



MPM – Master of Project Management

Cloud Adoption Challenges

What are the primary challenges for organisations when conducting cloud adoption projects?

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Student: Árni Þór Jónsson

Supervisor: Bob Dignen

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CLOUD ADOPTION CHALLENGES

Árni Þór Jónsson¹

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ABSTRACT

Cloud computing is an economic and operational model which has become mainstream and is growing every year. Besides providing an opportunity to control costs, the main reasons for companies adopting the cloud are to gain speed and agility. Organisations globally are increasingly moving to the cloud and initiating projects to manage this technological change. This leads to the research question: "What are the primary challenges for organisations when conducting cloud adoption projects?". The literature review defines cloud computing before examining the topics of change management and, more specifically, cloud adoption projects. Four IT professionals with experience of cloud adoption projects were interviewed for this research. The main finding is that cloud adoption projects face three main challenges: *the intrinsically highly transformational nature of cloud adoption itself and the associated disruptive nature of such transformations, the requirement for a baseline of organisational maturity, and the human factor - the psychology of fear and resistance when faced with a particularly unfamiliar and abstract change driver such as represented by cloud computing.*

¹ Árni Þór Jónsson. E-mail: arni.thor.jonsson@gmail.com. Tel:+354 8997652

1. INTRODUCTION

Currently, the world is undergoing its fourth industrial revolution. Whilst we may not understand it fully until a point in the future, symptoms are recognisable in a variety of business and personal contexts. One such symptom in professional life is cloud computing (Ólafur Andri Ragnarsson, 2019).

Cloud computing can be defined as the delivery of on-demand computing services (from applications to storage and processing power) on a pay-as-you-go basis (Ranger, 2018). By taking advantage of cloud computing, users can achieve cost savings and increase the speed and agility of their IT solutions along with various other benefits.

The history of cloud computing can be traced back to as early as 1961, with Professor John McCarthy already identifying that computing could one day be sold as a utility (Varghese, 2019). However, this research paper focuses on the phenomenon of modern-day cloud computing, which is considered to have started when Amazon launched its Amazon Elastic Compute Cloud to the public in August 2006. Amazon was far ahead of its rivals and has managed to secure a dominant position in the market, although competition is increasing with companies such as Microsoft, Google and IBM stepping into the arena (Miller, 2016).

Gartner Inc forecasts that the worldwide public cloud services market will grow by 17% in 2020 to a total of 266.4 billion US dollars, up from 227.8 billion in 2019. Sid Nag, research vice president at Gartner, says that cloud adoption is now mainstream, and he predicts that by the year 2022 up to 60% of organisations will be using external cloud services, which is double the number from 2018 (Costello & Rimol, 2019).

Therefore, it is safe to assume that for certain project managers in IT and other fields, cloud computing will be important in future projects in their organisations. For organisations making their way to the cloud, there are likely to be a number of new and specific challenges for those project managers tasked with leading this change process. Accordingly, the question that this paper aims to answer is:

What are the primary challenges for organisations when conducting cloud adoption projects?

The fact that so many organisations are adopting, and will adopt, cloud technology makes this question highly relevant. The paper aims to provide project managers with some valuable insights into the range of challenges that might occur during cloud adoption.

2. LITERATURE REVIEW

This paper examines challenges related to cloud adoption in the context of change management. These challenges will likely impact the project manager leading the change, individual team members, the teams involved as well as the wider organisation itself.

2.1 Definition of cloud computing

The US National Institute of Standards and Technology defines cloud computing as follows: *"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"* (Mell & Grance, 2011, p. 2).

The cloud presents existing technology in a new way. There is no cloud computer that must be bought to be able to take advantage of cloud computing. As the first line of NIST's definition states, cloud computing can be seen as an economic and operational model which allows the user to buy what he needs, when he needs it, and give it back when finished (Jackson & Goessling, 2018).

2.1.1 Five essential characteristics of cloud computing

NIST lists five characteristics of cloud computing; on-demand self-service, broad network access, resource pooling, rapid elasticity and measured service (Mell & Grance, 2011) For a short description and definition of what parameter each characteristic addresses, see table 1.

	Characteristic	Description	Parameter
1	Broad network access	Consume services from anywhere	Where
2	On-demand self-service	Consume services when you want	When
3	Resource pooling and virtualization	Pool the infrastructure, virtual platforms, and applications	How
4	Rapid elasticity	Share pooled resources to enable horizontal scalability	How
5	Measured service	Pay for the service you consume as you consume it	How much

Table 1 – Five characteristics of cloud computing (Ruparelia, 2016, Chapter 1, Table 1)

2.1.2 Three service models

"In IT, a service is a collection of IT systems, components, and resources that work together to provide value to users" (Ruparelia, 2016, Chapter 1, para. 12). NIST lists three service models in cloud computing. Ruparelia argues that two further service models be added to the NIST definition: Information as a Service (INaaS) and Business Process as a Service (BPaaS) (Ruparelia, 2016). For the purposes of this paper, the NIST definition is sufficient to simplify the cloud discussion (Jackson & Goessling, 2018).

