THE ADAPTION OF BIM IN ALBANIAN CONSTRUCTION INDUSTRY

COST, QUALITY, TIME OPTIMIZATION ON A BIM PILOT PROJECT PROPOSAL FOR PUBLIC SECTOR

A THESIS SUBMITTED TO
THE FACULTY OF ARCHITECTURE AND ENGINEERING
OF
EPOKA UNIVERSITY

BY

NIKI CANE

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
ARCHITECTURE

July, 2021

Approval sheet of the Thesis

This is to certify that we have read this thesis entitled **"The adaptation of BIM in Albanian construction industry"** and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

_____

Dr. Edmond Manahasa
Head of Department
Date: July, 09, 2021

Examining Committee Members:

Assoc. Prof. Dr. Anna Yunitsyna (Architecture) _____

Prof. Dr. Sokol Dervishi (Architecture) _____

Dr. Fabio Naselli (Architecture) _____

M. Sc Julian Beqiri (Architecture)_____

M. Sc Teuta Kodra (Architecture)_____

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name Surname: Niki Cane

Signature: _____

ABSTRACT

THE ADAPTION OF BIM IN ALBANIAN CONSTRUCTION INDUSTRY

Niki Cane
M.Sc., Department of Architcture
Supervisor: Msc. Teuta Kodra

The purpose of this paper is to examine the adaption of Building Information Modeling in Albanian construction industry. It is known that BIM application in some way is halfway ineffective in terms of cost, schedule and organization. Still, Albania has been introduced with BIM during these recent years, and has started its application in architecture and construction in several major projects. Yet, the aim of this study is to examine the incisive effect that BIM has in Architecture, Engineering and Construction (AEC) industry, coming up with specific conclusions about its influence and effectiveness along the whole process of the project. Such qualitative observation will be taken from interviews with architectural, construction companies and BIM professionals. Also, the goal is to conduct a set of questionnaires providing deeper and factual responses. It is to be found weather the application of BIM has been beneficial, which are its risks and how can they be improved taking into consideration three existing buildings in Albania. The aim of this research is therefore to identify barriers that affect the adoption of BIM technology in Albania, where the disciplinary users will be included, project lifecycle stages, digital visualizations–including software utilization—and organizational issues such as scheduling and sequencing. The potentials of such new discipline as BIM will be taken into consideration for the creation of new building normatives, as the standards and guidelines are still in absence. Also, BIM is being used in Albanian industry, from a majority of private sectors. Our aim is to come up with a proposal of a BIM pilot project, related to public sector, emphasizing the benefits and barriers that has to do with Cost, Time and Quality.

Keywords *BIM, Building information management, Construction project management, BIM tools, BIM Manager, BIM Coordination.*

ABSTRAKT

PËRSHTATJA E BIM-IT NË INDUSTRINË E KONSTRUKSIONIT NË SHQIPËRI

Niki Cane

Master Shkencor, Departamenti i Arkitekturës

Udhëheqësja: Msc Teuta Kodra

Bashkë-udhëheqësja: Assist. Prof. Dr. Anna Yunitsyna

Ky kërkim syonon të hulumtojë përdorimin e BIM-it në industrinë e konstruksionit në Shqipëri. Shqipëria, është prezantuar me BIM gjatë këtyre viteve të fundit, dhe e ka aplikuar në arkitekturë dhe konstruksion në disa projekte të mëdha. Gjithësesi, qëllimi i këtj studimi, përkon me shqyrtimin e efekteve që BIM ka në industrinë e arkitektures, inxhinierisë dhe konstruksionit, duke u mbështetur në konkluzione specifike për efektet e tij gjatë gjithë procesit të zhvillimit të një projekti. Ky studim kualitativ vjen si rrjedhojë e intervistave të zhvilluara me kompani arkitekture, konstruksioni dhe specialistë në fushën e BIM. Gjithashtu, synimi tjetër është realizimi i pyetësorëve për të patur përgjigje sa më objektive dhe faktike. Duhet hulumtuar nëse përdorimi i BIM ka qenë i dobishëm, cilat kanë qenë rreziqet, dhe si këto të fundit mund të përmirësohen duke marrë në konsideratë tre ndërtesa ekzistuese në Shqipëri. Ky studim synon të identifikojë barrierat që ndikojnë në përdorimin e teknologjisë BIM në Shqipëri, ku do të përfshihen përdoruesit e tij, fazat e ciklit të një projekti, vizualizimet dixhitale, përfshirë përdorimin e programeve të ndryshme, si dhe çështje organizative që kanë të bëjnë me planifikimin dhe fragmentarizimin e punës. Potencialet e nje disipine te re si kjo e BIM-it, do te meren ne konsiderate per krijimin e normativave të reja, standardeve dhe udhëzimeve që ende mungojnë. Gjithashtu, BIM-i përdoret në Shqipëri nga shumica e sektorit privat. Së fundmi, studimi ka për qëllim propozimin e një projekti pilot të punuar në BIM të një objekti që i përket entit publik, duke vënë në dukje avantazhet dhe barrierat që kanë të bëjnë me koston, kohën dhe kualitetin.

Fjalët kyçe: *BIM, Building Information Management, Menaxhim projekti, Mjetet e BIM, Menaxher BIM, Koordinimi me BIM.*

Dedicated to my family.

ACKNOWLEDGEMENTS

After finalizing my studies at Epoka University, I appreciate all the received valuable knowledge needed for the completion of this work.

As a student of the Department of Architecture, I want to express my gratitude in-particular to my supervisoer, Mrs Teuta Kodra, for her accurate guidance and her wide knowledge in the area of BIM. I also have to mention my deep appreciation for the flexibility she provided and also clues and advices that strengthened my direction in the process.

My sincere gratitude goes to my parents for their love, support and inspiration throughout these years. I would also like to thank my best friend Lezo Kroj, for his encouragement to complete this work.

I am very grateful to all the individuals in the filled of architecture, and the companies that helped me fill in the surveys and further develop my research.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

BIM Building Information Modeling

BIM Building Information Management

BMS Building Information System

AEC Architecture, Engineering, Construction industry

BCF Building Collaboration Format

CAD Computer Aided Design

LOD Level of detail

LOD Level of development

CD Construction Documentation

2D Two dimensions; x, y

3D Three dimensions; x,

CHAPTER 1

INTRODUCTION

1.1 Background Information

The Architecture, Engineering, and Construction industry (AEC), have been facing huge revolution in terms of technology along the phases of a projects from the very start of the design stage to the application on the real site. As a process in evolution, AEC has started its project drafts with the use of two-dimensional (2D) drawings, later evolving with the three-dimensional (3D) drawings and space projection, with the very helpful tool, that of Computer-Aided Design (CAD) (Kong et. al 2020) CAD came as a necessity to store the building graphics and information about the project, but it was not fully capable when it comes to further analysis, energy simulations or detailed data permits. BIM was then presented as an object-oriented tool to maximise the development of the project, *for instance, BIM has the potential to be modelled up to 6D with types of models of 2D drawings, 3D models, 4D time scheduling, 5D cost estimates and 6D facilities management.*

This study is a critical reflection on the integration of BIM in construction industry in Albania, as it has recently experienced prominent transformation. It has started with paper drawing, then in two-dimensional and three – dimensional Computer – Aided Design that still is not enough for further analysis, information exchange, and model optimizations. Building Information Modeling has become an inevitable solution, even though not widely used and challenge-oriented tool. The motivation for this study is as shown in ***Figure 1***.

BIM is considered to be an object – oriented facility and the use of 3D is sought to be the first step toward the usage of BIM in Albania. Datas, informations, simulations and analysis along the life – cycle of a building, now is being the new trend in construction. Even though is used in some specific project coming up with a

list of benefits, the results seem to be not quite positive along the process and the end-up product.

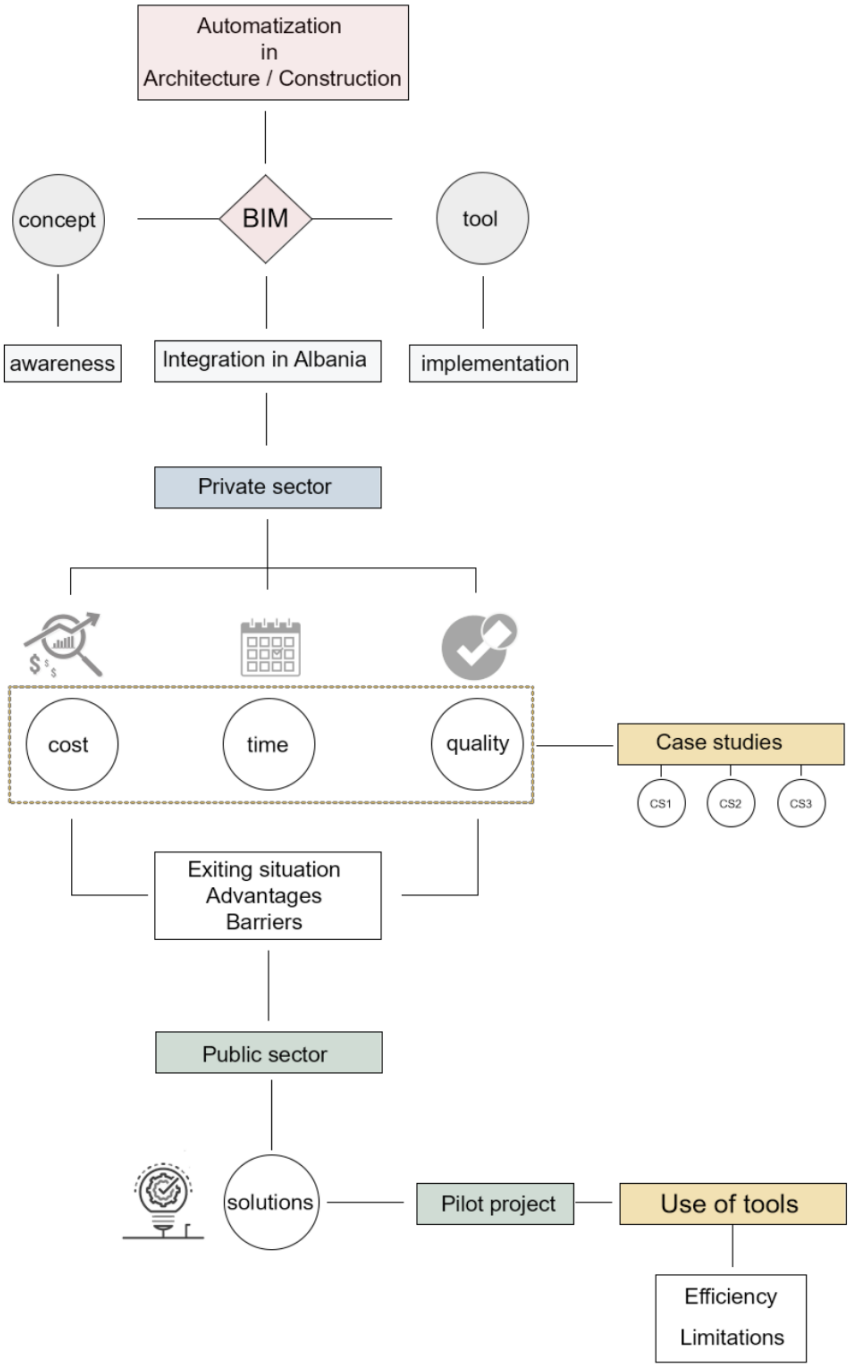


Figure 1. Motivation.

1.2 Problem Definition

Construction industry is being more open towards BIM usage all around the world. This rapid expansion in AEC has introduced BIM as the ultimate utilitarian tool for problem solving during the 4 stages of construction. However, Albania is still on the first steps toward BIM implementation for several reasons.

First of all, construction specialists and architectural companies are still not used with the conception of BIM. They tend to limit the process within the framework of methods they are used to. They find this implementation to be risky, expensive and difficult.

Second of all, the use of BIM needs a new strategic way when it comes to co-ordination of the construction project. This new approach will have consequences on changes, and results, on which the Albanian Construction is skeptical to BIM usage.

Thirdly, BIM-better buildings is a concept that needs to be used in Albanian construction. Effectiveness in design, documentation and construction phase, have to be developed through the use of BIM, as a starting point during the life- cycle of a building project. New approaches and strategies have to be taken into consideration.

1.3 Purpose

The purpose of this paper is to briefly understand the concept of BIM and its essential role in Construction industry as an innovative strategy towards better buildings, The aim of this study is to look forward in Albanian construction industry, providing information about the existing situation and highlighting the impact that BIM) has had in building process (benefits and risks), coming through the analysis of 3 case studies in Albania.

BIM is a vast subject area and its implementation has many aspects, uses and applications. This study will be focused on BIM application on the project planning cost, quality and time control.

BIM is being used in construction industry in Albania from a majority of private sectors. Our aim is to come up with a a proposal of a BIM Pilot Project, related to public sector, emphasizing the benefits while doing specific cost analysis, simulations, while using various numbers of softwares.

1.4 Research Questions

My research thesis aims to reveal the following questions:

- How has BIM been embraced in Albanian construction in terms of block patterns (Mangalem21), mixed-use skyscraper (Downtown Tirana) and the new Albanian national stadium?
- What are the benefits and the burdens that come along with the implementation of BIM in the case studies mentioned below in terms of Time, Schedule, Cost?
- Which are the barriers of public sector for not implementing BIM? Are there any future premises once a BIM Pilot Project is presented and a Project execution planning is being set up?

Hypothesis

- Albania is using BIM in construction industry, coming up with effective solutions in 3 existing buildings.
- Except the benefits of BIM implementation, it wil also be a great obstacle in the first stages of Design - Construction - Post construction process.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The literature review is aimed to set up an understanding of Building Information Modeling (BIM) as a new concept used in Architecture, Engineering and Construction. It will help for further evaluation of BIM presence and impact in the chosen case studies. A deep understanding will be concentrated on BIM standards, BIM strategy, BIM benefits in an overall project. This sort of information, will be collected from reliable sources such as; books written during these recent years, BIM documents, social media and academic articles. The followings are some critical literature reviews conducted in the concept of BIM.

Table 1. Reviewed scientific literature.

Contriburion Area	Authors	Description
BIM effectiveness in case studies	Kong et al,.(2020)	Has investigated the impact of BIM in Malaysia.
	Gray et al,.(2013)	A survey was delivered in in Australia and internationally to analyze BIM awarenes.
	Bryde et al,.(2013)	BIM usage was investigated in 35 construction projects, identifying the benefits.
	Lee el al,.(2014)	It was studied the adoption of BIM software in Hong Kong, contributing to academia and the professional environemnt.
	Jamal et al,.(2019)	A survey was presented to see the impact of BIM in architectural firms in Malaysia.
	Vinoth el al,.(2019)	Delivered a surbey to explore BIM impact in India, scenarios and the way it was adopted.
	Alabdulqader et al.,(2012)	A research was made in Australia, in AEC industry to overview the presence of BIM.
	Karathodoros el al.,(2013)	A quantitative research was done of BIM usage on a client perspective.
BIM positive aspects	Wiley el al., (2015)	BIM was presented as a positive tool in the building process.
	Forgyes et al.,(2012)	It represents the advantages of BIM in terms of cost efficient estimation in project stages.
	Turk, Z el al., (2016)	BIM is presented as a tool that hepls managae the stages of the project.

	Czmoch el al.,(2014)	In this study is presented an example of how the existing design is adopted in BIM technology.
	Bimal Kumar(2015)	In his book, he presented the key elements that should be taken into consideration before working on a BIM project
	Randy Deutsch (2011)	It tends to explain the user's return on investment (ROI)
BIM application in several phases.	YAN et al.,(2014)	This research was conducted to analyze the usage of BIM in large scale projects, analyzing the schedule, cost estimation, clash detection, and time simulation.
	Pärn el al.,(2017)	Aimed to examine BIM in terms of management in AEC industry.
	Zhang el al.,(2020)	Based on case study analysis, it shows how BIM can effect the improvement of the project coordination.
	Arayici et al.,(2011)	A systematic approach was done for small and medium sized enterprises. It as noticed that the traditional method did not seem to be efficient.
	Zhang et al., (2011)	A 4D information model is presented as a solution of conflict analysis and safety problems during construction.
	Shen Xu et al., (2013)	The research was made for cost estimation, including quantity, resource, and price information.
Difficulties and barriers	Chae el al.,(2015).	This study presents the difficulties that the contractor and BIM user might face and also the examination of 11 BIM manuals to understand the skills.
	Holzer, D. (2011)	The author presents the problematic aspects that BIM has in real implementation.
	Bernstein el al.,(2004)	In this study are mentioned the typical barriers that effect lack of BIM application. The reasons are the new software and technological approaches.
	Eadie et al.,(2014)	Online surveys were delivered to 74 UK's constructing contractors to identify the barrier that prevent the BIM usage.
n- Dimensions of BIM	Xu, Shen et al.,(2013	The knowledge of cost estimation is demonstrated and discussed. Initial analysis of the IFC schema has been completed, including analysis classification & inheritance structure.
	P. Raut (2017)	Explains the 4D BIM for better coordination, communication and information exchange between team members.
	Politi, R. et al.,(2018)	A case study presented the n-dimensions of BIM in construction phase, from 4D to 7D.
	Wong K et al.,(2013)	This paper investigates the contribution of BIM to sustainable buildings from the perspective of design performance and improved communication and coordination.
	Xu Z et al.,(2018)	It presents a model for simulation of sunlight's effect on building design under BIM technology, while using Revit.
	Shyamkant B et al.,(2017)	This paper gives a brief introduction about Clash detection in BIM. identifies cost & time optimization, of residential buildings.

Ashwini M et al.,(2016)	It is explained the advantage of using BIM navisworks for clash detection analysis and BIM coordination.

2.1.1 Investigation of BIM effectiveness in Case Studies

(Kong et al,.2020) has deeply investigated the impact of Building Information Modelling in Malaysia**,** which has recently been introduced and used by architects, engineers and constructors. Several interviews were conducted to get conclusions about the effectiveness of BIM in terms of cost, standards and project organization, as shown in ***Figure 2*** below.

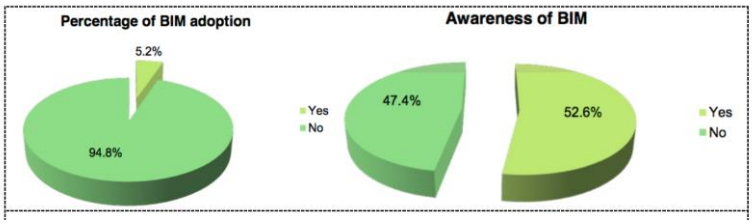


Figure 2. Case study evaluation.

Building Information Modelling is presented as the next evolutionary link in project delivery within the AEC Industry. (Gray et al,.2013) has reported a large-scale electronic survey of BIM implementation in Architecture, Engineering and Construction project not only in Australia but internationally. The aim was to fully-integrate all stakeholders, technology used, and the project lifecycle stages.

The survey aimed to gain information from all the (architects, engineers, surveyors, contractors, project managers etc.) about the awareness and use of BIM in their projects. It was taken into consideration the real process and then reflected in a conceptual framework of using BIM as a tool connecting various disciplines as shown in ***Figure 3.***

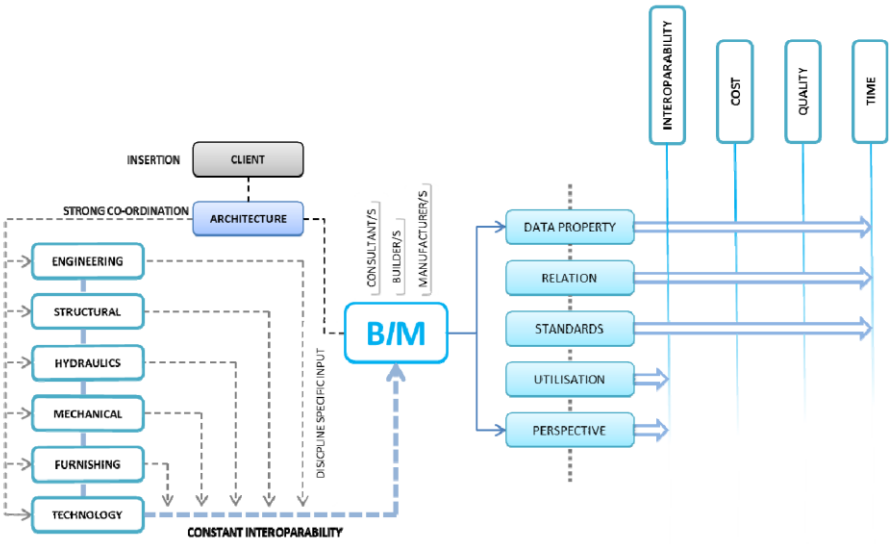


Figure 3.The use of BIM in various disciplines.

(Bryde et al,.2013) has investigated deeply into the expansion of BIM usage, identifying certain benefits have been part of the construction projects. His study consisted on an assemblage of secondary data from 35 construction projects that have further advanced with the usage of BIM.

As Kong Kong is seeing BIM as a new idea in building technology, this research tends to identify barriers that affect the adoption of BIM technology construction industry. (Lee el al,.2014) has brought a study that contributions to both academia and the professional environments in the aspect of knowledge in the BIM field about major factors affecting user adoption of BIM software technology in Hong Kong.

(Jamal et al,.2019) in his paper has presented a survey that looks into the insight of how architectural firms in Malaysia are confronting with the establishment of BIM in their building process. Due to the aim of this investigation, a quantitative survey methodology was used to reach 535 small and big architectural firms.

(Vinoth el al,.2019) made a survey in order to explore the impact of BIM in India, which were their scenarios and how was it adopted. The results ended up with

positives advantages, related to communication, better integration and efficient work-flow process. In ***Figure 4*** is shown the evaluation of BIM tools in terms of hours and time.

Task	CAD (hours)	BIM (hours)	Hours saved	Time savings
Schematic	190	90	100	53%
Design development	436	220	216	50%
Construction documents	1,023	815	208	20%
Checking and coordination	175	16	159	91%
Totals:	1,824	1,141	683	

Source: (Rick Rundel (7), 2007)

Figure 4. Project tools efficiency evaluation.

Research was made to overview the presence of BIM in AEC industry of Australia consisting in challenges and advantages regarding the physical properties, issues related to responsibility and data ownership, and issues related to security. Results showed that it was a huge absence of awareness and understanding of BIM as a new concept and methodology. (Alabdulqader et al.,2012)

A kind of qualitative research, was based on interviews and case studies, related to the impact of BIM usage on a client perspective (Karathodoros el al.,2013). Suggestions on how they should design and on what aspects should they focus was the key term of this thesis. “Effort curve” conceptually shows the impact that the design decisions made earlier in the project effect positively in the cost is shown in ***Figure 5***. The differences between the integrated and the traditional project delivery is graphically shown.

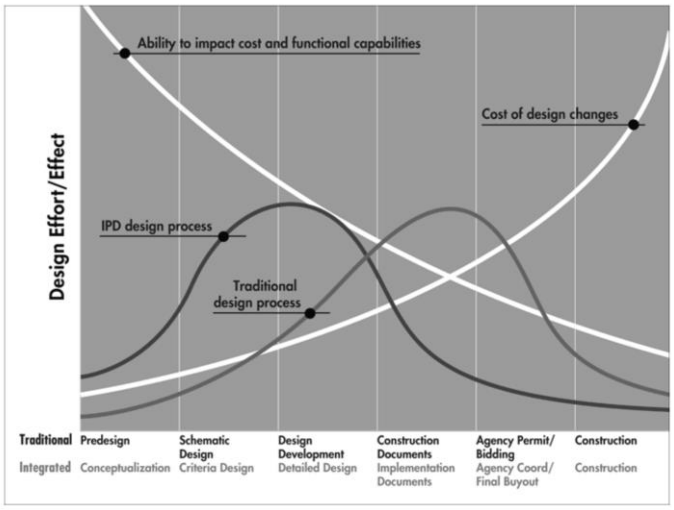


Figure 5. "The effort curve" by Patrick Macleamy (The American Institute of Architects, 2007)

A number of researches and academics are brought together to address analyzes about BIM methodologies and progresses. Forty submissions were taken in advance and five of them were selected for this issue (Liu el al.,2015)

2.2 BIM positive aspects/benefits

(Wiley el al., 2015) presented in his book a perspective of BIM as a positive asset shown in the building process. Introduced from the technological innovations, it has a direct impact in construction field. Such positive outcomes are presented as fundamental insights in AEC industry - “right tools for the right job.”

