The Role of Corporate Finance in Evaluating a Cloud Computing Strategy - A Chief Financial Officer perspective

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Master Thesis submitted in fulfillment of the Degree

Master of Business Administration

in New Media and Information Management

Submitted to Professor Graeme Rankine

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Vienna, June 11th, 2018

AFFIDAVIT

I hereby affirm that this Master's Thesis represents my own written work and that I have used no sources and aids other than those indicated. All passages quoted from publications or paraphrased from these sources are properly cited and attributed.

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ABSTRACT

Today every organization deals with a high degree of uncertainty, rapid technology innovation, much shorter product cycles, and global competition. A new level of agility to adapt quickly to address those business needs is required and cloud fuels this disruption and acts as a catalyst for innovation. But every organization is unique and so is every journey to the cloud.

This thesis provides guidance for organizations on how to create a common framework to evaluate moving to the cloud and provides answers to key economic questions about cloud computing. It supports companies to make decisions underpinned by global research, metrics and facts whether and how an organization should adopt the cloud for their needs. It specifically discusses the financial aspects of evaluating cloud, key finance metrics, the entire costs and benefit structure for a company and how to put the metrics into perspective and run risk analysis to support the business strategically on their journey to the cloud.

The paper discusses the role of the Chief Financial Officer and how critical the role is to help businesses survive and support innovation. Furthermore, the impact that cloud can have on the finance department of an organization, including key aspects such as forecasting and cost management.

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LIST OF ABBREVIATIONS

IaaS – Infrastructure-as-a-Service

SaaS – Software-as-a-Service

PaaS – Platform-as-a-Service

CapEx – Capital Expenditures

OpEx – Operation Expenditures

CFO – Chief Financial Officer

TCO – Total Cost of Ownership

ROI – Return on Investment

MIT – Massachusetts Institute of Technology

PUE – Power Usage Effectiveness

NPV – Net Present Value

IRR – Internal Rate of Return

GAAP – Generally Accepted Accounting Principles

IFRS – International Financial Reporting Standards

SMB – Small and Medium Businesses

CIO – Chief Information Officer

1 INTRODUCTION

1.1 Context and previous research

The proposed Master Thesis with the title "The Role of Corporate Finance in Evaluating a Cloud Computing Strategy – A Chief Financial Officer (CFO) perspective" is focused on the most common challenges, responsibilities and tasks for a CFO within a company that is evaluating and possibly adopting a cloud computing strategy.

The goal of the thesis is to provide an in-depth analysis of the role of finance, and how critical it is to this department and specifically for their CFO to support the company´s strategy going to the cloud. This thesis should provide a basic framework for estimating financial value and determine benefits from cloud computing.

The master thesis will be structured around some areas that are outlined later in this paper and it will give answers to the following research questions:

- **How can a Finance Department evaluate Cloud Computing to understand the impact on its organization's cost structure and financial strategy?**

- **Which methods can be applied to handle uncertainties in financial forecasting and cash flow projections related to adoption of a cloud computing strategy?**

During my literature review, I could identify little formal research, and only a few books that cover those aspects in detail. Instead there are multiple, well-known research and consulting companies such as KPMG, Gartner and PriceWaterhouseCoopers (PWC) and many smaller, less known consulting companies and organizations focused on cloud adoption that have released related articles, studies and whitepapers that deal with the economic and financial aspects of cloud adoption.

1.2 Cloud Computing Introduction

The history of "*cloud computing*" goes back to 1996 when Compaq mentioned the term in an internal document (Regalado, 2011). At the time when Amazon released their first cloud computing product "*Amazon Elastic Compute Cloud (EC2)*" in 2006 (which went in production in 2008), and Google released Google App Engine (GAE) in 2008 (and went in production in 2011), cloud and its concept became popular. On July 8th, 2008, Amy Schurr wrote in an article "*Keep*

an eye on cloud computing" that there is "*some confusion about what exactly constitute cloud computing, but one thing experts tend to agree on is the evolutionary effect this will have on IT*". At that time definitions varied greatly about what cloud computing is, most experts and analyst described it loosely as the delivery of software and hardware as services over the Internet. Gartner, one of the world's leading research and advisory company released a new report that "*points to the opportunity to shape the relationship among consumers of IT services, those who use IT services and those who sell them.*" (Schurr, 2008)

Computer scientist John McCarthy was arguably the first to refer to utility computing in MIT Centennial 1961: "*If computers of the kind I have advocated become the computers of the future, then computing may someday be organized as a public utility just as the telephone system is a public utility… The computer utility could become the basis of a new and important industry.*" (Biswas, 2011). This is how cloud computing works today.

To understand the current revolution in IT, cloud computing, we must talk about Thomas Edison and the year 1879. In Menlo Park, New Jersey, Thomas Edison on October 21st, 1879 he created the first incandescent lamp from carbon filament and, after successful tests and improvements on November 4th, 1879 he filed for U.S. patent 223.898 for an electric lamp.

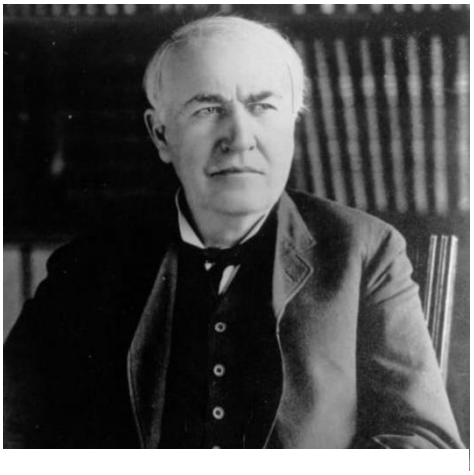


FIGURE 1 THOMAS EDISON, BIOGRAPHY.COM

He immediately knew that his technology had the power to change the life of everybody on the planet, but there was a problem with his invention: there was no public electricity available and it could not be produced efficiently and safely. In 1880 Edison founded the "*Edison Illuminating Company*" to develop an electric utility and patented a system for electricity distribution. Less than 4 years later the first power station was built in 1882 on Pearl Street Station in New York City and provided 59 customers in lower Manhattan with 110 volts of direct current (DC) power. People didn´t want the power station, but they wanted the light. Utility is the foundation of the industrial revolution. When power, water, and electricity became a utility the industry could focus on the output and make the industries more productive while the business only paid for what they consumed.

How does that relate to Cloud Computing? Most organizations are not in the business of running a datacenter, very much like the industry revolution where most organizations were not in the business of building power stations or generating electricity. Cloud Computing helps organizations to focus on the core business, provide better innovation cycles instead of purchasing, operating and maintaining core IT infrastructure. Utility based computing enables business to exactly align technology expenditure with business and customer requirements. While in the past

companies had to guess what they will need in the next 3 or 5 years, with Cloud computing they only consume and pay for what they need.

While there are many books, articles and studies available that explain cloud computing very well, this paper will only give a brief overview about what makes something a 'Cloud', what are some of the benefits of Cloud Computing, and why everyone talks about the cloud and its relevance for today's organizations and industry. The goal of the thesis is not to give a detailed view on cloud, its components, and deep technical details, but a basic understanding and enough details to understand the topics of this thesis.

To understand the concept of a cloud, in September 2011 the US National Institute of Standards and Technology (NIST) provides a document "*NIST Special Publication (SP) 800-145, The NIST Definition of Cloud Computing*" with definitive description of cloud computing and that every technology must have those five characteristics that are defined by them to be considered a cloud. Since the "*cloud has experienced a growth in technical maturity*" another evaluation document was published in draft status in May 2017 to "*provides an analysis of the NIST Definition of Cloud Computing based on today's perspective and provides a methodology for evaluating services, complementing the NIST definition*" (Eric Simmon, 2017).

The five essential characteristics of cloud computing are:

- **On-demand self-service**: any user should be able to subscribe to a cloud service through an internet browser.
- **Measured service**: cloud prices are based on usage, therefore monitoring and reporting capabilities enable those companies that are providing cloud services to offer a service by subscription, pay-per-use and other pricing models.
- **Elastic scalability**: the number of resources being used for a certain cloud services can be increased or decreased whenever needed.
- **Resource pooling**: the impression of infinite capacity is created by virtualized servers, storage, and networks that are pooled together, either within a single location or from different locations across multiple geographies.
- **Broad network access**: cloud only works with internet access, so every cloud technology requires broad network access to support efficient service delivery.

Furthermore, NIST defines three services models and four deployment models in their cloud computing description that are important to understand. The three service models are:

Infrastructure-as-a-Services (IaaS): simply speaking these are server, storage and network resources delivered as a service. So instead of buying server hardware and operating it in a Datacenter, a user can use IaaS to get this hardware virtualized without any hardware acquisitions and without the need to operate and maintain the hardware. Examples for IaaS are Microsoft

Azure or Google Compute Engine, which provide so called virtual machines that can be deployed and consumed within minutes.

Platform-as-a-Services (PaaS): this is the next abstraction layer above IaaS and includes middleware and development tools, such as programming languages and libraries. PaaS offers a platform to deploy and run custom-created applications to a cloud. Examples for PaaS offerings are Microsoft Azure or Amazon AWS, which both have multiple services that can be used as a platform to develop cloud applications.

Software-as-a-Services (SaaS): is the highest abstraction layer and offers business operations and services that can be used with a browser, or an application user-interface. Users do not care about the underlying hardware or platform or application, they are generally focused on using the applications. Some examples for SaaS offerings are mailboxes through outlook.com or gmail.com as well as office suites such as Office365.

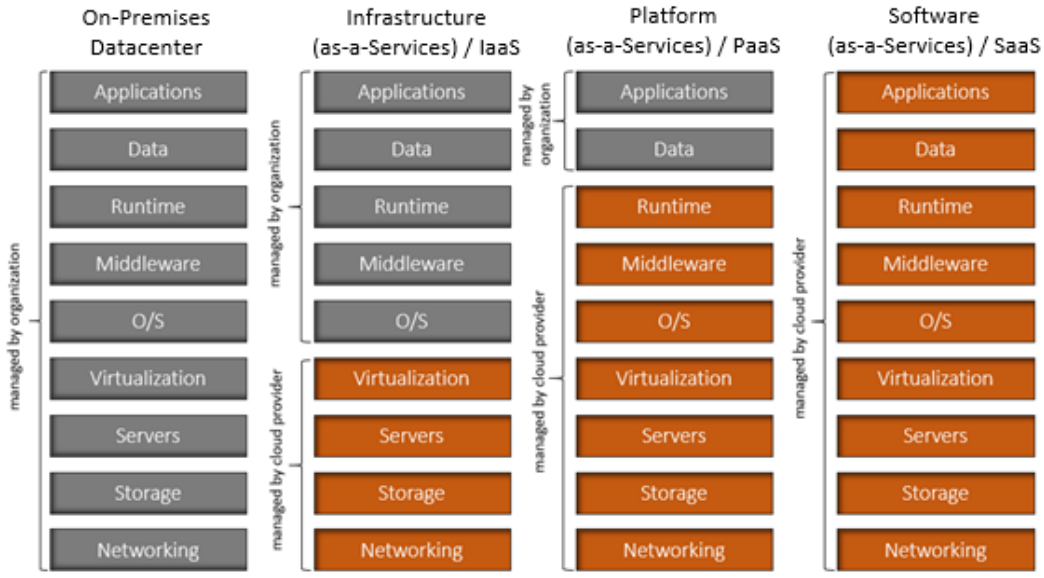


FIGURE 2 SEPARATIONS OF RESPONSIBILITIES

The last section of the NIST description explains the four deployment models that basically differentiate the scope of access (while this section will not discuss Community Cloud due its irrelevance for this paper):

Private: a private cloud is operated for a single organization providing the similar capabilities such as IaaS, but only limited to the user/employees of a specific operations. Private clouds are deployed, operated and maintained by the organization itself, so the need for hardware purchases still exist.

Public: a public cloud is available to the general public and is operated by a cloud service provider that sell those solutions and services. Organizations that use a public cloud do not have to purchase any hardware.

Hybrid: a hybrid cloud consists of both a private and public cloud, an organization that uses both deployment models to consume resources both in their own datacenter as well as in a public or multiple public cloud.

Across research companies, consulting organizations and cloud providers the forecast for cloud computing growth is significant and shows that more and more organizations are adopting cloud for their needs. (Statista, 2018)

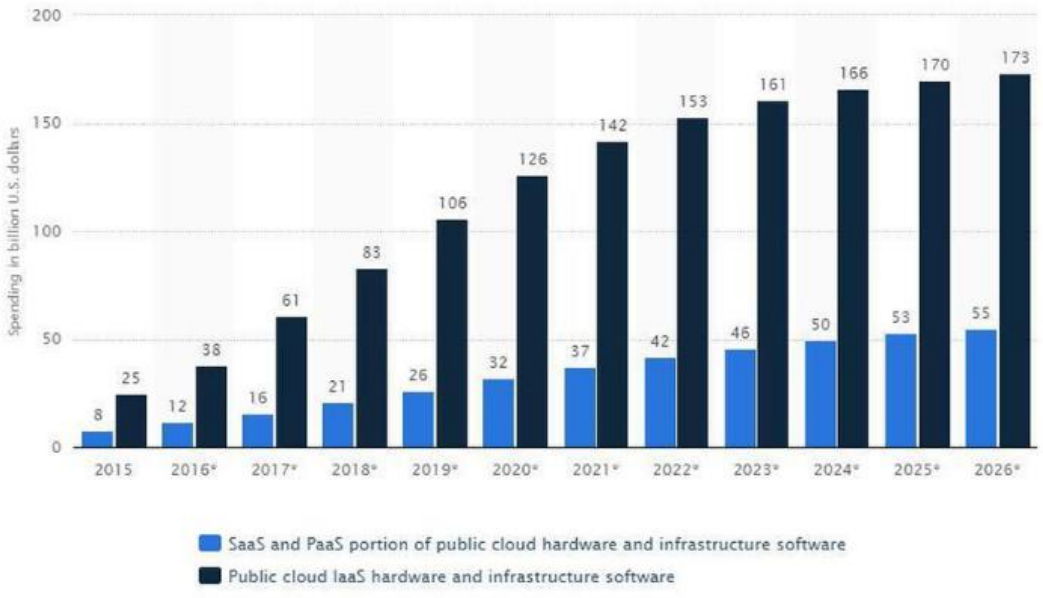


FIGURE 3 PUBLIC CLOUD IAAS HARDWARE AND SOFTWARE SPENDING FROM 2015 TO 2026, BY SEGMENT (IN BILLION U.S. DOLLARS)

1.3 Evolution of IT

In the last few years, we´ve witnessed a massive increase in digitalization in many aspects of our lives. The way we consume goods, contribute to our environment and communicate with others has already changed significantly and will continue to change. Today we are leveraging modern tablets and mobile devices to work, we book our vacations by using rating apps and online booking tools, we purchase food and other supplies through online retailer and we are using phones to do banking. While this is the consumer view, many enterprises have realized the potential of transforming their business, processes and ways of communicating and interacting with customers. Companies using data and analytics to drastically modify customer communications, product development and enhancement, and collaborative innovation.

Digital transformation is not simply about technology—it requires business leaders to re-envision existing business models and embrace a different way of bringing together people, data, and processes to create value for their customers. After three industry revolutions (steam, electricity, IT) the Digital Transformation is referred to the fourth industry revolution.

"*We stand on the brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before. We do not yet know just how it will unfold, but one thing is clear: the response to it must be integrated and comprehensive, involving all stakeholders of the global polity, from the public and private sectors to academia and civil society."* (Schwab, 2016)

Therefore, it is not a big surprise that technology is the #1 priority for many business leaders. In a recent survey by PriceWaterhouseCoopers, 86% of respondents believed technology would transform their business more than any other global trend in the next five (5) years. Leaders have realized that Digital Transformation is inevitable and mandatory.

"When compared with previous industrial revolutions, the Fourth is evolving at an exponential rather than a linear pace. Moreover, it is disrupting almost every industry in every country. And the breadth and depth of these changes herald the transformation of entire systems of production, management, and governance." (Schwab, 2016)

Through history, one of the most compelling catalysts behind industry transformation has been economic benefit. There were always barriers and significant resistance to change, when it came to industry transformation, but it is the economic benefits that come with change that have helped push innovation forward. In the automotive industry, as an example, when the first horseless carriages were produced around 1900, they were first scoffed at as being only ever available for the elite, with many economists saying that they were just a fad, and that people would continue to travel by horse. People didn't grasp the profound reductions in cost and complexity of operating them was, and their importance to daily life. The economic benefits seen in the transformation of telecommunications allowed operator models to transform into land line and phone booths, and now into the mobile megatrend we see every day. Information Technology is going through that same industry transformation today, and although there are barriers, obstacles, and resistance to change, powerful economic benefits are compelling companies to review and take action on industry trends.

"*During the mainframe era, client/server was initially viewed as a "toy" technology, not viable as a mainframe replacement. Yet, over time the client/server technology found its way into the enterprise (Fig. 3). Similarly, when virtualization technology was first proposed, application compatibility concerns and potential vendor lock-in were cited as barriers to adoption. Yet underlying*

economics of 20 to 30 percent savings[1] compelled CIOs to overcome these concerns, and adoption quickly accelerated.

The emergence of cloud services is again fundamentally shifting the economics of IT. Cloud technology standardizes and pools IT resources and automates many of the maintenance tasks done manually today. Cloud architectures facilitate elastic consumption, self-service, and pay-as-you-go pricing." (Harms & Yamartino, 2010)

	Technology	**Economic**	**Business Model**
Mainframe	Centralized compute and storage. Thin clients	Optimized for efficiency because of high cost	High up-front costs for hardware and software
Client/Server	PCs and servers for distributed compute, storage, and so on	Optimized for agility because of the low cost	Perpetual license for OS and application software
Cloud	Large Data centers, ability to scale, commodity hardware, devices	Efficiency and agility an order of magnitude better	Ability to pay as you go, and only for what you use

TABLE 1 EVOLUTION OF IT (MICROSOFT, 2010)

While business environments are becoming more and more complex, and new business models and startups are creating disruptive environments, customers are having increased expectations. To be able to fulfill those, it is important for enterprises to create an agile approach where time to market is critical. There are multiple examples in the recent past that showed that new startup companies such as Amazon[2], Uber[3] or Airbnb[4] threaten existing, traditional business with their new business models, processes and technology advantages.

[1] Source: "Dataquest Insight: Many Midsize Businesses Looking Toward 100% Server Virtualization". Gartner, May 8, 2009.
[2] http://www.amazon.com
[3] http://www.uber.com
[4] http://www.airbnb.com

"*Technology has always played the role of a disruptive force that somehow connects discontinuities and changes business models, ecosystems, or even the world order*" (Parakala & Udhas, 2011).

KMPG, (…), has conduct a survey across nearly 800 technology industry leaders that "*ranked cloud as the technology that will have the greatest impact in driving business transformation for enterprises*." (Rick Wright; Greg Bell; Tom Lamoureux; Mark Shank, 2014). Many other surveys and reports from well-known research and consulting companies have showed that cloud computing will play a major role to meet customer expectations and deliver services and drive the evolution of businesses.

What those enterprises need is speed, flexibility, scale and reduced cost. While many enterprises are moving to the cloud because of the costs (Rick Wright; Greg Bell; Tom Lamoureux; Mark Shank, 2014), there are many other reasons why they expand their journey to the cloud.

1.4 Benefits of Cloud

Independently of the organization size or the industry the business operates in, no matter whether education, manufacturing, financial, health care or in public sector, the adoption of cloud provides a set of benefits that are undeniable and could be critical for many businesses to survive the era of digital transformation. Understanding these benefits and how they relate to an organization is critical to achieve tremendous cost-savings and revenue growth while developing new opportunities and create an improved experience for the users and customers.

The ability to speed up time-to-market through innovations developed and delivered in an agile way to create customer value becomes more critical than ever before. Companies need to take advantage of insights and foresights using analyzing tools and platforms to deliver those values such as more efficient maintenance or prevent equipment breakdown. With automated provisioning it is possible to switch directions, chance architecture, hardware requirements, and number and amount of resources quickly, which results in a higher flexibility of organizations, better efficiencies and reduced costs. In the past, a change of requirements could result in long waiting times for internal teams to continue working or customers for improved services, but also in unused capacity, if IT had kept spare resources for such cases. The economies of scale are key to improve services and reducing costs at the same time.

Cloud-based solutions allow employees to access applications and services from anywhere in the world with an Internet-connected device. This accessibility creates an environment conducive to collaboration and more efficiencies across and within teams and departments within a company.

Providing more insights into resource consumption, performing financial analytics and understanding costs and revenues for individual business units and applications, it helps organizations to identify high-profit areas, understand costs and be able to focus their work and resource where needed the most.

One of the world's leading elevator manufacturers, ThyssenKrupp, with more than 1.1 million elevators worldwide, wanted to "*gain a competitive edge by focusing on what matters most to its customers in buildings the world over: reliability*" (Jennifer Chen, 2014). They have connected their elevators with the cloud, leveraging the potential of the Internet of Things (IoT) "*and gathering data from its sensors and systems and transforming that data into valuable business intelligence, ThyssenKrupp is vastly improving operations — and offering something its competitors do not."* (Jennifer Chen, 2014). With these insights, the company can provide higher uptime, improved reliability and reduce maintenance costs for both their customers and themselves.

Cloud also helps organizations pursuit new ideas, new businesses and new markets without the previous constraints on cash and/or time. Since there are no upfront capital investments required for on-premise infrastructure, such as servers, network, hardware or facilities, the financial risk is significantly reduced due to the avoidance of uncertain payoffs. Especially for startups and new companies, that is a tremendous advantage compared to the past, but also enterprises can benefit from the fact that single business groups can follow new ideas or projects without a huge upfront budget request. That means that cloud computing helps to accelerate innovations and time-to-market, which can result in a significant advantage over competitors.

"The biggest financial benefit of cloud computing, particularly in these capital constrained times, is avoiding taking on debt and keeping cash in the company longer. If a project uses a cloud-based service provider, then the CFO avoids writing a big check upfront. Instead, checks are written monthly or quarterly, in alignment with the return." (Talking To Your CFO About Cloud Computing, 2008)

The above reasons are about an improvement in productivity, more agility and efficiencies, but there are also other less significant reasons, such as the end of a contract for colocation or outsourcing. In the past, and even today, many companies use outsourcing vendors to host and/or manage their data center hardware or colocation contracts where the hardware is collocated in a joint data center facility with other companies' hardware. The end of these contracts is always an opportunity to evaluate other options such as cloud computing. The end of a facility contract can also be a driver for cloud adoption, where either the space is no longer available for an organization or it is just not the best option anymore.

Another benefit of using the cloud is less effort is required for any upgrades, both for hardware and software, as well as the fact that there may be less or no maintenance and system administration that takes place in the cloud because all that effort is managed by the cloud vendor.

The level of maintenance work that is required depends on the service model (see NIST model from 1.2 Cloud Computing Introduction), for Infrastructure-as-a-Service (IaaS) the level of maintenance is higher than for a higher service level such as Platform or even Software-as-a-Service, but all three service levels help organizations reduce the effort to keep the systems healthy and up-to-date since this maintenance work is performed by cloud vendors. In reality, it is not only a question of cost savings but also that employees can focus on what really matters to the business.

Another benefit of cloud computing is the efficiency of power that a datacenter requires compared to a cloud infrastructure. Most organizations operate their own data centers at a much higher power consumption than cloud providers, which leads to a higher efficiency and lower costs. Power usage effectiveness (PUE) is a metric used to determine the energy efficiency by comparing the total power used to run a data center to the amount used to power the computing equipment. For instance, if a data center has a PUE of 2.0, that means that for every watt of energy that powers the computing infrastructure such as servers, another watt powers the cooling, lighting, power conversations and other systems.

The below graphic from Margaret Rouse (Rouse, n.d.) explains how to measure PUE.

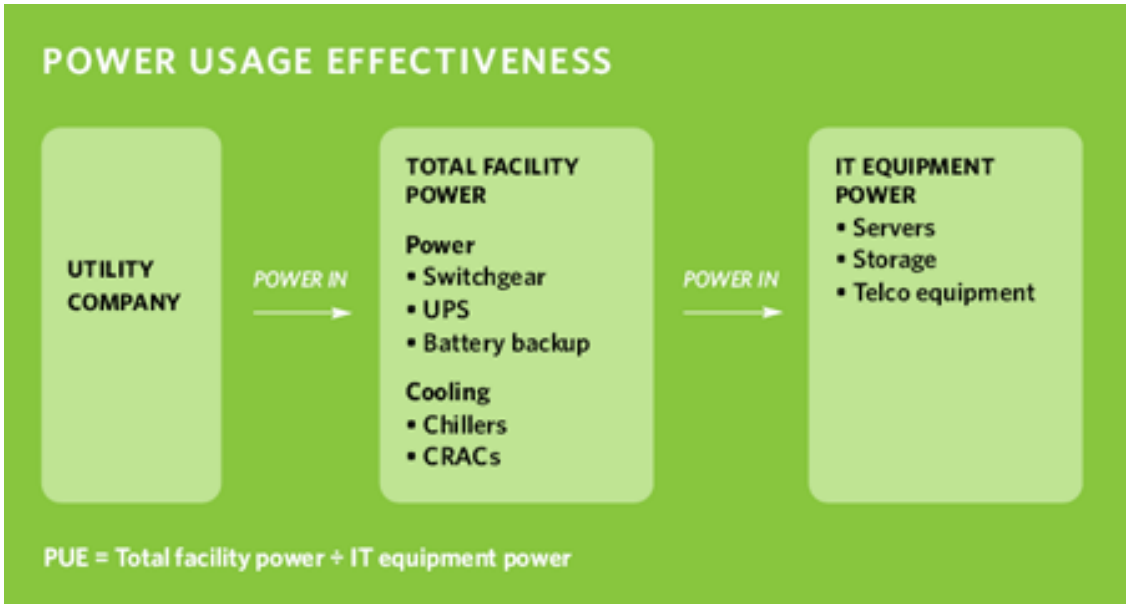


FIGURE 4 HOW TO DETERMINE PUE

This metric was introduced by Green Grid (The Green Grid, 2017) in 2007, a non-profit, open industry consortium. It specifies that the more power that is used for overhead such as cooling, lights the worse the PUE metric is. In "*PUE – A Comprehensive Examination of the Metric*" (PUE: A Comprehensive Examination of the Metric , 2014) Green Grid provides guidelines for determining the Power Usage Effectiveness (PUE) of a dedicated data center, a mixed-use facility, or specialized facility along with results, scalability analyses, and case studies.

