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Enabling Distributed SMEs

Hugo Trovão Mota

Master in Information and Enterprise Systems
(joint master)

2017

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Thesis supervised by Professor Doutor Henrique São Mamede
and Professor Doutor Miguel Mira da Silva

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Abstract

Technology can be a very powerful force to help the less technology evolved companies, that strive to keep up with their more advanced, digitally enabled competitors. To evolve, these companies can engage the digital transformation of their business, starting a disruptive change that encompasses digitally-enabled technological improvements to enterprise architecture.

In some industries, recruiting qualified resources can be a big problem for SMEs so why not take advantage of the transformation process, to move from a traditional team to a distributed team (spread around the world), gaining access a much larger base of possible human resources? While it doesn't apply to every industry, being distributed can also mean advantages to other business processes within the enterprise, so why not becoming a fully distributed company?

Digital transformation can be used to help SMEs in taking the steps needed to become distributed companies. By applying action-research methodology to an ongoing digital transformation process in an SME, the research intends to validate a transformation proposal, specifically targeting its information system.

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Keywords: Distributed SME, Computer-Supported Cooperative Work, Digital Transformation, Enterprise Architecture

Resumo

A tecnologia pode ser uma força muito poderosa para ajudar empresas tecnologicamente menos evoluídas, que se esforçam para acompanhar seus concorrentes mais avançados e digitalmente capazes. Para evoluir, essas empresas podem abraçar a transformação digital de seus negócios, iniciando uma mudança disruptiva que envolve melhorias tecnológicas com suporte digital, na arquitetura empresarial.

Em algumas indústrias, o recrutamento de recursos qualificados pode ser um grande problema para as PME, então por que não aproveitar o processo de transformação, passar de uma equipa tradicional para uma equipa distribuída (espalhada pelo mundo), ganhando acesso a uma base muito maior de possíveis recursos humanos? Embora não se aplique a todas as indústrias, ser distribuída também pode significar vantagens para outros processos de negócio, assim sendo por que não se tornar uma empresa totalmente distribuída?

A transformação digital pode ser usada para ajudar as PME a tomarem as medidas necessárias para se tornarem empresas distribuídas. Ao aplicar a metodologia de pesquisa-ação a um processo de transformação digital em curso numa PME, a pesquisa pretende validar uma proposta de transformação, visando especificamente o seu sistema de informação.

Palavras-chave: PME Distribuída, Trabalho Cooperativo Suportado por Computador, Transformação Digital, Arquitetura Empresarial

Dedication

To Cristina for all the support and motivation along the way.

To Sofia, Joana and Marta for making my days better.

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and knowledge.

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List of Acronyms / Abbreviations

AR – Action Research
BPMN – Business Process Management Notation
CC – Cloud computing
CEO – Chief Executive Officer
CRM – Customer Relationship Management
CSCW – Computer-Supported Cooperative Work
DC – Distributed Company
DMS - Document Management System
DNS – Domain Name Service
DSME – Distributed Small to Medium Enterprise
DT – Digital Transformations
EA – Enterprise Architecture
EAF – Enterprise Architecture Framework
ERP – Enterprise Resource Planning
IT – Information Technology
OD – Organizations Development
PaaS – Platform as a Service
PBX - Private Branch eXchange
PMS – Project Management System
PSTN - Public switched telephone network
SaaS – Software as a Service
IaaS – Infrastructure as a Service
SME – Small to Medium Enterprise
TOGAF – The Open Group Architecture Framework
TOGAF ADM – TOGAF Architecture Development Method
UML – Unified Modelling Language
VPN – Virtual Private Network

1 INTRODUCTION

While some companies are born digital and embrace cloud technology from the start, others never did. Not embracing technology is not necessarily a bad thing for certain, more traditional and less aggressive industries (although they would surely benefit in doing so), but there are other industries, where technology can be a very powerful disruptive force, and where less technology evolved companies strive to keep up with their more advanced, digitally enabled competitors.

Either new or established companies can evolve by using technology to pursue the digital transformation of their business, starting a disruptive change that encompasses all digitally-enabled technological improvements to enterprise architecture, and with it brings many challenges, but also many opportunities.

In technology, evolution and innovation happen at a very fast pace, that is why company size - once a competitive advantage - is becoming a liability, as larger companies that once dominated the market, are now struggling to keep up with the faster and more agile, smaller companies, where changes to business processes are easier to implement and matching results are faster to evaluate, than in bigger companies.

The concept of Distributed Companies (DC), or distributed organizations, is far from modern. Examples can be found in the Roman Empire and the Early Church [1]. Many believe the expression was first used by Toni Schneider, then CEO of Automattic, on his blog in 2010 [2]. He found the term “distributed” to be more accurate than “virtual” or “remote”, when referring to a company that has people working from all over the place, instead of a centralized office.

Yonder conference [3] - a round table conference bringing together leaders of distributed companies to share and learn from one another - takes place every year since 2014, but even today, “Distributed Company” isn’t a much mentioned or well known expression.

With the use of modern technology, every company can have the world as their limit, but distributed companies can potentially extract more advantages from technology.

To become distributed, a company needs to change at many levels, but the most important to enable a distributed team is the information system level.

Their reasons may vary, but with few exceptions, established SMEs want to evolve and to develop as an enterprise. For a clear majority, the best way to do it is by pursuing the DT of their business, starting a disruptive change that encompasses digitally-enabled technological improvements to enterprise architecture.

Applying technology to improve performance has impact in everything in the enterprise. By having such a broad reach, the process can be associated with many opportunities, but also with many challenges and treats. One thing all companies pursuing DT have in common, is that they want to gain as much as possible from the opportunities and to be able to handle the challenges and treats in the best possible way.

The thesis focuses on researching how digital transformation can be used to help SMEs in taking the steps needed to become distributed companies, specifically targeting the transformation supported on Computer-Supported Cooperative Work (CSCW) and Cloud Computing.

There isn't much literature related to the specific focus of the thesis, most of the work regarding DT are reports or analysis by consulting firms, or papers targeting bigger companies.

Although not SME specific, the literature found is related to the focus of the research and includes information and conclusions, that can apply to SME and to the research topics. In the literature found, researchers have presented work targeting SME strategy, development, performance and even business opportunities, but none covering the research focus entirely.

The thesis will attempt to fill the existing literature gap, by studying SME and how to help these companies achieve their objectives.

Creating a definition, throughout the research, a Distributed Company is to be considered: “one that does not depend on a physical location and in which the vast majority of its employees work from wherever they are comfortable and more productive”.

The expression “Distributed SME” (DSME) is to be interpreted within the same line of thought, but referring to small and medium enterprises. DC or DSME can also be referred as partially distributed, when the company enables only some its business processes or business units, to be distributed.