As a comparative study between commercial BIM softwares and work performance examination this study presents a list of efficient advantages of BIM in terms of cost estimation and calculations on the efficiency of the project stages. (Forgues et al.,2012)

BIM is not presented only as a digital tool that serves to visualize the projects, but it helps manage the whole stages of it. In overall, BIM functions as a building

information management, which today is made computer based. The goal is efficient support of business processes, such as with database-management systems (Turk, Ž el al.,2016).

(Czmoch el al.,2014) Has briefly presented the timeline of the traditional design in civil engineering. Later on, Building Information Modelling (BIM) has been presented as a new beneficial approach. It also gives emphasis to the difficulties that specialist confront during BIM implementation. The case study is a presentative example of the existing design adopted in BIM technology.

(Bimal Kumar 2015) In his book Bimal has intended to present a practical guide for a typical professional in the construction industry. He points out the key elements that should be taken into consideration before setting out on a BIM-based project. Nonetheless, a considered amount of basic theoretical material and introduction to the BIM is provided.

Randy Deutsch (2011) This book is addressed to the BIM user. It is not just a synthetized material about its methodology or BIM as tool, but it is more related to a business BIM book that tend to measures the user's return on investment (ROI) or provides business models or value proposition.

2.3 BIM application in several phases

(YAN et al.,2014) conducted research to analyze the BIM applications in huge building projects, by examining different functions of BIM technique applied to plan management that are presented in conjunction with relevant experiences of BIM pilot projects. It was found that its application was vastly used in 3D models with construction schedule management, project cost estimation, effective visualization, clash and collision detection, and simulation of total project time ***Figure 6.***

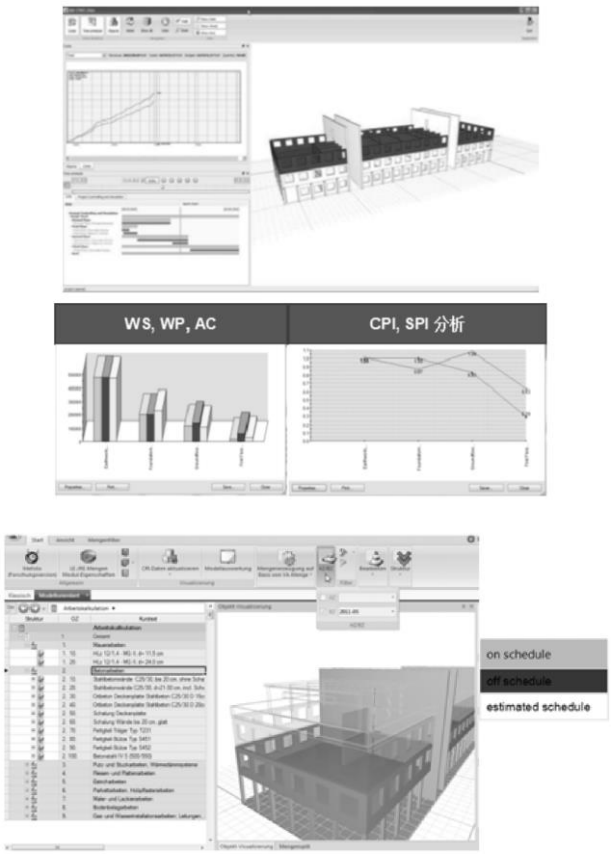


***Figure* 6.** Clash detection/cost evaluation.

(Pärn el al.,2017) made a synthesis of literature that aims to examine building information modelling in terms of management within the architecture, engineering, construction and owner-operated sector. They have presented a detailed and accurate report of published literature on the latest research and standards development that impact upon BIM and its application in facilities management during the operations and maintenance phase of building usage.

Based on the hypothesis of 'HOW and WHAT' can the concept of BIM can be developed as a tool to accomplish the principles of Lean construction, by aiming to improve the effectiveness during a certain construction project. The study is based on a case study analysis, which shows the relation between BIM and Lean principles, how BIM can contribute towards the improvement of project coordination (Zhang el al.,2020) ***Figure 7.***

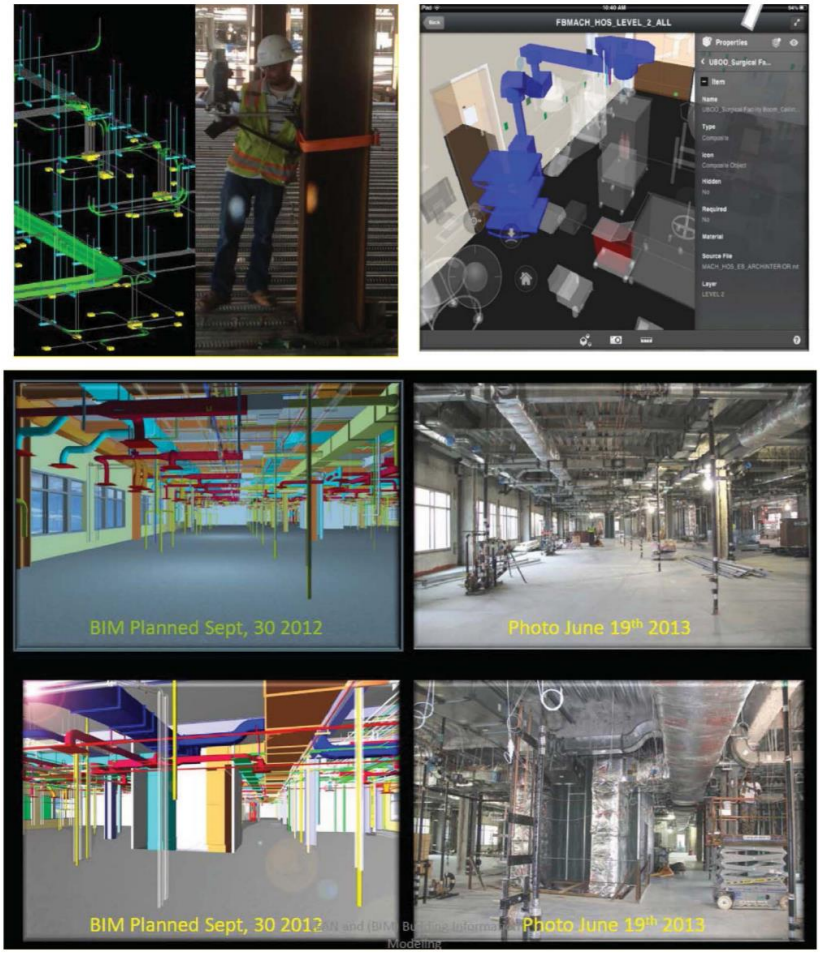


Figure 7. Interference analysis and time coordination

A systematic approach is aimed to be presented for the implementation of Building Information Modeling, (BIM), for architectural SMEs at the organizational level (Arayici et al.,2011). The aim of this paper was to present a systematic approach for BIM implementation for Architectural SMEs (Small and Medium Sized Enterprises) presented in ***Figure 8.*** So, the implementation of BIM was organized in four stages illustrated in the figure. John McCall Architects in Liverpool is focused in social housing and regeneration, and private housing and has worked with 2D cad only which seem not to be efficient.

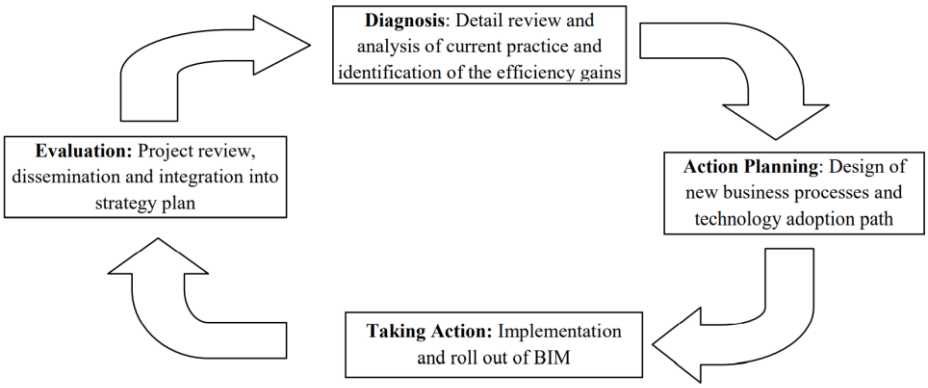


Figure 8. Systematic approach for BIM implementation

Zhang et al., 2011) Based on new developments in the Building Information Model, four-dimensional technology, time-dependent structural analysis, collision detection, and so on, a 4D structural information model is presented and established according to the overall solution of analysis and management for conflict and safety problems during construction as shown in ***Figure 9***. Hence, the integration of dynamic safety analysis of time-dependent structures, conflict analysis and management of schedule/resource/cost, and dynamic collision detection of site facilities is studied, and theories and key technologies are discussed in detail.

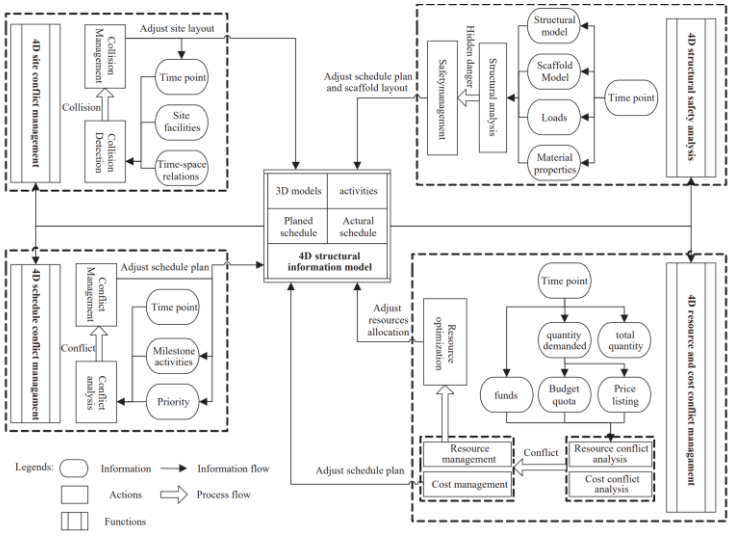


Figure 9. 4D structural information model.

(Shen Xu et al., (2013) aimed to conduct a research of cost estimation by using the IFC standard. The data needed for the cost estimation was summarized into 5 aspects: the building product information, the cost item information, the quantity information, the resource information and the price information.

A residential building was taken as a case study, constructed using conventional methods of building information management. The scope of utilization of BIM Coordination for the project under consideration was identified from the acquired data, as shown in ***Figure 10***.

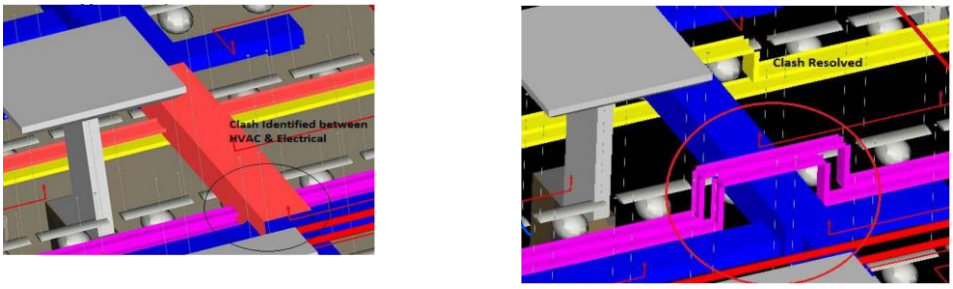


Figure 10. Interference problems and identifications

2.4 Difficulties

With the development of technology, Building Information Modeling is presented as the new advantage in construction industry. Despite these cons, owners are facing difficulties when it comes to contractor section, and the specific skills that a BIM user might have. The aim of this paper is to examine eleven BIM manuals to understand essential BIM skills and applications demanded by these BIM manuals (Chae el al.,2015).

(Holzer, D. 2011) aimed to report the problematic aspects that Building Information Modeling has in its practice. The author presents the so called

'roadblocks' that the users of BIM face during its application, dividing the radical view from its real implementation as presented in the graph ***Figure 11.***

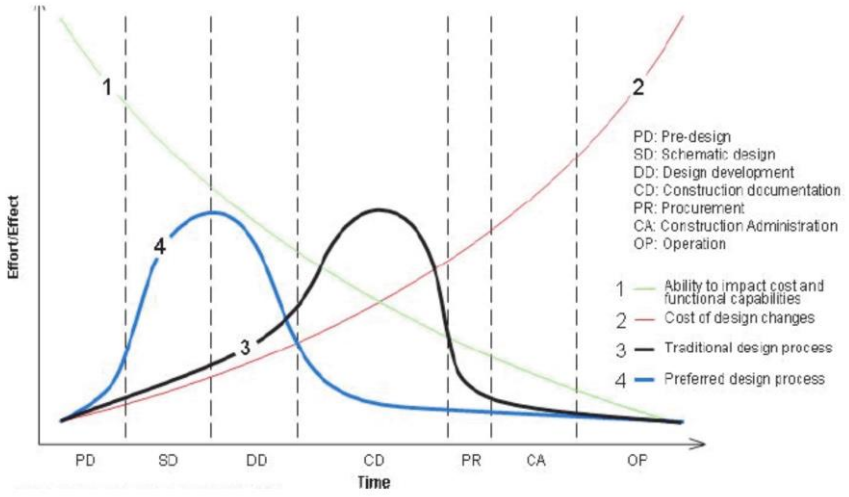


Figure 11. Traditional method vs use of BIM.

(Bernstein el al.,2004) In this paper are mentioned some typical barriers that effect the lack of BIM application in AEC. One major reason that the authors describe is the usage of software applications and new technological approaches.

(Eadie et al.,2014) Among many benefits linked with BIM application, there is also a list of barriers, that prevent BIM usage from different stakeholders. A study which gathered information from online survey from the top 74 United Kingdom construction contractors, demonstrated that the barriers came as a "Fear" factor". Also, "Scale of Culture Change Required/Lack of Flexibility" and "Lack of supply Chain Buy-in", are two other challenges when it comes to BIM.

CHAPTER 3

METHODOLOGY

In this chapter are described the methods how I will convey my research. Framing the study with the aim to have a clear understanding of Building Information Modeling in AEC industry, a theoretical part will be included based on literature review about BIM concepts, it's importance, BIM categories, BIM strategy, BIM benefits and challenges. Hence this study tends to briefly explain the methodology used in Albanian construction among years, new technologies and which are the first attempts of BIM usage and their effects during application. To narrow down the research, the following methods with be used:

3.1 Quantitative Methodology

Because of the very nature of this study, quantitative methods will take place. To deal with the issue, some survey samples need to be elaborated as in ***Figure 12.*** They aim to collect information from different stakeholders, (architects, engineers, contractors, designers, project managers etc), such as both non-BIM users and BIM users. The first category will be asked general questions about the actual building process, their current definition about BIM or reasons for not applying BIM. Meanwhile, the second category will be asked to identify their first impact on BIM usage, the softwares they use, the risks and benefits they have faced during the process. In this research, online surveys with standard questions will be delivered via email, for each firm such as: VARKA arkitekture, Commonsense studio, Arkon studio, Studioarch4, Kaso construction, etc.

BIM USERS	NON-BIM USERS
What is your current definition of BIM?	What is your current definition of BIM?
What are your reasons for employing BIM?	What are your reasons for not employing BIM?
How long has your organisation been using BIM?	Are you considering the implementation of BIM within your organisation?
From who have you had requests for BIM?	What aspects of BIM do you plan on utilising?
What aspect/s of BIM do you use?	Have you had any external requests for BIMs and from whom?
Others...	Others...

Figure 12. BIM users/ NON-BIM users questionnaire sample.

3.2 Qualitative Methodology

3.2.1 Data Collection and Semi-Structured Interviews

As Seaman (1999) states, these types of methods are used to collect qualitative data based on opinions or impressions about a specific topic [25]. To get an in-depth and profound understanding of the matter, these semi-structured interviews will be an essential tool toward the data collection. Three types of efficient interviews will be conducted in person, with various specialists in the field of architecture and construction with representatives from Kontakt Construction Company, AlbStar contractors, Xplan architects, Gener 2, and Kastrati construction, as shown in ***Figure 13***.

1. Semi structured interviews - with a list of themes and questions to be discussed

2- Structured interviews - a list of pre-arranged and a typical set of questions

3- Unstructured interviews - no set of arranged questions is introduced, except the main theme, where the specialist can express his/her opinions or his personal experience. [26] Some questions will emphasize the project life-cycle phases, such as the implementation of BIM in design, documentation, construction, operation and maintenance phase.

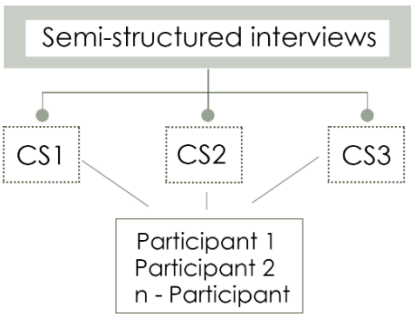


Figure 13. Schematic Organization of the Semi-structured interviews.

3.2.2 Data Credibility and Case Studies

Interviews are a reliable source for the case study selection process where a target group is selected to gather information from. They represent a solid basis to enhance the validity in case studies as well as with questionnaire for a far-reaching detail. Case studies are an observative method against factual and objective information. According to data credibility, three to four projects (case studies) will be chosen for further elaboration of the impact of BIM usage in the project, defining the challenges, benefits, risks, and the future definition of BIM projects in Albania.

3.2.3 Data Analysis

The data analysis will be carried out after the collection of in-depth interviews with the target groups mentioned so far shown in ***Figure 14***. Four steps will generate the information gathered from the surveys, interviews and case studies based on the creswell analysis spiral (Zaker, M. 2019).

3.1 *Organization of the data.* In this step, large units will be break down into smaller ones where a database will take place.

3.2 *Perusal of the collected information.* It consists on the observations of the preliminary interpretations, and then getting an overall sense of the data that might lead to possible interpretations.

3.3 *Classification of the general themes* Is the process of grouping the themes and classifying the statements into categories, for better interpretation of the data gathered.

3.4 *Data Synthesis* This step refers to the hierarchical organization of the documented data. The information is presented in tables, graphics, or diagrams as a compressed information.

INTERVIEWS	Nr	EXPERIENCE	INTERVIEW TIME
Architect		n - years	30 min
Engineer			30 min
Constructor			30 min
BIM Expert		n - weeks	30 min

INTERVIEWS	I1	I2	n-I
Company			
Position			
Experience			
Awareness of BIM			
Nr of BIM projects			

Figure 14. Data analysis sample

3.2.4 Selection Criteria

The selection criteria for the three case studies (Mangalem 21, Tirana Downtown1 and Air Albanai Stadium) was based on the unique typology that they have. The aim was to look closer in the project and see how BIM acts during the process, analyzing the advantages and limitations. These projects, especially DTO are large scale projects where new technologies are being used and the latest building parameters which are environmentally friendly. In diverse typologies, BIM acts differently.

CHAPTER 4

THEORETICAL FRAMEWORK

4.1 What is BIM?

The US National Building Information Modelling Standard defines BIM as; “Building Information Modeling (BIM) is a digital representation of physical and functional characteristics of a facility (GSA BIM Guide Series 01). A BIM is a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition. The concept of (BIM) is also defined as a work methodology which is seen as one of the greatest revolutions towards architecture, engineering and construction industry (AEC). It is predicted to be the predominant design and management tool used to design, review, approve, build, commission and operate buildings (Knight, M. D. 2008). Building Information Modeling addresses the key role that BIM is playing in shaping the software tools and office processes in the architecture, engineering, and construction professions as demonstrated in ***Figure 15.***

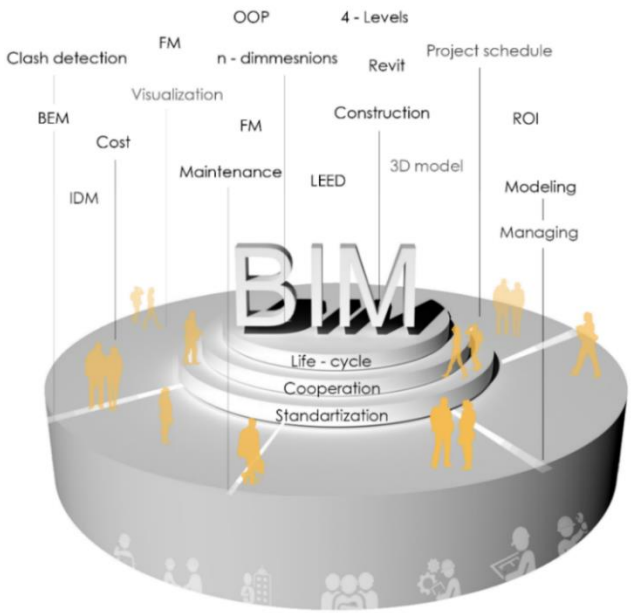


Figure 15. BIM concept, tools, stakeholders diagram

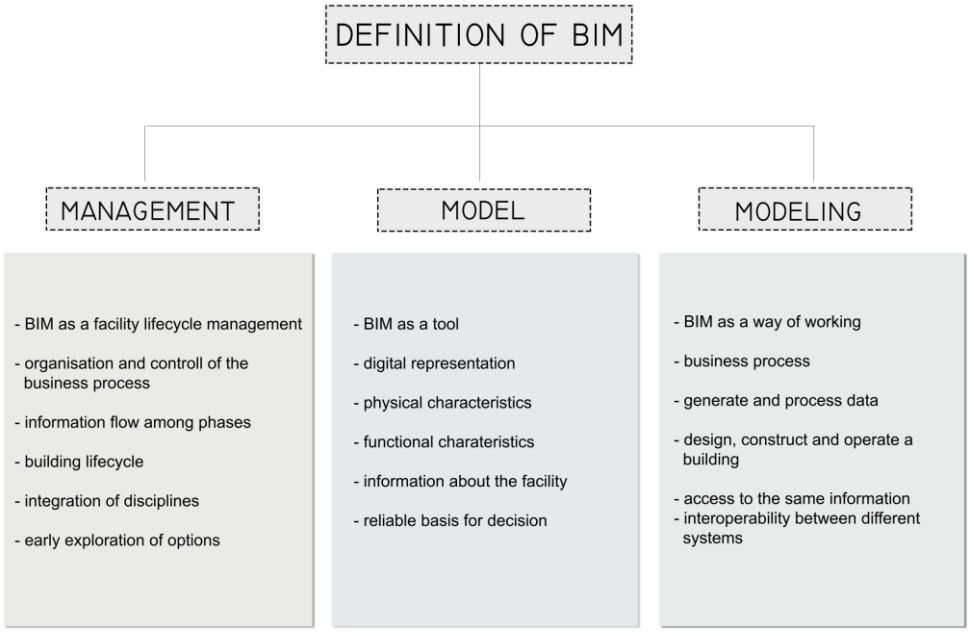


Figure 16. BIM Definition.

