A Guidebook to Successful Migration to a Cloud-Based Data Management System

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Abstract

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The topic of this thesis is cloud technology and cloud migration. Cloud migration has become an important goal for various organizations across industries. Utilizing cloud technology can greatly improve various business metrics, including improving operational efficiency, improving decision-making processes and overall, increasing organizational agility. To acquire and achieve the desired benefits, it is crucial to conduct cloud migration in a sound manner.

The topic was chosen because of the growing importance of digital transformations as a strategic initiative. Cloud migration is a core element of such transformations. The author also wanted to deepen his own understanding of the subject. The author wanted to create a product-based thesis, and the subject of cloud migration lended itself nicely to this kind of thesis.

The main objective of the thesis process was to create a product, namely a digital guidebook. The guidebook is intended for every organization that is considering cloud migration and that needs concrete, practical recommendations to achieve success. The information of the guidebook is based on the theoretical framework. The theoretical framework consists of concepts and information about cloud technology, new technology implementation, data management and most importantly, cloud migration.

The guidebook was created using Microsoft Powerpoint. The production began in April 2022 and was finished in August 2022. The guidebook provides a decent amount of practical recommendations for organizations that consider cloud migration. The information-heavy nature of the guidebook indicates that pre-migration strategic planning and analysis, and conducting the process of cloud migration in a logical, systematic manner, is very important.

Asiasanat
Cloud-computing, strategy, digitalization, cloud migration

Tiivistelmä

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Opinnäytetyön nimi
Opaskirja menestyksekkääseen migraatioon pilvipohjaiseen tietojärjestelmään

Sivu- ja liitesivumäärä
25 + 10

Tämän opinnäytetyön aihe on pilviteknologia ja pilvimigraatio. Pilvimigraatiosta on tullut tärkeä tavoite monille organisaatioille monilla toimialoilla. Pilviteknologian hyödyntäminen voi huomattavasti parantaa monia liiketalouden mittareita, kuten operaationaalisen tehokkuuden parantaminen, päätöksentekoprosessien parantaminen ja ylipäätään, organisaatioketteryyden lisääminen. Saavuttaakseen halutut hyödyt ja edut, on välttämätöntä suorittaa pilvimigraatio oikealla tavalla.

Aihe tuli valituksi, koska digitaalisten transformaatioiden tärkeys strategisena tavoitteena kasvaa. Pilvimigraatio on yksi tällaisten transformaatioiden pääelementeistä. Työn tekijä halusi myös syventää omaa ymmärrystään aiheesta. Tekijä halusi luoda produktiluonteisen opinnäytetyön, ja pilvimigraatio aiheena sopi tällaiseen opinnäytetyöhön hyvin.

Opinnäytetyöprosessin päätavoitteena oli luoda produkti, nimittäin digitaalinen opaskirja. Opaskirja on tarkoitettu jokaiselle organisaatiolle, joka pohtii pilvimigraation suorittamista ja joka tarvitsee konkreettisia ja käytännöllisiä suosituksia menestyäkseen. Opaskirjan informaatio perustuu teoreettiseen viitekehykseen. Teoreettinen viitekehys sisältää konsepteja ja informaatiota pilviteknologiasta, uuden teknologian käyttöönotosta, tietohallinnosta sekä tärkeimpänä, pilvimigraatiosta.

Opaskirja on luotu käyttäen Microsoft Powerpointia. Produktin luonti alkoi huhtikuussa 2022 ja valmistui elokuussa 2022. Opaskirja tarjoaa kelvollisen määrän käytännöllisiä suosituksia organisaatiolle, jotka pohtivat pilvimigraation suorittamista. Informaation suuri määrä opaskirjassa viittaa siihen, että ennen migraatiota suoritettava strateginen suunnittelu ja analyysi, ja prosessin suorittaminen loogisella sekä systemaattisella menetelmällä, on hyvin tärkeää.

Asiasanat
Pilvipalvelu, strategia, digitalisaatio, pilvimigraatio

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1. Introduction

The capability to innovate is arguably the greatest human ability, and technology, whether it is writing, universal money, the Internet or cloud-computing, has had a tremendous impact on society and organizations. In the 21st century, technology is increasingly used in all organizations, whether in a private business, NGO, or governmental organization, to improve business processes, drive down costs and reimagine entire businesses and business models. Digital transformation has become a key strategic issue for virtually all organizations. From a competitive perspective, digital transformation practically becomes a necessity, since otherwise the organization risks falling behind more innovative competitors. Technology leadership has therefore become one of the most powerful competitive advantages. The subject of this thesis is migration to a cloud-computing based data management service. This specific technology is one of the key factors in a digital transformation.

This thesis aims to uncover the best practices and biggest roadblocks in cloud migration. Large-scale change initiatives like digital transformations require extensive planning because they radically alter the entire organization.
Cloud migration can have great positive impact on multiple business metrics. These include for example increased agility and flexibility, ability to innovate faster, cost reductions and faster delivery of new products and services. (Accenture 2021.) The organizational ability to change and adapt becomes a competitive advantage in a world that is changing rapidly on multiple fronts. Certain business philosophies and their popularity therefore come as no surprise, like the agile methodology, which aims to create a more flexible and nimble enterprise more prepared to respond to external changes. Organizational change requires not only strategic planning, but also change in the people within the organization. In fact, some of the main reasons change initiatives fail are a lack of communication and creating a compelling case for change, lack of senior team alignment, inadequate focus on culture change or a lack of accurate and timely feedback on progress (IMD 2020). Even though this thesis is concentrated on cloud migration specifically, it will incorporate change management principles especially regarding communication, since success of the migration will be dependent on those aspects as well.

1.1 Background

The idea for the subject of this thesis originated from the author encountering the topic of digital transformation when doing voluntary studies on the author's free time. The author conducted further research into digital transformations and recognized that the topic is of increasing importance among many organizations in various industries and markets. Cloud migration specifically was mentioned as one of the first steps in digital transformations. Cloud migration was chosen as the main topic, because a digital transformation seemed way too large and complex as a topic to effectively create a thesis that creates value. Initially the topic was constructed as follows: "Migration to a cloud-based data management system to increase organizational agility". Upon developing the idea for the thesis, the author recognized that the initial thesis topic would not create the most value. This was because organizational agility is only one of the possible benefits of cloud migration. Therefore, the topic developed into cloud migration more generally and it would encompass the benefits of cloud migration more holistically.

Initially, the thesis was intended to be research oriented. However, upon further examination of the topic when creating the thesis plan, a product-oriented model appeared to be more logical and beneficial. Since cloud migration is understood as a process, a guidebook that encompasses the entire process seemed like the optimal choice. The author also wanted to create as much value as possible for the target audience, and so a comprehensive guidebook would provide more practical insights and recommendations than a research-oriented thesis. The task of producing a digital guidebook instantly appealed to the author, since it would create a framework for the thesis and require the author to extensively research aspects of cloud migration, because the guidebook should include all relevant information regarding cloud migration.

1.2 Objectives and task setting

The main objective of this thesis is to create a digital guidebook by researching, analyzing and then combining theoretical information. The guidebook should be a coherent and complete product. The research process should include a diverse collection of sources, therefore ensuring that no critical information has been missed, and that the recommendations and proposals in the guidebook have novelty value. The guidebook is meant for any organization that is intending to migrate to a cloud-based data management service. The guidebook is created based on theories and concepts around the topics of cloud-computing technology and cloud migration process as well as digital transformation. The guidebook also brings in some aspects of change management.

Since the thesis is product-oriented in nature, it does not have any specific research questions. However, since the guidebook is intended to provide organizations with recommendations to successfully migrate to the cloud, a main research question could be formulated: “How to migrate to the cloud successfully”? The purpose of the thesis process is for the author to learn and discover everything relevant about cloud migration without setting any preliminary research questions. Even before starting research into the topic, the author created an initial framework for the guidebook based on previous knowledge. This distinction is dividing the cloud migration process into pre- and post-migration sections. This aids the author in creating a coherent product, as well as helping with conducting research in a logical manner.

1.3 Delimitation

The target audience for the thesis has not been defined. The rationale behind this is that potentially more value will be created. Therefore, the guidebook will be more general in nature. The author also wanted to learn about cloud migration holistically, instead of focusing on a single organization, industry, or market. There are however two main limitations, regarding defining the cloud technology to one delivery model and one service model, namely the SaaS and public cloud models. The purpose here is twofold. Specifying the cloud technology decreases the risk of the guidebook being too general. It also creates the possibility of creating more novelty value, since these specifications will be considered in the guidebook. The fact that the target audience has not been defined is the biggest factor that affects the material and recommendations in the guidebook. Logically, the guidebook will not include organization, industry, or market-specific factors but rather the best practices and more general factors in cloud migration.

The thesis is however directed to the top management of the organization that considers the cloud migration. This is because only top management has the authority to plan and set a change initiative like cloud migration into motion. The thesis touches on the topic of change management indirectly regarding communication but does not specifically go into change management theory. This is because the thesis and guidebook would become too large and complex to create effectively.

1.4 Key concepts and structure

> *Cloud-computing* is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models.
> (National Institute of Standards and Technology 2011.)