1.1 Context

The research project will take place in SMBS, Lda., a small technological company, operating in Portugal but undergoing a digital transformation process with the intent to become a distributed company, using technology to improve the performance and reach of their business.

The need to evolve and the opportunities it brings, are what drives companies to pursue digital transformation and wanting to become distributed.

1.2 Problem

The main goal of the company is to take advantage of modern CSCW technology and move from a traditional team to a distributed team, spread around the world, gaining access a much larger base of qualified human resources and business opportunities.

The company’s information system cannot be easily accessed remotely. Without an information system prepared to be used by a distributed team, the company cannot

achieve its main goal, therefore the company must rethink their information system, to satisfy the needs of a distributed team.

1.3 Proposal

By applying action-research methodology to a digital transformation process in an SME that aims to become a distributed company, the research intends to validate a digital transformation proposal, specifically targeting its information system.

The study specifically focuses on the transformation supported on Computer-Supported Cooperative Work (CSCW) and Cloud Computing (CC), to enable a distributed team.

1.4 Structure

The document is organized into seven chapters.

Following this introduction, that refers the problem and research motivation, chapter 2 provides a brief history of action research, including an information systems perspective and a diagram of the action research cycle.

Since there isn't much literature related to the specific focus of this research, chapter 3 presents the theoretical background concepts, that support the proposed solution.

Chapter 4 introduces the company where the proposal will be applied, specifies objectives, identifies the suppliers that will be used and describes the migration method.

Chapter 5 describes the information system migration and in chapter 6 the migration is evaluated regarding the objectives that had to be assured and employee satisfaction.

Finally, chapter 7 provides the conclusion concerning migration evaluation, describes lessons learnt and future work possibilities.

2 RESEARCH METHOD

The adopted research method is Action Research (AR), focusing on change and reflection.

According to Baskerville, “The method produces highly relevant research results, because it is grounded in practical action, aimed at solving an immediate problem situation while carefully informing theory.” [4].

AR is an interactive process which has the dual aims of action and research, that came from the need to bridge the gap between speculation and reality, where “the emphasis is more on what practitioners do than on what they say they do” [5].

In answer to “How then can we develop an understanding of the interaction of complex social organizations and their information systems?”, Baskerville states “The fundamental contention of the action researcher is that complex social processes can be studied best by introducing changes into these processes and observing the effects of these changes.”, coming to the conclusion that “The fundamental contention of the action researcher is that complex social processes can be studied best by introducing changes into these processes and observing the effects of these changes.” [4].

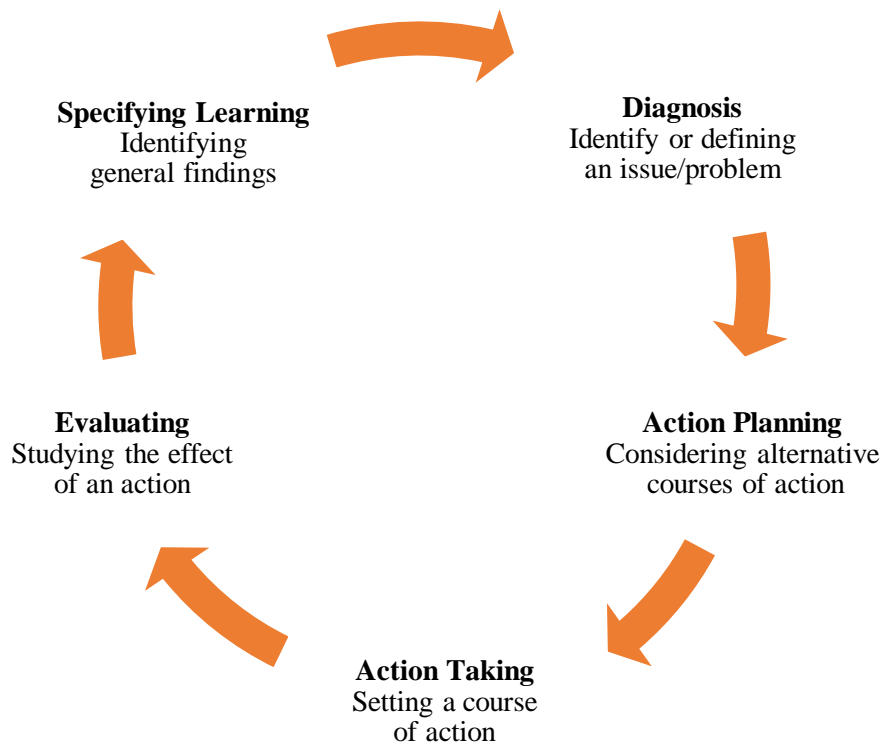
One of the characteristics of this type of research is that its participants try to intervene in innovative ways, already during the research process itself, not just as a possible result of a recommendation in the final stage of the project [6].

Action research has been accepted as a valid research method in other applied fields such as organization development (OD) [7], which directly relates with DT.

Before gaining popularity in scholarly investigations of information systems, AR was already an established research method in use in the social and medical sciences, having in its origins a simple two stages process, that basically consisted in a collaborative analysis by the researcher and subjects (*diagnosis stage*) and the introduction and study of changes (*therapeutic stage*) [4].

Today, AR is mostly applied with a four or five stages process, in a typically cyclical process that addresses issues/problems through experimentation and research, in a progressive way, leading to deeper understanding, not only of an issue/problem, but also of what influences it.

Figure 2.1 - The Action Research Cycle



Considering researchers observe and participate in the phenomena under study, evaluation can be done by accessing and evaluating the effects of the applied action, but since AR method approaches information systems research as social enquiry rather than social science, knowledge obtained through the use of AR methodology is difficult to validate [4].

Table 2.1 – Relation between Action Research stages and chapters/sections

Action Research stage	Chapter / Section
Diagnosis	Chapter 1
Action Planning	Chapter 4
Action Taking	Chapter 5
Evaluating	Chapter 6
Specifying Learning	Chapter 7 (Lessons Learnt section)

2.1 Diagnosis

How can a SME's information system enable the company to become a distributed company, allowing the company to evolve from a traditional team to a distributed team (spread around the world), thus gaining access a much larger base of possible human resources and business opportunities?

Diagnosis stage can be found in Chapter 1, namely in the Context, Problem and Proposal sections.

2.2 Action Planning

To allow the company to become distributed, the information system must adapt to allow employees access to company systems, from anywhere with an Internet connection.

In this transformation process, most company systems will be migrated to the cloud.

Chapter 4 is dedicated to Action Planning stage.

2.3 Action Taking

At this stage, the previous planning takes shape as it is developed and implemented in the real world.

