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**GRADUATION DISSERTATION**

Masters in E-Government Management

# The digital transformation of the Architecture, Engineering and Construction industry in Public Economic Enterprises. SETAM case study.


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## Summary:

Technological improvements and infrastructures in e-government activities solely form the tip of the iceberg. Transformed and streamlined services have become underlying mechanism for many government projects. The pace of technological development has put pressure on Public Economical Enterprises (EPE) to undergo digital transformation to answer consumer demand and to respond to competition. However, a holistic view of the digital transformation is missing even though it is a top-priority phenomenon for companies' executives. And especially in the AEC industry as digital technologies provide new opportunities for Architecture and engineering companies which have a fundamental need to change toward Digital Transformation (DT). Many experts and industry practitioners consider Building Information Modeling (BIM) to be a key technology to catalyze this transformation.

This single case study conducted in a large Architecture and Engineering company, explores the research problem of "How an EPE in the AEC sector is leading its digital transformation??" To answer this question, a systematic literature review was conducted a data gathered while doing my internship experience among middle and top management across the company.


**Key words:** Digital Transformation, E-government, EPE, BIM, Architecture Engineering and construction.



## ملخص:

لا تشكل التحسينات التكنولوجية والهياكل الأساسية في أنشطة الحكومة الإلكترونية سوى قمة جبل الجليد. وقد أصبح تحويل الخدمات وتبسيطها آلية أساسية للعديد من المشاريع الحكومية. وقد أدت سرعة التطور التكنولوجي إلى الضغط على المؤسسات الاقتصادية العامة لكي تخضع لتحول رقمي لتلبية طلب المستهلكين وللتصدي للمنافسة. غير أن النظرة الكلية إلى التحول الرقمي مفقودة رغم أنها ظاهرة ذات أولوية عليا بالنسبة للمسؤولين التنفيذيين في الشركات. وتوفر التكنولوجيات الرقمية فرصا جديدة لشركات الهندسة المعمارية والهندسة التي لديها حاجة أساسية للتغيير نحو التحول الرقمي. ويرى العديد من الخبراء والممارسين في مجال الصناعة أن "نمذجة المعلومات المتعلقة بالبناء" هي تكنولوجيا رئيسية لتحفيز هذا التحول.

هذه دراسة الحالة أجريت في شركة الدراسات التقنية والهندسة المعمارية بالمدية لاستكشاف مشكلة البحث "كيف المؤسسة الاقتصادية العامة في قطاع الهندسة المعمارية والهندسة تقود تحولها الرقمي؟ " للإجابة على هذا السؤال منهجية الأدب وأجري استعراض البيانات التي تم جمعها أثناء وبعد التدريب بين المتوسطة والإدارة العليا في الشركة.


**الكلمات الرئيسية:** التحول الرقمي، الحكومة الإلكترونية، المؤسسة الاقتصادية العامة، إدارة معلومات البناء، الهندسة المعمارية والبناء.



## Résumé:

Les améliorations technologiques et les infrastructures des activités d'administration en ligne ne constituent que la partie émergée de l'iceberg. Les services transformés et rationalisés sont devenus le mécanisme sous-jacent de nombreux projets gouvernementaux. Le rythme du développement technologique a fait pression sur les entreprises publiques économiques (EPE) pour qu'elles se transforment en digital afin de répondre à la demande des consommateurs et à la concurrence. Cependant, une vision globale de la transformation digitale fait défaut, même si elle constitue un phénomène prioritaire pour les dirigeants d'entreprises. Et tout particulièrement dans le secteur de l'AEC car les technologies numériques offrent de nouvelles opportunités aux entreprises d'architecture et d'ingénierie qui ont un besoin fondamental de se transformer vers la Transformation Digitale (DT). De nombreux experts et praticiens de l'industrie considèrent la modélisation des informations du bâtiment (BIM) comme une technologie clé pour catalyser cette transformation.

Cette étude de cas unique menée dans une grande entreprise d'architecture et d'ingénierie, explore le problème de recherche de "Comment une EPE dans le secteur AEC mène sa transformation digitale ? Pour répondre à cette question, une revue systématique de la littérature a été réalisée et des données ont été recueillies lors de mon expérience de stage auprès de cadres moyens et supérieurs de l'entreprise.



**Mots clés :** Transformation digitale, E-gouvernement, EPE, BIM, Ingénierie de l'architecture et construction.

## Acknowledgements:

I am truly grateful for the opportunity to write a Master's Dissertation on such an interesting and relevant topic. The topic of this dissertation hit the sweet spot of my interests: it combined the right elements of management of E-government major and management of urban techniques major, it covered digital transformation as an e-government phase and digital transformation as a digitizing necessity in the AEC sector. This made the research process itself extremely interesting and educational. However, conducting the dissertation would not have been possible without great people around me.

Firstly, I would like to thank my supervisor Mr Mezaach Lyazid. Thank you for the support, guidance and valuable insights during the process of writing this dissertation. There were moments of despair but with your response, it was always possible to get back on track and finish on time considering this circumstances with the COVID-19.

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Last but not least, thanks to my family and friends for all the support one could ask for. I want to thank my parents for letting me always to make my own choices and choose my own path. It has taken me to the places that I could not have even imagined when I was younger. Also, having great friends around me is something to be grateful for. Thanks to Fella, Nada, Nour, Chaima, Ikram and Sandra for making the university studies lots of fun. Finally, thanks to all my friends from different contexts!

-Maha

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## List of Abbreviations and acronyms:

3D: three Dimensions.

AE: Architecture and Engineering

AEC: Architecture, Engineering and Construction.

AI: Artificial Intelligence.

BIM: Building Information Modeling.

CAD: Computer Aided Design.

COVID-19: The coronavirus disease of 2019.

DAF: Director of Administration and Finances.

DT: Digital Transformation.

EPE: Enterprise Public Economic.

EU: European Union.

ICT: Information and Communication Technologies.

IoT: Internet of Things.

IT: Information Technology.

IS: Information System.

LAN: Local Area Network.

MENA: Middle East and North Africa.

NPM: New Public Management.

OT: Operational Internet.

PDG: President General Director.

RQ: Research Question.

SETAM: société des études techniques et d'architecture de Medea.

VRD: voirie et réseaux divers.

# INTRODUCTION

# 1 Introduction

This dissertation studies the digital transformation of the Architecture Engineering and Construction industry in a governmental firm named SETAM. The study is divided into the theoretical and empirical part. The theoretical part consists an extensive literature review on E-government and smart cities, digital disruption of industries, digital transformation of companies and the BIM as digitizing process in the AEC industry. The empirical part of this dissertation examines digital transformations of a large Architecture and Engineering company, and it is conducted by doing an internship in the company which allowed me to do some observations and interviewing executives and consultants of the company.

This first chapter is an introduction to the study. First, I present the background and motivation of this dissertation. Then, I define the research problem as well as three research sub-questions. After that, I discuss the objective and the scope of the study, and finally, I introduce the structure of the study.

## 1.1 Background

In the last few months the whole world faced the COVID-19 pandemic which made nations, countries, businesses, schools and almost every organism go on complete or partial lockdown, people were on quarantine and couldn't do their daily activities and mainly work, which lead governments to dysfunction in many ways as they were struggling to pull through this pandemic and to keep on track with life in general. That brought all the attention focused on the digital solutions for those activities. Which were there, triggered and started to be invented and innovated before this whole pandemic unleashed and the governments who were already advanced didn't struggle as much as others but still due to COVID-19 it was highlighted and enhanced, and for a country like Algeria it did accelerate few digital initiatives.

We also know that the Information and Communication Technologies (ICT) kept rising and expanding its field of implementation, use and how it's leveraged. That led to the appearance and addition of new concepts such as E-government that is defined by Layne & Lee, 2001 (p. 123) as the "government's use of technology, particularly web-based Internet applications to enhance the access to and delivery of government information and service to citizens, business partners, employees, other agencies, and

government entities". Some industries are digitized more than others and to different degrees from a country to another. Algeria is one of the countries which is not very advanced but on the other hand it is developing significantly due to the necessity of not getting left out behind as we saw how important to have an infrastructure that allow you to fully function at times like this.

In order to respond to this threat of digital disruption and to leverage opportunities of digital technologies and innovations, many established companies have started intentionally enhance their digital capabilities and resources (Sebastian et al., 2017; Svahn, Mathiassen and Lindgren, 2017). This phenomenon where companies aim to become digitally more advanced is often referred as digital transformation (Hess et al., 2016; Sebastian et al., 2017; Singh and Hess, 2017). The term "transformation" refers to the comprehensiveness of the change as organizations aim to gain business improvements from the new technologies such as mobile, analytics, cloud and Internet of things (Sebastian et al., 2017; Singh and Hess, 2017). The interest in the topic of digital transformation in the information systems research has been growing, but existing literature on the topic is still scarce (Gerster, 2017). As Hess et al. (2016) note, recent work in academia has focused on providing guidance on certain aspects of digital transformation, but the literature on companies' holistic approach to digital transformation is not addressed. Yet, more and more companies are setting up digital transformation initiatives to advance their digital capabilities and resources (Kane et al., 2017).

To face this necessity many reforms are being held to go on a transformative processes reshaping the lifecycle of their services from the back-office to the front end. One of the overly informative industries is the AEC (architecture, engineering and construction) industry. This sector holds a big part of economy and ask a lot of developed technologies because they need to process a lot of information and those info vary from a project to another which requires so much data for one project unlike projects in other fields that can be repetitive like producing the same product.

The AEC industry is very competitive and governmental firms face huge competitiveness against private firms in terms of digitization due to bureaucratic reasons and the scale of their firm which makes it's digitization hard to implement unlike small private firm where they can adapt easily to new technologies and cease

new opportunities while big governmental firms have certain rules to oblige to, long procedures to go through and a lot of validations and orders to make. Managing a project is difficult on its own and managing an e-government project is more complicated due to many variances that interfere in it because they are not just ICT projects they seek to maximize the impact. But we are still seeing a big resistance in some places and a lot of failures because the element of the public service environment faces a lot of challenges and restrictions unlike other private service providers. And many skip the process of digital transformation as they want to become digital overnight which is impossible especially in a sector that requires big data as AEC.

For more developed countries that has created a research gap firms are increasingly setting up company-wide digital transformation initiatives, while the academic literature does not cover holistically these new initiatives and how companies are leading them. This dissertation explores the phenomena of digital disruption and digital transformation, as well as the actions that large AE firms are taking in digital transformation which currently are not well studied. For example, what drives these firms to become digitally more advanced? How do executives of the companies lead digital transformation? By understanding better the digital transformation and how companies are leading it, companies can learn what the different practices are, how they work, and what the difficulties in them are. The enhanced understanding of digital transformation contributes to different fields of research as digital transformation is an organization-wide phenomenon. It sheds light, for example, on digital disruption of industries, digital transformation processes, leading practices of executives, and operational changes of organizations. The holistic understanding of current digital transformations of AE governmental firms makes it easier for companies, researchers, and other stakeholders to focus on the subject more in-depth, and thus develop the knowledge of digital transformation further.

## 1.2 Research Question

Given this environment. This Dissertation answer the question of why the AEC sector need to have an excessive digital transformation operations for their back-ends in order to build a smart city as a space to exercise E-government. Which will be studied in the following research question:

*How an EPE in the AEC sector can plan its digital transformation?*

This dissertation aims to a better understanding on digital transformation in general, why companies need to do it, how does ICT impact the digital transformation and how the digital transformation of a governmental institution of architecture and technical studies is processed in the AEC industry and their BIM experience in accordance of transformation. And that lead me to divide the main research problem into three different research questions:

*RQ1: What drives Economical Public Enterprises to Digital Transformation?*

*RQ2: How does ICT's capabilities influence the ability of enterprises to master the digital transformation?*

*RQ3: How BIM imply Digital transformation of an A and E firm?*

The RQ1 aims to create an understanding of EPE's drivers of change and thus create a sufficient foundation to answer RQ2 and RQ3. Academic literature regarding these questions is first examined in Chapter 2 where conceptualization of companies' digital transformations is built. As the digital transformation is a nascent concept in literature, a good understanding of the underlying factors, concept, and different practices are needed for the empirical part of the study.