	Service	Service offering
1	Infrastructure as a service (IaaS)	Hardware infrastructure (servers, storage, etc.) on a utility basis.
2	Platform as a service (PaaS)	Same as IaaS but includes the operating system and any other core applications of the operating environment to enable you to install and run your software. Pricing generally is on a utility basis.
3	Software as a service (SaaS)	As per PaaS but includes hosted applications that fulfil a function. The function could be a business, social, or personal function. You simply use the application or applications that you need, when you need it, and avoid the cost of installing and maintaining the application and its supporting hardware infrastructure. Pricing is on a per-use basis.

Table 2 – Three service models of cloud computing (Ruparelia, 2016, Chapter 2, Table 2)

2.1.3 Four deployment models

The four deployment models are private cloud, community cloud, public cloud and hybrid cloud. This paper focuses on the public cloud, as defined by NIST: *"The cloud infrastructure is provisioned for open use by the general public. It may be owned, managed, and operated by a business, academic, or government organisation, or some combination of them. It exists on the premises of the cloud provider"* (Mell & Grance, 2011, p. 3). Notable public cloud providers are Amazon, Microsoft, Google, Alibaba and IBM among others.

2.2 Motivations for migrating to the cloud

Amazon Web Services lists the four core benefits of cloud computing as agility, elasticity, cost saving and the ability to deploy globally in minutes ("What is Cloud Computing," n.d.). Reviewing the promotional material of vendors and related literature, these four themes are pervasive, although they may take a somewhat different form depending on vendor emphasis. Every organisation has its own specific motivation for moving to the cloud. Andy Jassy notes that although cost savings are compelling, the primary reasons for companies adopting the cloud are to gain agility and speed. Software developers, in particular, can use the cloud to focus their time flexibly to develop new ideas. In terms of speed, for example, a server may be established up and running in the cloud in a single day, as opposed to waiting weeks for an on-premises server (Orban, Jassy, Cockcroft, & Schwartz, 2018). In *the Cloud Adoption Playbook*, Abdula, Averdunk, Barcia, Brown, & Emuchay (2018) strike a similar chord, saying that innovation and rapid change are often the main motivations for adopting cloud technology.

2.3 Change management

Change management as a body of knowledge highlights the challenging nature of projects which drive transformation, citing resistance as common, and mechanisms to manage resistance as essential for success. John Kotter defines an eight-stage model for achieving major change. His identified stages are: establishing a sense of urgency, creating a guiding coalition, developing a change vision, communicating the

vision for buy-in, empowering broad-based action, generating short-term wins, never letting up, and incorporating changes into the culture (Kotter, 2012).

Kotter emphasises the importance of navigating these eight stages in sequence. Although all projects will operate in more than one phase at once after passing beyond the first stage, skipping a step or moving too far ahead too fast in the sequence usually fails to create the needed momentum (Kotter, 2012).

In his book, *Viral Change* (Herrero, 2008), Leandro Herrero critiques the Kotter model as too linear. Herrero summarizes his criticism by saying that change is essentially a bottom up / grassroots change. It is behavioural in character, with behaviours spread and scaled up by a small number of individuals who have little to do with the hierarchy of the system (Herrero, 2014).

Herrero's approach to change is echoed in much current leadership thinking which approaches outcomes in organisations less driven in linear fashion by 'heroic' leaders, but as an emergent process involving distributed or dispersed multiple agents – people and processes – in the context of a complex eco-system (Western, 2019).

In a 2012 article entitled *Accelerate*, Kotter introduced non-linearity into his own modelling by suggesting a dual system for change. He claims that whilst traditional hierarchies and managerial processes are good for the daily demands of running a company, they are not fast enough to identify hazards and opportunities and react to them successfully. He suggests a dual operating system for organisations: a hierarchy and a network. The network is the second operating system and is "*devoted to the design and implementation of strategy, that uses an agile, networklike structure and a very different set of processes*" (para. 6). Instead of eight steps, the network uses eight accelerators, similar to the earlier defined steps. The three main difference are:

1. The steps are often used in rigid, finite, and sequential ways, in effecting or responding to episodic change, whereas the accelerators are concurrent and always at work.
2. The steps are usually driven by a small, powerful core group, whereas the accelerators pull in as many people as possible from throughout the organisation to form a "volunteer army."
3. The steps are designed to function within a traditional hierarchy, whereas the accelerators require the flexibility and agility of a network. (Kotter, 2012, para. 9)

In an interview from 2014 Kotter explains that rates of change have been increasing and that on a macro level, the two biggest drivers are technological advancement and globalization, with no evidence that technology advancement is going to slow down. The speed and newness of change is the number one leadership challenge, and the ideas laid out in the *Accelerate* article are meant to form part of the solution (Lattimer, 2019)

2.4 Cloud adoption projects

Many consider that success in cloud adoption projects depends primarily on technology factors, for example that the selected specific solution fits to an organisational need and capability. However, success factors may be much broader

than issues of technology in contexts where projects of this type imply a shift in organisational culture. Importantly, Cloud computing is transformational on a number of levels beyond technical. Indeed, perhaps its major adoption challenge is facilitating a change of hearts and minds of people in the organisation (Jackson & Goessling, 2018). Cockcroft also acknowledges from his experience working on technology migration with enterprises that *"it is usually people and processes that are the blockers, not technology problems"* (Orban et al., 2018, Foreword, para. 5).

