

PEOPLE'S DEMOCRATIC REPUBLIC OF ALGERIA  
MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH  
HIGHER NATIONAL SCHOOL OF MANAGEMENT



A dissertation submitted in partial fulfillment of the requirements of the  
Master's Degree in Commercial Sciences

Major: Strategic Management and Information Systems

Theme:

**The integration of Building Information Modeling with ambidextrous  
Business Process management in the Extended Enterprise System.  
Case study: Global Business Construction and System Application  
Product**

Presented by:

Fatima Zohra HAMMOUTENE

Mohamed BOUROUAG

Supervised by:

Djamila TOUMI

6<sup>th</sup> promotion

*September 2020*

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*We dedicate this dissertation to our beloved families,  
our grandparents, parents, brothers and sisters,  
who have always been there for us.*

# Acknowledgments

*With boundless love and appreciation, we would like to extend our heartfelt gratitude and appreciation to the people who helped us bring this study into reality. We would like to extend our profound gratitude to the following:*

*Our supervisor Djamila TOUMI, ENSM Algiers, for the patient guidance, encouragement and advice she provided us.*

*Professor Hammoutene Ali for his guidance throughout this research work, his experience, insightful comments, and guidance were essential to us in this research endeavor.*

*To our mentors and colleagues at GBC and SAP Companies, for the time spent with us, for the experiences and knowledge shared with us, for making our journey in the company a great learning and enriching experience.*

*To all our MSSI classmates and to all our friends, especially my dear friend Reem Kambris.*

*Special thanks to all our lecturers at ENSM Algiers who imparted their knowledge to us in a competent manner.*

*Finally, we would like to address our grateful thanks to everyone who assisted us accomplish this work.*

# Abstract

With the advent of digitalization, the construction industry is reshaping itself, slowly but certainly faster than previously. Pressure for change is coming from several complementary directions such as evolving client expectations, new technological capabilities, the launch of large infrastructure projects and booming start-up environment.

Defining a digital strategy is widely considered as the first step to make, to comprehend the full picture of digitalization's stakes and assess the current level of maturity. As such, building information modeling (BIM) should be regarded as the backbone of the new way of working triggered and targeted by the digital strategy given that different elements such as various software, drones, construction engines, building and infrastructure equipment, should ultimately be connected to it.

In this context, our study provides current data and an illustration of the impact of BIM integration with the ambidextrous business processes in the enterprise's system in Algeria.

**Keywords:** construction industry, digitalization, Building Information Modeling, ambidextrous business process, enterprise system.

# Résumé

Avec l'avènement de la digitalisation, l'industrie de la construction se remodèle, lentement mais certainement plus rapidement qu'auparavant. La pression pour le changement provient de plusieurs directions complémentaires telles que : l'évolution des attentes des clients, les nouvelles capacités technologiques, le lancement de grands projets d'infrastructure, le boom de l'environnement des start-up.

Définir une stratégie digitale est la première chose à faire pour obtenir une image complète des enjeux de la digitalisation et évaluer le niveau de maturité actuel. La modélisation des informations du bâtiment (BIM) doit être considérée comme l'épine dorsale de la nouvelle façon de travailler, déclenchée et ciblée par la stratégie digitale, étant donné que différents éléments tels que divers logiciels, drones, moteurs de construction, équipements de bâtiment et d'infrastructure devraient être interconnectés.

Dans ce contexte, nous avons développé ce travail pour illustrer l'impact de l'intégration du BIM avec les processus métiers dans le système de l'entreprise en Algérie.

**Mot clés :** l'industrie de la construction, digitalisation, modélisation des informations bâtiment, processus métiers, système de l'entreprise.

## ملخص

تزامنا مع التطور التكنولوجي والرقمنة، يشهد قطاع البناء عدت تغييرات داخلية وخارجية بغية مواكبة هذا التقدم لإشباع رغبات المختلف الاطراف والاحاطة بأهم جوانب التكنولوجيا.

في ظل هذه التطورات بات ادراج استراتيجية لمواكبة الرقمنة من اهم ضروريات المؤسسات، خاصة في قطاع البناء الذي يشهد تطور غير مسبوق مع ظهور تقنية نمذجة معلومات البناء او ما يعرف بالنمذجة الشاملة، التي تركز على عديد تكنولوجيات البناء التي تسهل عملية تسيير وتتبع المشاريع.

في سياق هذه التطورات، تمحورت دراستنا حول كيفية ادماج تكنولوجيا النمذجة الشاملة مع تقنية توجيه ادارة العمليات ضمن نظام معلومات المؤسسة؟ وهذا بهدف تحسين مردودية المؤسسات.

**الكلمات المفتاحية:** قطاع البناء، الرقمنة، النمذجة الشاملة، نظام المعلومات ، توجيه ادارة العمليات.

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# List of abbreviations

BIM: Building Information Modeling

BPM: Business Process Management

ES: Enterprise System

EES: Extended Enterprise System

IT: Information System

SLR: Systematic Literature Review

SAP: System Application Product

GB: Global Business

GBC: Global Business Construction

GBIT: Global Business Information Technology

MRP: Material Requirement Planning

MRP 2: Manufacturing Resource Planning

ERP: Enterprise Resource Planning

IS: Information System

CRM: Customer Relationship Management

FRM: Final Resource Management

HRM: Human Resource Management

M/S: Marketing And Sales

SCM: Supply Chain Management

SaaS: Software As Service

SFA: Sales Force Automation

# **Introduction**

The most important challenge facing today's enterprises is how to initiate change and how to confront it. The traditional meaning of change management is one-time event or at least non-frequent event. But what if an enterprise is looking for the capability to handle not only change management but also management of change on a continual basis?

In the age of digitalisation and globalisation, this challenge has become more and more complex because of the unstable environment. According to a recent Mackinze Global Institute analysis "navigating the digital future" 10<sup>th</sup> October 2017: Digital transformation over the past five years shows that companies adopting a digital transformation strategy have gained a strong competitive advantage. Meanwhile, the construction sector was ranked second to last over 22 major industries overall digitalization rates. Moreover, productivity has stagnated for decades and the project reaching completion 20 months behind schedule and 80% over budget. The high complexity of projects processes and the resistance to adopt new building technologies such as, 7D building modeling and new information system technologies, are the main causes behind such deficiencies.

The "Boston Consulting group" stated additionally that the adoption of digitalisation will save cost of 13% to 21% in the design engineering and construction phases and 10% to 17% in the operational phases by 2025. "Gartner" further estimates that by the end of 2020, 75% of businesses will adopt digital transformation, but only 30% of those efforts will be successful due to many challenges such as the scattered landscape of software solutions that do not support adequately the complex business processes.

In this context and in order to bridge the gap between the effective digital transformation and the management style of construction companies, our dissertation is entitled as follows:

**"The integration of building technologies with business processes in the enterprise's system"**

This study focuses on the importance of adopting digital transformation in the construction sector and the effective way to achieve it. From that, we formulated our main question:

**"How to integrate the Building Information Modeling (BIM) with ambidextrous Business Process Management in the Extended Enterprise System?"**

From this main question, the following research questions are formulated as follows:

- How to integrate BIM with ambidextrous BPM and how will this integration affect the construction processes?
- How to integrate BIM-ambidextrous BPM in the EES and at what level this integration will solve the problem of the IT landscape?

This study aims to verify the following research hypotheses:

- **Hypothesis 1:** The integration of BIM-ambidextrous BPM in the EES will maximize the productivity and fix the scattered IT landscape.
- **Hypothesis 2:** The integration of BIM-ambidextrous bpm in the EES will maximize the productivity only.

These hypotheses were inspired from a white paper entitled “How to integrate BIM with business processes” made by (Peeter Parna, Jaan Saar 2017), after that we decided to go further and deeply on this research, in order to validate (accept or reject) each of those hypotheses, for that we initiated our study by creating a project that we called “project BIM”

To carry out this study, we adopted a systematic literature review (SLR) in order to collect the maximum studies about our topic by selecting leading construction and information systems journals, articles and researches for papers published from 2015 to 2020. After that, semi-structured interviews were carried out in order to collect and exchange relevant information and data on the subject.

Our study is structured around two parts, a theoretical part composed of one chapter, and a practical part composed two chapters which are as follows:

The first chapter, entitled “Theoretical Literature review and conceptual framework”, in which we will be approaching first the ambidexterity in organizations and ambidextrous BPM, then the link between BPM and IT, the enterprise system and the building technologies moving to defining the important concepts such as ambidextrous, oraganisation, BPM, ES, EES and BIM.

The second chapter, entitled “Methodological framework”, in which we will present the methodology of the study carried out.

The third chapter, entitled “The integration of Building Information Modeling with ambidextrous Business Process management in the Extended Enterprise System” in which we will present the two companies of interest with which our study was conducted as well as the

steps we followed to make successful this integration. We completed the study with a detailed analysis of the results of our research carried out in order to validate each of our two research hypotheses. Finally, a conclusion is provided at the end.

**CHAPTER ONE:**  
**Theoretical Framework**

## **Introduction of the chapter**

This chapter aims to demonstrate that our research work refers to scientific bases in the field of construction and technologies. This chapter also helps to clarify the meaning given to the concepts used.

### **Section 01: Literature review**

#### **1. Ambidexterity in organizations**

According to (Duncan R., 1967) the Organizational ambidexterity describes the co-existing corporate abilities of running the current operations as well as being able to continuously adapt the organization to a changing environment. With other words, the ambidextrous organization shows both exploitative and explorative strengths at the same time.

Exploitation aims towards securing the reliable execution of current business Processes, it describes activities that focus on leveraging existing knowledge according to (March, J. G., 1991). Typically, doing so involves continuously improving products and processes and standardizing products and processes to increase efficiency. Exploration, on the other hand, according to (March, J. G., 1991), focuses on new knowledge to an organization, it is targeting a much stronger outside-in perspective, its overall aim is to enable innovation, growth and an effective and efficient capitalization on emerging business and technical opportunities. Exploitation and exploration are closely related as exploitative capabilities can be seen as necessary, but not sufficient in a changing environment.

An organization not able to even execute-to-promise will have no foundation for far reaching explorative endeavors according to (O'Reilly, C.A., Tushman, M.L., 2004), This explains why many companies put substantial efforts in building exploitative capabilities before venturing into exploration. Unfortunately, many companies never make it beyond exploitative capability development. The ambidextrous organization, however, is ultimately strong in exploitation and exploration.

#### **2. Ambidextrous Business Process Management**

Business Process Management has substantially matured over the last two decades. The techniques, methods and systems available to scope, model, analyze, implement, execute, monitor and even mine a process have been scientifically researched and can be in most cases

deployed in practice according to (Rosemann Michael, 2014). In fact, many of these BPM capabilities are nowadays a commodity. However, an opportunity-rich environment and rapidly emerging digital disruptions require new BPM capabilities.

The ideas and principles of the ambidextrous organization can be deployed to the domain of Business Process Management. They allow us to identify those capabilities BPM has to develop to remain valuable in the future.

According to (Carin Lindskog, 2018) exploitation in the BPM context implies utilizing known tools, increasing efficiency in the processes, and techniques of BPM. Several quality management approaches and process integration, serve as appropriate approaches to deal with an exploitation oriented goal. Exploration-oriented BPM, on the contrary, aims at innovating processes, services, products, and business models, abductive thinking, design, and communication.

### **3. The link between BPM and IT**

Business process Management is a dire need for organisation ranging, in the age of digitalisation and globalisation, BPM should become more innovative and creative by using information technology in organisation's business process. To review the historical link between BPM and IT, a group of researchers (Tahir Ahmed, AmyVan Looy, 2017) in Ghent University, Ghent, Belgium, made a research, it's objective was to incorporate prior studies related to the co-evolution between BPM and IT in order to explore insight and innovation trend resulting from this IT interrogation in the BPM discipline. The mean research question was: What is the current state of the research regarding the link between BPM and IT?

To answer the question, they applied a systematic literature Review (SLR) as a research method in order to summarise existing studies combining IT and BPM; The systematic Literature Review was based on two essential Hypotheses they proposed:

H1: Information technology open new avenues for BPM research and practices, resulting in new themes emerging from new IT support in business processes.

H2: In the era of disruptive information technology, BPM growth is shifting from an organizational or managerial side towards digital innovation and explorative BPM.

After defining the hypotheses, they used an SLR protocol in order to answer to the research question by defining the Search source, method and criteria and in order to finalise the research they discussed the results for (H1, H2)

For the researches concerning hypothesis 01, The SLR showed that the BPM discipline grows rapidly by IT intervention, therefore the first hypothesis correctly clarifies that it inaugurates corridors, however the second hypothesis showed that they have the potential to investigate in depth qualitative and quantitative studies to dig out new IT involvement in escalating BPM capabilities and efficiency.

#### **4. Enterprise Systems and Innovation in contemporary firms**

Innovation is the lifeblood of many organization according to (Hsu Y., 2017), and according to (Nambisan S. 2013) Technology plays a vital role in triggering innovation in organizations. thus, in the last decade the nature of innovation has undergone considerable changes in most industries. In order to understand the innovation process enabled by Enterprise Systems (ES), (Sachithra Lokuge and Darshara Sedera, 2017) made a research to investigate the role of ES in fostering innovation. the main question of this research was: How do organizations innovate using ES in the presence of digital technologies. To answer to this question They made a research divided to seven section: introduction, theoretical propositions, Research methodology, the analysis, Research findings, Discussion section and the conclusion.

On the theoretical propositions section, they review the literature on ES and innovation and develop five key propositions:

P1: ES enable process innovation.

P2: ES enable radical process innovation during the shakedown phase.

P3: In the world and upward phase, ES enable incremental innovation.

P4: ES enable organizations to reduce the lead time of process innovation.

P5: ES led innovation provides a competitive advantage in the onward and upward phase.

In the Research methodology section, they conducted a qualitative study, qualitative approach and collected data from multiple cases to investigate how organization innovate using ES.

Concerning research findings section, first, they found support only for P2 (i.e., that an ES can introduce radical innovation when first introduced) where all case organizations

highlighted several dramatic improvements to their business processes, the organizations themselves, and to their culture: 1) the introduction of a strong focus on business process standardization, 2) real-time integration, and 3) enhanced functional coupling.

However, as for P1 and P3, we found no indication that ES catalyzed innovation beyond the initial implementation. For example, after the implementation of ES, during the onward and upward phase, organizations did not focus on improving the ES (P3). Specifically, organizations found that their ES contributed to unacceptable lead times for innovation (P4) and, as such, did not provide a competitive advantage (P5).

In the discussion section, they deeply explain the role of ES in facilitating process innovation in the contemporary business landscape, they also investigate what role ES plays in process innovation in the presence of digital technologies (RQ).

Finally, they conclude the research by investigating on how organizations innovate using an ES in the presence of digital technologies, by analyzing data collected from four case organizations, they empirically revealed how digital technologies facilitate innovation in organizations and show that managers and CIOs are reluctant to invest in ES for innovation. Most importantly, they uncovered the new role of ES in supporting innovation in organizations.

## **Section 02: conceptual framework**

### **1. Ambidextrous organization**

The ambidextrous organization combines between exploring and exploiting activities to end uncertainty and achieve better accomplishments. General managers and company executives ought to be able to relate between the products and processes of the past and innovations that will draw the future. Companies which balance between exploiting markets with their current products while simultaneously exploring new markets with innovations are known as ambidextrous organizations. But this is not easily reached!

Exploitation activities is efficiency and production of products. Exploiting current products and past innovations are what gives societies the ability to provide incomes. Exploration is searching, risk taking, experimentation and innovation for new products or services.

Innovation is conceivable on multiple levels, continuous, architectural and discontinuous. Continuous innovation is the process making steady enhancements to a known product or service, e.g. Gillette's launch of Mach III after Mach II, Architectural innovation, reconfigures a built up framework to interface the current parts in another manner, eg: a bank that moves its customer assistance to a lower labour cost country. Discontinuous innovation is the creation of a new product, service or process that can set other products out of business, examples of this kind of innovation are Disposable sanitizing tissues to be used on the body instead of the shower or bath. Innovation is an important activity for a company, as it can be very beneficial.

### **2. The link between business process management (BPM) and Information Technology (IT)**

#### **2.1. Business process management**

BPM is a discipline that uses different tools and methods to design, model, execute, monitor, and optimize business processes, it coordinates the behavior of individuals, systems, data, and things to supply business outcomes in support of a business strategy.

BPM focuses on putting a consistent, automated process in place for daily transactions and people's interactions. It helps to reduce the business's lower costs by decreasing waste and rework, and by increasing the efficacy of the team.