## 1.3 Objective and aim of the study

The objective of this study is to provide a holistic understanding about digital transformation processes to be established in AE Company. The phenomenon of digital transformation and E-government will be conceptualized, the Form of digital transformation in an AE firm which is BIM will be explained, executives' practices of leading digital transformation and the company's actions will be examined.

Theoretical Objectives:

- Provide a thorough understanding of e-government, Digital transformation
- Provide a comprehensive literature review of E-government, smart city concepts in the Algerian context
- Elaborate a comprehensive literature review of ICT and digital disruption.
- Synthesize the body of literature to create a basis for companies' digitization and enable understanding why an AE company approach is unique with BIM.

Practical Objectives:

- Provide knowledge regarding E-government, digital transformation state in an Architecture and Engineering company type EPE.
- Provide an understanding on drivers, Leadership practices and changes regarding digital transformation.
- Give insights about the current state of digital transformation in SETAM.

Scope:

To achieve the goals of the study, knowing the focus area of the dissertation is broad and the digital transformation has not been studied widely in the Algerian context, it is required to set some limitations to the scope of the study. This dissertation is performed as a qualitative case-study, and data collection is done by using interviews and observations. The approach to study digital transformation is strategically different. Thus, the focus of this dissertation is the digital transformation process in an AE firm.

The interviewees are aimed to be people who have a strategically view on companies' digital transformations: Directors, and companies' engineers. As the research regarding companies' digital transformations is scarce, the goal is to cover the AEC industry, while focusing on an AE EPE. However, as the topic of this dissertation is wide, the case study will be limited to one quite large company in order to ensure the required depth of the analysis.

## 1.4 Outline of the research

This is a Masters Dissertation and here I explain how my train of thoughts went coming up with this research paper, starting from an introduction that will include a background on the theme combining context motivation problem explanation and research questions then objectives and aim of the study. Then going to theoretical chapter and sectioning it to 3 main subject areas. After that I explain the methodology of the research justifying my approach, my collected data and how I analyzed them. Then we dive into the empirical part presenting findings and results and discussing them. Finally I end with a conclusion that ends with an open research opportunities.

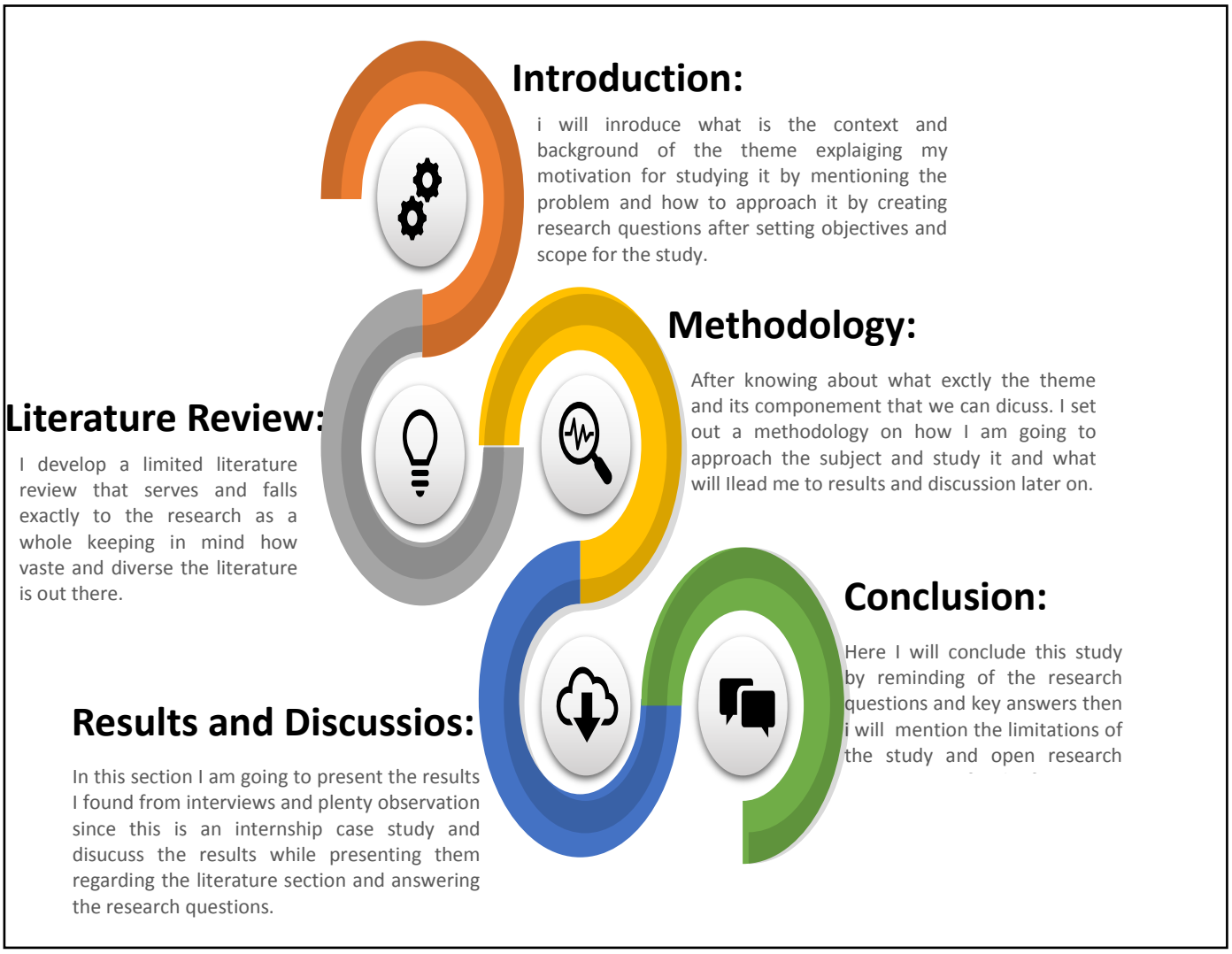



*Figure 1: the research outline.*

# LITERATURE REVIEW

# 2 Literature review

In this chapter, I present the theoretical background for digital transformation. This chapter aims to provide a sufficient foundation for the empirical part of the dissertation and reference this dissertation to now's academic literature. The literature review is divided into three main parts. Firstly, Sections 2.1 talks about the concept of E-government, Smart city and briefly the Algerian experience E-Algeria leading to E-transformation/ digital transformation in its enterprises. Section 2.2 examine the underlying mechanisms through which ICT capabilities and digital innovations change competition and thus disrupt industries and focus mainly on the AEC industry. Causes and challenges examination is required in order to understand the reasons why digital transformation is a high priority phenomenon for companies and to facilitate the latter part of the literature review. Sections 2.3 will dig deep on the digital transformation in the AEC industry and examine what digital transformation means and look like for companies in AEC today and how executives are leading it. In the end of the chapter, the different sections of this literature review are linked together with a chapter summary.

## 2.1 Digital transformation as an E-government project to build smart cities

In this section 2.1.I am going to review what has been already published from journals, articles, thesis's and books about E-government, Smart City their convergence then the Algerian experience around these concepts finally talk about digital transformation, its dynamics and digital innovations and competition which leads EPE in Algeria to it.

### 2.1.1 E-government

E-government (short for electronic government) is the use of technological communications devices, such as computers and the Internet to provide public services to citizens and other persons in a country or region. E-government offers new opportunities for more direct and convenient citizen access to government, and for government provision of services directly to citizens.[1]

[1] Caves, R. W. (2004). Encyclopedia of the City. Routledge. p. 180.

E-government inherits the administrative reform policies inspired by NPM reforms implemented throughout the EU over the past twenty years, which advocated that many of the techniques of private sector organizations can be applied to governmental bodies. The European Union (EU) defines e-government as "the use of Information and Communication Technologies (ICTs) in public administrations combined with organizational change and new skills in order to improve public services and democratic processes and strengthen support to public policies". [2]

I understood from what have been written about e-government that it's the transformation of government to assure public service that is efficient, suitable and transparent for citizens and enterprises through Information and Communication Technologies.

### 2.1.2 Smart city

Going through publications about smart city I found that there is no universally accepted definition of a smart city. It means different things to different people. The conceptualization of Smart City, therefore, varies from city to city and country to country, depending on the level of development, willingness to change and reform, resources and aspirations of the city residents.

Here some broad definitions:

The UK Department for Business, Innovation and Skills (BIS) considers smart cities a process rather than a static outcome, in which increased citizen engagement, hard infrastructure, social capital and digital technologies make cities more livable, resilient and better able to respond to challenges.

Cisco defines smart cities as those who adopt "scalable solutions that take advantage of information and communications technology (ICT) to increase efficiencies, reduce costs, and enhance quality of life".

A smart city is a municipality that uses information and communication technologies (ICT) to increase operational efficiency, share information with the public and improve both the quality of government services and citizen welfare.[3]

### 2.1.3 E-government and Smart city

[2] Lourdes T, Vicente O, Sonia R. (2005). E-government and the transformation of public administrations in EU countries…. University of Zaragoza. (Spain). P1.

[3] https://internetofthingsagenda.techtarget.com/definition/smart-city

Today, both concepts of e-government and smart city are increasingly used to refer to one another and have started to converge and cross roads. While e-government was brought up under the flag of better service delivery by focusing on internal processes and the use of information and communications technologies (ICTs) by administrations, the smart city concept nowadays builds on this as a way and a place to foster innovation by collecting, processing, integrating and using data on a larger scale than ever before.

However, most seem to agree a smart city should focus on collaborating with diverse stakeholders, using technology as an enabler to achieve better and more efficient services to citizens.

While the offer of e-government services has increased substantially in the last decade—both in numbers and in complexity—statistics on the demand side (i.e., the actual use), however, show less impressive results, perspective than ever before. This issue of Media and Communication delves deeper in the converging concepts of e-government and smart city, taking a critical approach and a perspective from communication-related disciplines and government studies. It tries to bring together research on this topic that follows a use-case driven research approach. Although results from case studies are difficult to generalize from local settings to a wider context or population.

### 2.1.4 The Algerian Experience: E-Algeria and the smart city of Algiers

#### 2.1.4.1 E-Algeria:

The only Algerian conversation about E-government that was published to the public and discussed with experts hoping for a better Algeria was the E-Algeria report by the e-commission, and sadly it was in 2008 which is 12 years ago. But as I mentioned it is the only literature base we can review. It held a plan for the Algerian electronic government strategy. Firstly, a brief introduction in the area of electronic government is presented which includes some of the most known definitions and the categories of electronic government it will continues with a presentation of the Algerian strategy where the main axes of the strategy are mentioned, then its presents the strategy's achievements and progress, the future challenges and the conclusion and future works.

The Algerian action plan is organized around thirteen major axes, for each axis a portfolio was developed followed by a definition of specific and key objectives list to

achieve by the year 2013, but here we are going to discuss the 1st and 2nd axis of the report.

**The first axis is the acceleration of the use of ICTs in public administration:**

This axis is devoted to the involvement of the ICTs, the enhancement of their use in the public administration and to make important transformations in its work and of its organizational modes. These transformations will help the public administration rethink its organization and operating modes with what serves the citizen appropriately, including the put online of its various services In this context, specific sub objectives and occasionally mutual were set for each ministry department of the government. They concern the following aspects:

• The accomplishment of networks and systems in both intranets and LANs levels.

• The establishment of an integrated information system.

• The deployment of industry-specific applications.

• Increasing human skills and knowledge.

• The development of online services for citizens, the businesses, employees and other government departments.[4]

**The second axis is the acceleration of the use of ICTs in enterprises:**

The use of ICTs has become necessary to increase the performance and business competitiveness and to benefit from the opportunities offered by a wider and highly dynamic market. Hence, a major goal has been defined, namely the integration of ICTs in the economy and support the appropriation of ICTs by businesses. This induces the following three specific sub objectives:

• Supporting the ownership of ICTs by small and medium-sized enterprises.