4.1.1 Why do we need BIM?

BIM works as an intelligent model-based process that connects professionals. Nowadays, a vast number of architects, engineers and contractors are BIM users along the whole building process. Due to the complex nature of the AEC projects, technological advances are helping the professionals work more efficiently and effectively. It offers a multidisciplinary collaboration, with the potential to allow architects, engineers, and stakeholders work on a coordinated system presented in ***Figure 17***. The user can easily control the information in the model to develop, improve, or even manipulate the design before it is built on the site. Experiencing the design before it is built with Virtual Reality (VR) while using realistic visualizations is quite a promising potential for the future. The innovation lies on getting valuable insights with analysis referring the energy consumptions, lighting, or structural integrity. Having a better understanding of the building leads to the result of an optimized design, reducing so project risks along its life cycle. BIM offers softwares

as the main tools to plan, design, and construct in 2D and 3D for better project outcomes while minimizing errors. It helps contractors to deal with better cost predictability, cost savings and also improved timelines along the building process.

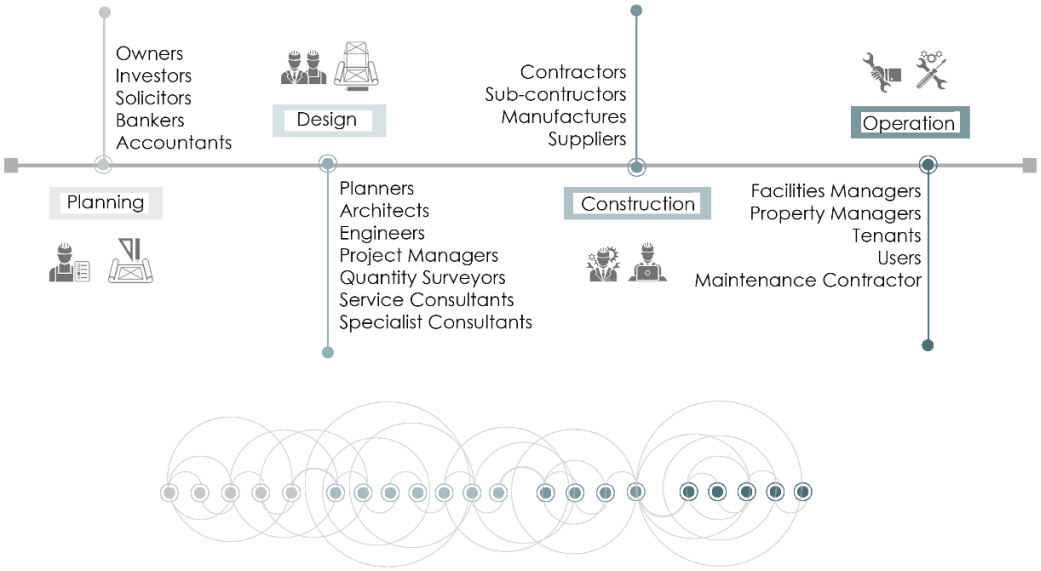


Figure 17. Collaboration of different stakeholders

4.1.2 Levels of BIM

Currently there is a lack of a clear definition in regard to what BIM actually is. (Lindblad, H. 2013). According to the UK government, a set of ‘Levels ‘to need to be elaborated in order to have a progressive process in construction industry. From zero to three, the meaning of each level can me identified as follows ***Figure 18***.

Level 0 BIM

The 0 level of BIM is the simpliest one where 2D Cad drafting is the only form used for line and text definition. Currently, it does not represent any aspect of Building Information Modeling. Here, no level of collaboration takes place, but just the production and shared information.

Level 1 BIM

It might be described as the level of collaboration. Here, the information is transferred from 2D Cad drawings to 3D models and visualizations.

Level 2 BIM

Described as a fully collaborative level, it emphasizes once again the communication that stakeholders need to have with one another during the project stages. The members of the group can have direct access on the same files working accordingly.

Level 3 BIM

This level represents the full integration and collaboration along the whole process lifecycle. All the data is collected and shared on real time. The designer, architect, and constructor, use one single source as a communication tool.

"Building information models supports the exchange of data between software to speed up analysis cycle times and reduce data input and transfer errors" - Fischer and Kunz (2006).

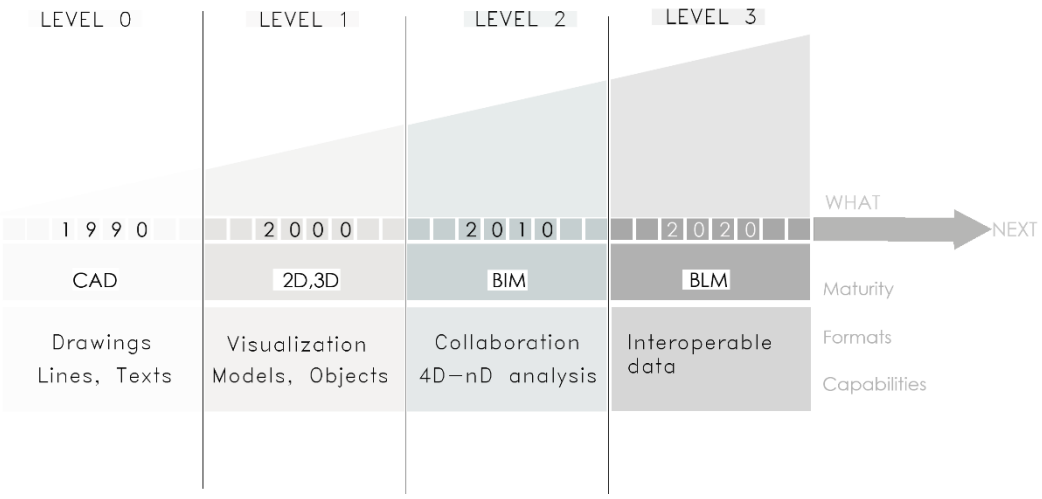


Figure 18. Levels of BIM maturity described by M. Richards and M. Bew

4.1.3 Uses and Benefits of BIM

Parametric modelling is the essence of the full application of BIM in practice. It allows quick implementation of changes in 3D model when it is necessary during the interdisciplinary coordination process. BIM is a new concept of designing and projecting on real time, increasing so productivity, and encouraging team work. Construction industry is one of the most complex ones when it comes to information flow, and flexibility in project delivery. BIM is however not a goal in itself but rather a tool to enable this higher productivity (Lindblad, H. 2013).

- BIM is a practical way when it comes to data and information delivery between the team members. It offers a flexibility in redoing the work, reusing the materials, or sharing the same files.
- BIM does not limit the architect, engineers or constructors only in the framework of 2D and 3D drawings. It facilitates certain energy/wind simulations, structural analysis, and improve the design before it is being built on site.
- BIM offers the solution towards costs time management and environemental issues.
- As a new digital form of a project representation, BIM provides the specialists and the clients with better visualizations about the projects, leaving space for better understanding from both parties
- Data analysis and documentation can be stored and reused anytime when needed with future projects.

n-dimensions of BIM

We seem to be more familiar with the terms of 2D drawings to 3D models and visualizations. But, the concept of BIM has gone beyond the third dimension ***Figure 19.*** To gain a clear understanding on what the other dimensions refer to, the following explenations will will help in defining the key terms.

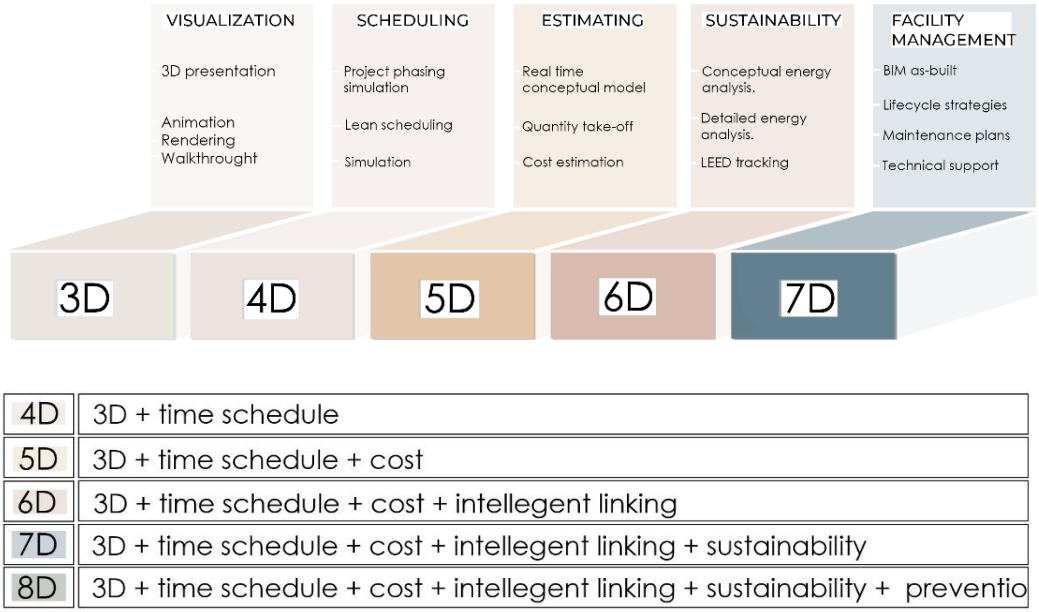


Figure 19. Dimensions of BIM

4.1.4 BIM Product/Process Barriers

BIM is a concept that seems promising in the future of AEC industry. But still, the question is: Why does the majority of the studios and companies, use other methods of projecting rather than the potentials of BIM? Except the benefits that it offers, BIM shows some risks and barriers in terms of product, process and people as presented in ***Figure 20.*** The reason for the slow BIM implementation is not simply one single issue, but rather the combination of several issues.

- BIM offers a variety of facilities which at first glance seems not familiar in the aspect of the trained staff, which on one hand need the appropriate education and instruction.
- New platforms, softwares, devices and training courses need extra cost from the companies, especially for small firms.

The implementation of BIM can provide great benefits, this change however; require a substantial change of the traditional ways of working (Arayici et al. 2009)

The use of international standards is quite different from the traditional method that the firms are used to work with.

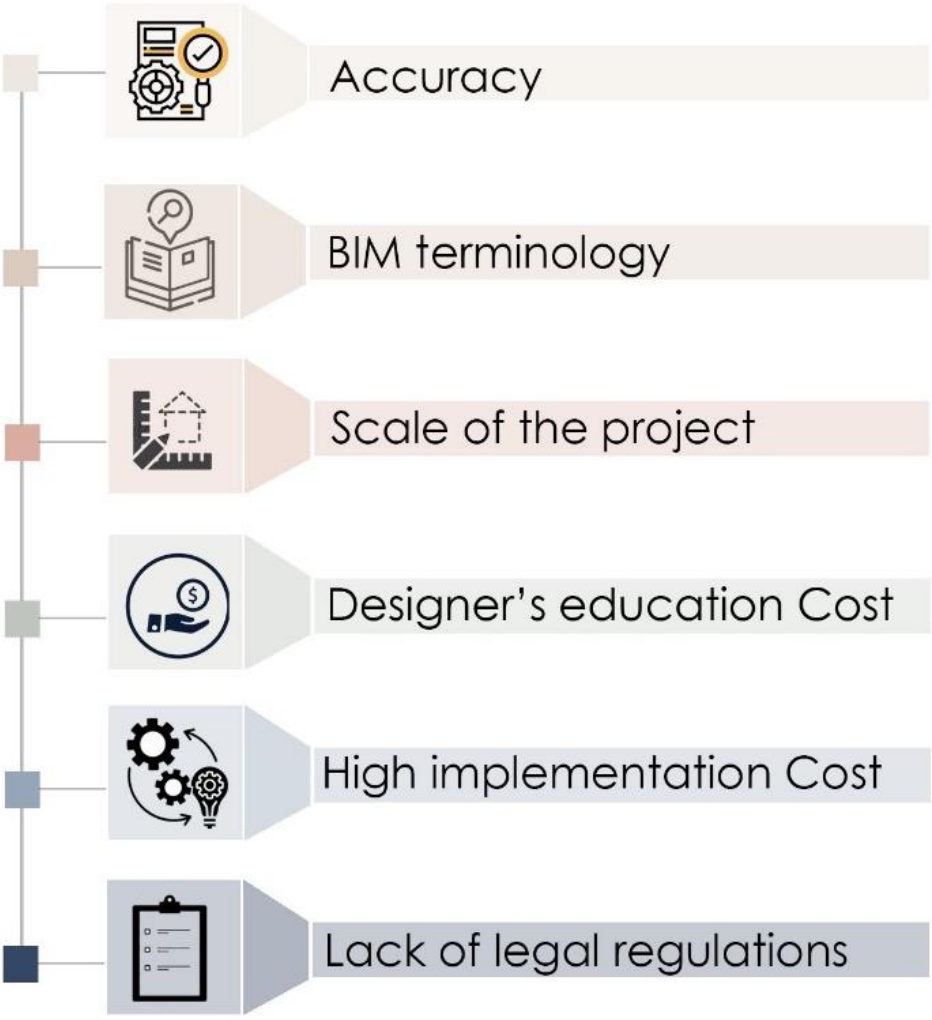


Figure 20. BIM barriers and risks

CHAPTER 5

RESULTS AND DISCUSSIONS

5.1 Construction Industry in Albania

5.1.1 Traditional Methodology

Until the 1990s the building process was characterized by a unique methodology when it comes to the preparation of drawing drafts and project delivery. All the drawings were prepared by hand from the architects on a translucent paper. Then, they were re-drawn again with ‘tiralinja’ where a kind of paint (boje tush) was inserted there to make correct drawings, with the desirable linewight. Later on, ‘rapidograf ‘a technical pen with refillable ink reservoir or a replaceable ink cartridge was used.

These drawings on translucent papers where then inserted on a machinery called holograph, processed with ammonia. This way, a huge number of printed copies were delivered in other institutions and stakeholders.
With the absence of digital devices, the measurements on the drawings such as plans, sections, facades, were made through a ruler called ‘linjeke’. It was segmented in three parts, where the middle one was movable, and was adapted to made all the structural calculations.

The first technological computers have arrived when INIMA – the institute of informatics. They were mostly used in seismology for accurate logarithms. After the 1990 a set of technological programs were used ***Figure 21.***

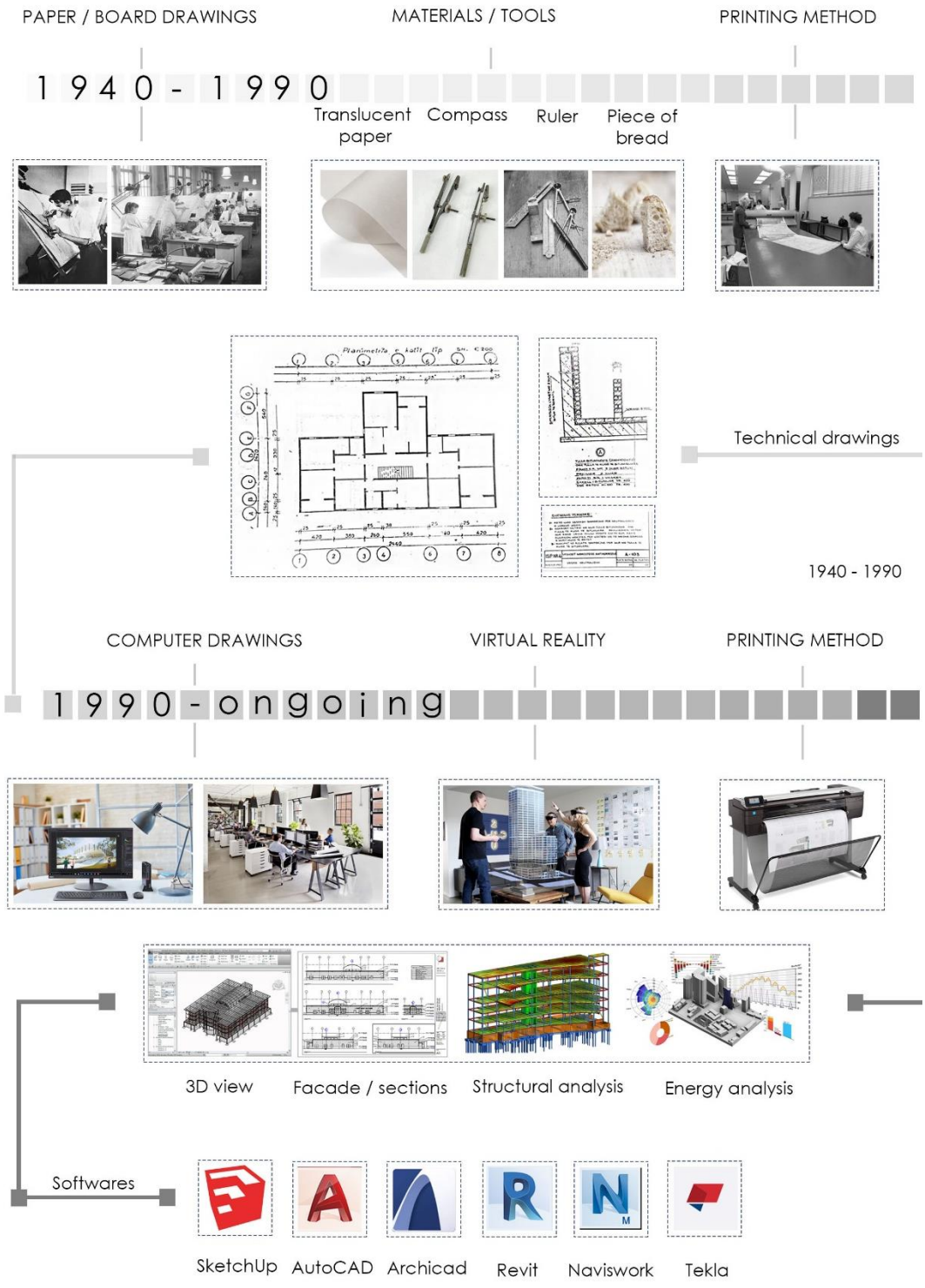


Figure 21. Timeline of methodology used in construction industry in Albania.

5.2 Survey Results

2 surveys were delivered to architectural studios and construction companies. This methodology was used to understand and analyse the BIM awareness, BIM proficiency, and BIM implementation in the mentioned companies, and evaluating the premises of using it in the future.

A number of closed ended questions with multiple choices were determined to get accurate information about the existing situation. The survey was designed to get general information about the years of experience, and the location of the workplace It was then devided into five sections:

1. ***BIM awareness***: The respondents were asked to define the knowledge they had bout BIM, the traditional working method, and BIM projects they had worked on.
2. ***Pre – Design Phase:*** The questions are articulated to get information about the construction contractors and architects in terms of using BIM in the Pre-Design phase.
3. ***Design Phase:*** Seven categories are included in this chapter: Roles and Responsibilities, Data Management, BIM Applications, Model Content & Level of Development (LOD), Clash Detection
4. ***Construction Phase:*** 7 categories are included in this chapter: Roles and Responsibilities, Data Management, BIM Applications, Model Content & Level of Development (LOD), Clash Detection, COBie Data, and Assessment.
5. ***Post – Construction Phase:*** 6 categories are included in this chapter: Deliverable, Data Management, BIM Applications, Model Content & Level of Development (LOD), COBie Data, and Assessment.

Respondants were asked general questions in the first section and their answeres are as below:

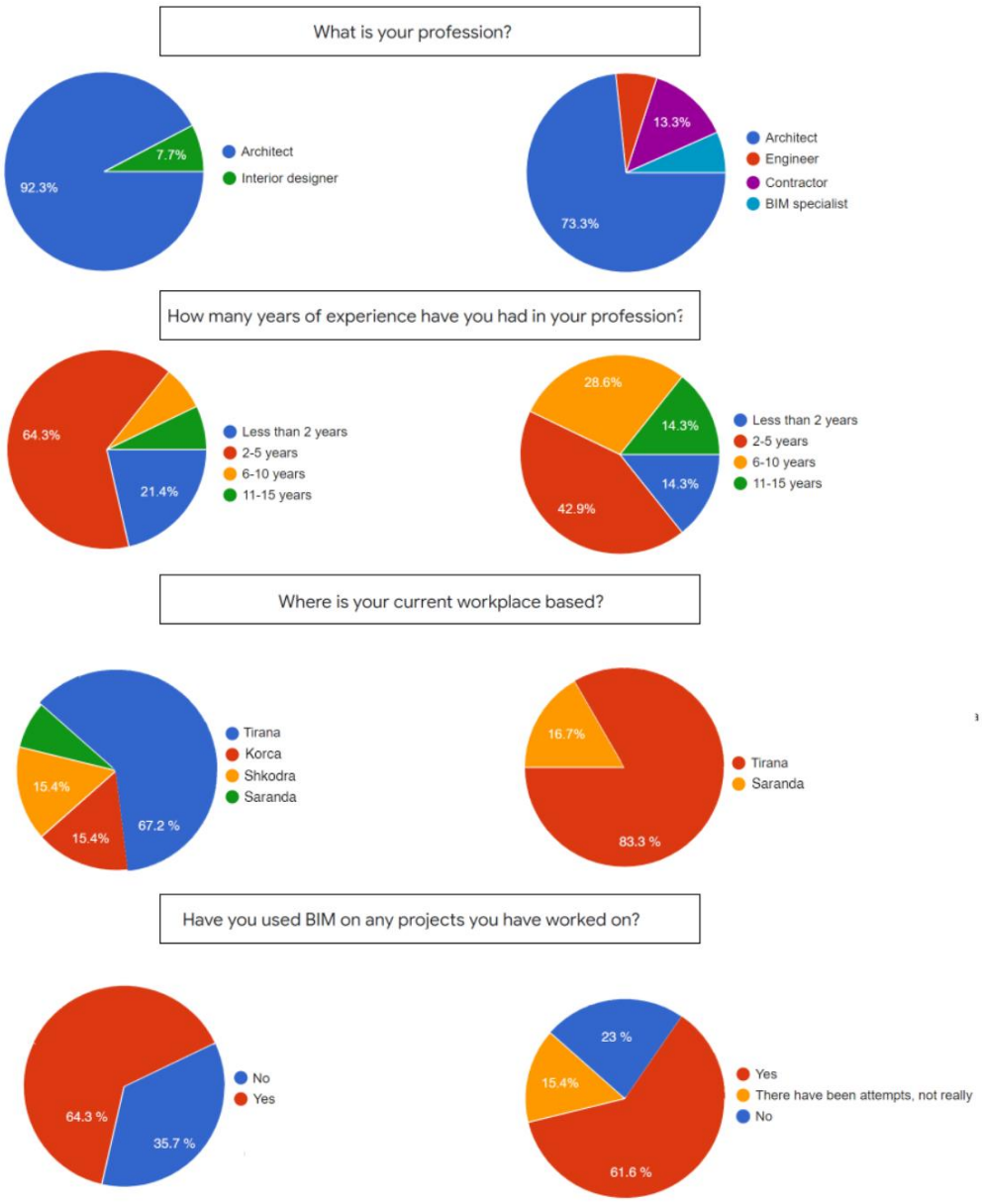


Figure 22. General question for companies.

Most of the respondants from the architectural studios were architects (92.3%) with 2-5 years of experience in their profession. 67.2% of them had their workplace based in Tirana and 15.4% in Shkodra and Korca. There were 64.3% respondants that had used BIM in their projects. On the other hand, in the survey delivered to the construction companies, the majority of them were architects and 13.3% contractors, mostly with 2-5 and 6-10 years of experience in their profession. 93.3% have their

company in Tirana and more than 60% had used BIM in their projects, including the ones that have attempted to impelement it.