In the 2014 Data Center Industry Survey the Uptime Institute reported that a "*vast majority (72%) of respondents measure PUE*" and "*a huge percentage of executives (82%) are tracking that metric and reporting it to their corporate management.*" In the same report the self-reported PUE was at 1.7 (2014 Data Center Industry Survey , 2014) for data centers owned by various organization, in 2011 the PUE was at 1.89. According to the article "*further improvements will require significant investment and effort, with increasingly diminishing returns."*

Cloud providers are far more efficient in power consumption. In 2011, Google reports a PUE of 1.14 and a PUE of 1.12 in 2017 (Google Inc., 2017). In 2016, Microsoft reports a PUE of 1.1 for their fifth-generation data center design, which resulted from an updated server design and a closed-loop waterside economization system. In a video blog post "*Data Defense: An inside look at your secure cloud*" Microsoft explains how the different generations changed the design and the temperature that the servers were operating in. "*Water is cooled in massive cooling towers outside of the facility and pushed through the cooling loop. Inside the building, the loop goes through a heat exchanger, from where a wall of fans pushed cold air into the IT hall.*" (Latest Microsoft Data Center Design Gets Close to Unity PUE, 2016)

Often data centers have grown over multiple different business or IT groups, so that historically heterogenous environment with different hardware vendors, and different software stacks are now binding many resources, and maintenance costs for these companies. This often triggers the consolidation of data centers including hardware, software and processes and are a good reason to evaluate cloud as an alternative. Very similar situations are mergers and acquisitions where suddenly multiple data centers belong to a single entity and integration can provide a significant benefit by improved efficiency and reduced costs.

1.5 Organizational Impact of Cloud

Cloud computing is significantly changing the way organizations use computer resources and power. While enterprises were used to long cycles of purchasing hardware, setup hardware and providing services to their business departments, now they are utilizing those resources in an automatic approach, no matter if their business unit is consuming that directly from a public vendor or through a centralized IT department. This automatic approach turns long-running processes into agile, quick actions. But implementing Cloud computing is far more than just technology chance or evolution. It not only brings changes to the local IT teams but also to business processes and all employees of any given company adopting cloud. In reality, cloud requires a considerable shift from traditional computing methods and business processes. In the world of cloud, there are people who argue that cloud is an operations model and not a new innovative technology. Given that a cloud consists of servers, networks and storage, this opinion is definitively not wrong.

But shifting operation models has a significant impact on existing business processes, organizational structures, roles and responsibilities, and the entire culture of an enterprise. The people aspect is at least as important as the technical details. Businesses that used to have full control over their IT management, now need to get used to a more collaborative approach and a much higher interdependency and more governance rules.

Companies that have not realized the importance of changing roles, responsibilities or processes while adopting cloud computing, are less successful or fail to gain the benefits of cloud. Besides the fact that cloud computing adoption requires a different set of IT skills, it also requires a different set of processes for the business units to work with the IT department, different roles and responsibilities that have to be defined to succeed.

Another important factor are the employees that are potentially seeing small changes that might impact their processes and daily life. Most of the improvements or benefits that the cloud brings a company are not obvious to the end users. Certainly, this introduce a risk that end users do not see the benefits, and thus provide resistance to cloud adoption.

In the thesis "*Organizational Challenges in Cloud Adoption and Enablers of Cloud Transition Program*" for MIT Sloan School of Management, Sneha Rajendran explains various existing theories such as the Resource Dependency Model, Stakeholder Theory, and Outsourcing theory to explain the changes to a financial organization between 2001 and 2008 while they introduced a hybrid cloud to their about 800 applications. He stated "*Cloud adoption can support a decision to change the business model. Such a move might entail reorganization of the entire business, so that it reflects the new business model*" and concludes that cloud adoption can have a list of advantages, but also requires changes, control and a strong leadership for successful implementation. Furthermore, it can be used to consolidate a company´s portfolio of applications and systems, an outcome that is driven by standardizing business processes and technology across businesses that might have not worked together previously. In fact, this is required to achieve a seamless communication across different units and systems. He also highlights the need for employees to be trained for cloud. (Rajendran, 2013)

2 INVESTMENT EVALUATION

This chapter explains the different techniques, approaches and methods for evaluating investments, how they help to understand whether and how fast the invested funds return, and finally, how they can be applied to cloud computing.

Cloud computing has become a reality for most organizations, regardless of the industry they are in, whether in the commercial sector, health care, or government. A large number of organizations are either in the process of migrating their systems and applications to the cloud or are evaluating the possibility. This decision is clearly a long-term investment and due diligence is critical to make the right decisions and have a successful outcome.

With the goal of moving to the cloud there are multiple questions that need to be answered. Besides a series of technical topics, the economic impact of moving to the cloud needs to be answered. Risks and uncertainties of cloud adoption should be evaluated and as a result be reduced.

"*An IGD Enterprises survey found that more than one in three IT leaders (37%) are concerned about the difficulty in measuring return-on-investment and assigning an accurate economic value to cloud solutions (second only to security)*." (How to Position Cloud ROI, 2015)

This section provides an overview of methods and measurements to evaluate cloud adoption and addresses the need for certain metrics that are required to understand the value that can be generated from the switch. Obviously, that causes some work and effort, but it is worth the outcome since a company wants to see if the investment in cloud justifies the costs, and if it is profitable or produces a measurable benefit to their business.

Investments can be of different type such as revenue enhancing, cost-reduction or mandatory investments due to regulation or law requirements. Cloud investments falls into the first two categories. It can increase revenues by entering in new markets, but it can also reduce cost. Before an organization adopts cloud by making investments, it will likely evaluate whether it will create value. Several analytic metrics, such as Net Present Value (NPV) or Internal Rate of Return (IRR), can help realizing if the investment is worth the effort.

Investments can be either considered standalone, where there are no influences or dependencies, or they are mutually exclusive and have dependencies on other projects or investments. In the latter case, it is about choosing the right investment over multiple options (such as different cloud deployment models). Using NPV can help compare the different options and ensure that the one with the higher NPV is selected, i.e., the option that creates the most added value.

In a survey from the *Journal of Applied Corporate Finance* where 392 CFOs of large U.S. based companies were asked which of the following capital-budgeting techniques are the most commonly used amongst them (Graham & Harvey, 2002):

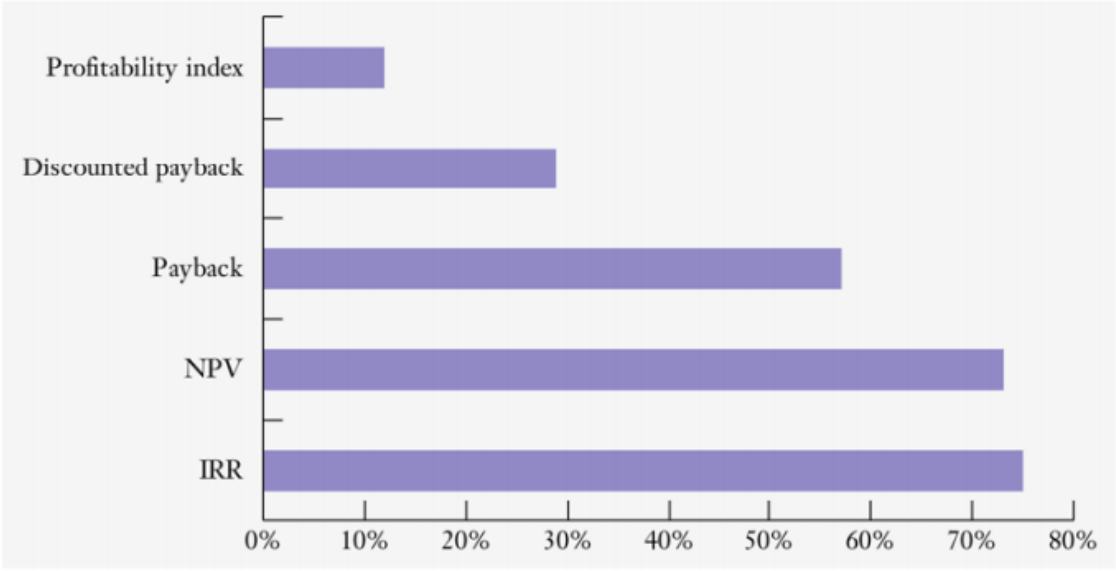


FIGURE 5 "HOW DO CFOS MAKE CAPITAL BUDGETING AND CAPITAL STRUCTURE DECISIONS?"

The goal of an investment assessment should be a fundamental understanding as to whether moving partly or completely to the cloud provides a positive effect on the organization's value. Decisions-makers must have a deep interest in understanding whether and how quickly the invested budget generates future returns. While cloud computing itself might not generating a positive return on investment, it might have a positive but indirect effect on competitiveness, market position or other revenue streams. These indirect financial investments are harder to measure than direct investments, but in this paper, this must be considered as part of an overall evaluation of cloud computing.

In the recent years, people tend to think "*cloud computing is good because it shifts capital expenditures to operational expenditures, and the latter is always preferable to the former*" (Meall, 2011). This over-simplify cloud computing from a financial and accounting aspect, while reality is much more complex and multi-faceted. The decision on how to finance technology can have an impact on financial management, financial reporting, and tax.

The transition to cloud-based services will have financial and budgetary impacts that organizations must consider at strategic and operational levels. While cloud-based services have the potential to reduce capital expenditure, organizations will have to consider the impacts on their budgets and financial statements.

2.1 Business Performance

Before this paper describes how cloud can add value to an enterprise, it is important to understand what is (financial) success for any given business. The reported profit of a business is an accounting concept that helps identifying the performance in terms of revenues (services provided) less expenses (services consumed), but often more important is cash flow which represents the cash that can be taken out of the business in a given interval. Both numbers, profit and cash flow, are highly correlated and need to be considered for implementing cloud computing and measuring the success of the adoption. In all the considerations and calculations, Corporate Finance will always look at reporting such as the Income Statement, Corporate Taxes, Balance Sheet and the Cash Flow Statement.

While both Financial Economics and Financial Accounting are related fields and show a lot of similarities, there are large differences and Cloud Computing has an impact on both areas. This paper explains the differences on Financial Economics and Accounting, specifically for businesses that are investing and moving into a new cloud era.

2.1.1 Financial Accounting

Financial Accounting refers to a system that involves recording transactions of a financial nature and subsequently summarizing, analyzing and reporting them. Accounting is a strategic investment and vital to the success of a business, independent of size or industry. It helps guiding operations and keeps cash flow healthy.

There are two distinct methods of accounting, cash-based and accrual. Most companies use the accrual accounting method to better measure their company´s profit during an accounting period. This method will report all the revenues actually earned (and not when the cash is received) and all expenses incurred (and not when the actual payment is made), and therefore, show a more accurate picture of a company's financial position. For this paper, the impact of cloud adoption on accrual accounting is considered, because most of the companies fall under this regulation, and need to adopt accrual accounting and double-entry bookkeeping in their mandated reports to shareholders.

Almost all organizations must adhere to some type of regulation and rules in the recording and reporting of accounting transactions. Generally Accepted Accounting Principles (GAAP) are used in the United States of America whiles International Financial Reporting Standards (IFRS) are used within the European Union. These regulations dictate that cash spent on long-lived assets (capital) should not be recorded as a current expense in the statement of operations, or income statement. Rather, cash expenditures for capital must be capitalized to the balance sheet and depreciated or amortized as an expense to the income statement over the useful life of the asset.

2.1.2 Financial Economics

Financial Economics is a social science that explains how goods and services are produced and distributed across economies, countries or even international (macroeconomics) and individuals' behavior regarding the use of resources such as capital, time, skills, tools and others (microeconomics). The primary goal is to focus on efficient allocation and distribution of resources in order to fulfill demand. It helps understand how economic choices and decisions affect society at large and can also help guide business decisions. Both macroeconomics and microeconomics are interdependent, and it is important to understand both fields for making a business successful.

2.1.3 Accounting Standards

Generally Accepted Accounting Principles are a book of standards for accounting for organizations with three major parties involved, the Securities and Exchange Commission (SEC), an independent agency of the US federal government, until 1973 the American Institute of Certified Public Accountants (AICPA) and since 1973 the Financial Accounting Standards Board (FASB) who replaced AICPA.

GAAP was adopted by SEC and turned into US-GAAP, while Europe and many other countries are following rules by the International Financial Report Standards (IFRS). At the conceptual level, IFRS is considered more of a principles-based accounting standard in contrast to GAAP, which is considered more rules-based. There are certain differences between GAAP and IFRS that also have an impact on cloud computing accounting (Nguyen, 2018)

Intangible assets

Under GAAP intangible assets are recognized at fair value, while under IFRS they will only be recognized if the asset will have any future economic benefit and can be measured reliability.

Write-Downs

IFRS allows reversing a write-down of inventory in future periods if specific criteria are met. Under GAAP, once the inventory has been written down (as an expense to the income statement), any reversal is prohibited.

Guidelines for financial accounting and reporting standards such as the income statements of business entities are formulated and released by the International Accounting Standards Board and many countries have local organizations such as the FASB in the United States.

In general, the U.S. Securities and Exchange Commission (SEC) recognizes the financial accounting and reporting standards of the Financial Accounting Standards Board (FASB) as "*generally accepted*".

A comprehensive (but not necessarily complete) list of FASB related documents for cloud computing are

- 205-20: Presentation of Financial Statements – Discounted Operations
- 350-40: Intangibles–Goodwill and Other – Internal-use Software
- 360-10: Property, Plant and Equipment
- 420-10: Exit or Disposal Cost Obligations
- 720-45: Other Expenses – Business and Technology Reengineering

2.1.4 Accounting for Cloud Computing

Until 2015, the GAAP lacked guidance on fees paid for cloud computing which led to a diversity of practice. On April 15th, 2015, the Financial Accounting Standards Board (FASB) issued new guidance on a customer's accounting for fees paid in a cloud computing arrangement (CCA). "*Examples of cloud computing arrangements include software as a service, platform as a service, infrastructure as a service, and other similar hosting arrangements. The Board heard from stakeholders that the absence of explicit guidance resulted in some diversity in practice as well as unnecessary costs and complexity for some stakeholders to evaluate the accounting for those fees.*" (Financial Accounting Standards Board, 2015)

While the issued document involves all types of cloud computing, the key difference in the guidance and which rules should be applied is between a hosting contract and software-as-a-service (SaaS) services. If the customer has the contractual right to take possession of the software at any time and it is feasible for the customer to run the software on its own hardware, it is considered to be within the scope of the internal-use software guidance, otherwise if both criteria are not met, it is considered a service contract. In cases where it is a multiple-element arrangement, including software licenses and a service of hosting, the costs must be allocated between license and hosting elements.

In a public paper Ernst & Young LLP concluded that "*A cloud computing customer that determines it is acquiring a software license will no longer consider the lease guidance to determine the accounting for the software license and would instead account for it in the same manner as other licenses of intangible assets. This would be a change in practice for entities that today analogize to the guidance on leases*" (Ernst & Young LLP, 2015)

In PwC's document "*In depth – A look at current financial reporting issues*" from September 2015, Michael Coleman and Michael Sandusky list the differences for both costs and its implication for accounting:

Financial statement	Internal-use software	Service contract
Balance sheet	Fixed or intangible asset	Prepaid asset
Income statement	Depreciation/amortization	Operating expense
Statement of cash flows	Investing activities	Operating activities

FIGURE 6 FINANCIAL ACCOUNTING IMPLICATIONS ACCORDING TO THE GAAP GUIDANCE ON CLOUD COMPUTING FEES

While the FASB clarified software licenses fees in such a cloud computing arrangement, it does not provide any guidance on costs for up-front costs, such as costs related to implementation or migrations to the cloud. In essence, if the cloud computing arrangement does not include a license than the customer should account for the arrangement as a service contract and can no longer capitalize upfront cloud project costs.

In an article from NetworkWorld (John Dix, 2016) the Deputy CIO and VP of Technology Services for AES, a Fortune 200 global power company, Hugo Vasquez, said "*prior to the change his company was able to capitalize the cost of a cloud migration project and write off that investment over three years. Now with the new rules, the project itself cannot be capitalized," Vasquez says.*"

He further claims that *"We were able to capitalize around $4.46 million to implement the project, which went live at the beginning of this month. Our integrator was Deloitte, and we capitalized those costs and the labor of our own people, so we had an incentive to move forward with a cloud solution. But today I couldn't capitalize that $4.46 million. And that change is resulting in a reduction in projects in our company to move to a cloud computing model."*

Many organizations commented on the issue and shared their concerns about not being able to capitalize migrations costs. James H. Hoffmeister, Corporate Controller for Visa, wrote in a letter to FASB: "*While we are supportive of the FASB's proposal for how to evaluate the arrangement to determine if it is a software license or a service contract, we respectfully request that the FASB consider expanding the proposed standard to include guidance on the accounting for one-time set-up fees incurred by a customer under a cloud computing arrangement.*" (Financial Standards Accounting Board, 2014)

Furthermore, Visa explains that "*set-up/integration costs should be considered part of the total service cost and recognized over the term of the service agreement*," because the set-up costs "*provide a future benefit to the customer in the form of continuous connectivity to the service provider*."

On May 10, 2017, the FASB board discussed the feedback from the EITF working group and stakeholders and voted to add this topic to EITF's agenda. "*The Board noted there may be challenges related to limiting the scope of the project to cloud computing arrangements that are considered service contracts. In addition, the Board indicated that such a project could ultimately be expanded to holistically address service contracts. However, the Board acknowledged that the accounting for implementation costs in a cloud computing arrangement is an emerging and prevalent issue, which should be added to the EITF's agenda.*" (Deloitte, 2017)

2.1.5 Balance Sheet

The balance sheet is a snapshot of all resources owned or controlled by a company, i.e., assets, as well as the obligations requiring payments in the future, i.e., liabilities. The difference between a company's assets and its liabilities is called the net assets and is equal to the stockholders' equity. The measurement of a company's assets and liabilities occurs at a specific moment in time, such as the end of a month or a year. In a situation where an organization owns a data center, it is required to report those as assets on the balance sheet and capitalize the costs of server, network or storage hardware. The matching principle of accounting requires that the expenses of the data center, including depreciation, will be matched with the appropriate revenues.

Cloud computing is a less asset-intensive investment than the equivalently sized on premise business since there is no requirement for any capital or inventory investments. For existing businesses, that means a transition from capital expenditures to operational expenditures and a change in the way budgets for IT spending are managed. Organizations must change policies and processes to make this change successful. In 2012, the Australian Government described the requirements for those changes in "*Financial Considerations for Government Use of Cloud Computing*" (Australian Government - Deperatment of Finance, 2012) by "*The transition to cloud computing will also have impacts on the way budgets will need to be managed in future. Traditionally cost savings have been measured against reducing operating expenditure. However, under the cloud model, the percentage of operating expenditure to total expenditure will increase, whilst capital expenditure (and by implication overall expenditure) will decrease over time.*"

Cloud computing not only mean a shift of capital expenditures to operational expenditures but an entire transformation of IT financial management and how organizations predicting and reporting IT costs.

Income Statement

While the balance sheet is a snapshot of a specific moment, the income statement is another financial statement that includes the revenues and expenses generated over a period of time, such as a month or a year.

For an organization running its own data center, this statement includes expenses for operating hardware such as power, cooling, labor such as IT administration and depreciation for purchased hardware. Companies that move into cloud computing reduce or eliminating expenses for on-premises hardware, as well as avoid depreciation of capital expenditures on cloud assets. On the other hand, they introduce expenses for service contracts from cloud computing vendors.

2.1.6 Cash Flow Statement

The Cash Flow Statement is the financial statement that reports the amount of cash and cash equivalents that an organization has received or paid out over a period of time. It is divided into operations, investing and financing activities. It complements the balance sheets and explains some items on the balance sheets of two consecutive years in which cash was invested in assets or paid out to reduce liabilities or pay dividends to shareholders. The cash flow statement helps investors understand the ability of a company to generate cash flows and how some of the company's cash is deployed. It provides important information about an organization's liquidity.

Cash flow is separated into three main components: core operations, investing and financing. The core business operations are about cash from business transactions that are generated by a company's products and services, adjusted for non-cash items, such as accounts receivables or depreciation. Cash flow from investing provides information on the cash outlays to acquire long-term assets, such as property, plant and equipment (e.g. purchase of new hardware). Cash flow from financing is focused on cash received (paid) from issuing (repurchasing) debt and equity securities as well as cash dividend payments. This section of the cash flow statement provides information about how the business is financed.

Since cash is the most liquid asset it is a critical asset in every company, enabling an organization to invest into people, infrastructure, buildings, research, and development. Depending on whether the organization is a startup or an enterprise, the amount and timing of cash flows can vary, as does so does the strategy to generate future cash flows. Cloud computing can help startups and relatively new businesses to gain access to required hardware and IT infrastructure without an upfront investment, but it also helps to finance their needs according to the growth of their business. Instead of purchasing IT for a projected growth of business that may be highly uncertain, an organization can meet the demands of their customers on a "*pay-as-you-go*" basis. Cloud can not only save many startups a considerable amount of money, but it also supports their growth into new markets, without requiring them to build new local or regional data centers.

A recent study from Microsoft India and Thought Arbitrage Research Institute (TARI) shows a positive impact of cloud for Small and Medium Businesses (SMB) within the first few years. The study shows captured data that indicates that the companies had an increase in market reach, improvement in employee productivity, operational processes, and a better overall work-life

balance as a direct result of increased cloud usage. "*Reduction in operating expenses and improvement in cash flow is seen to be a significant benefit of cloud adoption. SMBs can have improved cash flows of up to 308% due to the dexterity and flexibility enabled by cloud usage. 96% of SMBs find a positive impact on their operating expenses within two years of cloud use, which remains stable with time.*" (SMBs improve chances of better market access & profitability by three times with high cloud usage: Microsoft & TARI, 2018)

2.2 Economics of Cloud

Uncertain times also bring new opportunities for organizations to transform their business model and enable innovation, while at the same time reduce capital and operating costs, increase agility and gain a competitive gain by reducing time to market for new products and services. This section will highlight the advantages and benefits that cloud computing may provide.

"*Cloud computing is often referred to as a technology. However, it is a significant shift in the business and economic models for provisioning and consuming information technology (IT) that can lead to a significant cost savings.*" (Jackson, 2011). In the simplest term, the economics of cloud is focusing on the costs and benefits of adopting cloud computing, and since many enterprises have invested in data centers and on-premises infrastructure, it is critical for those organizations to identify and understand the economics to help making the right decisions. This requires a detailed cost and benefit analysis involving many criteria such as infrastructure, management, support, legal requirements, staffing needs for operations, research and development (R&D), and security.

Calculating the ROI (Return on Investment), TCO (Total cost of ownership) and other key metrics such as NPV (Net Present Value) of adopting cloud computing is critical to gaining an understanding how cloud can improve efficiency and generate cost savings for a business. It is also important to understand the current utilization of infrastructure of on-premises data centers, which, in some cases, may be below 20%. The reason for that is not miscalculations or investment mistakes, but the fact that companies must purchase for their peak demand (e.g. month-end or year-end calculations in a SAP system, or high point in internet sales on a black Friday) and not for the average day usage. Another reason for a company to have excess capacity by purchasing hardware is the business growth in customers or in transaction in the period of it might expect in the next three (3) to five (5) years.

As such, many companies carry up to five (5) times the required infrastructure (storage, networking, compute) during steady state business cycles. That means companies may spend considerably more money on IT to run their day-to-day business than they actual need (for most of the time). While this seems to strongly push IT into the cloud and use a "*pay-as-you-use*" model and turn capital expenditures into operational expenditures, the situation for enterprises is

much more complex. According to Rackspace "*bulk of expenditure over the lifetime of an application is not related to the purchase of physical infrastructure, it therefore makes sense to examine the impact of cloud computing on TCO rather than just CapEx.*" (Rackspace, 2017)

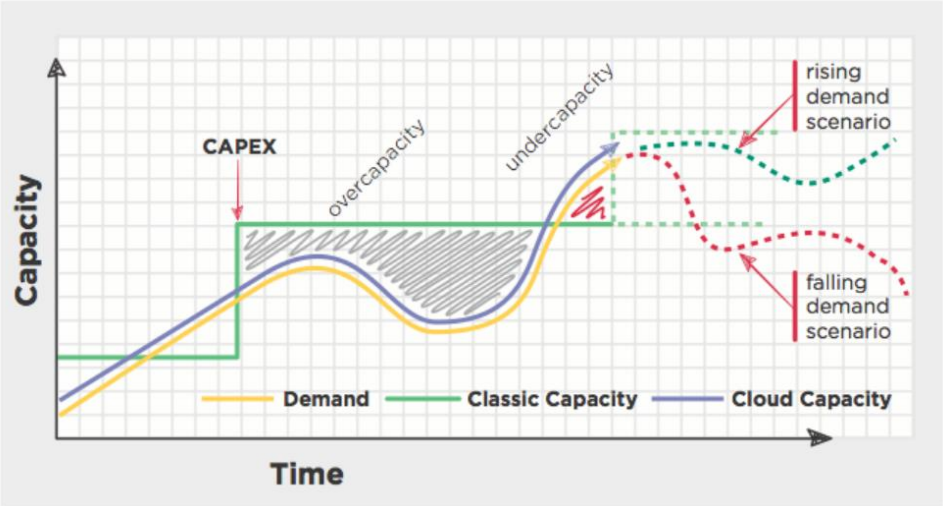


FIGURE 7 CAPEX VS. OPEX, RACKSPACE 2017

There are other criteria that need to be considered when moving to the cloud and organizations must be aware that adopting cloud involves understanding the risk and depth of change needed to embrace a cloud economics model. This model includes much more than a CapEx vs. OpEx discussion, but the truth is that cloud computing's new economic model is very different than the traditional economic model of on-premises data centers and local IT.

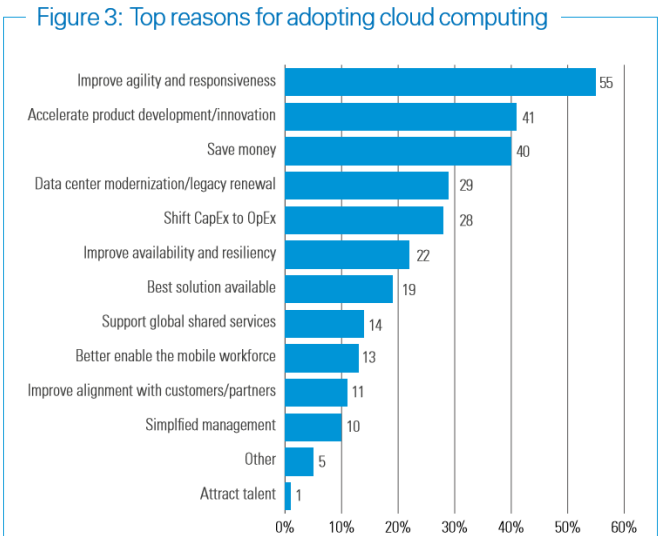


FIGURE 8 TOP REASONS FOR ADOPTING CLOUD COMPUTING, KPMG 2017

But one must understand the flexibility and agility that cloud computing can bring to a business, often critical to be able to provide the products, and services that customers are demanding. So, while cost savings and operational efficiency are key drivers for adopting cloud, other important

aspects such as revenue growth, customer retention, increased security, and employee productivity are also important.

In the "*Journey to the cloud*" article from KPMG from 2017 they list a series of reasons for enterprises to move and adopt cloud computing, but saving costs came in only at third position. "*This indicates that rather than looking for immediate cost savings they are now taking a longer term and more strategic perspective*." (David Conroy; James Williams; Saurabh Chauhan; Gary Harmson; Marc Snyder; Craig Symons, 2017)

2.2.1 Cost savings

While it might not be the number one reason for adoption cloud, cost savings are always important for enterprises to stay competitive and efficient in a world where startups can easily disrupt and transform an entire business and industry. Today "*organizations not only need to be innovative and fast, they must minimize cost and optimize margin at the same time in order to sustain their ability to continue to invest.*" (David Conroy; James Williams; Saurabh Chauhan; Gary Harmson; Marc Snyder; Craig Symons, 2017).