Cloud migration is the process of moving databases and IT processes into a cloud environment, or from one cloud to another (Cloudflare s.a). *Data management* is the process of collecting, keeping and using data securely, efficiently and cost-effectively. The goal of data management is to help people and organizations to optimize the use of data within the bounds of policy and regulation so that they can make decisions and take actions that maximize the benefit to the organization. (Oracle s.a.) *Strategy* is defined as a general direction set for the company and its various components to achieve a desired state in the future. Strategy results from a detailed planning process. (Management Study Guide s.a.)

The thesis follows the structural thesis model of Haaga-Helia. Chapter 1 includes the introduction and background into the topic, objectives, and delimitations. The first chapter also defines the key concepts and the structure of the thesis. Chapter 2 covers the theoretical framework. The chapter starts by defining cloud-computing technology and is followed by definitions of the SaaS- service model and the public cloud delivery model. Cloud-based data management is also defined. Next, the thesis focuses on new technology implementation generally. After this, the theoretical framework continues with a definition of the cloud migration process and theory on cloud migration regarding before- and after migration factors. Chapter 3 focuses on the guidebook itself, starting with introducing the research methodology and end result, and then explains the production plan and schedule of the thesis. The final chapter, chapter 4, is dedicated for the discussion portion of the thesis. It contains the evaluation of the production, suggestions for future development and ends with the author discussing his own learning experience. The final production will be attached at the end of thesis as Appendix 1.

2 Cloud-computing technology and cloud migration strategy

Modern technology has revolutionized the way organizations operate. The emergence of the Internet created various possibilities for completely new business ideas and business models. In an increasingly digitalized world, organizations must transform themselves with new technologies to stay competitive and to meet customer expectations. Transforming an entire organization however turns out to be a difficult endeavor. Since digital transformation is becoming increasingly important, it becomes crucial for organizations to put sufficient time and energy into planning and executing this transformation the correct way.

As with any large-scale change initiative an organization faces, extensive planning and strategy formulation are needed before beginning the execution of the initiative. Without strategic planning, the organization will most likely miss out on the benefits of the initiative, or the initiative might outright fail.

2.1 Cloud-computing technology

> Cloud-computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models.
> (National Institute of Standards and Technology 2011.)

The five essential characteristics are as follows: on-demand self-service, broad network access, resource pooling, rapid elasticity and measured service (National Institute of Standards and Technology 2011). At this point, it will be important to understand these fundamental characteristics, as they define and differentiate cloud-computing technology from other such technologies. Moreover, these technical characteristics form the foundation for the potential benefits gained from migration to a cloud environment.

> On-demand self-service means that a consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider. Broad network access means that capabilities are available over the network and accessed through standard mechanisms that promote use of heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops and workstations. (National Institute of Standards and Technology 2011.)

> Resource pooling is defined as the concept where the provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand (National Institute of Standards and Technology 2011).

Resource pooling is often achieved using virtualization. Virtualization allows providers to increase the density of their systems. They can host multiple virtual sessions on a single

system. In a virtualized environment, the resources on one physical system are placed into a pool that can be used by multiple virtual systems. (Rountree, Castrillo, Jiang & Ileana 2013, chapter 1.)

> Rapid elasticity means that capabilities can be flexibly provisioned and released, in some cases automatically, to scale outward and inward according to demand. To the user, the capabilities available for use often appear to be unlimited and can be provided in any quantity at any time. The concept of measured systems means that cloud systems can automatically control resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service. (National Institute of Standards and Technology 2011.)

2.1.1 SaaS- service model

Software as a Service (SaaS) is a software distribution model in which a cloud provider provides a service to users over the internet (Techtarget 2021). In the SaaS- model, the user does not have control over the cloud infrastructure which includes networks, servers, operating systems or even individual application capabilities with the possible exception of limited user-specific application configuration settings (National Institute of Standards and Technology 2011).

SaaS removes the need for organizations to install and run applications on their own computers or in their own data centers. This eliminates the expense of hardware acquisition, provisioning and maintenance, as well as software licensing, installation and support. The SaaS- model also has additional advantages. Rather than purchasing software to install, or additional hardware to support it, customers subscribe to a SaaS offering. Transitioning costs to a recurring operating expense allows many businesses to exercise better and more predictable budgeting. Users can also terminate SaaS offerings at any time to stop those recurring costs. (Techtarget 2021.)

Cloud services like SaaS offer high vertical scalability, which creates the opportunity for customers to access more or fewer services or features on demand. In a SaaS model, customers rely on the SaaS- provider to automatically perform updates and patch management. This reduces the burden on the in-house IT staff. Since SaaS vendors deliver applications over the internet, users can access them from any internet-enabled device and location. Also, SaaS applications are often customizable and they can be integrated with other business applications, especially across applications from a common software provider. (Techtarget 2021.)

SaaS- models also create some potential risks and challenges, as businesses must rely on outside vendors to provide and maintain the software and facilitate a secure environment for the business's data. Issues may arise when providers experience service disruptions, impose unwanted changes to service offerings or experience a security breach – all of which can have a profound effect on the customers' ability to use the SaaS offering. To proactively mitigate these issues customers should understand their SaaS provider's SLA and make sure it is enforced. (Techtarget 2021.)

In cooperating with a cloud service provider, switching providers can be difficult. To switch, customers must migrate large amounts of data. Furthermore, some vendors use proprietary technologies and data types, which can further complicate data transfer between different cloud providers. Vendor lock-in is the situation when a customer cannot easily switch between service providers due to these challenges. (Techtarget 2021.)

At this point in the creation of the theoretical framework, it is possible to make early recommendations relating to the process of cloud migration regarding the SaaS- service model. The advantages and disadvantages of SaaS offerings should be taken into consideration before migration. Since the customer has virtually no control over the SaaS- offering, it is important for the organization considering migration to carefully assess different companies that offer these kinds of services. A proper SLA should be created. In assessing SaaS- service providers, the organization should analyze whether vendor lock-in is probable, and if it is, researching whether a different service provider's offering could reduce the risk of vendor lock-in. Regarding the risks and benefits of SaaS- offerings, it is necessary to plan carefully before migration to maximize the potential benefits as well as mitigate the potential risks.

2.1.2 Public cloud model

> The public cloud model is a cloud infrastructure that is provisioned for open use by the general public. It may be owned, managed and operated by a business, academic or government organization, or some combination of them. It exists on the premises of the cloud provider. (National Institute of Standards and Technology 2011.)

In a public cloud, the organization shares the same hardware, storage and network devices with other organizations, and the organization accesses these services and manages the account using a web browser. Public cloud deployments are frequently used to provide different functions, such as web-based email, online office applications, storage, and testing and development environments. (Microsoft s.a.)

Public cloud service providers have different strengths, and there are a lot of different offerings and pricing models. Organizations considering a migration to public cloud need to

carefully consider their options when it comes to choosing a provider, especially if they will be locked into a long-term contract. Careful planning can help to keep costs down on monthly cloud service bills, but organizations with unpredictable public cloud usage may find it hard to avoid spending a lot of money on public cloud services when the use of service suddenly rises due to demand. (VMWare s.a.) A survey conducted by Anodot, a data analytics company, indicates that cloud cost control is an issue for many organizations, as 49% of businesses have problems keeping cloud costs under control. Additionally, 54% of businesses believe that lack of transparency into cloud usage is the primary source of cloud waste. (Anodot 2022.)

As servers in the public cloud share data from multiple companies, security in public cloud is another issue that IT managers will want to weigh. Encrypting data is a sound way to ensure stronger data security, but if the organization is combining the use of public and private clouds (also known as a hybrid cloud), not all encryptions will be suitable and effective in both public and private clouds. There is also an inherent security risk whenever data is moved between a private data center or private cloud and a public cloud. (VMWare s.a.)

Another consideration regarding the public cloud provider the organization will choose, is the location of the public cloud service provider. Data privacy laws in many countries require certain types of data to be stored in-country. These laws change often, so it’s best to choose a cloud service provider that is in your country and can confirm that the servers where your data will be stored are local and in compliance with regional laws. There is also the factor of latency, if your data is hosted on a different continent, it may take longer to access and use than if it were stored close by. (VMWare s.a.)

Similarly as in the previous chapter but this time regarding the public cloud deployment model, early observations can be made regarding cloud migration to a public cloud service. It is becoming clearer that rigorous but careful planning before migration is a crucial factor in successful migration. As demonstrated in the previous paragraphs of this chapter, cloud security becomes one of the main concerns especially in this deployment model, because of the open nature of public cloud offerings. Legal factors also create restraints for the organization considering migration to a cloud environment. Planning should also involve assigning a reasonable budget solely for the utilization of the public cloud service. The potentially unpredictable costs as usage of the service increases should be anticipated, therefore making the costs predictable. This would require the organization to have additional financial resources on hand that it could then utilize in scaling the use of the public cloud service. At this point, common themes can already be recognized regarding pre-migration planning regarding the service- and deployment

models in question. As an early conclusion, one of the first steps in the produced guide-book will be planning in general as well as more specifically regarding the limitations, namely the SaaS- service model and the public cloud deployment model.

