need to consider changes to their business model and their organization. Enterprises thus need a more nuanced strategy than simply proclaiming "cloud first!"

A sound cloud strategy isn't something you can copy from a recipe book or from another organization. Diverse starting points, objectives, and constraints imply different choices and trade-offs. Instead, you need a set of proven decision models that help you analyze your specific situation, evaluate options, understand trade-offs, and articulate your choice to a broad audience.

Unfortunately, most books on cloud computing either stay at a very high level or focus on specific vendors and products. This book closes this gap by questioning existing assumptions, establishing technology-neutral decision models, and presenting a new way to think about your cloud journey.

Life Teaches the Best Lessons

My book *37 Things One Architect Knows About IT Transformation* describes how architects can drive change in large organizations by riding the "Architect

Elevator" from the penthouse to the engine room. *Cloud Strategy* applies this mental model to cloud architecture and cloud migrations. Just like *37 Things*, *Cloud Strategy* includes many anecdotes and the occasional punch line based on my real-world experience.

I have been in charge of major cloud transformations in three distinct roles:

- As chief architect of a major financial services provider, I devised and built a private cloud platform to speed up application delivery.
- As technical director at a major cloud provider, I advised strategic clients in Asia and Europe, including some of the largest retailers and telecommunications companies, on aligning their cloud strategy with their organizational transformation.
- As a Singapore smart nation fellow, I laid out an overarching cloud strategy at the national level.

Each environment presented its unique set of challenges but also shared noteworthy commonalities. In this book, I distill them into concrete advice so that everyone can benefit from my experience and occasional mistakes.

Each technology migration involves specific vendors and products. This book stays away from individual products as much as possible, using them only as occasional examples where considered helpful. Documents describing products are widely available, and whereas products come and go, architectural considerations tend to stay. Instead, as with *37 Things*, I prefer to take a fresh look at some well-trodden topics and buzzwords to give readers a novel way of approaching some of their problems.

Cloud Stories

Corporate IT can be a somewhat uninspiring and outright arduous topic. But IT doesn't have to be boring. That's why I share many of the anecdotes that I collected from the daily rut of cloud migration alongside the architectural reflections.

Readers appreciated several attributes of *37 Things*' writing style and content, which I aimed to repeat for this book:

- *Real Experience*: Rather than painting rosy pictures of what could be done, I try to describe what worked (or perhaps didn't) and why, based on actual experience.
- *Unfiltered Opinion*: I prefer to call things the way they are. Also, I am not shy to highlight downsides or limitations. There are plenty of marketing brochures already, so I'm not keen to add another one.
- *Engaging Stories*: Stories stick, so I try to package complex topics into approachable stories and engaging anecdotes.
- *Less Jargon, More Thought*: IT people are well known for spewing out the latest buzzwords. But few can tell you when to use which products and what assumptions are built into them. I aim for the opposite.
- *Valuable Take-Aways*: Stories are nice, but architects also need concrete advice to make their cloud migration successful. I share what I know.
- *Useful References*: A lot has been written on cloud computing, architecture, and IT strategy. I am not here to regurgitate what already has been written but want to synthesize new insights. I am happy to point you to related material.

So, just as with *37 Things*, I hope that this book equips you with a few catchy slogans that you're able to back up with solid architecture insight.

Better Decisions with Models

Although cloud computing is founded in advanced technology, this book isn't deeply technical. You won't find instructions on how to have your CI pipeline auto-generate YAML Helm Charts for fully automated multicluster container orchestration management in a provider-neutral fashion. You might, however, find guidelines on how you would go about deciding whether such a setup is a good match for your organization.

This book focuses on meaningful decisions, those that involve conscious and sometimes difficult trade-offs. Individual product features step aside in favor of a balanced comparison of architectural approaches. Considering both strengths and weaknesses leads to vendor-neutral decision models, often accompanied by questions that you should ask the vendor or yourself.

Employing the "Architect Elevator" notion to better connect the IT engine room to the business penthouse means that elevating the level of discussion isn't

dumbing things down. Rather, it's like a good map that guides you well because it omits unnecessary detail. This book therefore removes noise and highlights critical aspects and connections that are too often overlooked. It will make you see the forest and not just the trees, sharpening your thinking and decision making at the relevant level.

What Will I Learn?

This book is structured into six major sections that roughly follow the cloud journey that a complex organization is likely to undertake:

Part I: Understanding the Cloud

The cloud is very different from procuring a traditional IT product. So, rather than follow a traditional selection and procurement process, you'll have to rethink the way your IT works.

Part II: Organizing for the Cloud

Cloud computing impacts more than technology. Getting the most out of cloud necessitates organizational changes, affecting both structure and processes.

Part III: Moving to the Cloud

There are many ways to the cloud. The worst you can do is transport your existing processes to the cloud, which will earn you a new data center, but not a cloud—surely not what you set out to achieve! Therefore, it's time to question existing assumptions about your infrastructure and operational model.

Part IV: Architecting the Cloud

There's a lot more to cloud architecture than picking the right vendor or product. It's best to dodge all the buzzwords and use architectural decision models, instead. This includes multi- and hybrid-cloud, but perhaps not in the way the marketing brochures laid it out.

Part V: Building (for) the Cloud

> The cloud is a formidable platform. However, applications running on top of this platform need to do their part, as well. This section looks at what makes an application cloud-ready, what serverless is all about, and what the big deal is about containers.

Part VI: Budgeting the Cloud

> With greater control also comes greater responsibility. The cloud's elastic pricing and high levels of automation can significantly reduce your operational costs—as long as you're willing to leave some past assumptions behind.

Although you're most welcome to read all chapters in sequence, the book is designed to be read in any order that best suits your needs. So, you can easily dive into a topic that's most relevant to you and follow the many cross-references to related chapters. A cloud journey isn't linear.

Will It Answer My Questions?

I often warn my workshop participants that they should expect to leave with more questions than they came with. Similarly, this book presents a new way of thinking rather than simply being an instruction sheet. It may therefore also raise new questions. I consider this a good thing for two reasons. First, you'll have better questions in your mind, the ones that lead you to making meaningful decisions. And second, you'll have better tools to answer those questions within their specific context, as opposed to relying on some generic paint-by-numbers framework.

There is no copy-paste for transformation. So, this book likely won't tell you exactly what to do. But it will allow you to make better decisions for yourself. Think about it as learning how to fish (see the cover).

Do's and Don'ts

Much of this book is dedicated to looking beneath the surface of the cloud technology buzzwords, aiming to give enterprises a deeper and more nuanced

view on what's really involved in a cloud migration. However, as an architect or IT leader, you're also expected to devise an execution plan and lead your organization on a well-defined path. For that you need concrete, actionable advice.

Several chapters therefore include a *Do's and Don'ts* section at the end that summarizes recommendations and provides words of caution. You can use them as a checklist to avoid falling into the same traps as others before you. Think about yourself as Indiana Jones—you're the one who dodges all the traps filled with skeletons. It's challenging and might be a close call sometimes, but you come out as the hero.

What's with the Fish, Again?

The cover shows a swarm of fish that resembles a large fish. I took it in the Enoshima Aquarium in Japan, just a short train ride south of Tokyo, not far from Kamakura. Keeping with the theme of using personal photos of fish from *37 Things*, I selected this swarm because it illustrates how the sum of the parts has its own shape and dynamic—a swarm is more than just a bunch of fish. The same is true for complex architectures and the cloud in particular.

Getting Involved

My brain doesn't stop generating new ideas just because the book is published, so I invite you to have a look at my blog to see what's new:

> https://architectelevator.com/blog

Also, follow me on Twitter or LinkedIn to see what I am up to or to comment on my posts:

> http://twitter.com/ghohpe
> http://www.linkedin.com/in/ghohpe

Of course, I am happy if you would like to help spread the word and tell your friends about this book. The best way to do so is by sharing this handy URL:

http://CloudStrategyBook.com

To provide feedback and help make this a better book, please join our private discussion group: https://groups.google.com/d/forum/cloud-strategy-book

Acknowledgments

Books aren't written by a sole author locked up in a hotel room for a season (if you watched *The Shining*, you know where that leads…). Many people have knowingly or unknowingly contributed to this book through hallway conversations, meeting discussions, manuscript reviews, Twitter dialogs, or casual chats. My heartfelt thanks to all of them for their friendship and inspiration.

Chef kept me company throughout and fed me tasty pizza, pasta, and home-made cheesecake.

Part I: Understanding the Cloud

Dedicating several chapters of a book to understanding the cloud might seem like carrying owls to Athens. After all, cloud computing has become as ubiquitous as IT itself and the (online) shelves are full of related books, articles, blog posts, and product briefs. However, much of the available material is either product centric or promises amazing benefits without giving much detail about how to actually achieve them. In my mind, that's putting the technology cart before the enterprise horse.

Putting Cloud in Context

When embarking on a cloud journey, it's good to take a step back and realize that the cloud is a much bigger deal than it might seem from the onset. This way organizations can avoid treating a cloud transformation like yet another IT project. Instead, they need to prepare for a full-on lifestyle change.

To really appreciate the impact that cloud computing makes, it's good to first realize that IT's role in the enterprise is changing. And to put that in context, it's good to look at how the business evolves. Lastly, to understand why the business needs to change, it's helpful to look at how the competitive landscape has evolved.

Modern organizations that have grown up with the cloud think and work differently from traditional enterprises that are embarking on a cloud migration. It's therefore good to understand why the cloud is such a good fit for them and how (or whether) their structure and their behaviors translate to your organization's situation. Each starting point is different, and so is the journey.

It's *Your* Cloud Journey

Adopting the cloud because everyone else does it might be better than doing nothing, but it's unlikely to be a suitable basis for a sound strategy. Instead, you need to have a clear view of why you're moving to the cloud in the first place and what success looks like to your organization. Then, you can weave a path from where you are to that success. Along the way you'll know that there isn't a simple endpoint or even a stable target picture: cloud platforms evolve and so does your competitive playing field, making it a perpetual journey. It's therefore well worth putting some thought into starting out right and understanding what conscious decisions and trade-offs you are making.