Action Taking stage is described in Chapter 5.

2.4 Evaluating

This stage is meant to take conclusions from the results of the actions taken.

It is important to evaluate if users can perform the same tasks they did before, if it became easier for users to perform these tasks or if there are any hurdles or problems that stop users from performing the same tasks they did before.

This stage supplies information for improving the work with a new round. This can be repeated until the process is good enough, so that it can't be improved by this work.

Chapter 6 is dedicated to the Evaluating stage.

2.5 Specifying learning

This stage aims to find patterns or new understandings that can be used to help in future issues within the organization.

The information obtained can also be used by similar organizations, that can copy the actions that seemed to work well and avoid the ones that didn't.

The result of this stage can be found in Lessons Learnt section of Chapter 7.

3 THEORETICAL BACKGROUND

State-of-the-art research revealed there isn't much literature related to the specific focus of this research, most of the work regarding DT are reports or analysis by consulting firms, or papers targeting bigger companies.

Searching for "digital transformation" AND "SME", returned few interesting results. Most of the results are not directly related to the focus of the research, but their analysis revealed some useful related keywords, that were then used to conduct additional searches.

To expand the available results, the search string was modified, removing "SME" and additional searches were conducted, using expressions like "cloud computing", "services computing", "distributed", "cscw", "it alignment", "organization development" (and synonymous or related terms). This approach returned some interesting results on:

- Digital Transformation;
- SME development, internationalization, strategy and performance;
- distributed work, distributed teams and CSCW;
- SME CC adoption and perspective.

Although only a few are SME specific, literature obtained is related to the focus of the research and includes information and conclusions, that can apply to SME and to the research topic, namely about:

- digital transformation;
- cloud computing adoption and perspective;
- distributed work, distributed teams and CSCW;
- enterprise architecture and TOGAF.

In the literature found, researchers have presented work targeting SME strategy, development, performance and even business opportunities, but none covering the research focus entirely.

The several reports and analysis by consulting firms (Altimeter Group, BCG, Capgemini, Deloitte, IBM, McKinsey, etc.) found, are “almost-scientific” (although not reviewed by peers, usually involve academic researchers) but may also be biased, because there can be economic interests in stake.

3.1 Digital Transformation

In 2011 Digital Transformation (DT) was defined as “*the use of technology to radically improve performance or reach of enterprises*” [8].

Digital technologies are reshaping business strategy as work can be carried out without boundaries of time or place. Business processes are becoming modular, distributed and global.

Digital Transformation encompasses all digitally-enabled technological improvements to enterprise business. If on the one hand, both fundamental (or radical) and incremental improvements are to be considered, on the other hand “radical” is an extreme word. Thus, the definition used throughout the research is: “*the use or the application of technology to improve performance or reach of enterprises*”.

Digital Transformation enables a regular SME to evolve into a Distributed Company. This process brings with it many challenges that have to be considered carefully [8], [9], but also many opportunities [10].

According to Nieminen [11], “*surprisingly little research on the topic of digital transformation was found during the literature review overall and even the existing literature focused quite heavily on understanding the state of digital transformation of the larger context of the operating environment instead of the organizational point of view*”. This not only corroborates the findings of the research conducted, but also gives meaning to the need of establishing guidelines, not only for SMEs, but for all kinds of enterprises.

Nieminen [11] also proposes a new five stages model for classifying different stages of Digital Transformation. This seems to be an interesting contribute, that should be researched further to verify if it can relate to the research intent.

Lindberg & Hemvik [12] state that *“It would also be interesting to investigate how recognition of opportunities differs between digital business transformation and normal business transformation”*, which can also lead to interesting findings that can contribute to the objective of this research.

The definition is still valid, but nowadays DT is getting more and more associated with Cloud Computing.

3.2 Cloud Computing

Several experts have presented definitions to the expression Cloud Computing [13]. Some defined it as *“A Cloud is a type of parallel and distributed system consisting of a collection of interconnected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements established through negotiation between the service provider and consumers.”* [14], while others consider that *“Cloud computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the data centers that provide those services.”* [15]. These are just a few examples, many definitions have been used regarding Cloud Computing, but most of them encompass the concepts of flexibility, virtualization and pay-per-use model.

Throughout the research Cloud Computing (CC) will be considered *“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”* [16].

Cloud computing (CC) was first adopted by larger companies and it have been used by individuals for years (services like Gmail, Dropbox, Youtube, Facebook and others, are supporting on CC), but many SMEs are still sitting on the fence and are contemplating whether to move to or not to move to the cloud [17], however is likely to be an attractive option for many SMEs, particularly in the current global economic crisis, due to its flexible cost structure and scalability [18] and as a way to compensate the lack of their own IT infrastructure [19].

CC is often described as a stack, referring to the broad range of services built on top of one another under the moniker “Cloud” [16]. The CC stack consists of computing services commonly referred to as Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) [20].

CC represents a convergence of two major trends in information technology, namely IT efficiency and business agility [21]. Many SMEs already began moving some collaboration and productivity tools to the cloud, with the adoption of services like Google Apps for Business or Office 365, invoicing software, amongst several other examples of cloud adoption.

Social media and social networking are also transforming the structure of social relationships in the enterprise [22].

On the basis of the evidence currently available, it seems fair to suggest that cloud computing adoption will continue to grow amongst SMEs as mean to improve business efficiency and agility. Further evidence lies on the continuously growth of cloud SaaS offers (supporting on CC), like for instance CRM from Salesforce, marketing tools like Autopilot and Mailchimp and more common business pages on Facebook, LinkedIn, etc.

Cloud Computing has the potential to multiply the productivity, efficiency and profitability of small scale enterprises [23], and to answer the need for modern CSCW within distributed business processes/units (e.g. sales team) or fully

distributed companies, whom by definition, rely on modern CSCW and other cloud supported tools.

3.3 Computer-Supported Cooperative Work

Computer-Supported Cooperative Work or CSCW is an established field of research, with over 30 years of existence. In 1984, Irene Greif and Paul Cashman [24] introduced the term in a workshop focusing on understanding and supporting collaboration by means of, back then, emerging computer technologies. CSCW soon emerged and the first CSCW Conference took place in 1986.

CSCW can be seen as a *“forum, an undisciplined marketplace of ideas, observations, issues and technologies”* [25], but throughout the research CSCW will be considered as *“the study of how people use technology, with relation to hardware and software, to work together in shared time and space”* [26].

SMEs have been using CSCW tools for years now. Email, groupware applications, ERP, CRM, instant messaging (Skype, Lync, Slack, HipChat, etc.), videoconferencing (Skype, Hangout, etc.) are just a few examples the majority will recognize. These tools are of the utmost importance to the success of most SMEs, enabling easy synchronous and asynchronous communication, employee mobility and faster response times.

