CLOUD COMPUTING

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INTRODUCTION TO THE INDUSTRIAL REVOLUTION 4.0

These didactical materials, which have been developed in the framework of the European project 'Industry 4.0 - INTRO 4.0', funded by the European Commission aims to come up with an overview of what has been done in the European Industry in terms of Industry 4.0.

The content of these didactical materials provides the most relevant and useful information on Industry 4.0 to a target group that includes: adults, educators (VET & Higher Education), teachers, trainers, coaches, employers, employees, the general public, and suppliers of innovative solutions.

This information is rooted within the report 'Current Status Of The Industry 4.0' and the report 'Summary Report of the expert interviews/questionnaires and the specific research on the field of manufacturing companies", both developed by the partners of this project.

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CLOUD
COMPUTING

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THIS CONTENT MAY BE OF GREATER INTEREST TO THE COMPANIES

THIS CONTENT MAY BE OF GREATER INTEREST TO THE GENERAL PUBLIC

🎯 LEARNING OBJECTIVES

❖   Increase general knowledge of the Cloud Computing.

❖   Show and improve basic skills.

❖   Identify Cloud Computing benefits.

❖   Have a trained and skilled workforce.

❖   To help the organization to create new opportunities.

INTRO 4.0

CLOUD COMPUTING

INTRODUCTION

CLOUD COMPUTING the practice of using a network of remote servers hosted on the Internet to store, manage, and process data, rather than a local server or a personal computer.

Specific Learning Objectives

- Understand Cloud Computing
- Identify the most useful tools
- Recognize and improve most value skills
- Monitor organizational challenges and good practices
- Increase company resources and benefits
- Detect advantages and disadvantage
- Perform useful strategies
- Set practical uses
- Provide useful information about courses and certificates

Taking decisions

General knowledge

What is this for?

Identification of risk to the product/services

Operational efficiency

Today uses
- Create new apps and services
- Test and build applications
- Store, back up, and recover data
- Analyze data
- Stream audio and video
- Embed intelligence
- Deliver software on demand

Did you know...?
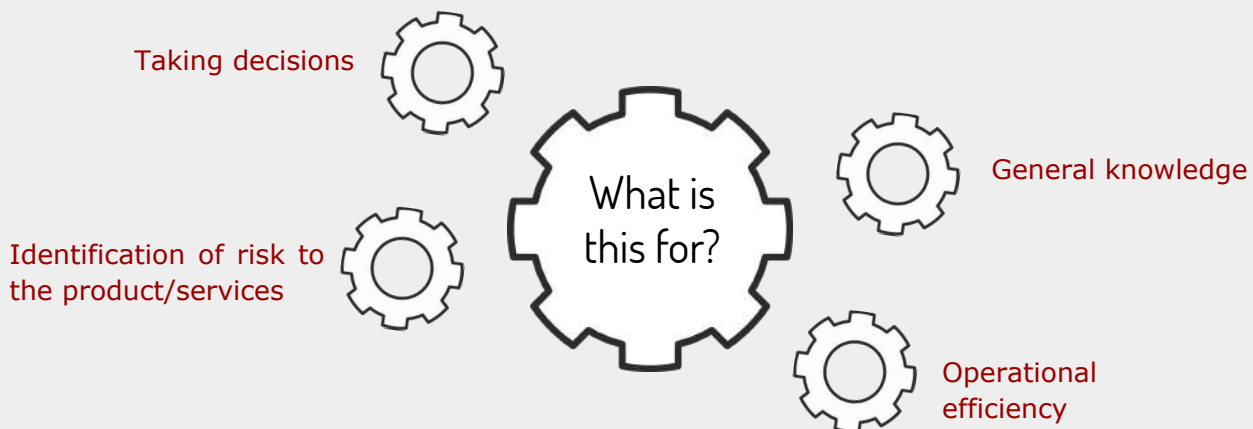
You're probably using Cloud Computing right now, even if you don't realize it. If you use an online service to send email, edit documents, watch movies or TV, listen to music, play games, or store pictures and other files, it's likely that Cloud Computing is making it all possible behind the scenes.

INTRO 4.0

WHAT IS IT?

Whether you are using it to run applications that share photos to millions of mobile users or to support business critical operations, a cloud services platform provides rapid access to flexible and low cost IT resources. With Cloud Computing, you don't need to make large upfront investments in hardware and spend a lot of time on the heavy lifting of managing that hardware. Instead, you can provision exactly the right type and size of computing resources you need to power your newest idea or operate your IT department. You can access as many resources as you need, almost instantly, and only pay for what you use.
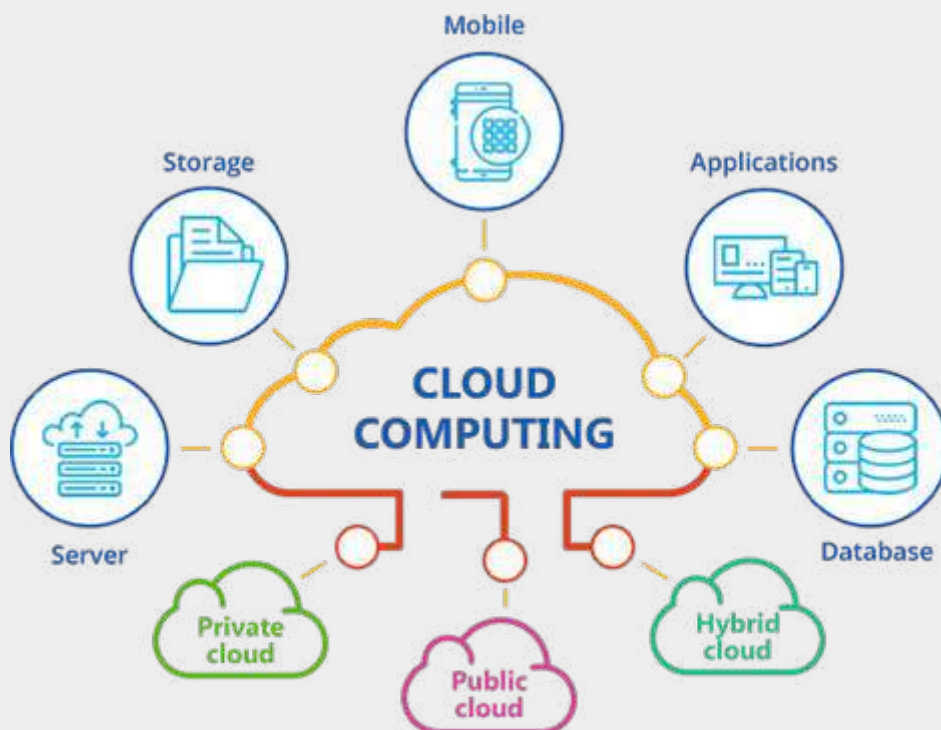

Figure 1. General view. Source: www.kcsitglobal.com

With the cloud, you can easily deploy your application in multiple physical locations around the world with just a few clicks. This means you can provide a lower latency and better experience for your customers simply and at minimal cost.

INTRO 4.0

WHAT IS IT?

Essentially, Cloud Computing is a kind of outsourcing of computer programs. Using Cloud Computing, users are able to access software and applications from wherever they are; the computer programs are being hosted by an outside party and reside in the cloud. This means that users do not have to worry about things such as storage and power, they can simply enjoy the end result.

Traditional business applications have always been very complicated and expensive. The amount and variety of hardware and software required to run them are daunting. You need a whole team of experts to install, configure, test, run, secure, and update them

When you multiply this effort across dozens or hundreds of apps, it's easy to see why the biggest companies with the best IT departments aren't getting the apps they need. Small and midsize businesses don't stand a chance.

60's
- MIT develop technology allowing for a "computer to be used by two or more people, simultaneously."
- The concept began with ARPANET in 1969, which was the precursor to what we know today as the internet.

90's
- The advancement of the internet being connected to huge numbers of personal computers
- Salesforce became a popular example of using Cloud Computing successfully. They used it to pioneer the idea of using the Internet to deliver software programs to the end users.

XXI
- Amazon launched Amazon Web Services, which offers online services to other websites, or clients.
- Google launched the Google Docs services.
- Expansion of PaaS, SaaS and IaaS

INTRO 4.0

WHAT IS THIS FOR?

With Cloud Computing, you eliminate the fact of storing your own data, because you're not managing hardware and software — that becomes the responsibility of an experienced vendor. The shared infrastructure means it works like a utility: You only pay for what you need, upgrades are automatic, and scaling up or down is easy.

Cloud-based apps can be up and running in days or weeks, and they cost less. With a cloud app, you just open a browser, log in, customize the app, and start using it.