Two other important questions were asked regarding the BIM experience, skills, expertise and information exchange between the team members. They expressed positive opinions about evaluating the new generations working with BIM, considering it as a critical viewpoint in their company ***Figure 23.***

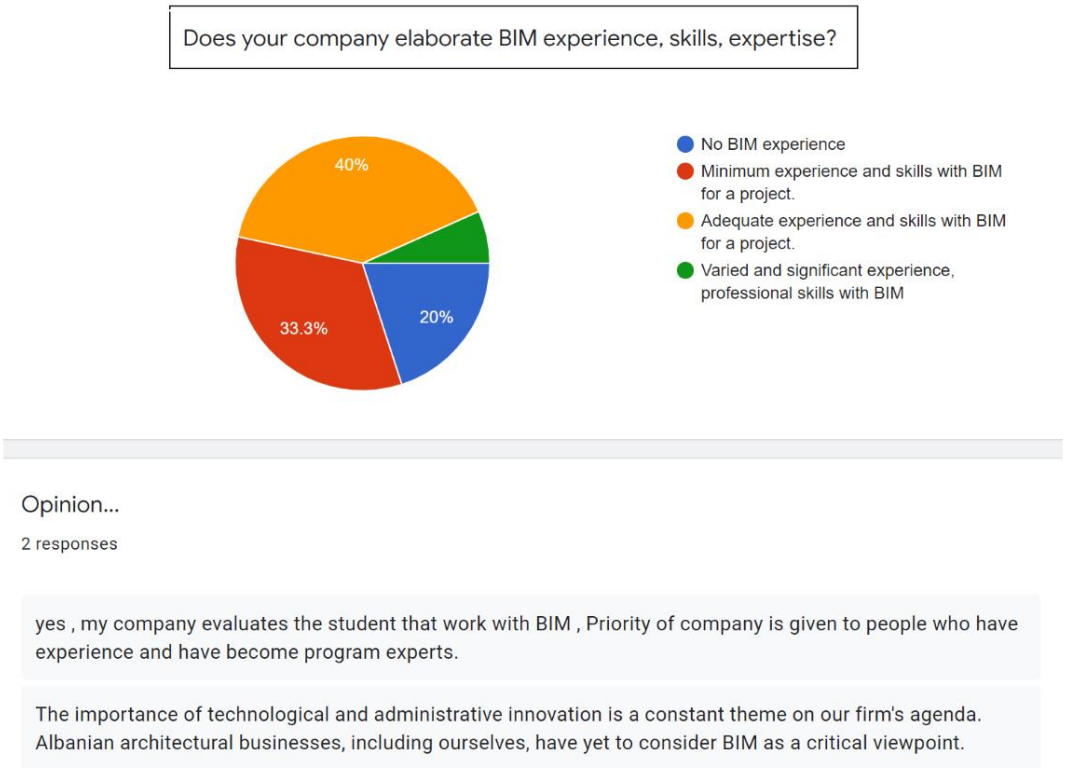


Figure 23. BIM expertise in Albanian companies

As shown in ***Figure 24***, the majority of the respondants (46.7%) did not use BIM as a coomunication tool in their work. The other (20%), updated, recorded changes in real time, avoiding erros through BIM.

Two respondants expressed their enthusiasm about implementing BIM, and the desire for working hard in learning how it works, even though challenges and limitations are part of the process.

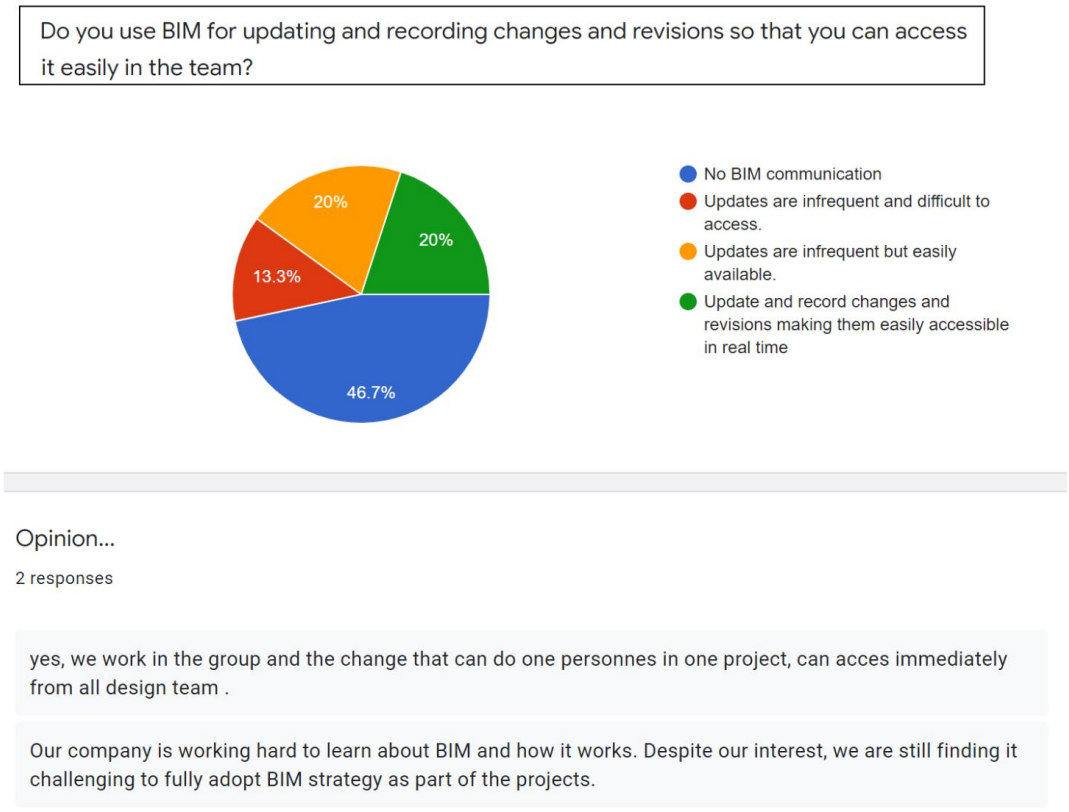


Figure 24. File accessibility

- Questions asked in the *Pre-Design Phase* with the respective answers are as below:

53,3% of the respondents were aware who was responsible for updating and recording the information in the pre-design phase. 33.3% of them found it impossible to define clearly the members in their team responsible for this task.

More than 50% of the architects did not use BIM for data analysis in the pre-design phase, and others had a superficial knowledge. 21% of them used several tools for validating program and space.

The calculation of the target cost, schedule and energy analysis were not applied in the pre-design phase from most of the respondents.

53.3% of them used the historical data on a common server, and only 13% of them used systematic recording and management with high protection.

- Questions asked in the *Design Phase* with the respective answers are as below:

In this phase different from the Pre-Design Phase, the information was managed from one experienced individual responsible for updates. Only 7% acted in an ad hoc manner.

14.3% had general knowledge about BIM tools but did not use them. 35.7% had some tools with expertise and 28% of them used only one tool with adequate knowledge.

Still, only 23% used one tool to develop cost analysis and schedule in this phase, and 15% used one tool with expertise to promote comparative energy analysis.

The data was managed systematically and the responsibilities were distributed for the team members in a higher degree than the Pre-Design Phase. 23% had a BIM manager and modeler who managed the files.

Clash detection analysis seem to be manually from the majority of the architects. 23% used limited tools to find some clashes.

- Questions asked in the *Construction Phase* with the respective answers are as below:

Companies were asked if they were aware for the responsibilities that BIM managers had. 30% of them had no idea and 46% had a general idea. Only a few of them knew conceptually the role of the BIM manager.

It is very cruicial for the design team to coordinate with the construction team. In this case, 46.2% had a meeting whenevr needed, 15.4% one time weekly and 23% had a meeting more than one time per week.

One experienced individual was responsible for updates in the companu (62%), 23% were not aware, and 8% the information management was treated with highest priority. Also, the project schedule was managed with BIM from 23% of the respondents.

Even though BIM explains the LOD conceptual and practical meaning, 85% had no idea of LOD in the construction phase, and 15% were aware of LOD 400 and its requirements.

Clash detection in this phase was cheched with BIM tools from 15% of the respondents, only 8% updated clashes in real time with expert staff and BIM tools and the others used limited tools or had just a general idea about such analysis.

- Questions asked in the *Post-Construction Phase* with the respective answers are as below:

In Post-Construction Phase, Operation and Maintenance Manuals should include the serial number for installed equipements, the location of equipements, installation instructions, testing and other reports. Only 21.4% of them included these specifications in manuals, and 14% had no idea about that.

Through the lifecycle of the project, many changes happen from the -- as designed to the - as built information. Providing precisely the information in this phase is vital. Only 23.1% provided all changes in the construction with BIM, 23% provide only important changes with electronic files or paper only.

The central model was protected from being copied or moved with BIM systematically with high priority from 14.3% of the companies, and 29% had some protection and security for the datas in the computer. Others protected through an authorized personel only, or had no protection at all.

LOD 500 for the as built model was provided from 7.7%, others knew conceptually the term, and the majority of them had no idea about LOD 500.

The companies that had worked with BIM evaluated it as a successful tool regarding the quality, cost and schedule (46.2%). 85% recommended BIM to use more in the future projects, and others could not suggest because they were not users of it.

Different from the architectural companies, the construction one had a better understandging of LOD 500. 28% of them had no idea abput LOD in the construction phase, and others knew it conceptually or had extensive knowledge about it.

Most of the information changing from as designed to as built was recorded and provided with electronic files (55.6%) and 22.2 of them provided changes in the construction with BIM.

Construction companies recommended BIM omplementation in a higher degree than the architectural ones. 50% definitely recommended its use, and 50% were very unlikely to recommend.

5.2.1 Discussions

The surveys were delivered in architectural and construction companies for each phase of the design. After analyzing the data gathered from the respondents, the results show that architectural studios are more likely to use BIM in the design phase. In the Pre-Design Phase, other tools were used to elaborate the model.

Also, BIM was used not only to generate the 3D model and other drawings, but it as a tool that improve the coordination and the coolaboration between stakeholders, protect the information and improve the building performance.

On the other hand, Construction companied were aware in the usage of BIM, in terms of coordination, protection and project delivery. Still, it is a complex work where can not be found a lot of BIM managers and project coordnators that work under BIM. Hence, both the architectural and construction companies recommended its implementation and integration in future projects in Albania as e need for improvements at work and quality of the object.

5.3 Case Studies

Case studies, are selected based on the data collecation gathered from the surveys and interviews made in person with architectural and construction companies. Deeper analysis will take on consideration all the phasis of the building process, such as; Pre-schematic, Schematic, Design, Construction, and Post construction phase evaluating so the BIM proficiency of the stakeholders. Level of Detail is presented and analyzed in several phases of the project regarding the LOD definition adapted from Bedric ***Table 2.*** LOD definitions (Adapted from Bedric 2008)

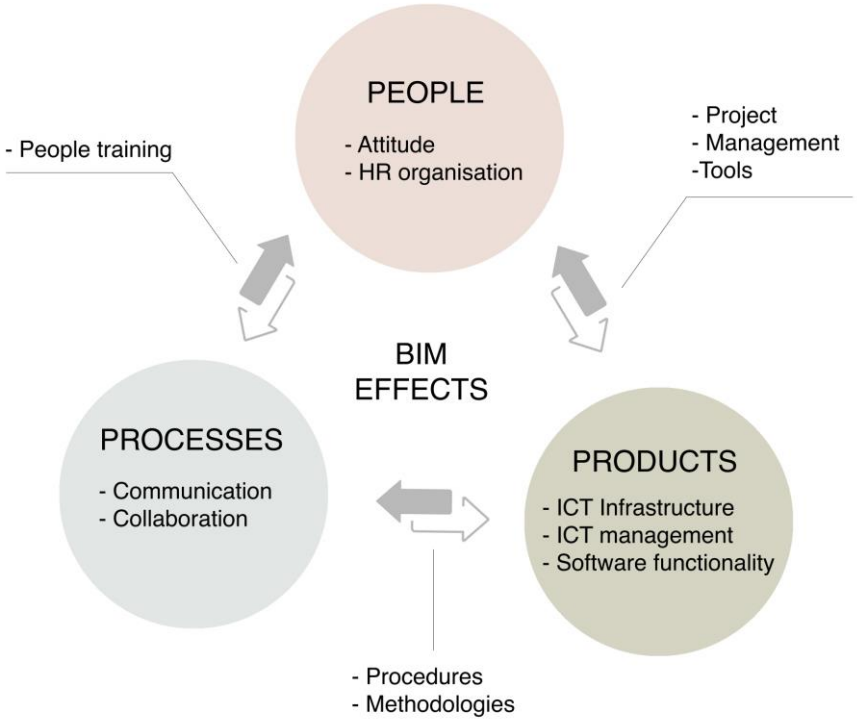
Table 2. LOD definitions (Adapted from Bedric 2008)

Project Phase	LOD 100	LOD 200	LOD 300	LOD 400	LOD 500
Design	Non-geometric line, areas or volume zones	Three dimension-generic elements	Specific elements with dimensions, capacities and space relationships	Shop drawing/fabrication with manufacture, installation and other specified information	As built
Scheduling	Total project construction duration	Time-scaled, ordered appearance of major activities	Time-scaled ordered appearance of detailed assemblies	Fabrication and assembly detail including construction means and methods	
Cost Estimation	Conceptual cost estimation	Estimated cost based on measurement of generic element	Estimated cost based on measurement of specific assembly	Committed purchase price of specific assembly at buyout	As-built cost
Energy Analysis	Strategy and performance criteria based on volumes and areas	Conceptual design based on geometry and assumed system types	Approximate simulation	Precise simulation based on specific information	Commissioning and recording of measured performance

5.3.1 Effects of BIM in project implementation

Such specific issues will be analyzed in the choosen case studies related to the collaboration and communication between stakeholders along the building process. BIM has a huge impact in three categories such as: People, Process, Producs. BIM in itself functions as a system which interconnects various complex phases and processes ***Figure 25.*** BIM effects

Such digital technologies that BIM offers have a direct impact in the collaborative process, where all the stakeholders are organized to conduct their duties and exchange information effectively. The 3Ps influence each other in a coherent order. For example, trained people with the required knowledge effect directly in the process of the projects. The process moves forward with the collaboration and the communication that the parties have while working and exchanging information, in order to come up with a better end product in terms of quality.



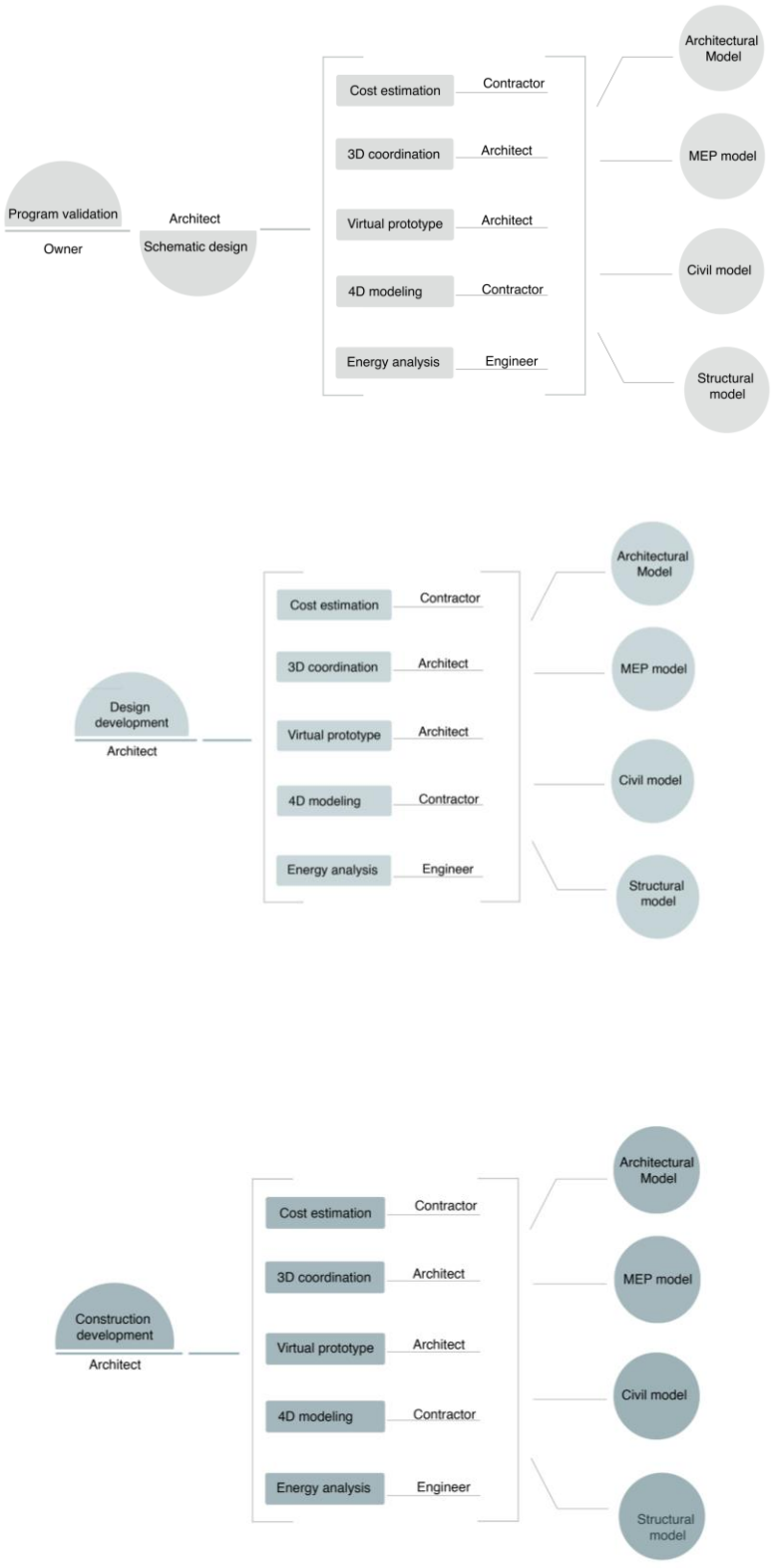


Figure 25. BIM effects and project phases

5.3.2 Mangalem 21

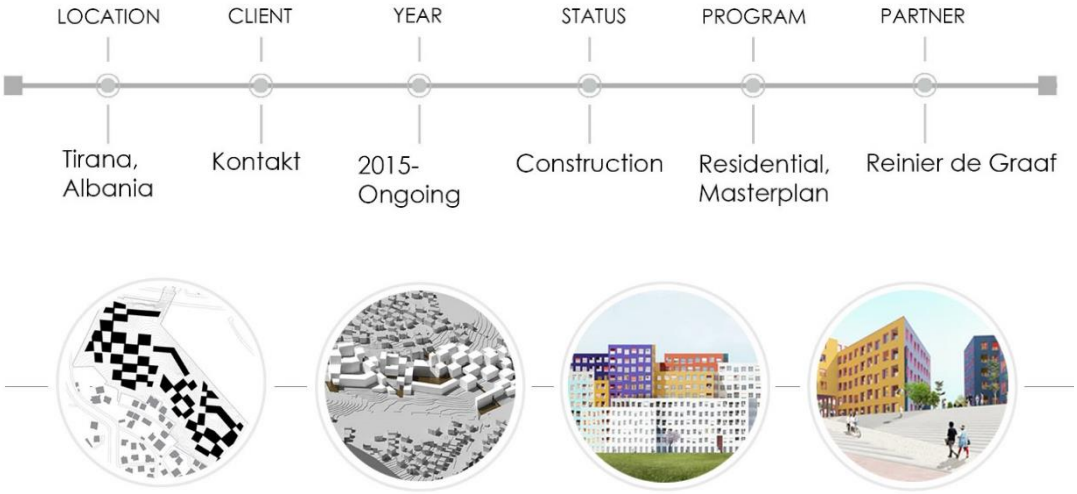


Figure 26. Project Information and Urban texture and morphology

Limited by the mountains and build on an outstanding slope, the blocks are built on a 27 meters' difference between the lowest and the highest points. The duch architectural firm OMA came with a proposal of blocks and courtwards as a chequerboard-like pattern. Clear visual connections between the buildings are created due to the sloppy nature of the terrain. Quite a dominant space is left for public plazas and green spaces, while the parking area stands underground, creating a car-free urban development.

The abstract chequerboard pattern turns into a continuous array of habitable spaces by elaborating the tangent corners into architectural entities. Three typologies emerge: the 'Straddle Core', a vertical circulation shared by two adjacent buildings, the 'Straddle Apartment', an apartment spanning over two adjacent buildings, and the 'Kissing Corner', two tangent building corners.

As Tirana is known for its colorful facades, these pattern blocks are presented as a continuous identity of the city. Shifting the opening is one primary principle used to give the sense of diversity. Also, the roofs are treated as a façade in itself, giving so a spectacular top view.

5.3.2.1 Project Analysis

Following the structured methodology for understanding the complexity of the BIM usage in the project, an interview was done in person with one of the architects that is working with ‘Mangalem 21’. Arch.Ardita Gusho, explained in detail the process, the benefits and challenges that they company has been involved along this time.

The propose of the project is done from the duch firm OMA and Kontakt has developed and implemented the project. BIM has been used since the beginning of the project from OMA, whose conceptual and schematic drawings were presented and delivered in Revit files. The firm has worked based on UK’s BIM protocol, and the standarts were adapted from the members according to the nature of the project.