With the advent and evolution of cloud computing, everything you do is now web based instead of being desktop based. You can access all your programs and documents from any computer that’s connected to the Internet [27]. This is also true for most modern CSCW software applications, like popular groupware tools.

By allowing synchronous and asynchronous communication, team members can contribute when and from where they want, without the need of rigid schedules. On the same line of thought, companies can also save money by eliminating the need for office space and associated costs.

With the help of Cloud Computing, which removes the responsibility for infrastructure and maintenance from SME [28] and enabled the surge of some useful SaaS, CSCW is becoming an even more powerful tool for team work and business competitiveness.

On logical grounds CSCW and CC are essential tools for assuring team communication within Distributed SMEs. Maybe in the future, CSCW will refer to “Cloud-Supported Cooperative Work”.

3.4 Enterprise Architecture

Enterprise Architecture “is a holistic approach to systems architecture with the purposes of modelling the role of information systems and technology in the organization, aligning enterprise-wide concepts and information systems with business processes and information” [29].

Along similar lines, Aier and Zimmermann stated that Enterprise Architecture Management and Services Computing are the approach of choice to organize, build and utilize distributed capabilities for Digital Transformation, since they provide flexibility and agility in business and IT systems [30], [31].

To create a next-generation instant-on enterprise, we need to analyse and modernize the existing applications and re-architect them for enabling to accommodate changes. This will ensure that we can quickly and easily add new functionality. It also ensures that today’s innovation does not become tomorrow’s legacy problem. This approach also reduces the operational cost of the new solutions [32].

Hooger, refers to “enterprise” as a business organization, stating that in a general way the term can be used for intentional and systematic purposeful activities. He also describes a four domain architecture for EA (Business, Organization, Information and Technology), and states that the mentioned activities need to be

addresses from the four described domains [33], each having their associated design principles.

Through the Enterprise Architecture, companies can implement enterprise integration to cope with dynamically changing business environment [34]. One of the primary goals of enterprise architecture aligning the business with the underlying support systems, including IT within an organization.

An enterprise architecture framework (EAF) is a conceptual framework to support the description of the architecture of a business and its information technology (IT), and their alignment [35].

There are several competent and established EA frameworks such as Zachman Framework and TOGAF, but also some alternative and less known frameworks, like for instance the CEO Framework. These help immeasurably in arriving at a viable Cloud strategy that leads to closer business – IT alignment [32].

The Organizational Engineering Center¹ proposes an alternative framework – the CEO framework – for “a framework for describing and associating organizational concepts at multiple levels of detail using three separate areas of concerns: goals and strategy, business processes and information systems” [36], presented as an extension to the Unified Modelling Language (UML).

Despite the existing diversity of frameworks, a “one model fits all” is unable to address the specific domains of an organization [37]. Antunes et al. proposes “using ontologies to integrate different enterprise architecture domains and to analyse the resulting models”, affirming the “approach contributes to the alignment of the different domains while ensuring traceability, consistency and extensibility” [37].

¹ Centro de Engenharia Organizacional, in Portugal.

Through the Enterprise Architecture, Enterprises can implement enterprise integration to cope with dynamically changing business environment. Existing Enterprise Architectures, however, lack of semantics for humans and systems to understand them exactly and commonly, which causes communication problems between humans or between systems or between human and system [34].

There seems to be no compelling reason to argue that using ontologies to integrate different enterprise architecture domains, should be considered as an option in EA and aligning IT for enabling distributed SMEs.

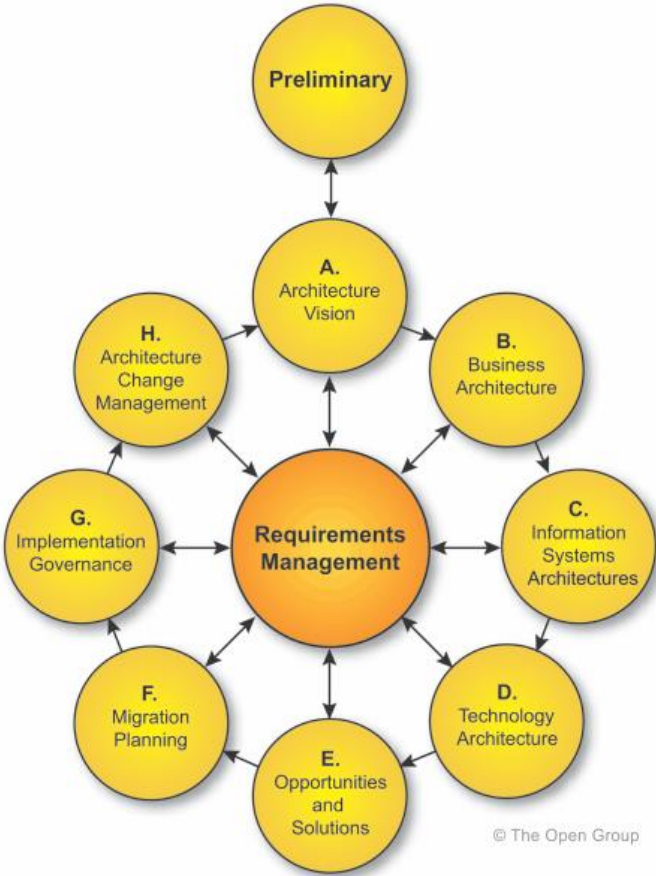
About utilization of applications on the cloud, Lin states that “their practical use on business can be expected as a trend for the next generation of business applications” [38].

3.4.1 TOGAF

TOGAF is a framework for enterprise architecture, developed by members of The Open Group Architecture Forum, that provides an approach for designing, planning, implementing, and governing and enterprise information technology architecture.

The TOGAF ADM is the result of continuous contributions from a large number of architecture practitioners. It describes a method for developing and managing the lifecycle of an enterprise architecture, and forms the core of TOGAF. It integrates elements of TOGAF described in this document as well as other available architectural assets, to meet the business and IT needs of an organization [39]

Figure 3.1 - TOGAF Architecture Development Method (ADM)



(The Open Group)

4 ACTION PLANNING

As previously stated, SMEs can move from a traditional team to a distributed team (spread around the world), gaining access a much larger base of possible human resources and business opportunities.

Only organizations that respond well and quick to change will be able to survive in the current business environment and economic climate [40].

The information system must respond to the challenge and provide the tools so that a company can became distributed and responsive.

4.1 About the company

SMBS is a small company specialized in web development using Drupal, also operating in related business areas, namely Digital Signage and Mobile Apps, using Drupal as a backend for their solutions.