• Developing applications for the Improvement of business performance.

• Developing and expanding the provision of services online by enterprises.[5]

### 2.1.4.2 Smart City of Algiers:

Algeria is very new to the notion of smart city and it lacks so much infrastructure to begin with but on the other hand Algeria has been working to diversify its economy, especially since the fall in global oil prices in 2014 led the authorities to not be dependent on one sector reducing the role of hydrocarbons and develop other sectors.

[4] Djilali Idoughi, Towards an Algerian E-government….University A. Mira of Béjaïa, international journal of ebusiness and egovernment studies. Algeria 2013.

[5] Djilali Idoughi, Towards an Algerian E-government….University A. Mira of Béjaïa, international journal of ebusiness and egovernment studies. Algeria 2013.

Industry, agriculture, tourism and ICT have been identified as priority areas to reach this target, and digitalization and entrepreneurship are set to play a major role in their development strategies. "Building entrepreneurial ecosystems is core to the growth of any economy, and Algeria is positioning itself at the forefront of that movement in the MENA region,"[6] Issa Aghabi said. As more IT innovations come to market, the country will have to adapt these models to make use of the latest developments and build an ecosystem to assimilate and exploit these technologies. This is expected to positively affect various sectors, including transport and logistics, financial services, industry and manufacturing, health, Construction and customer service.

The Algiers Smart City project represents a local continuation of broader ICT measures, including infrastructure investment to boost connectivity and develop a more favorable regulatory framework. Building upon this, the framework of the Algiers Smart City project is expected to create opportunities for domestic and international stakeholders to engage in various start-up ventures and partnerships.

In the report made by the oxford business group following the Smart Cities Global Technology & Investment Summit in Algiers in June 2018 where experts, students, investors, entrepreneurs and mainly the government authorities gathered to discuss the project potentials and opportunities for everyone some comments were:

AREZKI: As in other MENA countries, Algeria has vast untapped potential in its young, educated and tech-savvy populations. If governments across the region can implement the reforms that are needed to shift the direction of development so that it is led by the private sector rather than the public sector, as well as adopt successful approaches from other smart city projects, the region's economies could become digital powerhouses.

HARTANI: The project has been developed as an answer to three fundamental challenges: a fairly isolated technology ecosystem, limited technology transfer and low confidence in growing tech giants. The execution model put in place is aimed at addressing these three challenges, and the desired result is to overcome them progressively. Thus, the main goal is to develop the right talent mobilization models, expertise and know-how.

SHANAHAN: In order to answer this question, one has to go back to the main premise that lies behind the concept of leapfrog technologies. These are technologies

[6] Issa Aghabi, head of investments for MENA at the World Bank Group's International Finance Corporation. The oxford business report

that are fairly new, disruptive and fast-moving. Furthermore, they are defined within the wider concept of leapfrogging; this is a theory of development that argues that emerging markets can accelerate their development by limiting the adoption of legacy technologies in favor of moving directly to more advanced ones.

In most cases these technologies are widely accessible given that they are open source and globally collaborative in nature. They are a direct consequence of the development stage at which we find ourselves internationally in terms of the internet, where a few very large technology giants dominate the market. These major market players push forward the development of these technologies. In the case of the Algiers Smart City project we see that careful, well-thought-through choices are being made in order to leverage these aspects.

We believe this constitutes a wise approach, as it allows the city to exploit disruptions and narrow windows of opportunity. The other strategy would be to consider alternative ways of achieving specific technological development goals. Overall, we do not see any viable alternative other than leapfrog and non-linear technologies.[7]

### 2.1.5 E-government leading to e-transformation/ digital transformation projects

#### 2.1.5.1 Concept of transformative e-government projects

Since 2000s, public managers have had the inclination to see e-government projects as standard ICT projects. The concept behind e-government projects has evolved in time. Administrative focus has shifted from sole automation to participatory business model transformations and nowadays, to the open government concept (Rodríguez, 2010). The more transformative and innovative projects have penetrated into the administrative agendas, the more stressful adaptation has become in terms of response to the changing needs.

In order to manage projects accurately, emerging developments created need to clearly differentiate the e-government project from the regular ICT projects with respect to scopes and project deliverables.

**Main Differences in E-Government Projects**

[7] **Arezki, Hartani and Sharhan, THE REPORT Algiers Smart City:Practical & Pragmatic. Oxfordbusiessgroup.com. p11-12. p15.Algeria 2018.**

Considering the scope and the effects on institutional structure, e-government projects are categorized into 2 types:

1. Adaptive e-Government Projects, in which main focus remains on adaption to the new technology with respect to the front-office e-government layers without re-engineering back-office business processes and institutional structure. This type of projects has limited impacts on institutional structure.

2. Transformative e-Government Projects, in which main focus expands to re-engineering back-office and front-office business processes and updating the institutional structure. This type of projects affects the institutional structure extensively.

Based on the e-government projects concept and the field experiences, the main differences between adaptive and transformative e-government projects are expressed with qualitative scale of 3-levels at Table 1.[8]

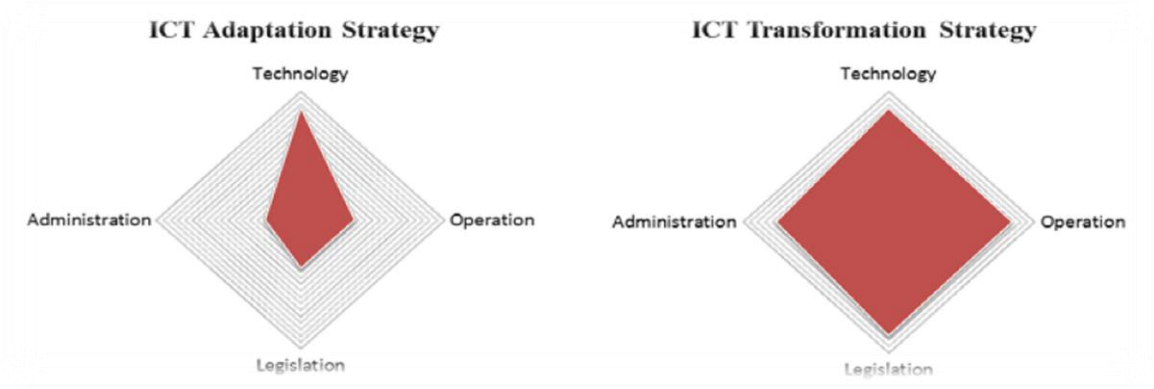
***Table 1: Comparison of the Adaptive and Transformative E-Government Projects.***

***Source:***

| Characteristic | Adaptive e-Government Projects | Transformative e-Government Projects |
|---|---|---|
| Returns by Project Dimensions | | |
| Back-Office Processes | Low | High |
| - Infrastructure Layer | High | Low |
| - e-Business Layer | Low | High |
| -Front-Office Processes | Medium | High |
| - e-Government Layer | Medium | High |
| - Access Layer | Medium | High |
| Effects on Institutional Structure | | |
| -Technology | High | High |
| -Administration | Low | Medium |
| -Operation | Low | High |
| -Legislation | Low | Medium |

It is illustrated in Figure 2 that transformation strategy requires equally deeper analysis in all aspects whilst adaptation strategy mainly focuses on technology.

[8] Mustafa A, Atilla A..etc. An e-government project management approach with e-transformation perspective. TÜBİTAK BİLGEM Software Technologies Research Institute (YTE). Turkey 2014.




*Souce:*

*Figure 2: Comparison of e-Government Project Strategies.*

In order to streamline the processes and to horizontally connect the systems there is a growing need in changes and complexity in analysis. On the other hand, transformative approach has high potential to increase the effectiveness and impact on stakeholders.

So to explain further what Digital transformation actually mean?

### 2.1.6 Digital transformation

After discussing all of the above to answer RQ1 to what drives EPE to Digital Transformation now we got to the point where we can explain the concept Digital transformation further.

Because digital transformation will look different for every company, it can be hard to pinpoint a definition that applies to all. However, in general terms, we define digital transformation as the integration of digital technology into all areas of a business resulting in fundamental changes to how businesses operate and how they deliver value to customers. Beyond that, it's a cultural change that requires organizations to continually challenge the status quo, experiment often, and get comfortable with failure. This sometimes means walking away from long-standing business processes that companies were built upon in favor of relatively new practices that are still being defined. With a plethora of articles and various definitions of digital transformation, it's easy to see why there is some confusion around the topic. For instance, author Greg Verdino focuses on what businesses that undergo digital transformation may expect to achieve. He says, "Digital transformation closes the gap between what digital customers already expect and what analog businesses actually deliver."

A definition from The Agile Elephant emphasizes all the ways businesses may need to adjust their existing practices: "[Digital transformation] involves a change in leadership, different thinking, the encouragement of innovation and new business

models, incorporating digitization of assets and an increased use of technology to improve the experience of your organization's employees, customers, suppliers, partners and stakeholders.

And the Wikipedia definition, while vague, touches on how the effects of digital transformation extends beyond businesses to society as a whole. "Digital transformation is the changes associated with the application of digital technology in all aspects of human society," it states.

## 2.2 The digital disruption of industries leading to digital transformation in the AEC industry

In this section 2.2 I am going to review the literature firstly about the digital disruption of industries also about the digital innovations and the competitions in the digital world Secondly IT-enabled dynamics capabilities and organization transformation and its challenges. Finally I'm going to talk about the AEC industry experience.

### 2.2.1 Digital disruption of industries

According to researches of thesis or scientific articles about digital disruption of industries they all say that Digital innovations have opened new opportunities to compete and achieve competitive advantage. It has been acknowledged that digital technologies have disruptive nature which can lead to industry transformation (Lyytinen and Rose, 2003). There are several examples from the industries such as publishing, media, and telecommunications where entire industries have been transformed by digital innovations (Yoo, Henfridsson and Lyytinen, 2010; Nunes and Downes, 2013; Heppelmann and Porter, 2014). These industries have faced disruptive innovations which have thoroughly changed incumbents' market position and customer behavior. The term disruptive innovation refers to innovations which are truly transformative and can alter existing rules of competition (Christensen, 1997; Lyytinen and Rose, 2003). For the past decades, Christensen's (1997) work on disruptive technologies and innovations has been one of the most influential theories in the field of innovation management. Worse performance than current solutions on a primary performance dimension, but it performs better on an alternate dimension. Over time, new innovation improves on the primary dimension so that it appeals to mainstream customers and thus it causes disruption in the market. As incumbent firms have focused on serving mainstream customers and their expectations, they fail to

recognize new competitors from niche markets that could take over the market. This can cause leading firms to fail because their products/services offer inferior value to customers and at this point, it is too late to reach the new entrant. (Christensen, 1997)

Even though Christensen's (1997) work has contributed significantly to the strategy literature and it is highly praised by managers, many scholars have challenged and criticized it in several aspects. In addition. To define the disruptive innovation better, Markides (2006) proposed that not all disruptive innovations are the same, but they should be categorized by technological, business-model and new-to-the-world product innovations.

How, then, digital disruption of industries happen? In the literature, there are different views of the underlying logic of digital disruption. Firstly, Nunes and Downes (2013) argue that we are in a new era where industries transform by "big-bang disruptions". Unlike Christensen's (1997) theory suggest, new technology and competitor does not start from unserved customers with different needs. Rather, it targets all customer segments because of its better performance at a lower price and greater customization. Three defining characteristics of "big-bang disruption" are unencumbered development, unconstrained growth, and undisciplined strategy. Examples of such disruptions include smartphone navigation apps with their impact on navigation-product makers, Skype and Whatsapp with their impact on calling and messaging and Spotify with its impact on radio and recorded music. As digital innovation happens on service or content layer, it is possible to diffuse innovation rapidly and with nearly zero-cost. Also, because of the layered architecture, disruption can come from unexpected directions why it is hard to defend. For example, when Google introduced its Google Maps (content and service layer) application on Android platform (service layer), every Android phone turned to be a navigator. This kind of rapid diffusion from previously separate industry is hard to defend which in turn led to steep business decline among navigation-product makers.