5.3.2.2 BIM Project Execution Planning

Being developed from the early stages of design, BEP is a required document that helps the team focus on important details when it comes to: communication, collaboration, data exchange, time saving and safe execution. It emphasized the project goal and BIM use in the whole process. A list with the beneficial effects of BEP is presented in the scheme below ***Figure 27.*** BIM project execution planning benefits

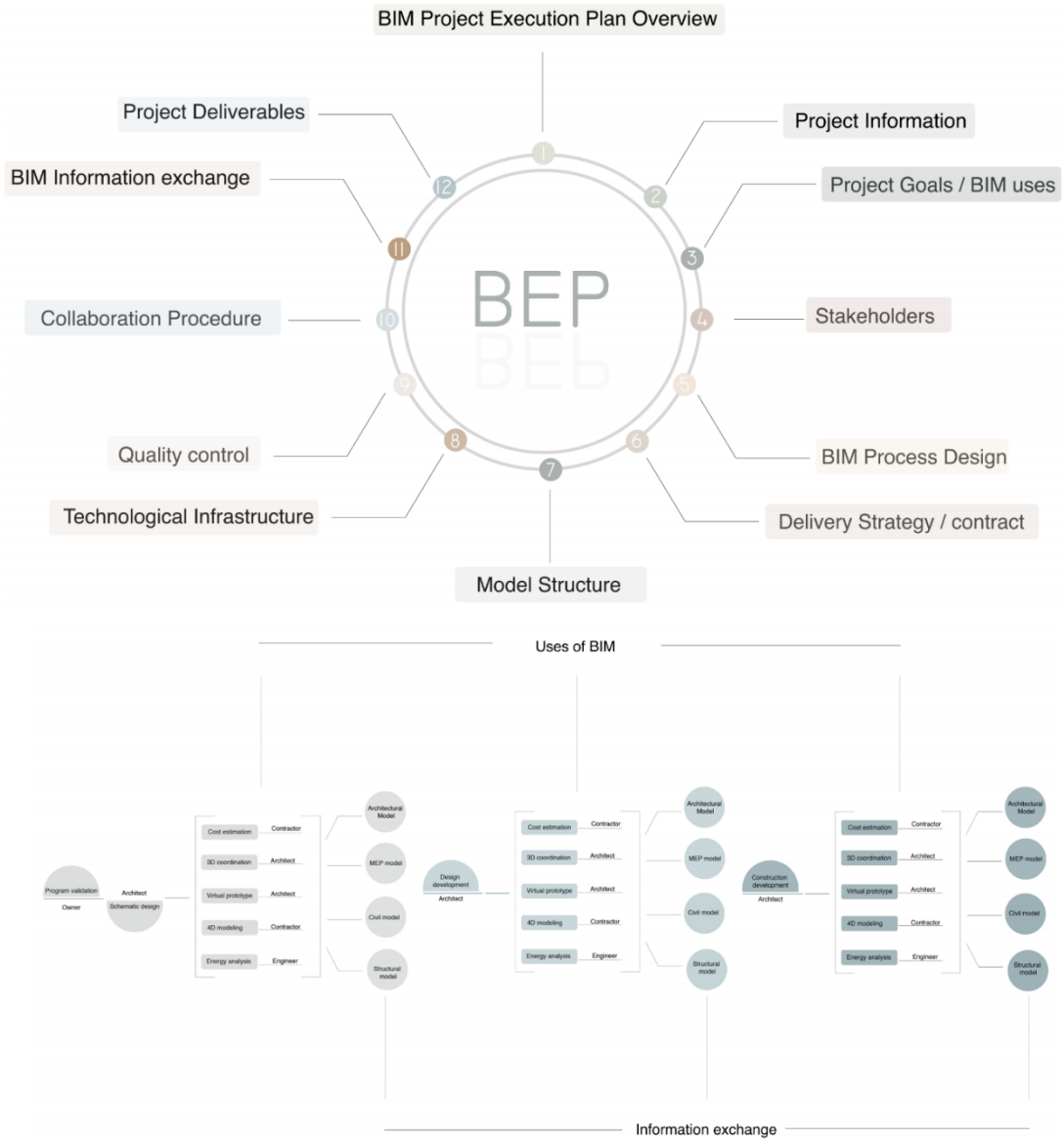


Figure 27. BIM project execution planning benefits

For a better coordination, few folders were created since the beginning of the project, with specific codes and names according to their content. ***Figure 28.*** Folder organisation

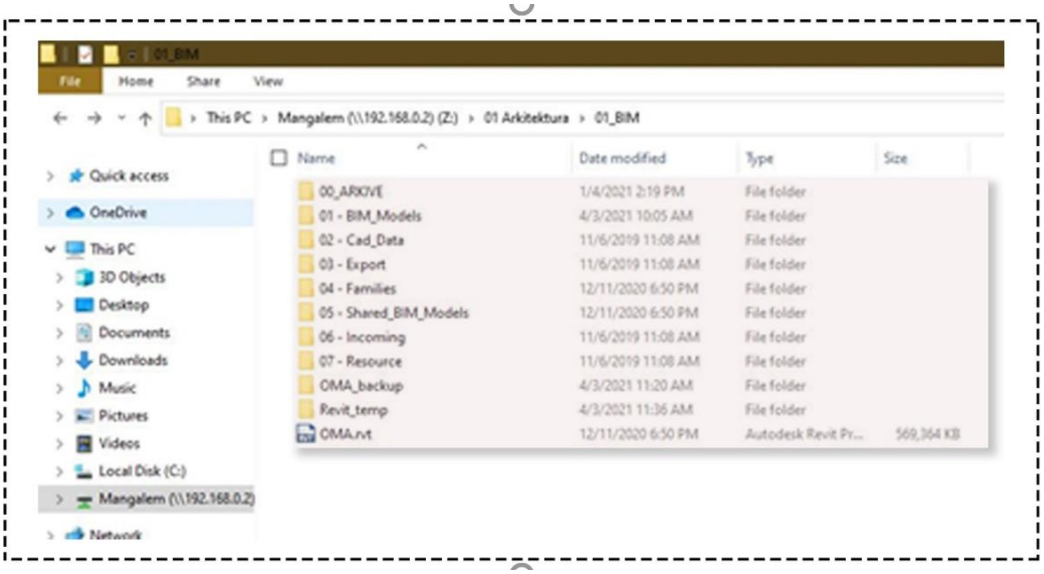


Figure 28. Folder organisation

'Kontakt' company has created a standardized working template in Revit, in order to have an organized working process and project delivery. They have started to work on SHEET PROPERTIES with the specific ViewSet and the information provided for the tittle box olso ***Figure 29.***

- Drawing Status – Construction Documentation
- Key Plan for each stair
- Drawn by – Name/Surname
  Checked by – Ardita Gusho
  Approved by – Fatmir Bektashi
- Sheet number – 01-14-001
- Sheet name – PHASE01_STAIR01
- Sheet issue date – 20/01/18
- Sheet Name 2 – LEVEL 01, LEVEL02 (as a parameter to be generated automatically)
- Sheet Name 3 – FLOOR 01, FLOOR 02
- Sheet size – A2
- View Scales – 1:100

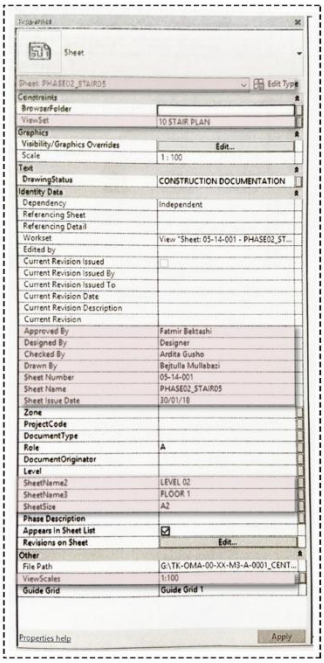


Figure 29. Sheet properties

After documenting the project process as explained before, a semi-structure interview was made with one of the architects of Kontakt company. Ms Ardita Gusho, provided some general information about BIM implementation in this project. Mrs Ardita explained that the working process was generally well coordinated using Revit. According to her, the architects in their studio found it very efficiently identifying the roles and the respnsiblities for each tema member. Also, such communication protocols and documentation lead to a secure and vital strategy as a guide to project milestone. As 'Mangalem' is not the first project they have worked with BIM Revit, the somehow had created their own standardized way of working by clearly defining targets in each phase. Putting a plan together, helped the team save time and move forward to complete the project in the due date.

5.3.2.3 Codification of Units in Revit

a) The creation of NUMBERING and types of units in Revit, linked with the Tag Area. The Tag Areas were created for 13 types of units, as a basis for filtering the schedule tables. ***Figure 30 .***

Nr	Name	Number	Cdo lloj Number tek Tag area do te filloje me numrin e shkalles
1	1+1	0145	Sipas parimit te Numertimit Alfa-Numerik
2	2+1	0146	Sipas parimit te Numertimit Alfa-Numerik
3	3+1	0147	Sipas parimit te Numertimit Alfa-Numerik
4	Bodrum	0148 ose 01001, 33025	Ne rast se bodrumet ndodhen ne nje kat ku numri i njesive nuk e kalon numrin 9 atehere bodrumi ka kod 4 shifror si njesite e tjera te atij katit. Ne rast se numri i bodrumeve e kalon numrin 9 atehere do perdorim kodifikim 5 shifror. Kodi 5 shifror fillon me numrin e shkalles dhe me pas nje numer tre shifror qe do filloje nga 001 dhe ne vazhdim.
5	Bodrum njesi sherbimi	0516	bodrumet e njesive te sherbimit kane kod 4 shifror si njesite e tjera te katit
6	Njesi sherbimi	0148	Sipas parimit te Numertimit Alfa-Numerik
7	Garazh	001 - 999	Sipas parimit te Numertimit Alfa-Numerik
8	Depo uji	09_08_07_DU	fillon me numrin e shkalles ku ndodhet dhe pastaj vendosen edhe numrat e tjere te shkalleve te cilave kjo depo ju sherben dhe ne fund dy iniciale DU
9	Kabine elektrike	09_KE	fillon me numrin e shkalles dhe pastaj dy iniciale KE. Ne vijim do plotesohet me te gjithe numrat e shkalleve te cilave kjo kabine ju sherben.
10	Korridor	09_Kati 2	fillon me numrin e shkalles ku ndodhet dhe pastaj shenojme numrin e katit. Kujdes jo te leveltt!!!
11	Korridor ne hyrje	09_Kati 1	
12	Korridor bodrumesh	09_Kati -1	
13	Rruge parkimi	000	

Figure 30. Unit numeration in Revit

b) 10 Construction phases were projected with 12,000 m2 with 3-4 buildings for each phase. At the time when the aim was reached and the phase was concluded effectively, the object gained the status of functionality as 100%.

5.3.2.4 Folder Specification in Browser

An important element while working in Revit are the WorkSets, which allow the architect to devide the project in portions and it can be shared with other memebers of the team. Each workset present a specific component of the building sucha as; doors, windows, floors, stairs ect.

In each phase of the project, certain VewSets were created from 01 to 10. Each of them had a personalized view template: PH01_Template, PH02_Template…Inside of the Viewset, Floor plans were created with their specific scope boxes. The view name was defined with the phase numbes PH01 followed from the level according to OMA standartsL00 – L16 as shown in the ***Figure 31.***

The studio created their own order of naming the ViewSets, referring to the information presented from the project. For example:

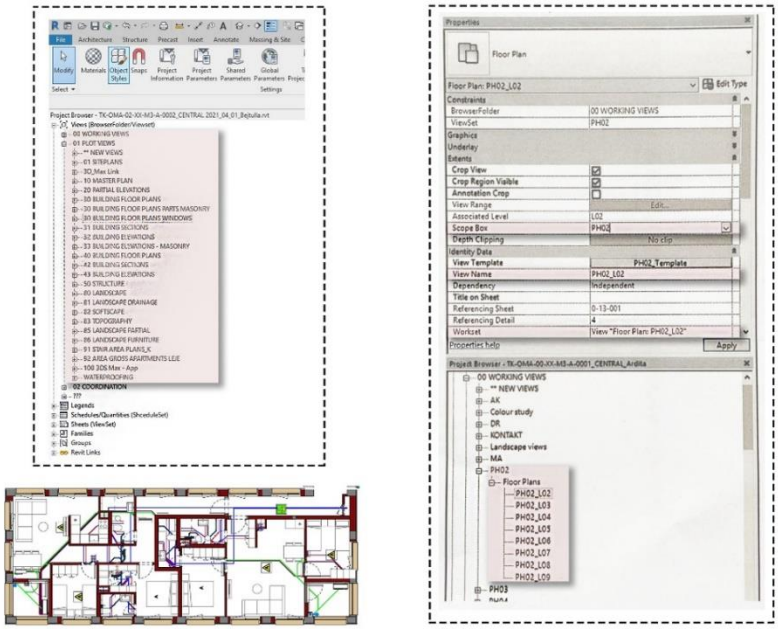


Figure 31. Viewsets

- The numbers from 01-01 showed general information about the master plan. - 10-19 detailed information about the plans, sections, facades and so on. On the other hand, the levels in each viewset were created based on the OMA standarts.

5.3.2.5 Sheet Format

Sheet formats were firstly formed based on the parameters that OMA has formulated, and then adapted according to Kontakt studio itself ***Figure* 32.** This sheet was a practical way in exchanging the provided information and everyone had direct access to fill in the form, when the project was about to be delivered.

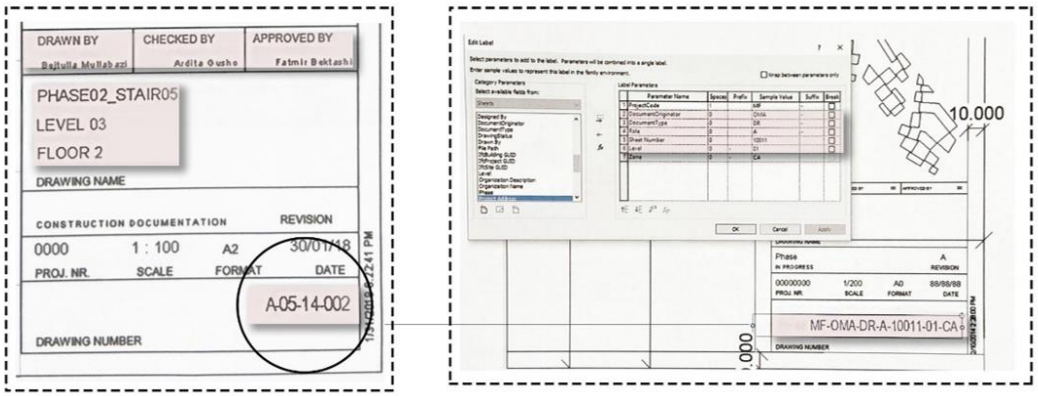


Figure 32. Sheet format

5.3.2.6 Project Schedule

Setting up a financial schedule during the building process, is very cruicial when it comes to manage the cost of the project within the defined doundaries. By generating quantities and material takeoffs, the company finds it easier to control the cost of the total final product since the beginning of the process ***Figure 33.*** The members of Kontakt team did so, and found it a practical way using Revit schedule to keep in control all the elements added into the schedule list and reducing so the cost whenever necessary. Revit allowed to make changes in quantities, add specific properties of an element from the project, such as; materials, type, number and areas,

and calculate each part of it to gain the total cost of the unit. Also, other calculations were done in Excel. According to Arch.Ardita, such schedule analysis was vital in overviewing the cost distriburion in the project, which lead to a better arrangement in financial activities. Including the 4D dimension of BIM in the process, reduced the risk of passing the initial budget, saved time in termes of information exchange.

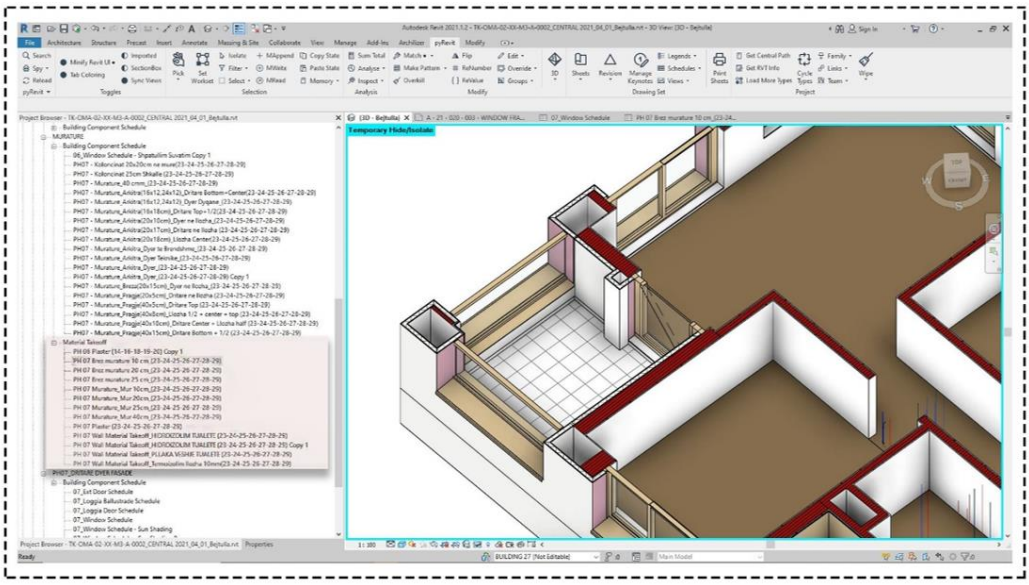


Figure 33. Material take-off

5.3.2.7 Clash Detection

Clash detection is another important element to be analyzed in a construction project. It is part of the process as a technique in itself, which points out how 2 components of the building obstruct with each other. Such clash analysis is required to be done because they help identify the modeling problems in the initial phases, reducing delays, unnecessary costs, and material waste.

In this case study were conductd some clash detection analysis. Some intents were made with Naviswork software. Revit links are inserted and planes are overlapped to identifly where and how the clash occurs. But having a little knowledge,

no analysis was done with Naviswork. Meanwhile, only some detections were conducted visualy in Revit, about the MEP 3D models, for instance when a beam ran through a pipe, or pipes within each other.

5.3.2.8 LOD in the Project

Level of Development in another term used in BIM, corresponding with 6 classifications, from LoD 100 to LoD 500. It is a broad concept with two different deffinitions. The first one corresponds to the American Institure of Architects the as ‘Level of Developments’. Secondly, the UK’s protokoll, defined it as the ‘Level of Details’, which emphasizes specifications in each phase of the building process. ***Figure 34.***

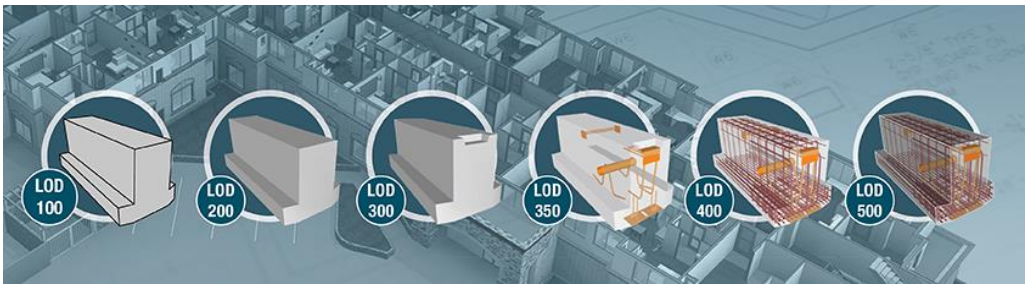
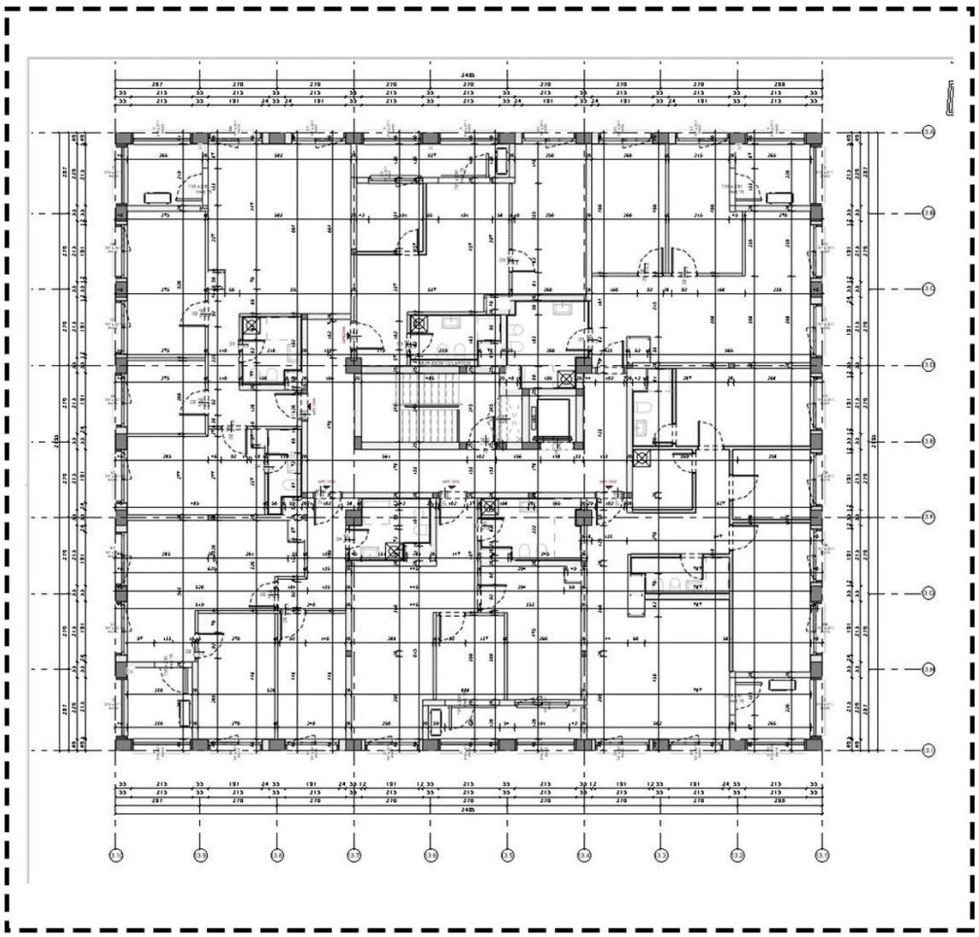


Figure 34. Level of detail

In this case study, LOD 200 was delivered from OMA to Kontakt to present the product with its exact location, size, and quantities to work on. The studio, then developed step by step LOD 300 and so on with precise measurements and detailed elements for each component of the site. In this phase, the design one is finishd and well defined, and certain analysis are done including time, cost and schedule.

LOD 200 corresponds to the design development, identifying general information about site specifics, orientation and so on. Colorful codification of Mangalem blocks, where architects or Kontakt started do add further details, and generate information to proceed with production.

After elaborating the master plan, drawings of smaller units such as plans of each floor and plans of apartments were drown accurately in Revit. Exact measurements for spatial dimensions, window and door speicifications and even materal take off were determined as shown in *Error! Reference source not found.*. S uch specifications were vital to cost estimation analysis for each stage of the project.



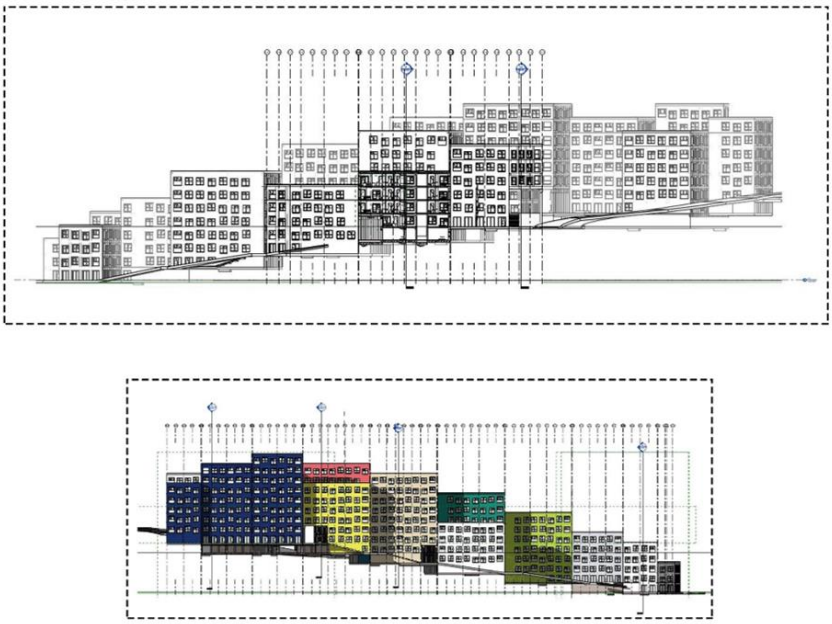


Figure 35. Plans, facades, LOD 300.

LOD 400 is the phase when the model is ready for fabrication. Configuration of details are made and the project is delivered to be constructed. The accurate models per each element is provided from the architect and BIM impoved the cooperation and material distribution which came to be a process with positive effects. Below is presented a mechanical plan in one of Mangalem's appartments, and the wall and window details for production. ***Figure 36 .***

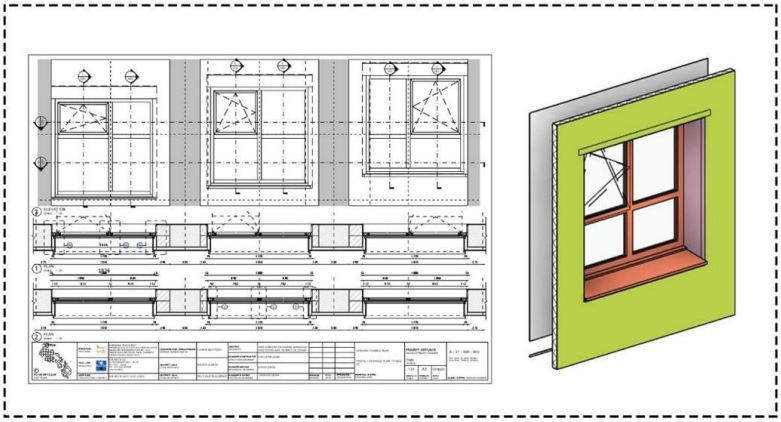


Figure 36. Window details / wall detail.