Every employee has a Mac or a Linux system and servers run on Linux. There is only one Windows PC, used for website testing and electronic contracting platforms.

The company also provides web hosting services as a complementary service for their customers, having around 30 rented servers, in data centers, both in Portugal and across Europe, but this services are outside of the direct scope of this work.

The company's information system is supported almost exclusively by open source-source software.

In the office, the company has 2 in house dedicated servers. One of the dedicated servers uses virtualization to provide several virtual servers, for email, customer relationship management (CRM), document management system (DMS), GIT server (for software version control), project management system (PMS) software, file sharing and development websites.

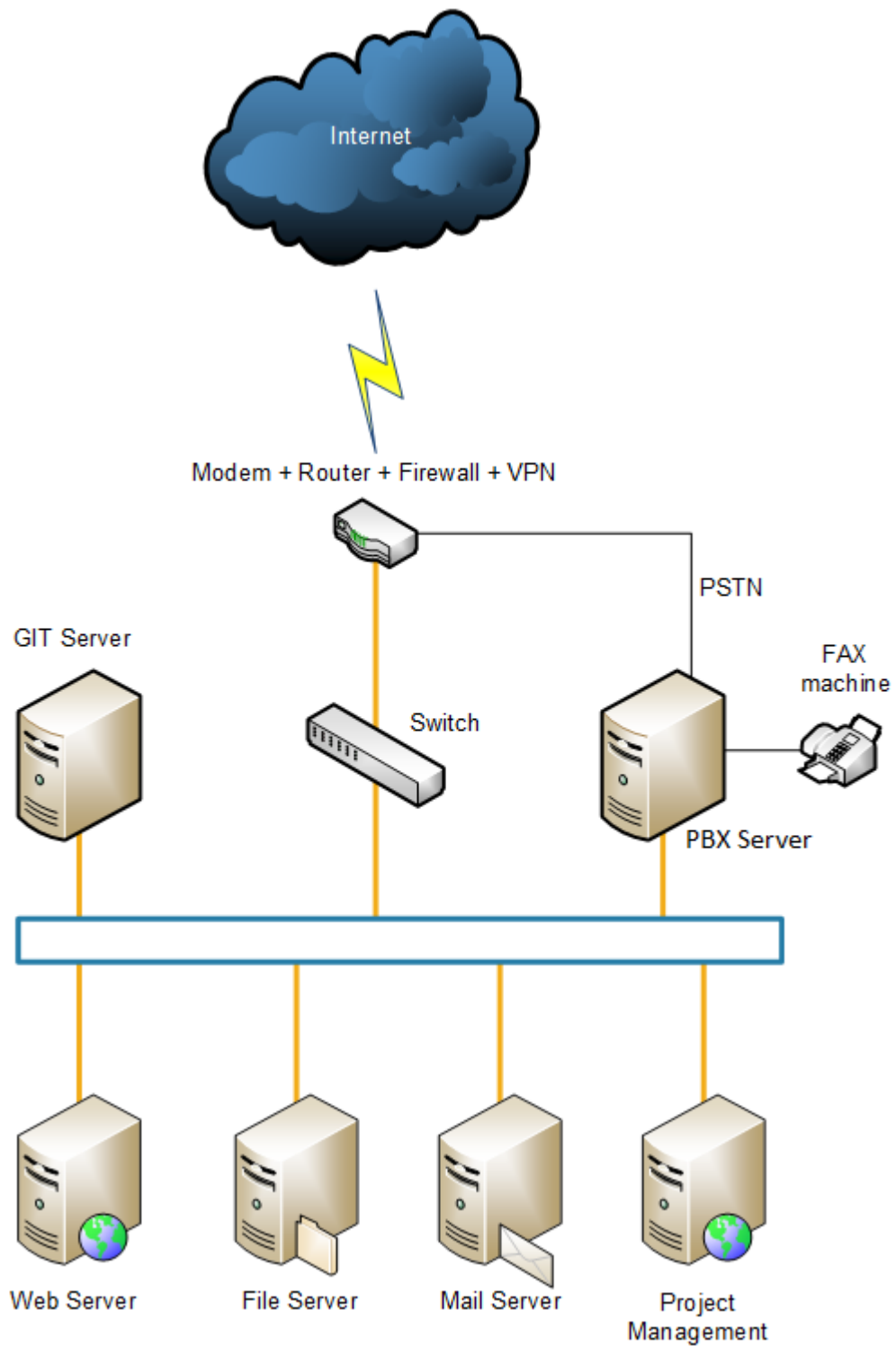
The other dedicated server is the PBX server (IP PBX) because it needs specific hardware card to communicate with public switched telephone network (PSTN) and FAX machine, that doesn't work with virtualization. They were using 6 IP phones and softphones were also used.

Internet connectivity is assured by a modem/router with built-in firewall and virtual private network (VPN) server. The equipment also has 2 PSTN interfaces, to which the IP PBX is connected.

Table 4.1 - Information system main applications before migration

Application	Software	Running on
PBX	Asterisk	Linux dedicated server
Email	Exim server	Linux virtual server
Files	Samba server	Linux virtual server
ERP	Keyinvoice	Linux virtual server
CRM	SugarCRM CE	Linux dedicated server
Customer Support	cPage + WHMCS	Cloud server
DMS	KnowledgeTree CE	Linux virtual server
PMS	Redmine	Linux virtual server
Development tools (GIT)	Git	Linux virtual server
Team Communication	Skype	Cloud

Figure 4.1 - Information system infrastructure before migration



4.2 Objectives

SMBS's main goal is to transform its information system, enabling the company to move from a traditional team to a distributed team.

To achieve this main objective, there are several smaller objectives that need to be addressed, regarding the company's information system:

- improve general availability;
- improve access from mobile devices;
- improve email quality and availability;
- access company files without the need for a VPN connection;
- use company's PBX from outside the office;
- provide access to DMS, CRM, ERP and PMS tools from anywhere;
- allow developers to access version control, hosting environments and project management tools from anywhere;
- assure correct security measures to restrict access to allowed users;
- applications/tools must allow for a distributed team to work and communicate.

Migrating the information system to the cloud will not only address all these objectives, but also improve the general accessibility, availability and reliability of the information system's applications and tools.

4.3 Service provider selection

Being mainly an open-source driven company doesn't mean that commercial software services can't be used. In fact, at one point, a decision was made in favour of reliability and workload reduction, meaning that in some situations commercial grade paid services, would be preferred to having to maintain another platform/server.

Since open source software can take a lot of time to setup and maintain, in some situations, a commercial service can be cheaper and more reliable.

At first, providers specialized in specific services were considered, namely Amazon, Box, Dropbox, Rackspace and Zoho, but the company preferred providers that offer combined services and the possible providers list became restricted to Google, Microsoft and Zoho.