Abdula et al. (2018) indicate that companies must understand the fundamental cultural changes needed to make cloud adoption successful. They explain a number of cultural elements that need to be considered: willingness to embrace change, decision-making style, attitude towards risk and view of failure. It is important to note that these elements can differ within organisations, or even within a single IT department, where powerful cultural differences exist between developers and operations specialists. Specifically, they note that adopting the cloud will lead to two changes in an organisation: firstly, the organisation will need more generalists and fewer specialists; secondly, the organisation will become less compartmentalized and more integrated.

The democratisation promised by the cloud is an interesting phenomenon. When discussing the second cloud characteristic of "on-demand self-service", Jackson & Goessling (2018) point out that almost anyone with a credit card can get started on the cloud without having to go through the proper channels within an organisation. This phenomenon or activity is often described as shadow IT. They add that this characteristic of the cloud can be troublesome because independent decision making of this form has the potential to instantly wreak havoc on established governance, security, long-term cost, strategy, internal politics, and collaboration. The presence of shadow IT, a phenomenon indicative of low organisational maturity, may be significant in the success of cloud adoption. Abdula et al. (2018) point out that when cloud adoption has been initiated by shadow IT outside of the IT department, the professionals who should be involved can see the cloud as a threat to their jobs, which generates initial resistance and challenge for the project.

3. RESEARCH METHOD

The aim of this research was to explore the possible challenges faced by organisations when conducting a cloud adoption project. The research method selected was a qualitative method. This chapter explains the reasoning for this decision and how the participants were selected.

3.1 Method

The possibility of a quantitative method was considered. There were three reasons that this method was not chosen:

- a) The domain of challenges is not known, making it difficult to create a questionnaire of fixed questions that adequately cover all possible challenges.
- b) The pool of eligible participants is small, and some screening of participants is necessary in order to establish that their experience is relevant to the research, as opposed to just having general knowledge and opinions on the

topic.

- c) The human factor would be less prevalent. In a quantitative research it is possible to establish simple data points, for example that it is a challenge to keep a project on schedule, but it does not provide much opportunity to clarify the causes of any challenge, and to which degree the nature of the project (cloud adoption) is a factor.

Performing a case study was also considered. A case study would have provided an opportunity to do a deep analysis of the challenges in one specific case. However, it would greatly limit the number of results. A single case is unlikely to provide enough data points to draw wider conclusions.

The method chosen was, therefore, qualitative, opting to interview a number of professionals who had worked on one or more cloud migration projects, asking them to specify their various challenges and to provide their own perspectives on them.

3.2 Participants

The criteria for selecting participants was threefold:

- a) An IT professional who has played a role on at least one cloud adoption project, whether it be as a project manager, project owner, digital lead, consultant or any similar role.
- b) The project should have been executed at any type of organisation within the public or private sector that was previously dependent on a legacy system before beginning the cloud adoption. This criterion really only leaves out entrepreneurial companies that base their start-up on cloud technology from the beginning and have no legacy systems or culture to change from.
- c) The project need not have been a wholesale migration into the cloud, but rather any organised effort to initiate, organise or execute any part of a cloud adoption process, which could be creating a strategy or executing a proof of concept, or similar undertaking.
- d) The group of participants and projects led should be as diverse as possible within the boundaries of the subject matter.

Six people were contacted, all initially agreed to participate. Two dropped out, leaving four participants to be interviewed.

3.3 Interview structure

Each interview was a one-on-one open discussion, where the participants were encouraged to share their experience of cloud adoption projects, with an emphasis on the challenges faced. The participants had the freedom to discuss one or more projects that they had been involved with.

The interviews took place between 26th March and 2nd April 2020. The duration was between 42 and 69 minutes and all were confidential. All interviews were conducted online via Microsoft Teams and were recorded.

The interviews enabled the participants to lead the discussion into the areas considered to be most challenging during the cloud adoption projects participated in, reflecting on the three main milestones of a project, ending with a general reflection on the subject. The interview was structured into five sections:

1. Profile of the participant
2. Preparation and planning
3. Implementation
4. Results
5. Reflections

A list of questions was prepared for each section to probe and prompt if needed.

4. RESEARCH RESULTS

This chapter details the results from each of the four interviews, starting with the profile of each participant. Each participant's comments are either paraphrased or summarised by the researcher, or directly quoted.

4.1 Profile of the participants

The aim of this section was to allow the participants to describe themselves and provide background. The participants have been named Participant A through D according to the order in which they were interviewed. Efforts have also been made to hide their identities by using placeholders for institutions and companies.

4.1.1 Participant A

Has an advanced educational background in the humanities with a keen interest in the practice of softer sciences within the hard sciences. She defines herself as someone who is "between technology and community". Currently works as a team leader in software development at a government institution (Institution A) where she has recently led a successful cloud adoption pilot project.

4.1.2 Participant B

Holds a bachelor's degree in computer science. Has worked in various IT roles, both as a specialist and as CTO. His first encounter with cloud technology was in 2007 while in a management role. He then started his journey as a cloud specialist in 2010. He currently works as a cloud specialist in the IT department of a large holding company.