It's important to know that BPM is not a software product, however there are BPM tools that help in implementing standard and automated business processes but BPM is not a software product in itself. It is not Task Management either, because a Task Management is about handling or organizing a bunch of activities. Bpm, is focused more on repetitive and ongoing processes that follow a process management.

There are two types of BPM based on the purpose that they serve. System-Centric BPM, this type handles processes that primarily depend on existing business systems (e.g., HRMS, CRM, ERP) without people's involvement. It has extensive integrations and API access to be able to create quick and efficient business processes. The second type is the Human-centric BPM, it considers people first, supported by numerous automation functions. These are processes that are firstly executed by humans, and automation does not easily replace them. These often have a lot of approvals and tasks performed by individuals. Examples of human-centric processes: customer service, handling complaints and filing expense reports.

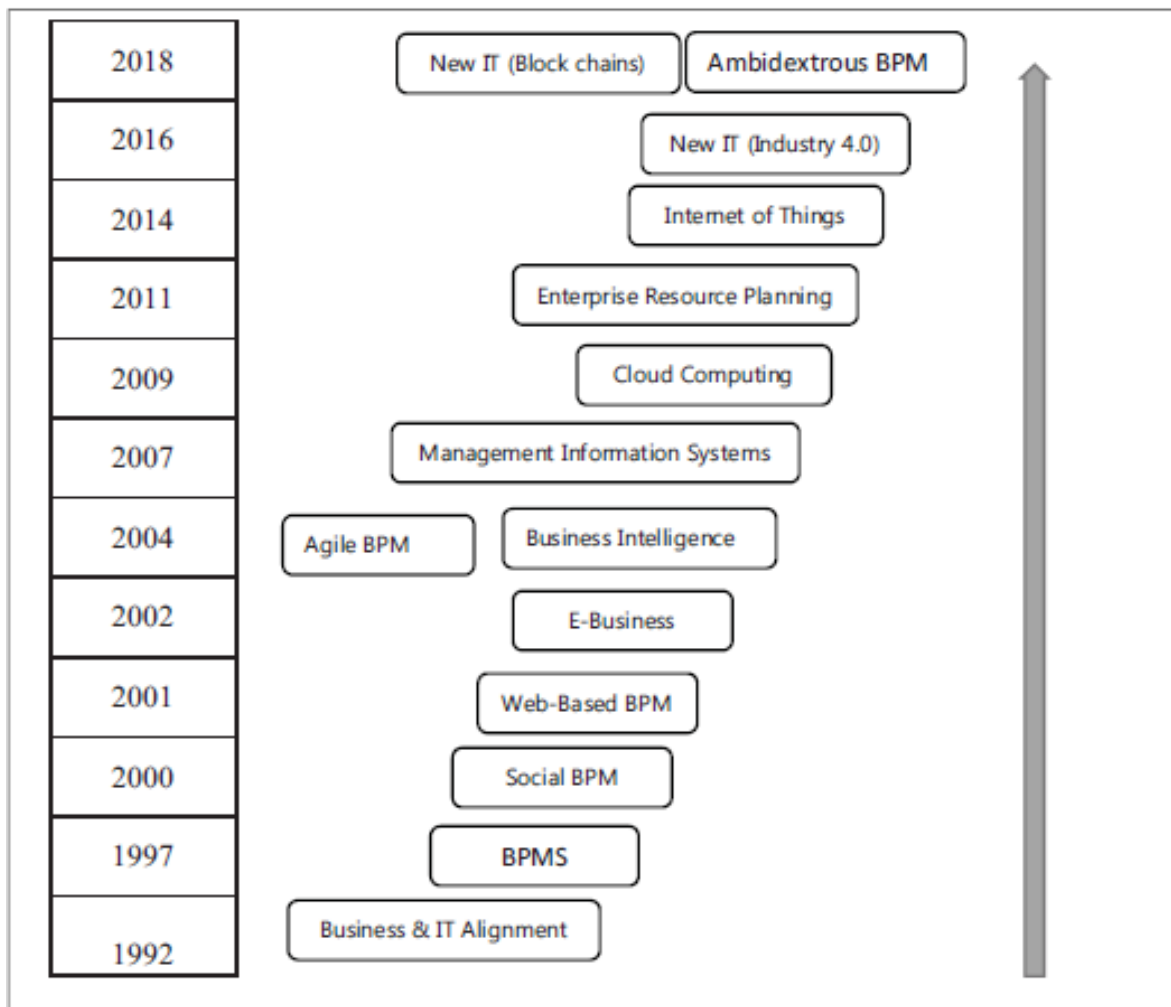
Business Process Management (BPM) is very important for organizations going from small enterprises to large ones, as they can use BPM capabilities to perform business functions in a more effective and efficient way. Since BPM capabilities associate internal and external knowledge in an organization, the opportunities based on Information Technology (IT) seem discomfited without BPM capabilities.

The main vision of BPM (i.e. automation and transformation of business processes) focused essentially on IT based business performance or digital innovations. Digital innovation, influences beliefs, values, structures and practices of organizations, which makes cultural and environmental change, so IT plays an important role for information management, data processing and communication in business processes.

## **2.2. The evolution of BPM-IT**

It started in 1992 with business and IT alignment arriving to 2018 and till our days with the ambidextrous BPM and the new IT: block chains as showed in figure 1, what interests us in our research is the BPM-IT alignment and the ambidextrous BPM and their definitions.

Figure 1: BPM-IT evolution chart



Source: (Tahir Ahmad, Amy Van Looy, 2019)

### 2.3. BPM-IT alignment

When business goals swivel, IT should be capable to respond with necessary solutions to support and maintain the enterprise's force. In turn, technological advances and enhancements are included into current and future strategies and initiatives, leading to one unified team.

Business and IT alignment will lead progressively to the “consumerism of IT,” where collective and personal technology interlace. Actually, there is already a large expectation that employees should have access to the same technologies at home and in the office, who does not want to search for information across their company’s databases as simply and rapidly as if they were asking Alexa or Siri!

An implication of business and IT alignment is the changing nature of corporate IT, which means roles that were traditionally inserted in IT departments, are now included into the business. This has meaningful implications for IT infrastructure because employees must be

efficient in their tasks, and be reliably, safely, and cost-effectively shared across the enterprise to get through any difficult points that arise. With this, CIOs are under rising pressure to focus on digital needs that grow and transform and to modernize the operational environment with new functions. They also must prove how IT is meeting a given business strategy. So looking forward, no matter how tiny or huge the business is, technology can deliver tangible and intangible benefits (like speed and performance) to hit incomes and operational targets, and meet customers' expectations of innovation. Having an excellent technological infrastructure improve the culture, efficiency, and relationships of business.

This continuous strategic circle (BPM-IT alignment) means enterprises function better, make more profits, increase their ROI because they achieve their goals with less effort. And while there may be no typical way to align successfully, an organization where IT and business strategy are in lock-step can further improve agility and operational efficiencies. This battle of the 'effs', efficiency vs. effectiveness, has never been so critical to business survival.

## **2.4. Ambidextrous BPM**

Nowadays, the fourth industrial revolution guided by social, mobile, cloud and smart technologies. In order to gain benefits from "new IT" such as Artificial Intelligence, Internet of Things, block chain and their opportunities for digital process innovation, organizations need to follow exploitative and explorative process capabilities at the same time, in order to deliver process innovation. This is called Business Process Ambidexterity it provides a fascinating challenge for the BPM discipline since it requires to move beyond its founding chart of process control and optimization, towards identifying opportunities for process disruption and the creation of process designs that truly interest customers.

### **2.4.1. Exploitation and exploration**

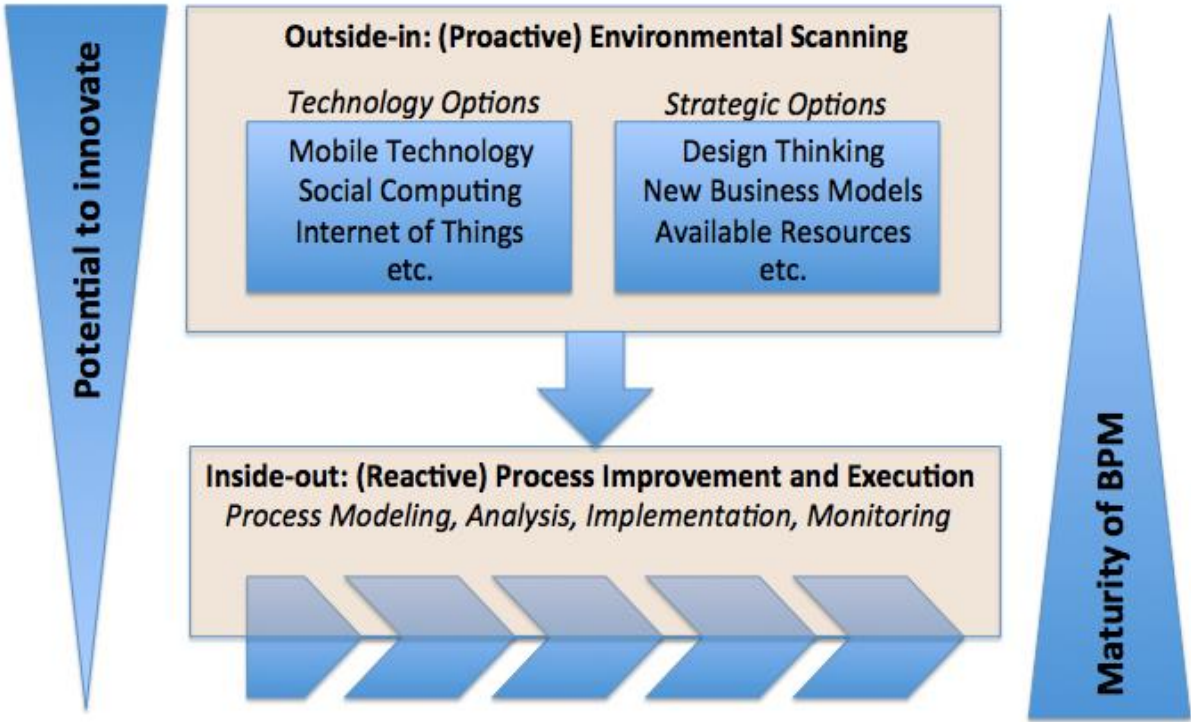
Business ambidexterity is the balancing act between exploitation and exploration: exploitation focuses on applying best practices on transactions with a concentration on net cost reduction, exploration is centered on transformational excellence targeting net revenue creation. And organizations need to be able to do both at the same time, even if they need different capabilities.

Process exploitation is about inside-out, reactive, problem-driven process management. Exploitation test a process and fixes what is broken. It doesn't excite customers or managers, but it's a requirement for staying in business. Process exploration, on the other side, is

conducted by outside opportunities (emerging technologies) and is proactive. It has the ability to deliver huge added value, and high levels of customer satisfaction, by offering new services or innovatively transforming existing services. And it presents a new and exciting challenge for BPM users and researchers. Though, process exploration is still in its beginning while current BPM methods, tools and techniques support process exploitation well.

Figure 02 shows the contemporary, mature inside-out BPM capabilities which serves well in an environment attempting for predictable, modernized and efficient processes (which we can represent as exploitation) but organizations aiming for innovation will require complementary outside-in capabilities establishing technological and strategic options and evaluating their applicability to the existing or a possible new view of processes (which we can represent as exploration).

Figure 2: The Maturity-Innovation Conflict in BPM



Source: (Rosemann Michael, 2014)

**3. The Enterprise System (ES)**

The term of enterprise System was coined by Thomas Davenport (1996;2000), who introduced ES as specific information system that helps to make a good and managing resources proactively and productively.

### 3.1.The Enterprise system Evolution

The evolution of ES passed from the Material Requirement planning (MRP) to ERP then the Extended Enterprise system (EES) this evolution was through the change of organization environment and their business needs.

Figure 3: Enterprise system's evolution

Evolution of Enterprise Systems			
System	Primary Business Need(s)	Scope	Enabling Technology
MRP	Efficiency	Inventory management and production planning and control	Mainframe computers, batch processing, traditional file systems
MRP II	Efficiency, effectiveness, and integration of manufacturing systems	Extending to the entire manufacturing firm (becoming cross functional)	Mainframes and minicomputers, real-time (time-sharing) processing, database management systems (relational)
ERP	Efficiency (primarily back office), effectiveness, and integration of all organizational systems	Entire organization (increasingly cross functional), both manufacturing and nonmanufacturing operations	Mainframes, mini- and microcomputers, client/server networks with distributed processing and distributed databases, data warehousing, mining, knowledge management
ERP II	Efficiency, effectiveness, and integration within and among enterprises	Entire organization extending to other organizations (cross functional and cross enterprise partners, suppliers, customers, etc.)	Mainframes, client/server systems, distributed computing, knowledge management, Internet technology (includes intranets, extranets, portals)
Interenterprise Resource Planning, Enterprise Systems, Supply-Chain Management, or whatever label gains common acceptance	Efficiency, effectiveness, coordination, and integration within and among all relevant supply-chain members as well as other partners or stakeholders on a global scale	Entire organization and its constituents (increasingly global and cross cultural) comprising global supply chain from beginning to end as well as other industry and government constituents	Internet, Service Oriented Architecture, Application Service Providers, wireless networking, mobile wireless, knowledge management, grid computing, artificial intelligence

*Source: historical evolution of erp's, Astri Ariyanti, Pinterest*

#### 3.1.1. Material Requirement Planning (MRP)

In the 1960s the main challenge was how to identify the time, quantities and kind of material needed for production, in this period (1964) Josef Orlicky developed a solution as a response to the Toyota Manufacturing program, this solution was to make up a calendar with list in order to match up supply with demand, this method was proven and began to be used in business, then it was developed as computer's software to be used at first by Black & Decker, this software called later Material Requirement planning (MRP); this MRP has three major functionalities: Master production scheduling, bill of material and, inventory tracking.

By 1975 MRP was implemented in 700 companies, this number moves to 8000 by 1981.

**3.1.2. Manufacturing Resource Planning (MRP 2)**

In 1983 the manufacturers realized that they need a software that could integrate their accounting systems, cover financial and employee needs and forecast inventory requirement, for that Olever Wight evolved a new generation of software based on the existing functions of the MRP and including a new features such as :

- Machine capacity scheduling
- Demand forecast
- Quality assurance
- General accounting

This a new software known in this period as Manufacturing Resource Planning (MRP2).

**3.1.3. Enterprise Resource Planning (ERP)**

This system first appeared in the late of 1980s based on MRP and MRP2 functions and integrating the core functions and processes needed to run a company. ERP is a core software used by companies to integrate and coordinate information in every area of the business, ERP programs help organization to manage company-wide business process using a common tools (Ellen Monk, Bret Wagner; concept in enterprise resource planning, fourth edition p2).

**3.1.3.1.The functional areas of ERP**

The majority of companies have four functional area of operations as shown on Table 01 below:

Table 1: the functional areas of ERP

<b>Functional area of operation</b>	<b>Marketing and sales</b>	<b>Supply chain management</b>	<b>Accounting and finance</b>	<b>Human resources</b>
	Marketing a product	Purchasing goods and raw materials	Financial accounting of payments from customers and to suppliers	Recruiting and hiring
	Taking sales orders	Receiving goods and draw materials	Cost allocation and control	Training

<b>Business functions</b>	Customer support	Transportation and logistics	Planning and budgeting	Payroll
	Customer relationship management	Scheduling production runs	Cash-flow management	Benefits
	Sales forecasting	Manufacturing goods		Government compliance
	Advertising	Plant maintenance		

Source: updated from technology course/cengage training

✓ **Marketing and sales (M/S):**

The main functions of this area are: developing products, determine pricing, promoting products to customers and taking customers needs, helps to create a sale forecast in order to insure the cash flow management.

✓ **Supply chain management SCM:**

SCM ensure the maintenance of balance between demand and supply by using: supply and demand management, sourcing procurement, logistic and asset management.

✓ **Accounting and finance FRM:**

FRM provide summaries of different financial statements, planning and budgeting, cash flow management and controlling accounts.

✓ **Human resources HRM:**

The main functions of this area are: personal administration, recruitment, organisational management training and reporting.

✓ **Cloud Based-Enterprise Resource Planning (ERP)**

Is a software that allows users to access to ERP using SaaS (software as service) technologies in order to: drive efficiency, optimise processes, reduce infrastructure and maintenance cost and enable data-driven decision making.