2.1.3 Cloud-based data management

> Cloud data management is the practice of storing a company's data on an offsite server that is typically owned and overseen by a vendor who specializes in cloud data hosting. Managing data in the cloud provides an automated backup strategy, professional support, and ease of access from any location. (Talend s.a.)

A global cloud data management platform provider, Snowflake (Snowflake s.a) states that data management in the cloud encompasses various activities regarding business data, including acquiring, storing, protecting, and processing data across an organization or business unit. Additionally, it also ensures that data is properly validated and fully accessible to relevant stakeholders when needed. Data governance, meaning internal rules and principles regarding data security can also be included in data management.

Talend (Talend s.a), a big data and cloud integration service provider, claims that the key to effective cloud data management is in well-organized data integration and holistic data governance. Their observation is that data in the cloud can be as ineffective as data on-premises if it is not seamlessly integrated and properly governed. The issue of data integration and governance will be explored more in the cloud migration chapter, as they are key issues that will determine the success or failure of the migration process.

2.2 New technology implementation

Digital transformation is a change initiative growing in importance. Organizations from private businesses to NGOs and governmental institutions, are transforming their organizations with new technologies. This chapter will cover the best practices in implementing any new technology.

Kevin Kerl, from Select One, a recruiting and staffing firm, has created a five-step framework for implementing new technology in the workplace (Kerl 25 February 2020). We will go through each of the steps, and the author will add his own thoughts at the end of each step.

The first step is to investigate technologies that will solve problems for your company. This is because the purpose of adopting new technology in a workplace is to provide solutions to problems or inefficiencies. After identifying the best technological solution for the problem, communicate it with your employees. Let them know that you're considering a new

technology and make sure to lay it out for them how it will solve a problem. (Kerl 25 February 2020.) Amanda Wowk, a freelance writer that created content for Qualtrics, an experience management company (Wowk 2 December 2020), claims that the first step in implementing new technology in the workplace is to gather continuous feedback from employees. It's important to collect feedback from a diverse set of people, for example from individuals in your technology support teams, business leaders, and most importantly, employees who are using your tools and services daily.

The first step regarding identifying relevant technologies to solve business problems is not directly relevant to this thesis, since the technology has already been identified. However, the aspect of communication between internal stakeholders is directly relevant. Since organizations are always composed of people, any new technology that is to be implemented in the organization, must first be accepted by the people working for the organization. Profound change in organizations is always bound to experience some form of resistance, because humans are inherently resistant to change. Therefore, if an organization considers implementing a new technology, it needs to clearly communicate to all relevant stakeholders why it is considering this new technology and what this change will require from employees.

The second step is to assemble an implementation team to advocate the new technology once it has been chosen. An implementation team is required because the new technology's superiority over its competitors and strategic value mean little when it comes to its acceptance among employees. Many implementation efforts fail because the scope and importance of such planning was underestimated. The implementation team must take on three crucial tasks: ensuring that the project receives adequate resources, overseeing administrative details and managing conflicting goals and priorities. (Kerl 25 February 2020.)

Aspects from this step will be taken into consideration in the actual cloud migration process. However, as the cloud migration will be into a SaaS- service model, of which the user organization will have little to no control, assembling an implementation team could be unnecessary, since the cloud service provider will provide the required infrastructure and maintenance of the service. Since the cloud service is entirely in the hands of the service provider, no extensive in-house IT staff may be needed. The service provider that has the required expertise in cloud-based data management should be able to provide consulting to the organization considering their services. Even if an implementation team is not assembled, top management needs to ensure that everyone at all levels of the organization understand the need for the new technology and the change accompanied with it.

The third step involves executing a pilot program to solve problems in implementation and to gain buy-in into the new technology. This experiment will prove technical feasibility to top management as well as serving as a convincing demonstration for other units within the organization. Along the way, your organization will likely solve certain problems, such as connecting the new technology to old ones and optimizing processes for completing tasks using the new tech. After the issues have been resolved, you'll be confident when it comes time to scale up. (Kerl 25 February 2020.)

Regarding the process of cloud migration, it will be important for the organization considering migration to test the service provider's cloud platform. This should include not only top management, but also lower-level employees who will use this new technology. As in the previous step, consultation will probably be needed.

The second to last step is to train your employees to use the new tool. Providing compelling training sessions are key to a successful execution. A few different aspects to consider when planning training sessions are recognizing that every employee can have different learning styles and needs and therefore you should design your training sessions to many types of learners by providing a diverse range of materials and options. Also, make the training personal, let people know why the new service matters to them, and how it will affect their daily work. Finally, encourage employees to give honest feedback regarding the new service. (Kerl 25 February 2020.)

This step will be relevant to a degree when considering cloud migration. Again, it will be important for the organization considering cloud migration to assess different cloud offerings and their complexity. Choosing a more simple, easy-to-use service will require less training from employees and therefore reduce resistance, leading to a higher adoption rate. Some training will still be required, and as the organization tests the cloud service, employees should be encouraged to give feedback.

The final step is to launch the use of the new technology, adjusting the technology to fit your needs as you go. Technology implementations don't perform well when companies execute the initiative but then forget about it. Successful integration of the new technology requires evaluating its performance post-execution. If problems exist and probably they will, continue iteratively improving the manner in which you use the technology. (Kerl 25 February 2020.)

This final step will be important in the post-migration stage in cloud migration. As the organization has migrated their data management to the cloud, open communication with

employees and acquiring feedback should continue, which will create iterative improvement of the cloud service in question. Close communication with the service provider should also continue, as the provider will have specialized expertise of the service and therefore will be able to consult the user organization as well as participate in improving the service.

2.3 Cloud migration process

> Cloud migration is the process of moving digital business operations into the cloud. Cloud migration is sort of like a physical move, except it involves moving data, applications, and IT processes from some data centers to other data centers, instead of packing up and moving physical goods. Most often, “cloud migration” describes the move from on-premises or legacy infrastructure to the cloud. However, the term can also apply to a migration from one cloud to another cloud. (Cloudflare s.a.)

In computing, hardware or software is considered “legacy” if it is outdated but still usable. Legacy products and services are often not as efficient or secure as more modern solutions. Infrastructure includes important business software or hardware, including servers, networking equipment, applications and databases. Legacy infrastructure, such as old servers or physical firewall appliances, can slow down an organization’s business processes. Legacy infrastructure is normally hosted on premises, meaning the hardware is located on the property where the organization operates from. (Cloudflare s.a.)

Cloud migration involves various challenges, these include for example the issue of migrating large sets of data to the cloud environment, data integrity, and ensuring business operations continuity (Cloudflare s.a). Additional challenges include a lack of strategy, lack of cost management, the threat of vendor lock-in and data security and compliance (Perry 26 August 2022). These challenges will be appropriately divided into the next chapters according to whether they should be done before or after migration.

Cloud migration also involves substantial benefits, but they can only be achieved through successful migration. Overcoming the challenges will be crucial in acquiring these potential benefits. The main benefits of the cloud are consistent with the nature of the technology. These include scalability, cost reduction, increased performance and increased flexibility (Cloudflare s.a.).

Scalability refers to the ability of the cloud to scale up to support larger workloads and more users, much more easily than legacy infrastructure. (Cloudflare s.a). This is one of the essential characteristics of cloud-computing, rapid elasticity. Cost reductions are possible, because cloud providers handle maintenance and upgrades and therefore companies migrating to the cloud can spend significantly less on IT operations. They can devote more resources to innovation, developing new products or improving existing products.

Migrating to the cloud can also improve operational performance and user experience. Applications and websites hosted in the cloud can easily scale up to serve more users according to demand, and can run in geographical locations near to end-users, to reduce network latency. (Cloudflare s.a.) The main limitations of this thesis, the specific service- and deployment models, have effects on the potential benefits as well as challenges, and so the migration process will be slightly modified to include these limitations. For example, the service and deployment model in this case will increase the benefits of scalability and cost reductions. This is because they reduce the control of the cloud service to a minimum, from the user organization's perspective. However, they might also increase some of the challenges, like data security since the user organization completely relies on the cloud service provider. Vendor lock-in will also become a substantial threat, because of the high level of reliance on the service provider.

2.3.1 Before migration

As already demonstrated in the previous chapters, successful migration will largely depend on addressing the challenges of cloud migration, as well as planning the migration beforehand. From the previous chapter, certain challenges should be addressed before migration. These include the migration of the actual data to the new cloud platform, ensuring data integrity and ensuring the continuance of business operations. Also, lack of strategy and cost management, the threat of vendor-lock in and data security and compliance are also factors that should be addressed before migration. It seems clear that successful migration will be dependent on careful, yet rigorous planning beforehand. This chapter will cover each of these challenges and how to address them, as well as additional insights from the theoretical information presented previously. Some of the previously mentioned factors are relevant both pre- and post-migration. Cost management as well as data security and compliance are issues that need to be continually assessed.