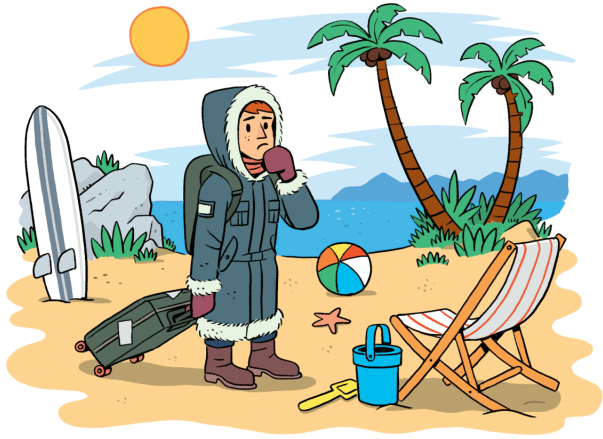
Rethinking Cloud Computing

This part helps you take a fresh look in the context of business transformation. Along the way, you'll realize a few things that the shiny brochures likely didn't tell you:

- That success in the cloud requires an IT lifestyle change
- That cloud-ready organizations think in the first derivative
- That wishful thinking isn't a strategy
- That principles link strategy and decisions
- That if you don't know how to drive, buying a faster car is a bad idea

1. Cloud Isn't IT Procurement; It's a Lifestyle Change

You don't buy a cloud, you embrace it.



"They warned us not to bring our entire wardrobe..."

Corporate IT is fundamentally structured around a *buy over build* approach. This makes good sense because it isn't particularly useful for the average enterprise to build its own accounting, human resources, payroll, or inventory system. The same is true of much of the IT infrastructure: enterprises procure servers, network switches, storage devices, application servers, and so on.

Naturally, enterprises tend to follow the same approach when they look at cloud platforms and cloud vendors. Sadly, this can lead to trouble before the first application is ever migrated to the cloud.

Procuring a Cloud?

Most traditional IT processes are designed around the procurement of individual components, which are then integrated in house or, more frequently, by a system integrator. Much of IT even defines itself by the bill of materials that they procured over time, from being "heavy on SAP" to being an "Oracle Shop" or a "Microsoft House". So, when the time comes to move to the cloud, enterprises tend to follow the same, proven process to procure a new component for their ever-growing IT arsenal. After all, they have learned that following the same process leads to the same desirable results, right? Not necessarily.

The cloud isn't just some additional element that you add to your IT portfolio. It becomes the fundamental backbone of your IT: the cloud is where your data resides, your software runs, your security mechanisms protect your assets, and your analytics crunch numbers. Embracing the cloud resembles a full-on IT outsourcing more than a traditional IT procurement.

A cloud platform isn't an additional element that you add to your IT portfolio. It resembles full-on IT outsourcing more than IT procurement.

The closest example to embracing the cloud that IT has likely seen in the past decades is the introduction of a major ERP (Enterprise Resource Planning) system—many IT staff will still get goose bumps from those memories. Installing the ERP software was likely the easiest part, whereas integration and customization typically incurred significant effort and cost, often into the hundreds of millions of dollars.

We're moving to the cloud not because it's so easy, but because of the undeniable benefits it brings, much like ERP did. In both cases, the benefits don't derive from simply installing a piece of software. Rather, they depend on your organization adjusting to a new way of working that's embedded in the platform. That change was likely the most difficult part of the ERP implementation but also the one that brought the most significant benefits. Luckily, clouds are built as flexible platforms and hence leave more room for creativity than the "my way or the highway" attitude of some ERP systems.

How the Cloud Is Different

Applying traditional procurement processes to cloud computing is likely to lead to disappointment. That's because most of these processes are based on assumptions that were true in the past but that don't hold for the cloud. Attempting to implement new technology using an old model is like printing out emails and filing the paper. You think no one does it? I still get occasional emails with a "save the environment; don't print this mail" at the bottom. Adopting new technology is fairly easy. Adjusting your way of thinking and working takes much more time.

Two classic examples of existing processes that won't mesh with the cloud model are procurement and operations. Let's have a look at each area and how the cloud changes the way we think about it.

Procurement

Procurement is the process of evaluating and purchasing software and hardware components. Because a good portion of IT's budget flows through it, procurement tends to follow strict processes to assure that money is spent wisely, fairly, and sparsely.

Predictability versus Elasticity

Many IT processes are driven through budget control: If you want to start a project, you need budget approval; likewise if you want to buy any piece of software or hardware. In the traditional view of IT as a cost center, such a setup makes good sense: if it's about the money, let's minimize the amount that we spend.

Traditional IT budgets are set up at least a year in advance, making predictability a key consideration. No CFO or shareholder likes to find out nine months into the fiscal year that IT is going to overrun its budget by 20%. Therefore, IT procurement tends to negotiate multiyear license terms for the software they buy. They "lock in discounts" by signing up for a larger package to accommodate any increase in usage over time, despite not being able to fully utilize it right from the start. If this reminds you of the free cell phone minutes that are actually

free only after you pay for them in bulk, you might be onto something. And what's being locked in here isn't so much the discount but the customer.

The cloud's critical innovation, and the reason it's turned IT upside down, is its elastic pricing model: You don't pay for resources up front but only for what you actually consume. Such a pricing model enables a major cost savings potential; for example, because you don't pay for capacity that you aren't yet utilizing. However, elasticity also takes away the predictability that IT so much cherishes. I have seen a CIO trying to prevent anyone from ordering a new (virtual) server, inhibiting the very benefit of rapid provisioning in the cloud. Such things can happen when a new way of working clashes with existing incentives.

Feature Checklist versus Vision

To spend money wisely, IT procurement routinely compares multiple vendor offerings. Some organizations, especially in the public sector, even have a regulatory requirement to solicit multiple vendor offers to assure disciplined and transparent spending. To decide between vendors, procurement makes a list of required features and non-functional requirements, scoring each product along those dimensions. They add up the scores and go into negotiation with the vendor with the highest number.

This approach works reasonably well if your organization has a thorough understanding of the product scope and the needs you have, and you are able to translate those into desired product features. Although this process has never been a great one (is the product with a score of 82.3 really better than the one with 81.7?), it was alright for well-known components like relational databases.

Unfortunately, this approach doesn't work for cloud platforms. Cloud platforms are vast in scope, and our definition of what a cloud should do is largely shaped by the cloud provider's existing and upcoming offerings. So, we're caught in a loop of cloud providers telling us what the cloud is so we can score their offering based on that definition. As I jested in *37 Things*, if you have never seen a car and visit a well-known automotive manufacturer from the Stuttgart area, you'll walk out with a star emblem on the hood as the first item in your feature list (see "The IT World is Flat" in *37 Things*). Trust me, speaking to IT staff after a vendor meeting makes even that cheeky analogy seem mild.

Because traditional scoring doesn't work well for clouds, a better approach is to compare your company's vision with the provider's product strategy and

philosophy. For that, you need to know *why you're going to the cloud* and that *buying a faster car doesn't make you a better driver*.

Snapshot versus Evolution

Massive checklists also assume that you can make a conscious decision based on a snapshot in time. However, clouds evolve rapidly. A checklist from today becomes rather meaningless by the time the cloud providers hold their annual re:Invent/Ignite/Next event.

Related to the previous consideration, IT should therefore look to understand the provider's product strategy and expected evolution. Not many providers will tell you these straight out, but you can reverse engineer a good bit from their product roadmaps. After all, the cloud platform's constant evolution is one of the main motivators for wanting to deploy on top of it. To speak mathematically, you're more interested in the vector than the current position.

Product versus Platform

Most items procured by IT are products: they serve a specific purpose, perhaps in coordination with other components. This makes it easy to look at them in isolation.

The cloud is a giant platform that forms the basis for software delivery and operations. While some large software systems can also be heavily customized and may be positioned as a platform, the cloud is different in that it's an extremely broad and flexible playing field. Attempting a metaphor, you could say that traditionally IT has purchased artwork, but with cloud it's buying a blank canvas and some magic pens. Therefore, when embarking on a cloud journey many more considerations come into play.

Local Optimization versus Global Optimization

When selecting products, IT commonly looks at each product individually, following a best-of-breed approach that picks the best solution for each specific task.

Cloud platforms contain hundreds of individual products, making a comparison between individual products rather meaningless unless you're limiting your

move to the cloud to one very specific use case like pre-trained machine learning models. When looking at the cloud as a platform, though, you need to look at the whole and not just the pieces (remember the book cover?). That means optimizing across the platform as opposed to locally for each component, an exercise that is more complex and will require coordination across different parts of the organization.

Matching the Business to the Software

Procuring a product is traditionally done by matching the product's capabilities against the organization's needs. The underlying assumption is that the product that most closely matches your organization's way of working will provide the most value to your business. If you have a family of five, you'll want a minivan, not a two-seater sports car.

In the case of cloud, though, you're not looking to replace an existing component that serves a specific organizational need. Rather the opposite, you're looking for a product that enables your organization to work in a fundamentally different way (that's what we call "transformation"). As a result, you should be adjusting your organization's operating model to the platform you're buying. Hence, you should see which model underlying the cloud platform you find most appropriate for your organization and work backward from there. Although the platforms might look roughly similar from the outside, upon closer inspection you'll realize that they are built under different assumptions that reflect the provider's culture.

Operations

The cloud doesn't just challenge traditional procurement processes, but operational processes, as well. Those processes exist to "keep the lights on", making sure that applications are up and running, hardware is available, and we have some idea of what's going on in our data center. It's not a big surprise that cloud computing changes the way we operate our infrastructure significantly.

Infrastructure Segregated vs. Integrated

Most IT departments distinguish infrastructure operations from application delivery. Reflecting this split in the organizational structure has "change" departments building applications to be handed (or tossed) over to "run" departments

to be operated. Critical mechanisms such as security, hardware provisioning, and cost control are the operations teams' responsibility, whereas features delivery and usability are in the application teams' court.

Automation, a central theme of cloud computing, gives development teams direct access to infrastructure configuration and thus blurs the lines. Likewise, security, cost control, scaling, and resilience span both application and infrastructure.

Compliance through Control vs. Transparency

Traditional IT's low levels of transparency led to a flurry of control processes, such as limiting developers' access to infrastructure configuration, restricting deployments, or requiring manual inspections and sign-offs. Such processes are at odds with modern software delivery approaches, such as DevOps or Continuous Delivery, and cause friction.