### 3.1.4. Extended Enterprise Systems (EES)

The most salient trend in the continuing evolution of ES is the focus on front-office applications and inter-organizational business processes, particularly in support of supply-chain

management. At present greater organizational effectiveness in managing the entire supply chain all the way to the end customer is a priority in business. The greater emphasis on front office functions and cross-enterprise communications and collaboration via the Internet simply reflects changing business needs and priorities, in this renewed context, ES enable enterprises to integrate and coordinate their business processes. They provide a single system that is central to the enterprise and ensure that information can be shared across all functional levels and management hierarchies (Vivek Kale, Enhancing Enterprise Intelligence)

In order to meet changing business needs the keys players such as Sap and oracle involved a new generation of enterprise system called EES (EXTENDED ENTERPRISE SYSTEM) this system has the same concept of ERP with the integration of the new Business-It trend such as Sales Force Automation (SFA), Business Intelligence, and E-commerce.

#### **4. Building Information Modeling (BIM):**

BIM is a process for simulating and evaluating any aspect of a design before the construction, it is described as a digital representation of physical and functional characteristics of a building, It also serves as a shared knowledge resource for information about a building forming a reliable basis for decisions during its life-cycle.

It refers to the consistent and continuous use of digital information throughout the entire lifecycle of a built facility, including its design, construction and operation (André Bormann, 2018). BIM is more than just a 3D animation: it's a model intelligent project in which information is integrated so that it can be shared between stakeholders throughout the process.

Today, more and more architectural firms have adopted BIM software and processes because it allows them to produce measurably more work of better quality, in shorter periods of time. Featuring case studies of firms of all sizes.

# **Chapter Two:**

## **Methodological framework**

## **Introduction of the chapter**

The objective of this chapter is to describe the methodological approach as well as the data collection and processing techniques used in order to answer the questions asked.

### **Section 01: Choice of theme**

The choice of theme is based on the importance of addressing the notion of change in companies, because they are going through many transformations and mutations. To support these transformations under optimal conditions, a set of methods and techniques must be used in order to achieve the desired result, so we are interested in how to conduct the changes in the frame of ES by using new actual technologies such as ambidextrous BPM and BIM.

#### **1.1.For the researcher and the building sector**

The digitalization plays a primary role in the different business sector, for a grand waiting project, it will be honest for us to be part of this digital transformation in order to achieve our academic objectives: being in touch with the last IT technologies and support our master diploma with strong references that allow us to have a strong competitive advantage to complete our doctorate studies.

At first, we were interested in innovation and new technologies in different sectors, we started our research by rating the progress of digitalization in every sector, then we targeted the most important sector in our country, especially that this sector is in the maturity phase and it is still managed with a classical way. Further, by the arrival of the covid 19, the sector stagnated and many companies were bankrupted. In this period, we realize that the adoption of new IT technologies became necessary and the digitalization became at the highest level of companies objectives, for that, we chose one of the biggest construction companies in Algeria GBC, and the world leader in IT solutions SAP to initiate our graduating project which we called “project BIM” in purpose to bring the SAP experience and technologies and fit it in our Algerian environment which is very far from the IT trends.

## Section 02: Research methods

### 1. Systematic literature review

We applied the systematic literature review technique proposed by (B.Kitchenham, 2004) which is a qualitative research method and follows a rigorous scientific process, it takes few steps to comprehensibly gather, combine and evaluate existing evidence.

#### 1.1. The main question

The main challenge in companies is: “How to help real estate developers and construction companies to design and build more efficiently and automate the process of moving from design to build?” “what if there is a solution to provide a single source of truth?”

We prepared our topic by asking the right and suitable question nor broad neither narrow one, we took a look at the available evidence and we found enough research to address our main question: “How to integrate BIM with ambidextrous BPM in EES?”

#### 1.2. Guiding hypotheses

According to (B.Kitchenham, 2004), researchers may use hypotheses to identify and report findings that support the developed hypotheses. we developed two research hypotheses (Table.) based on our research question.

Table 2: Guiding hypothesis

<b>Hypotheses formulation</b>
H1: The integration of BIM-ambidextrous BPM in the EES will maximize productivity and fix the scattered IT landscape.
H2: The integration of BIM-ambidextrous bpm in the EES will maximize productivity only.

Source: authors' table, inspired by (Peeter Parna, Jaan Saar 2017)

#### 1.3.SLR protocol

After formulating the SLR hypotheses, we developed our SLR protocol in line with (S. K. Boell and D. Cecez-Kecmanovic, 2015) (Table 3). A Systematic Literature Review Protocol typically includes a definition of the research question, search sources, search items, search strategy, inclusion and exclusion criteria.

Table 3: SLR protocol

<b>Research Question</b>	How to integrate BIM with business processes in the EES?
<b>Search Sources</b>	Web of science, research gate, ProQuest, google scholar, ENSM library.
<b>Search terms</b>	BIM integration, ambidextrous bpm, ES, EES, ERP, SAP
<b>Search Strategy</b>	Search queries with keywords in the “Topic”
<b>Inclusion Criteria</b>	<ul style="list-style-type: none"> <li>• Included paper according to search terms and source</li> <li>• papers written in English, French and Arabic</li> </ul>
<b>Exclusion Criteria</b>	<ul style="list-style-type: none"> <li>• Duplicates</li> <li>• Irrelevant studies if they do not cover BPM and IT interaction terms</li> </ul>

Source: authors' table, inspired by (Peeter Parna, Jaan Saar 2017)

#### 1.4. Search source and method

We started our search by going to the ENSM library, we did not find much books or articles related directly to our topic. Next, we searched on internet platforms that regroup databases from several disciplines (digital libraries) such as: ProQuest, ResearchGate and Google Scholar. At last, we completed by searching in the web of science library database and fortunately our search resulted in a large number of sampled papers. Web of science is recognized for only containing peer-reviewed papers of high-ranked journals and conferences and it provides information such as titles and author names which are listed in a structured way.

After following the first step of Table 4, we retrieved all searched titles and abstracts from the Web of Science and we exported them to MS Excel for an initial listing. In step 2, we removed the titles and abstracts resulting in 102 papers to be considered as not applicable. Since different keywords were used in step 1 to maximize the search horizon, 48 papers were duplicates and could be removed in step 3. Therefore, we excluded all same studies and those studies which were off the topic in concepts based on their abstract, even with relevant titles. We included only those studies that were related to the link between BPM and IT (or ICT or technology) and to the link between information system and building technologies. The main criteria to add a study was that any of our predefined keywords had to be present in the title or the same nature of study had to be in the abstract. Finally, in step 4, we analyzed the content of 530 papers based on the titles and abstracts.

Table 4: Steps we followed to collect papers for our study

Step 01	Search from library	ENSM library
	Retrieval date	23/03/2020
	Total Number of retrieved papers	29 papers
	Search from digital library	ProQuest
	Retrieval date	10/04/2020
	Total Number of retrieved papers	51 papers
	Search from digital library	ReasearchGate
	Retrieval date	11/04/2020
	Total Number of retrieved papers	67 papers
	Search from digital library	Google Scholar
	Retrieval date	12/04/2020
	Total Number of retrieved papers	50 papers
	Search from digital library	Web of science
	Retrieval date	24/04/2020
Total Number of retrieved papers	483 papers	
Step 02	Removal of Not Applicables	-102
Step 03	Removal of duplicates	-48
Step 04	Papers selected for initial analysis	530

Source: authors' table, inspired by (S. K. Boell and D. Cecez-Kecmanovic, 2015)

### 1.5. Search criteria

Since our study aimed at collecting a set of previous work on the link between IT and BPM, the new technologies in ES and building information technologies, the choice for proper search criteria was primary (table 5) "Information Technology" is a wide term and many substitute words have been used in the literature (e.g. IT, ICT or technology). Therefore, we also used those alternatives as search keywords to cover a large interval of research papers.

Table 5: keywords used for our research

First keyword	Second keyword	Total number of results
“business process management”	“IT”	350
“business process management”	“ICT”	199
“business process management”	“technology”	53
“information system technologies”	“construction system”	30
“information system technologies”	“building technologies”	48

Source: made by us, inspired by (S. K. Boell and D. Cecez-Kecmanovic, 2015)

### Semi-structured Interviews

A semi-structured interview is a meeting in which we do not strictly follow a formal list of questions. Instead, we ask more open-ended questions, which allow us to discuss with the interviewee rather than a question and answer form.

In this type of interview, the interviewer may prepare a list of questions but won't necessarily ask all of them, or touch on them in any particular order, using them instead to guide the conversation. In some cases, the interviewer will prepare only a list of general topics to be addressed (Alison Doyle, 2020).

We chose this kind of interview because: The semi-structured interview format encourages two-way communication. Both the interviewer and the candidate can ask questions, which allows for a comprehensive discussion of pertinent topics.

Notice that we used two ways to interview, one directly, face to face in the company (SAP+GBC). The other one was by phone calls or zoom calls.

### 1.6. Selection of interviewees

We interviewed a number of persons which are related to our topic (table 06):

Table 6: names of the interviewees, workplace and the way we communicated with them

Interviewee's name	Workplace	Communication way
Boudchicha Naem	CEO of GBIT	Face to face
Mebarek Jedid	PMO in GBC	Face to face
Alp Geckalan	SAP MENA CEO	ZOOM call

Rachid	BIM Manager	Face to face
Sofiane	Revit expert	Phone call
Meddahi Dahbia	Architect and BIM manager	ZOOM call
H�el�ene Lioussou	BIM manager at Nexity	ZOOM call

Source: authors' table

### 1.7. Interviews guide

As we have specified, the semi-structured interview is accompanied by an interview guide that we present in the appendix A.

## **Chapter Three:**

# **The integration of Building Information Modeling with ambidextrous Business Process Management in the Extended Enterprise System**

## **Introduction of the chapter**

this chapter will present the practical framework of our work using a new building technology called BIM and integrate it with the ambidextrous business processes in the enterprise's system.

### **Section 01: The fieldwork**

#### **1. Presentation of the companies**

##### **1.1. Global Business (GB)**

GB is a leading global engineering and construction contractor primarily focused on infrastructure, industrial and high-end commercial projects ;The origin of the Global Business is the passion of the founder Bourouag Miloud when he started as a craftsman in 1979 in the field of construction and then the property development.

Very quickly, his enthusiasm led him to diversification, by creating sister companies such as the quarry of aggregates, aluminum carpentry and the design office in architecture to create \*economies of scale instead of outsourcing services dearly.

In 2013, GBC changed its status from GBC SARL to GBC Spa, However, it was in 2017 that the group resolutely committed to diversifying its activities by developing logistics, trade, metal Our strategy is guided by five key pillars with the aim of maintaining our market leadership, expanding our geographic footprint and delivering top and bottom line growth to maximize shareholder value framing, farming, the manufacture of PVC and even socio-educational activities.

##### **1.1.1. GB's strategy:**

Our strategy is guided by five key pillars with the aim of maintaining our market leadership, expanding our geographic footprint and delivering top and bottom line growth to maximize shareholder value.

##### **1.1.2. GB's values**

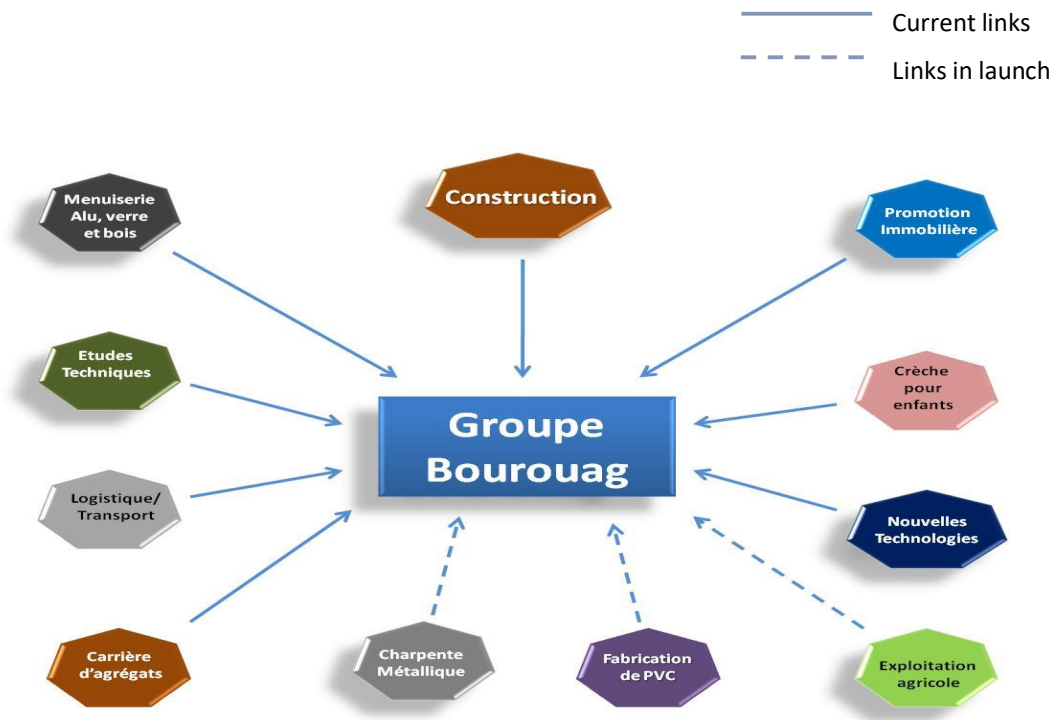
Our values underpin everything we do. We are committed to conducting our business ethically, responsibly and with excellence.

As a global business, these values set the standards for all of our employees, subsidiaries and partners and help us maintain the trust in Global Business that makes it a global Contractor of Choice for the communities and clients that we serve.

Our Code of Conduct, healthy and safety, quality, environment, and sustainability policies create the framework through which we do business with our stakeholders.

### 1.1.3. Current fields of activity

Figure 4: Current fields of activity



Source: Global Business Construction company

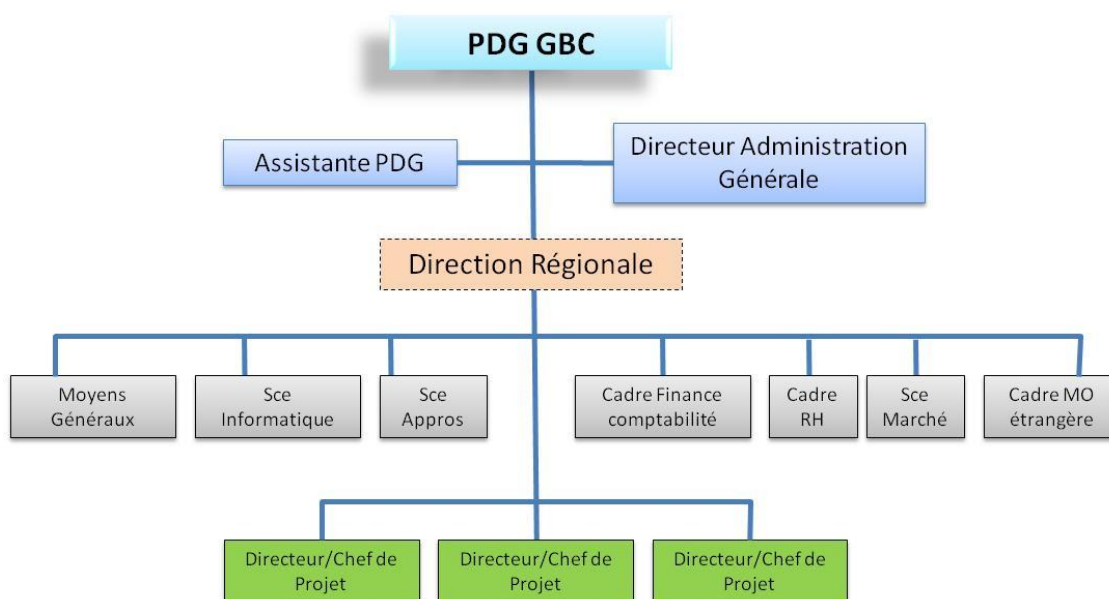
The company's scope of activity extends to different sectors as follows:

- ✓ **Construction (category8)**
  - Dwellings
    - Administrative buildings
    - Socio-educational buildings
    - Sports Infrastructure
    - Road work
    - Renovation of buildings
    - Foundations
  - **Real Estate Development**
    - AADL Dwellings
    - Dwellings LSP, LPA, LPP
    - Private promotion