Businesses are running all kinds of apps in the cloud, like customer relationship management (CRM), HR, accounting, and much more. Some of the world's largest companies moved their applications to the cloud after rigorously testing the security and reliability of our infrastructure.
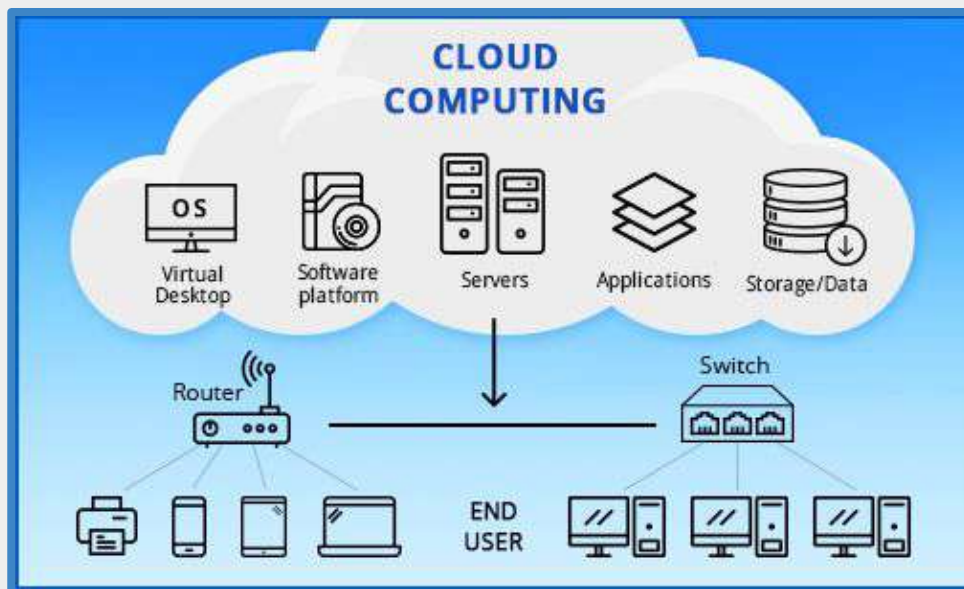
Figure 2. Cloud Computing solutions. Source: www.thinkitsolutions.com

As Cloud Computing grows in popularity, thousands of companies are simply rebranding their non-cloud products and services as "Cloud Computing".

Companies that provide Cloud Computing services actually host data centers with multiple servers interconnected to each other, and utilize special virtualization software to create a large computing and storage resource that can be divided into virtual resources which are rented to users and clients as a service.

INTRO 4.0

WHAT IS THIS FOR?

Here are a few examples of what's possible today with cloud services from a cloud provider:

Create new apps and services

Quickly build, deploy, and scale applications—web, mobile, and **API**—on any platform. Access the resources you need to help meet performance, security, and compliance requirements.

Test and build applications

Reduce application development cost and time by using

cloud infrastructures that can easily be scaled up or down.

> **Application Programming Interface (API)**
>
> *An API is a software intermediary that allows two applications to talk to each other. In other words, an API is the messenger that delivers your request to the provider that you're requesting it from and then delivers the response back to you*

Store, back up, and recover data

Protect your data more cost-efficiently—and at massive scale—by transferring your data over the Internet to an offsite cloud storage system that's accessible from any location and any device.

Analyze data

Unify your data across teams, divisions, and locations in the cloud. Then use cloud services, such as machine learning and artificial intelligence, to uncover insights for more informed decisions.

Stream audio and video

Connect with your audience anywhere, anytime, on any device with high-definition video and audio with global distribution.

Embed intelligence

Use intelligent models to help engage customers and provide valuable insights from the data captured.

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WHAT IS THIS FOR?

Modes of Cloud Computing

Not all clouds are the same and not one type of Cloud Computing is right for everyone. Several different models, types, and services have evolved to help offer the right solution for your needs.

First, you need to determine the type of cloud deployment, or Cloud Computing architecture, that your cloud services will be implemented on. There are three different ways to deploy cloud services: on a public cloud, private cloud, or hybrid cloud.

Public cloud

Public clouds are owned and operated by a third-party cloud service providers, which deliver their computing resources, like servers and storage, over the Internet. Microsoft Azure is an example of a public cloud. With a public cloud, all hardware, software, and other supporting infrastructure is owned and managed by the cloud provider. You access these services and manage your account using a web browser..

Hybrid cloud

Hybrid clouds combine public and private clouds, bound together by technology that allows data and applications to be shared between them. By allowing data and applications to move between private and public clouds, a hybrid cloud gives your business greater flexibility, more deployment options, and helps optimize your existing infrastructure, security, and compliance.

Private cloud

A private cloud refers to cloud computing resources used exclusively by a single business or organization. A private cloud can be physically located on the company's on-site datacenter. Some companies also pay third-party service providers to host their private cloud. A private cloud is one in which the services and infrastructure are maintained on a private network.
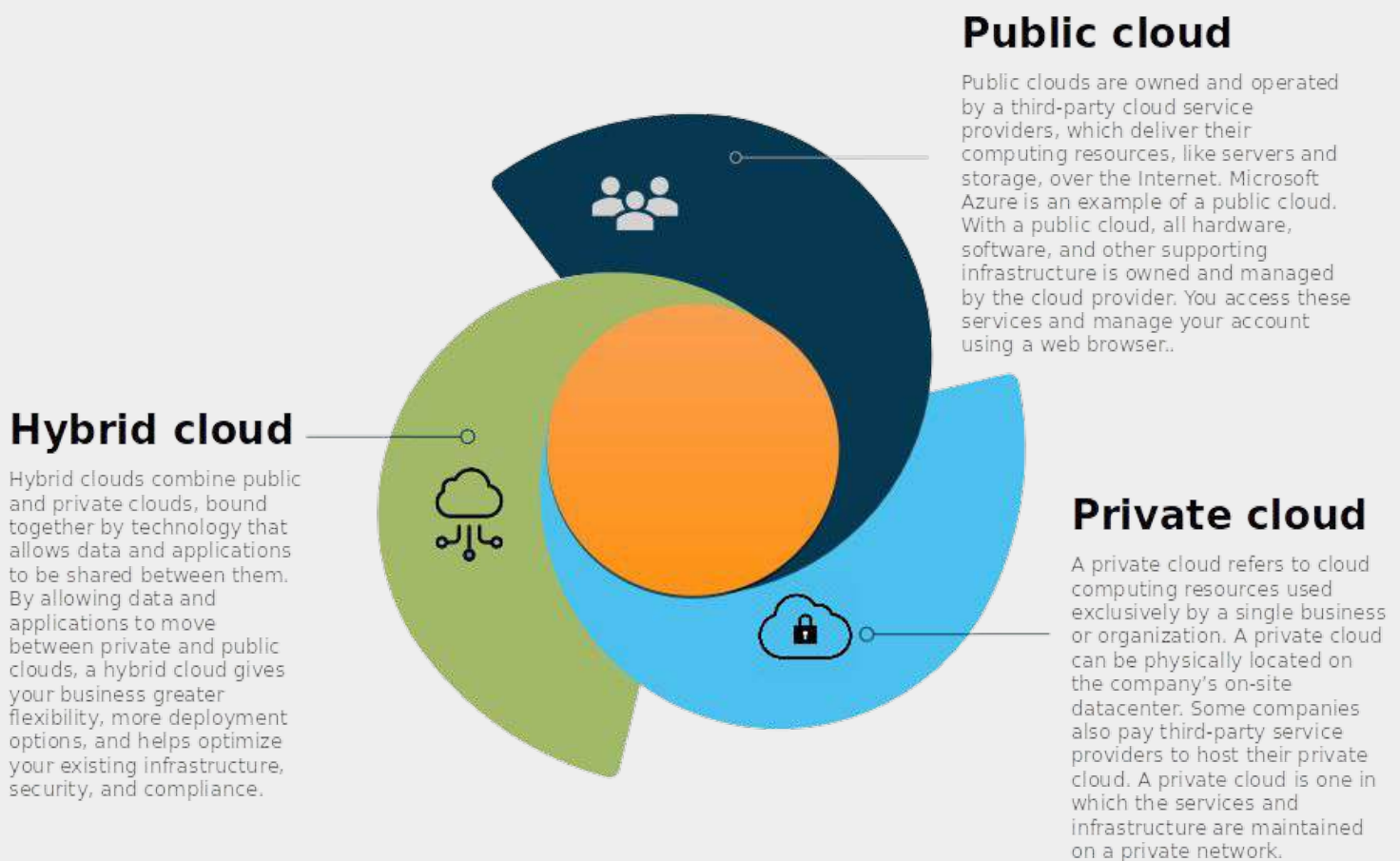
Figure 3. Modes. Source: Self made

INTRO 4.0

WHAT IS THIS FOR?

Types of Cloud Computing

SOFTWARE AS A SERVICE (SAAS)

also known as cloud application services, represents the most commonly utilized option for businesses in the cloud market. SaaS utilizes the internet to deliver applications, which are managed by a third-party vendor, to it's users. A majority of SaaS applications are run directly through the web browser, and do not require any downloads or installations on the client side.
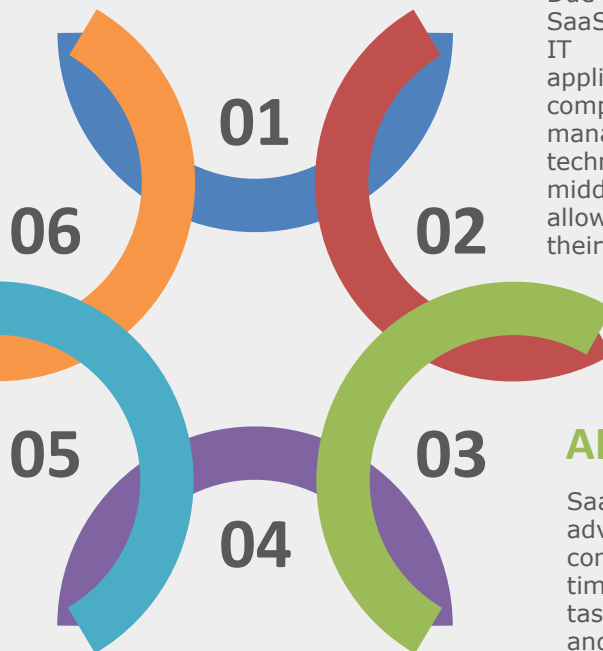
EXAMPLES

Google Apps, Dropbox, Salesforce, Cisco WebEx, Concur, GoToMeeting

DELIVERY

Due to its web delivery model, SaaS eliminates the need to have IT staff download and install applications on each individual computer. With SaaS, vendors manage all of the potential technical issues, such as data, middleware, servers, and storage, allowing businesses to streamline their maintenance and support..