Migrating to the cloud without a clear strategy is not effective and can cause problems. A cloud strategy preparation process is essential to prepare the organization for smart and rational decisions regarding the cloud initiative. Though numerous enterprises have indicated that cloud migration is a strategic priority, many of them don't have a well-established cloud strategy that clearly defines the important questions of their cloud implementation. A cloud strategy is an essential component that guides your organization towards achieving important objectives that will lead the company to achieve desirable outcomes. (Avenga 2021.)

Defining the cloud strategy aims to define the key activities as well as the roles and responsibilities for accelerating the cloud adoption. The strategy provides the organization

with a decision framework to evaluate opportunities in the cloud that are aligned with strategic business objectives. The strategy will also establish a cloud implementation roadmap as well as determine the targets, measures and key initiatives that assist with continuous integration and delivery. (Avenga 2021.)

Avenga is a global IT consultancy that has created a 7 step-guide to creating a cloud strategy (Avenga 2021).ii The steps are as follows:

1. Analyzing the cloud business objectives
2. Analyzing the current business context
3. Analyzing IT architecture requirements
4. Future / target state analysis
5. Gap analysis and activities planning
6. Risk assessment
7. Implementation plan

The author will go through each of these steps. This framework will create the basis for the cloud strategy development in the guidebook.

The first step is to analyze the business objectives the cloud migration is supposed to achieve. Strategic goals will need to be defined. From the enterprise's perspective, a cloud services adoption provides a solution to a problem or challenge that the business faces. Companies investing in a modern digital infrastructure want to achieve one or several of the following benefits including a quicker release of new services, products or business models, achieving operational excellence, acquiring and retaining new customers, upgrading the decision-making processes, gaining a competitive advantage and ensuring business survival. (Avenga 2021.) Since the thesis is specifically about cloud data management, the most relevant business objectives will be a faster time to market, achieving operational excellence as well achieving operational flexibility. Improving decision-making processes will also be a key objective since cloud data management will facilitate quicker and more accurate decision-making due to faster accessibility of data. Ultimately, the move towards migration to a cloud data management service should be to gain competitive advantage, improve profitability and create growth.

Assessing business capabilities for cloud adoption will also be important. Differences in intangible assets, like capabilities, may explain why one organization is more successful than another. Business capabilities mapping has emerged as a core enterprise modeling technique, thus laying the foundation for cloud adoption. (Avenga 2021.) Since the thesis is not directed to a specific target audience, but is more general in nature, this aspect will be difficult to define. This is because organizations even in the same industry can differ in capabilities and so specific recommendations will be difficult to make. However, it is reasonable to remark that cloud data management is a sufficiently new business area and

therefore, that most organizations will require some form of consulting regarding cloud migration. Consulting has been mentioned in the previous chapters and will most likely become an integral part of the guidebook.

The second step is to define the current business context. This includes capturing the macro-context of the business. The main objective of a business context analysis is to set up the direction of the business and define the cloud needs based on the strategy. Useful tools and techniques for this analysis include brainstorming sessions, a SWOT analysis, value chain analysis and the PESTEL framework. The brainstorming sessions with stakeholders, decision-makers and IT specialists are to determine and evaluate the impact of a cloud adoption. (Avenga 2021.) This brainstorming aspect has been previously mentioned in chapter 2.2 as one of the first steps of new technology implementation, communication. Communication between various internal stakeholders and gathering feedback seems to be an important factor not only generally in new technology implementation but also cloud migration more specifically.

Next, the organization should analyze its IT architecture. The objective of this analysis is to create an understanding of the IT architecture by defining its technical maturity as well as any factors that need improvement or adjustment to achieve a successful cloud implementation. IT architecture analysis includes the following elements: an assessment of the current IT enterprise architecture, applications, digital infrastructure, interfaces, data governance policies, metrics, and key objectives. An useful technique to help with clarifying the current, strategic, high potential or key operational cloud support systems is a McFarlan IT portfolio grid. Mapping the cloud infrastructure on the McFarlan IT portfolio grid helps to align business requirements to the cloud and to evaluate how current IT systems are contributing or not contributing to a company’s business objectives. (Avenga 2021.)

The fourth step in creating a cloud strategy is to conduct a future / target state analysis. The key objective of this analysis is to build a vision of the organization’s IT architecture once the cloud migration has been completed. This includes both business and technological aspects of the cloud migration. Certain issues related to cloud migrations are linked to factors in cloud security that narrow down the choice of cloud platforms. The aspects that should be considered are the authentication, identification, confidentiality, and auditability options. In defining the desired cloud state, organizations can utilize use-case modelling and analysis or a business value and benefits assessment. (Avenga 2021.)

Use-case modelling and analysis is used to determine the requirements of the cloud system and set the overall scope for the cloud provider. This helps create clarity around the migration so that everyone will understand what needs to be done so the business can

reap the most value from their cloud migration. The business value and benefits assessment allows an organization to quantify the pros and cons of the different cloud services and therefore choose a specific cloud solution by evaluating financial returns (cost savings) and non-financial returns (operational risks). (Avenga 2021.) Both tools are associated with planning and choosing the best possible service provider. This factor was already mentioned by the author in chapter 2.1.1. Incentives to carefully choose the right provider include previously mentioned factors, like the threat of vendor lock-in, as well as a high level of reliability on the cloud provider, especially since the service will be SaaS and public cloud. These tools are needed for general viability of the cloud migration, yet they also provide answers to some of the main challenges in cloud migration. Use-case modelling helps with the actual migration of the data into the cloud platform because it is used to determine the requirements of the cloud system for the organization. The business value and benefits assessment is one of the most important steps, since it analyzes different service providers. This step was already mentioned in chapter 2.1.1 in the context of the SaaS- service model. Choosing the most suitable provider will have profound effects, from data integrity, reducing the threat of vendor lock-in to data security and compliance.

The fifth step in cloud strategy creation is gap analysis and activities planning. Main activities here include determining the gaps and dependencies in potential cloud services to ensure there are no barriers to execution. This analysis should include the following evaluations: assessing potential technological and IT workflow gaps and opportunities for streamlining or simplification. Prioritizing the potential cloud and other technology advancements that are needed and developing an action plan to handle the challenges and issues determined by the evaluation. (Avenga 2021.)

The key activities at this stage consist of iterative fit-gap assessments. Fit-gap analysis is an analytic tool that can help with identifying and clarifying priorities, overlaps and shortfalls. The purpose of these assessments is to acquire a clear picture on all of the gaps or issues the organization faces and how the planned cloud service will solve them.

> The second to last step is conducting a comprehensive risk assessment. A risk assessment helps to determine and validate potential issues and compiles the appropriate mitigation strategies. A business risk assessment includes determining potential risks and then categorizing them into two categories. These are delivery risks and benefits risks. Delivery risks include the risks of the vendor not delivering the required capabilities. These may include the reliance of vendors, lack of scope clarity, unorganized deliverables or poor project management. Benefits risks include the risks of not achieving awaited business objectives. These may include a lack of alignment of the business with the IT department, misaligned technical standards in architecture, appropriate security compliance or undefined metrics to evaluate business outcomes. (Avenga 2021.)

In this step, after identifying the risks, they must be prioritized in accordance with their likelihood of occurrence. It is useful to create a tiered probability-impact matrix analysis. Such an analysis helps to define risk components in terms of their impact and probability. After the risks are prioritized, it is advisable to create a risk mitigation strategy plan. (Avenga 2021.) This step is also indispensable in cloud migration, since it is the final analysis of the various risks associated with cloud migration. Both delivery and benefits risks include a common factor, lack of communication and strategy. The factor of communication was mentioned in chapter 2.2, and it must be mentioned again. Lack of communication is a problem in all of the following risks: lack of scope clarity, unorganized deliverables, poor project management, lack of alignment with the IT department, misaligned technical standards in architecture and undefined metrics to evaluate business outcomes. Open communication with the service provider as well as various stakeholders will be a key component in the guidebook during all the steps.

Finally, the last step is to create an implementation plan. The key objective is to support the cloud delivery through a viable implementation roadmap and resulting recommendations. The main deliverables of a cloud implementation plan are:

1. Establishing a management framework for the cloud adoption that is in alignment with the strategic business priorities, operations, project management and data governance policies.
2. Arranging resource distribution and capability planning to ensure the resource requirements are fulfilled and the delivery is on track.
3. Classifying and prioritizing cloud projects in line with the project sequence, timeline and key milestones.
4. Forming best practices and recommendations for a successful cloud implementation.
5. Planning a governance process that encompasses the management and assessment of the cloud strategy and its implementation success.
6. Integrating and documenting the cloud strategy. (Avenga 2021.)

The seven steps described above are a generic approach towards a cloud migration. In practice, it is necessary to continuously adjust or extend the cloud strategy, then prioritize and adjust according to the business context the organization is in. In the planning stage, coherent organization-specific guiding principles for a cloud migration will serve as significant milestones towards a successful cloud strategy. (Avenga 2021.)

The creation of a cloud strategy will be the most important aspect of the guidebook. This is because as previously mentioned, successful cloud migration will be dependent on achieving the benefits and mitigating the risks of cloud migration. The cloud strategy will address both aspects. This strategy will encompass all relevant steps pre-migration. The pre-migration part of the guidebook will also include additional insights and recommendations from previous chapters, regarding the specific service and deployment model, as well as the importance of communication for successful migration. However, as important

as planning and creating a strategy for the migration is, it is not enough for sustaining success of the migration. This is where we turn to next, ensuring that the organization can sustain success of the completed cloud migration.