According to a report from KPMG "*typical IT organizations spend over 30% of their budget on infrastructure (primarily data centers and data networks), shifting some or all of this work to the cloud can save organizations anywhere from 10-20% of their annual IT budget*". The cost savings come from a different unit price that public cloud providers provide through the massive scale of hardware, a better and more efficient operations and newer technology. This effect is called economics of scale.

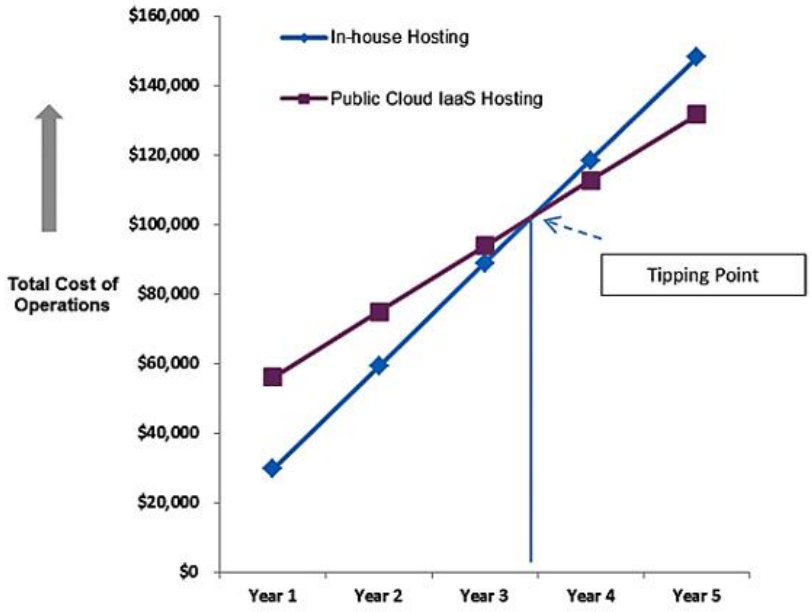


FIGURE 9 CUMULATIVE COST FOR A MEDIUM-SIZE APPLICATION, INCLUDING MIGRATION COST IN-HOUSE HOSTING COST VS. PUBLIC CLOUD IAAS HOSTING COST SOURCE: CEB ANALYSIS[5]

The challenge with the cloud and calculating potential cost savings are so called "*soft savings*", such as improved employee's productivity, improved revenues from better time-to-market or customer satisfaction. Certainly, these play a key role, but are much harder to measure, compared to quantifying savings such as the reduced spending on compute, storage and networking devices or reduction of operational costs.

The Total Cost of Ownership (TCO) of cloud computing can greatly vary based on the company's environment, industry and domain they are in. The type of organization (e.g. private vs. public) and the industry and processes (e.g. finance vs. manufacturing) do have an impact on e.g. regulatory requirements, existing laws, etc. which will result in different cost for cloud. Using a holistic framework to evaluate the potential impact of cloud computing is critical to making the right decision.

Forrester has developed the Total Economic Impact (TEI) methodology that provides a rigorous cost and benefit analysis framework that helps answering the key question "*What am I going to get for my money?*" (Chip Gliedman;Khalid Kark; Shaheen Parks; Nancy Wang , 2013). This framework includes due diligence through interviews with vendors and customers, designing a composite organization based on the characteristics of the interviewed organizations and

[5] https://www.cebglobal.com/blogs/how-to-explain-cloud-migration-costs-to-the-cfo/

creates a financial model. The financial results are used to determine the ROI and NPV, which plays a critical role for this analysis.

2.2.2 Economic Impact

The TEI framework by Forrester is a cost and benefit analysis framework that supports companies in their technology decision-making processes by demonstrating, justifying, and realizing the tangible value of IT initiatives. "*TEI is a comprehensive methodology that balances costs with three other equally significant factors: benefits, flexibility, and risk. While costs and benefits are typical ROI components, the analysis of risk and flexibility gives the TEI study added depth and credibility. Flexibility takes into account the value of future options that investing in a specific technology can provide to an organization. Risk accounts for and quantifies the likelihood that costs may be higher than original estimates and benefits may not reach targeted levels. The incorporation of risk makes the final ROI more realistic and allows for the identification of risk mitigation strategies, such as additional support or training.*" (Total Economic Impact (TEI), 2013)

The approach can be used to understand cloud products and covers the benefits (the value delivered to the business by the product), costs (all expenses necessary to deliver the proposed value, or benefits, of the product), flexibility (the strategic value that can be obtained for some future additional investment building on top of the initial investment already made) and risks (the uncertainty of benefit and cost estimates given the likelihood that estimates will meet original projections). It also considers financial metrics such as Present Value (PV), Net Present Value (NPV), Return on Investment (ROI), Discount Rate and Payback Period. (Forrester, 2017)

In 3.2 Economic Impact for IaaS and 3.3 Economic Impact for PaaS the details of TEI will be examined on specific cloud services such as Infrastructure-as-a-Services and Platform-as-a-Services.

2.2.3 Efficiency improvements

Another important aspect is efficiency improvements that comes with adoption of cloud computing. One of the key reasons for this is that enterprises sometimes over purchase hardware due to the high degree of uncertainty of the required capacity, and since hardware purchases in many cases occur only every few years, companies tend to buy more than they actually need or plan to need. Even if a detailed analysis of business growth was conducted, there is a tendency to purchase according to the available budget and not for the actual need. Another aspect is peaks in the business due to certain events such as extensive usage of a website on a Black Friday in the US or month-/year-end calculations of an ERP system. When demand is too high for the current capacity a delay occurs or requests are denied, both negatively affect the quality of service. The compute power needs to be architect for these peeks that happens to be only a small

and short amount of time and not for most of the time where the hardware is only used at 10% or 20%.

The graphic below (Figure 10 Traditional It usage of a local data center) shows an example of a traditional workload in a data center, where the green areas are highlighting the underutilization of a given hardware. While this is only one example which depends on the workload that runs on the hardware, it shows the problem with on premises data centers.

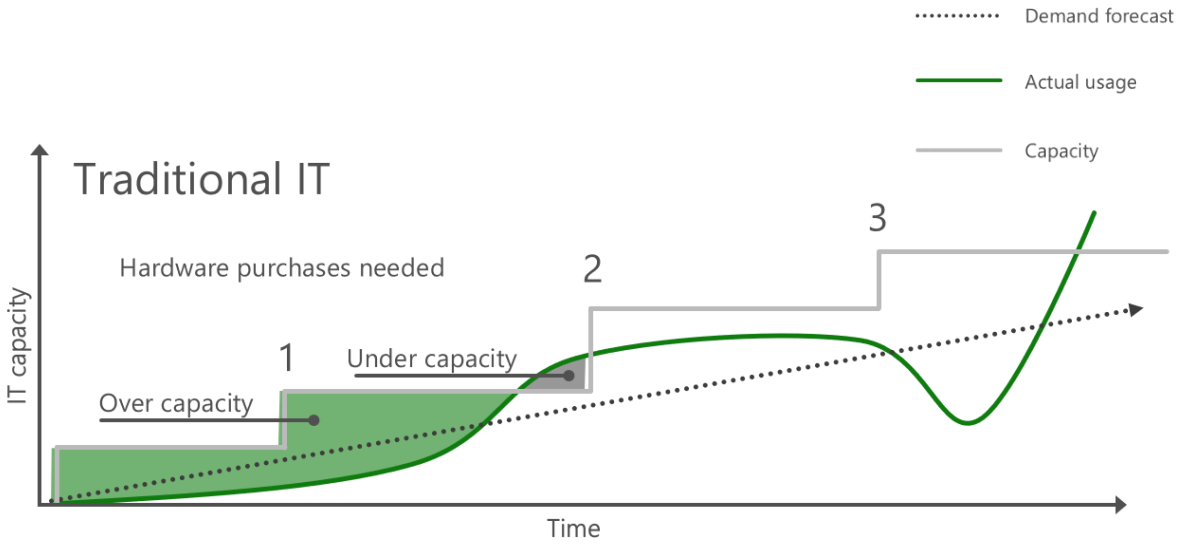


FIGURE 10 TRADITIONAL IT USAGE OF A LOCAL DATA CENTER

Cloud technology achieves flexibility through an on-demand delivery model using resource scaling. The actual hardware will always scale to the actual needs and can be adjusted – even completely automated – to fit the needs of any given workloads at any given time and no matter how the demand was calculated or estimated. In cases where there is a higher demand for compute or storage power the cloud can provide that scale to an enterprise and fulfil those needs (Figure 11 Scalability of Hardware in a Cloud Deployment)

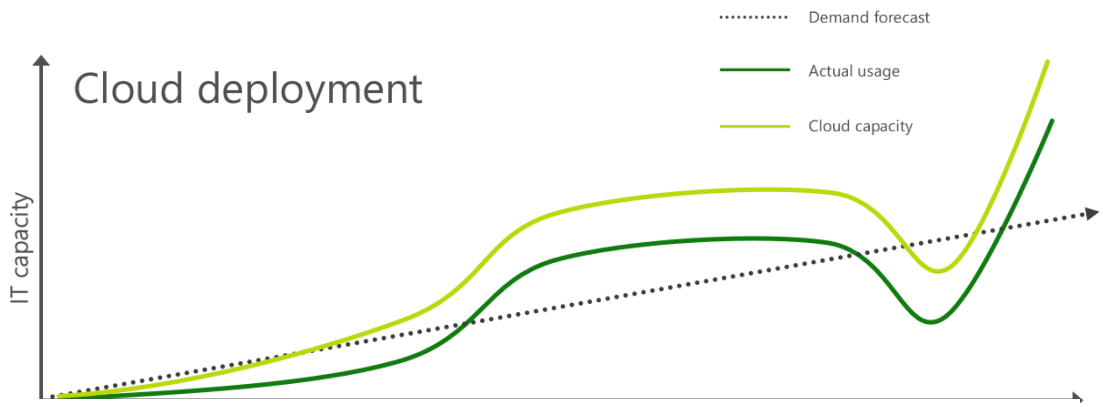


FIGURE 11 SCALABILITY OF HARDWARE IN A CLOUD DEPLOYMENT

The utilization of the existing capacity is a key driver for the cost and reality shows that the utilization is highly variable over time, "*often demanding large amounts of resources one minute and virtually none the next.*" (Harms & Yamartino, 2010)

In the paper "*The Economics of the Cloud*" the authors analyzed the different sources of utilization variability and distinguished five sources of variability:

1) **Randomness**

   End-user access certain services in a random fashion such as users accessing their email accounts. This demand can be fulfilled by a certain buffer of capacity.

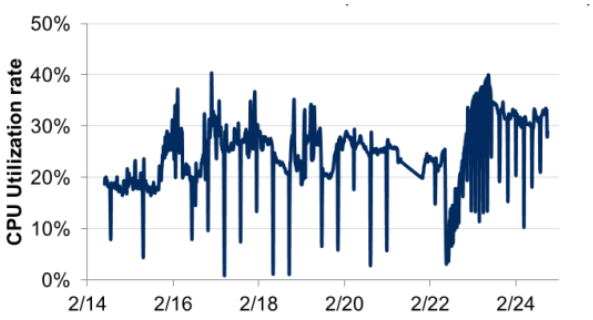


FIGURE 12 RANDOM VARIABILITY (MAIL SERVER)

2) **Time-of-day patterns**

   Daily recurring activities can be seen such as for consumer services in the evenings, and work-related services during the workday. Capacity has to be built for those peak times by scale and/or moving resources to different datacenters.

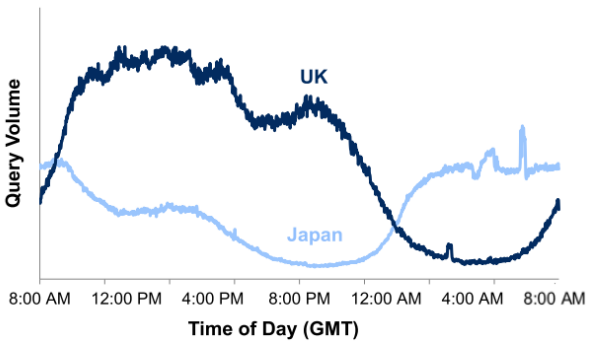


FIGURE 13 BING SEARCH VOLUME OVER 24-HOUR PERIOD

3) Industry-specific variability

Variability can also be observed by industries such as retail companies during the holiday shopping season (predictable) or major news stories (unpredictable). Capacity can be built for those predictable events.

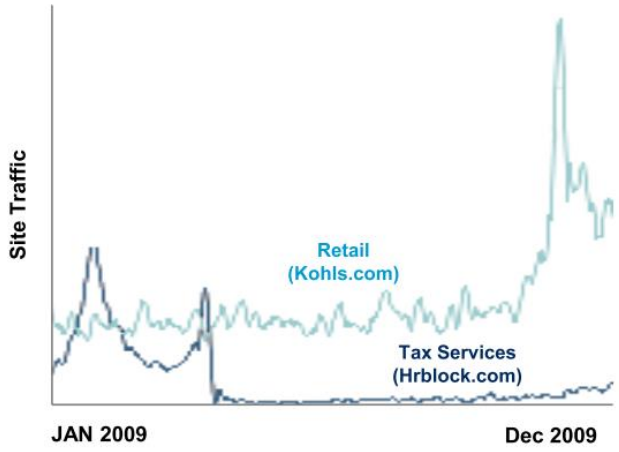


FIGURE 14 INDUSTRY-SPECIFIC VARIABILITY

4) Multi-resource variability

Different services have different resource needs, such as an email service, which tends to require more storage and less computing whereas search requires more computing than storage. Resources can be adjusted to meet the needs of certain services, or work-load diversification, by running complementary workload resource profiles.

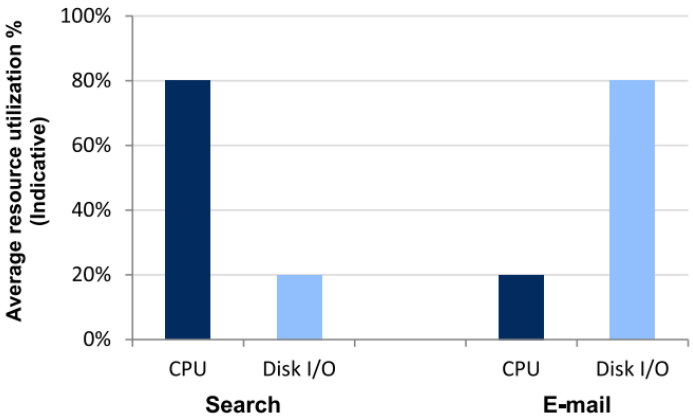


FIGURE 15 MULTI-RESOURCE VARIABILITY (ILLUSTRATIVE)

5) Uncertain growth patterns

Predicting the future in terms of growth is sometimes complex and can lead to unused capacity, especially since companies plan hardware purchase six to twelve months in advance.

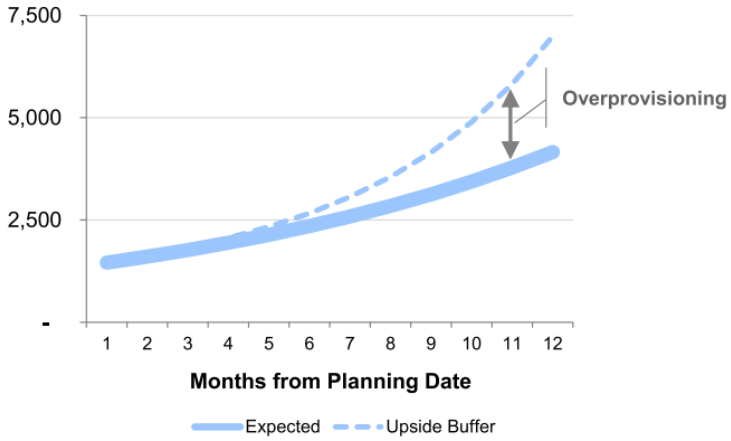


FIGURE 16 UNCERTAIN GROWTH PATTERNS

2.2.4 Capital Expenditures vs. Operating Expenditures

The decision to migrate compute workloads to the cloud typically involves evaluation the economic impact of trading operating expenses (OpEx) for capital expenditures (CapEx). Before going into the details on how companies treat the budgets for those two vastly different expense types, it is important to understand the differences between the two.

Capital expenditure (CapEx) are investments that occur for acquisition of new assets such as a new machine, building or computer hardware (servers or disks). CapEx, which show up on the balance sheet, are depreciated over the lifetime of the asset.

On the other hand, operations expenditures (OpEx) are costs that occur on a regular basis such as wages, maintenance, rent, and repair costs. Besides this significant difference, there is also a different accounting treatment: while CapEx cannot be deducted in the period when they incurred but are deprecated over a certain period such as five (5) years, Depreciation of assets are considered operating costs. OpEx are fully deducted in the accounting period in which they are incurred.

In the recent past, IT expenditure has been very capital intensive since hardware such as servers, networking components or racks had to be acquired outright from vendors. Software licenses were generally treated as an expenditure that appeared on the organization's balance sheet. Cloud Computing provides a major shift between CapEx and OpEx for many companies. Organizations were used to purchasing hardware such as servers, storage and networking devices from a vendor on a regular basis. These costs where CapEx and could be deducted over a certain period of time. Cloud is a recurring expenditure model, there is no initial hardware purchase needed. Computing power, storage and networking is acquired when needed, and therefore, is treated much like telephone or electricity expenditures, that is, they are accounted for as a standard operating expense.

Most organizations treat budgets for OpEx and CapEx very differently, while OpEx budgets are usually more tightly managed, CapEx budgets are not as carefully controlled. OpEx could be beneficial for a company as it provides the financial flexibility (terminate costs at any time) that the cloud provides from a technical perspective. In situations where a resource is no longer needed, payments for the resource are also no longer required. This is why organizations often lease vehicles or aircraft. Compensation of individuals is often tied to performance metrics such as EBITDA (earnings before interest, depreciation and amortization), EPS (earnings per share) and TSR (total shareholder return). This occurs because many investors use these numbers to understand the efficiency and true business performance of a company. They often use EBITDA as a proxy for cash flow that is generated from the ongoing operations of its business and represents a good indication of the health of a business. Since each country has different tax systems that influence the computation of depreciation and amortization expenses, EBIDTA provides a good performance metric because it is independent of the depreciation and amortization method.

According to a Gartner research paper "*enterprise IT spending decisions are made on whether spending can be capitalized or not. With changes in delivery models, CIOs need to have a firm understanding of capitalization and partner with CFOs to ensure the right IT investments are made*" (McGittigan & Gomolski, 2015). The article from Gartner highlights the importance of CIOs and IT leaders to understand the financial implications of OpEx and CapEx and that the perspectives of "*cash*" and "*profit and loss (P&L)*" are included in the decision-making process.

In the past, CFOs most often preferred CapEx for IT investments, due to the impact on accounting and tax treatments. Today, that is changing, and more and more enterprises are moving to OpEx for their IT investments. CapEx means they could take advantage of amortization and depreciation and provide an impact on the balance sheet. Those companies will display higher total assets. This means an increased book value (higher value of the asset), since only a portion of the expenditures will be deducted as an expense, resulting in an improvement in the company´s financial net income.

CapEx is not recorded on the income statement. Hence, companies that capitalize costs will have a higher profitability in the early years than it would have had if they expensed them immediately. On the other hand, the same companies will have a lower profitability in the later years. The disadvantage of capitalizing costs are higher net profits, which results in higher taxes, which could have been avoided if the costs were expensed. From a shareholder view, a large capitalized investment demonstrates how much a business is investing in its future and could impact the incentives to make large investments.

There are certain reasons why business prefer one over the other and typically they are treated differently by most organizations. Operation expenses can be fully deducted which reduces income tax. Capital outlays help to increase book value, since only a portion of the expenditures will be deducted as an expense. While there is no right or wrong answer, this section has described the importance of the CFO and CIO working closely together and understanding the importance of a financial economics and financial accounting when it comes to IT investments and how the IT strategy can and should be influenced by those criteria.

Today, it is getting more difficult to acquire capital for large purchases for organizations of all sizes, but certainly even harder for smaller organizations. Post-recession, banks have had to tighten their lending standards and they may be very cautious about the risk in their portfolios. Thus, they apply rigorous debt to equity ratio standards, which makes it either impossible or expensive to get access to debt finance. This has an impact on the progress of many enterprise projects too, and hence many organizations are interested in a model that avoids high upfront investment costs. Moving to an operation expense model removes the limitations and allows small scale projects to be undertaken, unconstrained by capital considerations.

While a move away from the capital expense approach is undoubtedly attractive to organizations of any size, there are other criteria – tangible and intangible - that play a critical role and need to be explored to justify moving to cloud computing.

2.3 Measurements

The key question for many organizations on their way to the cloud is, "*how can I measure the return-on-investment*" The cost of moving to the cloud is a real concern for many people in leadership positions. Finding the right way to calculate the return-on-investment is not easy, since most of cloud solutions are transformative and there is no easy equation. Cloud has an impact on speed, cost and people which makes it much harder to clearly identify the value of cloud.

For the financial evaluation, there is a large number of metrics that are currently used throughout businesses, some of which are considered static since they are more focused on the cash benefits without taking into account things like risk or time (such as Average Annual Rate or

Payback Period). Other metrics are dynamic including risk and time (such as Net Present Value, Internal Rate of Return or Payback Period).

Each is a way to measure the productivity of capital, to relate profit to invested capital, or cash flow to spending, and quantify the rate of return earned after getting the money back. Earning a return over the cost of capital is a prerequisite for adding value and enriching the owners. The higher the return, the more value is being created with the capital. A CFO may also logically assume that a business line earning a higher return may be a better candidate than another for further investment and growth – assuming past results can be replicated. A higher projected return also provides assurance that a given decision or plan is more secure. Key projections can be too optimistic, yet value can still be added or at least preserved when the expected return is higher in the future. And as an analytical tool, return on net assets (RONA) can be traced to operating margins and asset turns, in accord with the classic DuPont formula, and used to give line teams a rounded view of operating performance and balance sheet asset management. For many reasons, return measures like RONA have earned a prominent role in financial management over the years.

2.3.1 Time value of money

Before looking into various measurements and how to calculate them, one fundament principle is important to understand: the time value of money. The concept is straight forward by assuming a dollar in the hand today has more value today than a dollar that will be collected in five (5) years. The reasons for this is that a dollar today can be invested to generate more than a dollar in five (5) years. Thus, somebody has to pay or receive interest for lending or borrowing money and in the case of investments the business spends cash now "*in hopes of realizing a return at some future date.*" (Berman, Knight, & Case, 2013)

With the time value of money there are three (3) concepts that should be used to analyze capital expenditures: future value, present value, and the required rate of return. These concepts help calculate the time value of money and provide insights to make the right investment decisions.

2.3.1.1 Future Value

Future value simply tells how much a given amount of cash today is worth in the future. Obviously looking into the future needs some assumptions, involves risk and will not be accurate all the time. How much cash flows might grow in two (2) or five (5) years? The market is hard to predict, but calculating the future value using some assumption is at least an approach that results in an educated guess. The longer the investment outlook, the more estimations are required, hence the higher the risk. Using different assumptions can help generate different

scenarios (bad, good, best) that help to understand the bandwidth. Future value calculations allow a company to predict the amount of profit different investments can generate.

2.3.1.2 Present Value

While future value calculations try to estimate the future, present Value does the opposite by estimating the value today of a dollar to be received in the future. Assume an investment will generate $10,000 in cash flow every year over the next 2 years, an organization would like to know the present value of those $20,000 today. This concept is used for evaluating investments but again it requires assumptions such as the cash that an investment will generate as well as what kind of an interest rate should be used to discount the future value.

2.3.1.3 Required Rate of Return

The required rate of return specifies the minimum return an investor will need to earn to invest a dollar today. This bar is set by an organization and it will vary between organizations, industries and countries. Another aspect is the risk that is involved with an investment that will influence the required rate of return, the higher the risk the higher the required return will be. Few people are willing to invest in an opportunity with a high risk unless there is a chance to earn a lot of money. This approach helps organizations to identify the right investments given that the cash to invest is limited and there are usually alternatives to investing in the current project. The return that is expected to be generated from the next best alternative investment is called the opportunity cost.

Another factor that will influence investment decisions is the cost of capital for a company (also called the weighted average cost of capital, often shorten to WACC). The WACC is the weighted average of the returns an organization must pay to borrow funds from debtholders and the return it must provide to its equity shareholders. In cases where the expected return rate of an investment is less than the WACC, a rational organization will reject the investment because it decreases shareholder value. Conversely, an investment in which the expected return exceeds or is equal to the WACC is attractive.

A CFO needs to evaluate an investment such as adoption of cloud and understand the risks given the overall situation of an organization. The CFO also knows that shareholders expect the company to invest in its future, but also that the shareholders expect those investments to generate a return at least comparable to what they can get elsewhere at a similar level of risk.

2.3.2 Total Cost of Ownership

The total cost of ownership (TCO) is a financial method that is intended to help companies determine the direct and indirect costs of a product or system such as their own data centers or cloud computing. For IT there are the following areas of cots:

- Capital expenses (hardware, software licenses, building, etc.)
- Operating expenses (maintenance, support, services, etc.)
- Indirect costs (downtime costs, time-to-market, etc.)

Comparing costs between on-premise solutions and cloud computing can help to accurately assess the true costs of both options. The TCO analysis is intended to uncover the lifetime costs of acquiring, operating and maintaining both on-premises data centers and cloud computing including purchase, financing, maintenance, upgrades, deployments, security, depreciation, decommissioning and others. It is used to understand the difference between initial, upfront costs, and the total cost that operating IT in the cloud. The period of time used to calculate TCO depends on corporate standards which determine when ownership starts and ends.

Since data centers are mission-critical components of all large enterprises, the actual cost of building and operating it goes beyond servers and networking components. Predicting and measuring Total Cost of Ownership (TCO) for a data center is required for ROI analysis and other business decision processes.

For cloud computing, the type and nature of costs are different (e.g. less capital expenses), so comparing the TCO of an on-premises datacenter with a cloud solution may appear to be comparing apples with oranges. It is also a rather complex undertaking. Understanding the total cost of a datacenter is not an easy task but the computation helps business owners improve cost structures and efficiencies. Evaluating how to leverage cloud computing to achieve those goals can only be realized by revealing all datacenter related costs such as energy costs for cooling and power. Some of the challenging areas where calculations of in-house costs could fail are:

- Direct costs of running a server such as power, cooling, storage, floor space and IT operations
- Indirect costs of running a server such as network and storage infrastructure and IT operations
- Overhead costs of owning a server such as procurement, IT management, etc.