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WHEN TO USE

- If you are a startup or small company that needs to launch ecommerce quickly and don't have time for server issues or software
- For short-term projects that require collaboration
- If you use applications that aren't in-demand very often, such as tax software
- For applications that need both web and mobile access

ADVANTAGES

SaaS provides numerous advantages to employees and companies by greatly reducing the time and money spent on tedious tasks such as installing, managing, and upgrading software. This frees up plenty of time for technical staff to spend on more pressing matters and issues within the organization..

CHARACTERISTICS

- Managed from a central location
- Hosted on a remote server
- Accessible over the internet
- Users not responsible for hardware or software updates

Figure 4. SAAS. Source: Self made

INTRO 4.0

CLOUD COMPUTING

WHAT IS THIS FOR?

PLATFORM AS A SERVICE (PAAS)

Cloud platform services, or Platform as a Service (PaaS), provide cloud components to certain software while being used mainly for applications. PaaS delivers a framework for developers that they can build upon and use to create customized applications. All servers, storage, and networking can be managed by the enterprise or a third-party provider while the developers can maintain management of the applications.

DELIVERY

The delivery model of PaaS is similar to SaaS, except instead of delivering the software over the internet, PaaS provides a platform for software creation. This platform is delivered over the web, and gives developers the freedom to concentrate on building the software while still not having to worry about operating systems, software updates, storage, or infrastructure.

PaaS allows businesses to design and create applications that are built into the PaaS with special software components. These applications, or middleware, are scalable and highly available as they take on certain cloud characteristics.

EXAMPLES

AWS Elastic Beanstalk, Windows Azure, Heroku, Force.com, Google App Engine, Apache Stratos, OpenShift

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WHEN TO USE

There are many situations where utilizing PaaS is beneficial or even necessary. If there are multiple developers working on the same development project, or if other vendors must be included as well, PaaS can provide great speed and flexibility to the entire process. PaaS is also beneficial if you wish to be able to create your own customized applications. This cloud service also can greatly reduce costs and it can simplify some challenges that come up if you are rapidly developing or deploying an app.

ADVANTAGES

- Makes the development and deployment of apps simple and cost-effective
- Scalable
- Highly available
- Gives developers the ability to create customized apps without the headache of maintaining the software
- Greatly reduces the amount of coding
- Automates business policy
- Allows easy migration to the hybrid model

CHARACTERISTICS

- It is built on virtualization technology, meaning resources can easily be scaled up or down as your business changes
- Provides a variety of services to assist with the development, testing, and deployment of apps
- Numerous users can access the same development application
- Web services and databases are integrated

Figure 5. PAAS. Source: Self made

INTRO 4.0

WHAT IS THIS FOR?

INFRASTRUCTURE AS A SERVICE (IAAS)

Cloud infrastructure services, known as Infrastructure as a Service (IaaS), are made of highly scalable and automated compute resources. IaaS is fully self-service for accessing and monitoring things like computers, networking, storage, and other services, and it allows businesses to purchase resources on-demand and as-needed instead of having to buy hardware outright.

EXAMPLES

ADigitalOcean, Linode, Rackspace, Amazon Web Services (AWS), Cisco Metapod, Microsoft Azure, Google Compute Engine (GCE)

DELIVERY

IaaS delivers Cloud Computing infrastructure, including things such as servers, network, operating systems, and storage, through virtualization technology. These cloud servers are typically provided to the organization through a dashboard or an API, and IaaS clients have complete control over the entire infrastructure. IaaS provides the same technologies and capabilities as a traditional data center without having to physically maintain or manage all of it. IaaS clients can still access their servers and storage directly, but it is all outsourced through a "virtual data center" in the cloud.

As opposed to SaaS or PaaS, IaaS clients are responsible for managing aspects such as applications, runtime, OSes, middleware, and data. However, providers of the IaaS manage the servers, hard drives, networking, virtualization, and storage. Some providers even offer more services outside of the virtualization layer, such as databases or message queuing.

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WHEN TO USE

Just as with SaaS and PaaS, there are specific situations when it is the most advantageous to use IaaS. If you are a startup or a small company, IaaS is a great option because you don't have to spend the time or money trying to create hardware and software. IaaS is also beneficial for large organizations that wish to have complete control over their applications and infrastructures, but are looking to only purchase what is actually consumed or needed. For rapidly growing companies, IaaS can be a good option since you don't have to commit to a specific hardware or software as your needs change and evolve. It also helps if you are unsure what demands a new application will require as there is a lot of flexibility to scale up or down as needed.
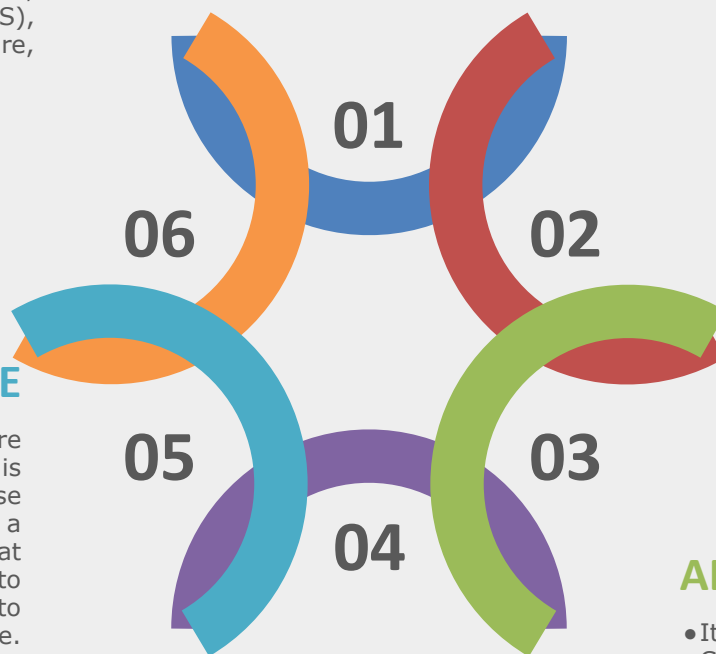
CHARACTERISTICS

- Resources are available as a service
- The cost varies depending on consumption
- Services are highly scalable
- Typically includes multiple users on a single piece of hardware
- Provides complete control of the infrastructure to organizations
- Dynamic and flexible

ADVANTAGES

- It's the most flexible Cloud Computing model
- Easily allows for automated deployment of storage, networking, servers, and processing power
- Hardware can be purchased based on consumption
- Gives clients complete control of their infrastructure
- Resources can be purchased as-needed
- Is highly scalable

Figure 6. IAAS. Source: Self made

INTRO 4.0

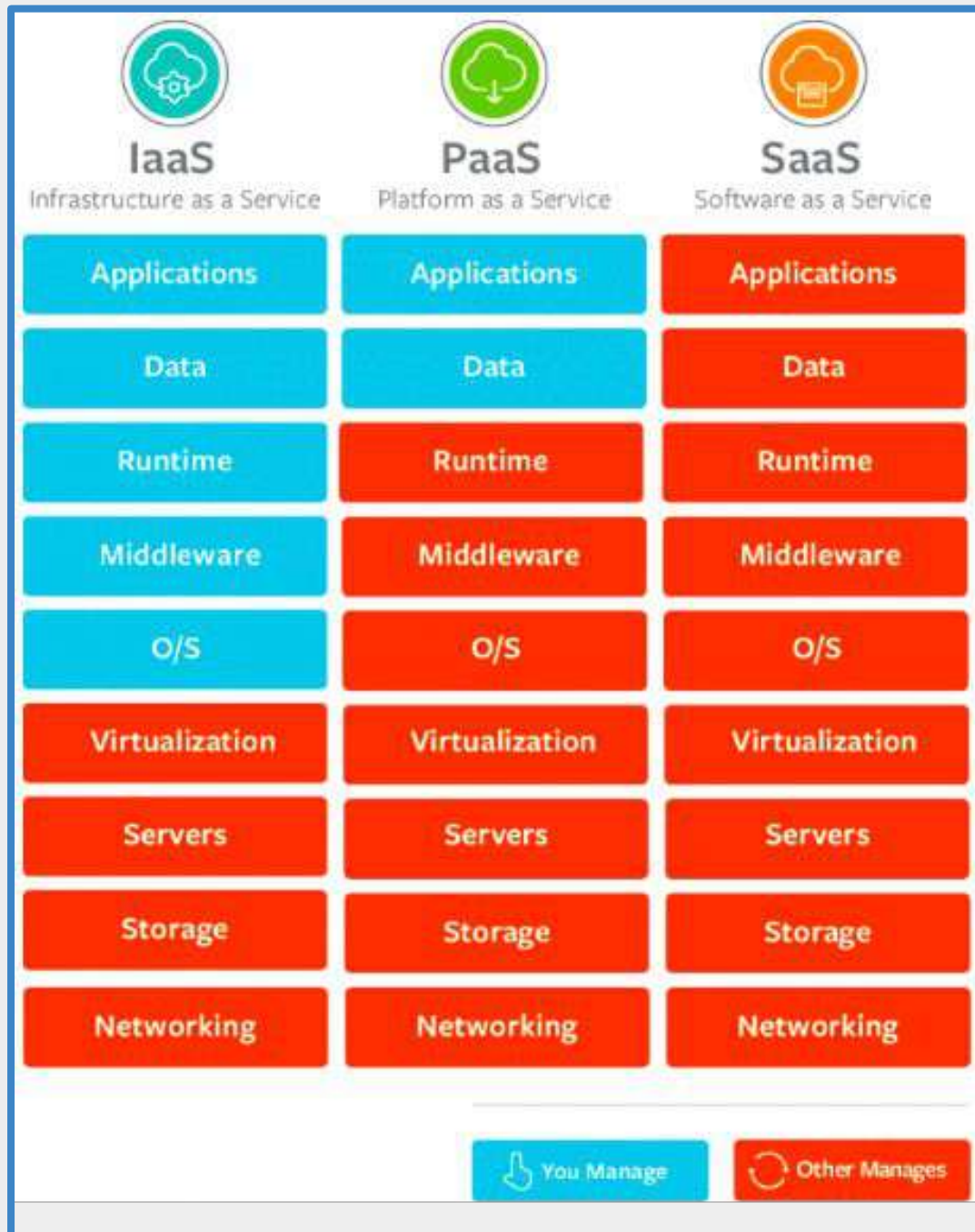# WHAT IS THIS FOR?