2.3.2 After migration

The previous chapter regarding factors to consider before migration including the creation of a comprehensive cloud strategy was quite heavy on information. This was necessary, since it became clear that success of a cloud migration is heavily dependent on pre-migration planning. Therefore, in an optimal scenario, the organization that starts their cloud migration process will have planned thoroughly, and that no unexpected problems will arise during migration. This will however be unrealistic, as the organization will never be able to anticipate all the possible problems that arise during migration. This chapter will cover factors that the organization should consider after the initial migration has been completed.

The organization can use various key performance indicators (KPIs) after the initial cloud migration is completed. These include for example analysis of the cloud infrastructure, application performance and user experience. Analyzing the cloud infrastructure can help the organization to determine whether the system is reaching its capacity and therefore may be slower to respond. On the other hand, excessive capacity is not beneficial either, because the organization will be paying for the capacity that is not being used. (Hico-Group 2021.) Since one of the essential characteristics of cloud-computing is rapid elasticity, the organization should be able to scale its use of the cloud service according to demand. Therefore, the system should constantly remain in an optimal state, not reaching its overall capacity and slowing down yet also not having additional capacity that is not being used.

Analyzing application performance is necessary, since hardware is not the only factor that can affect performance. The design of the cloud service can also affect overall cloud performance. To evaluate this metric, it is recommended to invest in application performance monitoring tools that can monitor how quickly cloud-based applications respond to user requests. (Hico-Group 2021.) Since the organization will essentially have no control over the cloud service, this factor will fall into the planning phase, namely assessing different cloud providers and choosing the best one for the organization. As previously mentioned in chapter 2.1.1 regarding the SaaS- service model, a comprehensive service-level agreement should be created. This is crucial since the organization depends entirely on the provider for the availability of the service.

Both infrastructure and application performance monitoring provide data-driven insights into the user experience. However, performance is rated the best by the individual users themselves. Gathering anecdotal data from your users can also help you obtain a valuable and actionable assessment of the user experience. (Hico-Group 2021.) Gathering feedback and open communication between stakeholders has been mentioned multiple times as a crucial part of new technology implementation and as an important part of cloud strategy creation.

The previous chapters indicate that migration to a cloud-based data management service is more dependent on pre-migration planning than post-migration actions. The most important output of this planning phase is the creation of a cloud strategy. This strategy will create answers for the difficulties of cloud migration and maximize the chance of a successful migration. Post-migration evaluation cannot however be neglected if the organization wants to sustain success of the new technology.

3 Description of guidebook production

The main objective of this thesis was to create a digital guidebook based on the theoretical framework presented in chapter 2. A product-oriented thesis seemed more optimal when considering the topic of cloud migration. This was because the product would be a complete entity with a clear framework, and it could provide more practical recommendations than a research-oriented model.

The theoretical framework covered all the relevant topics associated with cloud migration. These include the definition of the technology and its limitations, data management, new technology implementation and the cloud migration process itself. The structure of the guidebook is straightforward and simple, making it easy to follow and comprehend. The step-by-step nature of the guidebook is aided by a cloud strategy framework created by Avenga, a global IT consultancy. The author used this framework as the base for the guidebook, and then added additional information that are presented in the theoretical framework.

3.1 Methodology and end result

The guidebook was created with Microsoft Powerpoint. The rationale behind using Powerpoint was that it would provide a simple structure. The step-by-step nature of the guidebook is also logically created with the slide structure of Powerpoint. As one of the main goals was to create a complete and logical product, the author decided that there needed to be a clear framework that provided a solid base for the guidebook. A cloud strategy creation framework by Avenga, a global IT consultancy was chosen. The author researched multiple different possible frameworks, but this one was chosen, because it was structured clearly with a step-by-step nature created in a logical manner. This framework was also presented in chapter 2.3.1. The theoretical framework provided information for the different steps in the guidebook. When creating the various steps in the guidebook, relevant information was taken from the theoretical framework and added to the phase in the guidebook where it provided the most value. The author’s critical thinking skills and understanding of the subject had a crucial role in creating a valuable product.

The guidebook is heavy on information, yet it focuses mostly on providing practical recommendations for organizations that are considering cloud migration. The final product is 17 slides in total. The final product is a complete and comprehensive digital guidebook. The guidebook should provide reasonable value for organizations that are considering migration to a cloud-based data management system. The guidebook is of a general nature,

providing insights that apply to all organizations, independent of external factors such as a specific industry or market.

3.2 Production plan and schedule

The thesis planning process began in December 2021. The thesis process was roughly divided into two sections, the research and creation of the theoretical framework and the creation of the guidebook. The structure of the thesis follows official Haaga-Helia guidelines for a product-based thesis. The research process and creation of the introductory chapter and the theoretical framework began in January 2022. No concrete deadlines were set for the different sections of the thesis. The theoretical framework was fully completed in April 2022. Originally, the thesis was supposed to be completed by June 2022, but due to unforeseen health problems, the author had to delay the thesis creation process. The creation of the guidebook began in April 2022 and was finished in August 2022.

The production plan for the theoretical framework started with the author creating a table of contents that included all the relevant aspects associated with the topic of the thesis, cloud migration. The research process was extensive, and its purpose was to increase the author's understanding of the entire topic. Initially, the author visualized the source material as mostly academic publications and texts. During research into the topic, it became clear that since the subject of cloud technology and cloud-based data management is quite new, academic sources were somewhat scarce. Also, since the guidebook's purpose was to supply organizations with practical insights and recommendations, the information that seemed most valuable was from organizations like IT consultancies and such, that provide real-life organizations with practical advice and consulting. During the creation of the theoretical framework, the author aimed to use various sources. The purpose of this was to gain more understanding into the topic and create a more thorough theoretical framework and also a more complete guidebook.

3.3 Product description

The guidebook is based on the theoretical framework presented in chapter 2. The framework of the guidebook provides a solid foundation and a logical structure, and additional information from the theoretical framework are added to the guidebook. The nature of the guidebook is more practical in nature, providing organizations with concrete recommendations and steps to succeed in cloud migration. The guidebook consists of 15 slides of information. The framework of the guidebook is a cloud strategy creation framework created by Avenga. This framework includes seven specific steps in cloud strategy creation. These are the analysis of the cloud business objectives, analysis of the current business

context, IT architecture analysis, future and target state analysis, gap analysis and activities planning, risk assessment and an implementation plan. These steps and analyses create a comprehensive cloud strategy creation plan. Creating a thorough theoretical framework allowed the author to increase the informational value of the guidebook. This can be observed in various sections of the guidebook. For example, some of the main challenges in cloud migration include data integrity, large-scale data migration and other factors, like a lack of strategy, cost management and the threat of vendor lock-in. These and other factors are included in the guidebook in the most appropriate sections. In the future and target state analysis section, the issue of data migration was included in use-case modelling and analysis. The specific delivery and service model also affect the material in the guidebook. In the same analysis, due to the high degree of dependence because of the SaaS- delivery model, it becomes more important to carefully select the cloud provider. The threat of vendor lock-in is also mentioned in this section, since it becomes a bigger threat due to the high dependence on the cloud provider. This analysis also includes important practical recommendations taken from chapter 2.2, regarding testing the new cloud service and encouraging employees to give feedback on the new service.

The risk assessment section includes various potential risks that could affect the cloud migration initiative negatively. These include delivery and benefits risks. Delivery risks are due to problems with the vendor not capable of delivering the required capabilities. Benefits risks include the risks of not achieving awaited business objectives. Both types of risks are greatly mitigated due to a clear and comprehensive cloud strategy. Therefore the guidebook needed a framework that created a clear structure but also demonstrated the importance of a cloud strategy. Specific recommendations in the guidebook also mitigate some risks, for example the creation of a service level agreement should mitigate delivery risks, since the vendor must uphold a certain level of functionality. This agreement also addresses data integrity and data governance issues, which are key factors in proper data management. A lack of communication is a factor in multiple of these risks, and so encouraging open and frequent communication about the initiative is a recommendation that is visible in many sections of the guidebook. The challenge of cost management is also included in the risk assessment section. The post-migration section of the guidebook is brief since it became clear during research that pre-migration planning and execution is more important. The theory and product are tightly linked in every section of the guidebook. Comprehensive research into the topic of cloud migration ensured that no crucial information was missed. Ultimately, the value of the guidebook comes from the fact that it covered all relevant aspects associated with cloud migration and therefore maximized the chances of success of cloud migration initiatives for the target audience.

4 Discussion

New technologies can radically alter organizations, markets, and entire industries. Organizations that utilize these technologies can for example increase their operational efficiency and improve their organizational agility, but ultimately, they will be able to reimagine entire businesses and business models. Cloud-computing is one of these revolutionary technologies. In a world where the pace of technological development and innovation is rapid, it is becoming practically a necessity for organizations to adopt new technologies. It is no wonder that some of the largest companies in the world like Apple, Microsoft and Google, are technological leaders. Being a technology leader can create a tremendous competitive advantage, and on the flipside, lagging behind more innovative and technologically advanced companies can create a serious competitive disadvantage.