### 2.2.2 Causes of disruption and transformation

"Disruptions" and digital (business) transformation can be caused by numerous factors:

- **Technological innovations (technology-induced):** which are more impactful than ever before. However, again, it's not the technology that drives the disruption or transformation. It's how it is used and adopted by customers,

partners, competitors and various stakeholders. Technologies with clear disruption potential include IoT, artificial intelligence, edge computing, virtual and augmented reality and block-chain. However, the most disruptive potential occurs when they get combined and enable new applications as we see in the convergence of AI, IoT and big data analytics. In industrial transformation the convergence of IT and OT is also a game changer.

- **Customer behavior and demands:** This so-called customer-induced transformation and disruption is not necessarily related to technology. Technology often enables or, as just mentioned, causes it, when adopted and turned into business challenges. An example of a force that drives digital transformation and is not caused by technology but merely strengthened by it in combination with other factors: the demand of customers for ease of use and simplicity in dealing with businesses is far older than today. It goes back to times when even the Internet didn't exist. In that sense, digital transformation can be simply catching up too because businesses don't have another option anymore (it's not as if they didn't know the importance of making interactions and support for customers easy and frictionless decades ago). Customer behavior and needs can also be impacted by disruptions on a societal level.

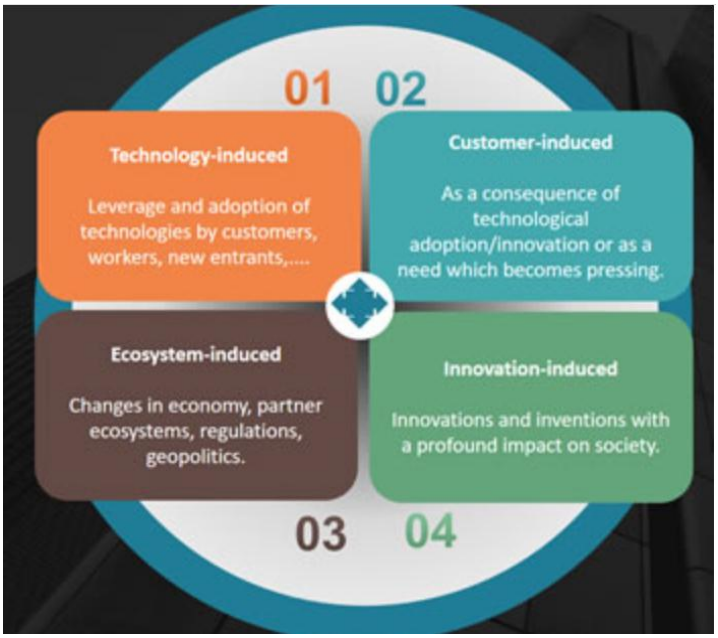



*Figure 3: Factors of digital disruption and transformation.*

- **Innovation- and invention-induced:** Entirely novel approaches to human and business challenges, as well as innovations and inventions that create a new reality, whether it's in science, business, technology or even a non-technological context of true innovation can be disruptive. The invention of

medicines that change healthcare and society (as has happened several times in the past), the printing press, the train, what can be next? Your best bet is probably in life sciences and the application of technology within the human body and mind.

- **Ecosystem-induced:** Organizations are part of broader ecosystems. economic changes, demands from partners who want you to adapt, evolutions towards collaborations in transformational business ecosystems, regulatory changes (consider the transformational impact of the General Data Protection Regulation or GDPR for example), geo-political changes, societal shifts, unexpected events, they all can impact and drive the need for digital transformation.

And this ecosystem aspect brings us again to this essential aspect of digital transformation: the interdependency and interconnectedness of everything – and according need to think holistically, across industries and with present and future shifts in mind as mentioned before.

Everything overlaps and is connected; from disruption, business processes and models to business activities and each single activity of the organization and the broader ecosystem in which it operates. It's the butterfly effect in action. Think about how virtually all business processes de facto are linked, the interconnectedness of business activities from the customer perspective, the way information runs across all digital transformations, the impact events can have on an economy, and much more.

Scenario planning is important here.

### 2.2.3 Digital transformation challenges

As the previously described in the literature on digital transformation shows, both management literature and corporations often acknowledge the need for digital transformation and a coherent digital strategy. Despite this growing acknowledgement of the importance of digital transformation, several companies have difficulties in starting and implementing digital transformation, and especially in benefitting from this transformation (Fitzgerald et al., 2015; Westerman et al., 2011). One focal point of this dissertation is to recognize and classify these challenges of digital transformation and evaluate how digital strategies described by management literature answer these challenges. This process is started by listing and categorizing the

challenges recognized in digital transformation literature and creating a framework concerning digital transformation challenges.

The traditional literature on the subject of managing strategy and business transformation and the challenges that corporates face when managing transformation is extensive and thorough (e.g. Kotter, 1995; Beer & Nohria, 2000; Sirkin et al., 2005; Beer et al., 1990). Even though the challenges on managing digital transformation obviously have some overlap with general transformation management challenges, digital transformation can also be argued to have its own distinct characteristics, and thus this section of the literature review focuses only on challenges recognized by digital transformation literature. This literature is narrower due to the rather new nature of the subject, but several articles identify and classify managerial challenges for digital transformation.

The identified and explained challenges are categorized into transformation challenges, innovation challenges and governance challenges. The three identified categories are introduced as challenges phases, but it is noteworthy that these phases are not to be interpreted as phases of linear transformation from state

A to state B. Neither is the framework to be interpreted so that the organization would move from one state to another. The challenges remain rather constant and individual digital initiatives such as new products, value creation models and business model innovations need to overcome these challenges with appropriate managerial and organizational actions. In addition, the challenges do not appear in isolation, but rather they interact strongly in different organizations and situations and different transformative initiatives may have highly differing key challenges even within the same organization. Together these challenges and the execution of digital initiatives create a dynamic and strongly interactive environment and an iterative digital initiative execution process.

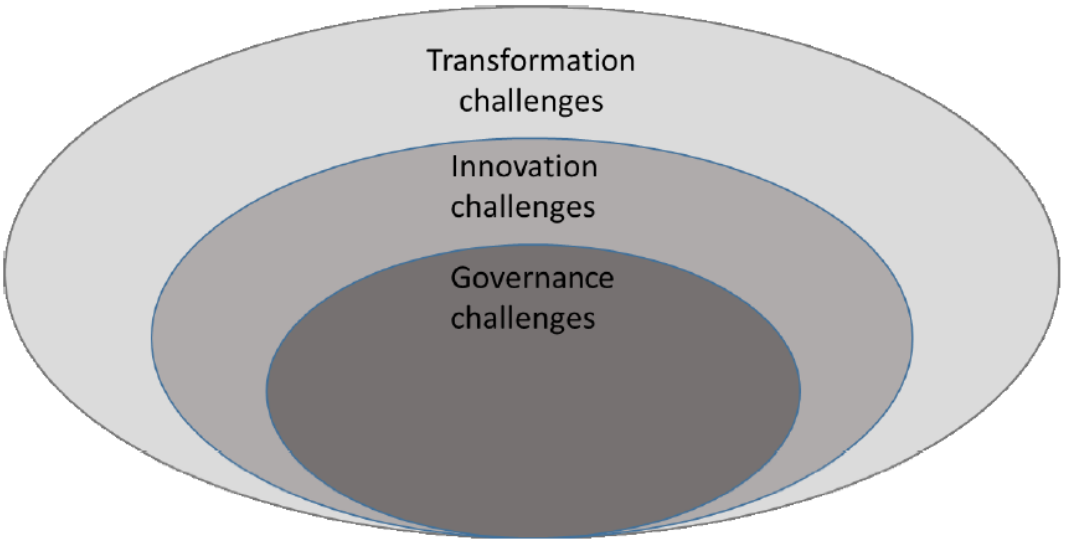



*Figure 4: Digital Transformation Challenges.*

**Transformation challenges**

The first and maybe the most important transformation challenge is the lack of vision or incremental vision concerning digital transformation (Fitzgerald et al., 2013; Westerman et al., 2011; Kane et al., 2015a). Fitzgerald et al. (2013) state that each digital transformation starts with a vision from top management, and according to Westerman et al. (2011), as the most significant digital transformation benefits are yielded by truly transformative activities, the required vision has to be radical and transformative rather than incremental. However, formulating and communicating a coherent vision is not always easy: Fitzgerald et al. (2013) found that in their study only roughly a third of the respondents felt that the senior management has shared a vision for digital transformation. Thus, in addition to creating a transformative vision, the challenge includes telling the right story to gain organizational traction for digital transformation.

Slightly related to the lack of vision, the lack of impetus and urgency was identified as a key challenge (Westerman et al., 2011; Fitzgerald et al., 2013). This challenge is especially affected by previously successful organizations, as the previous high performance both decreases awareness of digital opportunities and diminishes the motivation to pursue those (Westerman et al., 2011). This results in complacency that according to Fitzgerald et al. (2013) is the most common organizational barrier of digital transformation.

The third institutional challenge recognized in digital transformation literature is the threatening of current power structures (Fitzgerald et al., 2013). This challenge is

often referred to as resistance to change due to internal politics and defending, for example, traditional technologies, systems and organizational structure and value creation chains (e.g., Fitzgerald et al., 2013; Westerman et al., 2011; Pagani et al., 2013). This study, however, acknowledges that digital transformation does not appear in isolation and expands the challenge to consider also institutional rigidity. Management literature on institutional change acknowledges that existing relationships between institutional actors in the business ecosystem and especially existing value chains of established actors create institutional resistance to change (e.g. Battilana et al., 2009; Weyland, 2008; Kingston & Caballero, 2009).

**Innovation challenges**

The second category, innovation challenges, considers mostly organizational factors decreasing digital innovation activity within the organization. As described in previous sections, digital transformation shortens the life cycles of products, processes and business models, and highlights the importance of constant innovation. Perhaps the most common challenge is the lack of innovation culture within the organization (Westerman et al., 2011; Kane et al., 2015a; Kane et al., 2015b; Fitzgerald et al., 2013). Kane et al. (2015b) argue that organizational culture is critically important in leveraging digital transformation, and that the relationship between organizational culture and digital technologies needs to be right in order to pursue digital opportunities. The innovation culture issues include several challenges such as risk aversion, competing organizational priorities and resistance to novel technologies and approaches (Westerman et al., 2011; Kane et al., 2015b; Fitzgerald et al., 2013).

In addition to innovation culture, the lack of skills, capabilities and talent is a much-cited digital transformation challenge (Westerman et al., 2011; Kane et al., 2015a; Kane et al., 2015b). One of the most common features in organizations pursuing digital opportunities successfully is that they have a digitally talented workforce (Kane et al., 2015a; Kane et al., 2015b). Digital development changes the capability requirements of workforce especially in traditional industries and thus investing significant resources in building the necessary capabilities to support digital transformation initiatives is needed (Lenka et al., 2017). This talented workforce may be externally hired (Westerman et al., 2011) or internally developed, but the lack of skills and capabilities is considered to clearly hindrance digital transformation initiatives and innovations (Kane et al., 2015b). Interesting in the subject of lack of talented workforce is that often the required skills and capabilities especially in

managerial levels do not concern deep technical understanding of technologies (Kane et al., 2015a). The most vital capabilities concern conceptualizing how digital transform impacts current businesses models and processes and the ability to identify transformative opportunities that can be pursued through digital initiatives (Kane et al., 2015a; Kane et al., 2015b).

Even though able individuals are required for efficient digital transformation, most of the new ideas arise through collaborative efforts (Kane et al., 2015a). Siloing and lack of collaboration is the third common challenge affecting innovation quantity and novelty (Fitzgerald et al., 2013; Kane et al., 2015a; Kane et al., 2015b). As the products and business models become more complex and combine for example different organizational functions and even reform business networks, efficient innovation can rarely be conducted in silos or by individuals, however talented they are, and the organizations succeeding in digital initiatives are likely to use cross-functional teams in developing and implementing those digital initiatives (Kane et al., 2015a).