- **Aluminium and glass:**  
Study, advice, design, production, delivery and installation of:  
Bay windows  
Aluminum windows  
Aluminum doors  
As well as all the facade and transparent architecture work
- **Metal Frame (Start-up Activity)**  
Agriculture  
Acquisition of concessions for agricultural development and exploitation
- **Design office**  
Technical studies  
Architectural studies
- **Import export**  
Retail trad  
PVC Manufacturing (Start-up Activity)
- **Aggregate quarry**  
Sand, gravel and gravel for the Group’s construction sites
- **New technologies (Stand by activity)**
- **Logistics / Transport**  
Rental of public works vehicles (graders, dump trucks, excavators, bulldozers, water and diesel tanks, concrete mixers, cranes, mobile cranes, crane trucks, mini loaders, mini excavators, etc.).  
Supply and delivery of ready-to-use cement and concrete

#### 1.1.4. Current organizational structure

Figure 5: Global Business organizational structure

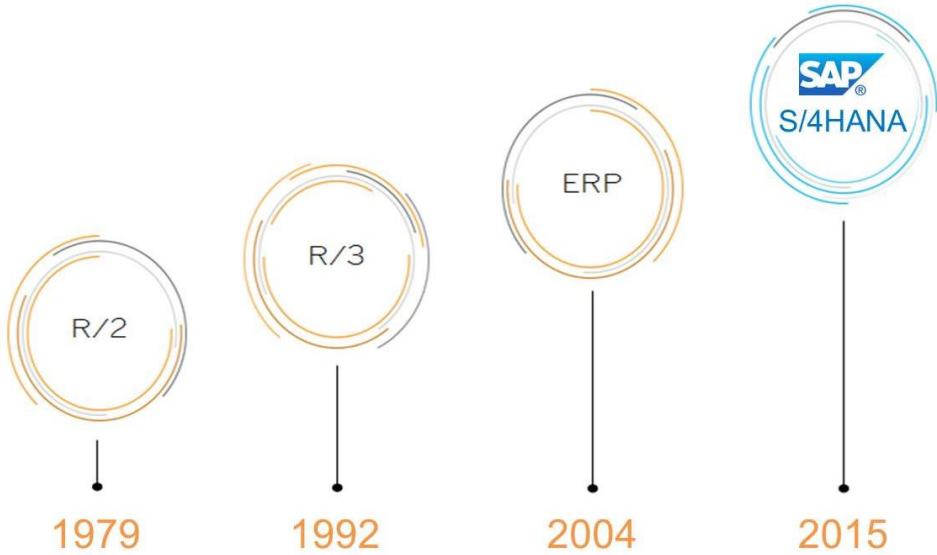


Source: Global Business Construction company

### 1.2. SAP AG

SAP stands for Systems, Applications, and Products in Data Processing. SAP was founded in 1972 in Walldorf, Germany and now has offices around the world. Originally known for leadership in enterprise resource planning (ERP) software, SAP has evolved to become a market leader in end-to-end enterprise application software, database, analytics, intelligent technologies, and experience management. A top cloud company with 200 million users worldwide, SAP helps businesses of all sizes and in all industries to operate profitably, adapt continuously, and achieve their purpose.

Figure 6: SAP historical evolution



Source: SAP website

#### 1.2.1. SAP in numbers

SAP headquartered in Walldorf in the south of Germany, and listed in Frankfurt and New York, is a market leader in business software, with more than 440,000 customers in more than 180 countries, and 100,330 employees worldwide (as of December 31, 2019). About 80% of its customers are small and midsize companies. Total revenue in 2019 was €27.63 billion, including €7 billion from its cloud business (which is expected to triple by 2023). SAP works with about 21,100 partners and builds software solutions for 25 industries. In 2019, it invested more than €4.3 billion in research and development, including at 20 SAP Labs development centers worldwide. SAP's business is helping customers optimize their business processes. SAP's purpose is to help the world run better and improve people's lives. Today, 77% of all

business transactions worldwide touch an SAP system. For example, SAP's customers produce 78% of the world's food products and 82% of the world's medical devices.

## Section 02: Presentation of findings

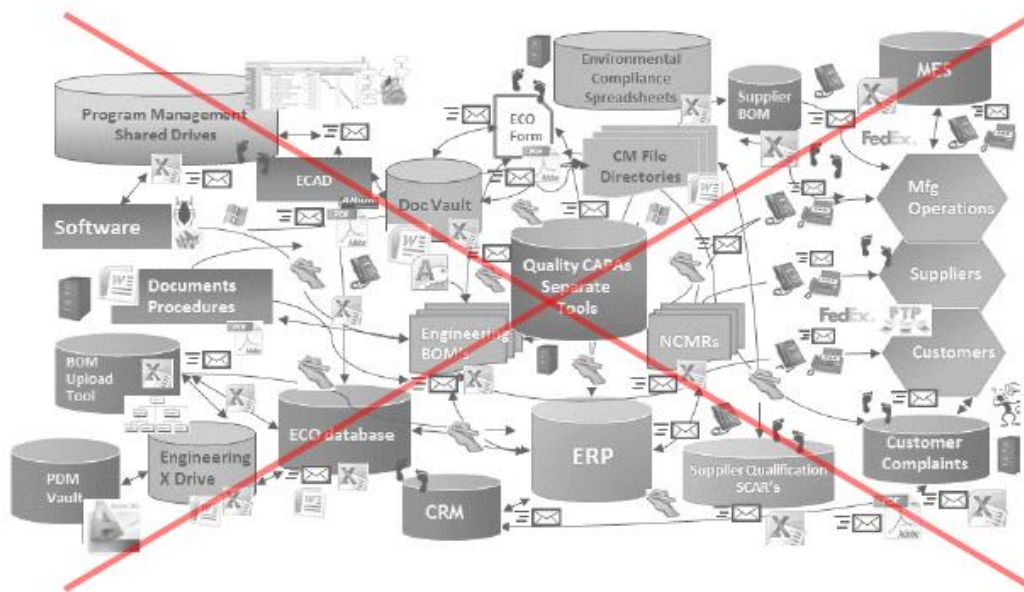
### 1. The classical ES

What is regularly observed in firms is a very dispersed landscape of software solutions (scattered IT landscape) without a specific process or integration between them. (Figure 07)

Single-point solutions are a very good way to solve particular problems but if you apply this approach to every single problem than you will lose transparency and cannot track project progress or materiel flow.

Business processes get complicated with tasks divide into parts between multiple systems this make it incrementally difficult to scale business and achieve the required level of end –user adoption. Industrialization of the construction process necessitate high level of automation which is not attainable with a heterogeneous software landscape and lack of integration.

Figure 7: Scattered IT landscape



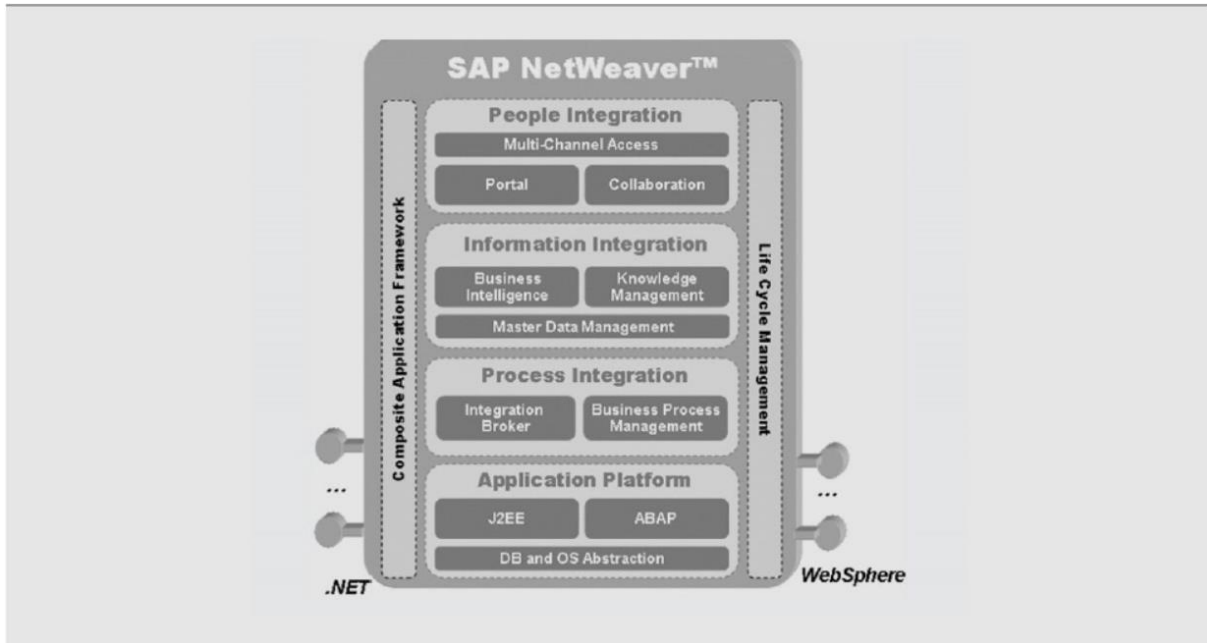
Source: ITELSYS BUILD website

### 1.8. SAP ERP and R/3

In 2004, SAP developed new integration application platform called SAP NetWeaver (figure 8) to answer to the highly demand of integration of business applications and the web. In this period, all SAP applications run on a common platform and customers and partners can build and integrate existing applications easily using widely adopted web standards; the SAP

R/3 name is now replaced by SAP ERP which is a part of a large family known as SAP business suit which also contains many other applications such as SAP CRM. The main problem of this business suit is scattered landscape with the huge number of applications SAP CRM, SAP SCM, SAP PLM and SAP FRM.

Figure 8: SAP NetWeaver application platform

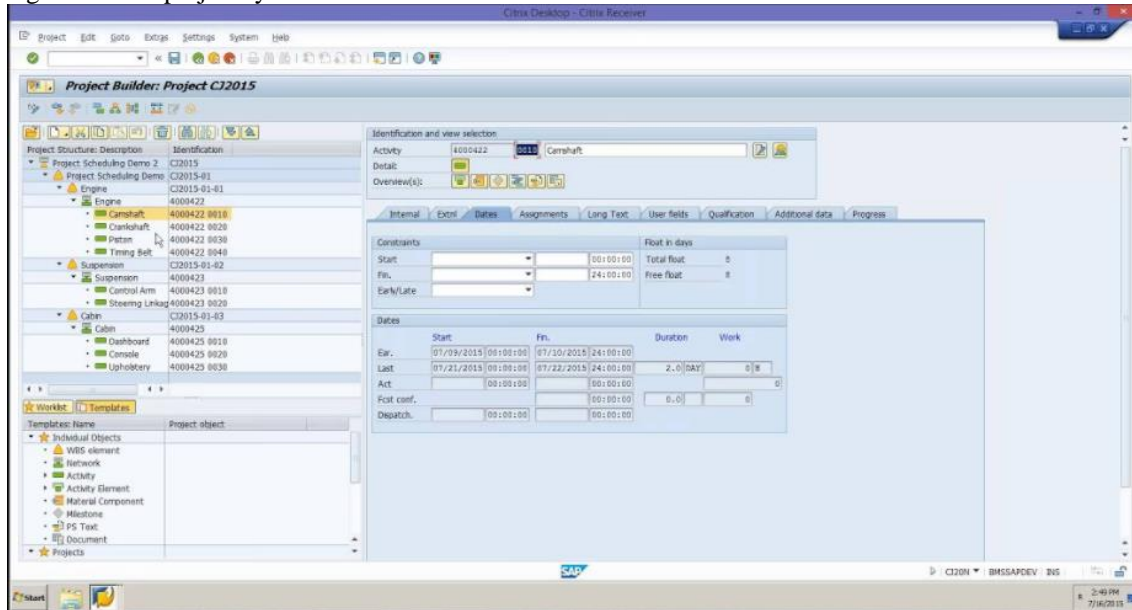


Source: SAP

### 1.8.1. SAP project system

The project system was developed based on the Microsoft project management with the integration of the commercial processes of a business before you can control all the tasks that occur as part of the project execution we need project-specific organizational form that should be in position central to the user departments involved. (figure 09).

Figure 9: SAP project system

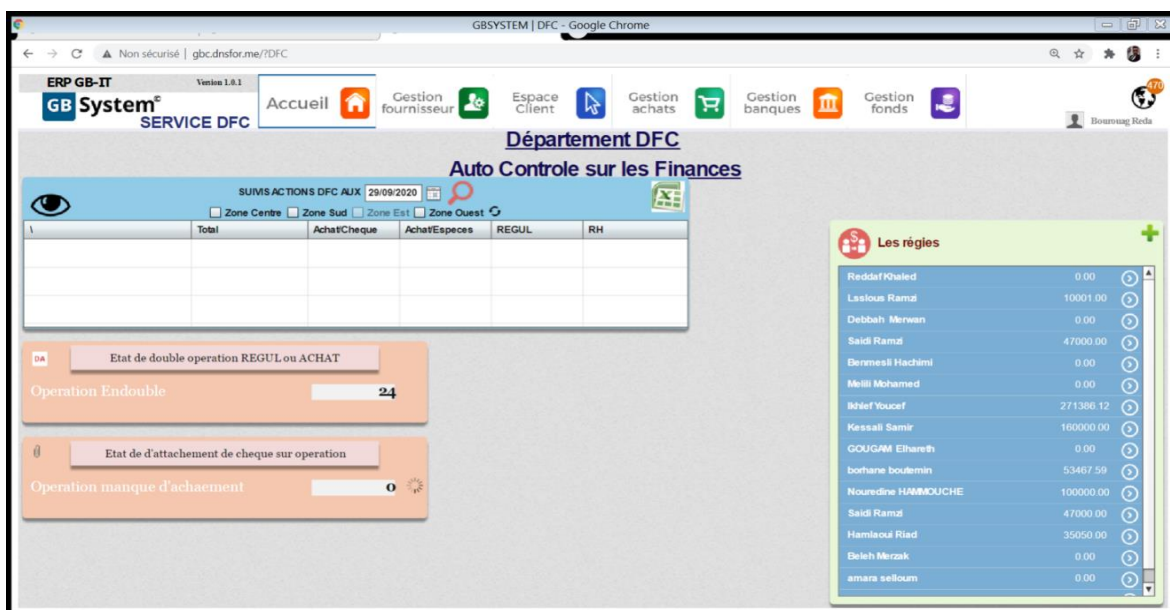


Source: SAP

### 1.9.GB ERP

GB ERP is a software developed by GB-IT in 2012 as the first ERP of the company in order to answer to the high demand of shareholders, it contains the main functions of GB construction such as, supply chain management, accounting and finance and project management, each function is presented as an application example: finance and accounting application (figure 10).

Figure 10: GB ERP

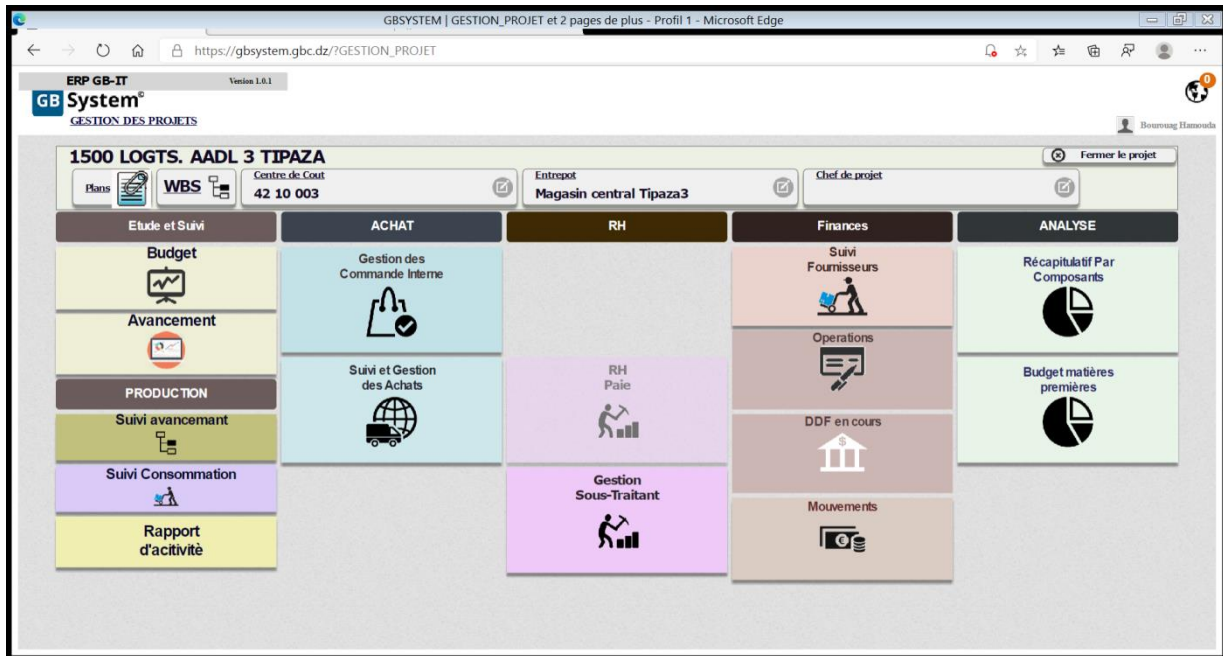


Source: GBIT

### 1.9.1. GB ERP project management

The project management application is one of the most important application in GB ERP (Figure 11), it was developed based on PMP principals with the integration of earned value management (Figure 12).