Although Zoho offers the most complete product range, it was eliminated due to its cost. Only Google Suite and Microsoft Office 365 (Office 365) made it to the short list.

Both Google Suite and Office 365 offer tools like email, word processing, spreadsheets, presentations, calendar, chat and video software, but Office 365 has the advantage of including the full version of Microsoft Office in some of the available packages.

Table 4.2 - Google Suite and Office 365 comparison matrix

	Google Suite	Microsoft Office 365
Email	30 GB	50 GB
Text chats	✓	✓
Voice calls	✓	✓
Video calls	✓	✓
Calendar	✓	✓
Social network	✓	✓
Storage	30 GB / Unlimited (\$10 plan)	1 TB
Word processing	✓	✓
Spreadsheets	✓	✓
Presentations	✓	✓
Mobile Apps	✓	✓
Installable apps	✗	✓
Retention policies	✓	✓
Auditing	✓	✓
Reporting	✓	✓
Management tools	✓	✓

Google Suite was the selected suite, because it can match Office 365 (with exception of installable desktop apps for word processing, spreadsheets and presentations), while having the advantage of unlimited storage.

Google Suite was the chosen solution but even with most employees using Google Docs, it was necessary to subscribe to 3 Office 365 Business licenses for the employees who need Microsoft Office, which remains the *de facto* standard in productivity tools.

For applications that aren't available on Google Suite or that are feature specific, other providers had to be identified, namely Acquia, GitLab and Slack Technologies.

4.4 Migration method

To provide a solid technical background for migrating the information system to the cloud, an enterprise architecture framework based method is proposed.

The proposed method consists of 4 phases, that relate to TOGAF ADM [39] and Jyhjong Lin method [38] phases, as described:

Table 4.3 - Correspondence between phases for the referred methods

TOGAF ADM	Jyhjong Lin method	Proposed method
A. Architecture Vision	1. Baseline Architecture Identification 2. Target (Clouds) Architecture Identification	1. Architecture identification
B. Business Architecture		
C. Information Systems Architectures		
D. Technology Architecture		
E. Opportunities and Solutions	3. Candidate Clouds Identification 4. Clouds Selection	2. Cloud service selection
F. Migration Planning	5. Clouds Migration Plan	3. Migration planning
G. Implementation Governance	6. Clouds Migration and Testing	4. Migration and testing
H. Architecture Change Management		

4.4.1 Phase 1 – Architecture identification

This phase, that maps to TOGAF ADM phases A, B, C and D, aims to identify the architecture and profile of the application/service, which will be used to identify the requirements, that target cloud services need to provide.

4.4.2 Phase 2 – Cloud service selection

Phase 2 maps to TOGAF ADM phase E and, considering the previously defined requirements, aims to identify cloud service candidates and proceeds to the choice of the cloud service to be used.

4.4.3 Phase 3 – Migration planning

Phase 3 maps to TOGAF ADM phase F and it's about planning the activities involved in the migration, to deploy the application or service, keeping in mind the specifics of each services models (SaaS, PaaS or IaaS).

4.4.4 Phase 4 – Migration and testing

Finally phase 4, that maps to TOGAF ADM stages G and H, consists on implementation governance and change management, implementing migration according to planned and testing accordingly.

5 ACTION TAKING

The tools that need to be migrated and features that each tool needs to assure, to enable a distributed team, are listed below.

Using the proposed 4 phases TOGAF-based method, applications/tools were migrated one-by-one, so that the impact was minimal.

5.1 Phase 1 – Architecture identification

5.1.1 IP PBX

The IP PBX is a Linux based Asterisk dedicated server, to which the IP phones at the office connect. The server has a specific hardware card for connecting to PSTN.

5.1.2 Email

Email server running Exim is hosted in a local virtual server, at company headquarters. It can be accessed through IMAP, POP and Webmail.

5.1.3 Files

Access to company files is assured by a Samba server, hosted in a local virtual server. Users can access files, either from within the office network, or through a VPN connection.

5.1.4 ERP

The office hosted ERP is a subscription service hosted on a local server, but the vendor has a cloud version for the same product.

5.1.5 Customer Support

SMBS provides a customer support platform to customers, which features a ticketing system and information about subscribed products and/or services.

The customer support platform is hosted in the cloud.

5.1.6 CRM

SugarCRM (community edition), used for customer relationship management, is installed on the same machine as the communications server (PBX).

5.1.7 DMS

The company has about 100 GB of documents on KnowledgeTree, hosted on a local virtual server.

5.1.8 Project Management

The company has been using Redmine, running on a local virtual server at company office, for project management for a few years.

5.1.9 Development tools

Web development is the core business of the company, there are quite a few development websites hosted on local virtual servers. Most of the websites are also associated with a local Git repository, hosted at another local virtual server.

5.2 Phase 2 – Cloud service selection

5.2.1 IP PBX

There are commercial PBX (hosting) services available, but the company decided to use a cloud server for maximum flexibility, since they have plans to interconnect the PBX and the customer support platform in the future.

5.2.2 Email

There are no advantages in maintaining an email server, not only because of the hardware and power consumption costs, but also because it means having to battle with SPAM, antivirus, disk space, blacklisting, etc.

Several commercial services were considered, but Google Apps for Business (now G Suite) was selected.

5.2.3 Files

Employees can't automatically sync files between their PC and the file server. They have to mount a network share (and sometimes connect to headquarters with VPN). Although this works fine for office users, it isn't very practical if an employee is at home or on a remote location.

Providing employees with an easy way to access company is very important and very much needed feature, so Google Drive was chosen.

5.2.4 ERP

Since there was a cloud service available, this is more a matter of moving the data to the cloud version of the same software.

Portugal is very restrictive in what concerns invoicing software and it isn't easy to migrate from one service to another, so in this case no other solutions were considered.

5.2.5 Customer Support

The customer support platform was already hosted in one of the company's cloud servers. The company has plans for interconnecting this platform and the PBX.

5.2.6 CRM

Although it could use other vendor, CRM is closely integrated with the PBX software, so it will be migrated to the same cloud server as the PBX.

5.2.7 DMS

Document Management System and all its data require a new cloud server with at least 200 GB of storage space.

5.2.8 Project Management

Redmine requires a dedicated cloud/virtual server and system maintenance is time-consuming.

The company decided to replace Redmine with Jira (SaaS version), one of the best project management systems for software development by agile teams.

5.2.9 Development tools

Development websites need to be moved to cloud servers so that they can be available on the Internet.

Local GIT repositories will be replaced by with Bitbucket.