The fourth factor affecting innovation activity and execution is unclear business cases (Westerman et al., 2011; Fitzgerald et al., 2013). Not all digital initiatives originally make sense to the company, and direct investment is easiest to reason when the returns are easy to see and quantify and occur in the near future (Westerman et al., 2011). According to Westerman et al. (2011) the business cases are often less clear for truly transformative initiatives, even though these initiatives are exactly what foundational capabilities become, enable creating novel digital products and platforms and drive the digital transformation.

**Governance challenges**

The third and last category of digital transformation challenges refers to challenges in governing the digital initiatives created by organizational innovation. These governance challenges include coordination issues and unclear roles and responsibilities (Westerman et al., 2011; Fitzgerald et al., 2013). These coordination issues may appear, for example, between business units that make progress on their own areas, but fail to influence the necessary practices across other organizational units (Westerman et al., 2011). According to Westerman et al. (2011) lack of coordination of digital initiatives across for example marketing and product innovation or business model innovation and customer interfaces decreases the significance of individual innovations and initiatives. In addition, especially the more

traditional industries and organizations face the challenge of coordinating between new and traditional business processes (Westerman et al., 2011).

In addition to coordination issues, limited resources for organizational innovators present a challenge for digital initiatives to pick up traction (Fitzgerald et al., 2013). These resources include, for example, time for developing digital initiatives and a supportive information technology infrastructure (Westerman et al., 2011; Kane et al., 2015; Pralahad & Krishnan, 2002). Westerman et al. (2011) argue that digital initiatives are built on a solid IT foundation providing necessary processes, data, solution delivery and the capabilities to create and extend digitally operated environments. They also claimed that a strong and collaborative relationship between IT infrastructure and business processes is very helpful in driving digital transformation. A key resource worth mentioning as an individual transformation challenge is the lack of funding (Westerman et al., 2011; Fitzgerald et al., 2013). Direct monetary investments are often necessary for implementing digital initiatives eventually (Westerman et al., 2011) and the lack of funding is perceived to be the second-largest challenge of digital transformation in a survey conducted by Fitzgerald et al. (2013).

## 2.3 The digital transformation of the AEC industry through BIM

In this section of the literature review I'm going to highlight BIM as the essential form of digital transformation in the AEC industry, when it comes to digitally transforming the AEC industry, we found that existing literature spans many of the common DT subjects, such as Internet of Things / Sensoring, Big Data / Data Management and AI / machine learning. Automation and Standardization are two other key areas. However, digital transformation in the AEC industry has been slow; factors such as the heavily fragmented construction industry and unsophisticated supply chain make it harder to digitize the whole construction process.

There is however an innovation that has made great strides the past years. Traditionally, the whole design, planning and control as well as the construction process was based on 2D drawings. Building information modelling (BIM) is one of the most promising recent developments in the architecture, engineering, and construction (AEC) industry. Using this technology it is possible to digitally construct a virtual model of a building (Azhar 2011). In the years since its introduction, BIM has grown to be the centerpiece of the AEC industry (Eastman 2008).

### 2.3.1 Digital transformation in an AEC firm

In the hyper-competitive A/E/C space, staying ahead of your competition is the key to survival in the new digital-first world.

Simply put, digital transformation is the process of finding new ways to bring together people, data, and processes to create value for your clients and maintain a competitive advantage.

Digital transformation can take many forms, and each firm's specific digital transformation strategy will be driven by unique circumstances related to the specific markets you serve, services you offer, and other factors. But, in the end, all digital transformation initiatives share a common thread – they leverage disruptive technologies to reimagine how you will win new business, deliver your services, and perform critical administrative and operational processes in the future.

In figure 5 some examples of Digital disruptors in the AEC industry.

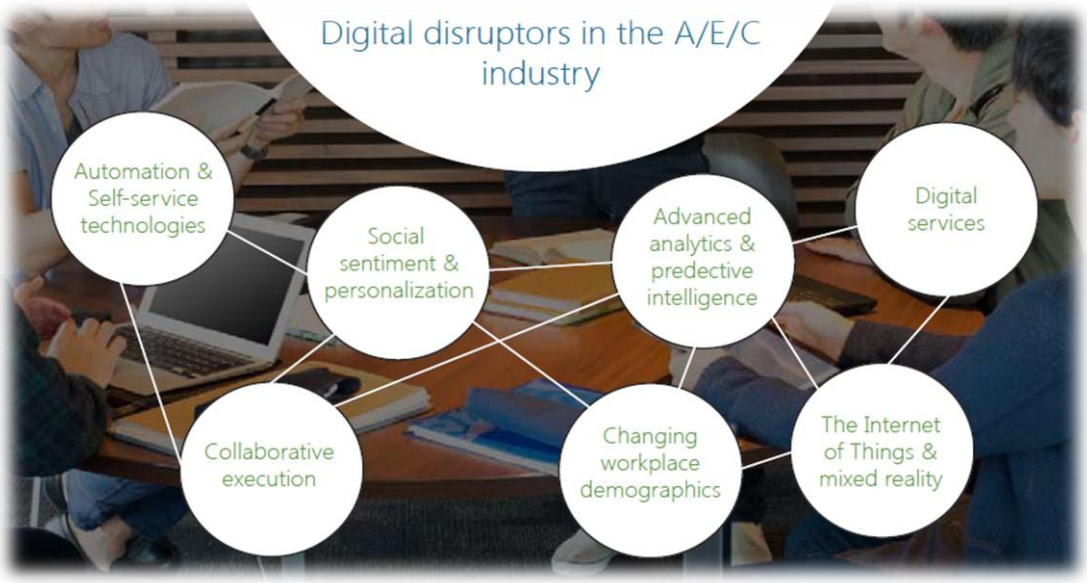



*Figure 5: examples of digital disruptors in the AEC industry.*

### 2.3.2 Definition of BIM

Since the apparition of the BIM concept in has grown significantly and more people are paying attention to it, "Building Information Modelling" has gained widespread popularity. But it has not gained a widespread consistent definition. (Bedricks, 2005) Actually, many organizations and professionals have already defined the term BIM. According to Miller, et al. (2009), BIM should be explained as a whole concept in three aspects Building, Information, and Modelling. The building can be simply

understood as the project. The information aspect can include almost anything such as building's geometric information, size, and shape that are the most obvious parts. It also can include the manufacturer's specifications, warranty information, energy use, location, etc (Kymmell, 2008). This means, all the information related to a project can be contained in as to the modelling, it is the visual component which means "the ability to manipulate the objects and simulate their behavior or performance". In this process, the BIM models and the information are linked together. (Miller, et al., 2009) BIM has several definitions; The National Institute for Building Sciences (NIBS) defines the acronym BIM as a computable representation which is digital, easily managed, and shared data that define a building throughout its lifecycle (HDR, 2010). McGraw Hill Construction defines BIM as: "The process of creating and using digital models for design, construction and/or operations of projects. "(Young Jr., et al., 2009).

### 2.3.3 Barriers for BIM implementation in AEC firms

Yan and Demian questioned 67 AEC academics and practitioners in the UK and found that according to their beliefs, the biggest barrier to BIM adoption was the time and human resource cost of BIM training (Yan and Demian 2008). This seems in line with a more recent study of BIM adoption in the Dutch construction industry by a Dutch publisher of market research in the construction industry. In their research they found that the required training and knowledge for BIM was the number one concern regarding BIM adoption ('BIM & Ketensamenwerking in Kaart' 2015). A close second was 'difference in BIM usage between parties'. Bryde et al found that most of the negative benefits or challenges of implementing BIM focussed on software or hardware issues (Bryde, Broquetas, and Volm 2013).

In their assessment of the current state of BIM benefits and challenges, Solnosky identified the following challenge classes (Solnosky 2013):

- Legal and contractual
- Educational training
- Information modelling
- Software
- Cost

These classes largely coincide with the findings from the explorative literature performed in preparation of this dissertation (Bosdriesz 2018). Solnosky also identified major possible future benefits for BIM, mainly in the domain of integration. Further integration with existing processes is the next step of BIM, but still proves to be a challenge.

In order to compare these barriers with our case study, we identify four main barriers:

• Barrier 1. Required training and knowledge

• Barrier 2. Difference in BIM adoption between collaborating parties

• Barrier 3. Software and integration issues

• Barrier 4. Legal and contractual

## 2.4 Summary of the literature review

In order to present and explain my theme of dissertation, in the literature review I filtered a lot of Data to come up with a reasonable flow of information while clarifying the subject. First I wanted to approach DT as a phase or a project of something bigger as my major E-government aiming to build Smart cities so I studied about those concepts and put them in perspective. Then going through so much literature about the concepts it has been great achievements around the world which are quite advanced comparing to the Algerian state right now so I tried to highlight the Algerian position on this matter. Then how exactly e-government is leading to a huge and important part which is Digital transformation also called E-transformation.

Secondly, I wanted to explain about the phenomenon digital disruption which is caused of huge digital transformation processes, what are its causes and challenges.

Thirdly, I wanted to talk about the digital disruption of the AEC industry and explain how BIM is the process of digital transformation in the AEC firms and what its barriers are so we can compare them and study them further in the case study.

# METHODOLOGY

# 3 Methodology

This chapter describes the case study and its relevance to the research then the research approach coming to data analysis after a data collection

## 3.1 The case study and its relevance to the research

The case company of this single-case study is SETAM (Société des Etudes Techniques et d'Architecture Medea), an Economical Public Enterprise that works under the tutelage of the Ministry of housing urbanism and the city in Algeria. SETAM is an interesting and well-suited case company for this study on organizing and facilitating digital change, because of both its internal characteristics as well as the relatively early phase of digital transformation of the industry. The phase of the digital business development process offers interesting aspects, as the digital strategy is still in its infancy within the organization and especially in the construction sector in general.

As a result there is clear emphasis on the importance of digital strategy, but at the same time the term "digitalization" and the effects of the phenomenon are regarded very differently within the organization. The development of digital business models is not organized nor supported top-down in hierarchy, but rather the individuals within the company have been having a lot of limitations to pursue the development paths they see as the most promising ones due to the lack of IS support from the management.

This limitation and lack of hierarchy within the organization manifests on how the digital development progresses in SETAM. The interviews and observations showed that even though there is cooperation between certain business units, this cooperation is rather informal and depending more on the individual relationships between the people in the organization than any explicit organizational structure.

The result of such a situation, where the significance of a phenomenon is recognized, but the resulting effects on current and potential future roadmaps are not explicitly defined is interesting from the management literature point of view. The result in SETAM is a situation where the individual employees are facing a lot of challenges.

## 3.2 Research approach

The study was conducted as a single case study focusing on observations qualitative analysis which is typically used aiming to produce contextual real-world knowledge

about the behaviors, structures and shared beliefs of a specific group of people. As this methodology is less controlled and more interpretive, you will need to reflect on your position as researcher, taking into account how your participation and perception might have influenced the results[9] which I have done during my internship at SETAM. As Yin (2009) states, case studies are suitable for situations that emphasize thorough understanding in an individual setting, that focuses on contemporary events. A single-case setting is also commonly regarded to be suitable for the exploratory nature of a specific setting the data was gathered through unstructured interview, extensive observations and field notes the qualitative analysis was used as the core method of analysis.

This single-case setting is also supported by the observation that digital transformation process is seen to manifest differently in differing industries and organizations, and thus the case company context is unique. The dissertation aims to the deepest possible understanding of the case company's digital transformation process in its context, and thus a single-case setting was chosen. According to Eisenhardt (1989), a case study is a good fit for such an objective to understand the dynamics in the single case context.

There is a common concern that case studies provide little basis for generalization and an internship makes the researcher the tool and instrument for collecting data, but Yin (2009) states that case studies can be generalized to the limits of their theoretical proportions. However, learning from an individual case in its context should not be overlooked (Dubois & Gadde, 2002). According to Dubois and Gadde (2002), understanding the interaction between the phenomenon and its context often requires in-depth case studies. Comprehensive theories are usually based on multiple studies focusing on the same phenomenon under differing conditions, and single case studies can be used to expand and generalize these theories (Yin, 2009).