Figure 7. Key Differences. Source: www.bmc.com
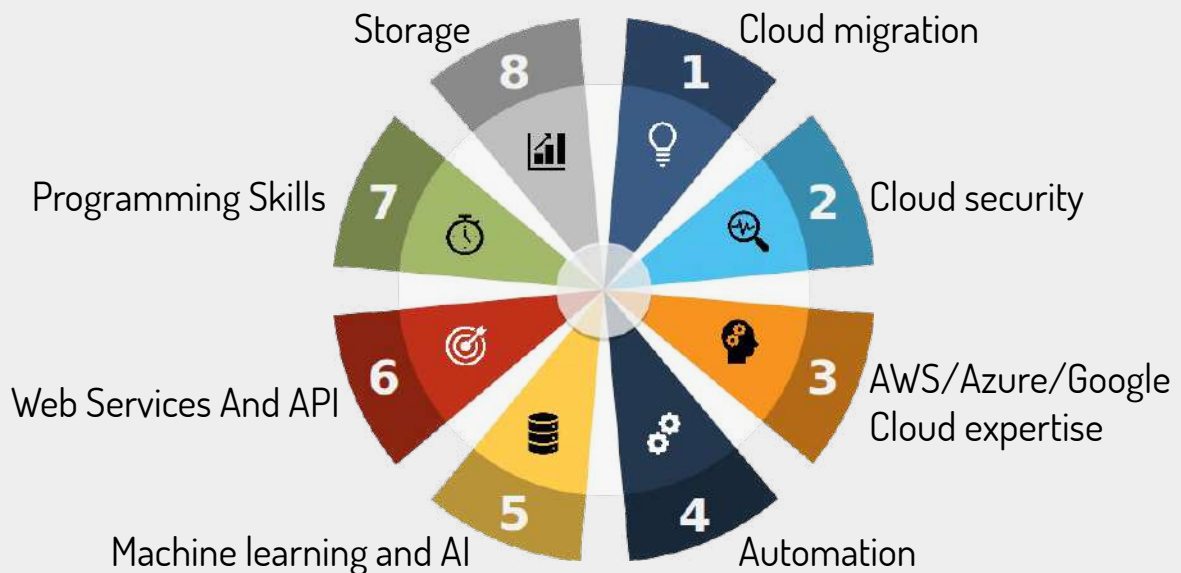
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WHAT IS THIS FOR?

TOP 8
CLOUD COMPUTING SKILLS FOR WORKERS

Figure 8. Top 8 Cloud Computing skills for workers. Source: Self made

Cloud migration: A huge hurdle for businesses adopting a cloud solution is migrating all their data to the cloud. Businesses need to transfer enormous amounts of data from one infrastructure to another without losing any of it. IT teams should be familiar with what their cloud infrastructure looks like and where all the data is supposed to go.Enterprise Companies that are struggling to measure resources to meet demand along with targeting to save time on basic tasks like database backup or maintenance will help from moving to the cloud.

Cloud security: In the early days, many companies were concerned about hosting their data in the cloud. But today, as cloud security has improved, there is more confidence in cloud data being safe and secure. Cloud security is a shared responsibility between the cloud providers and the businesses using them. This brings about the need for cloud professionals with specialization in cloud security skills. Cloud providers and organizations have a significant need for professionals who understand cloud security and can leverage the cloud security tools.

INTRO 4.0

WHAT IS THIS FOR?

The CISSP or Certified Information Systems Security Professional is known as one of the most sought after certification in the Cloud Computing world. This credential is given by the International Information System Security Certification Consortium, Inc., and the exam covers knowledge in areas like identity and access management, asset security, and software development security.

AWS/Azure/Google Cloud expertise: The top three cloud providers on the market are AWS, Azure, and Google Cloud. Most businesses are using at least one of these cloud services, so being familiar with them is a big benefit. Ideally, a cloud professional would know each of these services inside out. Amazon, Microsoft, and Google all offer certifications that show IT managers you know how to operate in each environment.

Automation: There are plenty of tasks in the cloud space that can be automated. IT workers need to be able to set up these automated tasks and ensure that they work properly. This requires knowledge of how the cloud network is laid out, as well as how to program tasks in it. IT teams can draw from several parts of the cloud architecture to automate tasks across the entire cloud spectrum. There are three popular tools "Jenkins, Terraform, and Chef". They are all standard tools that permit automation diagonally numerous platforms. They also permit professionals targeting to raise their profitability. These tools should also contemplate in addition to the skills to their knowledge path.

Machine learning and AI: Machine Learning (ML) and Artificial Intelligence (AI) are the additional Cloud Computing skills, recommended for a bright cloud career. Machine learning is a field of computer science or an application of artificial intelligence (AI) that shares systems the skill to automatically learn and progress from knowledge without being clearly programmed. Machine learning concentrates on the expansion of computer programs that can access data using statistical techniques and use it for themselves.

Whereas Artificial Intelligence, sometimes called Machine Intelligence, is an intelligence established by technologies, in divergence to the natural intellect displayed by humans and other animals. It is simply defined as the theory and development of computer systems able to achieve tasks normally requiring human intelligence, such as speech recognition, decision-making, visual perception and translation between languages

INTRO 4.0

WHAT IS THIS FOR?

Web Services And API: The underlying foundation is very important to any architecture. Cloud architectures are heavily based on APIs and Web Services because Web services provide developers with methods of integrating Web applications over the Internet. XML, SOAP, WSDL and UDDI open standards are used to tag data, transfer data, describe and list services available. Plus you need API to get the required integration done.

Thus having experience of working on websites, and related knowledge would help you have a strong core in developing Cloud Architectures.

Programming Skills: Cloud Computing is said to add a new dimension to the world of development. Now the developers have the ability to build, deploy, and manage applications quickly which scale to unlock the full capabilities of the cloud.

In the last couple of years, we have seen programming languages like Perl, Python, and Ruby rise to prominence in the cloud ecosystem. Traditional languages like PHP, Java, and .NET continue to be popular.

Python is a good starting point if you are looking to build your cloud programming skills. It is a high-level language and is easy to learn.

Storage: Cloud storage can be defined as "Storing data online on the Cloud" So company's data is stored and accessed from multiple distributed and connected resources. Some of the benefits of Cloud Storage are:

- Greater accessibility
- Reliability
- Quick Deployment
- Strong Protection
- Data Backup and Archival
- Disaster Recovery
- Cost OptimisatioN

The fact that data is centric to Cloud Computing. It is important one understands where to store and how to store it. This is because the measures taken to achieve what is mentioned above may vary based on the type and volume of data an organistaion wants to store and use. Hence understanding and learning how Cloud Storges work, would be a good idea making it an important cloud engineer skill.

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WHAT IS THIS FOR?

MOST VALUED SKILLS:

1. Teamwork
2. Problem solving
3. Strategic Understanding
4. Management And Business
5. Negotiation

Cloud professionals need business skills in addition to technology skills. Among them are:
- Managing personnel
- Communication
- Negotiation

The additional demands fall under two categories.
- Internal — within the organization
- External — vendors and other service providers

The professional must fully comprehend cloud security and its implications for online data and applications. They must take extra care to ensure the security of all online operations.

Cloud Computing makes customization of data for each business possible. Analysts, who can remodel data and tailor it into formats specified by each department in an organization, are a highly prized asset.

INTRO 4.0

WHAT IS THIS FOR?

Prerequisites for Learning Cloud Computing

If you are willing to learn Cloud Computing then there are some prerequisites you should know before learning Cloud Computing such as you should have basic knowledge of operating systems for example. There are few assumptions about learning Cloud Computing.

If you are not good at coding, you can't learn Cloud Computing. This is wrong, you don't have to be a coder for Cloud Computing Expert.

You can't start as a fresher in the cloud. This is wrong, whether you are a fresher or experienced, the doors of cloud career are open for you.

It is only for individuals who belong to IT. This is a myth only, anyone can learn Cloud Computing.

Figure 9. Prerequisites for Learning Cloud Computing Source: Self made

INTRO 4.0

WHAT IS THIS FOR?

How to Start Career in Cloud Computing?

If you are willing to start a career in Cloud Computing you should know about basic steps that can make you a Cloud Computing Expert along with the certifications available for a bright Cloud Computing career.Basic factors that will help you to achieve in Cloud Computing career are:

Strong Foundation in Cloud Computing Concepts
Strong foundation in Cloud Computing concepts can help you achieve the top cloud job positions like Cloud Architect, Cloud Consultant, Cloud Software Engineer, Cloud Software Application Engineer, and Cloud Security Expert.