Figure 11: Project management application



Source: GBC

Figure 12: Earned value management

Planned Costs	Selling Price	FORECASTS	Monthly Forecast	Production	BILLING
6 952 917 709,73 DA	7 687 604 078,12 DA		443 500 346,98 DA	4 934 700 473,26 DA	0,00 %

Source: GBC

## 2. The extended ES (EES)

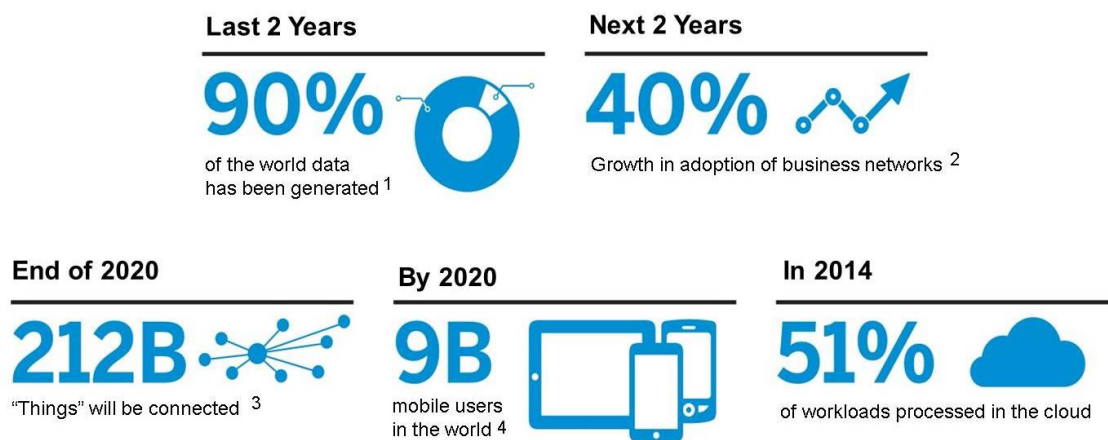
### 2.1. SAP EES

The Business Landscape is Increasingly Complex and Networked, it becomes obvious that the world around us is getting more complex, for the following reasons:

- Exponential growth of digital information, social, mobile, big data
- Globalization and spread of business networks
- Internet of Things (we could also say, the Internet of everything)

The exponential proliferation of mobile devices, social media, cloud technologies, and the staggering amounts of data that they generate has transformed the way that we live and work. In fact, 61% of companies report that the majority of employees use smart devices for everything from e-mail to project management to content creation (ardent partner, 2014) To keep pace this environment change, the response is so far the development of more Complex business processes (ambidextrous BPM), more complex organizations (ambidextrous organizations), and more complex software solutions (Extended enterprise system).

Figure 13: Technology progress prevision



<sup>1</sup> ScienceDaily. ScienceDaily, 22 May 2013

<sup>3</sup> Internet of Things (IoT) 2013 to 2020 Market Analysis: Billions of Things, Trillions of Dollars, IDC, 2013

<sup>2</sup> Technology Adoption Report: Business Networks, Ardent Partners, 2014

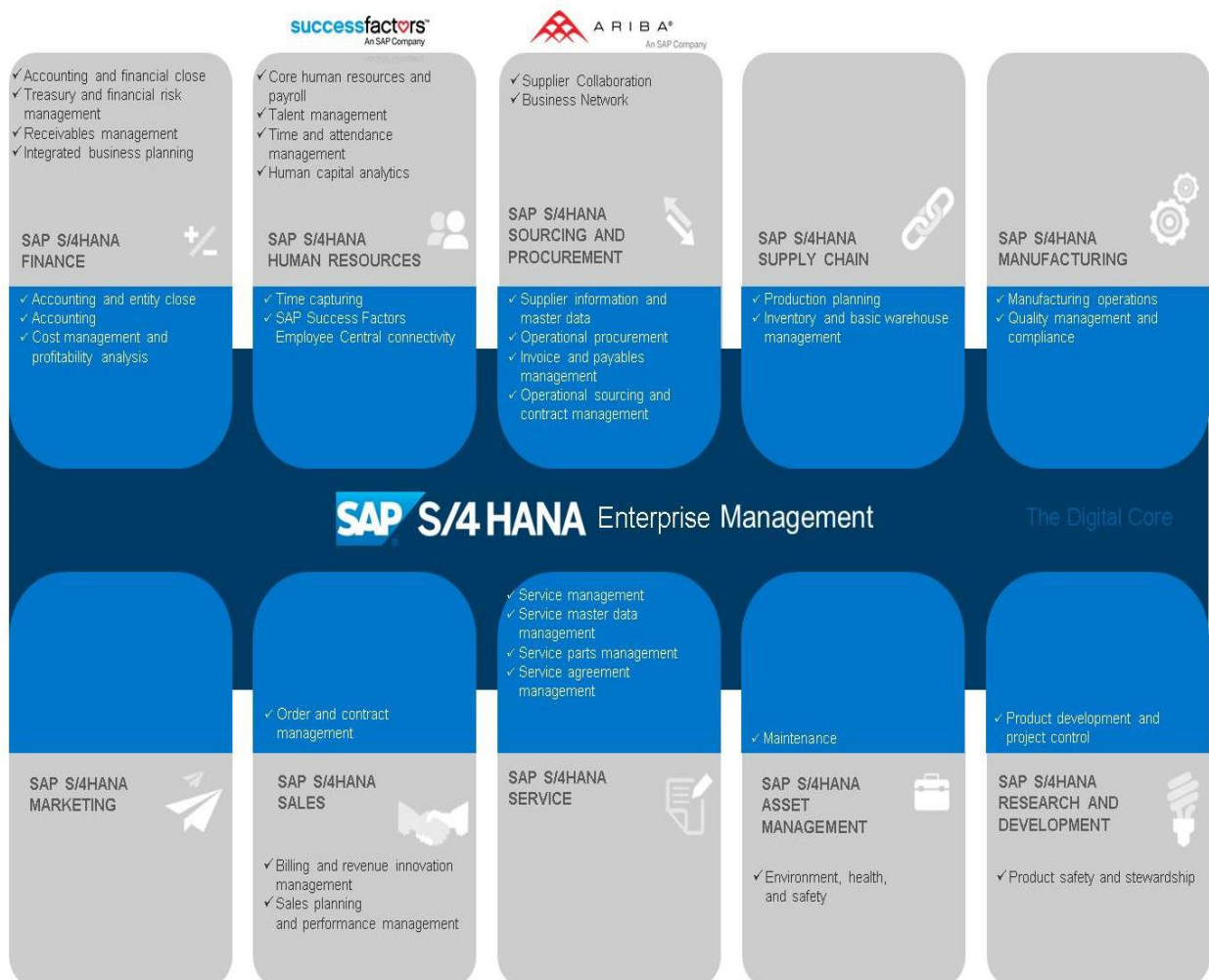
<sup>4</sup> Statista, 2014

Source: from internet

### 2.1.1. SAP S/4 HANA

SAP S/4 HANA is a new business suite of SAP business softwares which includes solutions for SAP S/4 HANA Finance, HR, Supply Chain, Asset Management, Sales, Services, Marketing, and for Sourcing and Procurement (figure 14).

Figure 14: SAP S/4 HANA enterprise management



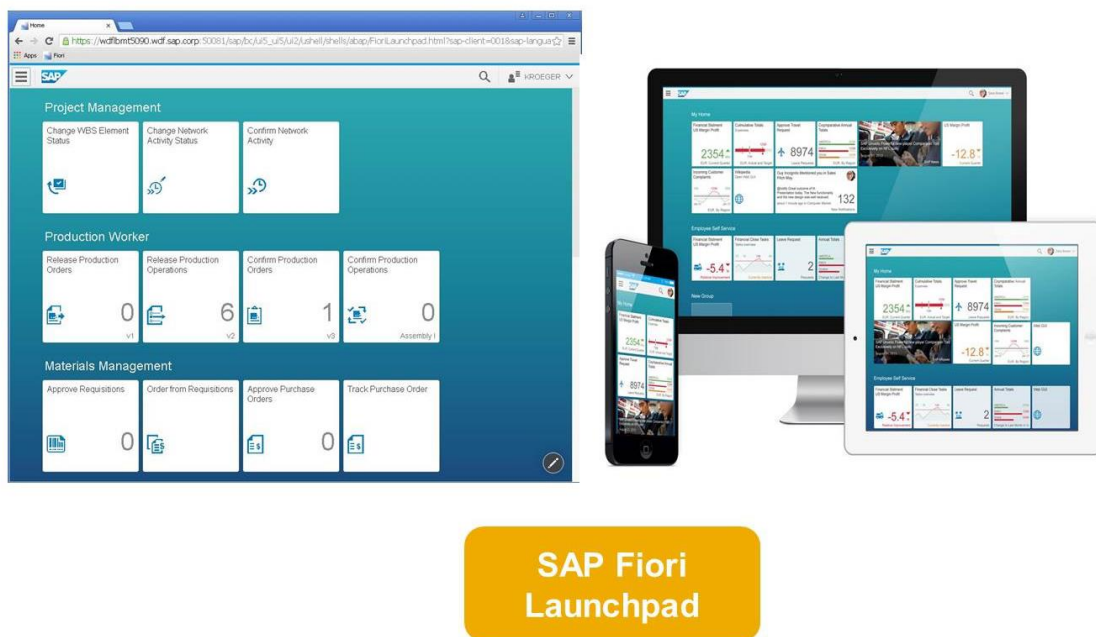
Source: SAP

### 2.1.2. Sap Fiori Launchpad

SAP Fiori Launchpad is known as the entry point to SAP S/4 HANA suit on mobile and desktop devices. It contains various tiles in Fiori system. Tiles are square objects that are used to access different Fiori Apps. Access to these tiles are based on the user roles.

SAP Fiori tiles run on multiple device types and provides a single point of access for business applications such as transactional, analytical, factsheet, smart business apps.

Figure 15: SAP FIORI Launchpad



Source: SAP

### 2.1.3. SAP LEONARDO

SAP Leonardo, SAP's approach to innovation, helps companies navigate the new digital revolution and guide their transformation into a digital business. SAP Leonardo is faster innovation with less risk.

SAP Leonardo is made up of four elements:

1. Proven Methodology: with Design Thinking & Prototyping.
2. Technology Expertise: alleviate the risk of constantly investing in new technologies.
3. Industry Accelerators: with industry experience to solve business problems faster with less risk.
4. Co-innovation with Customers: SAP knows its business better than anyone, co-innovation enables them to create a solution that's perfectly suited for its business.

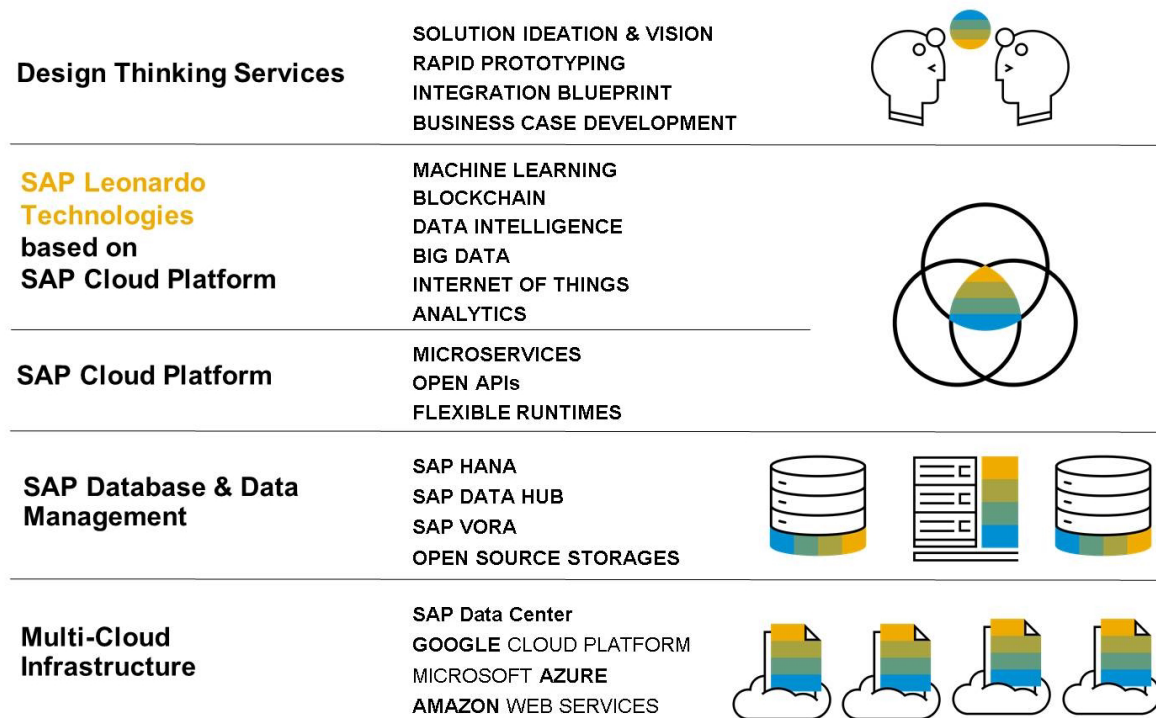
By leveraging SAP's expertise in advanced technologies, including Machine Learning, Block chain, Data Intelligence, Big Data, IOT, and Analytics, they can continuously innovate their business processes, faster than they could before, and with less risk of failing or wasting resources.

Through the use of SAP Leonardo technologies, they can foster digital transformation by optimizing and digitizing your business processes, maximizing their data for increased revenue

and growth opportunities, and building leading-edge innovations that deliver rich, new user experiences.

SAP Leonardo seamlessly integrates future-facing technologies and capabilities into the SAP Cloud Platform. This powerful portfolio enables them to rapidly innovate, scale new models, and continually redefine their business.

Figure 16: SAP LEONARDO technologies



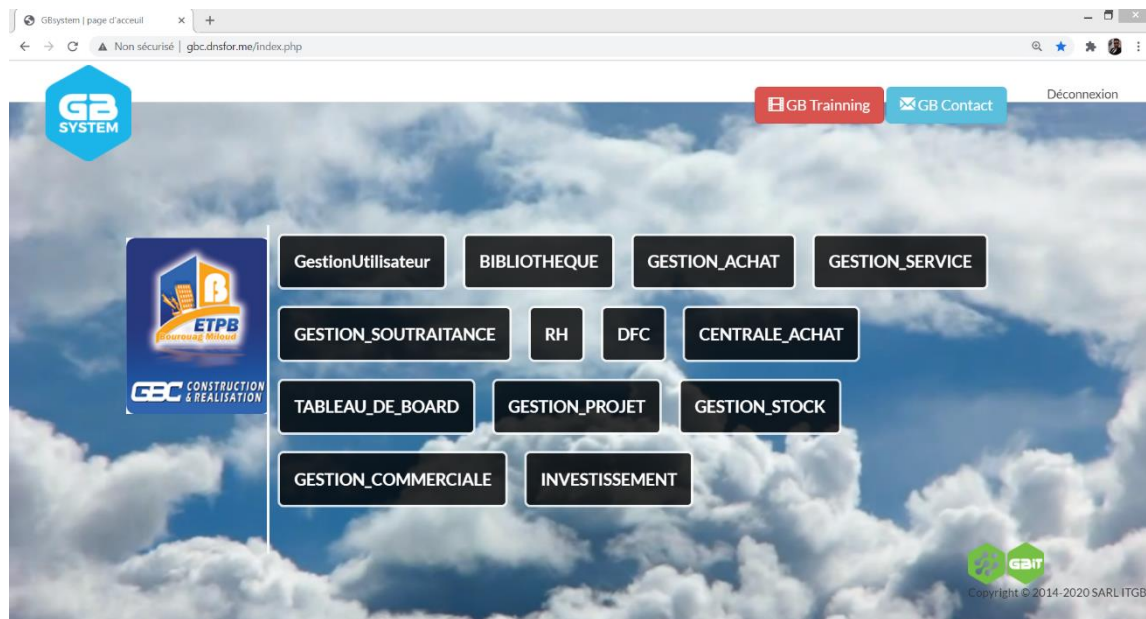
Source: SAP

## 2.2. GB EES

### 2.2.1. GB System

GB System is the first extended enterprise system of GB, launched by GB IT in 2020 and it is still in the development phase. This system is the fruit of the integration of all t GB Softwares (GB contacts, GB training and GBAUTH) in a unique IT landscape that support the complex business processes, IOT, E-commerce (figure 17).