From a capital expenditures perspective "*significant costs such as architectural and engineering fees, interest during the construction phase, land, inert gas fire suppression costs, IT build-out costs for racks, cabling, internal routers and switches, point-of-presence connections, external networking and communications fees, electricity costs, security costs, and operations and maintenance costs for both IT and facilities.*" (Koomey, Brill, Turner, Stanley, & Taylor, 2007)

In the past, it was not unusual to see a total power consumption of twice what was needed for the IT load, so for every kilowatt (kW) of IT load there was another kW for cooling and auxiliary equipment.

Some cloud vendors offer TCO calculators (e.g. Microsoft's TCO calculator[6]) to estimate the cost savings of their products/services while comparing on-premises infrastructure costs with the cloud. These calculators work with a series of documented assumptions and industry benchmarks and rely on costs that a user can enter such as hardware, software, electricity, networking, storage, and IT labor costs.

In cases where TCO costs cannot be adequately determined due to a lack of data, the Department of Finance and Deregulations of the Australian government recommends in a paper "*The Guide to Implementing Cloud Services*" that "*a cost comparison of known costs may be sufficient to compare solutions. This involves a break-down of known or reasonably estimated costs for the legacy system and the Cloud solution alternative (e.g. licensing, development, customization, hosting, maintenance, etc.). The business case should always attempt to compare like-for-like costs, and clearly identify where this is not the case, and where any assumptions have been made*" (A Guide to Implementing Cloud Services, 2012)

2.3.3 Opportunity Cost

Opportunity costs is the cost of the next best alternative. It is the return on the next best investment that is forgone by taking on the current investment. In effect the WACC is the opportunity cost. It is the best return that could be generated, with the same risk, on the debt and equity funds that will be invested in the current project.

From an investment perspective opportunity cost can be expressed into the following formula:

$$Opportunity\ Cost = Return\ of\ most\ lucrative\ option - Return\ of\ chosen\ option$$

Since opportunity are always forward-looking, they are always based on assumptions. But they play a crucial role in analyzing investment options, such as determining a business' capital structure.

The concept of opportunity cost with regards to cloud computing is interesting since many enterprises that are already invested in on-premises data centers would not see any direct cost of maintaining the status quo. By including the opportunity cost into the comparison between cloud and on-premises data centers, it provides a better approach comparing the different choices. The opportunity cost for cloud could include improved efficiencies, more agility, or the move from a capital expenditure to an operational expenditure cost structure.

[6] https://www.tco.microsoft.com/

2.3.4 Return-on-investment (ROI)

In general, the Return-On-Investment measurement specifies the benefit for an investor for a specific investment and measures future cash flows in relation to the capital invested. This very common measurement provides enterprises insights into the efficiency of an investment and can be used to compare different options of investments, such as different cloud vendors, strategies or tools. While ROI is one way of putting profits to capital invested and can be used to compare different investments, it is very simple to calculate and hence doesn´t consider many important criteria such as time, and it can be manipulated.

$$ROI = \frac{Gain\ from\ Investment - Cost\ of\ Investment}{Cost\ of\ Investment}\ x\ 100$$

For example, the ROI for a new cloud-based Customer Relationship Management (CRM) application that is deployed as a software solution in the cloud (SaaS) that is expected to have an investment of US $900,000 over a period of three years and provide benefits of $1,500,000 over the same period of time will yield a return of 55,6%.

$$ROI = \frac{1{,}400{,}000-900{,}000}{900{,}000}\ x\ 100 = 55{,}6\%$$

2.3.5 Payback Period

The Payback Period is a measurement that will calculate the length of time that it requires to recover the cost of an investment through net cash flow generated by the investment. An investment with a shorter period is considered to be better. Other than the net present value or the discounted payback period the payback period ignores the fact that money has a time value.

$$Payback\ Period = \frac{Investment\ required}{Net\ annual\ cash\ inflow}$$

This above formula works with even cash inflows (e.g. the same new project moving the CRM system to a SaaS solution requires $ 900,000 as an investment and generates additional $ 500,000 per year, which results in a 1.8 years period until the investment is paid back).

$$Payback\ Period = \frac{900{,}000}{500{,}000} = 1.8$$

While the payback method is easy to use and shows the cash flow of a project, it has several drawback and therefore other measurements need to be calculated to be able to fully understand the risks and opportunities of an investment. The Payback Method does not take into account the lifespan of an asset or the cash flow after the payback has been achieved. The most important disadvantage of this method is that it ignores time value of money.

2.3.6 Net Present Value

The Net Present Value (NPV) measurement is based on the fact that money has a time value, so the benefit of receiving money today is greater than received it later. The NPV measures the discounted value today of the future cash flows less the discounted value of the cost of the investment. If the NPV ≥ 0 the investment increases shareholder value, and hence should be undertaken. Because it uses the fact that money has a different value depending on time, this is a measurement that is the most used to determine if a project is worth investing into. By considering that the buying power of money today is greater than the buying power of the same amount of money in the future it is far more important and accurate than other measurements such as internal rate of return or payback method.

"*In practical terms, it is a method of calculating your return on investment, or ROI, for a project or expenditure. By looking at all of the money you expect to make from the investment and translating those returns into today's dollars, you can decide whether the project is worthwhile.*" (Amy Gallo, 2014)

The net present value is calculated according to this formula:

$$NPV = -A_0 + \sum_{i=1}^{n} \frac{I_t - O_t}{q^t}$$

NPV = net present value
A_0 = Acquisition costs in period 0
q = interest rate
n = useful life of the investment
t = period (t=0, 1, 2, …, n)
O = cash outflows in the year 1 to n
I = cash inflows in the year 1 to n

A positive net present value means that the return from the investment is greater than the minimum required return (or WACC) and indicates a profit of the investment. If the NPV of an investment is zero, the investment only produces the minimum rate of return and the cash flow can only cover the investment costs and the cost of capital for the capital employed.

The following example shows cash flows from an investment adopting cloud computing by moving several virtual machines from an on-premises data center to the cloud. The table below lists the cash flows for 4 periods, separating them into benefits (cash in) and migration costs (cash out). The initial investment in period 0 is $1.1 million (but also generates $0.1 million positive cash flow). The cost of capital (interest rate) is assumed at 8.5% per year.

	Period					
Undiscounted Cash Flows	**0**	**1**	**2**	**3**	**4**	**Totals**
Cash In: Benefits in $ M	0.1	0.9	1.1	1.3	1.3	4.7
Cash Out: Costs in $ M	1.1	1.2	0.7	-	-	3.0
Net Cash Flow in $ M	(1.0)	(0.3)	0.4	1.3	1.3	1.7

	Period					
Discounted Cash Flows	**0**	**1**	**2**	**3**	**4**	**Totals**
Discounted Cash In	0.1	0.8	0.9	1.0	1.0	3.9
Discounted Cash Out	(1.1)	(1.1)	(0.6)	-	-	(2.8)
Discounted Net Cash Flows	(1.0)	(0.3)	0.3	1.0	1.0	1.1
Cumulative discounted NCF	(1.0)	(1.3)	(1.0)	0.1	1.1	

Using the example above the initial investment is $1 million and the total discounted cash flow (DCF) in 4 periods is $2,7 million. This answers the question how much the sum of all future cash flows from that investment is worth today. The present value (PV) of the investment is worth $2,019,111.52 today (DCF + initial investment costs), which is greater than the initial investment of $1 million paid. The resulting positive NPV of the above project is $1,019,111.52, which indicates the investment increases wealth. However, the value of DCF and NPV are all dependent on several assumptions, such as the projected cash flow, the discount rate, and so forth.

2.3.7 Discounted Payback Method

The major disadvantage of Payback Period is that it ignores the time value of money, so the discounted payback period calculation differs in that it uses discounted cash flows.

A discounted payback period gives the number of years it takes to break even from undertaking the initial expenditure, by discounting future cash flows and recognizing the time value of money.

$$Discounted\ Cash\ Inflow\ = \frac{Actual\ Cash\ Inflow}{(1+i)^n}$$

i = discount rate

n = period to which the cash inflow relates

$$Discounted\ Payback\ Period\ = A + \frac{B}{C}$$

A = last period with a negative discounted cumulative cash flow

B = absolute value of discounted cumulative cash flow at the need of the period A
C = discounted cash flow during the period after A

Year(n)	Cash Flow (CF)	Present Value	Discounted Cash Flow	Cumulative Discounted CF
0	$ (900,000.00)	1	$ (900,000.00)	$ (900,000.00)
1	$ 160,000.00	0.925925926	$ 148,148.15	$ (751,851.85)
2	$ 200,000.00	0.85733882	$ 171,467.76	$ (580,384.09)
3	$ 260,000.00	0.793832241	$ 206,396.38	$ (373,987.71)
4	$ 340,000.00	0.735029853	$ 249,910.15	$ (124,077.56)
5	$ 440,000.00	0.680583197	$ 299,456.61	$ 175,379.05

In the above table the investment into moving a CRM system to the cloud is described with an initial investment of $900,000 and benefits of $1,400,000 within 5 years. Those cash inflows are discounted with a rate of 8.00% per year. The last negative cumulative discounted cash flow is period 4, and hence the investment is payed back in period 5.

$$Discounted\ Payback\ Period\ = 4 + \frac{124{,}077.56}{299{,}456.61} = 4.41434$$

Based on the formula, the assumptions of cash inflows and a discounted rate of 8% the investment will be payed back after 4.41 years.

2.3.8 Internal Rate of Return (IRR)

In general, the Internal Rate of Return (IRR) is a metric that calculates the profitability of an investment using the same formula as NPV does. The ROI is the rate of return (or discount rate) which makes the investment have a NPV = 0. The higher the IRR the more profitable a project is. If the IRR is higher than the cost of capital, then NPV is positive, while if the IRR is lower than the cost of capital, NPV is negative.

The IRR does not account for different discount rates, which is the case in reality, whereas NPV can easily leverage different discount rates and use them to discounts back the future cash flow.

$$IRR = \sum_{t-1}^{t} \frac{C_t}{(1+r)^t} - C_0$$

IRR = internal rate of return
C_t = Net cash inflow during the period t
r = discount rate
t = number of time periods
C_0 = Total initial investment costs

Using the same example as for the NPV calculation of an initial investment of $1,000,000 and cash inflows of 4 periods:

	Period					
Undiscounted Cash Flows	**0**	**1**	**2**	**3**	**4**	**Totals**
Cash In: Benefits in $ M	0.1	0.9	1.1	1.3	1.3	4.7
Cash Out: Costs in $ M	1.1	1.2	0.7	-	-	3.0
Net Cash Flow in $ M	(1.0)	(0.3)	0.4	1.3	1.3	1.7

	Period					
Discounted Cash Flows	**0**	**1**	**2**	**3**	**4**	**Totals**
Discounted Cash In	0.1	0.8	0.9	1.0	1.0	3.9
Discounted Cash Out	(1.1)	(1.1)	(0.6)	-	-	(2.8)
Discounted Net Cash Flows	(1.0)	(0.3)	0.3	1.0	1.0	1.1
Cumulative discounted NCF	(1.0)	(1.3)	(1.0)	0.1	1.1	

The IRR of this investment is calculated with 31.85% per year.

While the IRR accounts for the time value of money, it does not measure the absolute size of the investment nor the return. It assumes that the intermediate cash flows are reinvested at the IRR rate.

2.3.9 Sensitivity Analysis

All the above described metrics are based on forecast of quantifiable variables and the values of these variables are based on estimations. These estimations are based on the most probable forecasts, but they are influenced by a great number of factors and hence the actual values can be significantly different, especially if the forecast covers a long period of time. Sensitivity analysis investigates what happens to e.g. the outcome of an NPV calculation in those cases where the key variables or assumptions are changed.

Evaluating an investment such as cloud computing adoption means to investigate in a variety of options, to be prepared if something is changing along the way and consider a series of possibilities rather than assume that every assumption will be true. It is always better to have a range of options and to be prepared if some criteria are different than expected. and calculate an expected/base case, low case, and high case.

The purpose of a sensitivity analysis is to help identify key variables that are influencing the investment and the project cost and benefits, investigate the consequences of likely adverse

changes to those variables, whether project decisions are affected by those potential changes, and identify actions that could mitigate effects on the project. (Iloiu & Csiminga, 2009) The question is how sensitive is the outcome of the analysis to a particular input variable?

Following steps are required to conduct a sensitivity analysis:

- Identify the variables to which the project decisions may be sensitive
- Calculate the effect of likely changes in these variables
- Consider possible combinations of variables that may change at the same time
- Analyze the direction and scale of likely changes for the key variables identified

2.3.10 Monte Carlo Simulation

Since uncertainty, ambiguity, and variability is part of every business case and evaluation, despite have unprecedented access to information, a risk analysis should be conducted to better predict the future.

The low and high range scenarios are used as inputs to a simulation routine called Monte Carlo. Monte Carlo simulation is used to model the probability of different outcomes in a process that cannot easily be predicted due to the intervention of random variables. In the example below, a thousand trials were computed resulting in one thousand NPV values. These values are arranged in a histogram which allows for the calculation of various probabilities that are associated with each NPV outcome.

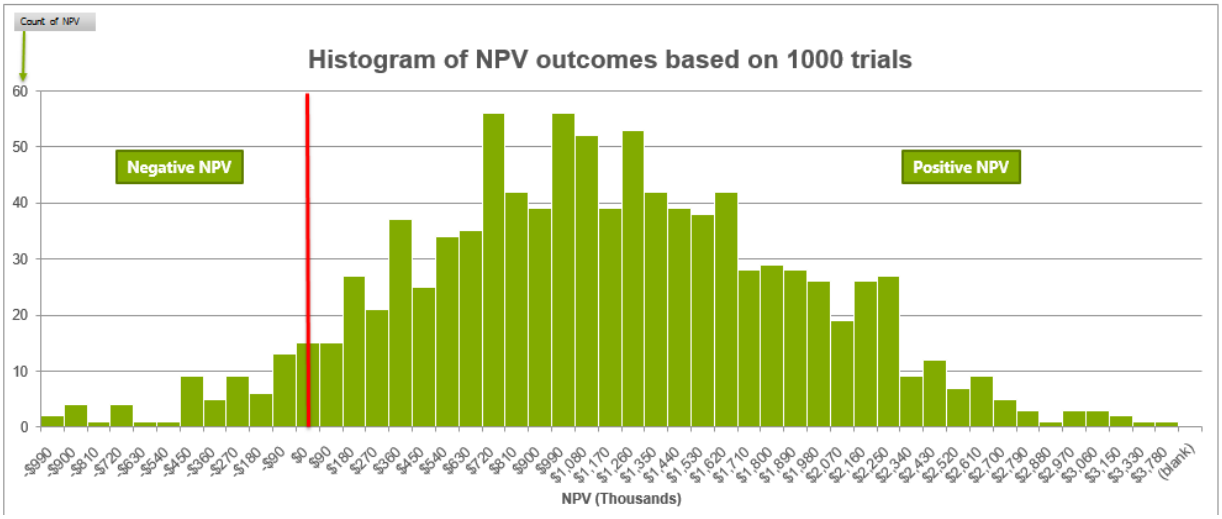


FIGURE 17 SAMPLE MONTE CARLO HISTOGRAM OF NPVS (BILL HUBBELL, MICROSOFT, 2018)

Monte Carlo simulation (also known as the Monte Carlo method) generates all the possible outcomes of a decision and assess the impact of risk, allowing for better decision making under uncertainty. It is a computerized mathematical technique that allows people to account for risk in quantitative analysis and decision making. The technique is used by professionals in such

widely disparate fields as finance, project management, energy, manufacturing, engineering, research and development, insurance, oil & gas, transportation, and the environment.

Monte Carlo simulation furnishes the decision-maker with a range of possible outcomes and the probabilities they will occur for any choice of action. It shows the extreme possibilities—the outcomes of going for broke and for the most conservative decision—along with all possible consequences for middle-of-the-road decisions. It performs risk analysis by building models of possible results by substituting a range of values—a probability distribution—for any factor that has inherent uncertainty. It then calculates results over and over, each time using a different set of random values from the probability functions. Depending upon the number of uncertainties and the ranges specified for them, a Monte Carlo simulation could involve thousands or tens of thousands of recalculations before it is complete. Monte Carlo simulation produces distributions of possible outcome values. By using probability distributions, variables can have different probabilities of different outcomes occurring. Probability distributions are a much more realistic way of describing uncertainty in variables of a risk analysis.

Probability Metrics Summary

Probability of negative NPV	**8%**
Probability of positive NPV	**92%**
Probability of NPV > Base Case	**54%**
Most Probable NPV (mean)	**1,052,675**
Std. Dev. NPV	**765,275**
Variance of Project Returns	**73%**
Lowest NPV	**(1,445,788)**
Highest NPV	**3,603,275**

FIGURE 18 SAMPLE OF METRIC SUMMARY FROM MONTE CARLO SIMULATION (BILL HUBBELL, MICROSOFT, 2018)

2.4 Evaluation Recommendations

Based on the above measurements and the disadvantages that are part of ROI, Payback Period or even IRR, the only measurement that is to be considered providing value in evaluating a cloud adoption investment is NPV. As UCLA finance professor Tome Copeland wrote in his book "*Financial Theory and Corporate Policy*" that "*NPV criterion is the only on which is necessarily consistent with maximizing shareholders´ wealth*". (Copeland, Weston, & Shastri, 2013)

NPV takes all the cash flows and the time value of money into account, it assumes the company's opportunity cost of capital and it complies with the value additivity principle. For a more complete discussion why NPV is best, it is recommended to read chapter 5 "*Net Present Value and Other Investment Criteria*" of "*ISE Principles of Corporate Finance*" by Richard A. Brealey, Stewart C. Myers and Franklin Allen. (Brealey, Myers, & Allen, 2016)

Ideally, the organization and finance department are using multiple financial metrics to evaluate multiple options for each investment and to best understand the implications and results of adopting cloud computing. While the TCO accounts only for the cost associated with the investment for its entire life span or a period of time, the ROI also investigate the benefits by the same. NPV compares anticipated benefits and costs over a specified period using a discount rate to calculate the present value of the sum of all future cash flows. IRR is a variant of NPV that helps calculate the discount rate that would make the NPV of the investment equal to zero. None of the metrics shown in this section are simple and require additional data and assumptions.

3 BUSINESS CASE

3.1 Introduction

In this chapter I apply the financial metrics from chapter 2 to build a business case for an organization. The reasons for that is to capture the rationale for cloud computing adoption by defining the time, the budget and agreed upon deliverables and outcomes for a company.

Organizations are often asking: "*How much cheaper is the cloud as compared to On-Premises and when will I realize the savings?*". The answer to the above question is one of the most difficult to answer for leadership, since the costs of cloud computing are beyond the obvious hardware and software costs, they must weigh the total cost of an IT service against its potential return. While this is certainly a general challenge, it is even more true for cloud computing since many benefits are not tangible or easily measurable. A meaningful assessment of adopting cloud computing must include short-, medium- and long-term gains, termination costs, as well as tangible and intangible benefits such as improved efficiencies or faster time to market. All the above must be properly quantified and considered in the equation.

Gartner reported that "*transitioning data and applications into vendor supported clouds can cut costs.*" Based on surveys of 152 U.S. federal IT decision-makers "*the U.S. federal government, for example, could save US$18.8 billion dollars by consolidating its data centers using cloud computing*" (Project Management Institute)

Looking at the financial benefits that an organization could gain from moving IT infrastructure to the cloud there are three core benefits:

- Shift from capital expenditure to operating expenditure
- Lowering the total cost of ownership (TCO) of IT
- Lowering the opportunity cost of running IT

Cloud is perceived as low up-front investment, and therefore, has a risk of overlooking associated investments of any service that plays a critical role in supporting and driving the business. It certainly requires investment such as resources, opportunity costs and organizational readiness.

KPMG points out that a typical IT organization spends "*over 30% of their budget on infrastructure (primarily data centers and data networks), shifting some or all of this work to the cloud can save organizations anywhere from 10-20% of their annual IT budget, savings that can either be returned to the firm or reinvested in growth and innovation.*" (KPMG, 2014). Furthermore, the article explains that "*this cloud run-rate economic advantage comes from two primary cost drivers: higher utilization rates as a result of a significant drop in*

"capacity hoarding" and lower unit costs from the increased scale, newer technologies, best practices, and improved operational efficiency of the cloud providers. The cost of ownership gap of 30 to 40% between traditional IT and public cloud services is predicted to continue, if not widen, over the next few years, driving growth in the market for high-quality and secure externally-hosted cloud capacity at over 40% per year" (KPMG, 2014)

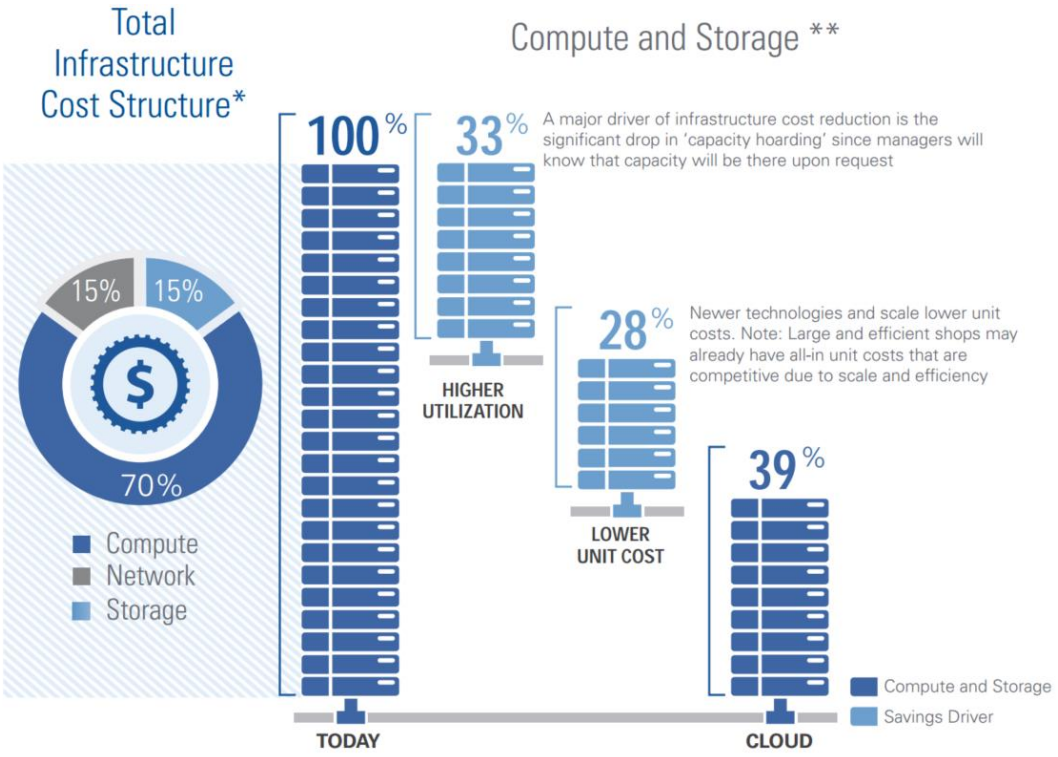


FIGURE 19 CLOUD RUN-RATE ECONOMIC ADVANTAGE (KPMG ANALYSIS 2014)

* Includes prorate share of facilities, until and labor costs supporting comput, storage and network capacity (approx. $17 million)
** Based on total run-rate cost of $15 million per year

Capacity hoarding is a problem for most organizations. Since most are not able to accurately forecast their future demand for a given IT service they tend to purchase more resources than needed and hold them back from getting used. Purchasing new hardware, integrating and deploying them into an organization takes long cycles and hence many organizations suffer from a shortage of IT services and resources either because they couldn't be used although they exist or because it takes too long to get them provisioned. That is where cloud computing provides infinite capacity that can be scaled out and up as needed and an organization pays only for what they use, so there is no need to keep spare resources for a potential rise in demand in the future.

Just as any investment, cloud computing too requires a deep analysis around return on investment (ROI) that encompass the entire life span of the investment and all continuously costs associated with it. Since for the ROI both all investment costs as well as all returns need to be calculated, it is critical to identify all potential costs and quantify the value of the return. For a

successful financial analysis, it is important to engage as many business functions as possible to fully understand the requirements. Most finance organizations have well-defined rules and rates for calculating ROI and other financial indicators such as weighted average cost of capital. The weighted average cost of capital is the average interest rate a company must pay to finance its assets or investments. Each investment must generate at least the same rate of return to satisfy shareholders or owners, its investors, and its creditors.

Building a credible business case requires the use of generally accepted finance principles, proven calculation methodologies and a strong dose of practical experience. Predictions of future investment return are inherently uncertain and for this reason, it is best to always create at least three scenarios: expected/base case, low case, high case. This provides a range of outcomes rather than a single point prediction. Sensitivity analysis can be leveraged to define those different cases using a variety of variable values. A Monte Carlo simulation uses distributions of the key variables rather than point estimates.

An interview-based survey by Tata Communications with a total of 1,000 interviews with senior IT decision-makers across the world from 2015 unveiled that a majority of the organizations "*have seen a positive return on their investment from moving to the cloud.*" (Tata Communications, 2015)

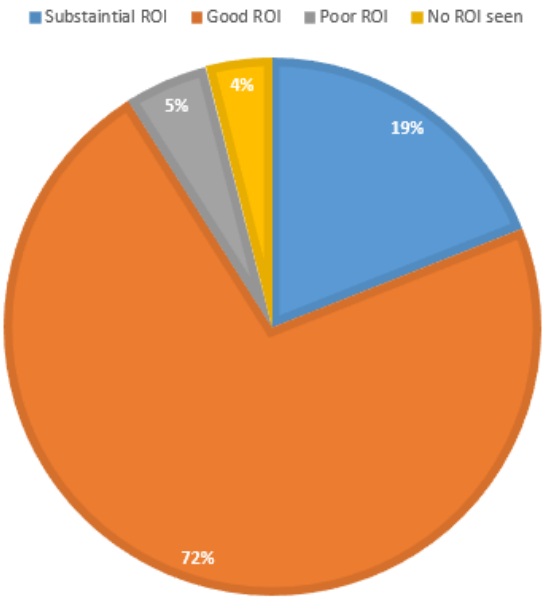


FIGURE 20 HOW SUBSTANTIAL HAS THE ROI BEEN FROM MOVING TO THE CLOUD (THE 970 RESPONDENTS IN ORGANIZATIONS THAT ARE USING A TYPE OF CLOUD WERE ASKED). TATA COMMUNICATIONS, 2015

The reasons why organizations see savings through cloud adoption are broad. The majority of companies have experienced savings through the increased speed of access to technology, about half of the respondents report savings through reduction in lead time and reduction in data loss, while only 2% of all have not realized any cost savings.