A case study is often highly iterative, and the researcher should not be set to find answers to pre-determined questions, but rather be focusing also to finding unexpected results (Eisenhardt, 1989). After initial definitions of motivation and context of the study, the research process followed quite well the case study structure presented by Yin (2009).

## 3.3 Data collection

[9] Date published February 25, 2019 by Shona McCombes. Date updated: June 5, 2020, **https://www.scribbr.com/dissertation/methodology/**

# 3 METHODOLOGY

After the initial literature review and familiarization to the case company, I conducted the first interview as a reference point and since I had the privilege to be supervised by the DAF (Directrice d'administration et finance) which makes her the 2nd highest person in hierarchy in terms of authority and decision making regarding the digital transformation of the firm I did further short interviews within the case organization. In addition, the first interview helped to clarify the interview focal points as well as the content of the interviews.

After the first interview, an initial idea for the future interviews and observations was set, as the aim was to focus on their specific areas of expertise. The interviews were relatively free discussions concerning the pre-selected topics, and the conversation allowed even completely new topics to be discussed in the hopes of finding unexpected results or points of view. The bulk of interviews, observations and field tips took place between early half March then my internship got paused due Covid-19 then I resumed it in half May until half June.

The data collection method was unstructured interviews and direct observation Interviews were chosen as the data collection method because they are suitable for focusing directly on case study topics and are insightful in the case context (Yin, 2009). The interviews were rather guided conversations than rigidly structured interviews and although they aimed to collect data relevant to the research objective, the discussions were relatively free and fluid.

The interviewees were selected because of their positions within the organization as well as through recommendations of previous interviewees. While discussing certain topics during the interviews, it was explicitly asked if the interviewee knew anyone within the organization with expertise on the specific subject. The selection of management personnel interviewed emphasized their knowledge on digital technologies and digital transformation. However, in order to reach a comprehensive, organization-wide view concerning digital transformation and innovation in the digital era, interviews with management personnel working in for example operations and sales were included in the data collection.

In addition to this main dataset, supportive data from previous interviews with SETAM management personnel was used. This data was gathered in the context of a relatively similar case study for SETAM in the spring of 2020, and consists of 7 unstructured interviews. The dissertation utilizes the written DAF's answers of one

interview and utilizes field notes of the other interviews in analyzing the culture and history of the case company.

The interviews process started by contacting the DAF's office on one-on-one interview, which described the objectives and goals of the dissertation. Then I was directed to other employees for interviewing the interviewees answered casually since I didn't have a scripted interview but I was discovering and asking as much questions I can get which is one of the benefits of observations method of qualitative DATA. All the interviews took place in the case company headquarter. The interviewees only received the general topics of interviews with no actual questions sent beforehand. All the interviews were in Algerian language, as that was the native language of all the interviewees as well as interviewers.

All the interviews began with the interviewees describing their position within the organization and me describing the motivation and goals of the study. Then we discussed the general topic of digital transformation and its manifestation and consequences in AEC industry. After digital transformation, the interview shifted more closely to think about how it's hard to accomplish. Finally, we discussed the challenges of managing digital business transformation and creating and implementing a digital strategy in the AEC industry.

I also attended a meeting with the company's PDG (President Director General) and the Agencies director of Bouira, Blida, Boumerdass, Ain defla, Chlef and Medea, in the meeting room where we discussed about the future of Digital Transformation of the firm and the AEC industry in general.

## 3.4 Data Analysis

All the interviews were done with the permission of the interviewees and the analysis started with field notes of the interviews. After the transcription, all the interviews were carefully read through and an initial thematic analysis was conducted.

The field notes collected were examined by the researcher then divided them under few initial themes referring to the literature review such as the significance of digital transformation to AEC industry and case company, the organizational vision of the case company, the current digital actions of the case company, the challenges for digital transformation and the current digital initiatives. The conclusive analysis aims to develop further understanding through a systematic combining of theoretical

knowledge and case-specific, in-depth insights of the empirical phenomenon and its context as described by Dubois and Gadde (2002).

The data analysis was an iterative process by nature, as is common for the analysis of case studies with qualitative material (Eisenhardt, 1989). After the initial review and categorization of interview themes, I identified intrapreneurship as a secondary research stream. This recognition required for additional literature concerning the new topic. After this initial analysis, all the interviews through more carefully and the thematic approach was finalized.

After a thorough review of interview and observation materials and describing the manifestation of digital transformation in the case company context while doing an my internship experience these quotations were then combined to the transformation challenge –framework based on literature review in order to create an in-depth understanding of the managerial ways for overcoming digital transformation challenges. Through this analysis in the first section of findings, this dissertation aims to answer the first research question regarding what drives companies such as EPE to digital transformation in a larger frame and context.

The second section of findings uses this digital disruption and digital transformation of industries concept and challenges with further empirical evidence in order to answer the second research question concerning digital transformation challenges. The analysis identifies the transformation path SETAM has taken and the relevant managerial actions in each phase of the transformation. Last, the dissertation compares the empirical evidence to the relevant literature and aims to interpret the insights into generalizable results.

# RESULTS AND DISCUSSION

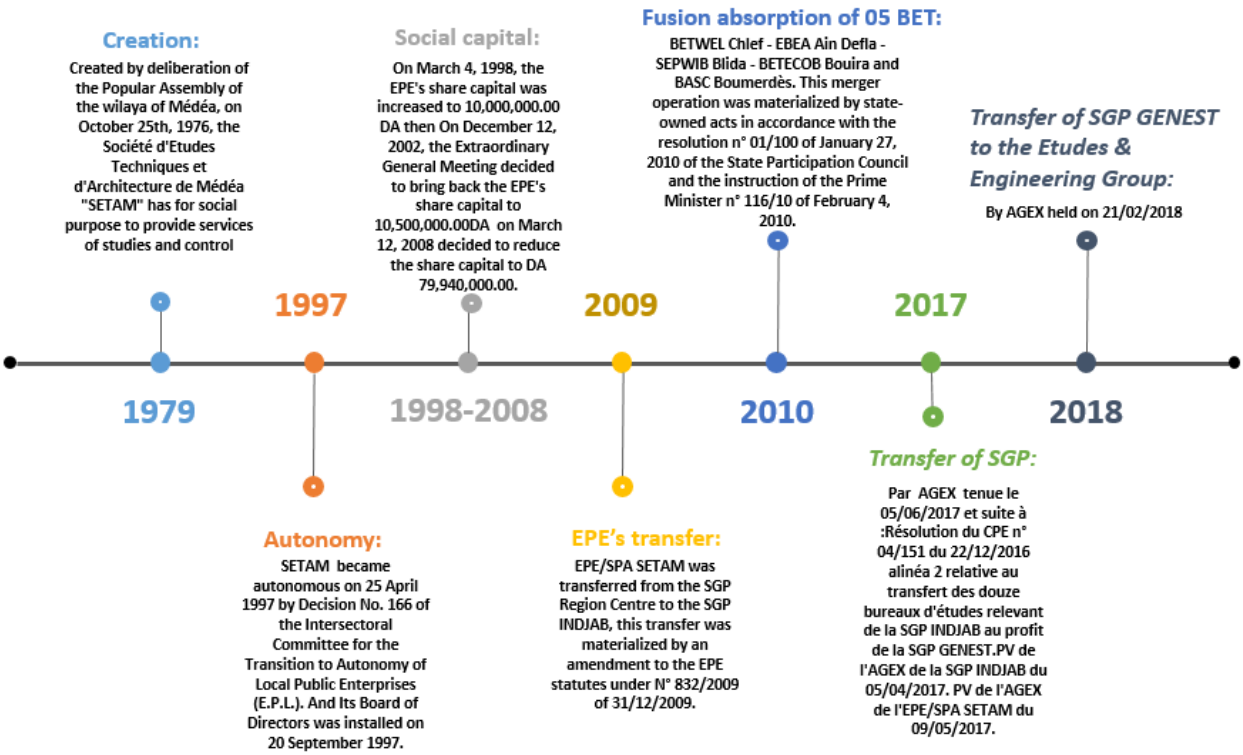
# 4 Results and discussion

This chapter presents the results and the discussion of the data analysis in four sections. The first section gives a short introduction of the case company's profile to enable further analysis. The next section 4.2 examines the drivers of case company's digital transformations, and thus addresses the research question Q1. The following section 4.3 evaluates the state and the executives' practices of leading digital transformation, and thus answers the research question Q2. Finally, section 4.4 analyzes changes that the case company are implementing in digital transformation, and thus addresses the research question Q3. The analysis leads to interesting findings of case company's practices in digital transformation.

## 4.1 The case company profile

As I hinted in the previous chapter about the case study, SETAM is a quite large company it consists of the central directorate which is the largest and oldest one and 5 Agencies focusing on developing and controlling architectural and engineering projects. In this figure 6 bellow you will see SETAM's timeline indicating their evolution and change. And it is one of the 12 AE governmental firms nationally (APPENDIX A).

*Figure 6: SETAM's evolution history.*



# 4 RESULTS AND DISCUSSION

SETAM is an Architecture and Engineering company that focused on large-scale construction projects, covering most of the value chain from project planning to delivery by monitoring and controlling the implementation to the end. SETAM differentiates from major AE firm by keeping its integrity and working to improve their image since they suffered from a dilemma in the past and got labeled with bad reputation giving the fact they are a governmental entity, for example, when they absorbed the 5 AE firms which they were on the verge of going bankrupt and had a very bad reputation among customers and partners and that was a big challenge for SETAM to face to bring up those Agencies in terms of HR and services.
SETAM evolved in terms of activities/ services to offer now they are very diverse and have competences in a lot of areas their services are the following:

***Table 2: Tabel of Activities.***

| Engineering office services | Laboratory services |
|---|---|
| architecture and urbanism<br>structure<br>CET<br>VRD<br>topography<br>environment<br>hydraulics<br>expertise and rehabilitation<br>monitoring and control<br>counselling and support | soil studies<br>materials analysis |

Their intervention sphere is basically the whole national territory where they had projects in every corner in Algeria from north to south and from east to west they even worked on projects in the Western Sahara. But even so the completion in the AEC industry is crucial especially for big scale projects and with today's inventions and development in this industry drives SETAM and the other firms to develop their game and step up their services to keep up with today's technologies and demands.
Now that we got a bigger about the company's relevance to the theme study I am going to discuss the founding's I found based on the data I collected doing my internship experience (APPENDIX B).

## 4.2 Digital transformation drivers and leaders

In this section we are going to present the data collected from my internship experience at SETAM the case study and discuss it to answer RQ1 about what drives such companies to Digital Transformation.

In the 1st week I asked a couple of employees about how familiar the company is with the concept of E-government to which they answered: *"what does that mean? I never heard of it nor crossed my work at any point"* and after I explained to them the concept they got the meaning and commented *"we also dream to accomplishing online services to the public but it is complicated"*

To position SETAM and where it is in terms of the government's strategy in implementing E-transformation in the AEC industry especially to leading to building smart cities. And too reference the 2.1.4 section of the literature review, SETAM as many governmental institution got exposed to the initiative and the term as a prep-talk in 2008 and they started doing some actions toward accelerating the use of ICTs in public administrations I found out they actually started and succeeded accomplishing some those objectives listed.

- They actually did accomplish placing networks in systems in LANs levels and Intranets but still the because the company has Agencies in other cities having and an intranet network that connects them is still not done due the need for a huge underground cables project that will cost them a fortune.
- They are still working on integrating an Information system.
- They deployed some of industry-specific applications/programs such as AutoCAD and an accountant.
- They increased their human skills and knowledge significantly.
- They have not developed any online service for citizens, businesses, employees and other government department.

For the 2nd Axis that covers the acceleration of the use of the ICTs in enterprises they only worked on the 1st objective and still behind in the other 2:

- They kind of did the supporting the ownership of ICTs by small and medium-sized enterprises and it's not entirely true because the government does not support, sponsor nor motivate SETAM to own the ICTs it is completely an autonomy decision made by the company as in you are expected to Do It Yourself (DIY) kind of approach, but they are doing it.