5.3.2.9 Discussion

As mentioned before, BIM is being used a lot in Europe, stablishing their standards and guidelines. OMA also, develop and deliver their projects in clearly defined phases and following so the Project execution planning and the exact schedule. Meanwhile, Albania is still getting familiar and used with BIM implementation in the projects. In the Pre-design phase architects prepare the conceptual ideas and schematic model. The schematic design phase then is the process where the hand drawing shetches are drafted and discussions take place based on them, including so the clinets of the project. In these two earliy stages of the project, BIM tools are not used for various purposes: First of all, the architects are not familiar with BIM to elaborate

shapes and give a real meaning to the conceptual sketches and diagrams. Secondly, there are still no trained members to coolaborate and manage such complex BIM tools.

In this case study, BIM revit was used mostly in the design development stage, where accurate plans and sections were drawn with details, specifications and dimensions. The sharing process of the files with other stakeholders was much easier, and the changes were made in real time. During the construction phase such tools were used to control the cost schedules avoiding so errors, and keep continuous control in time efficieny. Benefits of the project are expressed in the diagram below ***Figure 37.***

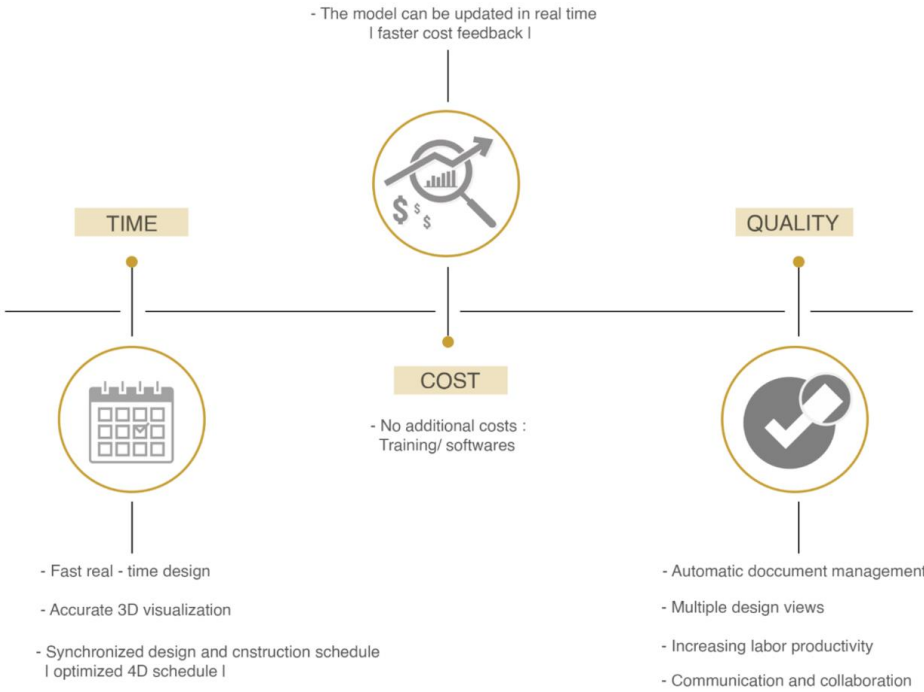


Figure 37. Benefits of BIM in the project.

5.3.3 Air Albania Stadium

Air Albania is the new national stadium as a mixed-use building in Tirana, constructed from Albstar in collaboration with Marco Casamonti, an Italian architect. Being inspired from the Roman Theatre, it represents a strong theatrical sense. Each

side of the building hosts a specific private area such as the hotel tower, shopping areas and the stadium itself. The “theatrical scene” hosts a small VIP grandstand, limited to 1,500 spectators.

Figure 38. Project information, Building form and facade.

The design lies on a very complex geometrical forms, where architecture, structure and special systems have adopted new technological methods of building for a better outcome and an efficient end product such as the advanced BIM software. The project is devided into five indepenedent blocks, while one of the tallest skyscrapers in Albania, is a multifunctional building with shoping areas and hotel rooms.

5.3.3.1 BIM Proficiency

Air Albania Stadium is really a huge and complex project done in our country. Having an efficient coordination was one of the major challenges that different groups of stakeholders found difficulties during the project cycle. In this case, the project itself was projected from the Italian studio of ‘Archea’. Pre-design and design stage were conducted from them, and then delivered to the Albanian construction company ‘Albstar’.

The 2D drawings were produced via AutoCad and the mass model in Revit, and were delivered as dwg abd pdf files. At this point, Albstar was required to continue working with BIM Revit. This method, had its challenges and benefits;

- First of all, it was a new concept and not everyone was an expert in BIM knowledge. Also, this project includes an enormous number of teams and members, where every single one of them needed a new clearly defined building execution planning.

- A lot of architects turned to be autodidact in learning Revit program, and being used to conclude all the project materials there. Doing so, no extra cost about professional training and software access was needed.

- A lack in coordination happened during the MEP models, as team memebrs of this drawin phase, had little or no knowledge on BIM Revit.

- On the other hand, some architects of Albstar, gave emphasize on the fact that using such a new program, was very productive and helpful when it came to project delivery of information exchange.

- As Revit can be linked with other softwares, a huge number of workers had the possibility to coordinate in real time with each other, and avoid errors in time without extra cost.

According to the enginners and architects that were asked in interviews, BIM resulted with positive feedback in the projection phase, but they couldn't say the same about the implementation phase. Concerns happened during the information exchange, as it come one material after the other in various sequences of time from Archea, and the Albanian team had to be adapted every time to continue working.

5.3.3.2 Building Execution Planning

Even though being a document with a significant importance, Albstar seemed not to use a specific one. A majority of working teams did not use a well-defined plan to follow the work in each step of it. They were all organized in a personalized manner inside their studio, and had specified their own strategy of working. One thing known for sure was that they used the same Revit links, worked at the same MEP and civil models.

5.3.3.3 Project Time Control

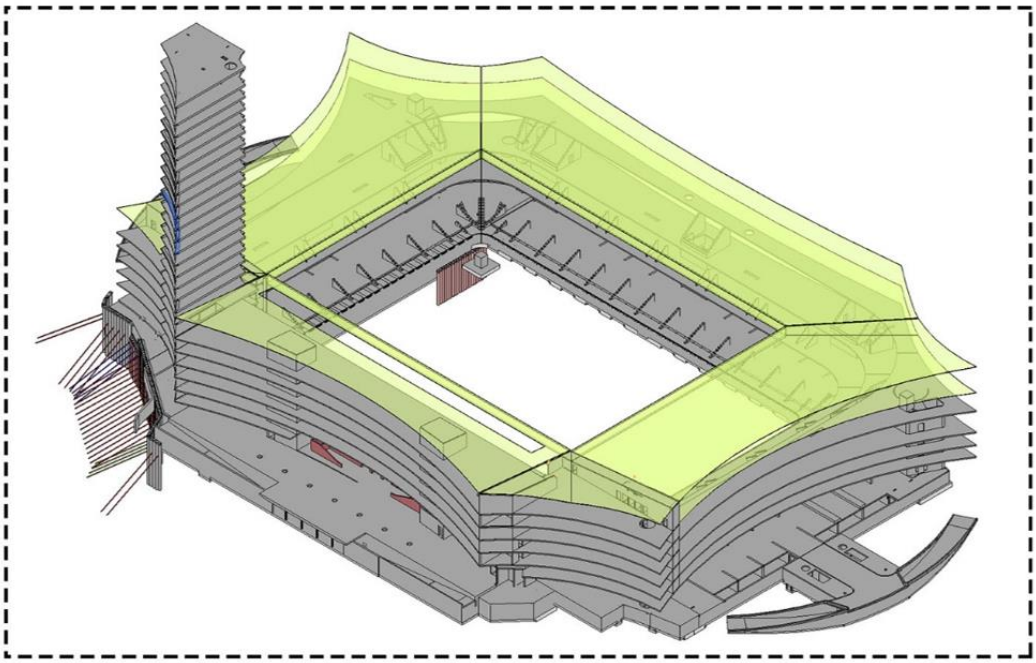
To maintain the project time under control is another challenge for the parties involved in the project. We can find a number of tools that are available to use in controlling the time. In this case study, Microsoft project or (MSP) was used to manage and control the project. It was described as an important tool in time organization, as various sequences of the project were established. The starting and ending adate of a task are set and report the exact project progress, helping to plan and replan the process whenever necessary.

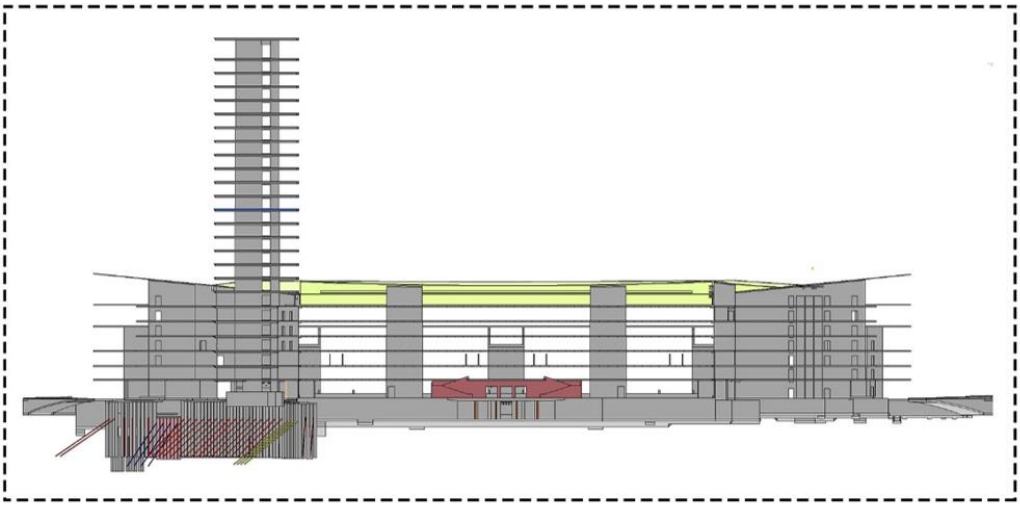
5.3.3.4 Cost Control

Having control over the cost of the is quite tought and needs a well management for a succesfull project. Predicting the cost of a construction project is very cruicial, and it happens to change almost everytime in different phases.

There is a need for qualitative data gathered from the Revit models, with specifications of material takeoff. So, it was in the case study, where automatic calculations were done in Revit, recorded and then exported to Excel spreadsheets. The final step, is the information exchange with the cost estimator.

5.3.3.5 On the Project





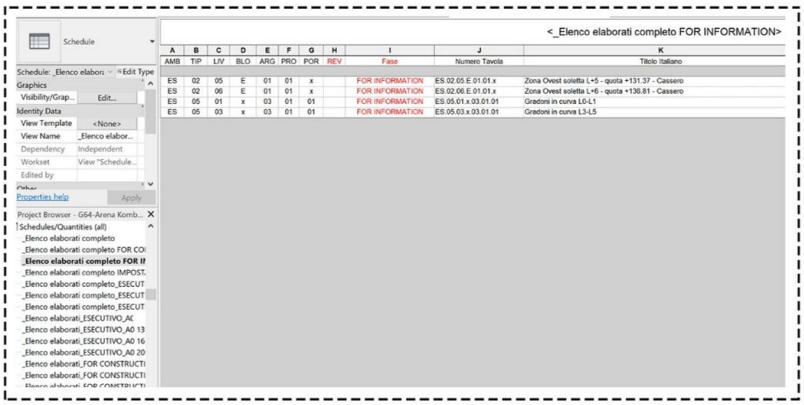


Figure 39. Revit 3D model / schedule and quantities

5.3.3.6 Discussions

In the case of Air Albania stadium, the interview was conducted with the construction company based in Tirana, Albstar with an engineer and an architect that are still working in the development of the project. As it was not possible to reach any member of Archea architectural studio to gain further information about the project and BIM implementation in it, the results were made based only on the construction company.

According to the information gathered, in this cace it seems like Archea was the one that implemented BIM during the process from the beginning of the project. Design phase was conducted in Revit and the documents were shared in (rvt) files with all the members, italian and albanian architects. Schedules about different elements were specified, and cost analysis were updated regulary with the material take-off option.

On the other hand, Albstar implemented the project in site, and BIM was used in just a few cases. The rvt files were delivered from Archea and as they had no knowledge of such new softwares, they learned with tutorials delivered the project step by step. Also, the usage of Revit, Navisworks and Dynamo, were new for other structural engineers, mechanicals and workkers, so it was hard to coordinate taking into consideration the timeline pressure. Even though being a huge project, in this case

BIM had caused problems when it cames to exchanging information and working on files that Archea had previously worked on.

5.3.4 DOWNTOWN ONE

Downtown one is a project in progress, consisting in 37-storeys with a 140 m hight. It is a mixed-use typology, accommodating several houses and office spaces. The project is developed from MVRDV, a studio based in Netherlands which works with BIM, with our local partner DEA studio. Downtown One is designed on behalf of Kastarti Construction, with the European standarts and quality of the building.

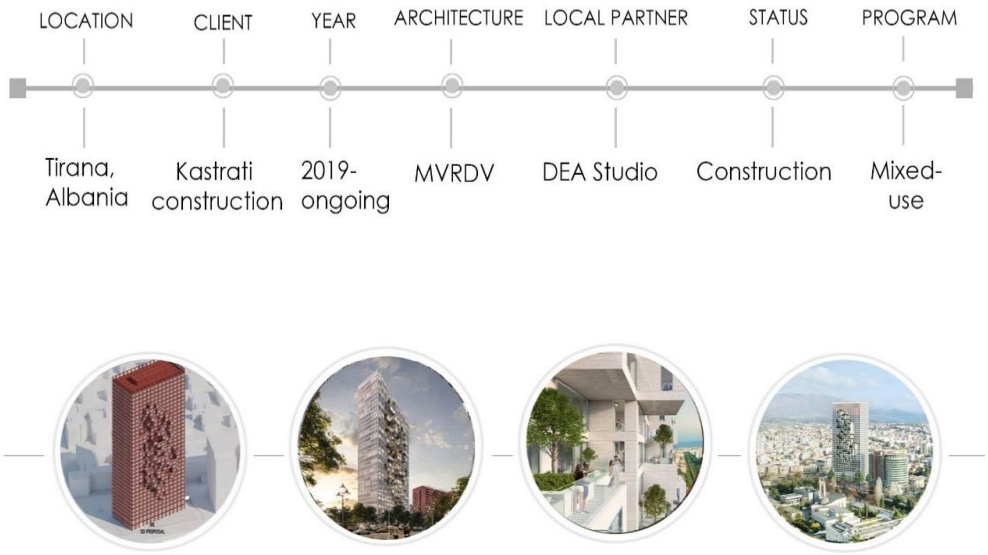


Figure 40. Project information, Building typology, 3d model and Façade.

It is located in the center of Tirana on the Bajram Curri Boulevard, to the south of the Lana River. It offers a panoramic view, and creates the feeling of a vertical village. The spatial composition and the façade itself, form the map of Albania which will be visible from the Skandergeg's square. The front façade is a representation the Albanian terrain as one of the key elements of the concept.

5.3.4.1 Overview of the Project Requirements

This multy-storey tower is projected as a mixed- use building where several facilities are offered. Appartments with vistas towards the city, and panoramic verandas create an experience in itself. Starting from the underground floor, there is a parking area. Housing spaces encompases the 18 floors of the whole area of the building, the other floors occupy office spaces and commercial ones. MVRDV applied the European Building Standarts. A strong coolaboratation took place between MVRDV, Kastrati Construction, Arup as the MEP supervisor, and DEA studio which was the local partner in this project.

The use of BIM was effective not only in the spatial design decisions, but it strongly applied in HVAC system, fire protection system, and the selection of the proper materials for the exterior façade.

Figure 41. Facade rendering

5.3.4.2 The Use of BIM Protocol and BIM Influence

BIM protocol was an important document since the beginning of the project, where certain specifications were made with all the partners that was part of the process, inclunding contractors and the client. Having applied the BIM protocol based on the guidelines and frameworks that were previously set up, the influence toward an efficient production were really high. ***Figure 42.***

As becoming more proficient while using BIM, the productivity reaches its high level. Examining in real time the 2D and 3D model helps the designer, architects and engineers to better understand the projects while getting improved with the trial-and-error methodology. The output will definitely be a unified design and process. Also, a concurrent presentation to the client fosters the understanding of the model while making the changes really quick.

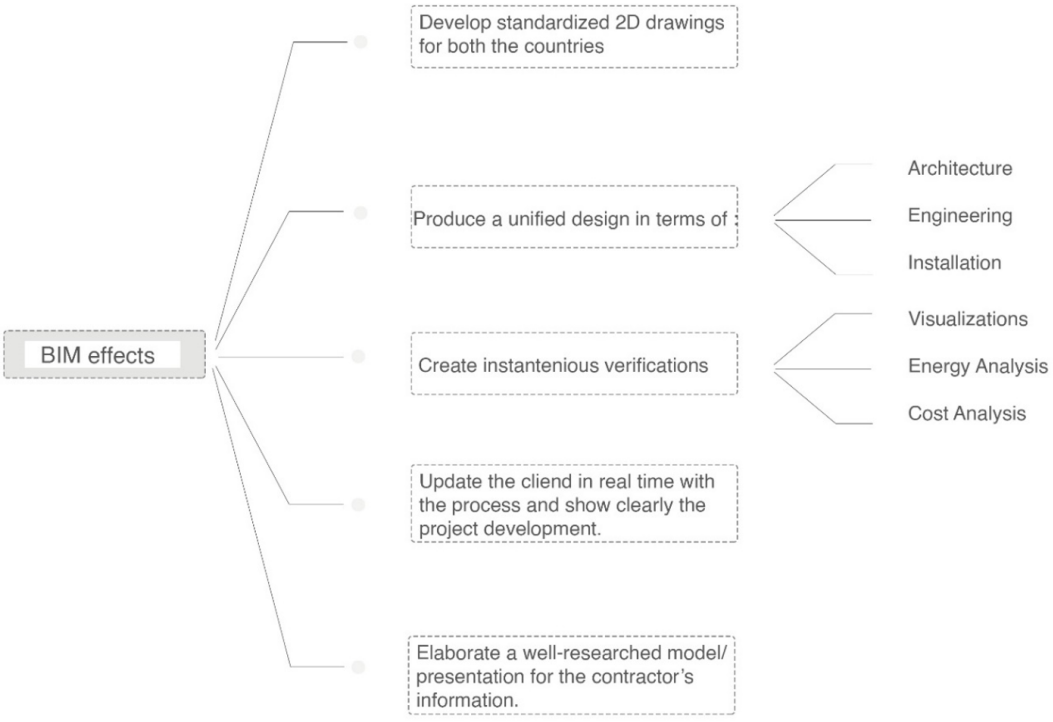


Figure 42. BIM effect on the project

Revit was the main tool for generating the actual 2D – 3D drawings in Tirana Downtown project. Accurate elements were modeles were created by clearly defining the elemens and components of each part that was added step by step along the process. Using a multi-tasking software such as Revit, other analysis such as clash detection and fire safety were made based on the actual model. On the other hand, Revit Insight clearly generated solar analysis, energy performance, acoustic performance and optimization.

One positive aspect of using Revit is the data exchange that can occur between different partners. In this case also, the information 'who has to do what 'was achieved with no obstacles. Each stakeholder did what was responsible for, in a well coordinated system.

In the picture below are presented four different models of different pases and levels of the project ***Figure 43.***

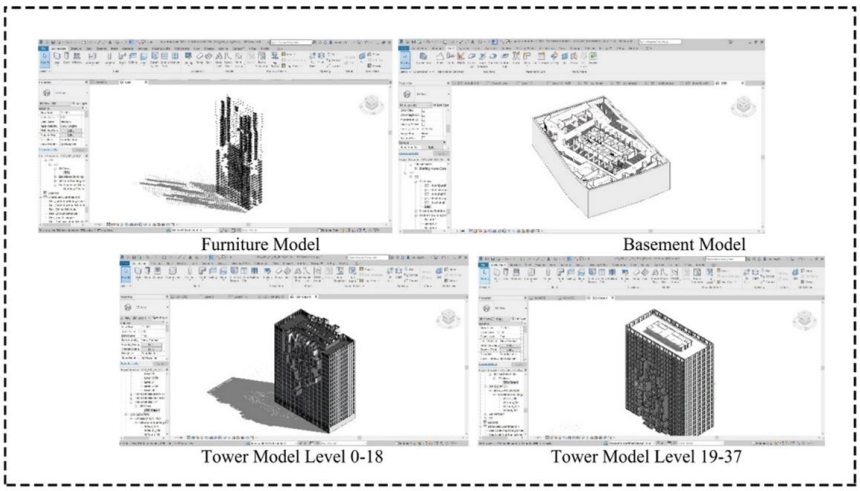


Figure 43. 3D model generation in Revit.

5.3.4.3 Clash Detection

As it was previously explained, clash detection catches the elements that overlay eachother once they are put together. Differents from the first case study of 'Mangalem', in this case, the analysis was not done in an approximate way in Revit,

but Naviswork was used to process the model. It generates actual 3D models for each discipline worked from the team members, and then elaborate them all together to identify the clashes. Hence, two members have a vital role in this process; the manager who is responsible for the clashes between models, and theproject coordinator who is responsible for resolving the clashes.

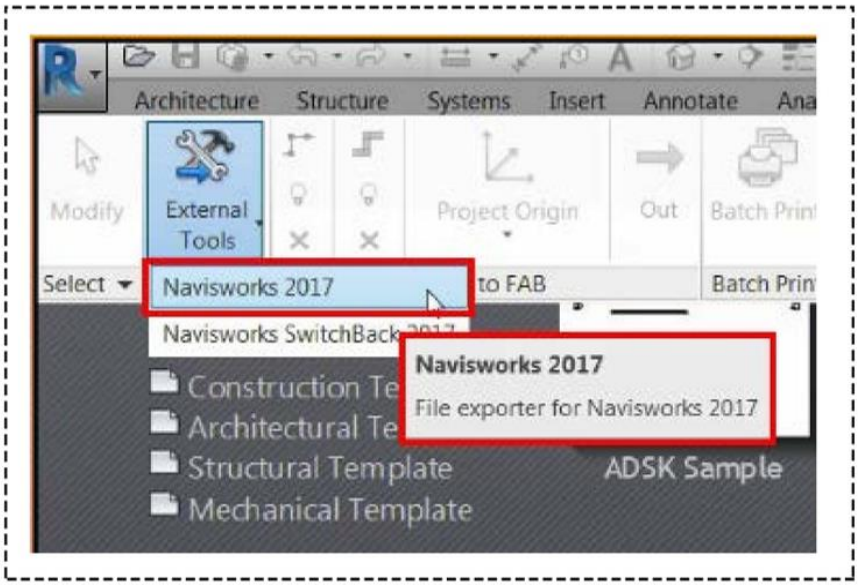


Figure 44. Export to Navisworks

5.3.4.4 BIM management Organization and Collaboration

To obtain and deliver an accurate virtual project, based on BIM standarts and technicalities, each project partner charges a BIM coordinator who is in direct contact with the BIM Manager of the company. Both of them has their own responsivilities and duties for the project coordination that are explained in the table below Table 3. Roles of the BIM coordinator and BIM manager***Table 3.***

Table 3. Roles of the BIM coordinator and BIM manager

BIM coordinator	**BIM Manager**
1. Naming and coding of the agreements. 2. Standardization and checking of the naming agreements. 3. Working on clashes with their own models. 4. Checking parameters in their own models. 5. Tracking the quality of the model and levels of detail. 6. Bringing together multiple models for verification. 7. Taking part in BIM coordination session.	1. Start-up discussion based on the protocol. 2. Check for compliance with the protocol agreement. 3. Clash detection controls of the models. 4. Keeping up with the internal BIM coordinators of the project partners. 5. Providing instructions for processing. 6. Organization of the central, shared software environment.