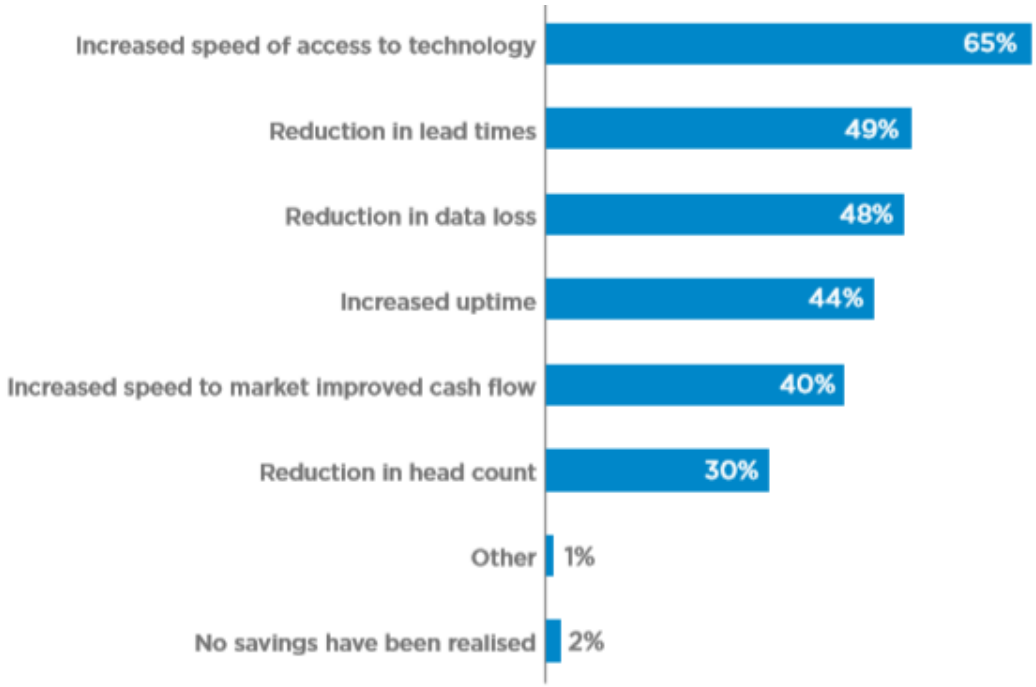


FIGURE 21 HOW WERE SAVINGS REALIZED DUE TO YOUR ORGANIZATION'S INVESTMENT IN CLOUD? (THE 970 RESPONDENTS IN ORGANIZATIONS THAT ARE USING A TYPE OF CLOUD WERE ASKED)

Google reported a survey of senior finance executives that showed a clear majority of company's biggest cloud project's expected cost savings could be met or were even exceeded across hardware-related costs, system-backup/data recovery costs, labor costs and software-related costs. (Surka & Rogers, 2012)

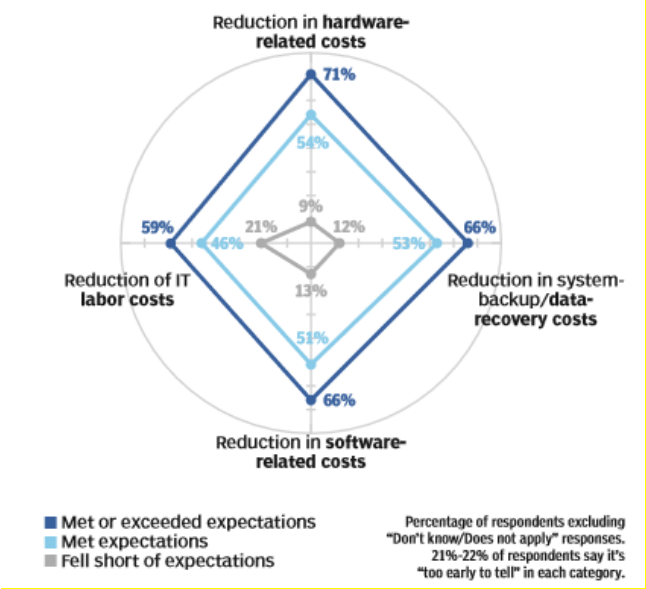


FIGURE 22 HOW HAVE THE COST-SAVINGS BENEFITS OF YOUR COMPANY'S BIGGEST CLOUD PROJECT COMPARED WITH YOUR EXPECTATIONS?

Every organization has a unique way to evaluate the ROI for cloud adoption, in fact, potentially every organization is different based on business objectives, industry they are in. Hence, they may view the opportunity differently. While startups and entrepreneurs do not have investment in on-premises hardware and would not see additional benefits from operational expenses for IT, most enterprise organizations are invested in on-premises data center and equipment and report depreciation expenses for existing hardware that they have already purchased. Identifying and making the right economic decisions can be more complex for these organizations, requiring additional investigation into the detailed costs and benefits of enterprise cloud.

Since this thesis is focused on enterprise organizations with large datacenter footprints, IT personal and complex dependencies between the business and their own IT department, this section will describe a way to estimate value and benefits from cloud computing as an alternative to conventional on-premises IT infrastructure, such as organizational owned and managed hardware.

In an article KMPG explains that many organizations have "*significant existing legacy investment in servers, storage, and data centers that cannot be easily divested, especially for the most recent acquisitions, a condition we call the CapEx conundrum.". This requires building a strong business case and value proposition and failing to do that "will likely doom the organization to a downward spiral of high-cost internally provisioned infrastructure and associated structural cost disadvantage to its competitors that will worsen over time. Additionally, and perhaps an even larger problem, is the opportunity cost to the business resulting from a lack of speed and agility.*" (KPMG, 2014)

3.2 Economic Impact for IaaS

In 2017 Microsoft commissioned Forrester Consulting to conduct a Total Economic Impact™ (TEI) study to investigate the potential return on investment (ROI) enterprises may realize by shifting some or all of their management and operations to Azure Infrastructure-as-a-Services. Values of costs and benefits are representative of a composite organization aggregated based on interviews with six Microsoft Azure IaaS Customers.

The study reports that the following benefits were gained by interviewed customers that migrated or re-architected some of all workloads from on-premises to IaaS:

- Greater revenue opportunities
- Increased profits
- Improved production efficiency
- Reduced datacenter, IT resource, and outsourcing costs
- Easier and faster software and hardware management

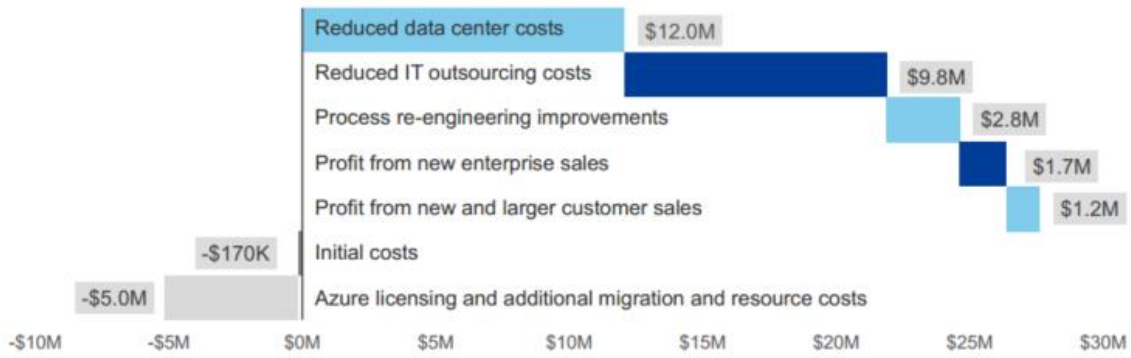


FIGURE 23 BENEFITS AND COSTS (FIVE-YEAR PRESENT VALUE)

While the TEI study reveals some of the key results such as reduced costs and increased profits, it also calculated and reported some key metrics:

ROI	Benefits PV	Costs PV	NPV
435%	**$27.6 million**	**$5.2 million**	**$22.4 million**

3.2.1 Quantified benefits

Amongst the quantified benefits that were measured over a five-year investment period the study reports that:

- A data center reduction of 50% - 73%, leading to cost savings of $12 million (PV). Servers deployed onsite or hosted with a partner were migrated to Azure, which reduced the internal office space or hosting costs.
- An annual reduction between 33% and 83% in IT outsourcing needs, leading to $9.8 million (PV) in cost savings.
- New sales leading to $1.7 million in new income from improved processes, global reach, and better customer service (five-year PV).
- Website scale and performance improvements, increasing annual customer sales between 48% and 63% and increasing transaction size between 20% and 27%, adding up to $1.2 million in new income.

3.2.2 Unquantified benefits

Amongst the unquantified benefits that were discovered through interviewing customers the study reports that:

- **Ability to experiment with new and (otherwise) cost-prohibitive technologies**. IT managers can test out and pilot new technologies such as Hadoop or high-performance computing (HPC) more quickly with virtualized environments on Azure, significantly lowering costs.

- **Developer and tester process improvements**. Developers and testers saw improvements in tasks such as setting up a new server environment (or turning it off when done); simulating real-time scale scenarios; and standardizing test, development, and production environments.
- **Additional business-critical workload migrations**. As lift-and-shift migrations are completed, organizations will move to migrate more business-critical workloads, leading to greater scale, performance, and mobility benefits.
- **Azure PaaS implementation.** Future plans include rearchitecting some applications or interfaces for Azure platform-as-a-service (PaaS) that are expected to create new benefit opportunities and save time and costs.

3.2.3 Costs

The following costs were experienced amongst the interviewed organizations:

- **Initial costs of $170,000**. Many workload migrations were simple lift and-shift migrations, meaning that the initial implementation was relatively quick and simple.
- **Azure licensing and management costs of nearly $5 million**. Azure license costs are estimated for a composite organization to start at $560,000 in the first year and grow to $1.4 million by Year 5. As more workloads are migrated in later years, additional costs are included for additional migration effort as well as expected new hires.

3.3 Economic Impact for PaaS

Microsoft commissioned Forrester Consulting to conduct a Total Economic Impact™ (TEI) study to identify and understand the potential return on investment (ROI) enterprises may realize by shifting their application development and deployment to Azure platform-as-a-service (PaaS). The purpose of this study was to give readers a framework to evaluate the potential financial impact, or ROI, of leveraging Azure PaaS for their organizations.

Forrester interviewed a total of eight customers with existing footprint in Azure PaaS, several years of experience with cloud (IaaS) and had more recently adopted PaaS. Based on the composite results of the interviews and financial analysis, they created a representative organization with 100 applications now supported by PaaS.

The representative organization experienced a number of quantified benefits in this case study:

- IT administration resource savings
- Avoided and reduced IT resource costs
- Improved service deployment time-to-market

- Application testing resource savings
- Application-enabled organization savings
- New business opportunities enabled by Azure PaaS

"*The representative organization five-year analysis estimates a 466% ROI and a net present value (NPV) of more than $5.9 million. Key improvements enabled by Azure PaaS include an 80% reduction in IT administration time required to manage apps deployed on the platform, a 25-hour average reduction in development and testing time required to develop or update Azure PaaS applications, and a 50% reduction in time required to help deploy a new application solution to a client.*" (Owens, 2016)

ROI	NPV	Time-To-Market	IT Time
466%	**$5.9 million**	**-50%**	**-80%**

3.3.1 Quantified Benefits

The representative organization, based on current Azure customers, saw the following risk-adjusted benefits:

- **Eighty percent less IT administration time was required for applications on PaaS, allowing the organization to focus on application innovation, not administrative tasks**. The organization previously spent significant time on server patching, networking setup, firewall configuration, and many other server-related tasks that are now included with Azure PaaS. This amounted to $132,240 of savings in the first year.
- **IT teams can reallocate or avoid hiring five IT administrators and two database administrators (DBAs) to other teams or more value-added tasks, adding up to $697,000 saved per year.** The organization would have needed to hire five new IT administrators and two DBAs within the first year to meet the demand and service otherwise enabled by Azure PaaS.
- **The organization improved application delivery time-to-market by 50% with Azure PaaS, leading to $376,441 in increased profit in the first year**. The organization could deliver applications running on Azure in half the time, meaning revenue could be earned more quickly.
- **The organization saved 25 hours in application testing and development time per application created or updated, improving developer productivity and adding up to $108,458 saved in the first year**. With Azure PaaS, developers can take advantage of integrated tools and, with the push of a button, testers can create new testing environments that exactly match the organization's development and production environments.

- **The organization saw $98,550 in employee issue identification and repair resource cost savings in the first year**. The representative organization deployed an employee-facing mobile application on Azure PaaS to meet a specific need related to facilities issue identification and repair, saving significant time and resource costs compared with the earlier paper-based processes.
- **The organization deployed customer-facing applications, leading to $168,750 in the first year in new profit from improved sales rep performance and direct customer sales**. Both customer self-service and sales enablement apps are easier to develop and contribute to new revenue and profit for the organization.

3.3.2 Costs

The representative organization, based on current Azure customers, saw the following risk-adjusted costs:

- **Initial implementation costs of $101,850 and ongoing resource and other costs related to Azure PaaS of $73,500 in the first year.** While significant administration, development, and testing costs can be saved with Azure PaaS, some implementation, training, and management costs are expected.
- **Azure subscription and support fees of $191,400 in the first year.** These are the estimated annual fees the representative organization paid to Microsoft for Azure PaaS services, billed monthly on a per-use basis.

3.4 The case of a Manufacturer

Building a business case for cloud involves multiple steps, including analysis of business requirements, business drivers, cloud service models, risk assessment, costs and benefits. In this section the scenario is limited to the financial aspects of an organization that would like to adopt cloud by moving their IT from their own datacenters to the cloud. This section will show how to quantify each of the areas, analyze the costs of their existing hardware, and the financial benefits they could gain by running their required hardware in the cloud.

The challenge with ROI calculations is that they typically define the payback of investments against the benefits to the business using financial terms and variables that are static. The same ROI calculations fall short when used in the more complex environments, where there is a continuous improvement of services such as cloud computing. In the cloud multiple deployment models exists, each of them having a different impact on costs and benefits and options change frequently and can break traditional ROI models, leaving potential benefits unaccounted for.

Many enterprise organizations would benefit considerably by having different deployment models, depending on the specific IT service or application that they choose to move to the cloud.

This section covers the evaluation of a manufacturer from Canada and one part of cloud adoption journey, moving a series of virtual machines from their on-premises data center to the cloud. Since the scenario is from a real customer, the data was concealed, and each value was altered, although the ratio of each data point was kept.

3.4.1 Savings

While adopting cloud computing is not solely about saving cost, organizations must keep the bottom line in mind when adjusting operations.

- Using resources more efficiently such as servers, storage devices, but also improved maintenance and operations through automation.
- Reduced costs for software and applications licenses through Software-as-a-Service solutions.
- Reduced costs for electricity and cooling of data center facilities
- Less labor needs from internal IT teams since certain tasks and administration needs are covered through cloud providers

Along with those potential cost savings there are intangible benefits that are much harder to calculate and measure, nonetheless they are equally important to look at.

3.4.1.1 Innovation

Organizations that can innovate faster and deliver a new product or services faster to the market (time to market) can achieve increased profit margins and market share. Assuming a product or a service will contribute $50,000 per month, and could be released 6 months earlier, could generate an additional $300,000 in revenue. Putting a price tag on innovation could help identifying additional gains.

3.4.1.2 Accessibility

Providing services to an organization’s workforce through the cloud could increase accessibility and increase collaboration across employees. Application and information could be accessed globally from any internet connected device supporting global staff to complete tasks from anywhere which will realize efficiencies in the daily processes. These gained efficiencies are measurable, and it is important to include them into the business case showing additional savings.

"*Temenos, a global banking software provider, has built a cloud-based version of its on-premises T24 core banking application to give customers functionality in the cloud. Temenos can offer cloud banking capabilities to companies that have traditionally used on-premises solutions, and it can help them meet strict security and compliance requirements. Also, Temenos customers can quickly access the cloud version of T24, and they have more flexibility.*" (Microsoft Customer Stories, 2017)

3.4.1.3 Productivity

Usually cloud providers deliver services and technology that is up to date without a need to worry about maintenance, which results in a higher productivity for the workforce. Since the tools for business unit workers are kept current, this results in modern skills for technical staff and less frustration about keeping outdated systems running. Cloud services help an organization to focus on the business they are in, and increase the value add instead of operating basic IT services such as mail, collaboration tools and security.

3.4.1.4 Agility

"*Cloud agility is the ability to rapidly change an IT infrastructure in order to adapt to the evolving needs of the business. This is becoming increasingly important in today's disruptive markets and the reality is that many enterprises are plagued with IT infrastructures that are so poorly planned and fragile that they are limiting business growth.*" (Cloud Technology Partners, n.d.) Nowadays businesses must adopt new customer needs and requirements faster, by being able to release new services and products to the market in a timely manner. With cloud computing, foundational services can be consumed and deployed within minutes, instead of days and weeks. As a result, it is more likely to keep existing customers satisfied and improve customer relationships, while also exploring new markets faster than in the past. In general, cost associated to win new customers are substantially higher than retaining existing customers, the benefit of agility is measurable for an organization.

Based on the whitepaper from CTP there are 4 components to agility:

1. Degree of change over time
2. Ability to adapt to change
3. Relative value of change
4. Individual perspective on agility

"*The value of the cloud scales with the value that its agility brings to your business. In other words, the faster an industry needs to change, the more value cloud brings.*"

3.4.1.5 Scalability

As described above, being able to scale out services and products solely, depending on the demand, helps reducing costs associated with on-premises excess capacity. Setting up new hardware, provisioning and integrating additional resources could be fully automated in the cloud. Organization that seek peak demand, such as a ticket sales company, can leverage cloud for bursting out resources to the cloud while maintaining on-premises resources for the daily usage. Similarly, new services or products can grow accordingly to the demand that users generate, which help startups as well as enterprises reducing costs (and risk) introducing new services or products.

"*Cost reduction was not the main reason we decided to move to the cloud. However, our cloud costs per streaming start ended up being a fraction of those in the data center -- a welcome side benefit. This is possible due to the elasticity of the cloud, enabling us to continuously optimize instance type mix and to grow and shrink our footprint near-instantaneously without the need to maintain large capacity buffers. We can also benefit from the economies of scale that are only possible in a large cloud ecosystem."* (Netflix, 2016)

3.4.1.6 Profitability

Organizations with an IT downtime can experience serious business impacts, according to a recent ITIC's 2017 Reliability and Hourly Cost of Downtime Trends Survey "*the cost of downtime continues to increase as do the business risks. An 81% majority of organizations now require a minimum of 99.99% availability. This is the equivalent of 52 minutes of unplanned outages related to downtime for mission critical systems and applications or, just 4.33 minutes of unplanned monthly outage for servers, applications and networks.*". (ITIC, 2017)

Ponemon Institute released their most recent study "*Cost of Data Center Outages*" in 2016 and analyzed the cost behavior of unplanned data center outages. According to that study, the average cost of a data center outage increased by 38% to $740,357 in 2016.

3.4.1.7 Utilization

Organizations tend to have hardware utilization rates of less than 20%, and in many cases, this is done intentionally to ensure there are enough resources available for peak demands, such as month-end, year-end calculations. Other business-related peaks require spare resources to fulfil the additional demand, but during the majority of the time when it is not needed, those unused equipment, such as servers, are not powered down.

Gartner talked about the "*80% rule*": that 80 percent of IT budgets get spent simply "*keeping the lights on*" and according to McKinsey and Company, typical servers in business and enterprise data centers deliver between five and 15 percent of their maximum computing output on average over the course of the year. In the cloud companies would only per what they use

(pay-as-you-go pricing) whereas organizations that build or run their own servers are paying for it regardless of whether they use them or not. Only a very few workloads and applications would consume are very high number of resources constantly such as High-Performance Computing (HPC) or Supercomputers. Since the introduction of virtualization in 2005 and it is broader adoption in the years later, the utilization of hardware was improved, but still a lot of servers are not used adequately and efficiently.

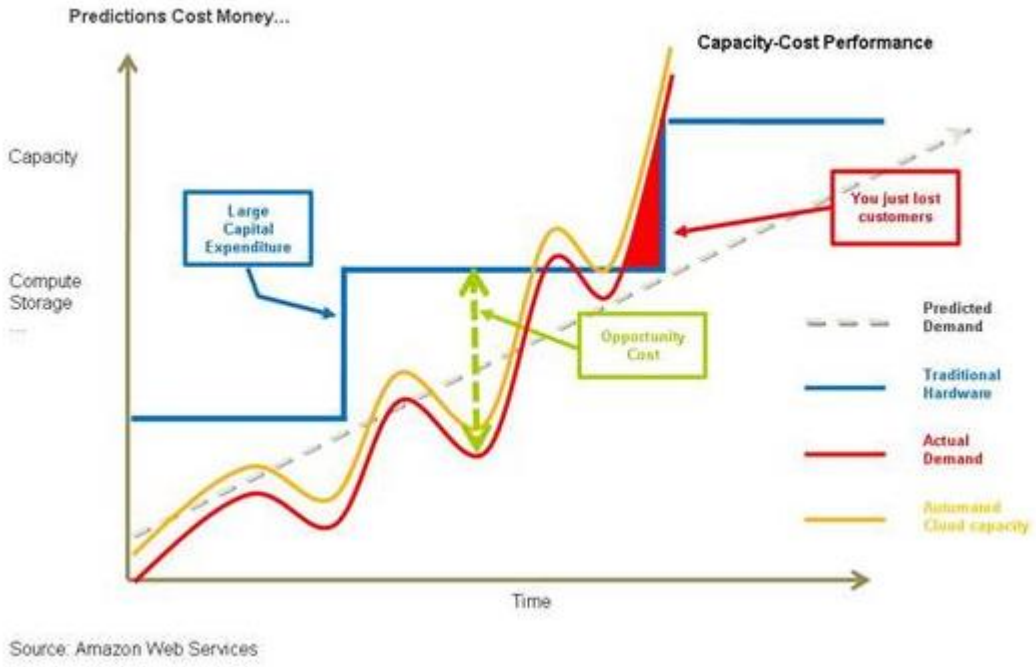


FIGURE 24 TRADITIONAL MODEL VS. CLOUD MODEL

The 2014 Data Center Efficiency Assessment from the NRDC has on-premises server utilization running at 12 to 18%, which is consistent with other estimates. ((NRDC), 2014)

In 2015 in an article in Forbes Magazine Ben Kepes sites a study from Anthesis Group and a Stanford University researcher Jonathan Koomey "*was trying to get a handle on how much data center capacity sits idle. The core findings of the study are based on a sample of anonymized data and revealed that 30 percent of the physical servers were "comatose." In this instance, comatose servers are those that have not delivered information or computing services in six months or more.*" (Kepes, 2015)

Furthermore, the article explains that the survey implies that, "*there are about 10 million comatose servers worldwide - including standalone servers and host servers in virtual environments. The findings support previous research performed by the Uptime Institute, which also found that around 30 percent of servers are unused.*" (Kepes, 2015)

The graphic below highlights the challenges with the traditional model of large CapEx investments for an on-premises data center. The blue line depicts hardware purchases which usually

happens periodically every few years in enterprise organizations. The increased capacity should match the projected utilization. The red line shows the actual demand which for many cases is below the purchased hardware (opportunity cost). The red arrow shows the time, when the demand is actually higher than the available resource, which potentially means a loss in customers or bad customer experience.

Highly regulated vertical industries such as Banking and Finance, Food, Government, Healthcare, Hospitality, Hotels, Manufacturing, Media and Communications, Retail, Transportation and Utilities must also factor in the potential losses related to litigation as well as civil penalties stemming from organizations' failure to meet Service Level Agreements (SLAs) or Compliance Regulations. Additionally, this does not take "*into account the cost of additional penalties for regulatory non-compliance or "good will" gestures made to the organization's customers and business partners that were negatively impacted by a system or network failure.*" (ITIC, 2017)

Obviously, the average cost of downtime is dependent on a lot of factors, while the monetary loss varies depending on revenue, industry, the actual duration of the outage, the number of people impacted, and the time of day. "*The ITIC survey data revealed that although monetary losses topped users' list of downtime concerns, it was not the only factor worrisome to organizations.*" (ITIC, 2017)

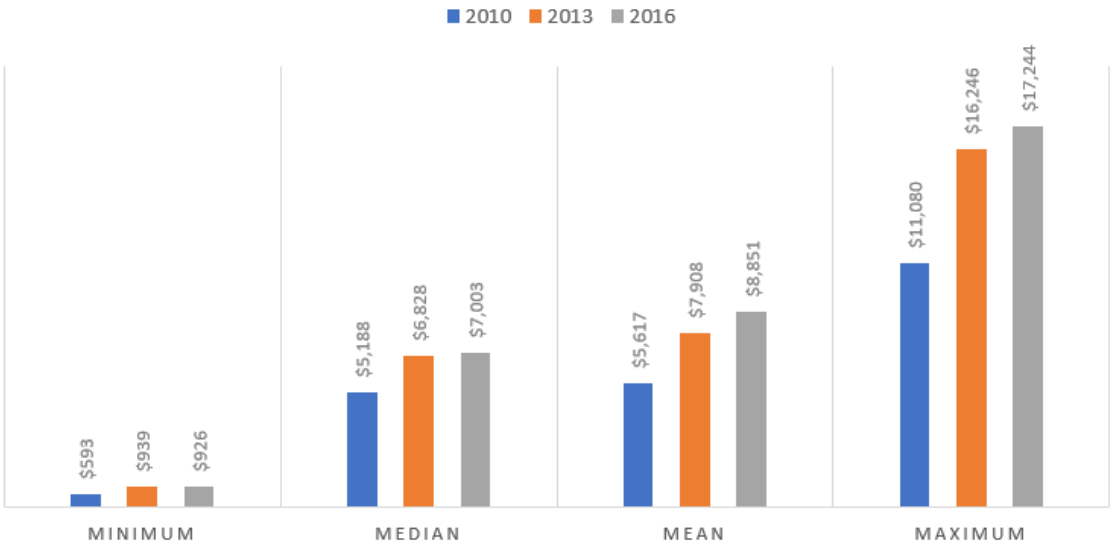


FIGURE 25 TOTAL COST PER MINUTE OF AN UNPLANNED DOWNTIME

Besides the monetary aspect, downtime can significantly impact the brand value and reputation, customer satisfaction, transaction and sales losses and lost employee productivity.

Business continuity is an increasing necessity and cloud providers make it possible to deliver IT infrastructure and solutions with limited downtime. They have SLAs defined to focus on up-time and connectivity. Microsoft, for example, has its SLAs published online for each cloud services[7].

3.4.2 Costs

Cost optimization is always important while making sure IT provides the resources needed to keep pace with the business demands. But some of the potential savings from adopting cloud computing will be offset by new costs.

a) With the need for additional bandwidth, networking costs will rise. Currently most of the major cloud providers do not charge for inbound data transfers, but outbound data is charged.
b) Once the decision to adopt cloud is made, the migration and deployment of applications and services has costs implications. Depending on the type of migration needed for a certain workload, the cost can greatly vary, but the situation also presents unique opportunities to focus on areas that usually are ignored, such as data clean-up.
c) Additionally, administrative costs for managing the provider relationship should be expected too.
d) Furthermore, expenses for retraining of IT staff must be considered as well as business personnel using the new cloud technology and applications.

"*We see that a company's cloud financial maturity on their cloud investment follows a consistent flow as the company matures. Companies early on in their cloud journey are focused on identifying hard costs and other clear cloud value drivers, which are easier to identify but provide a limited perspective to total ROI. (…) As companies mature through their economic analysis and cloud adoption journey, their financial maturity increases as they start to understand the value of agility and other soft costs.*" (Cloud Technology Partners, n.d.)