4.1.3 Participant C

Has an educational background in life sciences along with a long list of IT certificates. A recognized expert in the field, he now works as a consultant, with the last six years mostly as an architect for large internal systems. He has consulted on projects in various cloud technology, Azure, AWS and Google.

4.1.4 Participant D

Describes himself as a tech enthusiast. Started at age ten to program in BASIC and has been involved with computers since. He has an educational background in electronics and has worked extensively with both hardware and software. He joined a hosting provider company in 2007, and eventually found his way into the cloud from there.

4.2 Preparation and planning

The participants discussed the preparation and planning in a project or projects they had worked on.

4.2.1 Participant A

The institution she works for is still taking its first steps into the cloud. A project was selected which revolved around transforming one of the services currently provided and designated as a proof of concept (POC). The declared purpose of this POC project was to “challenge all borders”. She mentions procurement practices, data storage, GDPR concerns and design as examples of what was challenged during the preparation phase.

Part of the preparation was to perform a thorough analysis, consulting with third party independent advisors and internal stakeholders. Security was the main issue. Representatives from the business asked whether it was safe to put sensitive data on a server that wasn't even in Iceland, *“The questions the business asked were: should we store our data somewhere abroad where we have no control over it? Aren't we better of storing it down in the basement? Can't we have an employee located here to watch over it for us?”*. She considered the questions valid and it wasn't until after a thorough analysis that the decision was made to store the data in the cloud. The argument for the decision was that storing it in the cloud was in fact *more* secure and *was* in compliance with laws that address data storage. Another factor that affected the decision was that it would be more cost efficient to use the cloud than to use internal resources or a domestic hosting provider.

A lot of discussion went on within IT regarding all technical aspects of the project. Some of the topics were off-the-shelf vs new development, architecture, data storage. At that time the IT department wasn't particularly for or against the cloud. The software development work was done by a contractor.

She describes the various methods used to plan and organise the project. She describes a thorough planning phase with much stakeholder involvement. She also talks about how information regarding the projects was communicated to various stakeholders according to their needs and understanding.

4.2.2 Participant B

In 2007 he worked as a CTO for an international private company (Company A) that sold telecom solutions as a service. The software was hosted using a hosting service and the company was experiencing problems with scaling that they tried to solve by always buying additional hardware. A lot of time was spent on putting out fires. This situation was proving to be costly for both the company and its clients, so they needed to find an alternative solution.

After speaking with a few people within the IT industry he came to the conclusion that migrating to the cloud was a potential solution to his problems, so he presented this decision to his colleagues. Business and marketing did not have a strong opinion on cloud technology, but they were impressed with the fact that they didn't have to commit to a multi-year contract every time they took in new hardware, as was the practice at the time. To his surprise, the IT staff was greatly against migrating to the cloud, "... they were simply against it, they couldn't understand how you could run services with someone you hadn't made a contract with and you couldn't see the machines it was running on, they didn't understand the concept and were always talking about what would happen if they had to reboot the server and all that ... yes, they just didn't understand it." He goes on to explain that many of whom he had thought to be key employees, were the most against it. They were used to being able to call an employee of the hosting provider to ask for a reboot or some other assistance. They felt it was irresponsible to use servers they couldn't see or touch. He adds that it is important to bear in mind that this was still in the early days of cloud technology so all the objections could primarily be traced to lack of knowledge.

He had already made up his mind, so despite the resistance, he hired an outside contractor who had some cloud experience *"I used him as some kind of change agent, you know? ... and then I put a few young guys around him, not many, and then we found a candidate, a new service that we needed to make, and we decided to develop that for the cloud"*. He put this new team in a room together where they could work undisturbed on this pilot project.

He also talks about other projects that he has been involved in and explains that today he doesn't feel there is the same resistance as he experienced at Company A. The biggest challenges today are lack of education in the cloud and a deep understanding of how it works and how it differs from typical on-premises (on-prem) hosting. One issue that still gets brought up is security. He feels that many people still think that on-prem is a more secure option than the cloud. He disagrees and says that this is an example of lack of knowledge about how the cloud works.

Eight years later he worked for another company (Company B) where all the company's on-prem IT solutions were migrated into the cloud with success. He says that there was a lot less resistance than was at Company A, but that this could possibly be due to greater familiarity with the cloud among those involved. There were concerns about security which resulted in a lot of discussion. The concerns were tackled by studying the list of security requirements for the company's industry and finding out how these security requirements could be met in the cloud.

He also mentions his most recent professional experience (Company C). He explains that the company is going down a new path by putting new solutions in the cloud as opposed to hosting them on-prem as historically done. He explains that the decision to go to the cloud has been taken, but not clearly delineated nor documented. The atmosphere at Company C is similar to the atmosphere at Company B. He can observe that there is more understanding and curiosity regarding the cloud at Company C than there was at Company A. For example, he notes that at Company A there was active resistance, whilst not at Company C. He remarks that generational differences may be a driver of attitudes with the older generation not quite as eager or as curious as the younger generation. He feels that what is still missing at Company C is sufficient knowledge and understanding of the cloud and how it functions in contrast to the typical on-prem setup. He mentions, as

an example, that discussions about security still occur with some people still thinking that on-prem is more secure than the cloud, which is a misunderstanding in his opinion.