Figure 17: GB SYSTEM



Source: Screenshot of the GB SYSTEM

### 2.2.2. GB AUTH:

GB AUTH is a mobile application for iOS and android developed by GBIT in 2020 in order to facilitate business processes for the end-user. This application is linked directly with GB System software that allows the execution of transactions such as the purchasing orders validations and Fund requests. This application is programmed to be displayed in three languages: Arabic, French, and English.

## 3. Results presentation The integration of BIM with ambidextrous BPM in EES

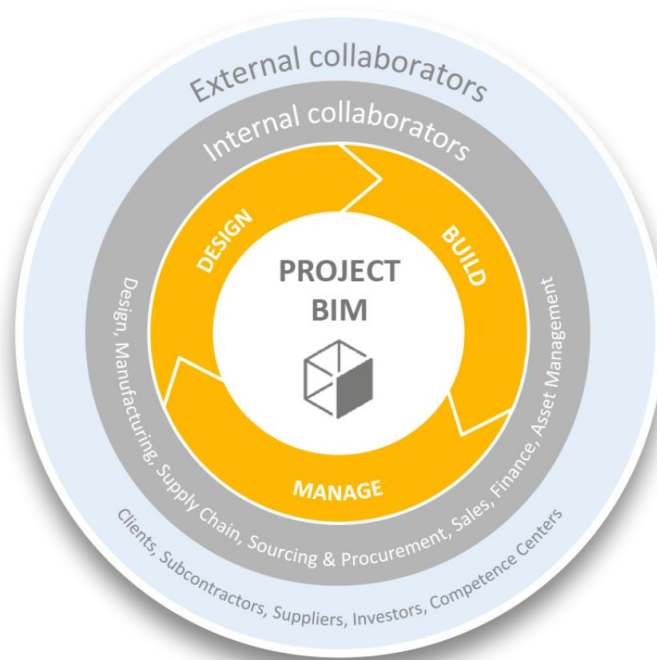
The result is presented as new approach in the construction sector that we called “project BIM” this project is breakdown into two integrations: the Integration of BIM with ambidextrous BPM , then the integration of BIM-ambidextrous BPM in the EES

### 3.1. The new approach

The evolution of BPM, BIM and ES technologies has now reached a point where it is possible to integrate the three without any additional middleware, this creates simple processes in a unified IT landscape.

The integration process is called “project BIM”, it passes through two major phases: The integration of BIM with ambidextrous BPM then The integration of BIM-ambidextrous BPM in the EES during the building lifecycle (Design, Build, Manage), this enables better collaboration between the internal collaborators such as designers, architects ...etc. and external collaborators such as clients, suppliers, etc (Figure 18).

Figure 18: Project BIM phases

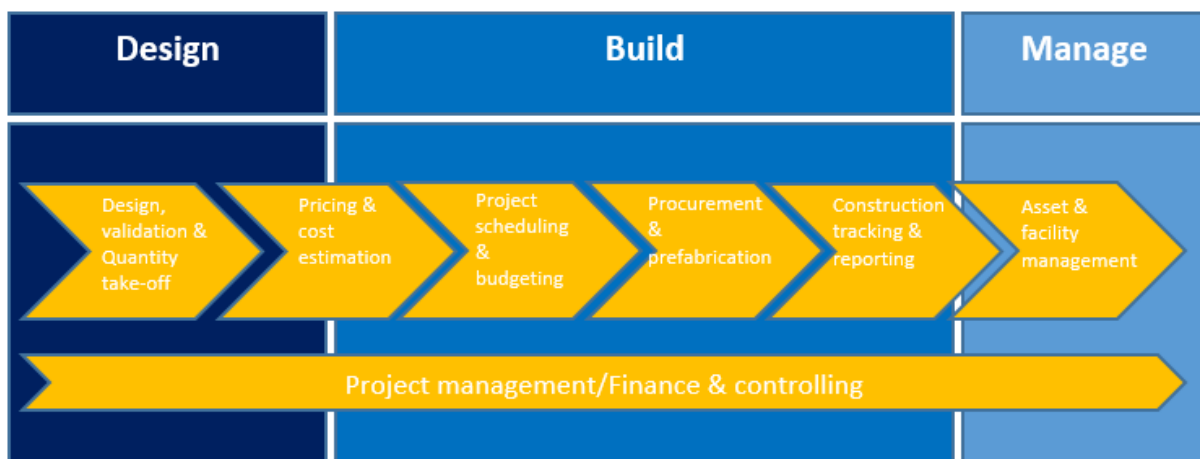


Source: INTESYS Build website

### 3.1.1. The integration of BIM with ambidextrous BPM

Constructing a building is not a simple task. There are many stakeholders involved and as projects get more complex it becomes increasingly difficult to manage the entire process. The building lifecycle can be summarized in three major stages: Design, Build and Manage. When considering BIM integration with business processes it is crucial to take into account the entire lifecycle because the data you accumulate throughout the process gives added value at every next step.

Figure 19: Building lifecycle



Source: Authors' illustration, updated from the INTELSYS build website

**Design:**

The 3D geometry of the BIM model is created and enriched with material characteristics. Co-ordination between design disciplines reduces errors and changes during the Build phases. An accurate 3D model is validated and used to determine exact quantities for pricing and estimation which will help us to optimize the business processes.

**Build:**

Detailed planning is required to ensure smooth progress for the build phase. The project is divided into sequential activities. Resources needed for the execution of each task are assigned to the schedule. Based on the schedule and material characteristics from the BIM model a precise estimate/budget is created which is later used for controlling. Field data is collected during construction to check progress and make sure the project is completed within time and budget constraints. Required quality checks are documented and linked to the as-built BIM model with any changes or modifications from the initial design.

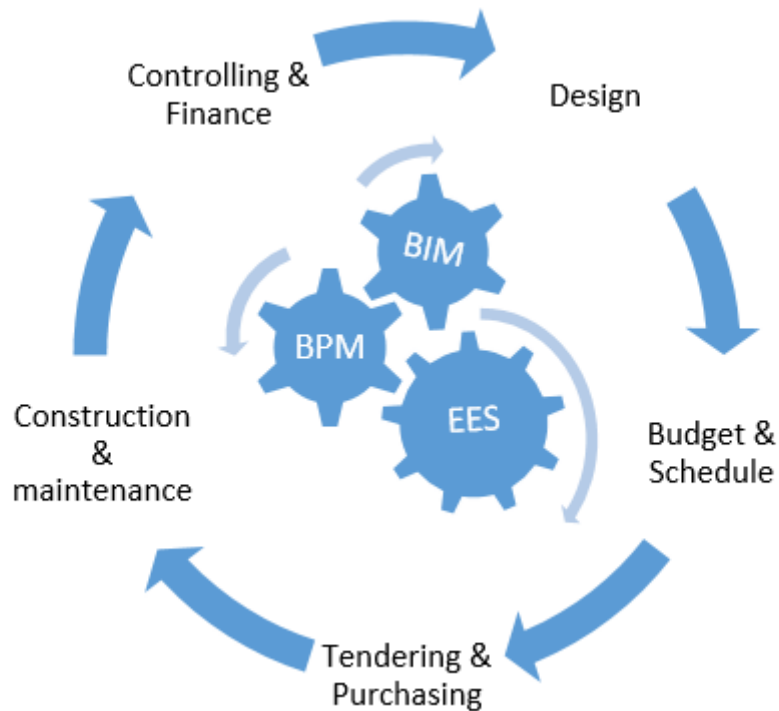
**Manage:**

Most of the costs related to the lifecycle of a building are obtained during operations. Efficient facility management guarantee that the assets are optimally used and the ROI is augmented.

**3.1.2. The integration BIM-ambidextrous BPM in EES**

The integration of BIM-AmbidextrousBPM in EES will solve the problem of scattered IT landscape by providing a harmonized system with a unified interface. This system resumed the Building lifecycle into five steps (figure20).

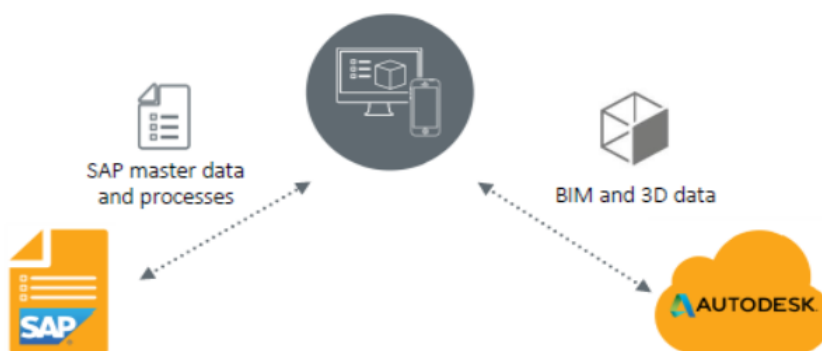
Figure 20: Steps of the integration of BIM-ambidextrous BPM in the EES



Source: Authors' illustration, inspired by (Peeter Parna, 2017)

ERP systems generally don't support BIM workflows, for that we moved for the EES such as SAP S/4 HANA and GB EES, in our case we used SAP S/4 HANA and integrate it with AUTODESK REVIT -AUTODESK is a software corporation which makes product services for the architecture, engineering and construction (figure 21) because Global Business company is still using the GB ERP and they are developing the GB EES.

Figure 21: SAP S/4 HANA and AUTODESK REVIT integration

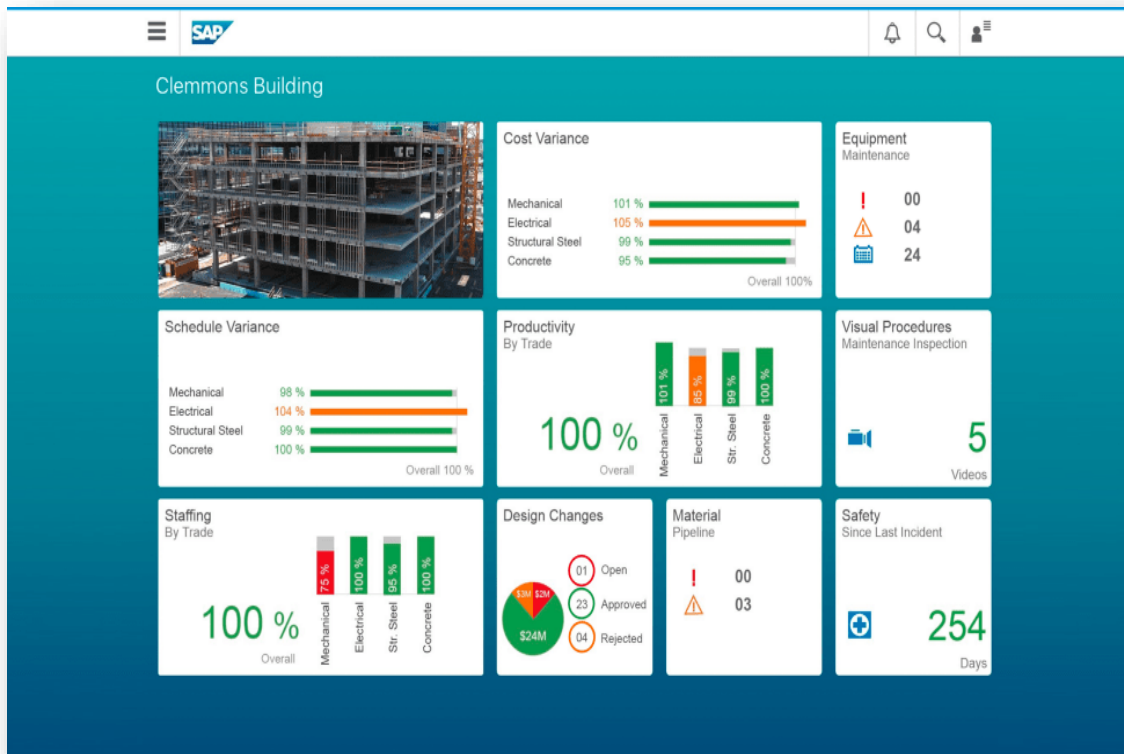


Source: authors' illustration, inspired by(jaaan, 2017)

The user interface of both SAP S/4 HANA (FIORI) and AUTODESK REVIT is based on standard technologies like JavaScript and HTML5 which enables the integration between BIM and SAP applications to create a unified interface end-user (figure22)

It allows a project manager to have a dashboard that serves as a single place to visualize all aspects of a project through the construction site tile.

Figure 22: End-user interface



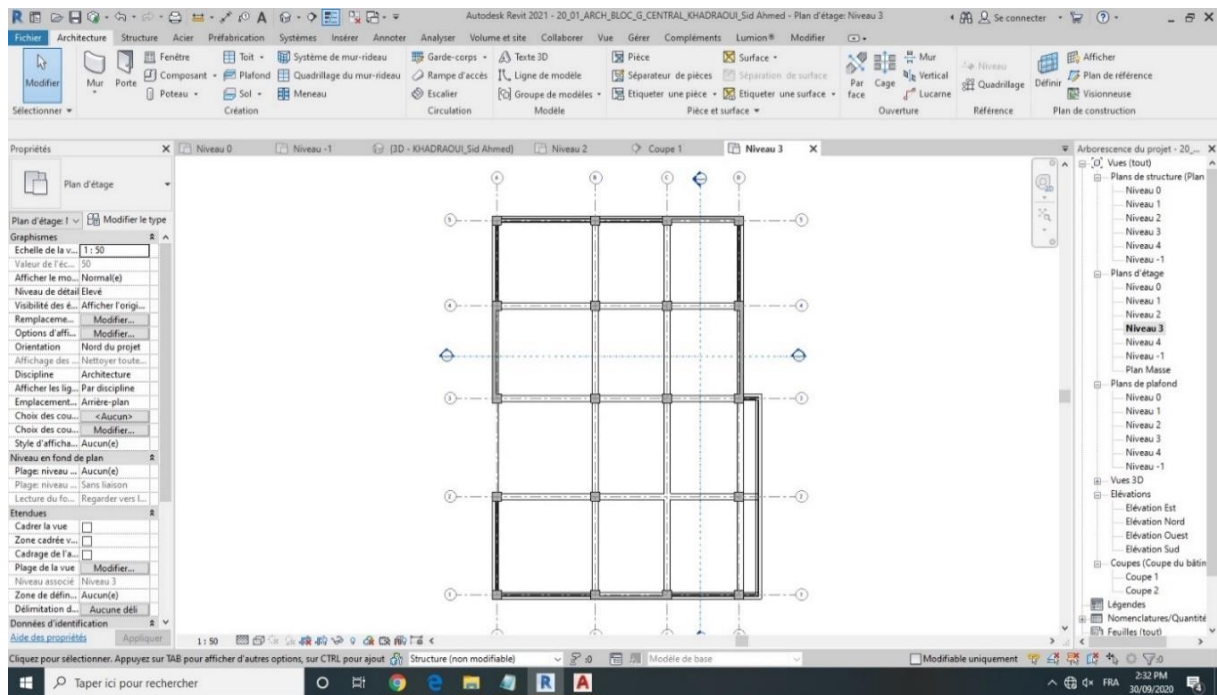
Source: Screenshot of the SAP FIORI Launchpad

This interface contains the five phases of the building lifecycle which are: design, budget and schedule, tendering and purchasing, construction and maintenance, controlling and finance.