Rather than rely on restrictive processes, the cloud's dramatic increase in transparency allows usage and policy violations to be detected automatically, increasing compliance while easing the process burden. Traditional paper sign-offs for manual steps ended up being mere proxies with a weak link to reality, anyhow. The new approach, while powerful, requires an IT lifestyle change to harness the platform's technical capabilities, such as automatically scanning deployment scripts for policy violations.

Resilience Through Redundancy vs. Automation

IT traditionally boosts system uptime through redundancy: if a server running an important application fails, there's a fully configured standby server ready to take over. The approach minimized the disruption but caused unfavorable economics as half the production servers were essentially doing nothing. Alas, with monolithic applications and manual deployments, there was no other choice as deploying a new instance would take far too long.

Cloud automation enables auto-scaling architectures, meaning new application instances can be added quickly and easily in case of hardware failure or load surges. Because new application or service instances can be deployed immediately, "warm standby servers" are no longer needed. This is one of several examples of how the cloud can bring substantial cost savings, as long as you adjust the way you work.

A Side-by-Side Comparison

The following table contrasts the operating models:

Capability	Traditional	Cloud
Budgeting	Predictability	Elasticity
Suitability	Feature Checklist	Vision
Functionality	Snapshot	Evolution
Scope	Component	Platform
Optimization	Local	Global
Alignment	Product to Business	Business to Product
Operational Model	App vs. Infra	Apps and Infra
Compliance	Control	Transparency
Resilience	Redundancy	Automation

This list gives you a indication that cloud is a 180-degree departure from many well-known IT processes. Selecting a cloud isn't your typical IT procurement and applying your traditional procurement and operational processes to a cloud adoption could easily put you on the wrong starting point. The list isn't exhaustive, as, for example, the cloud also challenges existing financial processes.

Same but Very Different

Despite the stark differences from traditional IT, the major cloud providers' product portfolios might look quite similar to one another. However, having worked not only at two cloud vendors, but also with many cloud customers, I can confidently state that the organizations behind the cloud platforms have very different cultures and operating models. If you have a chance to visit multiple vendors for an executive briefing, you should not just pay attention to the technical content, but also try to understand the organization's culture and underlying assumptions.

Because the cloud is a journey, compare cloud providers not just by their products but also their by their history and cultural DNA.

A telling indicator is the core business that each vendor engaged in before they started to offer cloud services. That history has shaped the vendor's organizing principles and values as well as its product strategy. I won't elaborate on the differences here, because I'd like you to go have a look for yourself (and I also don't want to get into trouble). However, I am sure that after spending a bit of time with each vendor outside of the typical sales pitch will give you a very vivid picture of what I am hinting at.

Because the cloud is a journey more than a destination, it requires a long-term partnership. Therefore, I highly recommend having a look behind the scenes, at the organization and not just the product, to understand the provider's culture and whether it matches your aspirations.

The Cloud in the Enterprise

Cloud providers dealing with enterprises face an interesting dilemma. On one hand, they represent a non-traditional IT model that requires enterprises to transform. However, they still need to help those enterprises on the way. So, the providers make their clouds "enterprise ready" without trying to lose their digital roots. "Enterprise" features such as industry certifications are highly valuable and necessary, but one sometimes wonders whether glitzy customer experience centers overlooking vast control rooms where no real crisis ever seems to be taking place are really needed to engage enterprises.

When I visit customer experience centers, I feel like going to a fancy casino: I am mightily impressed until I remember where all the money comes from.

Commitment-based pricing models favored by most enterprises stand in contrast to cloud's elasticity—discounts are given for multi-year agreements that specify a committed minimum spend. Traditionally, such plans compensate for the high cost of enterprise sales; for example, all those folks flying around the world for 60-minute customer meetings and elaborate conferences with

well-known musical acts. Isn't the cloud supposed to do away with much of that tradition? Cynics define "enterprise software" as being bloated, outdated, inflexible, and expensive. Let's hope that cloud and traditional enterprise meet somewhere in the middle!

Transforming organizations is challenging in both directions. Whereas traditional enterprises install free baristas because that's what they observed in their digital counterparts, internet-scale companies copy the cheesy customer experience centers that they observe in traditional enterprise vendors. Both initiatives are unlikely to have the intended effect.

Transformation Doesn't Have a SKU

Going to the cloud entails a major lifestyle change for IT and perhaps even the business. Transforming existing organizational structures and processes to embrace the cloud is challenging, especially for wealthy organizations. They're so used to getting it all that they believe everything is just a matter of securing sufficient funding. Such organizations resemble spoiled children who are used to getting any toy they wish for. Usually, their room is so full of toys that they can no longer find anything. I have seen many IT environments that look just like that—you can surely picture the CIO looking for his or her blockchain among all the other IoT, AI, RPA, and AR initiatives.

One critical lesson for such organizations, discussed in more detail in *37 Things*, is that an IT transformation isn't something you can buy with money—it doesn't have a SKU[1]. Rather, transformation forces you to question the very things that helped you become successful in the past. Ironically, the more successful an organization has been, the more difficult this exercise becomes.

Changing Lifestyle

It might help to think of moving to the cloud like moving to a different country. I have moved from the United States to Japan and had a great experience, in large part because I adopted the local lifestyle: I didn't bring a car, moved into a much smaller (but equally comfortable) apartment, learned basic Japanese, and got used to carrying my trash back home (the rarity of public trash bins is a favorite topic of visitors to Japan). If I had aimed for a 3,000 square-foot home

with a two-car garage, insisted on driving everywhere, and kept asking people in English for the nearest trash bin, it would have been a rather disappointing experience. And in that case, I should have likely asked myself why I am even moving to Japan in the first place. When in Rome, do as the Romans do (or the Japanese—you get my point).

2. Cloud Thinks in the First Derivative

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In economies of speed, the cloud is natural.

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Wishes are free but rarely come true.

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A Strategy Helps Wishes Come True

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A Strategy You Need

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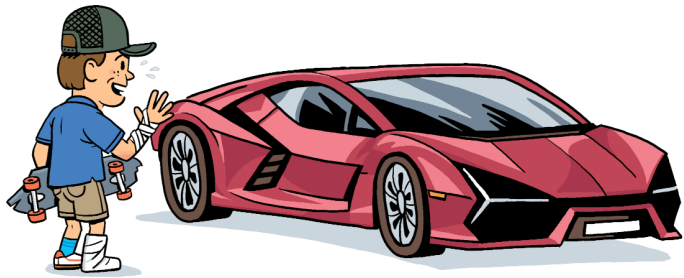
5. If You Don't Know How to Drive...

...buying a faster car is the worst thing you can do.



"When I grow up, I want one of those!"

Window shopping is a popular pastime: it doesn't cost very much and you can look at many exciting things, be it luxury fashion or exotic cars. Sometimes window shopping lures you into actually buying one of these shiny objects only to find out that they weren't really made for the average consumer. Or, to put it another way: the average driver is likely better off with a VW Golf (or perhaps a BMW) than the latest Lamborghini. The same holds true for corporate IT when it goes shopping for cloud[1].

Shiny Objects Can Make You Blind

Favoring a buy-over-build model, IT spends a fair amount of time shopping around for solutions. In the process, enterprises can compare vendor solutions, conduct evaluations, and also learn quite a bit. Of course, looking for new IT

[1]The analogies in this chapter refer to several traditional gender role models. They are intended purely for sake of metaphor and don't indicate any endorsement in either direction by the author.

solutions is a bit like window shopping for cars, clothing, or real estate. For a moment, you can break away from the constraints of reality and get a taste of the life in luxury: the racy two seater (that doesn't have room for the kids), the fancy dress (that's not washable and a bit too sheer), and the exquisite country home (that's half an hour's drive away from the next store). All these have their lure but ultimately give way to the pressures of reality. And that's generally a good thing, unless you're keen to take out the two seater wearing an evening dress to get milk (I guarantee it will get old).

So, when looking at products, IT or not, we are well advised to separate the "being enamored by shiny objects" from the "let's actually buy something that serves our needs" mode. While the former surely is more fun, the latter is more important.

Capability ≠ Benefit

A critically important but often-neglected step when evaluating products is the translation of a tool's abstract capability into concrete value for the organization. Some systems that can scale to 10,000 transactions per second are as impressive as a car with a top speed of 300 km/h. However, they bring about as much benefit to a typical enterprise as that car in a country that enforces a 100 km/h speed limit. If anything, both will get you into trouble. You either end up with a speeding ticket (or in jail) or stuck with overpriced, highly specialized consultants helping you implement a simple use case in an overly complex tool.

Not every tool feature translates into concrete value for your organization. Fancy features that you don't need mean you're paying for something that doesn't have any value to you.

Naturally, vendors benefit from us ogling shiny objects. It gives them a shot at selling us that two-seater. A common sales technique for this goes as follows: The salesperson leads us into describing ourselves as more sophisticated/modern/stylish than we really are. The next step, then, is the suggestion to buy a product that's suitable to a person or company of that inflated standing. This technique is nicely illustrated in Bob Cialdini's classic *Influence*[2]: a young woman comes to survey his social habits, which he naturally overstates a fair

bit. Next, she builds a rational business case for him to sign up for some form of social club membership that gives discounts for folks who frequently go out. Or, perhaps closer to (enterprise) home: "organizations like yours who are successfully moving to the cloud realize substantial savings by making a larger up-front commitment"—wanna tell them that your cloud migration is going a bit more slowly than anticipated?

The Best Tool Is the One That Suits Your Level

Fancy tools need fancy skills, meaning a product that matches your capabilities is best for you. Or, put another way, if you're a poor driver, about the dumbest thing you can do is buy a faster car. It will only make a crash more likely and more expensive—probably not what you were looking for unless you're angling to be immortalized in YouTube's amazingly popular "supercar fails" channels. It seems that *Schadenfreude* drives viewership, but perhaps not quite to the point of making the economics work out. So, first become a better driver and consider upgrading after you've maxed out your vehicle's capabilities.

The one time I tested my driving skills on the Nürburgring Nordschleife in a (admittedly underpowered) BMW 1-series rental car, I was passed by a VW Golf and a (surely overpowered) minivan. A faster car wouldn't have helped much except to get me into trouble.[3]

Back in IT the same applies. Transformation takes place by changing an organization's assumptions and operating model. There is no SKU for transformation—it's not something that you can buy. Better tools help you work in better ways (you probably won't take the Yugo to the Nürburgring), but there's a cycle of continuous improvement in which both tools and capabilities incrementally ratchet up.