4.2.3 Participant C

He talks about the two different groups of clients he has: firstly, organisations that have always operated their own data centres, either in-house or with a hosting service, but are now investigating the cloud and services in the cloud such as AI or large analytics services: secondly, the client that was never planning to run a data centre, but ends up taking everything into the cloud from the start.

He is often brought in by companies to consult on cloud adoption. He says that there are often already cloud solutions in use at these companies which have circumvented IT governance. He notes that it is very easy for a developer to set up a server in the cloud in a single day. This poses a problem, because programmers are less likely to be knowledgeable about infrastructure, networking, disc management and most importantly, security. He also indicates that the advancements in cloud have been so fast over the last few years that it is very hard for system operators to keep up.

Indeed, the traditional system of separation between development and operation is now being challenged. Historically, development hands over a finished software product to operations, who then install it on a server and run it. This procedure is not longer applicable in the world of containers and micro services. *"I think that over the next two years, ops people will be forced to learn how this works"*.

He talks about lack of direction within the organisations he has worked for. Quite often different business units within the same company are using different cloud providers. When asked about IT strategy he says that *"in every instance there is no strategy in place"*. He is often brought in to help with creating a strategy. He also remarks that it is common for Icelandic companies to not have an IT strategy.

When asked about change management, he answers that he is not aware of any such processes being in place. He then goes into explaining that the role of enterprise architect is also absent from Icelandic organisations. He claims that there are very few organisations that have a single individual who is responsible for architecture. Smaller companies might not need this role, but larger companies definitely do. This individual would play a large role in change management.

4.2.4 Participant D

His first experience with the cloud came when he was working in the biotech industry in USA in 2012 (Company D), where he had set up a large IT infrastructure to service large scale medical research. The system was on-prem. It quickly became a challenge for the system to store and process the enormous amount of data that was being created. Access was also an issue, and he was forced to start controlling user access to the cluster by allocating time slots and issuing tokens. This became problematic when valuable research projects would quickly finish up their allocated time slots, but less valuable projects had slots that were not being used.

He decided that moving to the cloud would be an ideal solution. Each user could have their own cluster in the cloud, and it would be possible to measure the cost precisely. This made it easier to assess the financial feasibility of a project in advance, because the IT related costs were known. No access control would be necessary because the cloud could scale up as needed.

In his current role as a consultant he sees a lot of "shadow IT" when it comes to the cloud. He says shadow IT is a known concept and names as an example when non-IT departments discover services like Dropbox and Google Docs and start using them to store company data without consulting the IT department. Regarding the cloud, he says that *"We are definitely seeing some cloud shadow IT going on"*. He also mentions that not all organisations are like that, some companies do seek his services to help them form a strategy before any shadow IT activity has taken place.

He mentions as an example of shadow IT, a government institution (Institution B) where the developers just took off into the cloud and left operations behind. He says that it had gotten to a point where development had managed to get control of the domain name server from operations. With support from management, the operations department was eventually made redundant and was cleaned out.

He has an explanation why this transformation is primarily being initiated from within development. He says it is because the most important cloud services, PaaS and some of the IaaS features, are invisible and can only be accessed via an API. Developers understand API very well, *"so it's really just the programmers who understand the service, why it is valuable, and can use it ... however, they become very dangerous because they don't know what they don't know about classical systems operation, they don't always understand all the security and firewall issues which operations people think about"*.

4.3 Implementation

The participants discussed the implementation of a project or projects they had worked on. All note that the implementation phase of the project was relatively unproblematic.

4.3.1 Participant A

She feels the project at institution A ran smoothly without notable challenges during the implementation period.

4.3.2 Participant B

In the beginning, the pilot project team at Company A didn't have a lot of interaction with the rest of the company, but gradually the other staff started to take interest and ask them questions around the watercooler and over lunch, so awareness and acceptance of what they were doing grew during the implementation period.

He says he met no resistance during implementation at Company C, but he feels that it would be helpful if there were more resources dedicated to cloud adoption. He also feels management might show more understanding and enthusiasm towards cloud adoption. He also mentions that there should be more

support from management. He feels there should be more leadership. He says that strong leadership is needed when embarking on a cloud adoption journey.

4.3.3 Participant C

Reconciling operations and development can be a challenge, *"Most of the time you need to be able to play with both departments. I am not saying it is dev versus ops"*. He then explains that operations need to understand the needs of development to be able to develop faster to satisfy business needs, and at the same time development needs to understand that operations want to slow down the process to be able to address serious operational issues, such as security. In his experience the connection between these two departments can often be difficult, although both have the best interest of the company in mind.

Lack of knowledge can be a challenge. A conventional operations department often has very specialized individuals; web server specialist, data base specialist, etc. He points out that *"the cloud is really everything, and you need to know a lot of things to be able to take advantage of all the features and benefits that the cloud has to offer"*. He feels that companies need to be more active in encouraging staff to seek knowledge and get certified. He points out that all cloud providers offer certification programs.