In this diagram is clearly presented the role of the Project partner in the Modeling process, duties and tools ***Figure 45.***

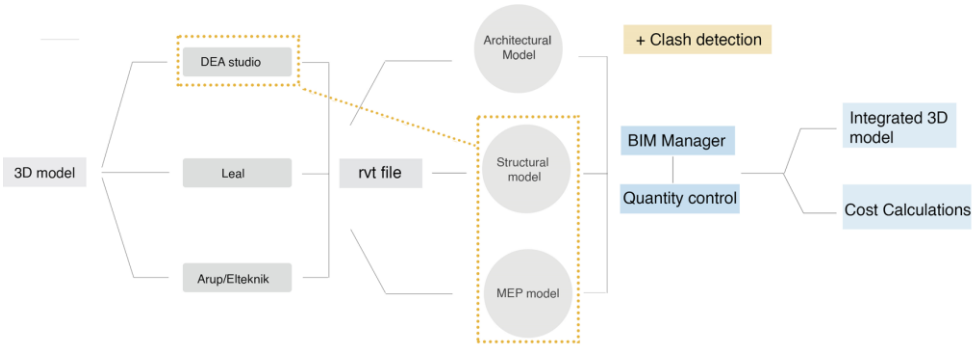
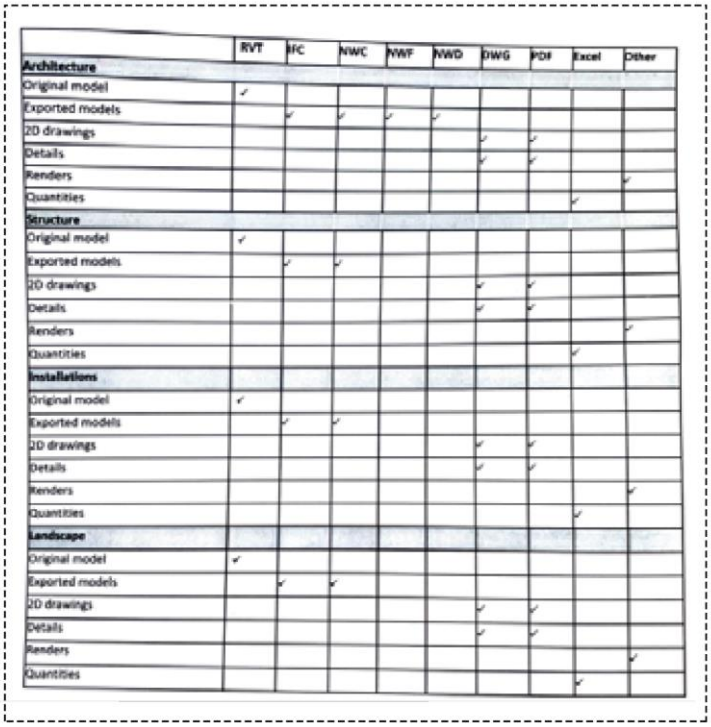


Figure 45. Team coordination in the project

5.3.4.5 Data Exchange, BIM Deliverables and Softwares

Data exchange is made through the selected partners in the project. Each of the partners maintain ownership for the model file, which can not be submitted to third parties without getting the agreement of the owner. The execution phase consists on the generation of the 2D drawings in e pdf format from the BIM models. Such information from the models is checked then from the contractor ***Figure 46.*** Yet, the process ongoes with the construction phase where the model is being updated in a continuous way. Also, the maintenance and the management of the building after it is being built need a deep knowledgement.



	RVT	IFC	NWC	NWF	NWD	DWG	PDF	Excel	Other
Architecture									
Original model	✓								
Exported models		✓	✓	✓	✓				
2D drawings						✓	✓		
Details						✓	✓		
Renders									✓
Quantities								✓	
Structure									
Original model	✓								
Exported models		✓	✓						
2D drawings						✓	✓		
Details						✓	✓		
Renders									✓
Quantities								✓	
Installations									
Original model	✓								
Exported models		✓	✓						
2D drawings						✓	✓		
Details						✓	✓		
Renders									✓
Quantities								✓	
Landscape									
Original model	✓								
Exported models		✓	✓						
2D drawings						✓	✓		
Details						✓	✓		
Renders									✓
Quantities								✓	

Figure 46. Data exchange.

Softwares

Various BIM softwares were used for the project, starting from Auto CAD to Revit and Navisworks, each to acomplishe different task from the team members assigned for the work**.**

Table 4. Softwares used in the project.

	Files	Tools
1.	RVT	Revit 2017
2.	IFC	IFC 2x3 Coordination view
3.	NWC	Navisworks 2017
4.	NWF	Navisworks 2017
5.	NWD	Navisworks 2017
6.	DWG	Autocad 2016
7.	PDF	Adobe PDF converter
8.	Excel	Microsoft Excel 2013

Table 5. BIM Deliverables.

BIM deliverables				
Design phase		Construction phase		Management phase
Geometric evaluation	Data-Analysis evaluation	On site	Procurement and delivery	Facility management
1. Design model geometry 2. Design review 3.Documentation Detailing 4. Rendering 5. VR 6. Construction model geometry 7. As-built model geometry	1. Code checking/validation 2. Cost control 3. Lightning analysis 4. Quantification 5. Clash detection 6. Energy analysis 7. Sustainability data	1. Construction Specifications 2. Planning/ Scheduling 3. Trade coordination	1. Equipements 2. Finishes 3. Furniture	1. Asset tracking 2. Assset maintenance 3. Space management 4. MEP systems

5.4 BIM Pilot Project

Building Information Modeling is being adapted from many countries, including both public and private sector in architecture and construction industry. Each country represents their own standarts and guidelines. The public sector has an

important role towards an orientation in adopting BIM in the industry. As BIM implementation is increasing continuously in an intensive way, governmental bodies and of varied countries internationally have applied BIM in their projects and provided various BIM standards and solutions.

In Albania, Building Information Modeling is being presented more as a concept than as an implementation tool in the project phases. There is a number of private architectural and construction studios that have started to elaborate their projects within the frameworks for BIM. On the other hand, it is still not taken into consideration form the public sector even in these last 5 years.

This BIM pilot project, concerns a public high school located in a small city in Albania, called Bilisht. First of all, the project aims to implement BIM tools which support the construction phases, performing so advanced analysis for better design decisions. Second of all, it will be used to ensure the positive impacts to the public client in terms of time saving, cost efficiency, error reduction and high-quality improvement. Certain BIM validations will be involved using Revit for the 2D and 3D model, energy and solar analysis, material take off, and clash detection identification using Naviswork as a tool.

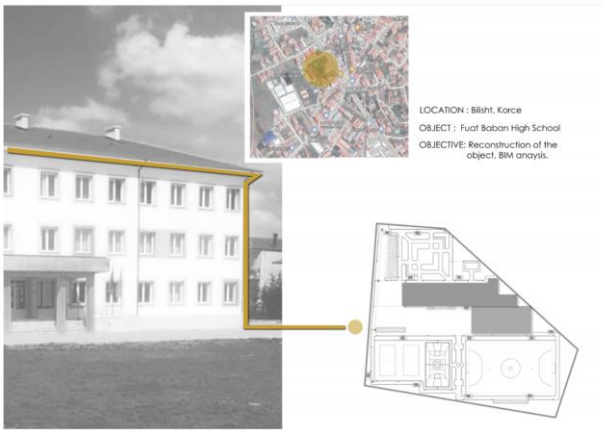


Figure 47. Pilot project – ‘’Fuat Baban’’ high school.

In the table below are explaned the staps to be followed from 2D drawing to 6D simulations, related to the aim and the suitable tools for specific tasks ***Table 6.*** Project methodology

Table 6. Project methodology

Steps	Aim	Tools
2D drawings	Develope accurate 2D drawings according to the site measurements.	Revit
3D Modeling	Develope the 3D model • Sections • Facades • Schedules	Autodesk Revit
Clash Detection	Idenltiy clashes betwenn elements and chech for errors.	Autodesk Navisworks
4D Modeling	Timeline simlulation based on scheduling	Autodesk Revit Autodesk Navisworks
5D modeling	Cost estimation - (efficiency) analysis, material take-off, quantitites.	Autodesk Revit
6D modeling	Solar analysis, (facade optimization)	Autodesk Revit

5.4.1 3D BIM

Autodesk Revit is a building information modeling software which helps for structural engineers, architects, MEP engineers, designers and contractors. It allows users to design a building and structure and its components in 3D, annotate the model with 2D drafting elements, and access building information from the building model's database. Revit is capable to plan and track the various stages in the building's lifecycle, from designing stage to construction and later demolition.

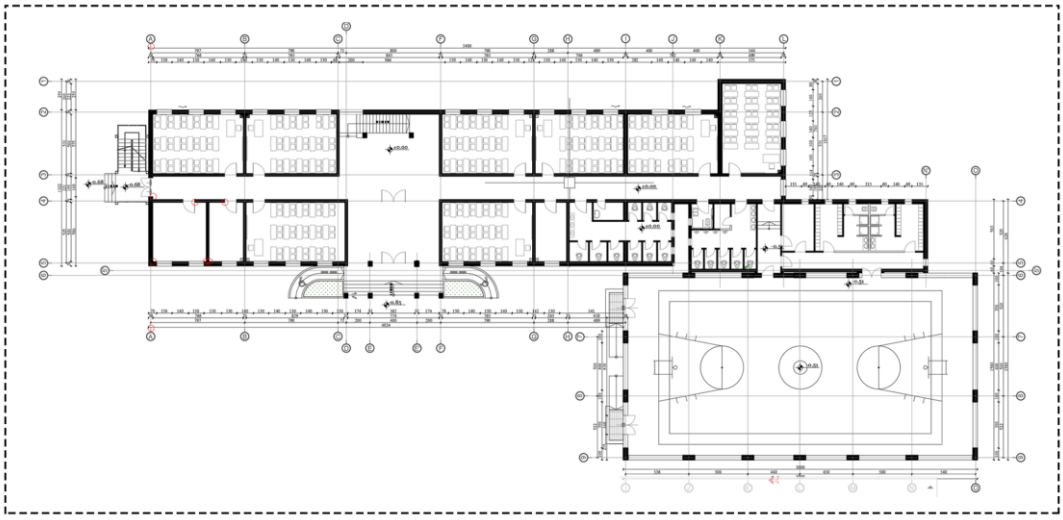


Figure 48. 2D plan.

As it is being analyzed and giving other optimal solutions to an existing public building, the 2D drawings were made due to the exact measuremnts. In BIM Revit, the work is done with Phasing, respectively for the existing building (in the existing phase) and the new prepositions (in the new construction phase). The 3D model then was generated for both the cases. There are presented the graphics used for each phase which was then specified in the project browser views.

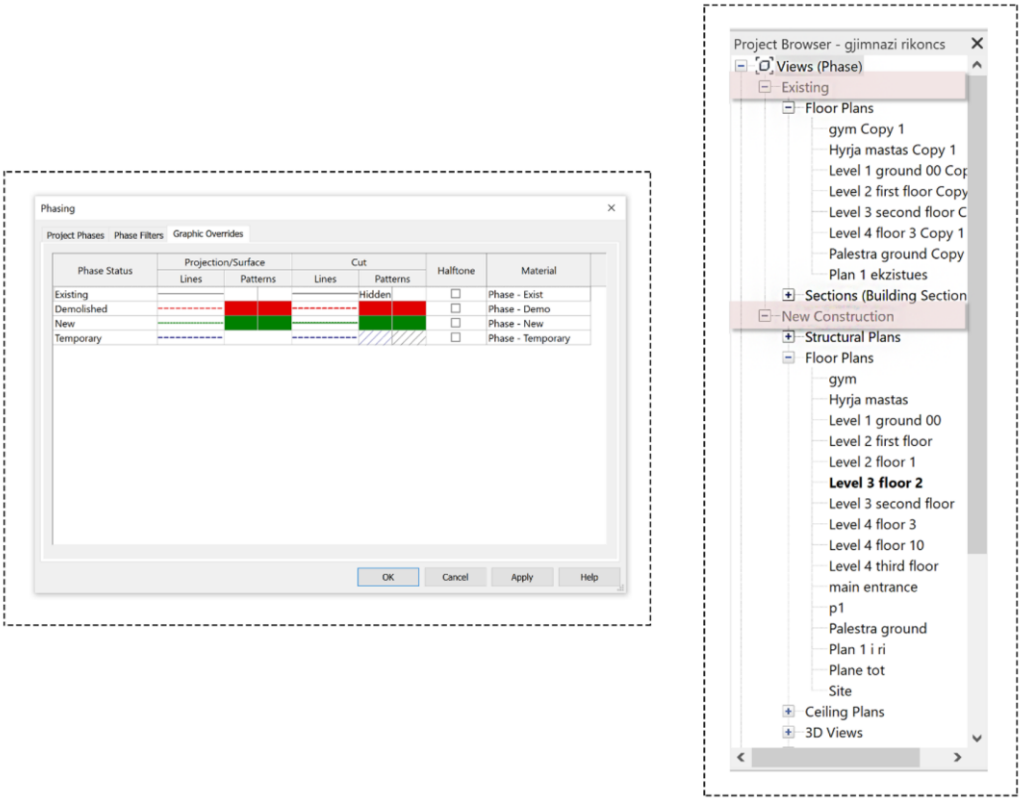
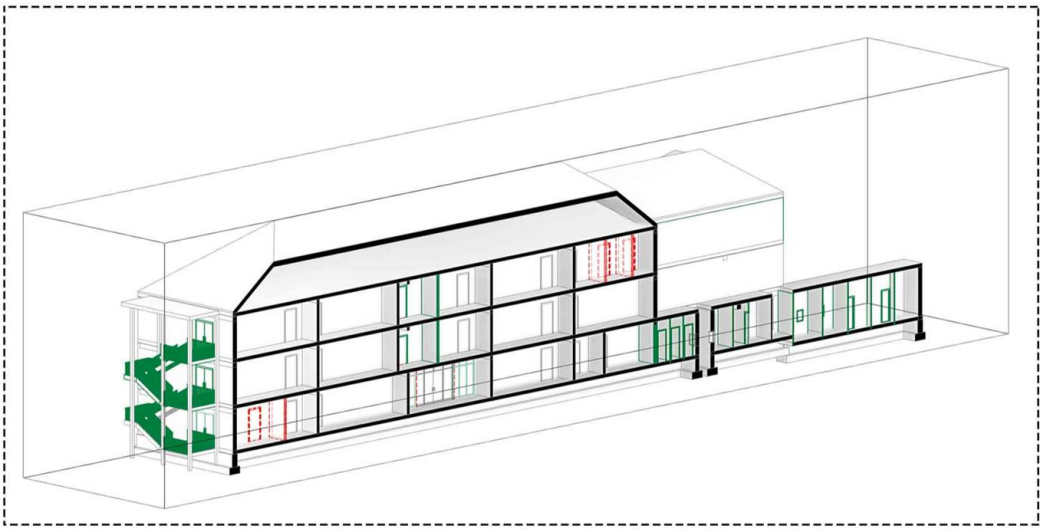
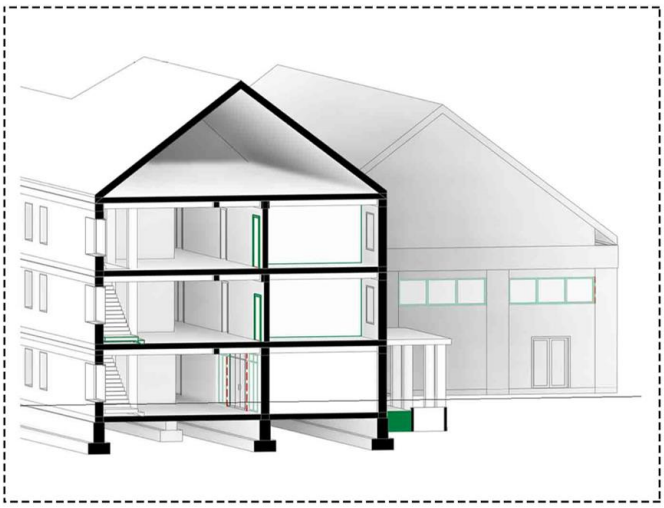


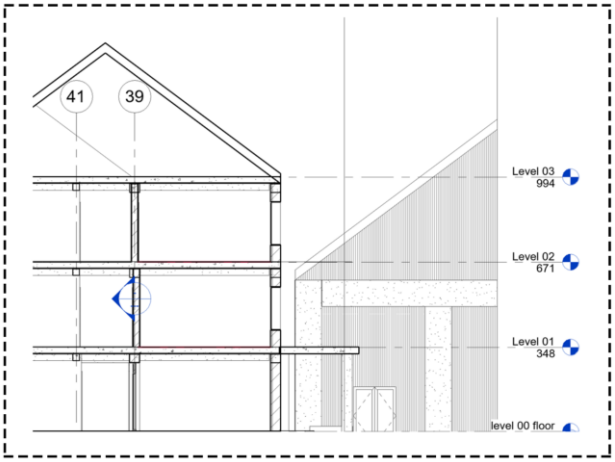
Figure 49. Project phasing

Certain results were obtained from Autodesk Revit, as a Building Information Modeling tool. The 2D Cad drawings were inserted in Revit to generate so the 3D model, sections, facades, 3D section views with the respective phases: existing and demolished. Each component was drawn step by step, from the structural elements to the architectural ones; foundation, columns, beams, walls, doors and windows with current specifications ***Figure 49***.

Revit offers the flexibility of navigating very quick from the plans to the sections and elevations, while checking for errors and fixing them all at once.






41
39
Level 03
994
Level 02
671
Level 01
348
level 00 floor

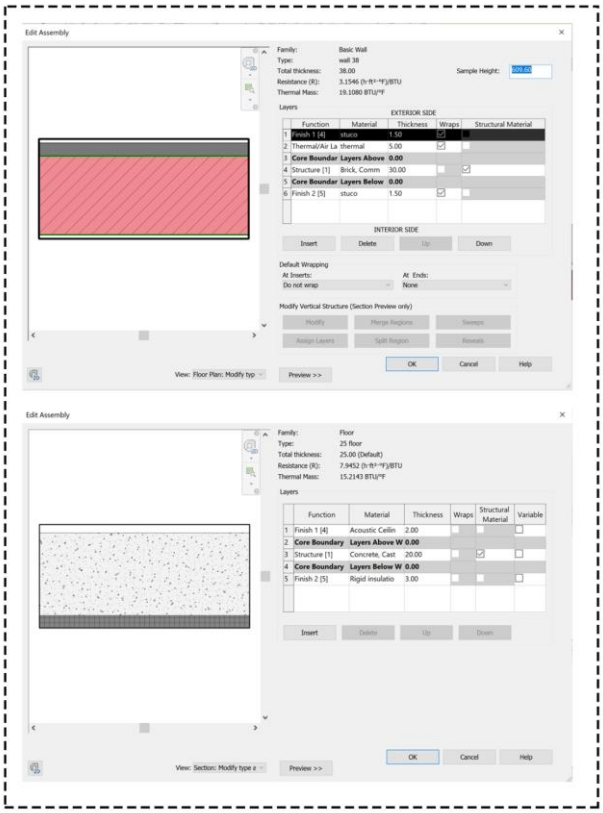


Figure 50. 3D sections, levels, wall and floor details

5.4.2 Room Configuration and Material Take-Off

Room tags are specified with different colors and room names according to their functions. This is done in order to clearly notify the facility, and manage the information with Schedules/ Quantities within the project browser. Schedules help to analyze the quantities of components and materials with specifications used in the project. A schedule presents the information in the form of a table, extracted from the properties of the elements we have included in the project.

The spaces are presented with numbers and names, areas, volumes and perimeters. Once the properties of a building element are modified, so it is the schedule updated automatically.

In the figure are presented the room tags of the first floor of the building, the rooms schedule and added /demolished walls.

<Room Schedule>

A	B	C	D	E
Number	Name	Perimeter	Area	Volume
1	Classroom	2495	37 m²	Not Computed
2	Storage	1542	14 m²	Not Computed
3	WC	2151	29 m²	Not Computed
4	Gym	9181	446 m²	Not Computed
5	Fitting room	2546	15 m²	Not Computed
6	Classroom	2509	38 m²	Not Computed
7	Classroom	2485	37 m²	Not Computed
8	Classroom	2543	38 m²	Not Computed
9	Classroom	2494	37 m²	Not Computed
10	Classroom	2455	36 m²	Not Computed
11	Classroom	2470	37 m²	Not Computed
12	Classroom	2487	37 m²	Not Computed
13	WC	3284	42 m²	Not Computed
14	Classroom	2690	42 m²	Not Computed
15	Entrance	2559	38 m²	Not Computed
16	Hall	10564	124 m²	Not Computed
17	Hall	1895	14 m²	Not Computed
18	Fitting room	2586	16 m²	Not Computed
19	Storage	1343	11 m²	Not Computed
20	Room	618	2 m²	Not Computed
21	Room	627	2 m²	Not Computed

<Wall Schedule demo>

A	B	C	D	E
Family and Type	Length	Phase Demolished	Volume	Width
Basic Wall: wall 25	531	New Construction	3.62 m³	25
Basic Wall: wall 25	531	New Construction	3.72 m³	25
Basic Wall: wall 25	531	New Construction	3.72 m³	25

<Wall Schedule -New>

A	B	C	D	E
Family and Type	Volume	Width	Length	Phase Created
Basic Wall: wall 12	0.89 m³	13	401	New Construction
Basic Wall: wall 12	0.53 m³	13	168	New Construction
Basic Wall: wall 12	0.53 m³	13	168	New Construction
Basic Wall: wall 38.5	1.62 m³	39	168	New Construction
Basic Wall: wall 12	1.22 m³	13	346	New Construction

Figure 51. Room Configurations and wall schedules.

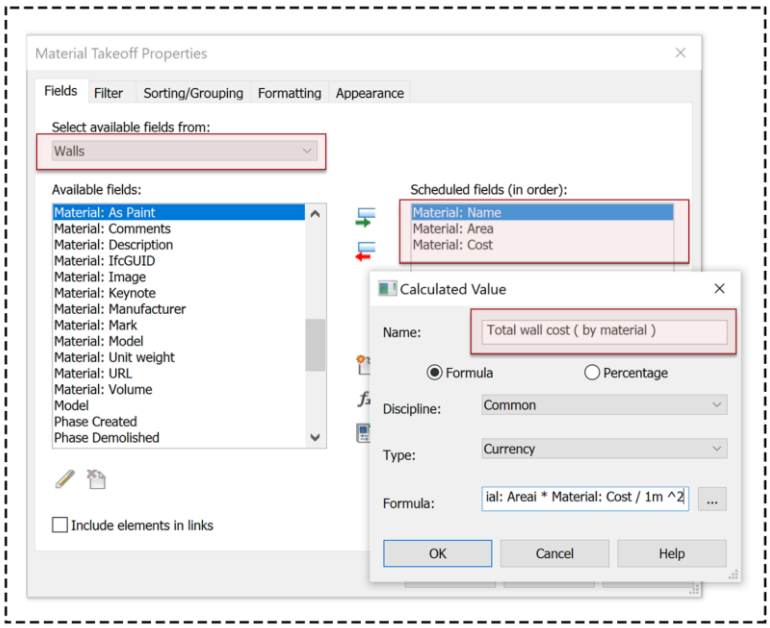
Revit is a design tool where certain inputs can be estimated automatically, containing type, material and elements quantities present in the project, and cost.