Look for products that generate value even if you use only a subset of features, thus giving you a "ramp" to adoption.

[3] I do get my redemption, however, every time I pass someone riding a much more expensive mountain bike.

When procuring IT tools, organizations therefore shouldn't pick those products that have the longest list of features, but those that can grow with them; for example, by providing value even if you use only a subset of features. I refer to this capability as affording *incremental value delivery*. Or, to quote Alan Kay: "Simple things should be simple, complex things should be possible."

Giant Leaps Don't Happen

As our capabilities improve, isn't it OK to buy a tool one or two sizes ahead of where you are now? It's like buying kids' shoes half a size bigger—they'll be the right size in two months. On the other hand, wanting to have an adult racing cycle when you're just learning how to balance is dangerous.

The same holds true for IT tools. A unified version control system and some form of continuous integration are a great step forward toward accelerated software delivery even if you still have to work on shortening your release cycles and improving your test coverage. A fully automated build-deploy-Kubernetes-container-Helm-chart-generator setup is likely less helpful—it's a great aspiration and may get you some bragging rights, but it's too much to bite off in one setting for traditional IT.

When looking at tools, target a clear progression and keep a balanced view on how far you can jump in one setting. If you're a bit behind, it's ever so tempting to catch up by making one big leap. The reality is, though, that if a small step is difficult to make, a giant jump is guaranteed to end up in utter failure.

Organizations that have fallen behind are tempted to make one giant leap ahead to catch up. Sadly, this is the most unlikely path to success.

IT's inclination to look too far ahead when procuring tools often isn't the result of ignorance but of excessive friction in approval processes. Because procuring a new product requires elaborate evaluations, business cases, security reviews, and so on, starting with a simple tool and upgrade soon after would be inefficient—you'd just be doing the whole process over again. Instead, teams are looking for a tool that will suit them three years down the road, even if it's a struggle for the first two. Systemic friction is once again the culprit for IT's ailments.

You Can Sell Only What People Don't Already Have

There's a common assumption that products are made and sold to address an unmet customer need. However, I don't find that equation to be quite that simple. In many cases it appears that demand is first created just so it can be subsequently addressed. Allow me to try another analogy from daily life.

Having lived and worked on three continents, I have observed how the fashion and beauty industries set quite different, and often opposing, ideals in different regions. In Asia, it's desirable to be fair skinned (a heavy tan makes you look like a farmer, supposedly), whereas in Europe the number of tanning studios is only barely outdone by fitness centers (being tanned means you can afford an exotic beach vacation or perhaps at least a tanning studio). Asian women often wish they were more full-figured, whereas everyone else seems to be trying to lose weight and become more petite. The list of contrasting goals continues to include high cheekbones (European models tend to have them, Asian models usually don't), wide or narrow noses, round or almond-shaped eyes, and so on.

While body image is always a delicate topic, I've personally come to derive two conclusions from this:

1) Be happy being whoever you are regardless of what's on the billboards.
2) People who sell you stuff will promote an ideal that's rare and difficult, if not impossible, to achieve. See conclusion #1.

Back in IT, we can find quite a few analogies. While your enterprise is proudly making its first steps into the cloud, you are made to believe that everyone else is already blissfully basking in a perimeter-less-multi-hybrid-cloud-native-serverless nirvana. Even if that were the case, it would still be fine to be going at your own pace. You should also be a bit skeptical as to whether there's some amplification and wishful thinking at play. Go out and have a look—you might see some of your peers at the tanning studio.

Don't fret if you're not on the bleeding edge. There *are* successful businesses that don't run all their applications as microservices in containers being deployed 1,000 times a day. It's OK.

Marketing Isn't Reality

Technology moves fast, but technology adoption is often not quite as fast as the readers of quarterly earnings reports or attendees of semi-annual launch events would like. Transforming IT infrastructure and changing the fundamental operating model may take a sizable enterprise two, three, or even five years. In the meantime, vendors have to announce new things to stay in business.

Hence, we get to see shiny demos that auto-deploy, auto-heal, auto-migrate, and almost auto-procure (lucky for us, not quite yet). Looking ahead at product evolution is quite useful when selecting vendors or products, so marketing serves a valuable function (I have many good friends in marketing and highly appreciate their work). But we mustn't confuse vision with reality. Marketing shares a possible target picture, whereas we are the ones who actually walk the path, and that's usually done by taking one step after another.

Does a Better Knife Make You a Better Cook?

Indulge me to share one last metaphor. I love cooking—it serves as an important therapeutic function that lets the hands and the intuition do their work while my brain cools off. After spending a good bit of time in specialty shops around the globe, Europe is my favorite source for pots and baking supplies. I look to Japan for knives, ceramics, wooden products, and hyper-specialized tools like my *ginger grater cleaner*. Over time, the significant price increase for basic kitchen tools, such as knives, struck me. General inflation aside, a very good German knife used to run some 30–40 Euros. Modern kitchen shops are now full of knives for easily five times that, sometimes running north of 400 Euros. While there's certainly a bit of priming at play (see *Making Decisions* in *37 Things*), another reason given by the stores were changes in cooking habits.

In most Western societies, the domestic role model up until the mid-to-late twentieth century was based on women taking care of food and child rearing while men would work in the fields or later in factories and offices. This division of labor led to knives being a tool—a thing that you use to cut your meat or vegetables. And a €30 knife managed that just fine. Men increasingly taking an interest in cooking changed kitchen supplies, especially knives, from being basic tools to being seen as hobby or even vanity items. This change led to a

very different product selection and pricing model—the cook is now a modern-age samurai who chooses to wield his 200-times folded carbon steel blade at tomatoes rather than enemies.

Translating my cooking experiences back to IT, I like to ask vendors pitching their shiny tools: will your better knife make me a better cook? Or will it rather put my fingers at risk? I do enjoy a good knife, but my experience tells me that good cooking comes from practice and a good understanding of how to prepare and assemble the ingredients. And you could say the same of good architecture! So, buy a solid IT tool, not a vanity item, and invest in your own skill!

Part II: Organizing for the Cloud

The cloud implies a fundamental IT lifestyle change. That's why getting the most out of it requires changes to the organization, including departmental structures, processes, career schemes, and HR guidelines. Moving to the cloud is thus as much an organizational as it is a technology topic. The relationship between technical and organizational change is one of the core themes of my book *The Software Architect Elevator*[1] and applies directly to cloud transformations.

Even adopting cloud computing as a purely technical move implies an organizational change. After all, you're outsourcing a big portion of your IT responsibilities to a third party. This doesn't mean, though, that all operational concerns disappear—quite the contrary. Organizing for the cloud has a wide-ranging impact on operational and business functions up to financial management.

Culture Changes

My friend Mark Birch, who used to be the regional director for Stack Overflow in APAC, pointedly concluded:

> *There is no Stack Overflow for transformation where you just cut and paste your culture change and compile.*

Organizations are often portrayed by their structure—the classic *org chart*. Many organizations therefore wonder what new kind of structure they should

[1] Hohpe, *The Software Architect Elevator*, 2020, O'Reilly Media

embrace when they move to the cloud. Sadly, structural changes alone rarely bring the anticipated results. Rather, changing the way of working, including the written and often unwritten processes, is essential to harvesting the benefits of moving to the cloud.

Organizational Architectures

To not leave this book devoid of references to *The Matrix* movie trilogy, the *Matrix Reloaded* includes a famous scene that has the Merovingian comment on Neo stopping a hail of bullets mid air with, "OK, you have some skill." Successfully migrating applications to or building applications for the cloud also requires some skill, perhaps short of stopping bullets with your bare hands.

Rather, technical teams need to be familiar with the wealth of products and services being offered, account management and permissions schemes, modern application architectures, DevSecOps, and much more. A decade ago, hardly any of these concepts existed. On one hand, that's a great level setter—everyone starts fresh. But it also means that not learning new technologies and new ways of working puts you at risk of quickly being left behind.

Organizations therefore need to decide to what extent they can train existing staff and how they are going to acquire new skill sets. Some organizations are looking to start with a small Center of Excellence, which is expected to carry the change to the remainder of the organizations. Other organizations have trained and certified everyone, including their CEO. The happy medium will vary by organization. So, along with your technical cloud architecture, you'll also want to be defining your organizational architecture.

Organizing for the Cloud

Organizations built for the cloud have learned that…

- The cloud is outsourcing, but of a special kind.
- The cloud turns your organization on its side.
- Needing new skills doesn't mean hiring different people.
- Hiring a digital hitman is bound to end in mayhem.
- Enterprise Architecture gets a new meaning in the cloud.

6. Cloud Is Outsourcing

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And outsourcing is always a big deal.

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Don't Outsource Thinking!

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And your customers will like it.

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8.
Retain / Re-Skill / Replace / Retire

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Re-Skill

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Replace

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Retire

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Training Is More Than Teaching

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Re-Label?

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What ends poorly in the movies rarely goes well in IT.

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The Digital Hit(wo)man

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Crossing Over into the Unknown

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What Do They Look for?

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It Sure Ain’t Easy, but It’s Doable

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10. Enterprise Architecture in the Cloud

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Keeping your head in the cloud but the feet on the ground.

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Bringing Value to the Cloud Enterprise

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Part III: Moving to the Cloud

Understanding that the cloud is an entirely different affair from traditional IT procurement is a good precondition for laying out a cloud strategy. Now, it's time to tackle the shift of on-premises resources to a cloud operating model.

In with the New…

The center of such a strategy will be the migration of existing on-premises applications to the cloud. However, simply moving your IT assets from your premises to the cloud is more likely to yield you another data center than a cloud transformation. You therefore need to shed existing assumptions—leaving things behind is a critical element of any cloud migration. Some of the things to be left behind are the very assumptions that made IT big and powerful, such as operating servers and packaged applications.

Connecting the Dots

Widespread "advice" and buzzwords can muddy the path to cloud enlightenment. My favorite one is the notion of wanting to become a "cloud native" organization. As someone who's moved around the world a good bit, I can't help but point out that "being native" is rather the opposite of "migrating". So, for a successful migration, we want to trade slogans for insights.