4.4 Results

The participants discussed the results and impact of a project or projects they had worked on. The levels of success reported varied.

4.4.1 Participant A

Since the successful completion of the POC project at Institution A, the IT department has undergone some changes. The institution now has plans to create a cloud strategy. They have hired a software architect, a cloud specialist and a few new IT managers. They have also created an internal software development team and are hiring developers.

She says that not all employees were given a role in the new IT organisation chart. The criteria to land a role in the newly transformed IT department was to be enthusiastic and willing to learn how to do things in a new way.

4.4.2 Participant B

The pilot project at Company A was a success. Around the time the project finished, most of the staff had become so interested in the cloud that they had started to request that new services would be developed for the cloud, *"one thing that I find funny is that those who were most strongly opposed in the beginning were the ones who were most happy with it by the end"*.

He describes the benefits: *"instead of constantly be putting out fires and having all our staff doing that, we went over to having more of our manpower developing new services"*. The adoption project also gave them an opportunity to transform their architecture and split up their system into more manageable units.

He says that the results at Company C could be much better if there was more leadership and support from management. He feels the company is not using the cloud to its fullest potential. He says it is not clear that the cloud is a part of the company's future vision and he feels that it is wrong that the employees should be the ones that are pushing the company in the direction of the cloud.

4.4.3 Participant C

When asked, he says that most of the projects he has been involved with have been a success. He says that in the end everyone is working towards serving the benefit of the company. He feels it is really a question of how long it takes to get the company and employees to adjust to this new way of working.

4.4.4 Participant D

The project at Company D was a success. There was however an incident later on, when there were some changes to management within IT, one of the managers saw the cloud setup as a threat to IT and wanted to roll it all back, *"He literally saw it that way that I was taking business away from him"*. He said the manager quickly lost his appetite for making changes when he realized the scope of activities and amount of data that was being stored in the cloud, *"We had become too big to fail!"*

He says that the success at Company D attracted some of their partners to learn from them, and he said he could feel how the cloud gradually became the default standard with other large companies that they were interacting with. *"When we were sharing large amounts of data with other large companies, then it was just a matter of saying 'hey, where is your S3 bucket'"*.

4.5 Reflections

The participants were asked to provide some final reflections.

4.5.1 Participant A

When reflecting on the project in whole, she says *"what was the biggest obstacle? Yes, I'd say people's feelings"*. She goes on to elaborate that during a decision-making process like the one she went through in preparation for the POC, you meet people at their core. She says that decisions are made based on arguments, but objections can often be based on feelings, and that is a factor that must be accounted for.

4.5.2 Participant B

He is certain that bringing in a consultant to run a pilot project at Company A was the key to the project's success. He claims that if he had tried to run this himself then it wouldn't have been successful. He is certain that the key employees who were against this would have been a hindrance to him. They needed to see the cloud in action to be able to change their minds.

He talks about leadership and says it is important to take decisions and follow up on them, have principles in place that everyone follows and to get all the employees into the same boat.

He brings up a point about Company C, where he says that he feels that there isn't an effective policy in place regarding how the solutions that are in the cloud will be operated once they go live. He points out that the cloud calls for a different kind of knowledge from operations and a traditional operations employee is not guaranteed to have that knowledge.

4.5.3 Participant C

Questions about security are valid when it comes to cloud computing. He often sees systems that have been set up without much regard for security, some even need immediate attention. He goes on to say that some cloud providers have rather lax default settings when it comes to firewalls, as an example. The cloud can be secure, but you need to have the knowledge to implement it correctly.

He emphasises the importance of design and architecture when setting up cloud environments. This is an issue in today's hosting environments and the cloud is not exempt from needing proper architecture.

4.5.4 Participant D

He emphasises that companies need to be ready for what is coming. Companies that have not started to educate themselves in cloud technology are going to have problems. He believes they face a real problem in losing forward thinking employees because they will not be interested in working in the traditional manner anymore.

He talks about resistance, *"a lot of IT people just feel threatened, because they don't know this, and somehow didn't go in to learn this themselves, and they just feel this threat, and when you don't know what something is and it also threatens you, then you'll jump onto all evidence that shows that this is bad"*. He says he has seen a wide range of reactions in his career, but that over the last two years there has been less negative reaction. He mentions that people might be sceptical of a service that is not hosted in-country. For a while the discussion revolved around the cost of bandwidth between Iceland and Europe, an argument that is less valid now in his opinion.

He says about the cloud, *"this isn't just one tool, this is the new world ... this is an industrial revolution, it's so obvious"*. He says that over the next few years there will be a lot of fallout from those that don't adapt.

5. DISCUSSION

Analysing the literature and the research results shows that key drivers, challenges and success factors for cloud adoption can be understood within three broad categories: the first relates to industry, and is a combination of the current status of the IT industry and the specific characteristics of the cloud itself; the second driver is organisational in nature; the third covers individual or human aspects.

5.1 The industry

5.1.1 Transformation

Cloud computing is transforming industry and commerce. It is a part of a new emerging business landscape, the so-called fourth industrial revolution. Participant D strongly emphasised this, and it is echoed in the narratives of the other participants. The fact that the cloud forms part of a transformational solution rather than an incremental optimisation strongly defines its character, and associated project dynamics.