Cloud migration can provide organizations with various benefits, but only if the migration is successful. As a large-scale change initiative, the planning and migration process turns out to be quite difficult. Strategic planning and extensive analysis is necessary for the migration to proceed in a logical, systematic manner. Adoption of a new technology most often requires radical change in an organization. Organizational transformations including digital transformations are notoriously difficult because they require large-scale holistic change, meaning that every aspect of the organization might need change, including strategy, structures, and the people of the organization. Organizational change always includes risk, but in this digitalized world, an argument could be made that not changing includes even more risk.

4.1 Evaluation of production

The topic of cloud-computing and cloud migration is highly relevant. Digital transformations and cloud migrations which are an integral part of these transformations have become a key strategic issue for many organizations. To maximize reliability of the product, the author aimed to use various sources to ensure that the guidebook will be as complete and comprehensive as possible, and that no important information will be missed. Since the nature of the sources is not purely academic, but more practical, the reliability of the sources could be called into question. IT consultancies were the most common source in the theoretical framework, which provided reliable and practical information. The author viewed these sources as more reliable than academic texts in the context of a digital guidebook that is supposed to create practical value. The lack of a commissioning organization had positive and negative effects on the reliability and potential value created by the thesis and product. The positive effects were that since the guidebook is not directed towards any specific organization or other target segment, it provides more value to a

larger audience. This also meant that the author could research the subject more completely, since there was no limitation to a certain target organization. The negative side of this was that since there was no commissioning organization or other segmentation regarding the target audience, the guidebook cannot provide the most amount of value for a specific organization. The information and recommendations in the guidebook are therefore more surface level. The theoretical framework is also comprehensive, encompassing various relevant factors relating to the topic, yet the information is also somewhat superficial. This could not have been avoided with the fact that the information had to be applicable to all organizations. The reliability of the guidebook is also affected both negatively and positively by the framework that provides the base for the guidebook. Since the framework in the guidebook is a specific cloud strategy creation framework created by a certain organization, this provides a clear, coherent, and logical structure to the guidebook. This leads to one of the set targets of the thesis, to create a product that has these characteristics that increase reliability. The negative effects of this were that the guidebook does rely heavily on the framework created by the organization that created it. The author aimed to mitigate this effect by extensively researching different frameworks and only then choosing the one that seemed the most optimal. In the end, not having a clear framework for the guidebook would have made the guidebook more chaotic, decreasing reliability.

The final product provides adequate value to organizations that are considering cloud migration. The guidebook is reasonably successful in the context of the pre-defined objectives for the guidebook in chapter 1.2. However, the product does somewhat repeat the information in the theoretical framework. The product creates some novelty value, when considering that the guidebook is a combination of theoretical information that is arranged into a coherent, unique whole.

4.2 Suggestions for future development

The execution of a cloud migration process is a key aspect of digital transformations. The increasing importance of digital transformations for organizations indicates that the subject should be further studied. The process of cloud migration should be studied from various perspectives. Since the cloud migration process must be different for every organization, due to external and internal differences, the process could be studied from the perspectives of organizations in different industries and markets to determine how the process differs. Also, the phenomenon of cloud-computing and its opportunities in business should be studied as interconnected with other technologies. On existing cloud computing platforms, AI techniques deploy to deliver extra value. SaaS companies incorporate AI technologies into larger software packages to give end-users more functionality (Datacenters

2022). Integrating cloud technology with other technologies could therefore create additional value for the cloud service user. Future studies into cloud technology should take the factor of interconnectedness into consideration. During the research process the author noticed the importance of change management in successful cloud migration processes. Unfortunately, the thesis couldn't go thoroughly into change management principles, but future developments into cloud migration should recognize the important role that change management plays in cloud migration initiatives.

4.3 Learning experience

The thesis process taught the author a lot about cloud technology and cloud migrations. The author gained a fundamental understanding of the best practices, obstacles, and concepts in cloud migrations. This was the most important criteria for success. The process required the author to develop and extensively use his critical and analytical thinking abilities. Researching the topic of cloud migration holistically gave the author a solid understanding of cloud technology in general as well as the cloud migration process more specifically. The task of creating a digital guidebook was quite demanding, and so it required the author to improve his project and time management skills. The process required the author to conduct extensive research and then to reach logical conclusions regarding the information and to then create a well-structured digital product. This process greatly improved the author's ability to critically analyze theoretical information and synthesize the information into a complete product that provides value. The systematic manner in which the process was conducted, could also be linked with an improvement in problem-solving ability. The lack of a commissioning organization made the topic definition more difficult, but it also required the author to learn the topic of cloud migration more comprehensively and so in this sense, the understanding of the topic reached a deeper level.

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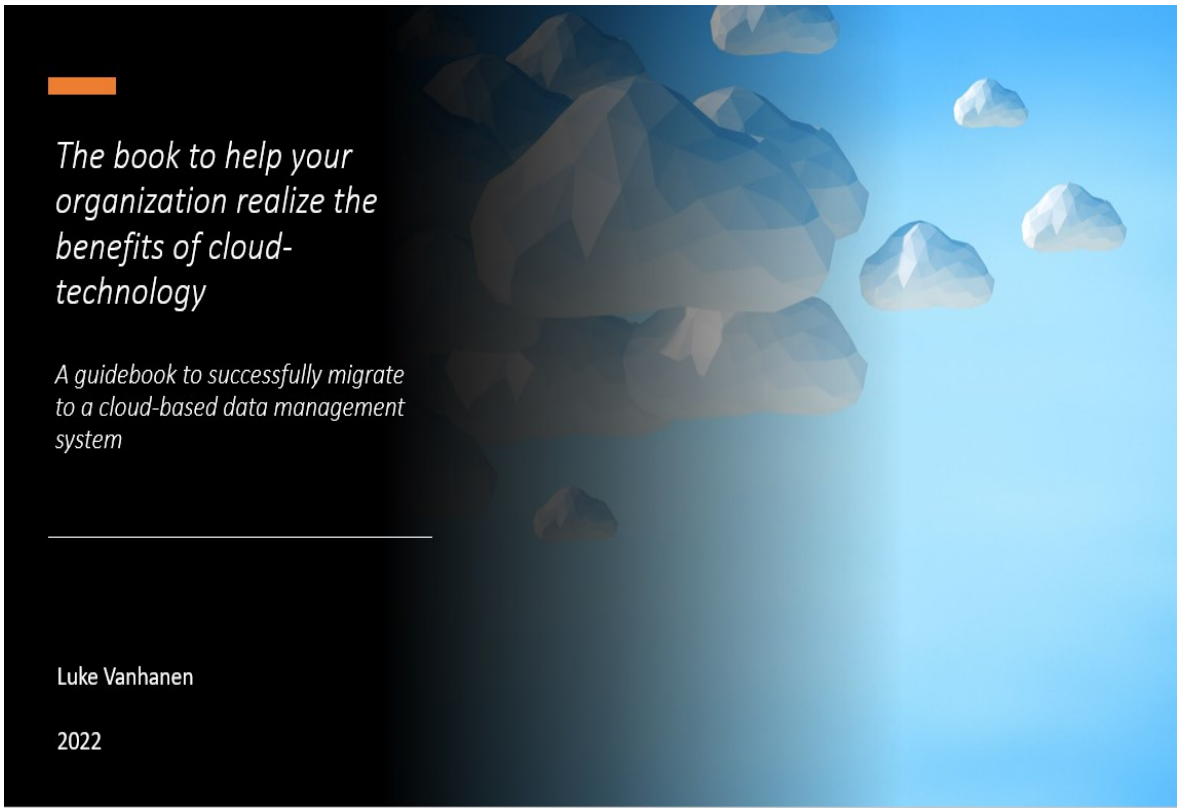
Appendices

Appendix 1. The guidebook



Contents

Foreword, purpose and benefits of this book

- This digital guidebook is intended for every organization that has determined to pursue migration to a cloud-based data management system. The book will include practical recommendations for your organization to start your journey towards successfully executing cloud migration.
- As technology develops ever quicker, the new technologies affect organizations radically. Digital transformations are becoming a key strategic issue for all organizations. Cloud migration is one of the first steps in a digital transformation. The ultimate purpose of this guidebook is to uncover the best practices and to avoid the biggest roadblocks in cloud migration, therefore equipping your organization with the tools to succeed.
- As the guidebook will not be directed towards a specific organization, industry or market, the material and recommendations will be of a general nature. As you, the reader, starts studying this guidebook, keep in mind that your organization's specific circumstances, both external and internal, will have effects on the recommendations in the guidebook. The guidebook will however have two main limitations, namely limiting the service and delivery-models to the SaaS and public-cloud models.
- The guidebook will be created in a linear fashion and divided into pre-migration and post-migration sections and so following the guidebook should be easy.