Practical Knowledge
If you have hands-on experience and good practical knowledge, then you will be in more demand in the industry.

Latest Technology
Cloud Computing technology is continuously updating. So keep updating yourself with the latest technology to start a career in the cloud.

Certifications
There are a number of Cloud Computing Certifications that can make a difference in your profile. AWS Certifications, Microsoft Azure Certifications, Google Cloud Certifications, Alibaba Cloud Certifications, VMware Certifications, Cloud Security Certifications are the top Cloud Computing certifications to boost the Cloud Computing career.

INTRO 4.0

GOOD PRACTICES

Any enterprise considering a move to the cloud must understand that the perceived benefits can be short-lived without a plan that places Cloud Computing in the context of its overall business strategy and affects security, performance, and connectivity.

In particular, large organizations will need to be able to integrate Cloud Computing into existing IT systems and applications. Very few organizations are ready or willing to start from scratch and most will not move all of their business processes fully to the cloud at once. This makes it essential to plan for the integration challenges ahead.

Figure 10

In fact, there may be business processes and applications that never move off-premise. This means we may always need to connect on-premise to on-premise, as well as on-premise to cloud, and cloud-to-cloud, adding more complexity to integration than ever before. With enterprise IT increasingly freed from ongoing infrastructure management to focus on new areas for innovation, business integration demands simplification. With this in mind, let's look more closely at how we advise our own customers considering the cloud.

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GOOD PRACTICES

Create a strategy and a set of (realistic) goals upfront	**07**
Learn from the mistakes of those who came before you	**06**
Maximize connectivity options	**05**
Ensure performance and availability of the data	**04**
Address security concerns	**03**
Get serious about autonomy	**02**
Avoid upfront costs	**01**

Figure 11 . Good practices for your company. Source: Self made

Avoid upfront costs

One reason businesses turn to Cloud Computing and software-as-a-service (SaaS) is to mitigate risk. With a pay-as-you-go model, you can simply turn the system off if it is not working for you, and you only pay for what you use. Be sure not to jeopardize return on investment with expensive software licenses -- your integration solution, like every other part of your Cloud Computing investment, should use a flexible subscription model, too.

Get serious about autonomy

Integration of on-premise applications has traditionally required a team of IT specialists who have a deep understanding of underlying application frameworks and processes. SaaS applications are designed to be managed by business users-non-domain experts who will need to quickly and easily connect data with other enterprise systems. Cloud integration should complement the model by minimizing development, implementation, and maintenance resources, allowing users to focus on their core business.

GOOD PRACTICES

Address security concerns

According to analysts, nearly 75 percent of CIO and IT executives cite security as their number one concern when it comes to Cloud Computing. Because integrated Cloud Computing involves moving sensitive data between the cloud and on-premise networks, guaranteeing security is vital. When vetting an integration solution, determine which standards are supported for securing the data in transit. Keep in mind that as enterprises move more processes to the cloud, the volume of sensitive data flowing to and from the cloud increases.

Ensure performance and availability of the data

Today, popular Cloud Computing services provide levels of availability and performance that outperform internal infrastructure, in many cases 99.9 percent uptime or better. When designing a cloud strategy, identify integration requirements for each system (real-time, near real-time, batch), and determine the number of simultaneous requests to be handled, and specify all special architecture requirements. Success depends on ensuring information will not be lost if the cloud or on-premise source goes down. (Yes, even the cloud needs a backup plan.)

Maximize connectivity options

Cloud Computing has become a loose definition for services on the Web: everything from SaaS and platform-as-a-service (PaaS), to Web-based utility and storage solutions, and emerging Web 2.0 properties such as Google Docs, LinkedIn, and Twitter. According to research1 from Saugatuck Technology, by the end of 2010, one-quarter of business process improvement initiatives will include integration of information from enterprise social computing solutions.

GOOD PRACTICES

Connectivity requirements will continue to evolve beyond standard enterprise applications, legacy systems, and databases, to modern Web service and Web 2.0 APIs.

Learn from the mistakes of those who came before you

Early adopters took a standalone approach to Cloud Computing. The services were readily available, easy to consume, and economical. Implementation challenges were few. However, for enterprises where traditional IT infrastructure often serves core business operations, the "detached" cloud might deliver only short-term value and potentially require future re-implementation or migration. Although a standalone approach risks creating silo-ed applications, an integrated cloud strategy will deliver long-term results.

Create a strategy and a set of (realistic) goals upfront

Some businesses are jumping in without articulating a long-term cloud strategy and how it relates to their overall business. As with any project, establish realistic goals and priorities, a clear budget and deadline, as well as a shared understanding of what resources are available for implementation and maintenance. Although Cloud Computing promises significant **ROI** (productivity gains of 50 percent or more) keeping complexity and cost to a minimum requires planning and strategy.

Return on Investmen (ROI)

is a performance measure used to evaluate the efficiency of an investment or compare the efficiency of a number of different investments. ROI tries to directly measure the amount of return on a particular investment, relative to the investment's cost.

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GOOD PRACTICES

Netflix's business is growing rapidly and experiences very uneven demand (highly skewed toward evenings, when, by some accounts, its video streaming service represents 29 percent of all Internet traffic). In this kind of environment, Netflix didn't want to experience service interruptions due to its inability to build data centers fast enough to handle the huge number of customers. This implies that each service must deliver high availability and be failure-resistant. When Netflix found that it was outpacing its traditional data center's capabilities, it turned to the cloud for help with scalability in order to meet spikes in demand and lulls in activity. They successfully migrated all of its databases to the cloud in 2016. As a result, the streaming giant can now produce more content, onboard more customers and easily handle sharp increases in usage spikes (typically when new episodes of a show are made available). The company can also add or reduce storage amounts in real-time based on its current viewers.

Some leading providers:

BENEFITS FOR THE COMPANY

Cloud Computing capabilities:

Cloud Computing is a hot topic these days and it promises to be a fundamental transition in the evolution of IT. Every organization is under pressure to do less with more and there is an incredible pressure to maximize the ROI (Return on Investment). Measurable benefits such as lower costs, greater agility and better resource utilization helps one to focus on what is important for your Business.

Features like security, scalability, cost-efficiency, automated backups, and recovery form the basis of why the cloud is so great.However, there are more subtle benefits that are often overlooked, yet can be a real game changer for your business.

❖ SHORT-TERM
  ➢ Reduction of vendor lock-in
  ➢ Improved means to deal with data and communication
  ➢ Better understanding of cloud capabilities and programmability of cloud services
  ➢ Useable management of trust, privacy and confidentiality
  ➢ Adequate market regulatory frameworks and viable business models
  ➢ An affordable, international mobile data service

❖ MID-TERM
  ➢ Reduced costs
  ➢ Increased security
  ➢ Performance & reliability, programmability
  ➢ Overcoming heterogeneity
  ➢ Standards / Interoperability / Orchestration

❖ LONG-TERM
  ➢ Flexibility, heterogeneity, distribution (new techniques for interoperation)
  ➢ Performance & reliability, adaptability (new programming and executing paradigms, new devices)
  ➢ Common agreement on the legal framework, including data protection etc.
  ➢ Common contractual terminology
  ➢ Full connectivity (new data management mechanisms)

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BENEFITS FOR THE COMPANY

Some benefits of migrating to a cloud-based infrastructure

Minimal launch time (Performance)

The biggest Cloud Computing services run on a worldwide network of secure datacenters, which are regularly upgraded to the latest generation of fast and efficient computing hardware. This offers several benefits over a single corporate datacenter, including reduced network latency for applications and greater economies of scale. Rather than taking hours—if not days—to launch or update, cloud applications are typically up and running in seconds or minutes, and easy to learn.

Reliability

Cloud computing makes data backup, disaster recovery, and business continuity easier and less expensive because data can be mirrored at multiple redundant sites on the cloud provider's network.

Greater scalability

Users can effortlessly scale their compute or storage capacity up or down depending on what's needed, keeping your infrastructure simple and efficient.

Immediate global workforce

Enable your team to access information through the Cloud anywhere, anytime, and on any mobile device — so long as they have an internet connection.

Reduce or eliminate infrastructure maintenance

Cloud systems can automatically sync with the main server to get the latest updates and patches, which drastically cuts back on time spent doing administrative task

Intelligent automation

Self-provisioning tools give users the ability to spend more time responding to customer and business needs, and less time tinkering with manual intervention.

Low startup and capital costs

Maintain easy access to vital information with minimal upfront investment. With the Cloud model, simply pay as you go and based on how much storage space you are using.

INTRO 4.0

BENEFITS FOR THE COMPANY

Security & confidentiality

The primary concern with Cloud Computing is security. Serious companies need to ensure that private data in the Cloud stays confidential. Using one of two SharePoint cloud hosting platforms, the consultants at Innovative Architects will make sure your migration to the Cloud is quick, easy, but above all, secure.

Cost

Cloud Computing eliminates the capital expense of buying hardware and software and setting up and running on-site datacenters—the racks of servers, the round-the-clock electricity for power and cooling, and the IT experts for managing the infrastructure. It adds up fast.

Big data

In addition to helping store data, cloud computing services give you the ability to sift through vast amounts of unstructured data to find meaningful business intelligence—a must-have tool for making informed decisions about your organization's future goals.