5.3 Phase 3 – Migration planning

5.3.1 IP PBX

VoIP trunks are widely used for incoming and outgoing calls, but it was only a few years ago that Portuguese telecom companies made them generally available to small companies. These IP trunks can be used to make and receive calls, so they can replace PSTN integration, that requires specific hardware.

5.3.2 Email

Email is a pretty important tool for every business and, since there had been some troubles in the past (including downtime and loss of emails), it was listed as the first service to be migrated to the cloud.

User accounts for the new service must be configured and all existing emails migrated to the new service.

5.3.3 Files

Google Drive must be configured to replicate folder structure and folder permissions, so that files can be migrated.

5.3.4 ERP

Since the software is the same, it is just a question of migrating the data to the cloud version.

5.3.5 Customer Support

The customer support platform is already hosted in one of the company's cloud servers.

With the migration of the ERP to the cloud, customer support platform can read and write to ERP data through its API and provide new features, like billing and payments information and automation, to company customers.

5.3.6 CRM

The local CRM installation and all its data needs to be migrated to the new cloud PBX server.

5.3.7 DMS

The Document Management System software and around 10 GB of data will move to a new cloud PBX server.

Since KnowledgeTree Community Edition is no longer supported and developed by KnowledgeTree, other solutions are likely to be evaluated in a near future.

5.3.8 Project Management

Moving from Redmine to Jira, means project data has to be extracted from Redmine and imported by Jira.

Jira External System Import will be used to import Redmine data.

5.3.9 Development tools

New development websites will use mainly Acquia Cloud, a specialized Drupal hosting service.

Git repositories will be migrated to Bitbucket, providing a feature rich version control software.

5.4 Phase 4 – Migration and testing

5.4.1 IP PBX

A new IP PBX was installed on the cloud and all IP phones were configured to connect remotely to this server.

This new setup has the advantage of enabling users to connect their IP phones from everywhere, providing they have a good Internet connection.

Besides real IP phones, employees also started using softphones (a software IP phone) directly from their PCs and smartphones.

The company phone system is now more accessible and not limited to the company office, allowing everyone to work from anywhere.

5.4.2 Email

Since currently some of the accounts use more than 20 GB of disk space, migration of all the emails to the new service took 2 days to complete, but service began receiving emails as soon as DNS changes propagated.

Email service is more responsive, very reliable and SPAM is no longer a problem. Webmail access has very powerful search features (as expected from Google), that make it very easy to find what we are looking for.

5.4.3 Files

It took quite some time to migrate all files do cloud and configuring folder shares, but after that, access to company files became very easy and fast.

Previously it was hard to access files on devices other than desktop PCs, but now it is very easy to access files using tablets and smartphones.

5.4.4 ERP

The platform is the same, but now company employees can easily access ERP, wherever they are.

On the one hand, using the SaaS cloud version has a higher cost, on the other hand cloud version means the end of hardware and maintenance costs.

5.4.5 Customer Support

The software is the same, but now with added billing and payments information and automation feature.

In this case, the platform was already hosted on the cloud, Customer Support is mentioned only as an example on how companies can find opportunities when migrating their information system to the cloud.

5.4.6 CRM

SugarCRM, used for customer relationship management, was installed on the communications server machine (PBX) and is now more available and not limited to the office or VPN connection.

5.4.7 DMS

The migration took some time but was successful. DMS software and around 10 GB of data were migrated to a new cloud server.

Document management system is now available from anywhere, to all company employees.

5.4.8 Project management

Jira External System Import feature was used to import Redmine data. The process wasn't exactly simple, but in the end projects in Redmine were imported into Jira, so migration can be considered a success.

Jira requires no maintenance, user interface is great and the platform allows integration with Git repositories and Slack.

5.4.9 Development tools

Development websites are now available in one of the company's cloud servers, while new projects use mainly Acquia Cloud, a specialized Drupal development and hosting services.

Local GIT repositories were replaced with Bitbucket, proving a safer environment, with features like visual code comparison, code search, bug tracker, pipelines, wiki,

integration with several applications (like Slack), central management of different projects, etc.

Table 5.1 - Information system main applications after migration

Platform	Software	Running on
PBX	Asterisk	Cloud server
Email	Google Mail	Google Cloud
Files	Google Drive	Google Cloud
ERP	Keyinvoice	Cloud
CRM	SugarCRM CE	Cloud server
Customer Support	cPage + WHMCS	Cloud server
DMS	KnowledgeTree CE	Cloud server
PMS	Jira	Cloud
Development tools (GIT)	Bitbucket	Cloud
Team communication	Skype	Cloud

6 EVALUATING

This work had the purpose to help SME in the process of evolving to DSME, specifically to help in their information system migration to enable distributed teams.

Overall, the migration of SMBS's information system can be considered successful, all applications, tools and platforms were successfully migrated and employee feedback is very good.

The company's information system is now prepared to be used by a distributed team.

6.1 Before and after migration

Comparing the organization's information system before and after the migration, regarding requirements achievement and organization effectiveness and responsiveness, it is safe to say that the company's information system is now a lot more capable of scaling, thus making the company a lot more competitive than before.