Cloud strategy creation

- At this point, your organization has already determined that migration to a cloud-based data management system would be beneficial. The next question in your mind is probably: "Where and how do I start?" The most important deliverable and process to complete is the creation of a clear, comprehensive cloud strategy. This strategy will ensure that your organization can achieve the benefits of the migration and also mitigate the biggest risks in the migration. The guidebook will be more information-heavy in the pre-migration section. This indicates that initial planning should not be overlooked.
- The following slides will introduce a cloud strategy creation framework, which includes seven steps. Completing every step will be crucial for successful migration. Additional insights will also be included regarding the chosen service and delivery models as well as factors regarding communication. On the right, you can see the seven steps in cloud strategy creation. The following slides will go through each of these steps.

- 1. Analyzing the cloud business objectives
- 2. Analyzing the current business context
- 3. Analyzing IT architecture requirements
- 4. Future / Target state analysis
- 5. Gap analysis and activities planning
- 6. Risk assessment
- 7. Implementation plan

2

Analysis of the cloud business objectives

- The first step in cloud strategy creation is the analysis of what the cloud migration is supposed to achieve. (the business objectives of the planned migration). Since your organization has already determined that cloud migration would be beneficial, it is necessary to define the specific objectives your organization wishes to achieve.
- On the right, you can see the most common objectives that organizations that consider cloud migration are looking to reach.
- Since the guidebook is more specifically about data management, the most relevant objectives will be faster time to market, improving operations and increasing organizational agility as well as upgrading decision-making processes.
- Ultimately, as this change initiative will require considerable financial resources as well as time, the goal should be to differentiate your organization from competitors, create growth and improve profitability. Increasing organizational agility will also be a key goal, since today's business environment changes quickly. The new cloud service should prepare your organization to respond more quickly and more effectively to external changes.

- Quicker release of new products, services and business models (faster time to market)
- Achieving operational excellence and operational flexibility (and increasing overall organizational agility)
- Acquiring and retaining new customers
- Upgrading decision-making processes
- Gaining a competitive advantage and ensuring business survival

3

Business capabilities assessment and defining the current business context (1/2)

- Business capabilities are your organization's outcome of investments in staffing, training, compensation and other HR areas. Differences in intangible assets, like knowledge and expertise, may explain why one organization is more successful than another.
- Due to the general nature of this guidebook, specific recommendations will be difficult to make, since organizations even in the same industry or market can differ widely especially in intangible assets. However, a factor that will most likely be mentioned throughout this guidebook is consultation. Especially if your organization lacks technological knowledge and expertise, it will be necessary to choose a cloud provider that provides consultation regarding the cloud migration process.
- The second step is to define the current business context. Here, you must capture the macro-context of the business. The main deliverable will be to set up the business' direction and define the cloud needs based on the strategy. Multiple tools can be utilized, including a SWOT analysis, value chain analysis, the PESTEL framework and brainstorming sessions.
- The SWOT analysis can be used to create a matrix of different cloud deployment models and how they serve the needs of the business. A SWOT analysis also facilitates assessing company operations and helps to determine areas that need improvement. (continues)

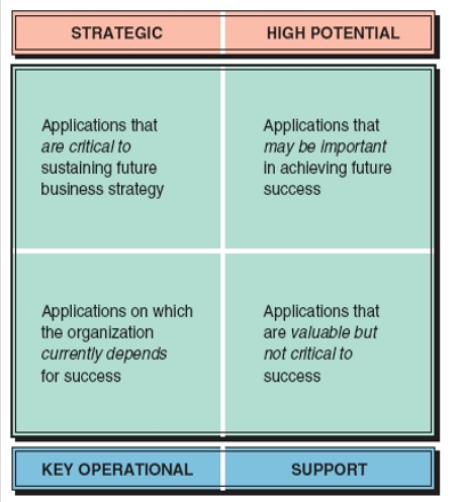
4

Defining the current business context (2/2)

- Using SWOT to determine what deployment model to choose will not be necessary, since in this guidebook the chosen deployment model will be the public-cloud model.
- A value chain analysis can determine what the primary activities of your organization's are that create the most customer value and whether the cloud improves the effectiveness and efficiency of these processes. However, it must be pointed out that the nature of cloud technology is such that it will improve efficiency and effectiveness by itself. This of course does not mean that your organization should not conduct a value chain analysis. Optimally, the new cloud service should improve your organization holistically, meaning that all business processes will be improved due to the new system.
- The PESTEL framework can be useful for determining macro-environmental factors (Political, Economic, Social, Technological, Environmental and Legal) When creating this framework, it is useful to focus most on factors that most affect the cloud migration in question. For example, political and legal factors can affect data security and compliance issues. Overall, this framework is useful in uncovering external factors that could potentially affect the success of the cloud migration.
- Conducting brainstorming sessions involving a diverse collection of people, including stakeholders, decision-makers and IT specialists to evaluate the impact of cloud adoption. (continues)
- The brainstorming sessions underline a crucially important notion that needs to be mentioned. As your organization begins to plan a cloud migration, it is necessary to encourage open communication regarding the new change initiative. Since your organization will be radically changing due to the new technology, internal stakeholders on all levels of the organization will need to be convinced that the change is necessary. Gathering feedback should be continuous, also from lower-level employees, because they will be using the new service.

5

IT architecture analysis



Picture 1. McFarlan IT portfolio grid (Metadataportal 2008).

- The objective of this analysis is to create an understanding of your business' IT architecture by defining its technical maturity and other factors that might need to be developed and reworked to execute a successful cloud implementation.
- This analysis includes atleast the following factors: assessment of the current IT enterprise architecture, applications, digital infrastructure, interfaces, data governance policies, metrics and key objectives
- An useful framework for this analysis is the McFarlan IT portfolio grid. This grid can help your organization to define the current, strategic, high potential or key operational cloud support systems. Mapping the cloud infrastructure on the McFarlan portfolio grid can help in matching business requirements to the cloud and to evaluate how your existing systems are contributing to your company's business objectives.
- Similarly as in slide 6, it will be beneficial for your organization to choose a cloud provider that can provide consultation, especially if your organization lacks IT expertise. Since the cloud provider will have more technical expertise and knowledge, they should be able to provide input in analyzing your IT architecture.

6

Future / target state analysis (1/2)

- The key objective of this analysis is to develop a vision of the cloud-enabled enterprise architecture. This includes technological and business aspects. At this point, impact on business processes and operations are considered.
- Two different strategic tools should be utilized here, **use-case modelling and analysis**, and a ***business value and benefits assessment***.
- Use-case modelling and analysis is utilized to determine the requirements of the cloud system and therefore set the overall scope for the cloud provider. This creates clarity for what needs to be done so that maximum benefit can be reaped from the cloud investment. This analysis is important especially in the context of the deployment and delivery models in question. Since your organization will have virtually no control over the cloud service, this will increase your dependence on the cloud provider. A service-level agreement needs to be created. This agreement will ensure that the provider must keep the service available and functioning properly. Use-case modelling will also help with the actual migration of your data since it is used to determine the requirements of the system.
- This analysis is useful in the context of the deployment model, namely the public-cloud model. Cloud security is one of the main concerns in this model, due to its open nature. When assessing cloud providers, your organization should keep in mind the factor of cloud security, and make sure that the cloud provider you do choose has adequate knowledge of cloud security issues. The service level agreement should therefore include that the provider is responsible for maintaining cloud data security. The cloud provider should also be knowledgeable of legal issues, like data privacy laws, and make sure that the cloud servers are in compliance with these laws.

7

Future / target state analysis (2/2)

- The business value and benefits assessment enables your organization to quantify the pros and cons of different cloud solutions and thus choose a specific cloud solution by evaluating both financial returns (cost savings) and non-financial returns (operational risks) This tool is also vital in choosing a suitable cloud provider. In the previous slide it was mentioned that your organization will have a high degree of dependence on the cloud provider. This increases the need for carefully assessing different providers. This high degree of dependence can lead to a condition called vendor lock-in.
- Vendor lock-in is the potential scenario in which your organization becomes "locked-in" to a specific, in this case, cloud provider. In this scenario, switching providers will incur significant financial costs. Your organization needs to evaluate the possibility of vendor lock-in while assessing different providers. Vendor lock-in is part of evaluating both financial and non-financial returns, since switching providers will create costs and the state of being locked in increases operational risks.
- Since the new cloud service will most likely be used by employees on many levels of the organization, as you assess different providers and at the very least when you have a few potential providers in mind, you should be able to test the new service. Employees will also need training to use the new service efficiently. Choosing a more simple, easy-to-use service will require less training for employees and also reduce resistance from employees, leading to a higher rate of adoption. As previously mentioned, employees should be encouraged to give feedback on the proposed service.

8

Gap analysis and activities planning (1/2)

- Gap analysis includes identifying gaps and dependencies in the cloud solutions your organization is considering to ensure there are no barriers to implementation. This should include an assessment of the potential technological and IT workflow gaps and opportunities for streamlining, reorganization or simplification.
- The key deliverables at this stage are iterative fit-gap assessments. This tool can help your organization to identify priorities, overlaps and shortfalls. The main objective is to get a clear picture on the problems your organization faces and how the proposed cloud solution will solve them.
- A five-category table can be created. This tool will answer fundamentally important questions regarding the scope of the change initiative. The table is presented in the next slide.