Specific change challenges also arise from the cloud's characteristic of "on-demand self-service". The risk presents itself in the fact that almost anyone with a credit card can get started on the cloud without having to go through the proper channels within an organisation, with potentially devastating consequences for established governance, security, long-term cost, strategy, internal politics, and collaboration (Jackson & Goessling, 2018). This potential for a single cloud adoption to act as a highly disruptive phenomenon to the status quo, even to those familiar with cloud operations, means that it can stimulate rapid and deep resistance within the organisation as described by both Jackson & Goessling (2018) and Abdula et al. (2018).

5.1.2 Accelerated speed of change

Not only is cloud computing transforming industry and commerce in general, but it seems to be doing so at great speed, both in terms of the adoption and advancement of technology. Cloud adoption is growing at a rapid rate per year (Costello & Rimol, 2019), and the associated technology is advancing at great pace as well. Participant C said that the advancements in cloud have been so fast over the last few years that it is very hard for system operators to keep up. Kotter observed this phenomenon, not simply for cloud computing, but with technology in general, and has said that speed and newness of change is the number one leadership challenge today (Lattimer, 2019), and suggests that companies must adopt more agile methods than before to deal with the challenge (Kotter, 2015).

5.2 The organisation

5.2.1 Clear strategic thinking and architectural design

Participant C emphasised the importance of strategic clarity and the effective design of architecture when setting up cloud environments. He said this was a key issue in planning and managing today's hosting environments. He noted that, at least with his experience of Icelandic companies, more often than not the role of a systems architect was missing from the organisation. Other participants touched on the same theme, indicating that this might be a common issue within IT departments in Iceland. This lack of strategic clarity and operational control links to other concerns regarding IT governance and change management.

5.2.2 Effective IT governance and organisational maturity

Organisational maturity and quality of governance are critical phenomena when considering IT transformations such as represented by cloud computing. Both C and D participants said they often engage with companies that want to move to the cloud but are challenged because they have other competing cloud projects running that have circumvented IT governance. To make matters more complex, such shadow IT projects might originate from both within the IT department or from non-IT business

units. Participant C indicated that within one company more than one public cloud provider may be in use.

Participant C talked about the challenge which cloud adoption brings to organisational structures and dynamics, with the cloud challenging the current separation between development and operation in organisations. The organisation needs to be aware of the potential organisational changes that can come out of cloud adoption. Participant D gave an example of how a development group at Institution B managed to push operations to the side until there was no operations-development paradigm at the institution anymore. Neither participants C nor D elaborated on how companies were handling the issue.

5.2.3 Deployment of effective change management

Participant A describes success deriving from careful change management processes where emphasis was put on preparation, analysis, stakeholder communication and deployment of specific roles. With respect to this latter point, it is noted that cloud adoption was successfully kicked off with a pilot project with the use of contractors for the technical and programming work. Participant B described a less prepared, but conscious process of using a change agent (a third-party strategy) to lead a pilot project, which then resulted in a successful move to the cloud. Participant C said that in his experience, consulting with various companies in Iceland, that he was rarely aware of any formal change management put in place for these projects. Participant D spoke about Institution B, where the change process was conducted organically. Success was achieved with the involvement of senior leadership to gain an executive decision which formally finalized the cloud adoption. Participant B mentioned the importance of strong directive leadership with respect to decision making and clear principles that everyone follows to build consensus, echoing Kotter's views on top-down change management (Kotter, 2012).

5.2.4 Competence

All the participants emphasised the importance of developing employee skills related to cloud computing, but none gave examples of organisations that successfully did this. Participant D said that he felt that companies need to be more active in encouraging staff to seek knowledge and certification. He mentioned that all cloud providers offer certification programs. The issue of lack of understanding of the cloud came up often during the interviews. This raises the question of whether cloud education should be a significant component of cloud adoption projects. The degree of disruptive project experience possessed by project leaders was also cited as a factor in planning and adoption success, with lack of experience seen as detrimental.

5.3 The individual

5.3.1 Bias against the unfamiliar and intangible

Participant B describes the problem his colleagues had with adopting a technology related to their inability to see or touch the cloud. Indeed, they felt it was irresponsible to trust in technology that they didn't have direct physical access to, or which lacked an immediate line of communication – a help line – in case of issues. Participant D said that some people fear the cloud because they don't understand it. This opens the possibility that the cloud is specifically psychologically challenging for some individuals as they have a hard time conceptualising it.

5.3.2 Age

Only one participant (B) mentioned that there seemed to be a difference in reaction according to age and that the older employees seemed less curious or keen to engage with the cloud, whereas the younger employees seemed to embrace it.

5.3.3 Fear of job losses during change

Participant D talked about how people might feel threatened by the cloud. He told the story of a manager who wanted to roll back a cloud project after it had been completed and was running successfully due to a perceived threat to employment. Participant A talks about how such objections are primarily subjective rather than objective, and can often be based on feelings, yet that this is a very real factor that must be accounted for. In fact, she went as far as saying that people's feelings were the biggest obstacle, echoing Jackson & Goessling (2018) when they say that the biggest challenge is changing the hearts and minds of the people in the organisation.