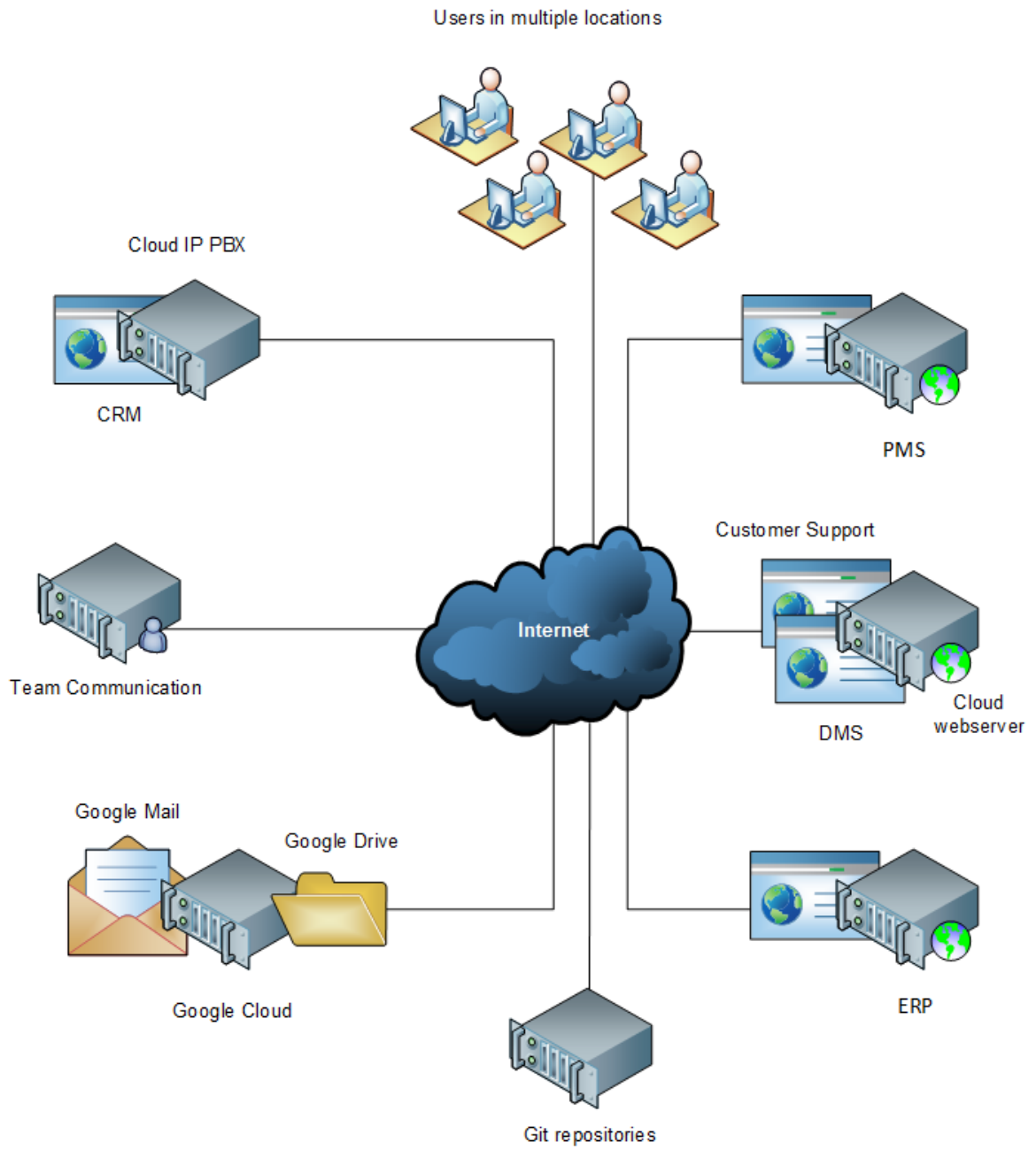
There are no more servers at the office. Everything was migrated to the cloud or new cloud based tools were adopted.

One thing to assess is if the choice to enable a distributed was successful. It seems obvious but this is an important point and one that can easily be overlooked.

Conflicts tend to be common, particularly in distributed teams, with antecedents that derive from distance separately from those that derive from technology mediation. The latter may be experienced by traditional teams to the extent that their members rely on technology to communicate and work with one another even when collocated; the former, however, are likely to be unique to distributed teams [41].

Every employee can access everything, from anywhere, with an Internet connection. This means is now possible for the company to become truly distributed.

Figure 6.1 - Information system infrastructure after the migration



6.2 Improvements

At this point, some of the actions may have to be reviewed, while others may be found very effective or even found ideal and helpful to others.

After migrating each application/tool and implementing all related changes, the “new” application/tool was tested by company employees.

If there were any issues with the application/tool being tested, the system had to be perfected until they suited all needs. Careful diagnosis and planning, followed by the usage of a TOGAF-based migration method, resulted in just a few minor adjustments in first weeks following the migration.

Along the transformation process, the company ended up adopting some new products and solutions.

6.2.1 Git repositories

After some usage, Gitlab was found a better solution for Git repositories, because its basic version is less limited than Bitbucket's.

6.2.2 Team communication

Skype was used for communicating but following some available integrations on other platforms, Slack ended up installed and advantages over Skype became clear.

Slack has some cool features that are not available on Skype, like channel creation. For example, there can be different channels for different projects, thus allowing that messages related to one specific project reach only the users involved in that project.

Since HipChat is closely integrated with Jira, HipChat was also tested, but Slack ended up being chosen because it was the preferred by all employees.

Table 6.1 - Information system main applications after improvements

Platform	Software	Running on
PBX	Asterisk	Cloud server
Email	Google Mail	Google Cloud
Files	Google Drive	Google Cloud
ERP	Keyinvoice	Cloud
CRM	SugarCRM CE	Cloud server
Customer Support	cPage + WHMCS	Cloud webserver
DMS	KnowledgeTree Ce	Cloud webserver
PMS	Jira	Cloud
Development tools (GIT)	Gitlab	Cloud
Team communication	Slack	Cloud

7 CONCLUSION

Nowadays SMEs can be born digital and embrace cloud technology from their inception, but an established company may have to digitally transform their information system to get to a point from where being distributed is possible.

Digital Transformation and Cloud Computing are essential tools for existing SMEs to become distributed SMEs, since being a DSME is very closely related with the company's information system ability to provide the tools for team cooperation.

In this work, the obtained results are in sync with the research objectives, of enabling SMEs information systems, to be used by distributed teams.

Having achieved the objectives set regarding the information system, the company can now continue to take the necessary steps to become truly distributed.

7.1 Lessons Learnt

It is not possible to apply fixed rules to the migration of the information system of an SME, what makes sense is to define and apply a methodology in the planning and execution of that migration.

Careful planning greatly increases the odds of success.

Once SMEs make the decision of changing to distributed SMEs they must identify the business processes in which they plan to intervene. It is necessary to assess and evaluate each defined business process, to:

- set a list of objectives to be assured, to enable the necessary changes;
- identify and map, often new, methods and tools to satisfy the needs defined and all future needs.

Becoming distributed has the possibility of increasing company responsiveness and competitiveness, but only if keeping agile. Increasingly complexity of information systems and application landscape changing, make it almost mandatory to do so.

The migration of the whole information system to the cloud enabled new integrations and services, that otherwise wouldn't be available. The cloud provides easier access to company systems and facilitates the interconnection of different company applications and systems.

Not only it is very important to act accordingly to acquired knowledge, especially if it comes from mistakes made (and mistakes made by others), but also agile methodologies, like Scrum can be used to speed up change process, in organizations under pressure to meet demands.

7.2 Future Work

Since the study was carried out in only one company, there are several opportunities for future work, namely concerning validation, optimization and scope enlargement.

It is important to note that SMBS is small technological company and that the whole team understands technology, therefore resistance to change was little or none, but this will probably be very important to keep in mind when working with SMEs operating in other industries.

It would be interesting to study which applications can provide new features or benefits by exchanging data with other applications. Not only because that can present advantages, but also because if applications exchange data, that should be considered in the selection of the service provider

Although this work is information system specific, lessons learnt can be tested with other business processes in SMEs, potentially producing more lessons, which could eventually lead to a Distributed SME specific Digital Transformation framework.

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