- The development of applications is still far but is present in further strategy.
- Developing and expanding the provision of services online by the enterprise is still in the making.

Now to touch on the Smart City of Algiers reference when I asked about it the DAF said: "we were never been invited to assist, contribute not share our skills and experience we heard of the summit/project as any other outsider audience". SETAM was never included in such meetings, conferences nor been part of the talk about this vision. Even though it was organized but the wilaya not the ministry directly but many AEC firms from the whole national territory were included but not governmental ones.

SETAM work under Ministry of Housing Urbanism and the city which never organized a meeting point to discuss such concepts to their tutelage or at least that was the case for SETAM.

After the analysis I categorized two aggregated themes that drive companies to digital transformation: external and internal pressure to change. These drivers are presented in Table 2 which summarizes the discussed drivers of digital transformations. I will discuss these identified themes separately in the following subsections.

*Table 3: Digital Transformation Drivers.*

| Dimension | Drivers of digital transformation |
|---|---|
| External pressure | • Clients needs and demandes<br>• Responding to competitive pressure from the market<br>• Defending and fighting for the long-term competitive position |
| Internal pressure | • Finding new growth sources<br>• Finding ways to decrease costs |

## External pressure

Firstly, the digital transformation of companies is driven by the external pressure. There were 3 underlying themes related to the external threats that emerged from the data collected: Clients' needs and demands, responding to competitive pressure from the market, defending and fighting the long-term competitive position, growing competition due to regulation and ending life-cycle of legacy systems.

**Client's needs and demands:** SETAM is a public enterprise that offers services to the public but their main client is the government. Which means their demands doesn't only focus on selecting their project managers and drivers based on who make

the best offer in a revers auction or select them for their privilege in being a governmental company with certain integrity they also look for a better "advanced" service. In the meeting with the agencies directors one of them stated: *"we need to be present online even in social media because all of our potential customers are digitally mature and expressing their need for digital solutions"*.

When customers experience better digital offerings in other sectors, the general expectations of digital offerings rise and transfer to other sectors as well.

**Responding to competitive pressure from the market:** In all companies, there were shifts in the competitive environment which created pressure to change. New entrants and existing competitors' new services were a catalyst for SETAM's digital transformation. As the AEC industry operated with the technologically advanced industry, this shift in the AEC market due to digital innovations was illustrated by their executives: *"And in a way, the large entry barrier vanished. In the past, you had to invest to paper canvases and drawing materials to enter the market, but suddenly Internet and ICT programs took those investments away".* That shows the importance of digital transformation is in the AEC industry and how big the areas it touches and how drastic that change would be.

**Defending and fighting for the long-term competitive position:** A common reason for the digital transformation of the companies was their willingness to defend the long-term competitive position. SETAM saw that they need to develop their digital offering now so that they have a solid competitive position in the future. As the DAF noted: *"You could say that there is not that much digital business yet. Most of the competition is still based on the activity's dispensability and can do it at lower prices. But the competition of future position on that future market, which has not been defined yet, I think that is clearly fierce".* Similarly, the PDG noted about their new strategy: *"If you don't want to lose your current revenue levels because of disruption and increasing competition, you need to think where to get new earnings. That is the foundation why we do this."* These observations imply that companies seriously believed that digital disruption could change their competitive position in the future why they were putting efforts to respond proactively to the threat of digital disruption. Furthermore as SETAM belongs to the government they still need to follow specific regulations and extra bureaucracy which can change and affect the flow in a disrupt way as in a specific order they should follow and accelerate their advancement or can slow thing down due to their lack of interest and motivation.

## Internal pressure

Secondly, companies' digital transformation is driven by internal pressure. Companies had pressure to grow revenues and cut costs, and the digital transformation was seen as a vehicle to do that. There were two underlying themes related to the internal pressure that emerged from the data: finding new growth sources and finding ways to decrease costs.

**Finding new growth sources:** SETAM had not had much capabilities in the past years that's why they were looking for new growth sources in their digital transformation. The management was looking for new ways to grow. Thus, digital innovations were seen as a way to grow their business. The importance of creating growth in the digital transformation was also emphasized. The DAF mentioned: "we were one the 1st firms in the industry to integrate and use new technologies as REVIT and some others" Digital innovations were seen as a way to differentiate from the competitors and thus create new growth for the company.

SETAM's revenue are the source for their budget to sponsor this digital transformation and they need to study it carefully and they tried to find new sources of growth actively.

**Finding ways to decrease costs:** SETAM was also looking for ways to decrease costs by using digital innovations which allow companies to digitalize and automate processes which in turn leads to better efficiency. But ironically those digital innovations are not cheap like everything in the AEC industry the DAF noted: *"Of course, digitalization enables much more efficient processes which in turn gives us a possibility to automate many of our current tasks and improve significantly improve our cost-efficiency. But also there so many variable that go in the process that it might not seem the best option we have like the coast of subscription for a program for all the employees will cost me more than the income I get from those tech programs."* SETAM had had difficulties with the profitability, and they aimed to improve their cost-efficiency with the digital innovations but slowly and wisely.

**Digital transformation Leader in SETAM**

I want to give an info flash over how SETAM' executives lead the digital transformation. It emerged from data that executives establish digital transformation and they drive digital transformation forward. Companies' top management plays a key role in digital transformation by establishing the phenomenon. The data shows

that executives establish digital transformation 1st by building a company-wide vision starting from including different top management people's opinions and contributions on what are the goals they want to achieve and consult them in almost every step. 2nd recruiting new personnel they recently hired 2 IT engineers which is very modest but significant step as they are planning on recruiting more and opening and IT unit from operational staff to managers with IT background to lead and develop this phenomenon.

## 4.3 Managing Digital transformation challenges in SETAM:

The RQ2 concerns the ICT's capabilities and how they influence SETAM's ability to face the challenges and try to master digital transformation and as mentioned in the literature review the AEC industry is very dependent on the ICT's. an AE firm had to had computers before many other administrations in other sectors. They started using programs to design everything from plans of buildings to roads to networks to cities. And because the ICT sector develops so quickly and created many options and started disrupting industries. The AEC industry got affected immediately. And that made companies such as SETAM face challenges and we are going to mention the common challenges in a digital transformation process. To evaluate these challenges in the context of SETAM.

All the different challenge themes and the approaches to those challenges that arose while doing the interviews and being part of the IT cell in the company were categorized under the three literature-based digital transformation challenge categories and presented in Figure 4. In addition, some other challenges were found in the case study that weren't mentioned in detail in the literature review.

**Transformation challenges in SETAM**

The digital transformation literature described three explicit transformation challenges: Lack of vision, lack of impetus and the threatening of current power structures. SETAM's case illustrates the first two challenges and their respective managerial tools rather similarly as described in the existing literature. However, as explained in the literature review, the threatening of power structures most commonly refers to the internal politics defending traditional technologies and practices. Empirical evidence in SETAM's case does not describe such an internal challenge. In SETAM's case, the existing power structures considered to create inertia and resistance to change are external rather than internal and affect the digital

transformation of the whole industry, not just the transformation of an individual organization.

The transformation challenges concerning lack of vision or impetus are on of the major issue in SETAM's case. The DAF mentioned that most of the time they face challenges with not finding the commitment from the employees to the company where they don't care much about the vision not the big picture of the companies's future goals. And that goes back to different affecting factors but from a managerial point of view they do lack in communicating their vision to most of the staff. for the 3rd transformative challenge the threatening of current power structure it is completely external because inside the company I did not come across someone who had resistance to change they are all for it. I observed and saw many employees learn by themselves on the internet on new technologies and programs and the top management are supportive verbally to these kind of efforts.

On the other hand, the most common individual challenge the interviewees pointed out was the conservative industry and the difficulty of championing digital transformation in such an environment. The large existing actors in the industry have established rather rigid relationships and have little motivation to disrupt the existing value chains. The DAF stated: "I don't want to invest alone a huge amount on a technology that I need to work in collaboration with partners where they resist to change and stay working the traditional way which will make me double the work in both traditional and digital work".

Generally due the age-range in SETAM where most of the employees are young there isn't much resistance to digital transformation as they are very familiar with IT.

As the figure 8 shows only 16% of the employees who passed 49 years old. 21% of them are between 40 and the 49. 32% between 30 and 39 years old. And 31% of them are below 30 years old and that was fascinating to me to find this in a governmental institution but it serves the digital transformation vision very well where it omit many resistance problems.

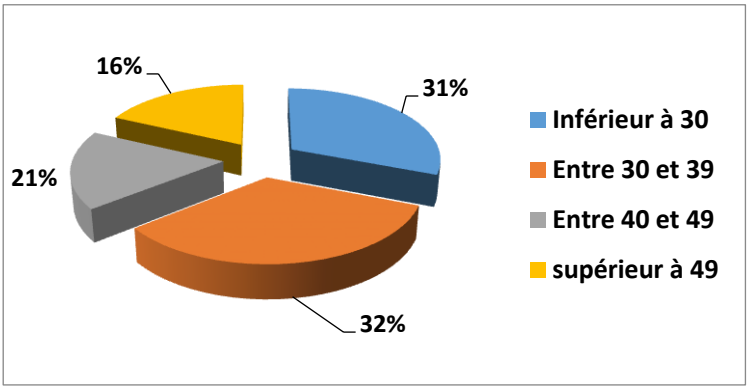



*Figure 7: Age repartition in setam.*

**Innovation challenges in SETAM**

The innovation challenges proved to be an interesting challenge category in terms of challenge themes, as most of what I observed made feel that ensuring the quality and quantity of digital initiatives and developing them consistently was of great importance. These innovation challenges as described by digital transformation literature are cultural issues, lack of skills and capabilities, and lack of collaboration and unclear business cases. The empirical evidence in SETAM's case is rather well in line with these challenges and illustrates them well, and there is no distinct deviation from the challenges described in existing literature.

The first major challenge for SETAM in ensuring the quality of innovations was considered to be having the required skills and capabilities within the organization. Novel digital technologies and digital transformation in general presents completely new demands for skills and capabilities in an AE company.

Within SETAM, this demand for new skillsets has been approached by both recruiting basic digital capabilities as well as developing them internally. Approximately half of all employees in SETAM are engineers who studied with technology and used to it to certain extent, which is clearly in the industry average. The employees also consider that they are more open to novel ideas and approaches, including digital initiatives. In addition to recruiting, SETAM has also focused on developing digital capabilities internally. For example, more than one interviewee stated that one of the main benefits of SETAM is they have freedom to explore, learn about new digital initiatives and bring them to the table. As the DAF stated: *"we might not recruited the most experienced and professional staff but we definitely offering them a workspace where they can develop and grow within the company"* With the recruitment of the 2 IT engineers they have created both knowledge and certain trust feel to be more curious on the digital topics, and the ability to describe and solve problems concerning digitalization either internally or in collaboration with other actors because the top management has their partners who are more advanced in terms of digital transformation and there is a wiliness from top management to ask for consultation from them and collaborate in the future.

None of the interviewees mentioned the issue of unclear business cases per se. SETAM encourages the digital initiatives to pursue digital transformation, experiment business models and build organizational capabilities and knowledge

The third common innovation problem occurring in company was the soloing of business units and lack of collaboration. To put it in perspective for example when the company offers new training and a development opportunity they need to make sure the employees wont resign after comleting the training in order to work outside for competitors they need to ensure their investment in personal pays back after but some employees refuse to commit to the company which leads to cancelation and demotivation of not only the benefiters but the top management too and slow down the digital transformation process. But they all also considered that SETAM has a culture that supports this kind of collaboration and a top management that supports collaborative development efforts and decision-making.

**Governance challenges in SETAM**

The third transformation challenge category, Governance challenges, has been perhaps the most problematic one for SETAM's digital transformation. The main governance challenges identified in the digital transformation literature are coordination issues, lack of resources and lack of funding. The lack of resources and lack of funding manifest in SETAM very similarly to what the existing literature describes. However, the coordination issues in SETAM's case have been more complex and more emphasized than often described in the existing digital transformation literature.