[7] https://azure.microsoft.ocom/en-us/support/legal/sla

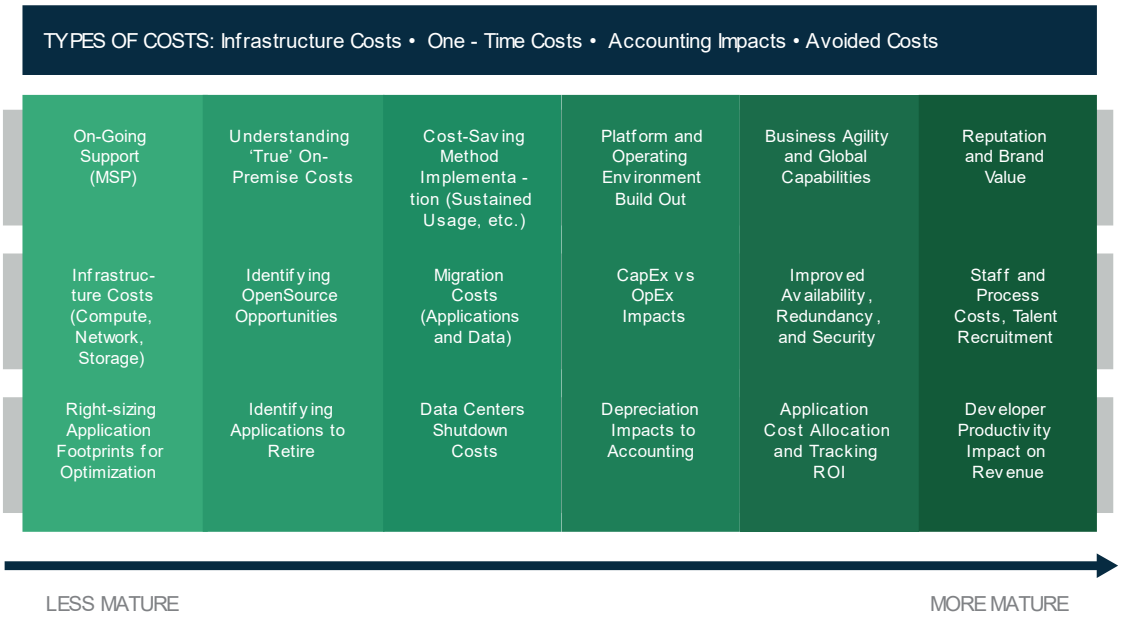


FIGURE 26 ACHIEVING CLOUD FINANCIAL MATURITY

In their whitepaper "*Calculating Cloud ROI: From the Customer Perspective. An ISACA Cloud Computing Vision Series*" ISACA has classified the costs of cloud computing into three categories:

- Upfront costs
- Operational costs
- Change/Termination costs

Upfront costs consist of the initial investment required to setup the cloud:

i. Technical readiness: the costs to accommodate the network installation or to upgrade certain components required for the connectivity to cloud,
ii. Implementation and integration: the professional services needed to manage the transition to cloud and integrate it with either the in-house or other cloud services.
iii. Configuration/customization: the costs to configure customer-based SaaS application
iv. Training: the resources required to manage the cloud vendors and services
v. Organizational change: the processes required to accommodate the cloud-specific needs, such as internal audit, change management, monitoring, etc.

Recurring costs are related to the routine fee and supports to maintain the use of cloud services:

i. Subscription fees: the agreed-on periodic fee for the subscription to cloud services
ii. Change management: the costs incurred when requesting system changes

iii. Vendor management: the costs related to routine monitoring on cloud service provider activities, SLA, and other evaluation.
iv. Cloud coordination: the costs to manage the coordination between clouds
v. End-user support and administration: the costs that are still retained in the customer
vi. Risk mitigation: the efforts required to reduce the risks to acceptable level
vii. Downsize/upsize: the costs related to upscale or downscale the computing resource

Termination costs occur when the organization tries to revert to premise systems or change to other cloud service providers, such as

i. cost to extract or sanitize the data
ii. penalties of early termination
iii. reallocation of IT resources and people, etc.

Summary

Potential Savings	**Potential Costs**
Hardware	**Networking**
physical servers	additional bandwidth
storage	administration/operations
maintenance	**Applications**
Applications	Migration
software licenses costs	Integration
maintenance costs	Testing
Facilities	**Data**
Less power consumption	Migration
Less cooling	Testing
Less space	**Labor**
Labor	Retraining of IT
IT administrators	Retraining of Application Users
	Vendors
	Relationship Management

3.5 Process

Despite the many benefits and opportunities that cloud computing can introduce to an organization, many organizations face challenges on their journey to the cloud. Dealing with those challenges requires a comprehensive strategy for cloud computing, including strategy, tactical, legislative, technical, financial and organizational capabilities. One possible approach is described in the article "*Cloud Migration: Finding your path to value with the cloud*" by Miha Kralj, Accenture, who describes a phased approach for cloud adoption. (Kralj, 2017)

Moving to the cloud can never be an Enterprise IT-only decision and has to include many other departments (business, finance, legal to name a few) to completely understand the costs and benefits, which then impacts the financial results. It is key to align an organization´s cloud strategy and goals to their business strategy and goals. Initially it is important to understand the business drivers for adopting cloud (e.g. reducing costs vs. increasing revenues vs. improved efficiencies). Each of those business drivers have a different impact on the cloud adoption strategy. There are various approaches and frameworks available that describe methodologies and concepts of cloud computing adoption.

Most organizations will start piloting the use of cloud computing with "*either low-risk projects, or projects in which the on-premises computing resources would not normally be available.*" By assessing on-premises application applications that are candidates for the cloud will be identified. The assessment includes uncovering risks associated with them, customization needs, process complexity and business need that traditional computing cannot fulfill. (Grabski, Kambil, & Root, 2013). Gartner has developed the five ways to migrate applications to the cloud:

- **Rehost**
    - Redeploy an application to a different hardware environment (cloud) by changing the configuration. It does not include changes to its architecture and is considered as a "*lift & shift*" approach to IaaS.

- **Refactor**
    - Leveraging cloud infrastructure to reuse application languages, frameworks, and code, thus moving existing investments into PaaS.

- **Revise**
    - Modifying existing code base of an application and then rehost or refactor to deploy to the cloud.

- **Rebuild**
    - This requires discarding investments into code and logic to re-architect the application and deploy it into a PaaS environment

- **Replace**
    - Discard the entire existing application and use a commercial software delivered as a service.

"*Choosing the optimal application-migration option is a decision that cannot be made in isolation*," said Mr. Watson. "*Any cloud-migration decision is, in essence, an application or infrastructure modernization decision and needs to be approached in the broader context of related application portfolio management and infrastructure portfolio management programs."* (Pettey & Meulen, 2011)

"*Cloud computing has brought a radical shift by transforming IT services into a commoditized service and delivered in a manner similar to utilities. (..) Several frameworks or approaches have been suggested in IS-related literature for cloud computing.*" (Utomo, 2014) Besides that also many major cloud provides offer Cloud Adoption Frameworks that help companies to achieve the expected results.

In a whitepaper "*Calculating Cloud ROI: From the Customer Perspective*", the Information Systems Audit and Control Association (ISACA), an independent, nonprofit, global association, developed a three-step framework that describes how enterprises can find the right approach. Although every organization's cloud adoption journey is a unique process, a set of core steps are common amongst most of them. The ISACA whitepaper describes them as:

- Phase 1 - Determine to-be cloud costs and benefits
- Phase 2 - Evaluate as-is costs and benefits
- Phase 3 - Calculate ROI

Since this thesis is focusing on the financial aspects and does not cover any of the other areas, it is assumed that an organization must define their unique comprehensive cloud computing strategy which also includes the financial aspects described in this thesis. Furthermore, the thesis will describe phase three using key metrics such as Net Present Value (NPV) and Internal Rate of Return (IRR) instead of the Return on Investment (ROI).

3.5.1 To-Be Cloud Costs and Benefits

The first phase of defining the ROI is to define the to-be cloud cost. This includes cost of hardware, software, maintenance, facility and infrastructure costs. Below is a real-life example from a large manufacturing company from Canada that is interested into moving a series of virtual machines to the cloud. The numbers in the tables were all modified with a fixed number to obscure customer data, but the ratio between the various numbers is retained.

The company runs its own datacenter with 4194 sq. ft (= 390m²) raised floor area., operating 36 medium, 8-core physical servers, and about 311 large, above 8 cores physical servers. On those physical servers a total of 592 virtual machines are operated, 508 of them are medium sized, the rest are large-sized machines. Their server profile includes various Windows Server versions, 2 different Linux distributions (Red Hat and Suse) and a small number of other operating systems. Their virtualization rate is 75% and their growth rate is 6.4% every year. Their total storage is at 508,4 TB and is growing at about 6.4% year over year. They have 11 full time employees to manage their datacenters (management, server administration, storage administrators, network administrators) and two (2) contractors. The cost per full time employee was 133 USD/hour and 113 USD/hour. Per year the annual downtime

Cloud Costs	Year 0	Year 1	Year 2	Year 3	Year 4	Total
Cost of Hardware						
Hardware Acquisition						
Cost of Network						
Network Cost	83,186.95	87,346.30	91,713.61	96,299.29	101,114.26	**459,660.41**
Cost of Software						
Cost of Server Software - Windows	1,387,347.09	1,456,714.44	1,529,550.16	1,606,027.67	1,686,329.05	**7,665,968.41**
Cost of Server Software - Others	199,309.02	209,274.47	219,738.19	230,725.10	242,261.36	**1,101,308.14**
Cost of Virtualization						
Cost of Maintenance						
Network maintenance	8,318.70	8,734.63	9,171.36	9,629.93	10,111.43	**45,966.04**
Server spare and replacement cost						
Server software maintenance	126,932.49	133,279.11	139,943.07	146,940.22	154,287.23	**701,382.12**
Cost of facilities and Infrastructure						
Facilities Cost						
Power and Cooling						
Cost of Administration						
Administration Cost - Server	30,748.03	32,285.43	33,899.71	35,594.69	37,374.43	**169,902.29**
Administration Cost - Storage	10,249.34	10,761.81	11,299.90	11,864.90	12,458.14	**56,634.10**
Administration Cost -Network	5,124.67	5,380.91	5,649.95	5,932.45	6,229.07	**28,317.05**
Backup Costs						
Backup Equipment Costs (Tape Drive)						
Backup Software Costs						
Backup Software Support Costs						
Tape Media Costs						
Cost of Storage						
Cost of Storage	274,536.00	288,262.80	288,262.80	288,262.80	288,262.80	**1,427,587.20**
Storage Power, cooling						
Cost of End-point protection						
Antivirus & Monitoring agent						
Total Costs of System	**2,125,752.29**	**2,232,039.90**	**2,329,228.75**	**2,431,277.05**	**2,538,427.76**	**11,656,725.76**

3.5.2 Evaluate As-Is Costs and Benefits

The second critical step is to establish a baseline cost of the current, on-premises datacenter including the datacenter infrastructure costs, licensing costs for software, labor costs and training costs. A TCO model let an organization compare the cost of running their entire infrastructure on-premises or within co-located facility (hosting).

Data Center On-Premises Costs	Year 0	Year 1	Year 2	Year 3	Year 4	Total
Cost of Hardware						
Hardware Acquisition	1,591,089.50	1,670,643.98	1,754,176.17	1,841,884.98	1,933,979.23	**8,791,773.86**
Cost of Network						
Network Equipment Cost	159,108.95	167,064.40	175,417.62	184,188.50	193,397.92	**879,177.39**
Cost of Software						
Cost of Server Software - Windows	531,468.38	558,041.80	585,943.89	615,241.08	646,003.14	**2,936,698.29**
Cost of Server Software - Others	31,434.65	33,006.39	34,656.71	36,389.54	38,209.02	**173,696.30**
Cost of Virtualization	223,559.01	234,736.96	246,473.81	258,797.50	271,737.38	**1,235,304.66**
Cost of Maintenance						
Server/network hardware maintenance	717,581.36	753,460.43	791,133.45	830,690.13	872,224.63	**3,965,090.01**
Server spare and replacement cost	254,574.32	267,303.04	280,668.19	294,701.60	309,436.68	**1,406,683.82**
Server software maintenance	125,833.93	132,125.62	138,731.90	145,668.50	152,951.93	**695,311.88**
Cost of facilities and Infrastructure						
Facilities Cost	2,005,575.00	2,105,853.75	2,211,146.44	2,321,703.76	2,437,788.95	**11,082,067.89**
Power and Cooling	343,921.16	361,117.22	379,173.08	398,131.74	418,038.32	**1,900,381.52**
Cost of Administration	-	-	-	-	-	**-**
Server and Datacenter - Administration Cost	147,026.88	154,378.22	162,097.14	170,201.99	178,712.09	**812,416.32**
Storage Management Cost	49,008.96	51,459.41	54,032.38	56,734.00	59,570.70	**270,805.44**
Network Administration Cost	24,504.48	25,729.70	27,016.19	28,367.00	29,785.35	**135,402.72**
Cost of Backup						
Backup Equipment Costs (Tape Drive)	2,903.53	3,048.70	3,201.14	3,361.19	3,529.25	**16,043.81**
Backup Software Costs	290.35	304.87	320.11	336.12	352.93	**1,604.38**
Backup Software Support Costs	11.61	12.19	12.80	13.44	14.12	**64.18**
Tape Media Costs	5,972.97	6,271.62	6,585.20	6,914.46	7,260.18	**33,004.41**
Cost of Storage						
Storage Costs	388,960.00	408,408.00	428,828.40	450,269.82	472,783.31	**2,149,249.53**
Storage power, cooling	23,337.60	24,504.48	25,729.70	27,016.19	28,367.00	**128,954.97**
Cost of End-point protection						
Antivirus & Monitoring agent	61,081.31	64,135.37	64,135.37	64,135.37	64,135.37	**317,622.79**
Total Costs of System	**6,687,243.95**	**7,021,606.15**	**7,369,479.69**	**7,734,746.91**	**8,118,277.48**	**36,931,354.19**

3.5.3 Migration Costs

The scope of the application and the current IT infrastructure will determine how large the cost of the migration process will be. There are a number of factors that need to be considered to calculate the total effort of migration such as data migration, development requirements, integration of application, testing as well as cost for consulting to help migrating to the cloud.

The migration costs were calculated over three (3) years with a 40% migration of virtual machines in year 1, 40% in year 2 and 20% in year 3. Since some of the servers are based on old versions that are no longer supported, they need to be migrated using a workload migration. This approach is based on the redeployment of the workload in the cloud. The other servers running current versions can be migrated using a lift-and-shift approach. This approach involves shutting down the virtual machine in the on-premises datacenter, copying the virtual machine data to a cloud storage account and then recreating the virtual machine in the cloud. The costs include an end-to-end service, including discovery, assessment, migration, and operations support as well as a 10% risk reserve.

Year	0	1	2	3	4	Totals
Migration Costs in $	1,429,339	1,429,339	873,291	0	0	3,731,969

3.5.4 Calculate ROI

Using the comprehensive list of all the costs and benefits associated with the project, a Cost-Benefit Analysis can be conducted to understand weather moving to the cloud is financially feasible. The table below uses the numbers from the sections above to put them into perspective.

Cloud Cost	Year 0	Year 1	Year 2	Year 3	Year 4	Average Annual Saving
Cost of Hardware		$ -	$ -	$ -	$ -	
Hardware Acquisition	$ 831,870	$ 873,463	$ 917,136	$ 962,993	$ 1,011,143	$ 1
Cost of Network						
Network Cost	$ -	$ -	$ -	$ -	$ -	$ -
Cost of Software						
Cost of Server Software - Windows	$ (1,109,479)	$ (1,164,953)	$ (1,223,201)	$ (1,284,361)	$ (1,348,579)	$ (1)
Cost of Server Software - Others	$ (182,874)	$ (192,018)	$ (201,619)	$ (211,700)	$ (222,285)	$ (0)
Cost of Virtualization	$ 116,883	$ 122,728	$ 128,864	$ 135,307	$ 142,072	$ 0
Cost of Maintenance						
Network maintenance	$ 366,854	$ 385,197	$ 404,457	$ 424,680	$ 445,914	$ 0
Server spare and replacement cost	$ 133,099	$ 139,754	$ 146,742	$ 154,079	$ 161,783	$ 0
Server software maintenance	$ (61,143)	$ (64,200)	$ (67,410)	$ (70,780)	$ (74,319)	$ (0)
Cost of facilties and Infrastructure						
Facilities Cost	$ 1,048,575	$ 1,101,004	$ 1,156,054	$ 1,213,857	$ 1,274,549	$ 1
Power and Cooling	$ 179,812	$ 188,803	$ 198,243	$ 208,155	$ 218,563	$ 0
Cost of Administration						
Administration Cost -Server	$ 46,122	$ 48,428	$ 50,850	$ 53,392	$ 56,062	$ 0
Administration Cost - Storage	$ 15,374	$ 16,143	$ 16,950	$ 17,797	$ 18,687	$ 0
Administration Cost -Network	$ 7,687	$ 8,071	$ 8,475	$ 8,899	$ 9,344	$ 0
Backup Costs						
Backup Equipment Costs (Tape Drive	$ 1,518	$ 1,594	$ 1,674	$ 1,757	$ 1,845	$ 0
Backup Software Costs	$ 152	$ 159	$ 167	$ 176	$ 185	$ 0
Backup Software Support Costs	$ 6	$ 6	$ 7	$ 7	$ 7	$ 0
Tape Media Costs	$ 3,123	$ 3,279	$ 3,443	$ 3,615	$ 3,796	$ 0
Cost of Storage						
Cost of Storage	$ (71,176)	$ (74,735)	$ (64,058)	$ (52,848)	$ (41,077)	$ (0)
Storage power and cooling	$ 12,202	$ 12,812	$ 13,452	$ 14,125	$ 14,831	$ 0
Cost of End-point protection						
Antivirus & Monitoring agent	$ 31,935	$ 33,532	$ 33,532	$ 33,532	$ 33,532	$ 0
	$ 1,370,540	$ 1,439,067	$ 1,523,757	$ 1,612,682	$ 1,706,052	$ 2

FIGURE 27 COST BENEFIT ANALYSIS

The Cost-Benefit-Analysis identifies the areas where the cloud project has advantages such as hardware and facilities costs and disadvantages such as cost of software.

Using the numbers from the previous sections for all the tangible benefits, the key metrics identified in 2.3 Measurements for the potential cloud adoption project of the manufacturer can be calculated.

	Period					
Undiscounted Cash Flows	**0**	**1**	**2**	**3**	**4**	**Totals**
Cash In: Benefits in $ M	0.137	1.151	1.371	1.613	1.706	5.978
Cash Out: Costs in $ M	1.429	1.429	0.873	-	-	3.732
Net Cash Flow in $ M	(1.292)	0.278	0.498	1.613	1.706	2.246

"*Cash In*" is measured by quantifiable benefits that are derived by the investment, "*Cash Out*" is measured by all costs and expenses needed to support the investment. "*Net Cash Flow*" is the

difference between "*Cash In*" and "*Cash Out*". In the first year the cash flow is negative, but in the second year the cash flow turns slightly positive and is increased in the years after.

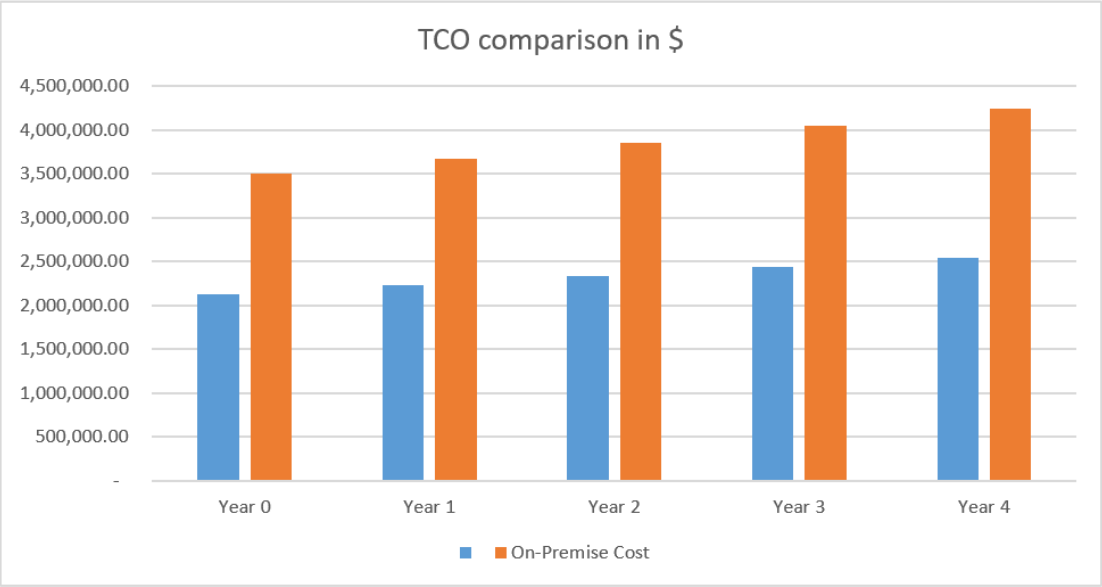
The weighted cost of capital (WACC) is calculated for the organization at 8.5%. The table below has all cash flows (in and out) discounted by the WACC.

	Period					
Discounted Cash Flows	**0**	**1**	**2**	**3**	**4**	**Totals**
Discounted Cash In in $ M	0.137	1.061	1.165	1.263	1.231	4.857
Discounted Cash Out in $ M	-1.429	-1.317	-0.742	0.000	0.000	-3.489
Discounted Net Cash Flows in $ M	-1.292	0.256	0.423	1.263	1.231	1.368
Cumulative discounted NCF in $ M	-1.292	-1.549	-1.125	0.137	1.368	

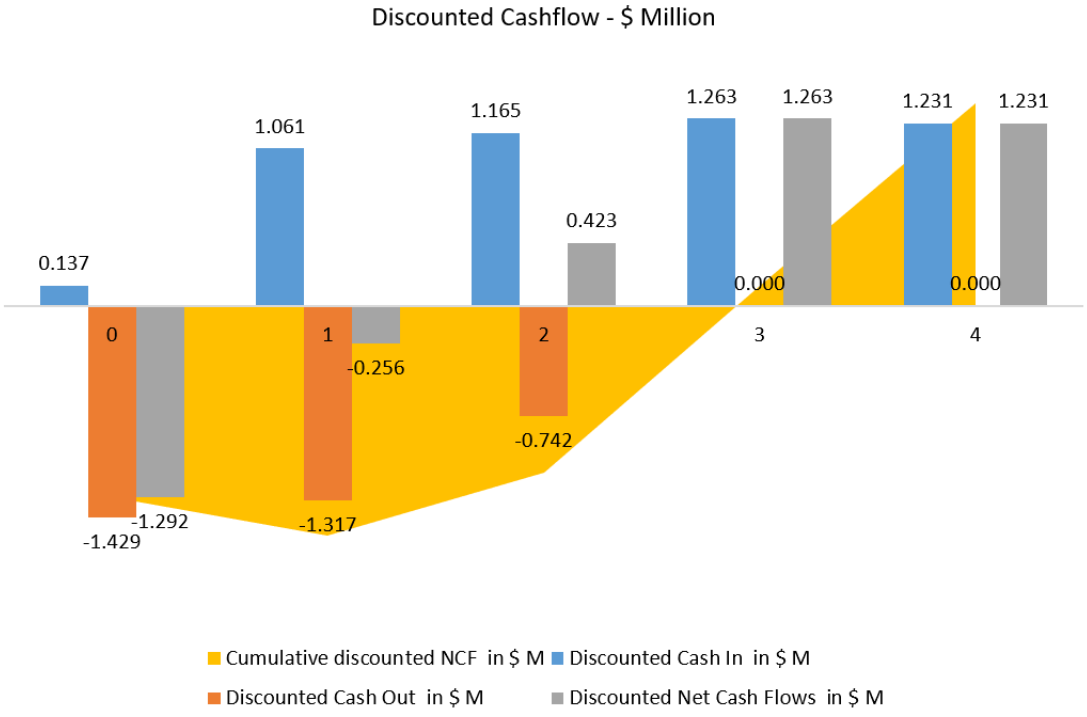
The manufacturer's project has a total cost of ownership (TCO) of about $3.5 million and a total benefit of $4.8 million. The NPV of the investment is calculated to be $1,260,963.43. The IRR is 33% and the discounted payback periods is about 35 months (within almost 3 years the investment is payed back).

Business Case – Summary	
Total Benefits in $ M (undiscounted)	**5.978**
Total Sum invested in $ M (undiscounted)	**3.732**
Net Present Value of Investment in $ M	**1.261**
Internal Rate of Return	**33%**
Discounted Payback Period in Months	**34.68**

The yearly TCO compared between the current, on-premises data center and the cloud cost are visualized below:



Overall, the project for the manufacture would generate significant benefits for the company and can be rated as positive. Nevertheless, other options, such as different cloud service models or architectures, could be analyzed and compared as well.



3.5.4.1 Sensitivity Analysis

As shared in chapter 2.3.9 Sensitivity Analysis it is critical to understand the impact of each variable to see how much a change could cause a different result and turn this project negative. For a sensitivity calculation, the case is made that the benefits seen from adopting cloud is reduced by 20 per cent and in another case the costs are increased by 20 per cent. The following outcomes have been calculated:

a) Cost of migration is 20% higher than assumed:

	Period					
Undiscounted Cash Flows	**0**	**1**	**2**	**3**	**4**	**Totals**
Cash In: Benefits in $ M	0.137	1.151	1.371	1.613	1.706	5.978
Cash Out: Costs in $ M	1.715	1.715	1.048	-	-	4.478
Net Cash Flow in $ M	(1.578)	(0.564)	0.323	1.613	1.706	1.500

b) Benefits of migration is 20% less than assumed:

	Period					
Undiscounted Cash Flows	**0**	**1**	**2**	**3**	**4**	**Totals**
Cash In: Benefits in $ M	0.110	0.921	1.097	1.290	1.365	4.783
Cash Out: Costs in $ M	1.429	1.429	0.873	-	-	3.732
Net Cash Flow in $ M	(1.320)	0.508	0.224	1.290	1.365	1.051

The result of the sensitivity analysis shows that the NPV changes significantly in both cases. In a scenario where the costs are increased by 20 per cent, the NPV and IRR drops, but less than if the benefits of the investment are decreased by 20%.

Business Case – Summary		**Cost + 20%**	**Benefits -20%**
Total Benefits in $ M (undiscounted)	**5.978**	**5.978**	**4.783**
Total Sum invested in $ M (undiscounted)	**3.732**	**4.478**	**3.732**
Net Present Value of investment in $ M	**1.261**	**0.62**	**0.37**
Internal Rate of Return	**33%**	**19%**	**16%**
Discounted Payback Period in Months	**34.68**	**41.52**	**43.2**

The result of the sensitivity analysis shows that the NPV changes significantly in both cases. In a scenario where the costs are increased by 20 per cent the NPV and IRR drops, but less than if the benefits of the investment are decreased by 20%. In both

cases, the NPV was still positive and it showed that a significant change in either costs or benefits won´t change the NPV into a negative number.