It is interesting to contrast differently planned cloud adoption processes, from the carefully planned pilot project at Institution A, to the shadow IT takeover at Institution B, as told by Participant A and D, respectively. These entirely different approaches to adopting the cloud had similar consequences, although the latter was more severe. Participant A said that not all employees were given a role in the new organisational chart. Participant D described how development gradually took over operations responsibilities. Both indicate that fears of job losses can impact on the conduct of cloud adoption projects.

5.4 Comments concerning project implementation phase, competence and success

There is a noticeable lack of difficulty during the implementation phase reported by the participants. It is unclear whether this is due to the fact that most of the issues are dealt with during preparation, or whether the conduct of the interviews impacted on data collected in this respect. Potentially, participants could have been pushed to reflect more on the implementation phase, to reveal further challenges and complexities not mentioned.

It is also noteworthy that none of the participants cited their own competence or capability to be a factor in the project success or failure. Again, this may be a bias reinforced by the interview style of the researcher. It could have been interesting to present a line of questions that would encourage the participant to be critical of their own role in the project. The participants' role in success or failure would be an interesting topic for further research.

Linked to the previous point, most of the participants describe projects they have worked on as having been a success. This is a claim that could have been better investigated. The metrics for defining success in a project can vary between organisations. The researcher could have investigated notions of success more deeply and asked participants to define success more specifically rather than simply claiming it.

6. CONCLUSIONS

The three main challenges presented by cloud adoption projects are *the intrinsically highly transformational nature of cloud adoption itself and the associated disruptive nature of such transformations, the requirement for a baseline of organisational maturity, and the human factor - the psychology of fear and resistance when faced with a particularly unfamiliar and abstract change driver such as represented by cloud computing.*

- *The transformational and disruptive nature of the cloud* - Moving to the cloud brings about significant transformation within an organisation with traditionally separated divisions merging, and employees needing to adopt a wider skill set to survive the transformation. Moreover, cloud transformation is in itself a form of radical change to the operating paradigm of how IT operations are structured, and how IT services are consumed. The accelerated nature of technical development in cloud computing can also place significant pressures on individuals to remain competent, and on the solutions adopted to remain relevant.
- *The maturity of the organisation* – In a majority of the cases mentioned in the interviews, the complex issues raised by cloud adoption require a high level of organisational coordination and alignment to resolve challenges. A lack of organisational maturity can present serious obstacles to successful cloud adoption, for example with project disturbance created by shadow IT's capability to adopt cloud initiatives in parallel to formal projects. For example, an organisation might discover when planning cloud adoption that one business unit has already signed up for an AWS account and is running services there, while another unit is already up on Azure doing similar things. Importantly, the ease with which rogue elements may operate independently in a shadow IT function is partly a unique quality of the cloud.

Accordingly, an organisation that intends to adopt the cloud needs to assess its own maturity levels and take appropriate measures to mitigate risks caused by weak maturity. The following questions highlight the scope of risk which could be scoped:

- *Strategy, planning and leadership* – Is there a plan for how the company will approach going into the direction described in the architecture? Who is leading the way on the journey?
- *Architecture* – Is there a design in place that gives a clear picture where the organisation is going? Is someone responsible and empowered to review, update and follow up on the design?
- *Change management* – Does the organisation use recognized change management practises?
- *Dealing with disruption* – How is it dealt with? Are there strict controls in place or is there a more fluid system that embraces it and tries to channel it?
- *Dealing with the people* – How are the employees included and informed about the company's vision? How are their concerns being met?

- *Management of the people dimension of change* – All of the participants interviewed raised this issue. The necessity of dealing with people’s doubts and fears is also emphasised in the literature, with cloud adoption projects being no exception. Moreover, the unfamiliarity of the cloud and its abstract almost invisible and intangible nature may lead to higher than usual levels of fear and associated resistance. Many key concerns, for example concerning job losses, are real and valid, yet are sometimes poorly addressed.

It is unlikely that this is a complete list of challenges for a cloud adoption project, but it should be useful to consider these three dimensions before embarking on a cloud adoption project, and to try to anticipate how they will manifest within a particular project, and create an appropriate strategy to mitigate risk and ensure success.

Each of these challenges is worthy of a research of its own. Particularly important is analysis of the transformative and disruptive nature of the cloud, and its inherent tempo: in what ways does this affect, even compromise, cloud adoption projects *before* they are formally initiated? Is it possible that the disruptive element might still be formally managed during a cloud adoption project, and with which tools and processes exactly? Additionally, the abstract nature of the cloud and people’s reactions to it raises the question whether cloud computing projects require specific psychologically-drive change process.

The aim of this paper is not to present solutions, but it would be amiss to not mention some of the solutions applied by the participants, such as conducting proper planning, the use of an external change agent to affect change within the company, and utilizing consultants to help in implementing a strategy and a vision. All of these solutions mentioned deserve further research to deepen the insight into their nature and efficacy.

As cloud computing is still relatively new, and it is likely to predominate further and affect a wide range of businesses in the future significantly, this topic should be researched further to provide deeper insights into this critical aspect of the fourth industrial revolution.

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