✓ **Design**

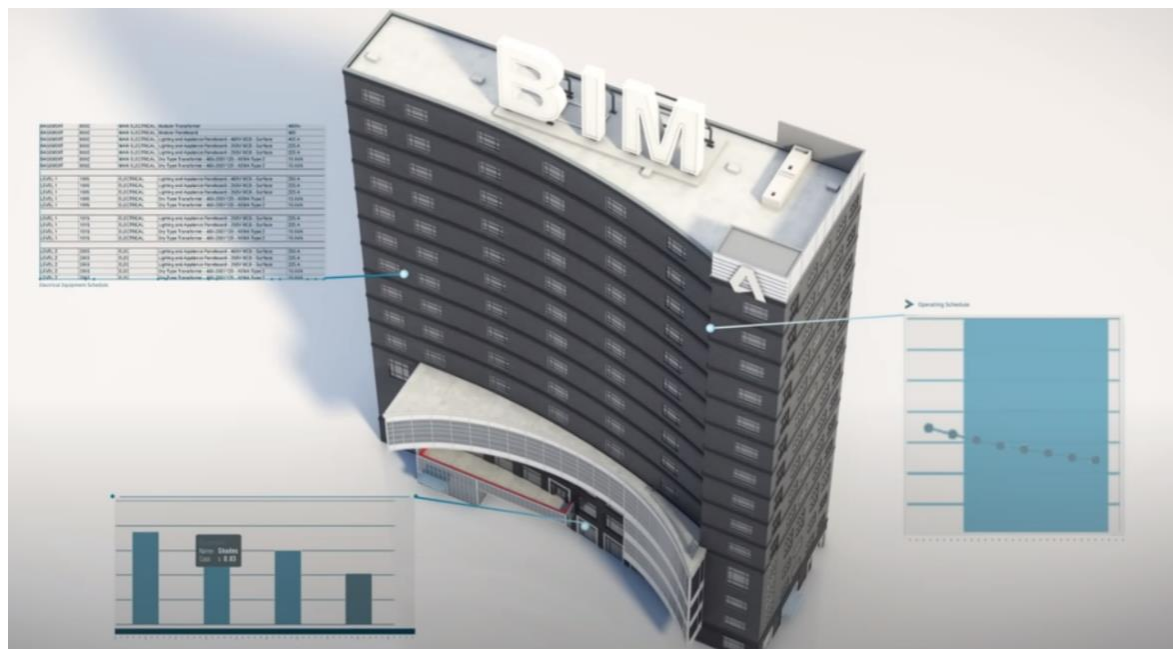
In this phase designers create digital 3D models using the REVIT software (figure23) the 3D model includes data associated with physical and functional characteristics (figure 24)

Figure 23: Design phase



Source: Screenshot of the design on the REVIT software

Figure 24: 3D model



Source: INTELSYS build website

✓ **Budget and schedule**

After design validation, the REVIT Software gives us the main input for pricing and cost estimation illustrated in a table called nomenclature (figure 25).

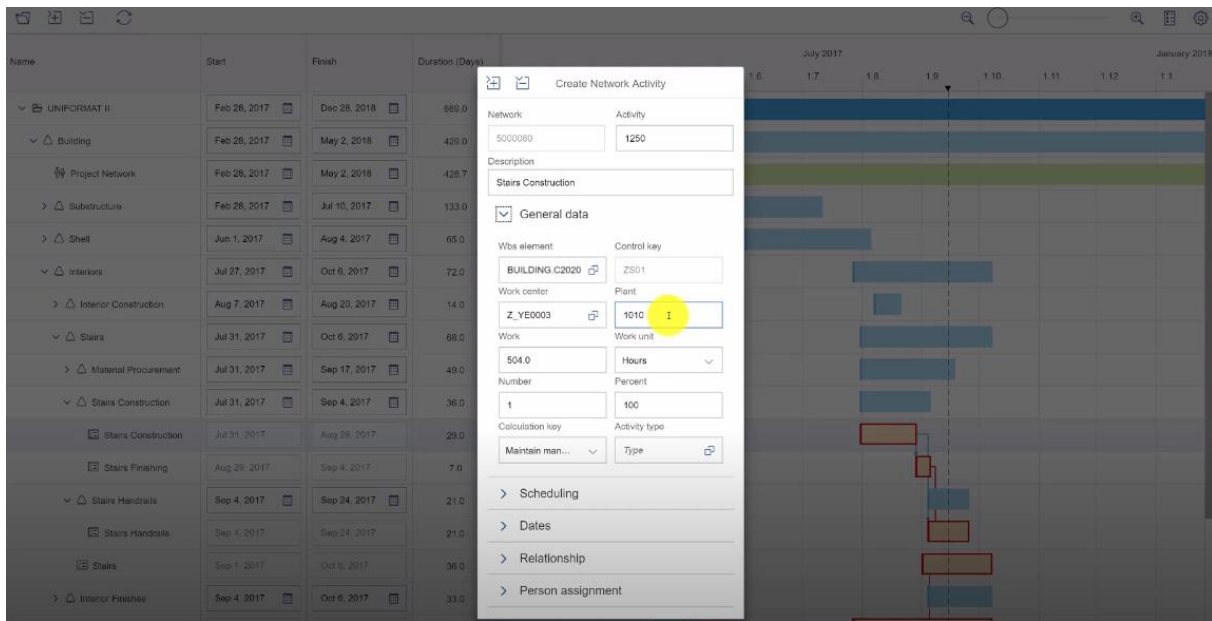
Figure 25: Budgeting phase

<Nomenclature de mur>					
A	B	C	D	E	F
Famille et type	Largeur	Longueur	Surface	Coût par m²	Coût Total
Mur de base: Acrotère en BA 15cm	0,15		42,96 m²	3 200,00	137472
Mur de base: Mur Double Parois - Ext. 30 cm	0,30		933,67 m²	3 200,00	2967750,379901
Mur de base: Mur Simple Parois - Int. 10 cm	0,10		1 905,94 m²	1 500,00	2858906,837568
Mur de base: Voile en BA 20 cm	0,20		422,37 m²	3 200,00	1351585,854779
<b>Total général: 267</b>			<b>3 304,94 m²</b>		<b>7335715,072248</b>

Source: Screenshot of the budget on the REVIT software

Based on this table, we transfer this informations to the SAP S/4 HANA which has a very powerful project system and a high degree of integration with other application components which enables us to use it for planning, executing and accounting of projects in order to create a network activity (figure 26).

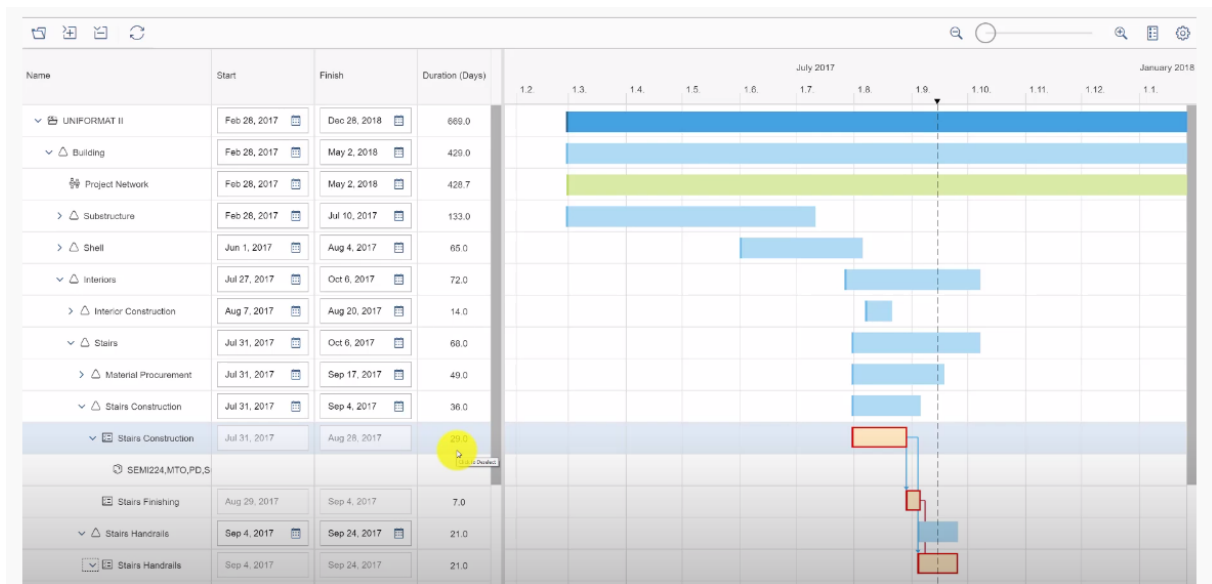
Figure 26: Scheduling phase



Source: Screenshot of the schedule on the REVIT software

The network activities created Would be presented in a GANTT chart that gives a nice visual overview of the entire project timeline at the highest level of the hierarchy. (Figure 27).

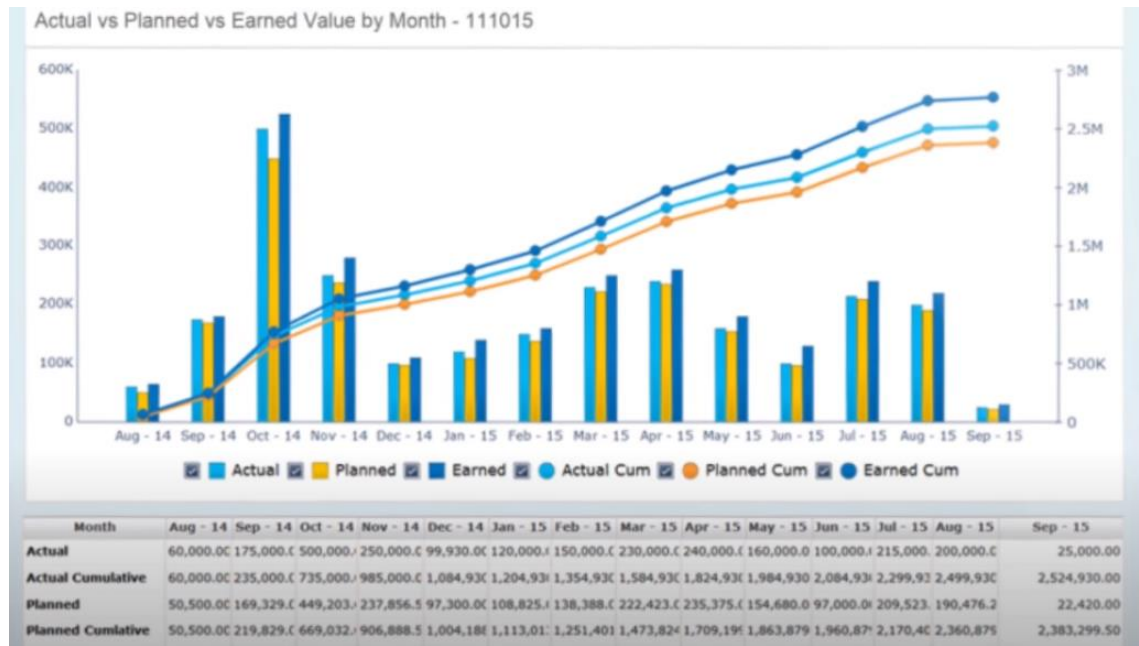
Figure 27: GANTT chart



Source: Screenshot of the GANTT chart on the REVIT software

Now, based on the previous steps, the system creates automatically a global representation of the project using the Earned Value Management approach.

Figure 28: EVM

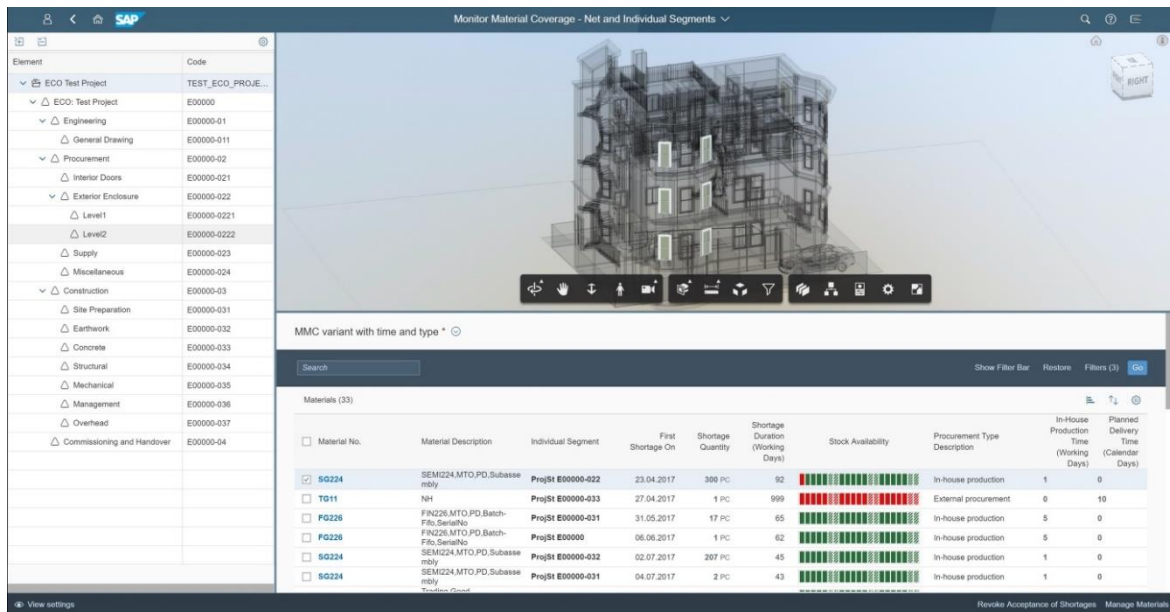


Source: Internet

✓ **Purchasing and procurement**

Procurement and production team make sure they have the right materials by taking it from the BIM model, using quantity take-off and linking it to the project schedule. The system knows exactly when each and every material for the project is required (figure 29).

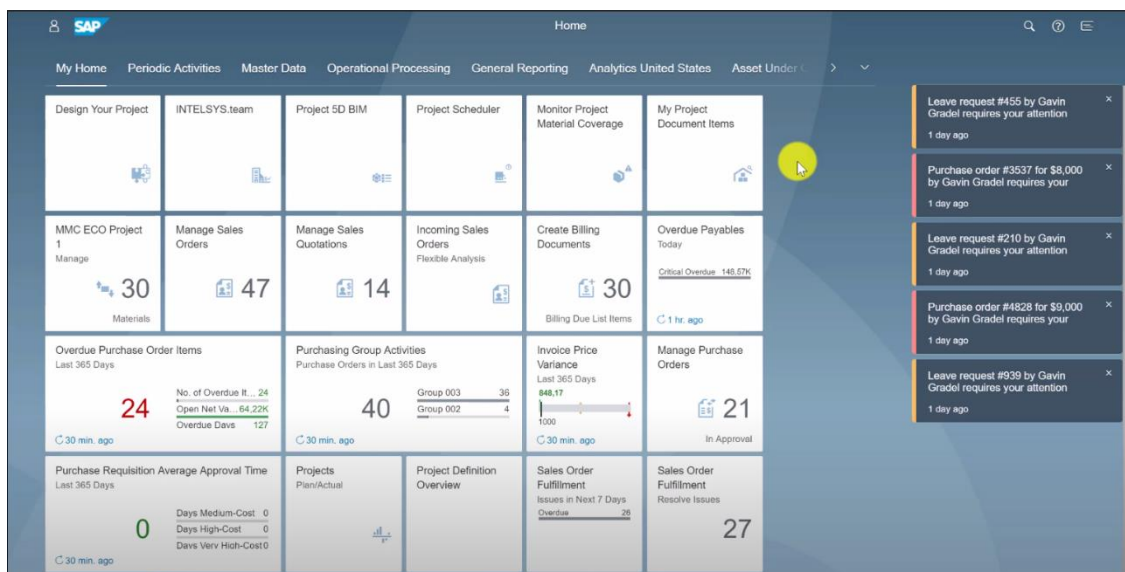
Figure 29: Procurement phase



Source: Screenshot of the procurement on the REVIT software

To complete the procurement step, we use SAP FIORI Launchpad that helps us to monitor material coverage, manage purchasing orders and cover all the project aspect (figure 30).