Measuring Progress

Your goal shouldn't be to achieve a certain label (I'll give you any label you'd like for a modest fee), but to improve on concrete core metrics that are relevant to

the business and the customer such as uptime or release frequency. Measuring IT metrics like percentage of workloads moved might be more satisfying but is bound to be a proxy for real progress.

Plotting a Path

Cloud service providers and third parties provide many resources that help you with the mechanics of a cloud migration. For example, AWS, Microsoft Azure, and Google Cloud each published an elaborate Cloud Adoption Framework.

Those frameworks lay out options ranging from re-architecting applications to just lifting-and-shifting them as is. Most of them assume a one-step process, though: you decide the path for each application and off you go. Reality isn't as simple as that. Applications are interdependent, and migrations often take multiple passes of preparing, shifting, optimizing, and re-architecting workloads. A migration strategy is more than dividing applications into buckets.

Rather than replicate advice that's already presented in a well-structured format, this chapter fills in the gaps by alerting you to common pitfalls and highlighting important nuances:

- Be clear why you're going to the cloud in the first place.
- Remember that no one wants a server.
- Realize that you shouldn't run software that you didn't build.
- Don't let internal processes turn your cloud into a non-cloud!
- Make sure you have the right team and a good plan for your move to the cloud.
- Dig out your high school course notes to apply Pythagoras to your cloud migration.
- Making progress is good, but what counts is value delivered.

11. Why Exactly Are You Going to the Cloud, Again?

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Knowing where you want to go will help you get there.

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There are Many Good Reasons to Come to the Cloud

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Cost

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"It Runs in the Cloud" Doesn't Make the Mark

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But What About...

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Strategy = Setting the Vector

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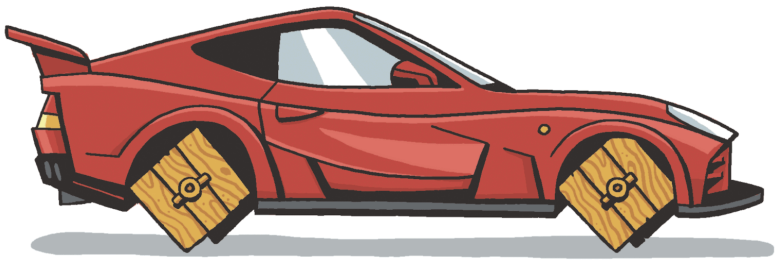
14. Don't Build an Enterprise Non-Cloud!

Be careful not to throw the cloud baby out with the enterprise bathwater.



This fancy looking sports car is unlikely to meet your expectations

Many enterprises that moved to the cloud have found that not all of their expectations have been met, or at least not as quickly as they would have liked. Although an unclear strategy or inflated expectations can be culprits, in many cases the problems lie closer to home. The migration journey deprived the enterprise of exactly those great properties that the cloud was going to bring them.

Enterprise-Flavored Cloud

When enterprises move to a commercial cloud provider, they don't just grab a credit card, sign up, and deploy away. They have to abide by existing policies and regulations, need to ensure spend discipline, and often have special data encryption and residency requirements. Therefore, almost every IT department

has a cloud transformation program underway that attempts to marry existing ways of working with the operating model of the cloud. Now, because the amazing thing about the cloud is that it rethinks the way IT is done, we can imagine that this translation process isn't trivial.

Enterprises don't just grab a credit card, sign up for a cloud provider, and deploy away.

When I work with large organizations on their cloud strategy, several recurring themes come up:

- Onboarding process
- Hybrid cloud
- Virtual Private Cloud (VPC)
- Legacy applications
- Cost recovery

Each of them makes good sense. Let's take a closer look.

Onboarding

Enterprises have special requirements for cloud accounts that differ from start-ups and consumers:

- They utilize central billing accounts to gain cost transparency instead of people randomly using credit cards.
- They need to allocate cloud charges to specific individual cost centers.
- They negotiate discounts based on overall purchasing power or "commits", stated intents to use a certain volume of cloud resources.
- They may limit and manage the number of cloud accounts being shared in the organization.
- They may require approvals from people whose spending authority is sufficiently high.

Most of these steps are necessary to connect the cloud model to existing procurement and billing processes, something that enterprises can't just abandon overnight. However, they typically lead to a semi-manual sign-up process for project teams to "get to the cloud". Likely, someone must approve the request, link to a project budget, and define spend limits. Also, some enterprises have restrictions on which cloud providers can be used, sometimes depending on the kind of workload.

Cloud developers might need to conduct additional steps, such as configuring firewalls so that they are able to access cloud services from within the corporate network. Many enterprises will require developer machines to be registered with device management and be subjected to endpoint security scans (aka "corporate spyware").

Hybrid Network

For enterprises, hybrid cloud is a reality because not all applications can be migrated overnight. This will mean that applications running in the cloud communicate with those on premises, usually over a combination of a cloud interconnect, which connects the VPC with the existing on-premises network, making the cloud look like an extension of the on-premises network.

Virtual Private Cloud

Enterprises aren't going to want all of their applications to face the internet, and many also want to be able to choose IP address ranges and connect servers with on-premises services. Many enterprises are also not too keen to share servers with their cloud tenant neighbors. Others yet are limited to physical servers by existing licensing agreements. Most cloud providers can accommodate this request, for example with dedicated instances or dedicated hosts (e.g., AWS or Azure).

Legacy or Monolithic Applications

The majority of applications in the enterprise portfolio are going to be third-party commercial software. Applications that are built in house often are architected as single instances (so-called "monoliths"). These applications cannot easily scale out across multiple server instances. Re-architecting such applications is either costly or, in case of commercial applications, not possible.

Cost Recovery

Lastly, preparing the enterprise for a commercial cloud, or the commercial cloud for enterprise, isn't free. This cost is typically borne by the central IT group so that it can be amortized across the entire enterprise. Most central IT departments are cost centers that need to recover their cost, meaning any expenditure has to be charged back to business divisions, which are IT's internal customers. It's often difficult to allocate these costs on a per-service or per-instance basis, so IT often adds an "overhead" charge to the existing cloud charges, which appears reasonable.

There may be additional fixed costs levied per business unit or per project team, such as common infrastructure, the aforementioned VPCs, jump hosts, firewalls, and much more. As a result, internal customers pay a base fee on top of the measured cloud usage fee.

Remembering NIST

The US Department of Commerce's National Institute of Standards and Technology (NIST) published a very useful definition of cloud computing in 2011 (PDF download). It used to be cited quite a bit, but I haven't seen it mentioned very much lately—perhaps everyone knows by now what the cloud is and the ones who don't are too embarrassed to ask. The document defines five major capabilities for cloud computing (edited for brevity):

On-Demand Self-Service
: A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction.

Broad Network Access
: Capabilities are available over the network and accessed through standard mechanisms.

Resource Pooling
: The provider's computing resources are pooled to serve multiple consumers using a multitenant model, with different physical and virtual resources dynamically.

Rapid Elasticity
: Capabilities can be elastically provisioned and released to scale rapidly outward and inward with demand.

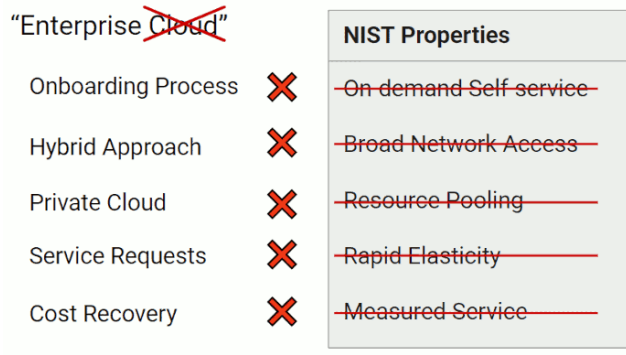
Measured Service
: Cloud systems automatically control and optimize resource use by leveraging a metering capability (typically pay-per-use).

So, after going back to the fundamental definition of what a cloud is, you might start to feel that something doesn't 100% line up. And you're spot on!

The Enterprise Non-Cloud

Putting the enterprise "features" that I mentioned earlier next to the NIST capabilities, you realize that they largely contradict:

- Lengthy sign-up processes contradict on-demand self-service because they routinely require manual approvals and software installs—corporate IT processes send their regards.
- Your corporate network isn't going to be quite as broad as the internet, and firewalls and loads of other restrictions make network access far from being universal.
- Dedicated instances aren't as widely pooled and have poorer economies of scale. Your network interconnect is also dedicated.
- Traditional applications don't benefit from rapid elasticity, because they don't scale out and deployment often isn't automated.
- A high baseline cost charged from corporate IT makes the cloud a lot less "measured" and often burdens small projects with prohibitive fixed costs.



The enterprise non-cloud

That's bad news: despite all good intentions your enterprise didn't get a cloud! It got yet another good, ol' corporate data center, which is surely not what it was looking for.

Many "enterprise clouds" no longer fulfill the fundamental capabilities of a cloud.

What Now?

So, how do you make sure your enterprise cloud remains deserving of the label? Although there's no three-step recipe, a few considerations can help:

Calibrate Expectations

Realization is the first step to improvement. So, being aware of these traps helps avoid them. Also, it behooves us to temper rosy visions of cost savings and digital transformation. Moving all of your old junk to a new house means you'll be living with the same junk, just in a fancier environment. Likewise, carrying your enterprise baggage into the cloud won't transform anything.

Bring the Cloud to You, Not Vice Versa

The cloud isn't a classic IT procurement, but a fundamental change in IT operating model. Therefore, you should be cautious not to transport your

existing operating model to the cloud, because that will lead to the results cited earlier. Instead, you need to bring some elements of the cloud operating model to your environment. For example, you can replace cumbersome manual processes with automation and self-service so that they benefit both on-premises systems and those running in the cloud.

Measurable Goals

A cloud migration without clear measurable goals risks getting off track and becoming lost in shiny new technology toys. Instead, be clear why you're going to the cloud: to reduce cost, to improve uptime, to launch new products faster, to secure your data, to scale more easily, or to sound more modern. Prioritizing and measuring progress helps you stay on track.

Segmentation

Enterprise IT loves harmonization, but one cloud size won't fit all applications. Some applications don't need to undergo all firewall-compartment-peering-configuration-review-and-approval steps. Perhaps some applications—for example, simple ones not holding customer data—can just go straight to the cloud, just as long as billing isn't on Jamie's credit card.