3.5.4.2 Monte Carlo Simulation

Furthermore, I have used the Monte Carlo simulation to model the probability of different outcomes with a total of 1,000 random cases, each year both costs and benefits could go up and down independent of the previous year. Based on that assumption and a sample size of 1,000 cases the results are:

Activity	Year 0	Year 1	Year 2	Year 3	Year 4	NPV
Base	(1,319,695)	(508,336)	223,814	1,290,145	1,364,841	$396,812
Distribution	300,000	100,000	100,000	300,000	300,000	
Bottom	(1,619,695.00)	(608,336.00)	123,814.00	990,145.00	1,064,841.00	($831,644)
Top	(1,019,695.00)	(408,336.00)	323,814.00	1,590,145.00	1,664,841.00	$1,625,268
Deviation (Variable)	25%	25%	25%	25%	25%	

The data above uses the base scenario from the case described with 5 years of investment gains/losses. Using a variable deviation leads to a bottom and top case (highest loss/gain assumed, lowest loss/gain assumed), including a highest and lowest NPV (assuming that the top and bottom numbers wouldn´t deviate even more than what was assumed).

Using the rand() function in Excel 1,000 cases were generated for each year, independent of each other. That means that even if year 0 was even worse than the base case, any other year could be significantly better than the base case. Picking one of the 1,000 cases to demonstrate the independence of each year and its random cases, in year 0 the costs were at $1,537,932 and therefore 16.5% higher, while year 1 was actually close to the base case ($516,941; 1,7% difference) and compared to that in year 3 the investment returned 17% less than the base case ($1,070,451).

Each year had a 1,000 test cases and all 5 columns produced a normal distribution as shown in the histograms below:

Year 0

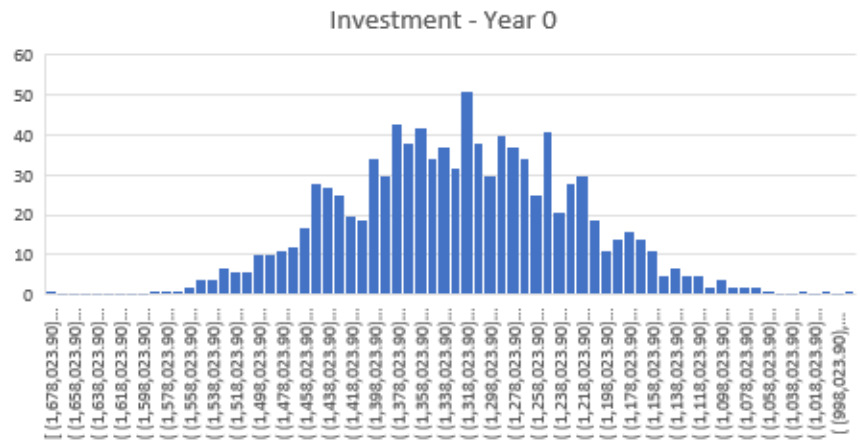


FIGURE 28 YEAR 0 DISTRIBUTION

Year 1

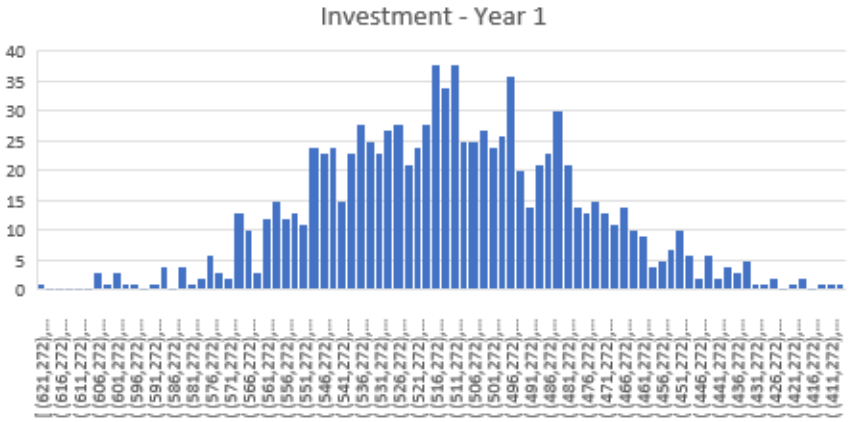


FIGURE 29 YEAR 1 DISTRIBUTION

Year 2

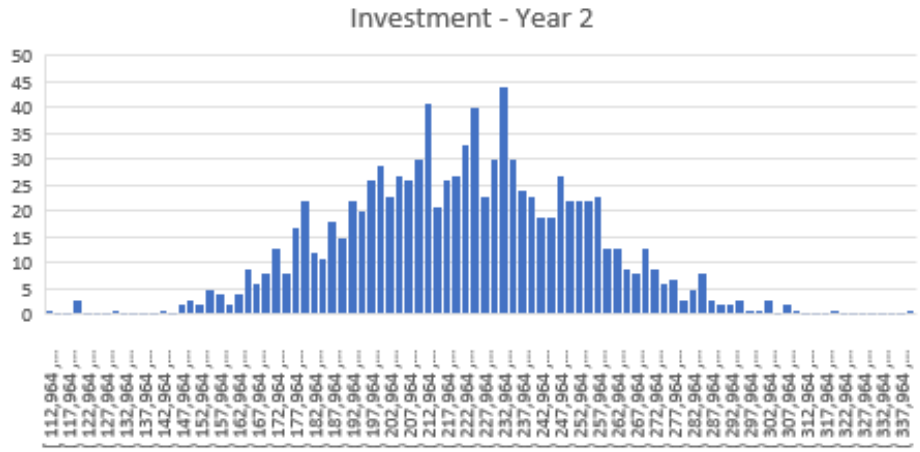


FIGURE 30 YEAR 2 DISTRIBUTION

Year 3

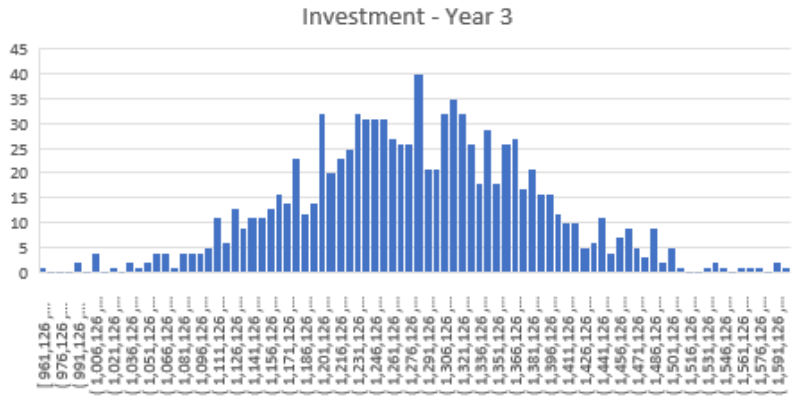


FIGURE 31 YEAR 3 DISTRIBUTION

Year 4

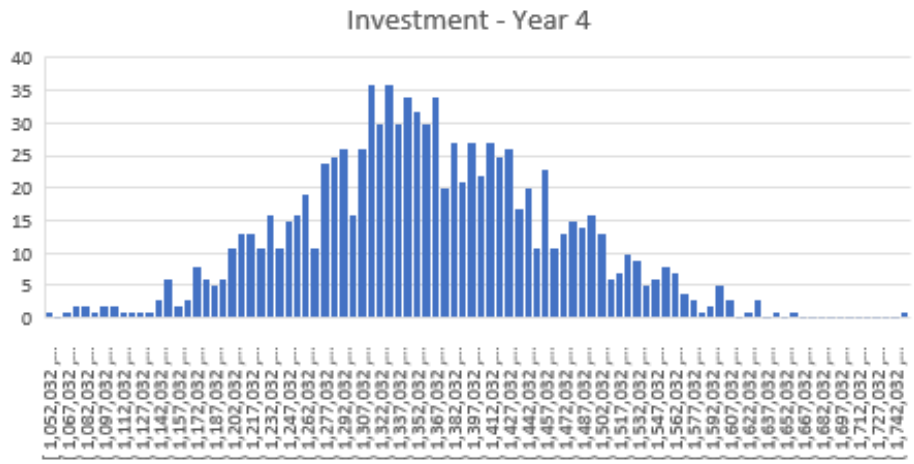


FIGURE 32 YEAR 4 DISTRIBUTION

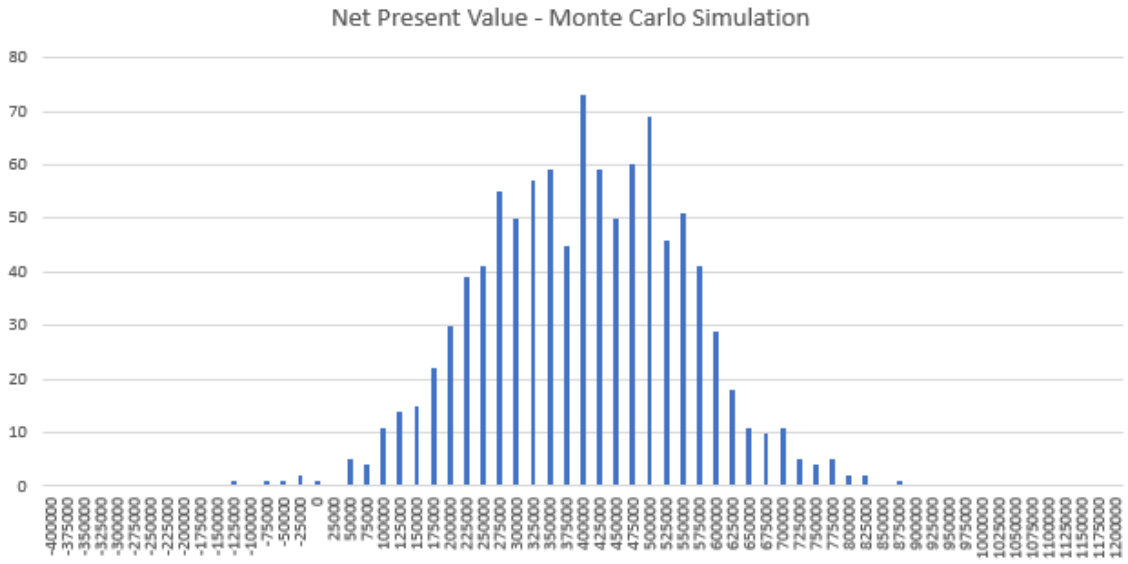
For each case, the Net Present Value (NPV) and the probability of having a negative NPV was calculated. The probability of a negative NPV for a 25% deviation in each year´s cost/benefit was about 0.6%. After 20 runs of 1,000 random cases, this never went above 0.90%.

After that the deviation for each year was changed a few times to find out at which stage the chances of having a negative NPV would increase significantly. The results are shown in the table below:

Year 0	**25%**	**45%**	**50%**	**30%**
Year 1	**25%**	**35%**	**25%**	**10%**
Year 2	**25%**	**35%**	**25%**	**10%**
Year 3	**25%**	**35%**	**25%**	**10%**
Year 4	**25%**	**35%**	**25%**	**10%**
Probability >0	99.40%	91.50%	94.10%	99,60%
Std.Dis	$154,623.17	$281,657.27	$263,582.64	$141,205.09
Min	($132,975)	($530,079)	($666,728)	($111,362)
Max	$864,484	$1,374,389	$1,330,834	$841,108
Mean	$397,114	$390,692	$399,776	$394,647
μ - 3σ	99.7%	99.7%	99.7%	99.7%
μ + 3σ	99.7%	99.7%	99.7%	99.7%

TABLE 2 PROBABILITY OF POSITIVE NPV FOR DIFFERENT DATA SETS

Overall the Net Present Value of the investment for the Monte Carlo simulation using 25% deviation in each year lead to a normal distributed NPV histogram below:



The Monte Carlo simulation was used to model the probability of different outcomes in a process that cannot easily be predicted due to the intervention of random variables. The deviation of the assumed costs/benefits for each year of the investment was set to different values to demonstrate the impact on the NPV and the probability of having a positive NPV that would support the decision of starting the cloud adoption project.

4 IMPACT ON FINANCE

4.1 Overview

In this chapter, I will describe the impact that cloud has on finance and specifically the role of a CFO. This section explains why cloud potentially changes the expectations and activities of a CFO and which measurements

More and more it is critical for many roles within a company to understand the impact of IT investments such as cloud computing and make sure they are not decided purely on whether a spending can be capitalized or not, but other criteria are considered as well. In a whitepaper, EY claims that CFOs who understand cloud technology, as well as the associated challenges and risks, are better placed to manage the impact of cloud computing on the finance function and potentially gain a competitive advantage over less informed competitors. Moreover, CFOs must engage an agile innovation strategy focused on deploying the right operating model in order to realize fully the benefits of cloud computing. Christian Mertin, an advisory partner at Ernst & Young believes, "*In order to truly comprehend and realize the benefits that cloud computing brings, finance decisionmakers must understand and determine the right blend of cloud models*" (When finance moves into the cloud, will CFOs sleep better at night?, 2015).

Financial leaders face rapidly changing market and economic conditions. They must become a strategic partner in a company and play a significant role in an organization's decision-making process, its strategy and its program delivery. The CFO is now expected to be a key strategist and leader, shape overall strategy and direction, and act as an agent of change who can instill a performance-driven culture throughout the company. Embracing cloud can catalyze behaviors across the organization and to execute strategic and financial objectives, while diligently creating a risk intelligent culture. (CFO Insights - Is the cloud within your reach?, 2013)

Reducing cost and complexity can only achieve so much and do little to deliver sustainable value. The goal of a CFO is "*to deliver not just efficient services, but – more importantly – effective services as well*". Simply put, value comes from services and processes that enable the business to better achieve its long-term objectives. The more efficiently and effectively these services are, the more value is driven into the organization. (Transforming Finance - Challenges and breakthrough solutions for CFOs, 2011)

"*As CFOs increasingly take over responsibility for their companies' IT investment strategy, they are looking at the benefits of cloud computing to deliver business value in the form of improved business processes – especially those able to increase operational efficiencies and support new growth initiatives.*" (The New Competitive Advantage - Strategic CFOs Embrace the Cloud, 2012)

When we try to understand the finance point of view on the cloud, it is important to keep in mind that there are distinct roles in finance:

- Chief Financial Officer (who oversees all finance)
- Accountant (who drives statutory and tax reporting amongst many other tasks)
- Analyst (who is in charge of managerial analysis)

4.1.1 Accountant

An accountant not only prepares the financial statements, but also provides analytics on important indicators such as taxation, EBITA, RoA and asset turnover. For any accountant, the choice between cloud and on-premises is frequently about an OpEx vs CapEx discussion.

Taxation is very dependent on specific situation such as the country and its regulatory requirements and laws. Yet, in general if corporate income tax is considered, usually it is in favor of cloud (OpEx), because typically the company is not allowed to depreciate hardware/software as fast as it wants for taxation purposes and cloud expenses are fully recognized as taxable expense, lowering as such the taxable base. Comparing purchasing cloud service versus purchasing equipment and software shows that cloud has its benefits for cash flow (OpEx).

EBITDA (Earnings before Income Tax, Depreciation and Amortization) can be used to analyze and compare profitability between companies and industries because it eliminates the effects of financing and accounting decisions. EBITDA first came into common use with leveraged buyouts in the 1980s. As time passed, it became popular in industries with expensive assets that had to be written down over long periods of time. EBITDA is a good metric to evaluate profitability but not cash flow. EBITDA also leaves out the cash required to fund working capital and the replacement of old equipment, which can be significant. EBITDA is a non-GAAP (Generally accepted accounting principles) measure that allows a greater amount of discretion as to what is and what is not included in the calculation. This also means that companies often change the items included in their EBITDA calculation from one reporting period to the next. While evaluating EBITA, on-premises investments mean an increase of volume of assets while cloud services do not imply any depreciation or amortization. For some situations, such as an upcoming Initial Public Offering (IPO), this might seem beneficial. At the same time, an accountant should be critically evaluating the quality of assets. Usually the right approach is to consider only the assets related with the primary company activity, which often is not the case considering hardware/software purchases.

Return on Asset (RoA) is one of the key performance indicators (KPI) and shows the return on every dollar invested in assets of the company and gives investors an idea of how effectively the company converted investment into profit. Obviously, choosing the Service IT model versus on-

premise lowers the company's assets (in a perfect world limiting them to only the assets related to primary activity of the company), hence the RoA is better if cloud services are used.

Like RoA also **Asset Turnover** by design is in favor of the cloud. This activity indicator shows the value of a company's revenue generated relative to the value of its assets. This indicator can often be used to define the efficiency with which a company is deploying its assets in generating revenue. Liquidity rations such as the Current Ratio are in favor of the cloud IT model too, for the same reasons covered earlier in the section about cashflow. Less money outflow means better liquidity.

4.1.2 Analyst

Analyst usually compares cloud with on-premises as two IT infrastructure upgrade projects and selects the most beneficial one by comparing money inflows and outflows, using indicators like NPV (net present value), IRR (Internal Rate Return) or TCO (Total Cost of Ownership) and others described in section 2.3 Measurements. While it is usually more complex for analysts to quantify and compare the inflows, for cost comparison the TCO (total cost of ownership) models can be leveraged.

4.1.3 Chief Financial Officer

As companies increasingly adopt cloud solutions, executives will need a greater understanding of how the Cloud impacts Revenue Recognition, Operating Expenses, Fixed Assets, Taxes and Performance Management. Cloud computing radically changes operating models and finance must be able to model new impacts on revenue, profits, and operating margins, as well as the risks of exposing services in the cloud. Cloud computing will impact finance's processes for investing in, monitoring, and depreciating IT assets. Using cloud services will impact sales and use tax obligations.

The CFO looks for a solid return on investment, by evaluating potential investments, whether it is an acquisition or a capital investment. The goal for every CFO is to understand the ROI including timeline and numbers. Another important topic for the CFO is to identify and drive growth through the efficient use of available resources. Understanding competition, identifying key metrics and developing strategic initiatives for sustainable future growth are important topics for a CFO.

Since Chief Financial Officers (CFO) look at the long-term picture by driving forward-looking forecasting and strategic decision making, there are some key questions and risks that need to be addressed.

Some key questions a CFO needs to ask:

- How do I manage the unpredictability of costs in a pay-as-you go model?
- What are the implications of moving to a service model from an accounting and tax perspective?
- How can IT costs reflect the needs of individual business units?

In terms of performance management, a CFO sometimes lacks insight into the cost of cloud services, compared to traditional IT models, and new margin structure for services models (subscription based) instead of software licences. These can all impact the effectiveness of enterprise performance management. Another challenge for the CFO is cost control for "*shadow*" IT, since IT could never be purchased easier than today. Essentially a credit card is everything needed to provision common IT services in the cloud to run applications or other services. Uncertain tax laws and regulations and the impact to determine nexus that could be interpreted differently depending on country and state, is creates risk for the CFO of an organization as well. (Insights into the Cloud for finance and accounting professionals, 2013)

4.2 Forecasting

The role of a CFO is to manage cash flow and establish proper controls and guidelines. In the past, for an on-premises datacenter and other IT investments, organizations and finance departments developed a good sense of requirements, and their costs. Due to the nature of IT investments being high capital expenses, most if not all, on-premises costs were known upfront and could be depreciated over a known period of time.

Today cloud costs seems to be unpredictable, and much harder to track since they are OpEx driven costs and the flexibility and agility of cloud makes the costs more volatile. That is a significant problem for many finance leaders. They need visibility into cloud costs, drive accountability and establish governance processes and guidelines for their organisations.

While the pay-as-you-go concept sounds great in principle, it can cause surprises for finance, if for example, the usage of a certain service increases. Having little information about future usage, capacity and costs, can provide potential barriers for cloud adoption.

Some questions finance should ask:

- What are the cloud cost in three years when usage will increase?
- How can growth planning and capacity planning be established and reduce or eliminate surprises?

While many cloud providers offer tools that help to calculate cloud costs, such as the *Pricing Calculator from Microsoft*[8], most of them operate on an as-is basis and do not include predictions or models of future consumption or costs, demand peeks or time where resources are not needed at all.

The components that impact the total costs for cloud computing depend on the cloud model and the provider. Platform-as-a-Service has different components of costs than Infrastructure-as-a-Service. Leveraging the cloud as a data platform, and for example, running an SQL Server database, results in a basic hourly price for the virtualized hardware for the platform, storage costs and memory. The better the required hardware, the higher the hourly price. Additionally, there are charges for transactions and additional storage that can be purchased. Whereas for an Infrastructure-as-a-Service offering, such as a virtual machine, the costs are for computing, storage, and memory is an hourly rate. Besides the hourly price additional storage or network, resources can be purchased.

All offerings have in common that the overall costs depend on the requirements of the service (quality of services, availability, etc.), the time it is used and – indirectly – how many users are connected or using the resources. If the number of users increases, which could mean either an increase of customers and revenue, or an increase of internal users, the requirements might change. In this case, improved hardware, with more compute power or additional transactions, is needed. These additional requirements would drive up costs.
Similarity, the quality of service will have an impact on the costs as every resource can also be consumed in high-available environments for production and more critical scenarios such as an online gaming solution where downtime means a miss opportunity of revenue, but it could also be used in less critical scenarios such as development environments where downtime is less important.

The last criteria that impacts cost is the time that the resource is being used. For development environments, resources are frequently not used 24 hours per day and can be decommissioned for a few hours every day or on weekends. Another common scenario are peak demands where additional resources are consumed but could be decommissioned for most of the time and regular usage [I'm not sure I understand the point]. This could reduce the total costs of cloud computing.

[8] https://azure.microsoft.com/en-us/pricing/calculator

Finally, the prices of each cloud resource can be changed by the cloud provider, and hence, the costs may increase, or even decrease. While those changes are announced prior to being effective, it is unlikely that those price changes will drive a change of an organization´s cloud provider, and hence, will much impact on the cloud costs. These prices are hard to control or forecast, but it is also unlikely that the costs will go up, the past has shown that there is a downward trend and prices were usually reduced.

RightScale Inc. tracks a broad range of public cloud providers and their prices over several years. Overall, many prices decreased, and the average reduction has been in the double digits within a single year (see Figure 33 Average Size of Reductions by Cloud Provider). But a more recent blog post from November 2017 showed that the reduction of prices continued, with 70 percent of most common 104 price points have gone down between April and November in 2017. Besides the public available price points, it is important to understand the discount options each provider offers to its customers. For customers committing to usage on cloud providers, discounts of up to 75% (such as Azure Reserved Instances) are frequently offered.

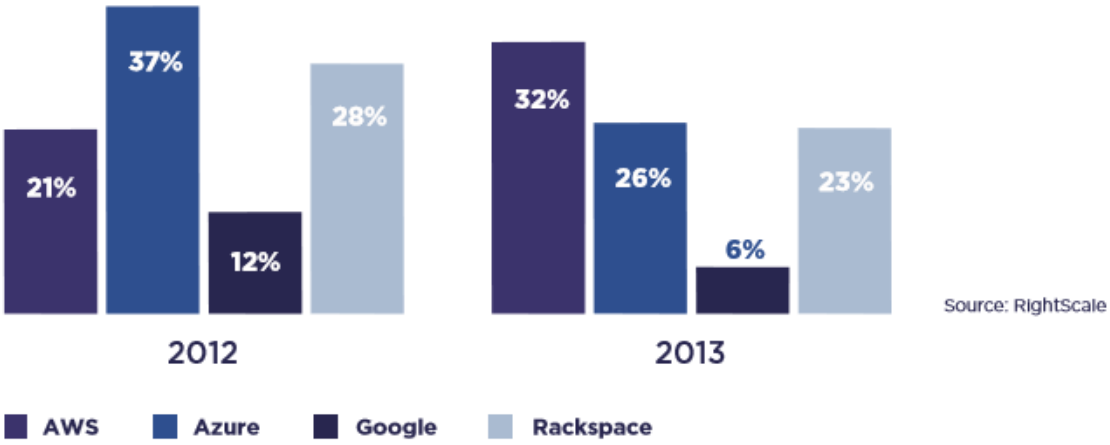


FIGURE 33 AVERAGE SIZE OF REDUCTIONS BY CLOUD PROVIDER

Through 2015, some observers were even talking about a "*price war going on in cloud computing*" (This One Chart Shows The Vicious Price War Going On In Cloud Computing, 2015), but in the more recent years that has slowed down, as Barb Barrow from Fortune reported (Cloud Cost Cuts Simmer Down, 2016)

4.2.1 Methodology

"*Forecasts should be accurately enough for a significant number of clients in regard to that there is a decrease of uncertainty not a transition into a different kind of uncertainty, being the*

uncertainty of the accuracy of the forecast. Furthermore, a forecast should be accurately enough that the variance of the prediction is not greater than the range of uncertainty." (Ingen, 2012)

In his paper, "*Cloud Costs Forecasting*", Ingen described two distinct methods of forecasting, judgmental and statistical. This is based on the methodology tree for forecasting by J. Scott Armstrong and Kesten C. Green. (Armstrong & Green, 2014). The Methodology Tree for Forecasting classifies all possible types of forecasting methods into categories and shows how they relate to one another.

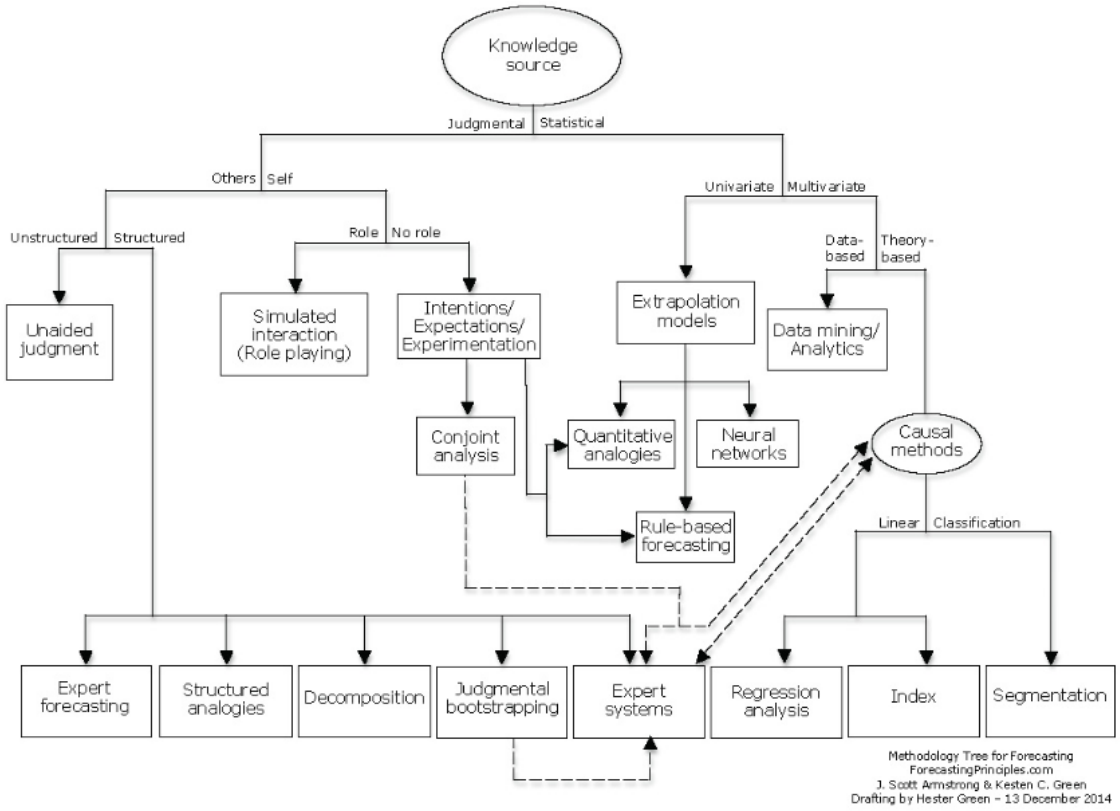


FIGURE 34 METHODOLOGY TREE FOR FORECASTING

Judgmental forecasting is used in cases where there is no quantitative data available and includes opinions and subjective probability estimates. This approach is very common for the scenario of a new product or services and where there is a complete lack of historical data. This section will focus on the latter, statistical forecasting using quantitative analysis of dependencies between variables.