Figure 30: Purchasing phase



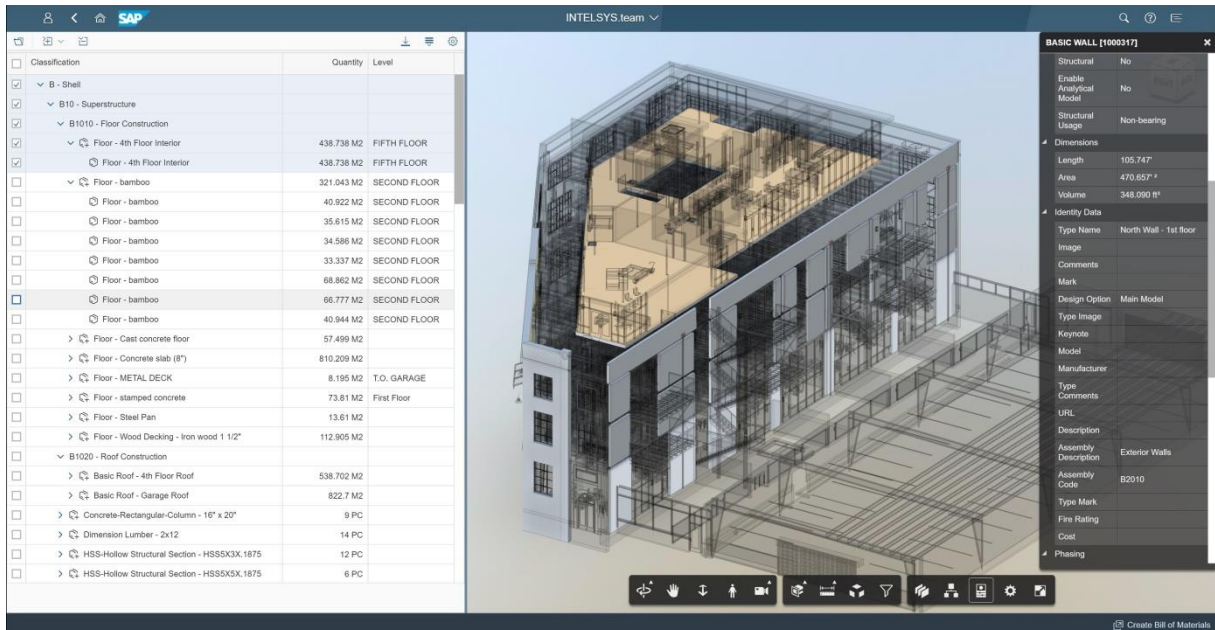
Source: Screenshot of the purchasement on the REVIT software

✓ **Construction and Maintenance**

After finishing the procurement, schedule, budget, and design phases we start the construction phase by executing BIM plan. We start defining the roles, responsibilities and authorities then we define the major project milestone which is provided by the budget and

schedule phase. Using the software, we can track our project by drones and cameras for example when we achieve one floor it will appear in the 5D model (figure 31).

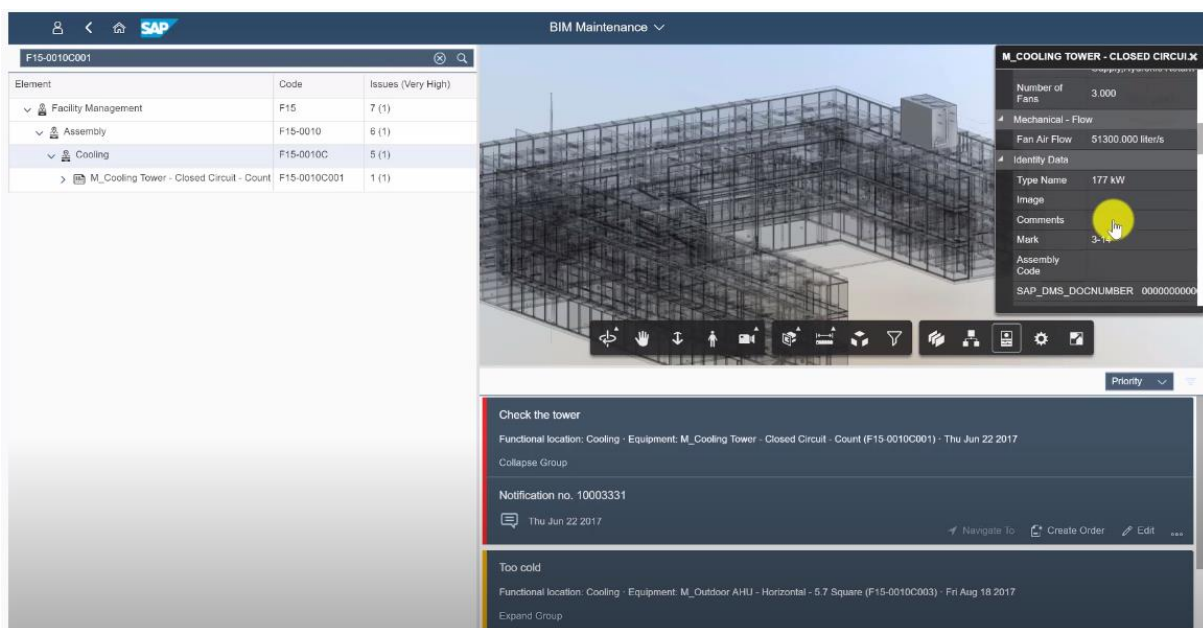
Figure 31: Construction phase



Source: Screenshot of the construction on the REVIT software

We can visualize the maintenance using the 5D model, this will reduce cost and time by detecting the main and potential issues (figure 32).

Figure 32: Maintenance phase

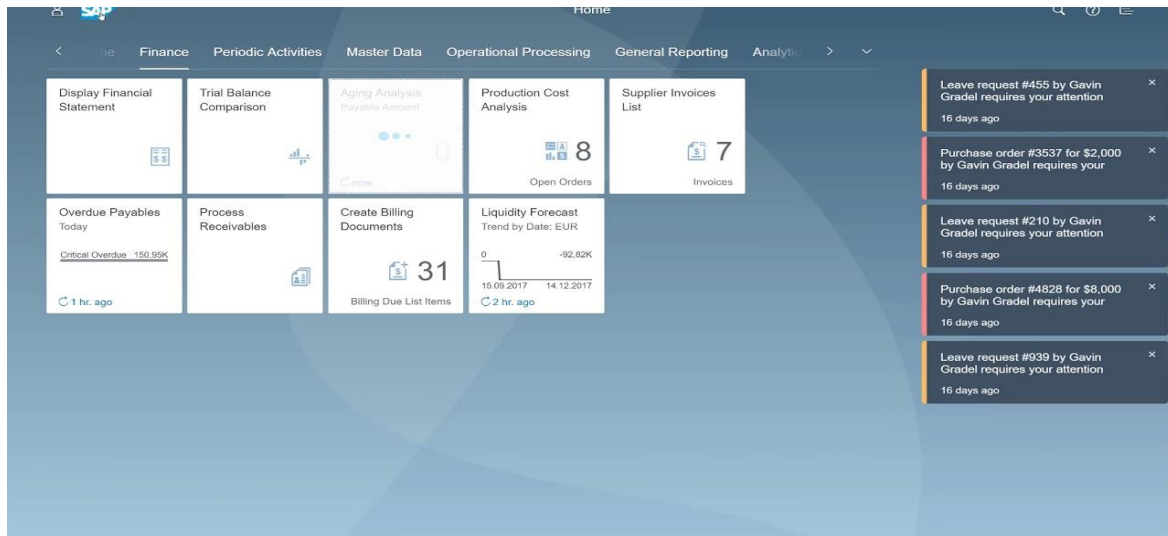


Source: screenshot of the maintenance on the REVIT software made by us

### ✓ Finance and controlling

Finance and controlling is the life support system of construction companies; the software provides a combined interface which includes all the project finance aspects from the design to the manage phase. This will allow us to analyze the production costs, track the billing documents, liquidity forecasting, and display the different financial statement of the project.

Figure 33: Finance and controlling phase

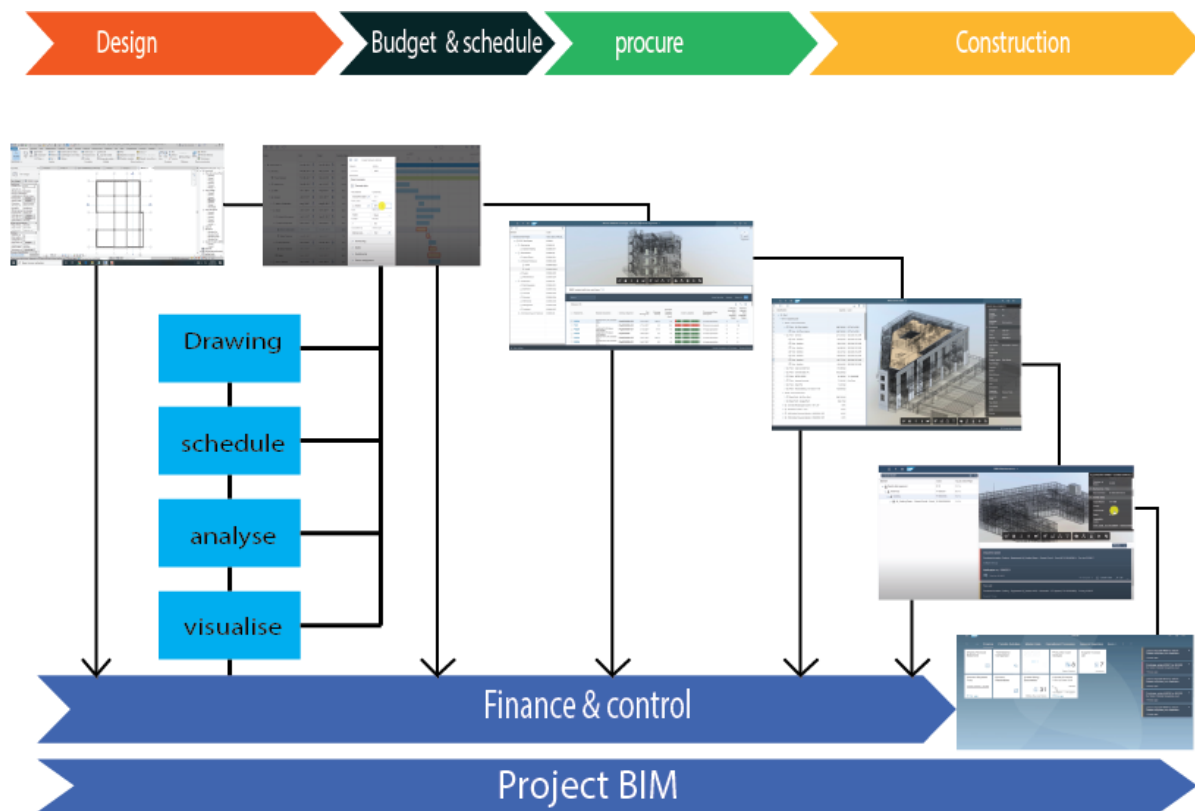


Source: Screenshot of the finance and controlling on the REVIT software

## Section 03: Discussion of results and validity of guiding hypotheses

Based on the previous results, we confirm the first hypothesis H1: “The integration of BIM-ambidextrous BPM in the EES will maximize the productivity and fix the scattered IT landscape” because this integration improve productivity by transforming the high complexity of projects into 3 main phases: Design, Build and manage using the BIM-ambidextrous BPM integration, further, the integration of BIM-ambidextrous BPM in the EES solves the problem of the scattered IT landscape. as a final result, we have a unique performant system which can manage the hole project and will resume the building process into five phases: Design, budget and schedule, procurement and purchasing, construction and maintenance and finance and controlling.

Figure 34: The project BIM cartography



Source: Authors' illustration

Concerning the second hypothesis, we reject it, and it can be applicable in the case of the integration of BIM with ambidextrous BPM only because it improves the productivity but we need other softwares to manage our project such as: Primavera, BIM 360, MS Project, ERP, Autodesk FORGE and other construction softwares, this huge number of softwares will create a problem in the IT landscape.

## **Conclusion**

## CONCLUSION

This study aimed to find a way of applying new building technologies by integrating the Building Information Modeling (BIM) with the ambidextrous Business Process Management (BPM) in the extended enterprise systems (EES) of SAP and GBC and examine the likely consequences on productivity levels of the enterprises and their IT landscape.

The first step was to search, define and understand the notions related to the main theme of the study as digital transformation, construction industry, building technologies, building information modeling, ambidexterity in organizations, business process management, ambidextrous business process management and enterprise systems.

The second step was to detect the main problems facing today's construction enterprises especially Algerian enterprises and how we can successfully address them by applying new building technologies such as BIM. We found out that the main problem was the lack of productivity due to the high complexity of projects in a side, and the inadequate digital strategy which affects the IT landscape.

After understanding the concepts that we worked on and the problems facing construction companies today, we were able to identify the main question and the sub-questions that helped us to set up the guideline work plan that could lead us to achieve our objectives. The main question was: "How to integrate BIM with ambidextrous BPM in the EES of SAP and GBC" and the sub-questions, the first one was about the construction process, whether the integration was going to affect it or not, and the second question was about the integration also, will it solve the IT scattered landscape or not.

The third step was mapping the actual information system of GBC in order to understand the actual business processes and if this system will fit with new technologies the result was that the existing system (GB ERP) don't support BIM work flows for that we move to SAP in order to find the appropriate system that allow us to complete our research, for that we use SAP S4 HANA which support the most IT technologies such as BIM, internet of thing, block chain.

After finding the appropriate system we dived our integration into two step ; BIM-ambidextrous BPM integration in order to find a solution to the high complexity of project and BIM-ambidextrous BPM integration in EES in order to solve the problem of IT landscape, we found that the first phase of "integration BIM-ambidextrous BPM" optimize the construction process and resume them into three main phases : design , build and manage those phases breakdown into seven processes : design validation and quantity take-off, pricing and cost

## CONCLUSION

estimation, project scheduling and budgeting , procurement and prefabrication , construction tracking and reporting , asset and facility management & project management .

Based on those result we move to the second phase of integration “BIM-ambidextrous BPM in the EES” this passed through five phases : design, budget & schedule , Tendering & purchasing , construction & maintenance and controlling & finance ; in the design phase we use Autodesk Revit in order to create a 2D design then transfer it to 3D model in order to determine the exact quantities for pricing and cost estimation then we transfer those information to SAP S4 HANA which enable us to manage the rest of phases of the construction process.

Based on SAP’s experience in the BIM technology integration, we moved to GBC in order to applicate our result in their new EES (GB SYSTEM). we faced many challenges such as the lack of project management strategy (they are managing the hole project as one project that created many problems such as cash flow management) for that we recommend to manage each project separately, because each project has its own scope and specifications. In addition, the BIM treats each project separately based on its cost, time and requirements.

Moreover, we found that GBC are using a database (oracle database 11g release 1) which don’t support many technologies such as (artificial intelligence, IOT, blockchain...) so we recommend to change it to (19<sup>c</sup> oracle database) in order to use those technologies in the different phases (example in the maintenance phase IOT can detect a problem in the elevator without human effort, this will reduce risk and the maintenance cost).

Otherwise, during our work on this research, we encountered many problems, similar to any other work, especially in this rather exceptional year. Our research was limited by various factors such as the access for the organization were it was denied to the host organization because of Covid-19, also the fact that we brought a new technology that is still in the starting phase and many international companies just started adopting it which leded us to work and communicate with different experts which had different opinions.

The results of our study paper are not the end of the research work in the contrary it opens the door to researchers to explore further building technologies that have proved their efficacy in the world’s biggest construction companies, by seizing rising opportunities and integrate it in their research by asking questions such as: How to integrate robotics and artificial intelligence (AI) in the construction sector? How can we reduce project-related risks by applying IOT?

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# **APPENDICES**

**INDIVIDUAL SEMI-DIRECTIVE  
INTERVIEWS GUIDE**

**Project BIM:** The integration of BIM-ambidextrous BPM in the EES

**Date:** dd / mm / 2020

**Start time:** hh: mm

**End time:** hh:mm

**Interviewer:** HAMMOUTENE Fatima Zohra

**Directorate / department concerned:** .....

.....

Interviewee name	Workplace	Communication way

**Objectives of the interview:** .....  
.....

**PART ONE:** Introducing the interviewer, the researcher and the interviewee.

The first part of the interview guide allows the two interlocutors to introduce themselves, as well as to introduce the objective of this interview as well as that of the research.

**1. Presentation of the interviewer:**

We introduce ourselves to the interviewee, and inform them of our current training.

**2. Presentation of the research:**

We present our theme, the methodology followed as well as the objectives of the research.

**3. Presentation of the interviewee:**

To close this 1st part, we collect socio-professional information on the interviewee.

**PART TWO:** Detailed questions

Note: the following topics are not dealt with in the same interview, nor with the same actors.

**✓ Could you describe how your department works?**

- What are the responsibilities of your position?
- What is your working procedure?
- What are the other departments or actors with whom you work?
- What information do you exchange with them?

**✓ what are your data sources?**

- What data are used?
- How do you currently retrieve this data?
- What do you do with this data once obtained?
- Are your data sources reliable?
- Does the data obtained meet your needs?

**✓ How are you managing your projects actually ?**

- Do you use specified softwares ?
- Are you satisfied with your management style?
- How complex are your projects ?
- how far are you using building technologies in your projects?

**✓ what are your main difficulties with using BIM?**

- Is BIM easy to use? does it require an effort to be able to handle it?
- Does it contain reliable data? updates?
- Does it have the necessary features to accomplish your tasks?