When You're in the Cloud, Use the Cloud!

Cloud migrations navigate in treacherous waters. Many enterprises are falling into the trap of wanting to avoid lock-in at all cost and look to achieve that by not using cloud-provider-managed services because most of them are proprietary. This means no DynamoDB, Athena, SQS, BigQuery, Spanner, and so on. You might still have a cloud, but one that predates the NIST definition from 2011. If you embrace the cloud, you should also embrace managed services.

Enterprises embarking on a cloud journey often focus on the great new things they will get. But equally important is leaving some of your enterprise baggage behind.

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Get the right crew and watch where you're going.

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Federated vs. Centralized Execution

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Phase 3: Validation

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Environment Validation

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Cost Validation

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Business Goal Validation

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End Up Where You Need to Be

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16. Cloud Migration per Pythagoras

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It's time to dig out your schoolbooks.

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Adding Value to Pythagoras

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Part IV: Architecting the Cloud

It's difficult to imagine being successful in the cloud without understanding its architecture. Cloud platforms aren't single products but vast collections of services that often have an outsize impact on the way we work.

Busting Buzzwords

IT discussions are routinely dominated by product names and buzzwords. "To implement <buzzword>, we are evaluating <product A> and <product B>" is a common part of IT discussions, only outdone by the second version, "To become <buzzword>, we are evaluating <product C> and <product D>." I'll leave you to assign the words *Agile*, *Lean*, *digital*, *anti-fragile*, *zero trust*, *DevOps*, *IaC*, and *cloud native* to the respective sentences.

Translating buzzwords into meaningful considerations is one of enterprise architects' most important but also more delicate tasks. Although buzzwords promote *wishful thinking* because they often lack substance, they can aid communication by providing a common vocabulary. The key to achieving the latter is to create a common understanding that's deep enough to enable your audience to participate in the thought process without confusing them.

Spewing buzzwords at your audience shuts them out of the thought process. Architects need to do better than that.

It's More Than Picking Ingredients

Vendor certifications might fuel the notion that cloud architecture is mostly about selecting services and memorizing the respective features. It feels to me a bit like becoming a certified LEGO artist by managing to recite all colors and shapes of LEGO bricks (do they make a blue 1x7?). Selecting the right vendor and the right services is important, but putting those pieces together in a meaningful way that supports the business objectives is what cloud strategy and cloud architecture are all about.

I frequently compare being an architect to being a restaurant's star chef: picking good ingredients is useful, but how they're put together is what earns the restaurant its reputation. And, as anyone who has tried to re-create their favorite restaurant dish can attest, there's usually a lot more involved than is apparent from the end product.

Taking a true architect's point of view involves popular concepts like multi-hybrid and hybrid-multi-cloud, but perhaps not in the way it's described in the marketing brochures. There is no "best" architecture, just the one that's most suitable for your situation and your objectives. Hence, defining your cloud architecture requires a fair amount of thinking—something that you definitely should not outsource.

The Architect Elevator Connects Levels

The Architect Elevator defines a role model of an architect who can connect the business strategy in the corporate penthouse with the technical reality in the engine room. Instead of simply promising benefits, when such an architect looks at a collection of vendor products, they reverse engineer the key assumptions, constraints, and decisions behind those offerings. They will then map that insight to the enterprise's context and balance the trade-offs of putting these products together into a concrete solution.

Classic IT is built on the assumption that technical implementation decisions derive from business needs, making architecture a one-way street. The cloud

turns this assumption, like many others, on its head, favoring high-level decision makers who understand the ramifications of technical choices made in the engine room. After all, those technical decisions are the critical enablers for the enterprise's ability to innovate and compete in the market. Thus, it is the elevator architect's role not only to make better decisions but also to communicate them transparently to upper management. Decision models and visualizations prove to be extremely useful tools in this context.

Modeling Decisions

One could fill an entire book on cloud architecture, and several people have done so (I was lucky enough to write the foreword for *Cloud Computing Patterns*[1]). Cloud service providers are also increasingly providing architecture guidance such as Microsoft Azure's cloud architecture patterns).

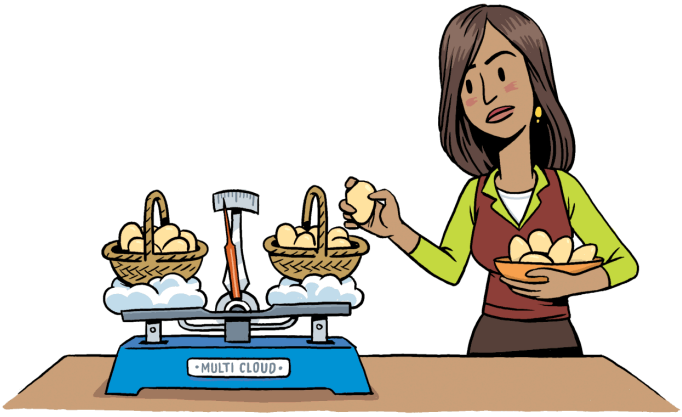
Building on top of that material, this part shifts attention towards meaningful decisions and trade-offs. Decision models and mental models guide you through major decision points along your cloud journey and allow you to make better informed and more disciplined decisions:

- There are many flavors of multicloud and you should choose carefully which one is best for you.
- Hybrid cloud requires you to separate your workloads into cloud and on-premises. Knowing your options helps you choose the best path.
- Architects like to look under the covers, so here's how different vendors architect their hybrid-cloud solutions.
- Many architects see their main job as battling lock-in. But life's not that simple: don't get locked up into avoiding lock-in!
- The cloud changes many past assumptions that drove popular architecture styles. Hence, we may see the end of multitenancy.
- Architects concern themselves with non-functional requirements, also known as "ilities". The cloud brings us a new "ility": disposability, and in an environmentally conscious fashion.

[1] Fehling, Leymann, Retter, Schupeck, Arbiter, *Cloud Computing Patterns*, Springer 2014

18. Multicloud: You've Got Options

But options don't come for free.



"Now, one more application over here..."

While most enterprises are busily migrating existing applications to the cloud or perhaps building new cloud-ready applications, analysts and marketing teams haven't been sitting idle, concocting slogans like *multi-hybrid-cloud computing*. Or perhaps it was *hybrid-multi*? I am not sure myself.

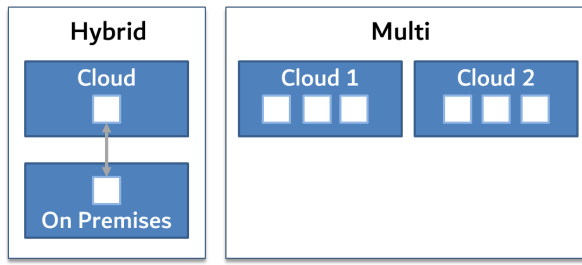
Are enterprises already falling behind before even finishing their migration? Should they "leapfrog" by going straight for multicloud nirvana? Do people actually mean the same thing when they say "multicloud"? It's time to bust another buzzword and bring things back to earth and to business value. We'll find that, again, there are meaningful decisions to be made.

Multi-Hybrid Split

The initial promise of a multi-hybrid cloud approach sounds appealing enough: your workloads can move from your premises to the cloud and back, or even between different clouds whenever needed; and all that ostensibly with not much more than the push of a button. Architects are born skeptics and thus inclined (and paid) to take a look under the covers to better understand the constraints, costs, and benefits of such solutions.

The first step in dissecting the buzzwords is to split the *multi-hybrid* combo-buzzword into two, separating *hybrid* from *multi*. Each has different driving forces behind it, so let's try two simple definitions:

- **Hybrid**: Splitting workload(s) across the cloud and on premises. Generally, these workloads interact to do something useful
- **Multi**: Running workloads with more than one cloud provider



Hybrid and multicloud

As simple as these terms might seem, a disproportionate level of confusion remains. For example, some folks want us to think that multi and hybrid are very similar ("on premises is just another cloud"), whereas others (including myself) highlight the different constraints of operating on premises versus the public cloud.

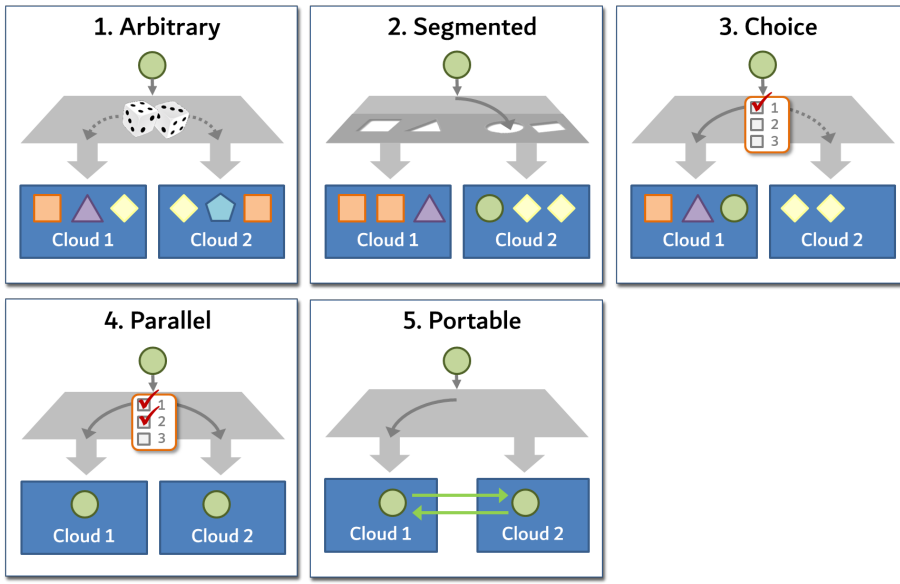
From an architect's point of view, which focuses on decisions, there's one major difference between the two: hybrid cloud is a given for most enterprises, at least during the transition, whereas a multicloud strategy is an explicit choice you make. Many enterprises are very successfully running on a single cloud, optimizing cost along the way; for example by minimizing the skill sets they need and harvesting volume discounts.

Therefore, as an architect you want to understand what multicloud choices you have and the decision trade-offs that are involved. A buzzword-sanitized decision framework helps you get there.