For statistical forecasting multiple methods and approaches can be used. This section will cover the most common forecasting methods, regression analysis and extrapolation.

Regression analysis is a way of mathematically sorting out which variables does indeed have an impact on the variable of variable of interest, i.e., the dependent variable. (Ingen, 2012). Understanding the potential variables that impact forecasting is critical, and it requires both organization internal knowledge and data as well as market data such as cloud provider data, and market environmental factors. There are regression-based analytic models for capacity planning of multi-tier applications.

Linear regression has its boundaries with prediction of resources as Mark Chamness has demonstrated in his paper "*Capacity Forecasting in a Backup Storage Environment*". Figure 36 shows an example where data indicates the system reaches 100% capacity within a few days, but the regression line predicts a longer timeframe. In a cloud world, that would not likely happen, but still would require administrative activities such as, provisioning additional cloud storage (or it could be automated).

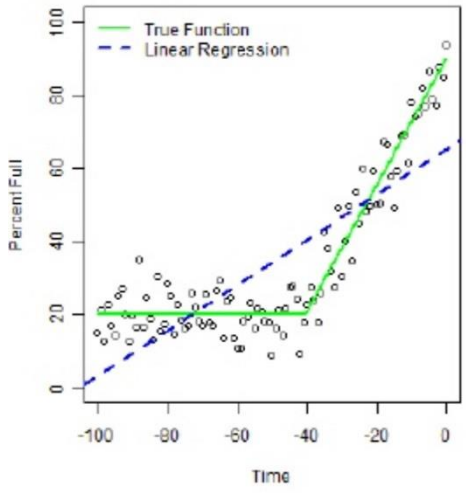


FIGURE 35 EXAMPLE CAPACITY DATA FOR THE PRIOR 100 DAYS. (TIME = 0 IS THE MOST RECENT DATA.) THE STANDARD DEVIATION IS 6 THROUGHOUT THE DATA. THE BLUE LINE SHOWS THE RESULT OF APPLYING LINEAR REGRESSION TO THE ENTIRE DATA SET

Using piecewise linear regression could help identifying the right data subset that best represents the most recent behaviour. In order to find the best subset of data, the boundary must be determined where the recent behaviour begins to deviate. Figure 36 shows that analysing the quality of many linear regressions has a positive impact on the outcome.

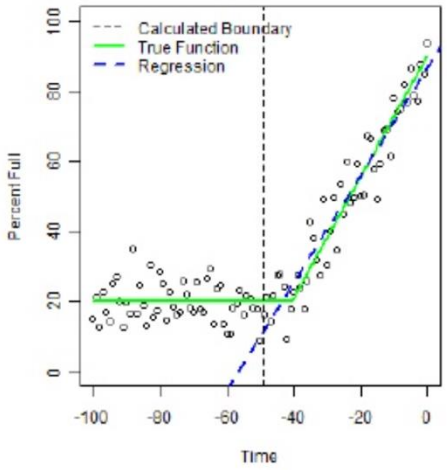


FIGURE 36 PIECEWISE LINEAR REGRESSION RESULTS IN A BETTER FIT TO THE DATA

The challenge with linear regressions are unforeseen human activities, such as changing the retention policy for storage. This has a significant impact on the usage and any projection since these false positives are almost impossible to consider in any model.

The other popular method to forecast future costs is called extrapolation. This approach uses historical data to do short-range or long-range forecasting. It constructs new data points outside existing ones; ideally timely and accurate data is used. A method that weighs recent data more heavily than older data is exponential smoothing. Another important criteria to make extrapolation work is the relationship between past occurrences and future occurrences. If there are patterns from the past that are expected to happen recur, forecast accuracy is likely to improve.

"*Historical data are useful for extrapolation if they are timely and accurate, and if the underlying process is expected to be stable in the future. If historical data are not available, a situation that occurs for large changes, one might examine historical data from analogous situations. If analogous situations do not exist, it may be necessary to use simulated data from either laboratory or field tests. Exhibit 7-1 ranked these four types of data (historical, analogous situations, laboratory simulation, and field test) as to appropriateness for estimating current status and for making short-range and long-range forecasts. Rankings were also provided on cost and the effects of researcher bias. The method of Markov chains has been widely studied. It seems appropriate when there are various states of behaviour that are related to one another. Unfortunately, little evidence could be found that Markov chains provide more accurate forecasts.*" (Long Range Forecasting - From Crystal Ball to Computer, n.d.)

4.2.2 Cloud Forecasting

In the past, on-premises datacenters cost projections and demand where estimated through a capacity management methodology. Leveraging regression analysis and other mathematical approaches, cloud has changed that methodology.

"*Cloud requires a different capacity management process to that used for traditional, on-premises IT services.*" (Rainshtein, 2017). Capacity management in the cloud is much more granular and move from long-range to the short-range planning.

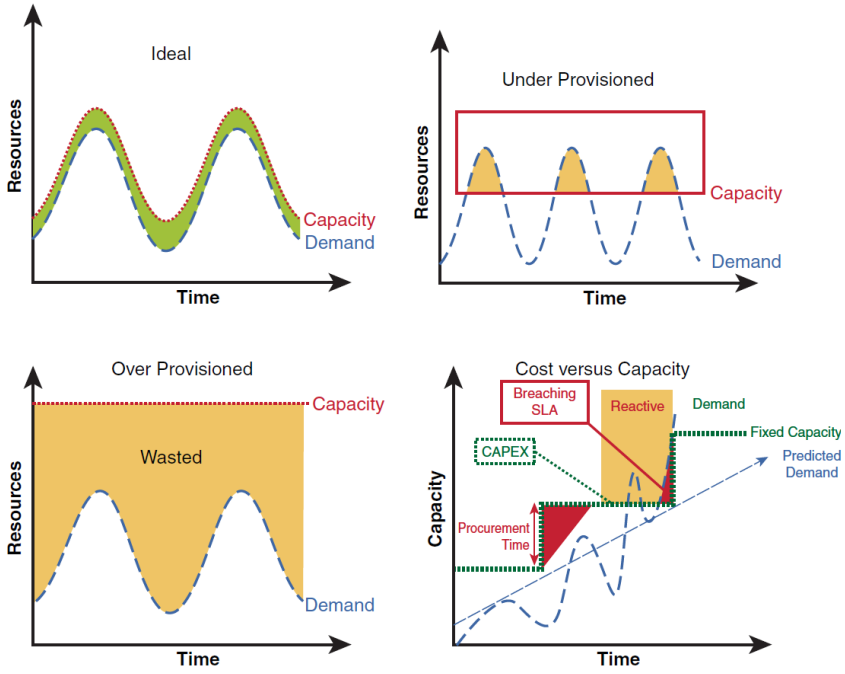


FIGURE 37 CONSEQUENCES OF CAPACITY MANAGEMENT[9]

While it took something between nine-to-twelve months to design, procure and deploy a reasonable complex on-premises system with a lifetime of three to seven years. That used to be the planning cycle for capacity managers, but today cloud has significantly impacted that process, since demand can be easily fulfilled within few minutes rather than months. Still longer predictions should be used to avoid costs using reserved cloud capacity, but the goal is financial efficiency and not unfulfilled demand.

[9] "*Cloud Computing: Automating the Virtualized Data Center*", Venkata Josyula; Malcolm Orr; Greg Page, 2012

The entire speed of change has increased significantly since scaling up or down is a few clicks away in a cloud world, whereas for on-premises, that could take months to add system resources and, sometimes, it was not even possible due to the system architecture. (Rainshtein, 2017)

4.2.3 Cost Management

As cloud adoption spreads across the enterprise and the complexity of cloud environments grows, it is becoming more and more difficult for stakeholders to have full visibility into cloud expenditures and utilization rates. A lack of visibility and insight into cloud usage and costs almost certainly leads to unnecessary spending and reduced confidence. IT executives need to better understand cloud spend across the company to ensure they are making the most of the budget before they ask for more budget and finance needs to improve forecast accuracy of cloud spend and drive more accountability from project owners across the company.

Cost management helps optimize cloud spending by tracking cloud usage and expenditures. As a result, it identifies underutilized resources that can be adjusted (e.g. deprovisioned) to save costs. Monitoring usage and spending is critically important for cloud infrastructures because organizations pay for the resources they consume over time but leveraging thresholds agreements could provide information that usage is in excess.

Projecting costs based on average usage assumes that an organization's consumption remains consistent over a given billing period. Instead of using the average usage of previous months, it is critical to understand usage patterns as well as other organizational triggers for a significant change such as, a new product release, a new marketing campaign or new features with new or additional cloud resources requirements.

4.2.4 Designing Growth Patterns - Permanent vs. Temporary

One way to plan growth in applications and resource demands is analysing usage using past patterns and employing algorithm to predicts what may happen in the future through interpolating.

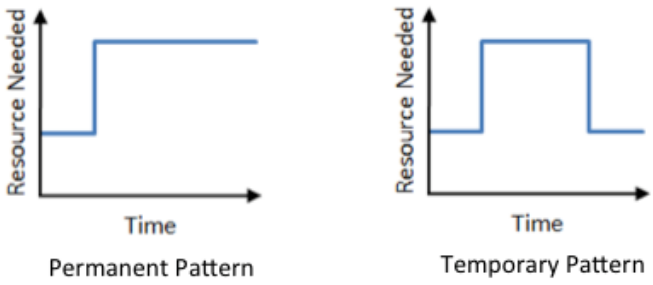


FIGURE 38 GROWTH PATTERNS

Rightscale has defined patterns to be permanent or temporary. A permanent pattern does not change over time, but a change in the baseline number of resources such as, adding additional virtual machines to address an additional demand (e.g. an increase of permanent users of a system) [I'm not sure I understand this]. A temporary pattern lasts only for a certain duration and at the end will return to its original usage. An example of a temporary pattern is a peak demand for year-end calculations, or a ticket sale for a concert that requires additional resources for a short period of time.

There are several other different growth patterns such as constant growth for increasing number of users, seasonal growth such as holiday shopping season during Christmas or lifecycle growth for a new product launch and marketing activities that last for a few weeks or months. (Hosseini, 2013)

4.2.5 Tools

Forecasting is important for planning purposes, and cloud makes the process of projecting the future cost for IT services much more agile and the amount of data that is needed to successfully do forecasting has increased exponentially. Tools that allow tracking and managing historical, current, and forecasted cloud costs, access to billing reports, monitoring cloud usage and the capability to establish governance policies is a must for successful planning. Ideally tools exist that allow a company to leverage multiple cloud providers, since many organizations will use more than just one cloud provider.

All major cloud providers support finance with basic reports, dashboards and data for usage. For example, Microsoft provides a tool, Microsoft Azure Cost Management, also known as Cloudyn, that helps managing cloud spend across an organization and supports other cloud providers too.

4.3 Role of CFO and Financial Department

According to Mark Tucker and Morris Treadway from KPMG, Chief Financial Officers are facing many challenges in today´s world of disruption and technology. Treadway, the Global Head of Financial Management Advisory, KPMG, based in the United States, says that it´s "*not a time for CFOs to apply 'safe' thinking*" and that many typical financial tasks become more automated and CFOs must shift their focus on technology and embrace robotic processing, artificial intelligence, owning enterprise performance management data and analytics, and building business partnering skills. (Tucker & Treadway, 2017)

And disruption is no longer an abstract concept but rather reality for many industries. In the article "*Disruption need not be an enigma*", Accenture states that business leaders often think disruption is beyond their control and 93 percent of executives say they know their industry will be disrupted at some point in the next five years and only 20 percent feel they are highly

prepared to address it. But there is a pattern for disruption and Accenture has created an index that helps it understand the industries. (Abbosh, 2018)

Assuming that disruption is happening, the strategic position of a CFO´s role is increasing, they are critical to helping businesses survive and play an integral role in the success of their business by supporting innovation. But CFOs not only manage disruption, they also have to identify and invest in the business models, products, and services that will lead to sustainable, profitable growth. Treadway thinks "*CFOs need to think more like venture capitalist*". CFOs are required to drive evaluation, allocation and monitoring of strategic investments in new platforms, customers and products.

Deloitte has created a framework "*Four Faces of the CFO*" that undermines their thinking that today's CFOs are expected to play four diverse and challenging roles. (Deloitte, 2016)

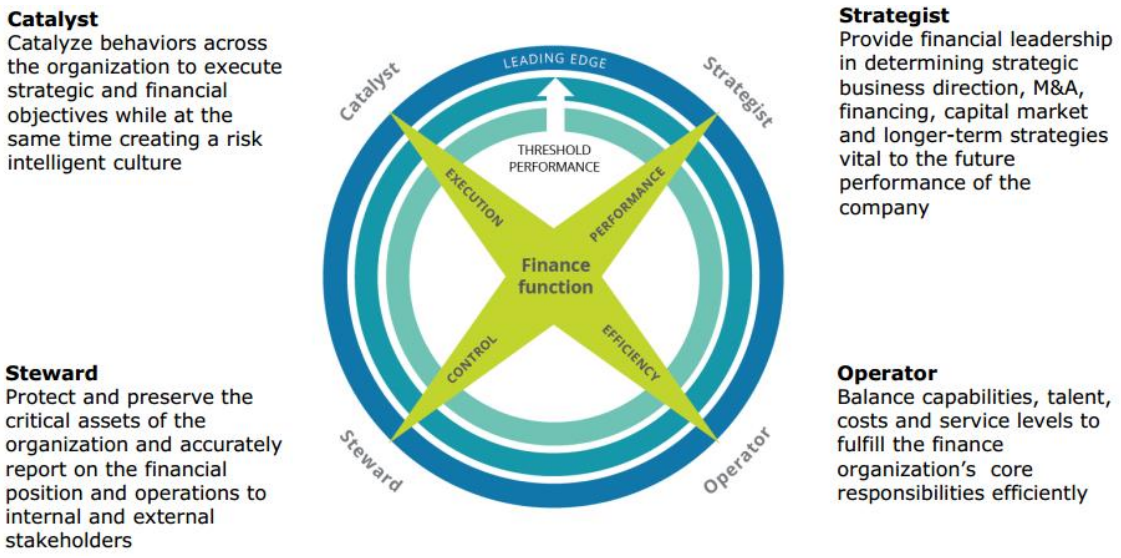


FIGURE 39 DELOITTE´S FRAMEWORK "FOUR FACES OF THE CFO"

The specific implications for cloud computing for those 4 faces are:

Catalyst: cloud computing may shift behaviours to allow users to choose technology features that provide most impact to the business.

Strategist: Cloud computing may shift to increased data analytics and value generation.

Operator: cloud computing may help enable the finance organization's ability to partner with the business and smoothen technology expenses and cash flow

Steward: cloud computing may give rise to additional data and transmission concerns in order to protect sensitive information.

In addition to overseeing the financial operations of a company, and ensuring compliance with applicable laws and company policies, today's CFO is expected to harmonize growth strategies with financial imperatives, foster accountability, catalyze change, communicate with investors, and implement operational excellence across all business domains. These varied roles make a CFO's job more complex than ever.

2017 CFO Survey from Grant Thornton LLP found that CFOs spend more than a third of their time as strategic advisers, taking on roles well beyond traditional financial management. The study also showed that CFOs want to focus on digital transformation initiatives but cannot do so because they are spending so much money maintaining aging technology. "*The simple truth is that CFOs face an uphill battle when it to comes to adopting technologies like cloud computing and advanced analytics,*" says Mike Ward, national managing principal of Business Consulting & Technology for Grant Thornton. "*And they are feeling a sense of urgency: Nearly half of survey respondents – 46 percent – believe that their IT platforms lack the ability to operate effectively and require future investment.*" (CFOs Spending More Time on Strategic Guidance, 2017)

Tom Powledge, Vice President of Product Delivery at Symantec states that "*CFOs play an integral role in ensuring the organization takes control of its cloud environment to mitigate risk and realize scalability and agility, particularly when any business manager with a corporate credit card can easily acquire new cloud services with the click of a button.*" (Powledge, 2012)

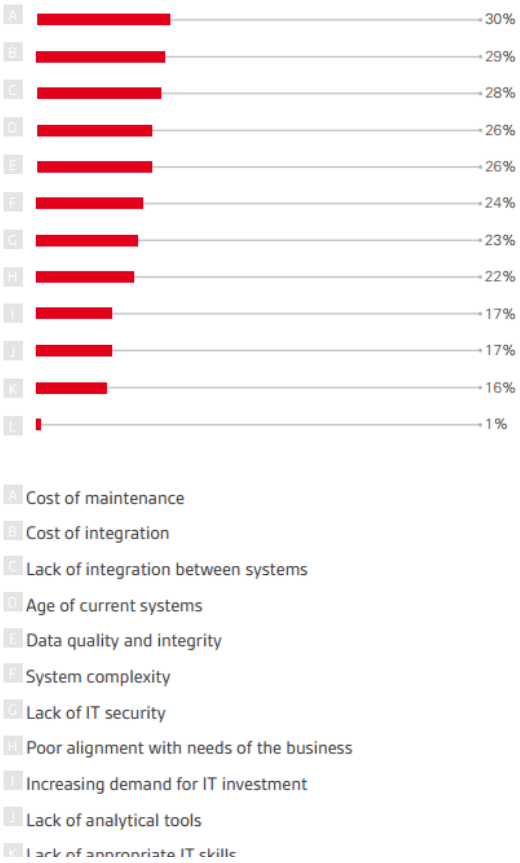


FIGURE 40 WHICH OF THE FOLLOWING ASPECTS OF YOUR COMPANY'S CURRENT

But the reality for many CFOs is that they still must deal with legacy IT systems and keep the lights on for them as well. Longitude Research commissioned by Oracle and Accenture, recently surveyed 930 CFOs across Asia, Europe, Latin America, and North America and found out that poorly integrated and expensive legacy systems are still a concern for CFOs. Cost of maintenance, the cost of integration and the lack of integration between systems, was amongst their top three concerns (see Figure 40). "*Simply dealing with these legacy problems consumes a significant amount of time that might otherwise be better used to implement more innovative technologies, such as cloud computing, mobile, and social, into the business.*" (Mitchell, Ozzimo, & Brennan, 2013)

What is clear from reviewing many reports, surveys and opinions, that CFOs need to get more technically savvy. As cloud computing, and other

technology trends play a greater role in both the cost and growth agendas, better understanding of technology is becoming a critical capability for today's CFOs. As a result, CFOs have become much more closely involved in IT investment decisions and in managing IT infrastructure. Eighty four percent of CFOs say that co-operation between the finance leader and CIO has increased over the past three years.

"*The decision on cloud computing is broader than the information technology department and requires a productive working relationship between the CIO and the CFO. CIOs' and CFOs' alignment through the cloud decision can help them decide where cloud is appropriate for their organization. The approach to determining whether cloud is appropriate involves assessing technology in the context of business purpose and risks.*" (CFOs and CIOs: How do you know when to reach for the clouds?, 2012).

Finance and IT partnerships are strategic in nature and should be part of the overall strategic plan. Anthony Cusimano has developed some best practices in Developing a CFO and CIO partnership that should help addressing common goals that will enable growth, cost reduction, and reallocation of resources to improve growth. (Cusimano, 2013)

- **Develop a Common Understanding of the strategic initiatives**
    - having a common understanding of each other's roles and challenges
    - Shared communication between finance and IT
    - Working together in teams—through weekly meetings and discussion
    - Business plans are developed to target the direction of the business

- **Leverage Technology to Define Performance**
    - performance metrics help teams assess how they stack up against the strategic initiatives.
    - Helping them identify the data model and how to standardize performance measurement can only be achieved through technology
    - CIO can provide a framework for the analysts on the finance team in defining and understanding how they are performing

- **Understanding Each Other's Strengths and Weaknesses**
    - CFO knows what it takes to invest, acquire, manage, and develop business plans for growth and can help execute those plans. The CIO has the experience with the available technology to take those plans and turn them into action and can bring to the table his or her knowledge of ways to simplify and standardize.

- Leveraging the strengths of both the CFO and the CIO
- Developing a true partnership between the CFO and the CIO can be achieved only through communication and

4.4 Tax

Due to the complexity of the topic, this paper will not cover in depth how cloud computing should be taxed and how organizations need to adopt but will provide a brief overview about the current state, and the complexity of current tax regulations.

It is nowhere more apparent, than with cloud computing, that technology is evolving faster than laws and regulations. Many countries' regulations have not kept up with providing clear guidance on how to treat cloud computing usage and transactions. Since cloud by default defy borders and provides global services, it makes, "*determining how they should be taxed – a system traditionally based on physical location – an enormously complicated task.*" (Taxing the cloud - A foggy endeavour, 2014). Cloud computing involves taking assets that the company currently owns and lease them from a cloud vendor, an organization is shifting what was once a capital expenditure and turn that into an operational expenditure. This has an impact on organizational cost structure, but also on tax calculations. "*When it comes to cloud strategy, tax has a valuable strategic role to play, helping to identify potential cost savings, greater return on investment, and enhanced risk management. The key is to make tax planning part of the conversation before any contract is signed for cloud services*" (Ozzimo, 2015)

According to Reid S. Okimoto, National Tax Leader for Emerging Technologies at KPMG in many companies the "*finance department has built a structure to make sure that the company is as tax efficient as possible and when you change that structure around, the company's whole tax strategy can be affected*".

Joe Bollard, Tax Practice Leader from Ernst & Young in Ireland: "*The tax problems with unplanned international investments in the cloud can be quite significant suboptimal investment decisions, unrecorded taxes and surprises affecting the pricing of your product - to name just three. And once your business is on a certain track, it can be very difficult to restructure the model later on.*" (Ozzimo, 2015)

"*If the tax department is not involved early, an organization can end up creating substantial risk and missing out on tax-planning opportunities*," according to Steven Fortier, principal-in-charge of KPMG's US "*tax in the cloud*" initiative. A change to a company's cloud arrangement could make it ineligible for tax benefits, in particular, or it could very easily swing the return on investment of the whole project negative, he notes (Hoffelder, 2012). According to KMPG the tax implications often are not fully considered at the time that the transition to cloud is being planned

and executed and it can influence the long-term outcomes of planned new cloud projects. (KPMG, 2012)

Due to its borderless and commercially fluid nature, cloud computing resulted in a rising complexity of tax laws and regulations. This is particularly relevant as more and more tax authorities wake up to the complexities of cloud and try to prevent any potential tax leakage. Ernst and Young (EY) has created a guide that should help understand the tax differences that exist in various countries. EY "*generally views cloud computing as borderless commercial transactions conducted over a virtual network (i.e., the internet) in which goods or services are provided to a user (related or unrelated) anywhere in the world with access to such network.*"

In the past, cloud service providers have been challenged to effectively manage tax treatment of cloud-related operations, as more and more organizations that adopt cloud computing are doing. At the same time, more and more authorities are focused on how they need to adopt tax regulations and laws for cloud computing.

The Organization for Economic Co-operation and Development (OECD) has specifically identified digital economy transactions as an area where base erosion and profit shifting (BEPS) may occur. They released a report under Action 1 of the BEPS Action plan on addressing the tax challenges in the digital economy.

The Worldwide Cloud Computing Tax Guide from EY is covering over 140 countries with their specific tax regulations and has created an operating model with three separated views: Commission agent model, commissionaire model and buy-sell model.

The guide consists of tax considerations for each operating model and consists of:

- Income characterization
- Withholding tax
- Permanent establishment (PE)
- Indirect tax

The guidance in this model from EY was created on their common use in practice and simplicity but with certain caveats and assumptions. The operating model is high-level and shouldn´t be used for specific decision-making since the circumstances in every organization is likely to be more complex.

5 CONCLUSION

Peter Drucker, an Austrian-born American management consultant, and author once said, "*The greatest danger in times of turbulence is not the turbulence – it is to act with yesterday's logic*." Today, companies are facing unprecedented uncertainty, and the amount of economic changes seen in the market, and the disruptive changes across all industries and across all areas of business operations, has reach heightened levels. A new level of agility to adapt quickly to those business needs is required. Cloud computing fuels this disruption and act as a catalyst for innovation by enabling organizations to build new business models. These new business models require efficiency, agility, elasticity and cost optimizations, and cloud helps them to achieve that. It addresses the need for organizations to respond to change quickly. But there are no silver bullets for a successful adoption of cloud and no one-size-fits all strategies. Every organization is unique and so is every journey to the cloud. Today´s cloud provides many different options to succeed and achieve the ultimate goals of an organization: to focus more time and energy on winning new customers, developing new products and services, and being successful at creating innovation driven organizational culture.

This paper demonstrates that there are significant economic benefits to be gained from adopting cloud computing, both directly through reduced costs, and, indirectly by allowing for increased focus on the organization's core business functions. These are the reasons why cloud computing is gaining popularity. Gartner predicts the total cloud market will grow from $153.5 billion (2017) to $302.5 billion (in 2021). (Gartner Forecasts Worldwide Public Cloud Revenue to Grow 21.4 Percent in 2018, 2018)

Moving to the cloud requires a solid business case that takes all costs and benefits into account. Lower upfront costs do not necessarily make the cloud a cheaper option. Decisioning framework and following a phased approach can help building a compelling business case for cloud adoption and understand the Total Cost of Ownership. Leveraging key measurements such as, Net Present Value and Internal Rate of Return, will help identify the right solution, but the process can be a complex, and frequently very time consuming.

As companies continue to embrace the cloud, finance and specifically CFOs are becoming more and more important. They play a critical role in helping businesses thrive and in supporting innovation. There is a need to bring CFOs and CIOs closer together, in order to understand both technology and costs. CFOs need to model new impacts on revenue, profits, and operating margins, as well as the risks of exposing services in the cloud. Cloud computing will impact finance's processes for investing in, monitoring of, and depreciating IT assets. Given the volatility of cloud consumption and cost, forecasting and planning for those costs is another critical and complex activity for finance. Cloud services will also impact tax obligations, so including tax departments into the planning and considering those impacts from the beginning may improve a company's

bottom line performance and operating effectiveness. Rather than looking backwards, CFOs are now charged with analyzing and forecasting conditions and costs, and with creating a sustainable competitive advantage.

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