The coordination issues can be divided roughly to unclear roles and responsibilities and coordinating between digital businesses and traditional AE business. According to the staff, the roles and responsibilities have not always been as clear as they could be and there has been no clear champio'n of digital transformation in the top-management level. The free innovation culture discussed above results in a situation where there is no real coherence in digital transformation. This is good in terms of exploring as many transformation avenues as possible, but may result in confusion concerning the roles and responsibilities. This ambiguity of roles and responsibilities has decreased recently as SETAM has clarified the organizational structure concerning the digital initiatives and named an IT cell to be in charge of the digital initiatives. As they noted: *"Back in the day the AE engineers who used numerical*

*programs were considered the IT experts and their open cubical area was considered the IT department".*

In addition to coordination issues, SETAM has had some issues concerning the lack of resources, especially in terms of time that the employees can allocate to development projects. And since there is only 2 IT engineers, the development work is usually done in addition to the day-to-day work allocated to the entrepreneurial individuals. This works in the early phases of the initiatives, but the further they are developed the more weekly hours the development and implementation requires. In late phases of each initiative, the time and capabilities required often go beyond what an entrepreneurial individual can accomplish in addition to their day-to-day job. the employees pointed out that in these later stages of digital initiatives, there is a need either for additional time allocated to developing the initiatives, for organizational resources such as the aid of external professional IT or digital technology personnel.

One of the employees said: *"they are asking too much work from very few engineers. In addition to my actual work. I had to take care too much problems, and that affects my progress which is not fast as it should be".*

The issue of lack of funding the digital initiatives, especially in an AE firm, was discussed in the interviews, and the DAF mentioned that*: "the programs we need are very expensive and on top of that it requires collaboration with external companies some private and some international and that leads to extra security, legal precautions as we are an EPE. Also the budget for importing these digital innovations we are completely responsible for from the company's own revenue with no extra sponsorship from the government aka the responsible ministry".*

## 4.4 SETAM's Digital transformation through BIM

In this section of the findings and discussion I am going to go through SETAMs experience with BIM. And answer the RQ3 on how does BIM imply DT in an AE firm, after discussing with the interviewees and explaining what my goal was from this research they all mentioned BIM as the result of what I am looking for in a company like that. And based on the transcript I was given by the DAF I found the following DATA.

SETAM stated: *"Being aware of the obvious advantages of this innovative solution and the added value, through the implementation of BIM that will have an impact on the company and its processes, as well as all of its technological tools, EPE/SPA SETAM has decided to implement BIM as a working process, and is carrying out this*

*consultation for the selection of a BIM training and support organization capable of carrying out this mission in accordance with the requirements of all the provisions of this specification."*

So we can say that there is a will and intiative is being made since they have being trying to start implementing BIM in these past years but they have faced numerous barriers while doing so. Some kind of BIM usage the norm for most projects, at least as far as designing 3D models capable of containing extra object information. For each of the barriers identified from literature, we discuss whether we encountered these while doing the investigation.

**Barrier 1. Required training and knowledge**

The company specified the training of employees designated by the company in the pilot project as the following table 3 shows.

*Table 4: tabel that shows the number of people trained for the pilote project.*

| N° | Corps de métier | Désignation de la formation | Durée de la formation | Nbre. d'agents à former |
|---|---|---|---|---|
| 01 | **Architecture** | REVIT Architecture Initiation | 40heures | 02 |
| | | REVIT Architecture Perfectionnement | 24heures | 03 |
| 02 | **Génie Civil** | REVIT Structure Initiation | 40heures | 02 |
| | | REVIT Structure Perfectionnement | 24heures | 02 |
| 03 | **CES** | REVIT MEP Initiation | 40heures | 01 |
| | | REVIT MEP Perfectionnement | 24heures | 02 |

This barrier is present in our case study. The company Formed BIM engineers, but any pilot project that requires non BIM trained employees to participate, is expected to run into resistance.

**Barrier 2. Difference in BIM adoption between collaborating parties**

This barrier is present, they often work with the same set of parties, and therefore know what to expect when it comes to their BIM usage. They have guidelines in place for how models should be delivered and what they should contain, and the design stage is very collaborative and internal. However, when BIM usage would be pushed beyond the design stage which means for the mentoring of the project realization, this barrier will re-emerge, since different parties play a part during the construction process; they might have differing BIM capabilities from the firm itself.

**Barrier 3. Software and integration issues**

This barrier is present. Wanting to increase BIM usage as well as enriching the data available in the models is highly desired, but the desire is to connect BIM to existing

software solutions/workflows, so integration is required. The solutions for this have been scarce, as many products seem to focus on bringing as much functionality as possible into the model, rather than extracting and adding data from and to the model through existing solutions. But they have promises for decreasing this barrier.

*"The SETAM EPE/SPA is committed to providing the members of the BIM pilot project, after an audit to be carried out by the selected organization, at its own expense, with adequate equipment for the smooth running of the BIM pilot project*."

**Barrier 4. Legal and contractual**

This barrier is present in our case study as I mentioned this digital solution is not an Algerian invention nor highly available in our country so to be trained, able to purchase and get certified you have to reach out to international companies which also puts a governmental company in legal obligations and certain criteria to follow.

(APPENDIX C)

# CONCLUSION

# 5 Conclusion and avenue for future research

In this chapter, the research questions as determined in 1.2 will be answered. After all the sub questions have been answered, we look at the main research question of this research. Furthermore, the limitations and contributions of this research will be assessed.

## 5.1 Research results summary

***What drives Economical Public Enterprises to Digital Transformation?***

The first research question regards the drivers of digital transformation for EPEs. Companies are driven to digital transformation by multiple factors as there is actually concepts appearing and starting project to implement such as E-government in Algeria. There is future demands as Algeria aspires to build smart cities that are functional. And many other factors that can be aggregated under two main dimensions: external pressure and internal pressure. Most of the factors that were identified were normal competitive forces, such as growing competitive pressure, changing clients' needs and demands, and defending and fighting for the long-term competitive position. However, there were new distinctive new features in these forces that companies needed to take into account, e.g. clients' requirement levels were shifting over the traditional industry boundaries and new digital entrants from completely separate industries were entering to companies' markets.

Customers' needs are shifting across the industries which push companies to digital transformation. As customers experience the possibilities of digital innovations in more digitally advanced industries, their expectations rise and transfer to other industries as well. This, in turn, creates pressure for firms across the industries to develop digital innovations. For example, as clients are using shopping or bank apps, they start to think why the interfaces and clients experiences in design or traditional construction are not similar. These results give strong evidence how clients expectations increase over the traditional industry boundaries which in turn push companies to digital transformation.

EPEs are also facing new types of competitive pressure due to new entrants from private different firms. These new entrants are often private firms which have large resources and measurable competencies in digital innovations. This causes the

entirely new type of threat for companies and pose a great pressure to companies to drive their digital transformation forward.

There is also internal pressure that drives an EPE to digital transformation such as finding new growth sources because in an AE firm the core of the company do not function without digital tools and as technology is giving new techs the company has to keep up or else they will stay behind and get bankrupt. And of course finding new ways to decrease the costs is a high priority for any Economical Public Enterprise.

***RQ2: How does ICT's capabilities influence the ability of enterprises to implement the digital transformation? And what kind of challenges does the DT impose in an AE firm?***

This 2nd sub research question was answered in the literature review by mentioning how ICT enabled and triggered digital disruption and transformation of industries and developing a literature-based categorization for digital transformation challenges and evaluating the manifestation of those challenges in a traditional industry setting through an empirical research. As a result, the dissertation proposes a three-layered categorization for digital transformation challenges. These categories are **transformation challenges** focusing on creating direction and impetus for change both internally and externally, **innovation challenges** focusing on ensuring the quality and quantity of transformative innovations and **governance** challenges focusing on governance, funding and supporting of digital initiatives.

The comparison of management literature and the empirical evidence showcased that in the case of SETAM, there is a difference in which challenges are emphasized. The management literature focuses on internal challenges such as organizational vision, internal capabilities and quality and quantity of innovations, while the case demonstrated that the most difficult aspects of digital transformation often concern the external environment. The reason may be that the case company SETAM is trying to get ahead and drive digital transformation in the industry rather than just coping with the changing industrial environment. However, the challenges concerning facilitating digital transformation in a stagnant environment are often overlooked in the management literature and present a potential future research stream.

In general, SETAM has succeeded well in the initial steps of digital transformation. They have done well at creating a transformative digital vision and communicating

that vision internally. They have also managed to create organization-wide impetus for change and commitment for digital transformation among most employees. The initial exploration of potential future avenues through both internal development projects can be considered rather successful. These successes are mainly considered to be a result of a dedicated and skilled workforce and the strong, open internal culture of experimentation and constant development. The organization has experience on strategic transformation and the culture supports and highlights the capability for disruptive transformation.

The largest difficulties thus far in the context of SETAM have revolved around the governance challenges and top inter-communication such as the ministry.

***RQ3: How BIM imply Digital transformation of an A and E firm?***

The RQ3 is answered by summarizing the way how AE companies has many digital disruptors but importantly it is though BIM and can be considered as the base of the digital transformation. As being Aware of the obvious advantages of this innovative solution and the added value, through the implementation of BIM, which will have an impact on the company and its processes, as well as all of its technological tools will finally lead the firm to take a leap of advancement for their digital transformation.

I looked at the barriers as found in literature. In section 4.4 I attempted to compare these barriers with practice. While a variety of different barriers exist, I found that the biggest barriers found both in literature and in practice were Required Training and Knowledge and legal and contractual issues.

The former is about the high complexity of BIM models, and the costs of training personnel to make use of everything BIM has to offer. This also means that centralizing BIM as a data source becomes more difficult, as more users will come into contact with BIM and might need training. The latter considers all the issues with the government's obligations and ways of running thing, which makes integration a challenge too.

## 5.2 Limitations

The research presented in this dissertation has several limitations. First of all, context of all the gathered data is ONE quite large sized Algerian governments' AE firm, which, is a strong representative for the AEC industry, is still just one firm and there is 12 governmental AE firms and countless private ones. The study should be validated in a wider array of organizations. Furthermore, all data is focused on the

Algerian AEC industry which is not quite advanced as in the theoretical research and comparing studies conducted outside Algeria they have passed us with years ahead which put me in a research gap between what is already done years ago abroad is still fresh initiatives in the case study. So other markets are organized differently, so results are not automatically applicable everywhere else.

Lastly, the COVID-19 phenomenon and quarantine made the company slow and put on hold my internship and their digital project implementations for a while. Where I could have been in the company the day they launch their website that I helped create it has been prolonged to a further notice.

## 5.3 Future research

This research struggles from a big research gap between what is already out there theoretically in literature on digital transformation, leading, implementing, strategizing and drive DT in e-government projects, public and private companies, AEC industry and BIM process, management, implementation and development through levels. Compared to the study case that is still glorifying actions declared 12 years ago and still haven't accomplished them all.

But note that this dissertation provides knowledge on the digital transformation. By having this dissertation contributes to the academic research which is empty by providing new empirical results regarding drivers, executives' practices, and companies changing strategy and operations' in digital transformation

Furthermore, the literature could be expanded upon by truly analyzing the data requirements of every single AEC business process in order to create more standardized messages for additional tasks. The AEC industry is heavily fragmented, and, there are still various initiatives needed to truly make proper use of DT, and if this can be further standardized that will reduce the entry barrier for BIM usage even further.

The big next step though, is to take the subject further into the inter-organizational collaboration field. The AEC industry is heavily divers, so full integration between chains partners could possibly lead to huge benefits concerning the efficiency of the construction process.

The case study has shown that if overcoming their challenges will satisfy its requirements and that one pilot project could be completed successfully, but much wider tests are needed for full scale deployment. I hope that this work encourages

practice to think bigger when it comes to digital transformation with BIM, with proper integration the possibilities are immense. Furthermore, more feedback on the usefulness in practice is always welcome.

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