Multicloud Options

The best starting point is taking a step back from the technical platform and examining common usage scenarios. We can then examine the value each one yields and the trade-offs it implies. After participating in several initiatives that would fall under the general label of "multicloud", I believe that they can be broken down into the following five distinct scenarios:

1. *Arbitrary*: Workloads are in more than one cloud but for no particular reason.
2. *Segmented*: Different clouds are used for different purposes.
3. *Choice*: Projects (or business units) have a choice of cloud provider.
4. *Parallel*: Single applications are deployed to multiple clouds.
5. *Portable*: Workloads can be moved between clouds at will.



Multicloud architecture styles

A higher number in this list isn't necessarily better—each option has its advantages and limitations. Rather, it's about finding the approach that best suits your needs and making a conscious choice. The biggest mistake could be choosing an option that provides capabilities that aren't needed, because each option has a cost, as we will soon see.

Multicloud architecture isn't a simple one-size-fits-all decision. The most common mistake is choosing an option that's more complex than what's needed for the business to succeed.

Breaking down multicloud into distinct flavors and identifying the drivers and benefits for each is a nice example of how elevator architects see nuances where many others see only left or right. Coupled with simple vocabulary, it enables an in-depth conversation void of technical jargon that gets everyone on the same page. That's what *The Architect Elevator*[1] is all about.

Multicloud Scenarios

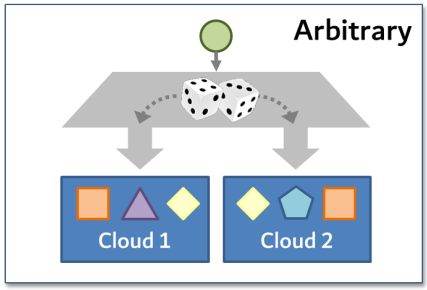
Let's look at each of the five ways of doing multicloud individually, with a particularly keen eye on the key capabilities it brings and what aspects to watch out for. We'll summarize what we learned in a decision table.

Arbitrary

If enterprise has taught us one thing, it's likely that reality rarely lives up to the slide decks. Applying this line of reasoning (and the usual dosage of cynicism) to multicloud, we find that a huge percentage of enterprise multicloud isn't the result of divine architectural foresight, but simply poor governance and excessive vendor influence.

This flavor of multicloud means running workloads with more than one cloud provider, but not having much of an idea why things are in one cloud or the other. Often the reasons are historic: you started with one cloud and then added another vendor thanks to a substantial service credit, all the while some developers loved a third cloud so much that they ignored the corporate standard.

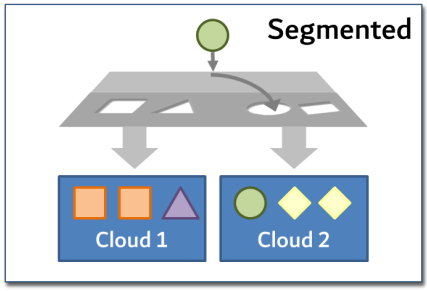
[1] Hohpe, *The Software Architect Elevator*, 2020, O'Reilly Media



Some stuff in any cloud

Strategy isn't exactly the word to be used for this setup. It's not all bad, though: at least you're deploying *something* to the cloud! That's a good thing because before you can steer, you first have to move. So, at least you're moving. You're gathering experience and building skills with multiple technology platforms, which you can use to settle on the provider that best meets your needs. So, while *arbitrary* isn't a viable target picture, it's a common starting point.

Segmented



Different clouds for different needs

Segmenting workloads across different clouds is also common, and a good step ahead: you choose different clouds for specific types of workloads. Companies often land in this scenario because they want to benefit from a particular vendor's strength in one area. Different licensing models may also lead you to favor different vendors for different workloads. A common incarnation of the *segmented* scenario is running most large workloads on the primary provider and using analytics services of another.

You may decide on cloud providers by several factors:

- Type of workload (legacy vs. modern)
- Type of data (confidential vs. openly available)
- Type of service (compute vs. analytics vs. collaboration software)

Understanding the *seams* between your applications avoids excessive egress charges when half your application ends up on the left, and the other half

on the right. Also, keep in mind that vendor capabilities are rapidly shifting, especially in segments like machine learning. Snapshot comparisons therefore aren't particularly meaningful and may unwittingly lead you into this scenario just to find out a few months later that your preferred vendor is now offering comparable functionality.

Also, I have observed enterprises slipping from *segmented* back into *arbitrary* when sales teams use their foothold to grow their slice of the pie. If you use a very specific service from another vendor, its (pre-)sales folks will surely try to pitch their other services, as well—that's their job, after all.

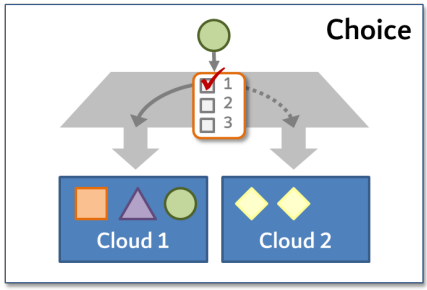
Decision discipline is the backbone of any sound strategy, so you have to remain friendly but firm in such situations. Another slippery slope back into the *arbitrary* model are résumé-driven architectures, so wear your shades and stay away from too shiny objects. Otherwise you might end up in situations where 95% of your applications run in one country and a few percent on another cloud thousands of miles away—a real example, which incurs latency and egress cost, and unnecessarily duplicates the required skill sets.

When comparing clouds, avoid the trap of optimizing for each individual service. A cloud platform should be evaluated as a whole, including how services interoperate with one another and with cross-cutting concerns like access management or monitoring. It comes down to one of the most important lessons in enterprise architecture:

The sum of local optima is rarely the global optimum. Optimize globally, not locally!

Choice

Many might not consider the first two examples as *true* multicloud. What they are looking for (and pitching) is the ability to deploy your workloads freely across cloud providers, thus *minimizing lock-in* (or the perception thereof), usually by means of building abstraction layers or governance frameworks. Again, there are multiple flavors, separated by the finality of the cloud decision. For example, should you be able to change your mind after your initial choice and, if so, how easy do you expect the switch to be?



Freedom of choice

The least complex and most common case is giving your developers an initial choice of cloud provider but not expecting them to keep changing their mind. This *choice* scenario is common in large organizations with shared IT service units. Central IT is generally expected to support a wide range of business units and their respective IT preferences. Freedom of choice might also result from the desire to remain neutral, such as in public sector, or a regulatory guideline to avoid placing "all eggs in one basket", often seen in financial services or similar critical services.

A *choice* setup typically has central IT manage the commercial relationships with the cloud providers. Some IT departments also develop a common tool set to create cloud provider account instances to assure central spend tracking and corporate governance.

The advantage of this setup is that projects are free to use proprietary cloud services, such as managed databases, based on their preferred trade-off between minimizing lock-in and operational overhead. As a result, business units get an unencumbered, dare I say *native*, cloud experience. Hence, this setup makes a good initial step for multicloud.

Parallel

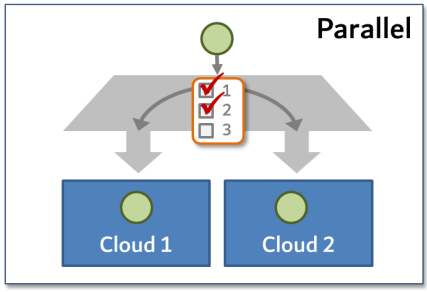
While the previous option gives you a choice among cloud service providers, you are still bound by the service level of a single provider. Many enterprises are looking to deploy critical applications across multiple clouds in their pursuit of higher levels of availability than they could achieve with a single provider.

Being able to deploy the same application in parallel to multiple clouds requires a certain set of decoupling from the cloud provider's proprietary features. This can be achieved in a number of ways; for example:

- Managing cloud-specific functions such as identity management, deployment automation, or monitoring separately for each cloud, isolating them

from the core application code through interfaces or pluggable modules.

- Maintain two branches for those components of your application that are cloud-provider specific and wrap them behind a common interface. For example, you could have a common interface for block data storage.
- Using open-source components because they will generally run on any cloud. While this works relatively well for pure compute (hosted Kubernetes is available on most clouds), it may reduce your ability to take advantage of other fully managed services, such as data stores or monitoring. Because managed services are one of the key benefits of moving to the clouds in the first place, this is an option that will need careful considerations.
- Utilize a multicloud abstraction framework, so that you can develop once and deploy to any cloud without having to deal with any cloud specifics. However, such an abstraction layer might prevent you from benefiting from a particular cloud's unique offering, potentially weakening your solution or increasing cost.



A single app in multiple clouds

While absorbing differences inside your code base might sound kludgy, it's what Object-Relational Mapping (ORM) frameworks have been successfully doing for relational databases for more than a decade.

The critical aspect to watch out for is complexity, which can easily undo the anticipated uptime gain. Additional layers of abstraction and more tooling also increase the chance of a misconfiguration, which causes unplanned downtime. I have seen vendors suggesting designs that deploy across each vendor's three availability zones, plus a disaster recovery environment in each, times three cloud providers. With each component occupying 3 x 2 x 3 = *18 nodes*, I'd be skeptical as to whether this amount of machinery really gives you higher availability than using nine nodes (one per zone and per cloud provider).

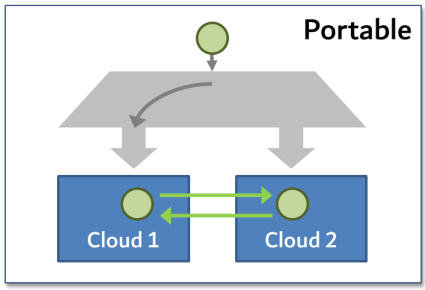
Second, seeking harmonization across both deployments may not be what's actually desired. The higher the degree of commonality across clouds, the

higher the chance that you'll deploy a broken application or encounter issues on both clouds, undoing the resilience benefit. The extreme example are space probes or similar systems that require extreme reliability: they use two separate teams to avoid any form of commonality.

Higher degrees of harmonization across providers increases the chance of a common error, undoing potential increases in system uptime.

So, when you're designing for availability, keep in mind that the cloud provider's platform isn't the only outage scenario—human error and application software issues (bugs or run-time issues such as memory leaks and overflowing queues) can be a bigger contributor to outages.