9

Gap analysis and activities planning (2/2)

Fit-Gap Analysis

	Current state	Future state	Gap	Actions to close gap
What	What is happening?	What should it look like?	What is different?	What will be done to address the gap?
Where	Where is a confusion	Where will it change?	Where will it be different?	Where will it be addressed?
When	When is it done?	When it will be addressed?	When are the differences needed?	Where will it be addressed?
Who	Who does the work?	Who will do this?	Who will identify the gap?	Who will make the decision?
How	How is it sequenced?	How will it be timed and resourced?	How will the gap be improved?	How will it be rolled out?

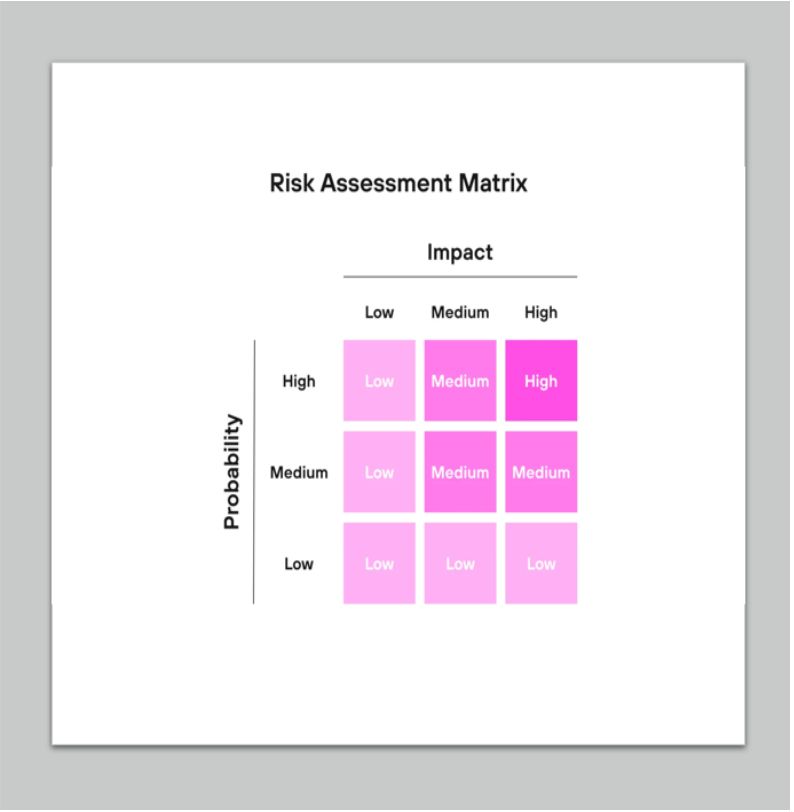
Picture 2. Fit-gap analysis. (Avenga 2021).

The utility of this table is in asking important questions regarding the present and the future business situation of your organization. This systematic approach will ensure that it is fully clear to your organization what needs to be done, what will change, when specific steps will be completed, who will do it and how will it be done.

Answers to the questions in this table create the foundation for the implementation plan of the cloud solution. Regarding communication, it is beneficial for a diverse set of people to participate in creating this analysis. This is because different people bring different perspectives and therefore the answers to these questions will be more complete.

RISK ASSESSMENT (1/2)

- The sixth step in the creation of your cloud strategy is conducting a risk assessment. This assessment will help your organization to determine and validate potential issues and then to create appropriate strategies to mitigate these issues. Risks in this assessment can be categorized into delivery and benefits risks.
- Delivery risks include the risks that might occur if the vendor cannot deliver the required capabilities. These include the reliance of vendors, a lack of scope clarity, unorganized deliverables or poor project management.
- Benefits risks include the risks of not achieving awaited business objectives. These include a lack of alignment of the business with the IT department, misaligned technical standards in architecture, inappropriate security compliance or undefined metrics to evaluate business outcomes.
- After identifying the potential risks, they must also be prioritized according to their likelihood of occurrence. A tiered probability-impact matrix analysis should be created. This will help your organization to define the various risk components in terms of their impact and probability. This framework is presented on the right. The top right square is the risk with the potential highest impact and highest probability of occurring. Perhaps self-evidently, the risks with the highest impact and highest probability of occurring should be addressed before the less crucial risks.



Risk assessment (2/2)

- In the end, the previous steps in the cloud strategy creation process and the analyses associated with them should reduce the probability of the risks identified in the previous slide. For example, the risks that could occur if the vendor cannot deliver the required capabilities should be mitigated as you create a service level agreement, since then the vendor must uphold a certain level of functionality of the service. The service level agreement should also address data integrity and data governance issues. Since these are important principles in data management, the service provider should be aware of them and therefore be able to provide a high level of service.
- As cloud cost control can be difficult, financial planning as a part of cloud strategy creation is vital for success. Assigning a reasonable budget solely for the cloud and scaling its use will reduce the risk of costs rising uncontrollably. This is a part of activities planning and finally the implementation plan.
- An important factor to mention here again is the impact of communication (and a lack of communication) on the potential delivery and benefits risks. A lack of communication is partly a reason for all of the following risks: lack of scope clarity, unorganized deliverables, poor project management, lack of alignment with the IT department, misaligned technical standards in architecture and undefined metrics to evaluate business outcomes.
- Open communication with internal stakeholders is crucial in clarifying the change initiative. Communication with the service provider should also be continuous so that the provider understands your organization's situation and business objectives.
- Ultimately, the biggest risk in this change initiative is starting the process without a clear strategy. The strategy will provide a logical and comprehensive framework that covers the most important factors to ensure success. The cloud strategy will provide clarity to the initiative and reduce confusion.

12

Implementation plan

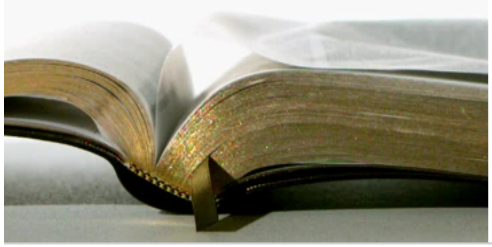
- The seventh and final step is the creation of an implementation plan. The goal is to form a plan that supports the cloud migration process through an implementation roadmap with practical recommendations. These recommendations include establishing a management framework that is aligned with strategic business issues as well as the arrangement of resources and capabilities planning to ensure that the migration process is staying on track.
- Forming best practices for a successful cloud implementation. This includes the training of employees who will use the new cloud data management service. Planning a governance process that encompasses the management and assessment of the cloud strategy. Here, consultation from the service provider and perhaps other data management experts could be beneficial. Integration and documentation of the cloud strategy should also be conducted. Again, since the service provider will most likely have extensive knowledge of the service and cloud technology, communication between the organization and the provider should be frequent, as well as communication within the organization to solve the problem of integration.
- This concludes the pre-migration portion of the guidebook to successful cloud migration to a data management service. However, as mentioned already, this cloud strategy framework is generic. Your organization's specific circumstances and goals will most likely affect some of the steps. The general nature of this guidebook should however provide your organization with the most important aspects to consider in cloud migration as well as simple but useful tools to analyze the process. In the next slide, post-migration factors to consider will be presented.

13

Post migration actions

- The pre-migration portion of this guidebook has been heavy on relevant information and analyses. As previously mentioned, this does suggest that success of the planned migration is quite dependent on pre-migration strategic planning.
- Post-migration factors are to do with sustaining success of the new technology and service that your organization is now operating with. The initial strategic planning should in theory anticipate all the possible issues that arise during and after migration. This is however unrealistic, since your organization cannot anticipate every single variable that could cause problems post-migration.
- KPIs (key performance indicators) are an useful tool to analyze aspects like the cloud infrastructure, application performance and user experience. The cloud infrastructure and its capacity should be optimal at all times, since one of the essential characteristics of cloud technology is rapid elasticity. Therefore, your organization should be able to scale the use of the service according to demand.
- Application performance analysis is necessary. Since your organization will be using a SaaS delivery model, you will not have virtually any control over this analysis. The service level agreement should cover this aspect, therefore making the service provider responsible for keeping a high standard of application performance
- Users of the service should be encouraged to give feedback. This could lead to iterative improvement of the service. Frequent communication with the service provider could also create similar improvement.

14



Conclusions

- This is the final slide of this digital guidebook. This book demonstrates the most crucial issues in cloud migration and how to plan for a successful migration. But as a reminder, the analyses, tools and recommendations presented in this guidebook are not exhaustive. The general nature of this guidebook should provide your organization with a solid framework to begin the migration to a cloud-based data management system.
- To maximize the chances for success, you will need to consider the specific external and internal aspects of your organization, for example market and industry conditions and your organization's strengths and weaknesses. Also, do not underestimate the importance of open and clear communication, which is a core change management principle.
- The systematic structure of this guidebook should be easy to follow. Every step in this guidebook has its own analyses, and they should all be completed. The insight gained from each step will facilitate better decision-making related to cloud migration. After completing each step, your organization will be well equipped to avoid the biggest roadblocks in the migration and to gain the benefits from this new technology.

15

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