Advantages

- Cost Savings
- Manageability
- Strategic Edge
- Easy implementation
- Accessibility
- No hardware required
- Flexibility for growth
- Efficient recovery

Disadvantages

- Downtime
- Vendor Lock-In
- Limited Control
- Bandwidth issues
- Vulnerability to Attack
- Cybersecurity risks
- Customer Support
- Network Connection Dependency

Figure 13. Advantages and Disadvantages of Cloud Computing. Source: Self made

🚀 FUTURE APPLICATIONS

Emerging cloud technologies and services:

Cloud providers are competitive, and they constantly expand their services to differentiate themselves. This has led public IaaS providers to offer far more than common compute and storage instances.

For example, serverless, or event-driven computing is a cloud service that executes specific functions, such as image processing and database updates. Traditional cloud deployments require users to establish a compute instance and load code into that instance. Then, the user decides how long to run and pay for that instance.

With serverless computing, developers simply create code, and the cloud provider loads and executes that code in response to real-world events, so users don't have to worry about the server or instance aspect of the cloud deployment. Users only pay for the number of transactions that the function executes. AWS Lambda, Google Cloud Functions and Azure Functions are examples of serverless computing services.

Public Cloud Computing also lends itself well to big data processing, which demands enormous compute resources for relatively short durations. Cloud providers have responded with big data services, including Google BigQuery for large-scale data warehousing and Microsoft Azure Data Lake Analytics for processing huge data sets.

Another crop of emerging cloud technologies and services relates to artificial intelligence (AI) and machine learning. These technologies build machine understanding, enable systems to mimic human understanding and respond to changes in data to benefit the business. Amazon Machine Learning, Amazon Lex, Amazon Polly, Google Cloud Machine Learning Engine and Google Cloud Speech API are examples of these services.

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# 🚀 FUTURE APPLICATIONS

Practical Uses of Cloud Computing:

The uses of Cloud Computing are not just limited to personal emails or storage, rather these scalable solutions have become the medium of choice for development, testing and deployment of software as well. The examples of Cloud Computing are everywhere from the messaging apps to audio and video streaming services.

Scalable Usage: Cloud Computing offers scalable resources through various subscription models. This means that you will only need to pay for the computing resources you use. This helps in managing spikes in demands without the need to permanently invest in computer hardware.

Netflix, for instance, leverages this potential of cloud computing to its advantage. Due to its on-demand streaming service, it faces large surges in server load at peak times. The move to migrate from in-house data centres to cloud allowed the company to significantly expand its customer base without having to invest in setup and maintenance of costly infrastructure.
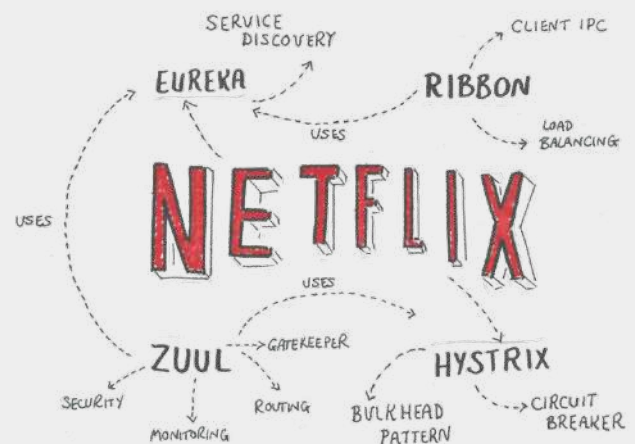
Chatbots: The expanded computing power and capacity of the cloud enables us to store information about user preferences. This can be used to provide customized solutions, messages and products based on the behaviour and preferences of users.
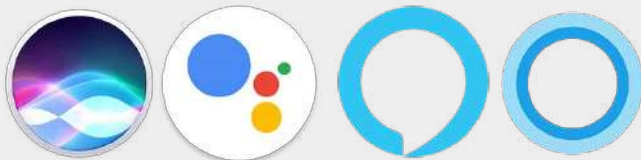
Siri, **Alexa**, **Cortana** and **Google Assistant** all are cloud-based natural-language intelligent bots. These chatbots leverage the computing capabilities of the cloud to provide personalized context-relevant customer experiences

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🚀 FUTURE APPLICATIONS

Communication: The cloud allows users to enjoy network-based access to communication tools like emails and calendars. Most of the messaging and calling apps like **Skype** and **WhatsApp** are also based on cloud infrastructure. All your messages and information are stored on the service provider's hardware rather than on your personal device. This allows you access your information from anywhere via the internet.

Productivity: Office tools like **Microsoft Office 365** and **Google Docs** use Cloud Computing, allowing you to use your most-productive tools over the internet. You can work on your documents, presentations and spreadsheets - from anywhere, at any time. With your data stored in the cloud, you don't need to bother about data loss in case your device is stolen, lost or damaged. Cloud also helps in sharing of documents and enables different individuals to work on the same document at the same time at you will get different results. All this is made possible using big data.

Business Process: Many business management applications like customer relationship management (CRM) and enterprise resource planning (ERP) are also based on a cloud service provider. **Salesforce**, **Hubspot**, **Marketo** etc. are popular examples of this model. This method is cost-effective and efficient for both the service provider and customers. It ensures hassle free management, maintenance and security of your organization's critical business resources and allows you to access these applications conveniently via a web browser.

🚀 FUTURE APPLICATIONS

Backup and recovery: When you choose cloud for data storage the responsibility of your information also lies with your service provider. This saves you from the capital outlay for building infrastructure and maintenance. Your cloud service provider is responsible for securing data and meeting legal and compliance requirements. The cloud also provides more flexibility in the sense that you can enjoy large storage and on-demand backups. Recovery is also performed faster in the cloud because the data is stored over a network of physical servers rather than at one on-site data centre. **Dropbox**, **Google Drive** and **Amazon S3** are popular examples of cloud backup solutions.

Application development: Whether you are developing an application for web or mobile or even games, cloud platforms prove to be a reliable solution. Using cloud, you can easily create scalable cross-platform experiences for your users. These platforms include many pre-coded tools and libraries like directory services, search and security. This can speed up and simplify the development process. **Amazon Lumberyard** is a popular mobile game development tool used in the cloud.

Test and development: The cloud can provide an environment to cut expenses and launch your apps in the market faster. Rather than setting up physical environments developers can use the cloud to set up and dismantle test and development environments. This saves the technical team from securing budgets and spending critical project time and resources. These dev-test environments can also be scaled up or down based on requirements. **LoadStorm** and **BlazeMeter** are popular testing tools..

🚀 FUTURE APPLICATIONS

Big data analytics: Cloud Computing enables data scientists to tap into any organizational data to analyze it for patterns and insights, find correlations make predictions, forecast future crisis and help in data backed decision making. Cloud services make mining massive amounts of data possible by providing higher processing power and sophisticated tools. There are many open source big data tools that are based on the cloud for instance **Hadoop**, **Cassandra**, **HPCC** etc. Without the cloud, it won't be very difficult to collect and analyze data in real time, especially for small companies.

Social Networking: Social Media is the most popular and often overlooked application of cloud computing. **Facebook**, **LinkedIn**, **MySpace**, **Twitter**, and many other social networking sites use cloud computing. Social networking sites are designed to find people you already know or would like to know. In course of finding people, we end up sharing a lot of personal information. Of course, if you're sharing information on social media then you are not only sharing it with friends but also with the makers of the platform. This means that the platform will require a powerful hosting solution to manage and store data in real-time - making use of cloud critical.

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🚀 FUTURE APPLICATIONS

TRENDS:

Businesses nowadays are seeking innovative ways to grow and accomplish their business goals. With the help of Cloud Computing, this business will keep on growing in the future. Cloud Computing is powerful and expansive and will continue to grow in the future. Some trends for the next year will be:

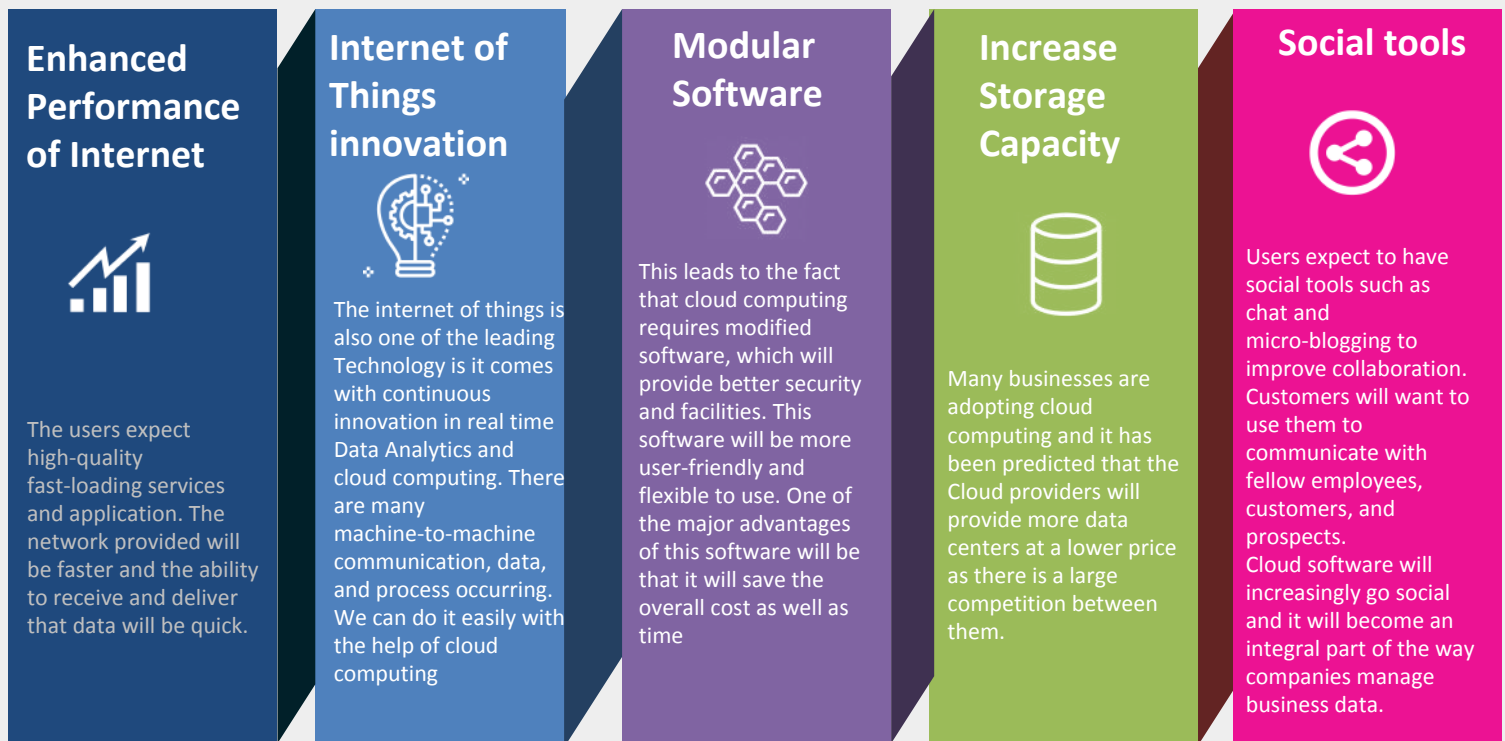| Enhanced Performance of Internet	Internet of Things innovation	Modular Software	Increase Storage Capacity	Social tools
The users expect high-quality fast-loading services and application. The network provided will be faster and the ability to receive and deliver that data will be quick.	The internet of things is also one of the leading Technology is it comes with continuous innovation in real time Data Analytics and cloud computing. There are many machine-to-machine communication, data, and process occurring. We can do it easily with the help of cloud computing	This leads to the fact that cloud computing requires modified software, which will provide better security and facilities. This software will be more user-friendly and flexible to use. One of the major advantages of this software will be that it will save the overall cost as well as time	Many businesses are adopting cloud computing and it has been predicted that the Cloud providers will provide more data centers at a lower price as there is a large competition between them.	Users expect to have social tools such as chat and micro-blogging to improve collaboration. Customers will want to use them to communicate with fellow employees, customers, and prospects. Cloud software will increasingly go social and it will become an integral part of the way companies manage business data.

Figure 14. Cloud Computing Trends.
Source: Self made

Given the vital role that IT plays in today's business environment, cloud computing is also fundamentally changing the way that companies operate. Tens of thousands of companies of all sizes in a broad range of industries are utilizing cloud-based software, platforms, and even infrastructure to streamline processes, lower IT complexity, gain better visibility, and reduce costs.

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ADVANCED CONTENT

Nature and Features:

Cloud Computing in simplified terms can be understood as the storing, processing and use of data on remotely located computers accessed over the internet. This means that users can command almost unlimited computing power on demand, that they do not have to make major capital investments to fulfil their needs and that they can get to their data from anywhere with an internet connection. Cloud Computing has the potential to slash users' IT expenditure and to enable many new services to be developed. Using the cloud, even the smallest firms can reach out to ever larger markets while governments can make their services more attractive and efficient even while reining in spending.
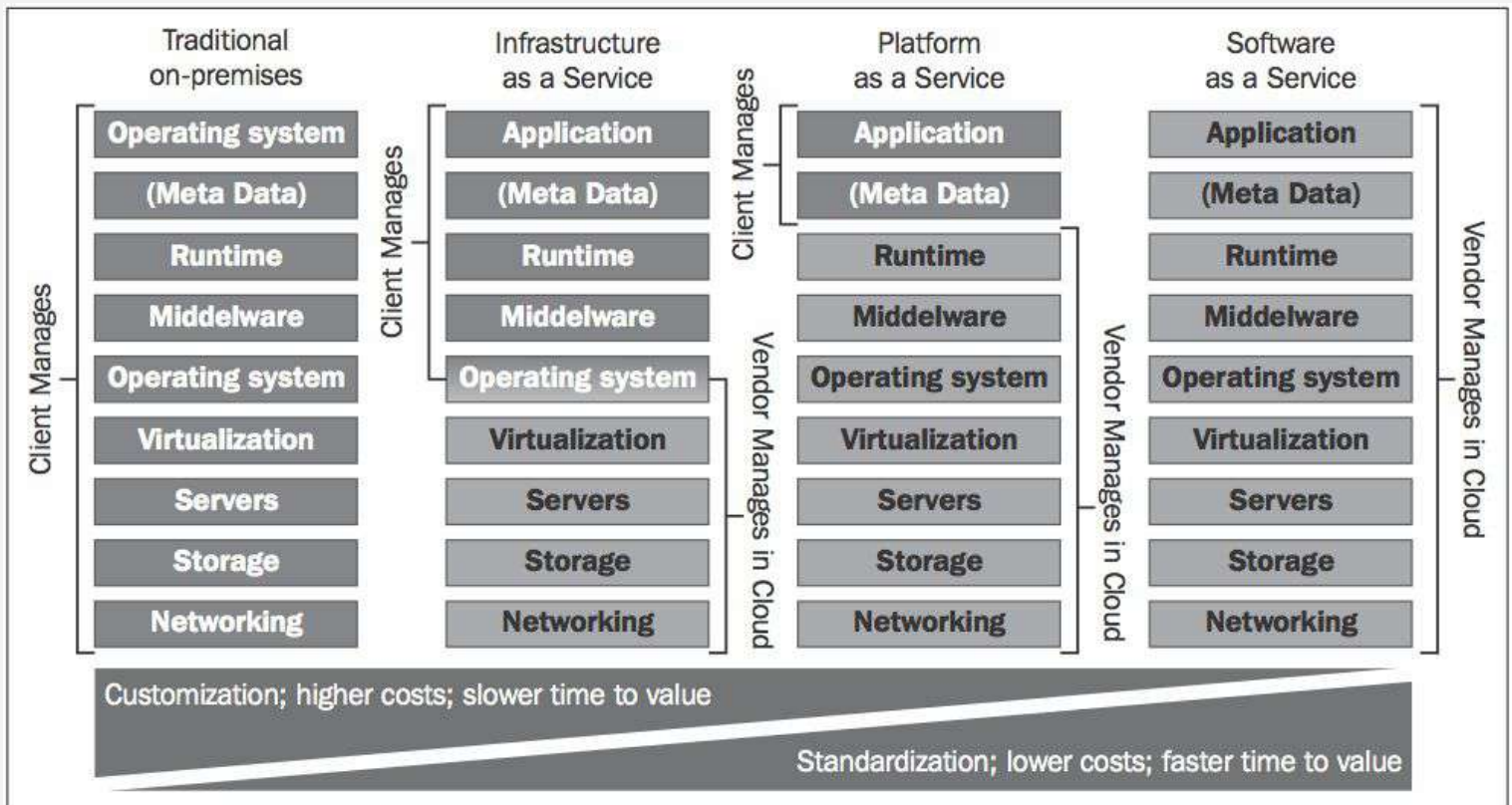
Figure 15. Nature of Cloud Computing.
Source: www.ibm.com

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1 Hardware (computers, storage devices) is owned by the Cloud Computing provider, not by the user who interacts with it via the internet

2 Cloud providers often move their users' workloads around (e.g. from one computer to another or from one data centre to another) to optimise the use of available hardware

3 Organisations and individuals can access their content, and use their software when and where they need it, e.g. on desktop computers, laptops, tablets and smartphones

4 The remote hardware stores and processes data and makes it available, e.g. through applications (so that a company could use its cloud-based computing in just the same way as consumers already today use their webmail accounts)

5 The use of hardware is dynamically optimised across a network of computers, so that the exact location of data or processes, as well as the information which piece of hardware is actually serving a particular user at a given moment, does not in principle have to concern the user, even though it may have an important bearing on the applicable legal environment.
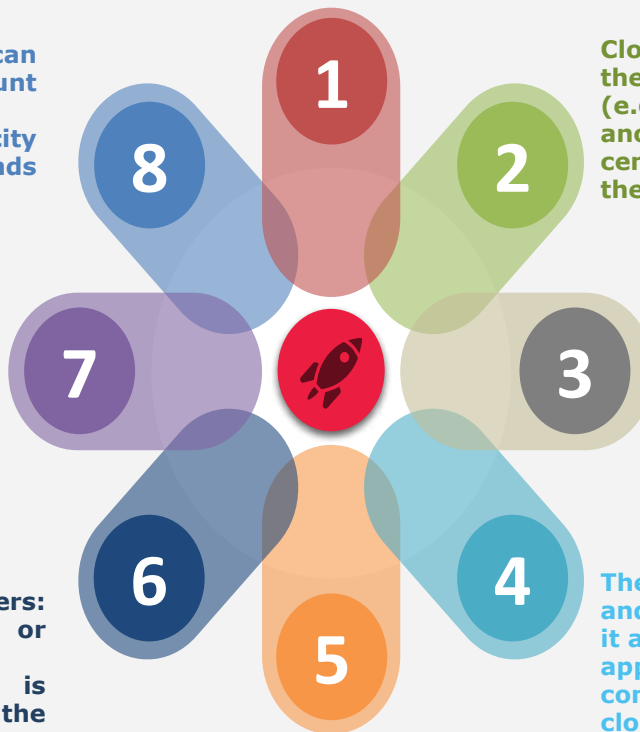
6 A cloud set-up consists of layers: hardware, middleware or platform, and application software. Standardisation is important especially at the middle layer because it enables developers to address a wide range of potential customers and gives users choice

7 Users normally pay by usage, avoiding the large upfront and fixed costs necessary to set up and operate sophisticated computing equipment

8 At the same time, users can very easily modify the amount of hardware they use (e.g. bring new storage capacity online in a matter of seconds with a few mouse clicks)

Figure 16. Cloud computing features.
Source: Self made

INTRO 4.0

ADVANCED CONTENT

Creating a strategy

Before investing the money for Cloud Computing & deploying cloud applications companies must necessarily consider the requirements, strategically plan them for business needs and consider:

❏ Client accessing facility
❏ Budget requirement
❏ Type of deployment - private, public, community or hybrid
❏ Privacy and Data security
❏ Data backup requirement
❏ Data export requirement
❏ Requirement of training

The three main phases are:

1 **Strategy Phase**

Here, companies discuss about the problems that customers might encounter. There are two steps of examining this phase:

➢ Value proposition of Cloud technology: It involves IT management simplifications, maintaining cost reduction, low-cost outsourcing, high QoS (quality of service) outsourcing & innovation in the business model.
➢ Strategy planning of Cloud technology: Based on analysis of value proposition, the strategy is established; and the strategy documentation is made according to the problems the customer might encounter while using cloud technology.