Portable



Shifting at will

The perceived pinnacle of multicloud is free portability across clouds, meaning that you can deploy your workloads anywhere and also move them as you please. The advantages are easy to grasp: you can avoid vendor lock-in, which, for example, gives you negotiation power. You can also move applications based on resource needs. For example, you may run normal operations in one cloud and burst excessive traffic into another.

The core mechanisms that enable this capability are high levels of automation and abstraction away from cloud services. Whereas for parallel deployments you could get away with a semi-manual setup or deployment process, full portability requires you to be able to shift the workload any time, so everything better be fully automated.

Multicloud abstraction frameworks promise this capability. However, nothing is ever free, so the cost comes in form of complexity, lock-in to a specific

framework, restriction to specific application architectures (e.g., containers) and platform underutilization (see Don't Get Locked-Up Into Avoiding Lock-in).

Also, most such abstractions generally don't take care of your data: if you shift your compute nodes across providers willy-nilly, how are you going to keep your data in sync? And if you manage to overcome this hurdle, egress data costs may come to nib you in the rear. So, although this option looks great on paper (or PowerPoint), it involves significant trade-offs.

Chasing Shiny Objects Makes You Blind

As highlighted in "If You Don't Know How to Drive", when chasing shiny objects, you can easily fall into the trap of believing that the shinier, the better. Those with enterprise battle scars know all too well that polishing objects to become ever more shiny has a cost. Dollar cost is the apparent one, but you also need to factor in additional complexity, managing multiple vendors, finding skill sets, and assuring long-term viability (will we just go serverless?). Those factors can't be solved with money.

If you want all options all the time, chances are that you'll drown in complexity and don't get any of them—an effect known as Gregor's Law. It's therefore paramount to understand and clearly communicate your primary objective: are you looking to better negotiate with vendors, to increase system availability, or to support local deployment in regions where only one provider or the other operates a data center?

Also, remember that cloud providers continuously reduce prices, increase availability, and deploy new regions. Hence, doing nothing can be an unexpected, albeit quite effective strategy for addressing these issues. Avoiding lock-in is thus an abstract meta-goal, which, while architecturally desirable, needs to be translated into a tangible benefit. Don't justify one buzzword with another one!

Multicloud ≠ Uniform Cloud

When advising enterprises on a multicloud strategy, I routinely remind them to stay away from building a uniform cloud experience across all providers. Each cloud provider has specific strengths in its product offering but also in its

product strategy and corporate culture. Attempting to make all clouds look the same doesn't actually benefit your internal customers. Instead, it incurs a heavy burden; for example, because they won't be able to use an inexpensive managed service from cloud provider X. Or they might be working with an external vendor that's familiar with the original cloud but not with the abstraction layer woven over it. I call this the Esperanto effect: yes, it'd be nice if we all spoke one universal language. However, that means we all have to learn yet one more language and many of us speak English already.

Choosing Wisely

The following table summarizes the multicloud choices, their main drivers, and the side effects to watch out for:

Style	Key Capability	Key Mechanism	Consideration
Arbitrary	Deploying to the cloud	Cloud skill	Lack of governance; traffic cost
Segmented	Clear guidance on cloud usage	Governance	Drifting back to "Arbitrary"
Choice	Support project needs/preferences	Common framework for provisioning, billing, governance	Additional layer; lack of guidance; traffic cost
Parallel	Higher availability (potentially)	Automation, abstraction, load balancing/failover	Complexity; underutilization
Portable	Shift workloads at will	Full automation, abstraction. Data portability	Complexity; framework lock-in; underutilization

As expected: TANSTAAFL—*there ain't no such a thing as a free lunch.* Architecture is the business of trade-offs. Therefore, it's important to break down the options, give them meaningful names, understand their implications, and communicate them broadly.

19. Hybrid Cloud: Slicing the Elephant

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Enterprises can't avoid hybrid cloud, but they can choose their path.

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Hybrid Is a Reality. Multi Is an Option.

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Two Isolated Environments Don't Make a Hybrid

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Hybrid splits: 31 Flavors?

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Hybrid Implementation Strategies

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Architecture Creates Options

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One Cloud, Please, but with Lock-In on the Side!

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Shades of Lock-In

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Open Source and Lock-In

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Maneuvering Lock-In

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Part V: Building (for) the Cloud

The cloud is a platform on which you deploy applications. Unlike traditional setups in which application and infrastructure were fairly isolated and often managed by different teams, cloud applications and the associated tooling interact closely with their environment. For example, platforms that offer resilient operations usually require applications to be automatically deployable. Similarly, serverless platforms expect applications to externalize their state and be short lived. So, when we talk about cloud platforms, we should also talk about how we're building applications.

Application Complexity Increases

Although cloud gives applications amazing capabilities like resilience, auto-scaling, auto-healing, and updates without downtime, it has also made application delivery more complex. Listening to modern application developers speak about green/blue deploys, NoOps, NewOps, post-DevOps, FinOps, DevSecOps, YAML indentation, Kubernetes operators, service meshes, HATEOAS, microservices, microkernels, split brains, or declarative vs. procedural IaC might make you feel like application delivery was invaded by aliens speaking a new intergalactic language.

Many of these mechanisms have a viable purpose and represent major progress in the way we build and deliver software. Still, the tools that bring us such great capabilities have also caused a jargon proliferation like we haven't seen since the days when database column names were limited to six characters. Explaining these many tools and techniques with intuitive models instead of jargon will help us understand cloud's implications on application design and delivery.

Removing Constraints Impacts Architecture

The constraints of the environment influence the structure of applications. For example, if deploying software is laborious, you'd lean toward deploying a large piece of software just once. Likewise, if communications are slow and nontransparent, you might prefer to keep all application components together to avoid remote calls.

Cloud platforms, in conjunction with modern software stacks, have reduced or eliminated many past constraints, allowing new software application architectures to emerge. For example, microservices architectures, now a very popular architecture style, only became viable thanks to lower run-time overhead and automated software deployment. Understanding such implications helps architects shape a path for application evolution to the cloud.

Platforms Expand and Contract

Platforms to improve application delivery have existed for quite a while. For example, PaaS (Platform as a Service) products simplified application deployment with prefabricated build packs that included common dependencies. However, most of these platforms were designed as "black boxes" that didn't easily support replacing individual components. After plateauing for a while, the pace of innovation picked up again, this time favoring loose collections of tools, such as the Kubernetes ecosystem. Shifting toward sets of tools allows components to evolve independently but usually leaves the end user with the complexity of assembling all the bits and pieces into a working whole.

I have seen projects where the build and deployment system had become more complex than the application itself.

Over time, as approaches stabilize, we can expect platforms to again become more prescriptive, or "opinionated" in modern IT vernacular, and hence better integrated. Anticipating such platform cycles can help us make better IT investment decisions.

Applications for the Cloud

Many existing resources describe how applications should be built for the cloud. This part in the book isn't intended to be an application development guide but rather looks at those aspects of application development and delivery that directly relate to cloud platforms:

- An application-centric cloud looks very different from an infrastructure-centric one. We could say it's more flowery.
- Cloud seems to like containers. But what's really packed up inside that container metaphor?
- Serverless isn't really server-less, but perhaps it can make you worry less?
- What makes an application suitable for the cloud? Instead of complicated frameworks, let's try FROSST.
- Automation is a critical part of the cloud, so why shouldn't it use actual code?
- Things break, even in the cloud. It's best to stay calm and operate on.

24. The Application-Centric Cloud

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Cloud Applications Should Be FROSST

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(Not Just) Infrastructure as actual Code

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Part VI: Budgeting the Cloud

By now you have migrated existing applications and built new ones so that they take advantage of the cloud computing platform. You're rightly expecting to reap the rewards of your investments: increased agility, lower operational costs, and higher transparency should surely earn you a pad on the back from the CEO and the board. But not so fast—cloud also impacts how you manage and account for your IT spend and the benefits you generate.

New Tech Brings New Financial Models

Embracing the cloud permeates all parts of your organization, whether it's IT, business, HR, or finance. As your cloud consumption increases, your financial management might take notice and have a different view on the savings you achieved. Also, although your initial migration has likely yielded promising benefits, there's surely some optimization work left to do. Lastly, with new powers come new responsibilities, including financial awareness and discipline.

To round off this book, this last part discusses the financial aspects of fully embracing the cloud as a new lifestyle:

- Cloud savings don't arrive magically; they *have to be earned*.
- You may find that migrating to the cloud *increased your run budget*. That's likely a good thing!
- Traditionally, we think of *automation as increasing efficiency*. That'd be missing the key benefits of cloud automation.
- Small items do add up, also in the cloud. *Beware the Supermarket effect*!

30. Cloud Savings Have to Be Earned

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There ain't no such thing as a free lunch. Not even in the cloud.

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How Much Cheaper Is the Cloud?

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Earn Your Savings

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Lighting up dark corners may lead to unpleasant surprises.

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Small stuff adds up, too.

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Author Biography

Gregor Hohpe is an enterprise strategist with AWS. He advises CTOs and technology leaders in the transformation of both their organization and technology platform. Riding the Architect Elevator from the engine room to the penthouse, he connects the corporate strategy with the technical implementation, and vice versa.

Gregor served as Smart Nation Fellow to the Singapore government, as technical director at Google Cloud, and as chief architect at Allianz SE, where he deployed the first private cloud software delivery platform. He has experienced most every angle of the technology business, ranging from start-up to professional services and corporate IT to internet-scale engineering.

Other Titles by This Author

The Software Architect Elevator, O'Reilly, 2020
Enterprise Integration Patterns, Addison-Wesley, 2003 (with Bobby Woolf)

Michele Danieli is the head of architecture practice at Allianz Technology Global Lines, leading globally distributed architecture teams building platforms. He started his career in the engine room and sees architecture and engineers as best friends. A good diagram and a mind map are his essential tools, and code is not a foe.

Tahir Hashmi has developed large-scale distributed applications at internet businesses serving more than 100 million users, like Flipkart, Zynga, Yahoo, and most recently, Tokopedia, where he now leads the technology strategy as vice president and technical fellow. His mission is to make distributed cloud computing as simple as writing a program on the laptop.

Jean-François Landreau leads the infrastructure team at Allianz Direct. When SRE and DevOps shifted the collective excitement from software development toward operations, he decided to follow along. He is a strong believer that you can't take enlightened enterprise decisions if you are too far away from the engine room.