ADVANCED CONTENT

2 Planning Phase

Here the problem analysis & risk analysis for switching to cloud technology is checked to ensure whether the customer is satisfied in meeting their business goals or not. The steps for planning are:

➢ Development of Business Architecture

➢ Development of IT Architecture

➢ QOS development requirement

➢ Development of Transformation plan

3 Deployment Phase

Deployment Phase pivots its strategies based on the above two phases of planning and involves the following steps:

➢ Selecting appropriate providers of Cloud: This selection is made based on SLA (Service Level Agreement), which defines the level of service the cloud-provider will provide.

➢ Maintaining the Technical Service: The provider must ensure the proper maintenance of services by providing the best Quality of Service to their users.

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Factors to Consider Before Investing

1 **Availability**

As soon as all your business-critical data get stored in the cloud storage, it becomes essential to check whether the data is available or not, whether the data is secured or there are loopholes that might become the reason of the downfall of an organization's business. Therefore, as a user you should stay focus & check this aspect with the service provider before signing the deal.

2 **Compliance**

Even though it seems that all data gets stored in the cloud storage, but data resides on multiple servers; these servers are located in different nations of the globe. Though it has an advantage for data availability, users must concern about the legality issue; the issue in the sense - users need to check whether there will be any discrimination or restriction for a particular type of data to store beyond national boundaries.

3 **Compatibility**

Users must check the compatibility of IT infrastructure of his/her organization before investing money in Cloud. Though cloud technology is providing users with the optimum possible benefits, as a vendor users must also harvest and extract the maximum usage of cloud. Moreover, it has to keep in mind that the employees of the organization must cope-up with the infrastructure of the cloud technology. the toil.

4 **Monitoring**

As you put your data on cloud storage, the cloud service provider takes the responsibility and control of your data. For this reason, monitoring becomes an issue. Since complete monitoring of data is possible, so users should make sure that proper monitoring of data is allowed by the providers based on user requirement.

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ADVANCED CONTENT

SOME CLOUD COMPUTING TOOLS:
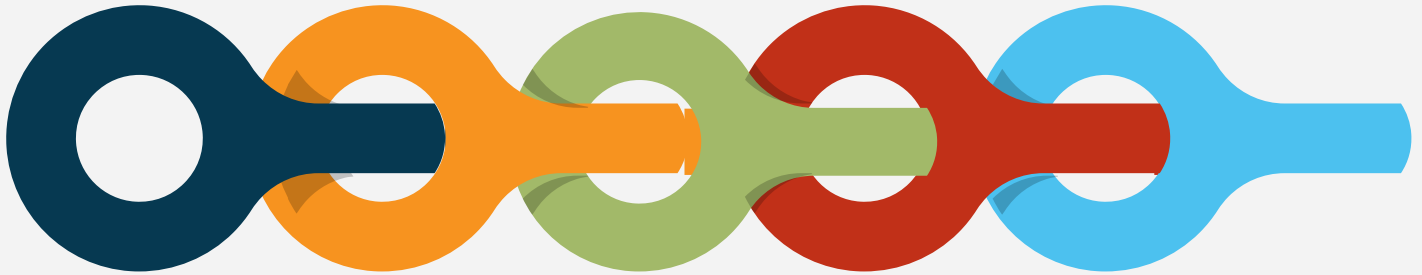
Cloudability

It aggregates expenditures into reports, helps identify opportunities for reducing costs, offers budget alerts and recommendations via SMS and email, and provides APIs for connecting cloud billing and usage data to any business or financial system.

Cloudyn

These tools are designed to help corporate IT from over-buying Amazon cloud resources. Cloudyn's suite of services gives users a dashboard showing detailed information on all of their virtual machine instances, databases, and storage

AtomSphere

Is a cloud-based software Platform as a Service used by customers who want to integrate their various cloud-based applications with each other and with on-premise apps

EnStratius

Provides cross-platform cloud infrastructure management for public, private, and hybrid clouds that can be closely aligned with an enterprise's governance and security requirements.

Informatica

Cloud integration tools that include enhancements that address data security issues in the cloud and help enterprise IT manage data integration issues in hybrid cloud deployments
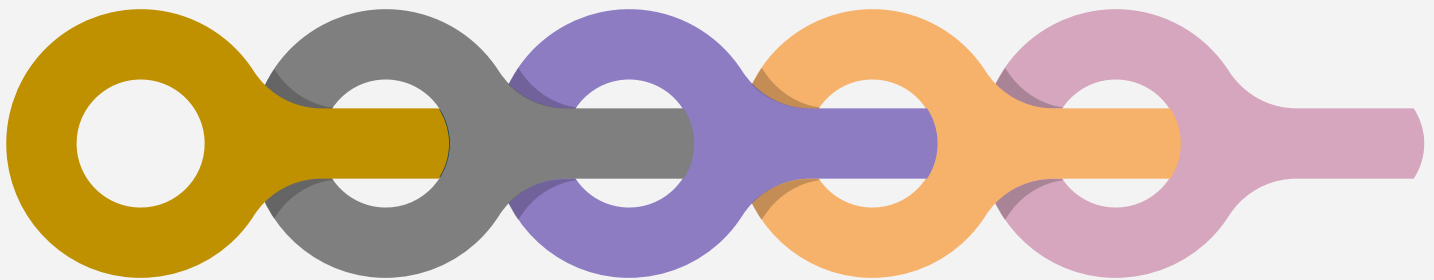
MuleSoft

Delivered as a packaged integration experience, CloudHub and Mule ESB are built on open source technology to provide quick, reliable application integration without vendor lock-in.

Opscode

Chef is an open source Ruby-based configuration management product served up by Opscode under the Apache license,focuses on provisioning, configuring and integrating cloud resources.

PuppetLabs

Is an IT automation software that gives system administrators the power to easily automate repetitive tasks, quickly deploy critical applications, and proactively manage infrastructure changes, on-premise or in the cloud

RightScale

Its platform lets organizations easily deploy and manage business-critical applications across public, private and hybrid clouds. RightScale provides configuration, monitoring, automation and governance of Cloud Computing infrastructure and applications.

DXC-Agility

Provides a single, integrated control point for governance, compliance and security across an enterprise's cloud applications and cloud environments.

Figure 17. Some B tools.
Source: Self made

INTRO 4.0

EDUCATION

Test your knowledge of **Cloud Computing** with this quiz:

> *Self-assessment tool:*
>
> https://searchcloudcomputing.techtarget.com/quiz/Quiz-Cloud-computing-basics

Degrees/Masters

❏ Cloud Computing MSc, PGDip - University of Leicester

❏ Online Cloud Computing Architecture Master's Degree - University of Maryland University College

❏ BSc (Hons) Cloud Computing - University of Wolverhampton

❏ Master of Technology in Cloud Computing - K L University

MOOC's

❏ Cloud Computing Concepts, Part 1 - Coursera

❏ Cloud Computing Concepts: Part 2 - Coursera

❏ Cloud Computing Security - edX

❏ SAP Cloud Platform Essentials - openSAP

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EDUCATION

## External manuals & tutorials for more information

❏ Practical Guide to Cloud Computing Version 3.0, by Cloud Standards Customer Council

❏ Cloud Services For Dummies, IBM Limited Edition, by J. Hurwitz, M.Kaufman, and Dr. F. Halper

❏ Cloud Computing Tutorial for Beginners

❏ Cloud Computing Bible, by B. Sosinsky

Certifications

❏ Google Certified Professional Cloud Architect

❏ Project Management Professional (PMP)

❏ AWS Certified Solutions Architect – Associate

❏ Microsoft Certified Solutions Expert (MCSE): Server Infrastructure

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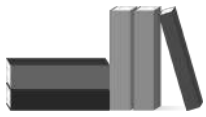
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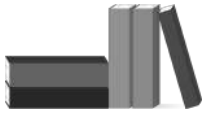
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SELF APPRAISAL

★ After having read this text have I a clear idea of what Cloud Computing is?

★ What tools am I used to?

★ Do I know the benefits that Cloud Computing can bring to my company?

★ Can I recognize the advantages and disadvantages of its implementation for my company?

INTRO 4.0

INTRODUCTION TO THE INDUSTRIAL REVOLUTION 4.0