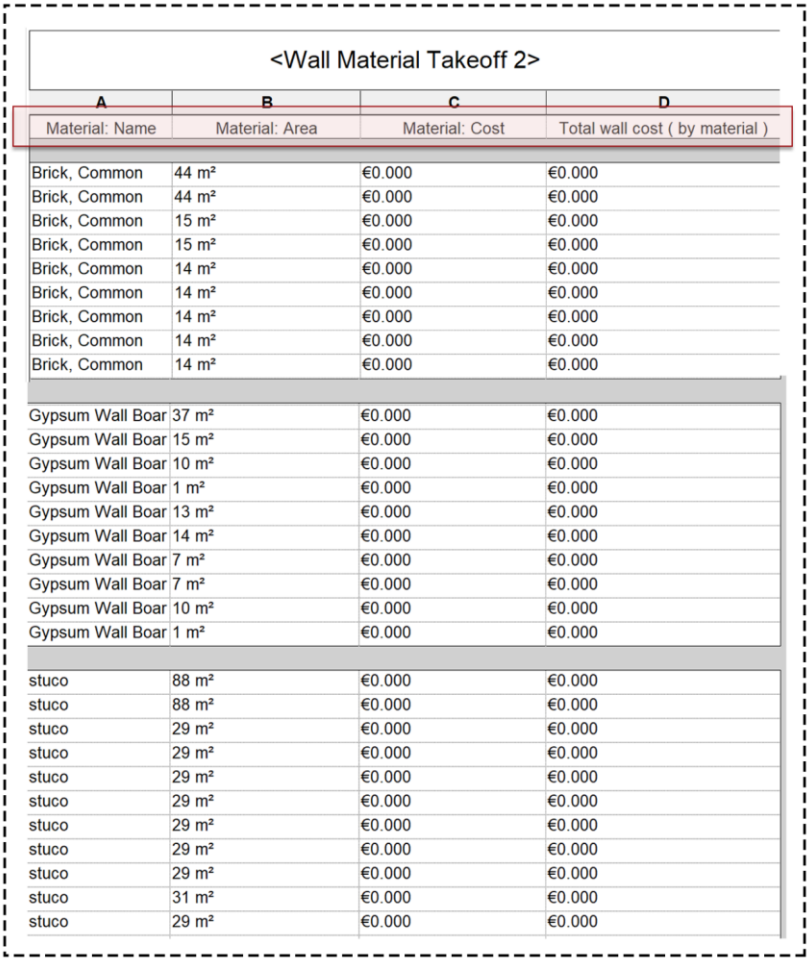
into a Microsoft Excel spreadsheet and then attach them to the cost estimator who is responsible for measuring the time, cost of the construction work, the labour selected to assist in the project, or either recommend ways for a product to be more cost effective. Such material takeoffs generated with Revit tool, can be used as fundamentals for cost estimation, decision making or procurement.

In the figure below is shown an example for a material takeoff about two types of windows. There are specified the family type with the exct dimensions, phase created weather it is a new construction element or existing one, the cost, total cost and the grand total of the elements ***Figure 52.***

<Window Material Takeoff>

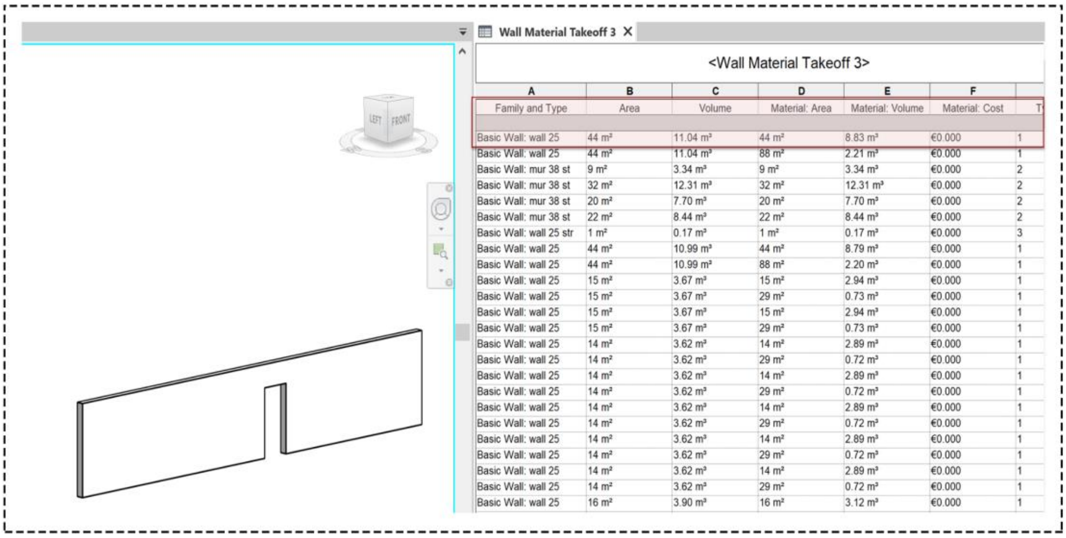
A	B	C	D
Family	Family and Type	Phase Created	Cost
€			
Fixed	Fixed: window 60x80	New Construction	
Fixed	Fixed: window 60x80	New Construction	
Fixed	Fixed: window 60x80	New Construction	
Fixed	Fixed: window 60x80	New Construction	
Fixed	Fixed: window 60x80	New Construction	
Fixed	Fixed: window 60x80	New Construction	
Fixed	Fixed: window 60x80	New Construction	
Fixed	Fixed: window 60x80	New Construction	
Fixed	Fixed: window 60x80	New Construction	
Fixed	Fixed: window 60x80	New Construction	
€			
Fixed	Fixed: window 100z165	New Construction	
Fixed	Fixed: window 100z165	New Construction	
Fixed	Fixed: window 100z165	New Construction	
Fixed	Fixed: window 100z165	New Construction	
Fixed	Fixed: window 100z165	New Construction	
Fixed	Fixed: window 100z165	New Construction	
Fixed	Fixed: window 100z165	New Construction	
Fixed	Fixed: window 100z165	New Construction	
Grand total: 18			





<Wall Material Takeoff 2>

A	B	C	D
Material: Name	Material: Area	Material: Cost	Total wall cost (by material)
Brick, Common	44 m²	€0.000	€0.000
Brick, Common	44 m²	€0.000	€0.000
Brick, Common	15 m²	€0.000	€0.000
Brick, Common	15 m²	€0.000	€0.000
Brick, Common	14 m²	€0.000	€0.000
Brick, Common	14 m²	€0.000	€0.000
Brick, Common	14 m²	€0.000	€0.000
Brick, Common	14 m²	€0.000	€0.000
Brick, Common	14 m²	€0.000	€0.000
Gypsum Wall Boar	37 m²	€0.000	€0.000
Gypsum Wall Boar	15 m²	€0.000	€0.000
Gypsum Wall Boar	10 m²	€0.000	€0.000
Gypsum Wall Boar	1 m²	€0.000	€0.000
Gypsum Wall Boar	13 m²	€0.000	€0.000
Gypsum Wall Boar	14 m²	€0.000	€0.000
Gypsum Wall Boar	7 m²	€0.000	€0.000
Gypsum Wall Boar	7 m²	€0.000	€0.000
Gypsum Wall Boar	10 m²	€0.000	€0.000
Gypsum Wall Boar	1 m²	€0.000	€0.000
stuco	88 m²	€0.000	€0.000
stuco	88 m²	€0.000	€0.000
stuco	29 m²	€0.000	€0.000
stuco	29 m²	€0.000	€0.000
stuco	29 m²	€0.000	€0.000
stuco	29 m²	€0.000	€0.000
stuco	29 m²	€0.000	€0.000
stuco	29 m²	€0.000	€0.000
stuco	29 m²	€0.000	€0.000
stuco	31 m²	€0.000	€0.000
stuco	29 m²	€0.000	€0.000



<Wall Material Takeoff 3>

A	B	C	D	E	F	
Family and Type	Area	Volume	Material: Area	Material: Volume	Material: Cost	T
Basic Wall: wall 25	44 m²	11.04 m³	44 m²	8.83 m³	€0.000	1
Basic Wall: wall 25	44 m²	11.04 m³	88 m²	2.21 m³	€0.000	1
Basic Wall: mur 38 st	9 m²	3.34 m³	9 m²	3.34 m³	€0.000	2
Basic Wall: mur 38 st	32 m²	12.31 m³	32 m²	12.31 m³	€0.000	2
Basic Wall: mur 38 st	20 m²	7.70 m³	20 m²	7.70 m³	€0.000	2
Basic Wall: mur 38 st	22 m²	8.44 m³	22 m²	8.44 m³	€0.000	2
Basic Wall: wall 25 str	1 m²	0.17 m³	1 m²	0.17 m³	€0.000	3
Basic Wall: wall 25	44 m²	10.99 m³	44 m²	8.79 m³	€0.000	1
Basic Wall: wall 25	44 m²	10.99 m³	88 m²	2.20 m³	€0.000	1
Basic Wall: wall 25	15 m²	3.67 m³	15 m²	2.94 m³	€0.000	1
Basic Wall: wall 25	15 m²	3.67 m³	29 m²	0.73 m³	€0.000	1
Basic Wall: wall 25	15 m²	3.67 m³	15 m²	2.94 m³	€0.000	1
Basic Wall: wall 25	15 m²	3.67 m³	29 m²	0.73 m³	€0.000	1
Basic Wall: wall 25	14 m²	3.62 m³	14 m²	2.89 m³	€0.000	1
Basic Wall: wall 25	14 m²	3.62 m³	29 m²	0.72 m³	€0.000	1
Basic Wall: wall 25	14 m²	3.62 m³	14 m²	2.89 m³	€0.000	1
Basic Wall: wall 25	14 m²	3.62 m³	29 m²	0.72 m³	€0.000	1
Basic Wall: wall 25	14 m²	3.62 m³	14 m²	2.89 m³	€0.000	1
Basic Wall: wall 25	14 m²	3.62 m³	29 m²	0.72 m³	€0.000	1
Basic Wall: wall 25	14 m²	3.62 m³	14 m²	2.89 m³	€0.000	1
Basic Wall: wall 25	14 m²	3.62 m³	29 m²	0.72 m³	€0.000	1
Basic Wall: wall 25	14 m²	3.62 m³	14 m²	2.89 m³	€0.000	1
Basic Wall: wall 25	14 m²	3.62 m³	29 m²	0.72 m³	€0.000	1
Basic Wall: wall 25	16 m²	3.90 m³	16 m²	3.12 m³	€0.000	1

Figure 52. Material take-off.

There are some ways on how to generate the material take offs of the elements in the project. It can be measured as the total cost of the whole wall in m3 or more precisely, getting the significant cost for each layer of floor or the wall (brick, stucco, thermal layer). Material area, volume, cost and type marks can be assigned related to the family and type, generating so the total material cost based on the cost manuals proved in Albania.

5.4.3 BIM Solar Analysis

As the aim of this pilot project is to clearly define the effects that BIM has in cost, time and quality of a project. The solar analysis is made to emphasize the contribution of the BIM systems when it comes to cost, time and quality. In this pilot project Revit insight was used to examine the solar radiation and its impact in the selected high school. The results show that such analysis can be done since the design stage of the project, making it cost efficient, while working with real physical configurations. Such measurements are a necessary representation toward a constant improvement of time and cost.

In this project, the physical model was made with a conceptual mass. Some specifications about the location were made for accurate results. Solar radiation

analysis is conducted for the fourth seasons: Spring Equinox, Summer Solstice, Fall Equinox and Winter Solstice. From each of them were taken results for three hours during the day: 9:00 AM, 12:00 PM, 14:00 PM, in all the four orientations for a better understanding and precise conclusions, as shown in

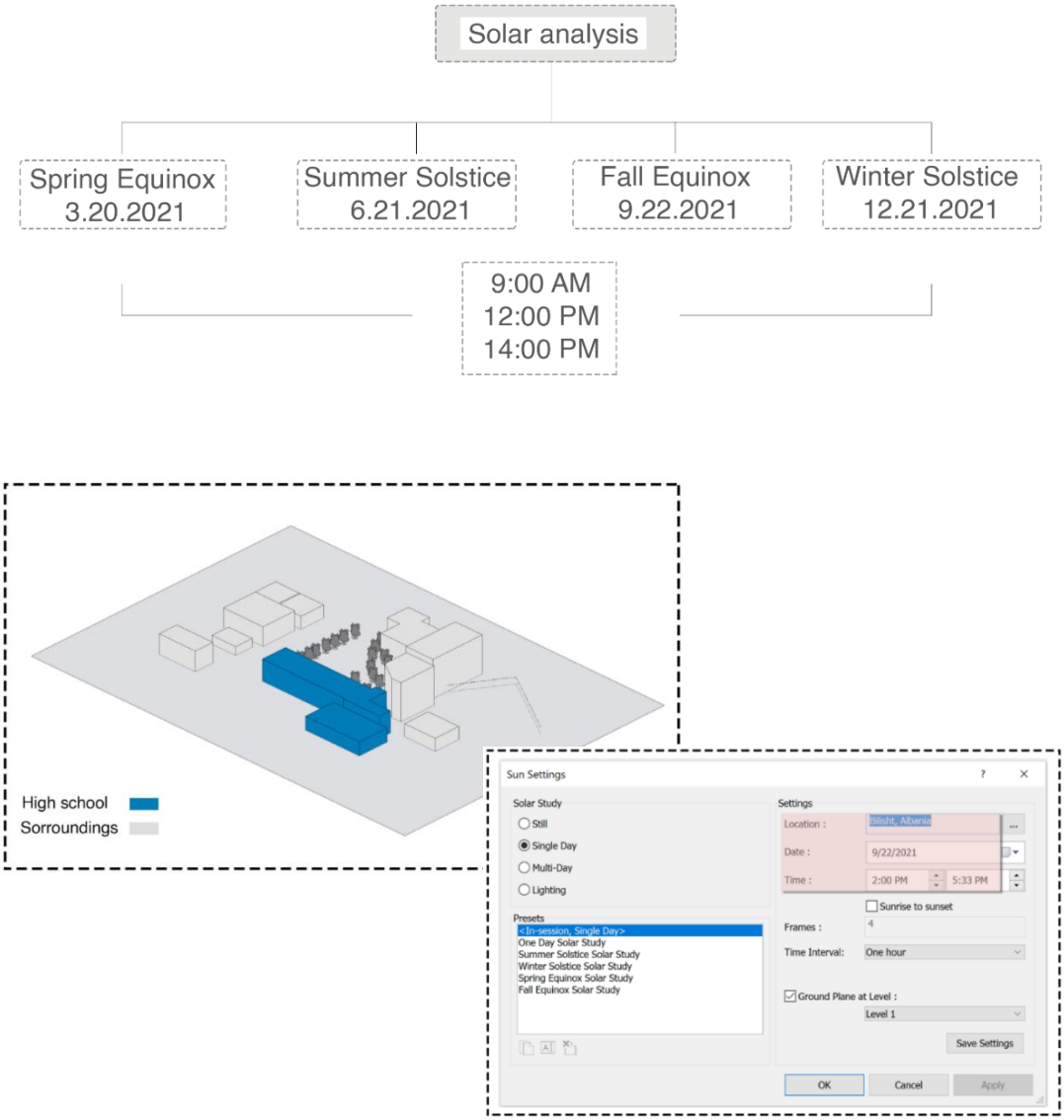
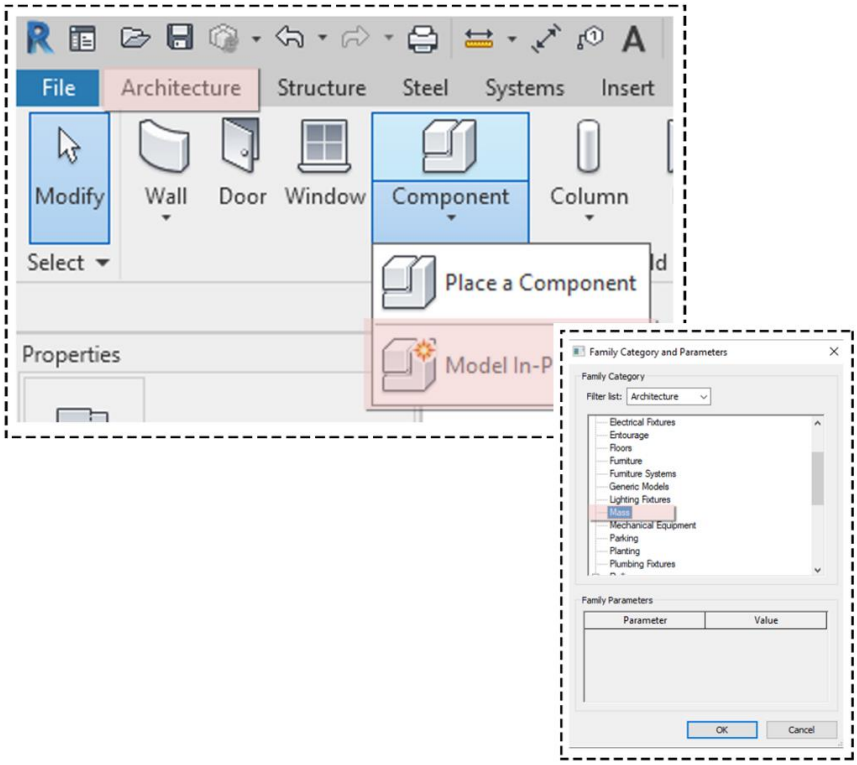


Figure 53. Solar analysis settings.

In the figure below is shown a general table as an example of this study. There are three different colors that identify the solar radiation flow tracking so the solar energy allover the design. The yellow one shows the high intensity of the solar

rays during the day. The light green color represents that the façade is well lit, meanwhile the dark color shows that the presence of the sun light is missing and that part of the building does not perceive the necessary natural light during the day.



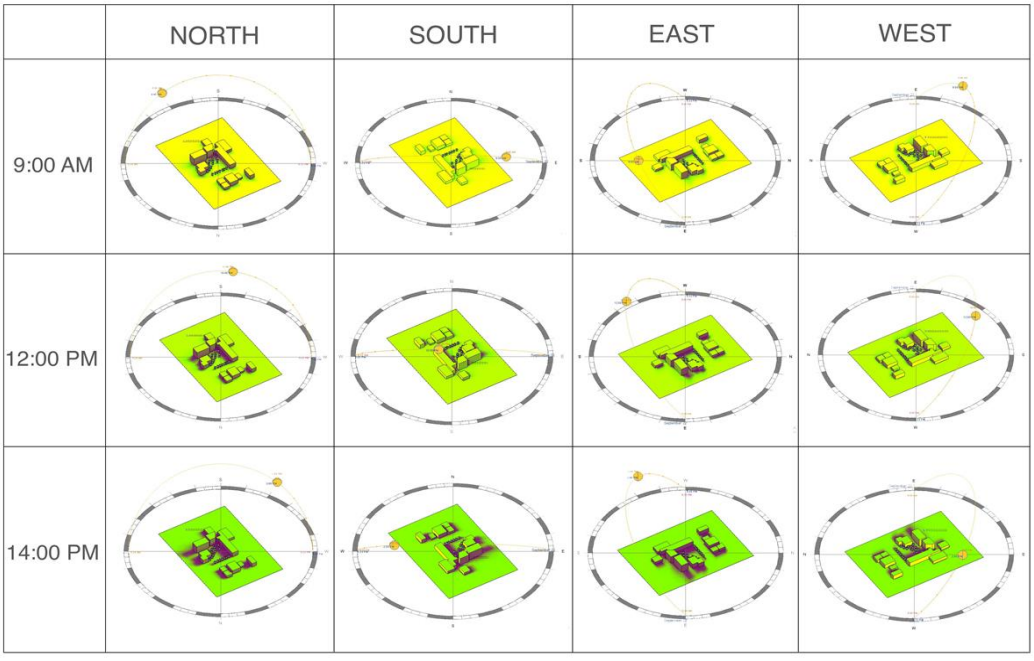


Figure 54. Whole day solar study.

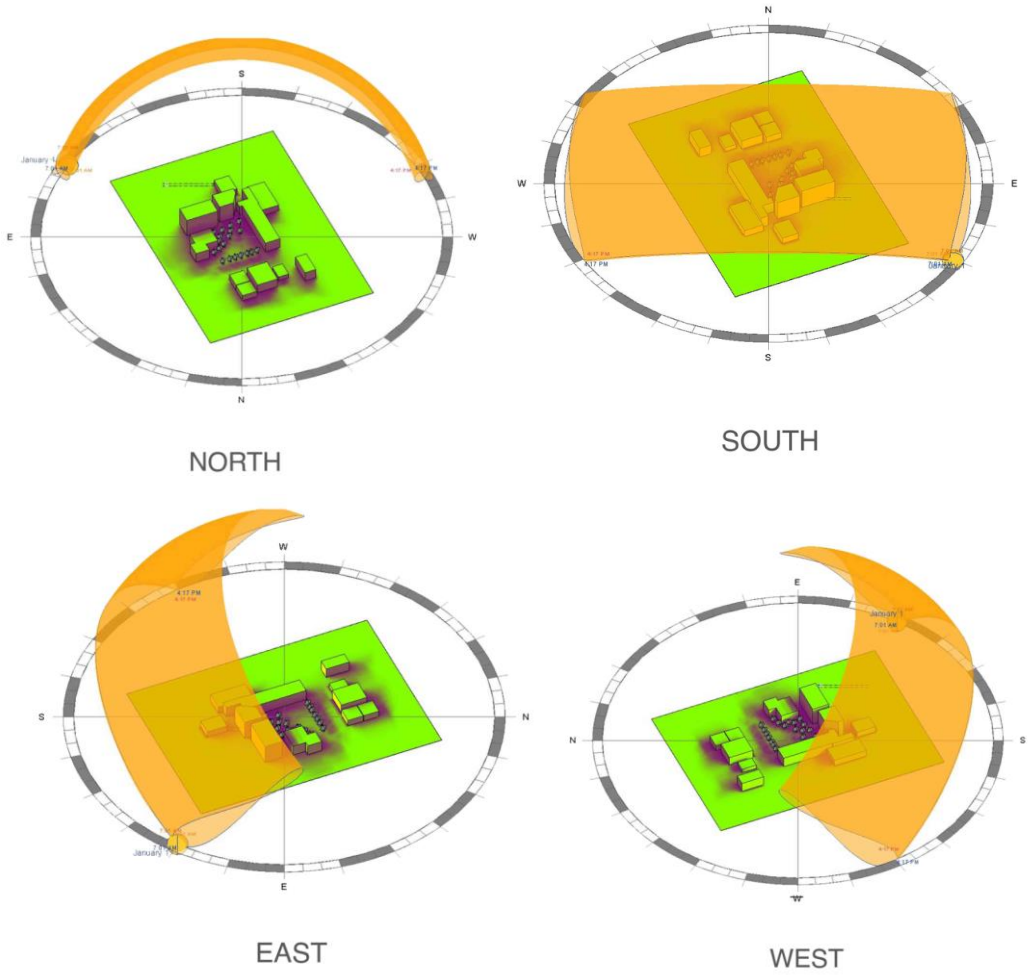


Figure 55. Full year solar study.

In order to obtain a general overview about the solar simulations in this project, the analysis is done for ‘a one-year solar study’, starting from 01.01.2021 to 01.01.2022 with the respective time from 07:00 AM to 16:17 PM. ***Figure 54.***

The analysis done in Revit, were exported in Microsoft Excel to further examine graphically, the solar indication into the school façade. The selected areas were the ones with the highest Average Insolation Value, and that with the lowest Insolation valuecwhere the classes were oriented. Each of them is named from F1 to F4 as shown in the ***Figure 56*** F1 is the South West façade with the highest amount of energy heating the area each day (2474.53 kWh/m2), also because no other objects or

landscape features create barriers. F2 and F3 are the facades that gain just a little amount of energy and have similar values. The one facing the East had to obtain a greater amount of energy but other 4-5 storie hight buildings prevents the solar rays. F4, the North East façade has the lowest Insolation Value, indicated from the sorroundings and the landscape features, dominated by shadow even in the high peak of the day.

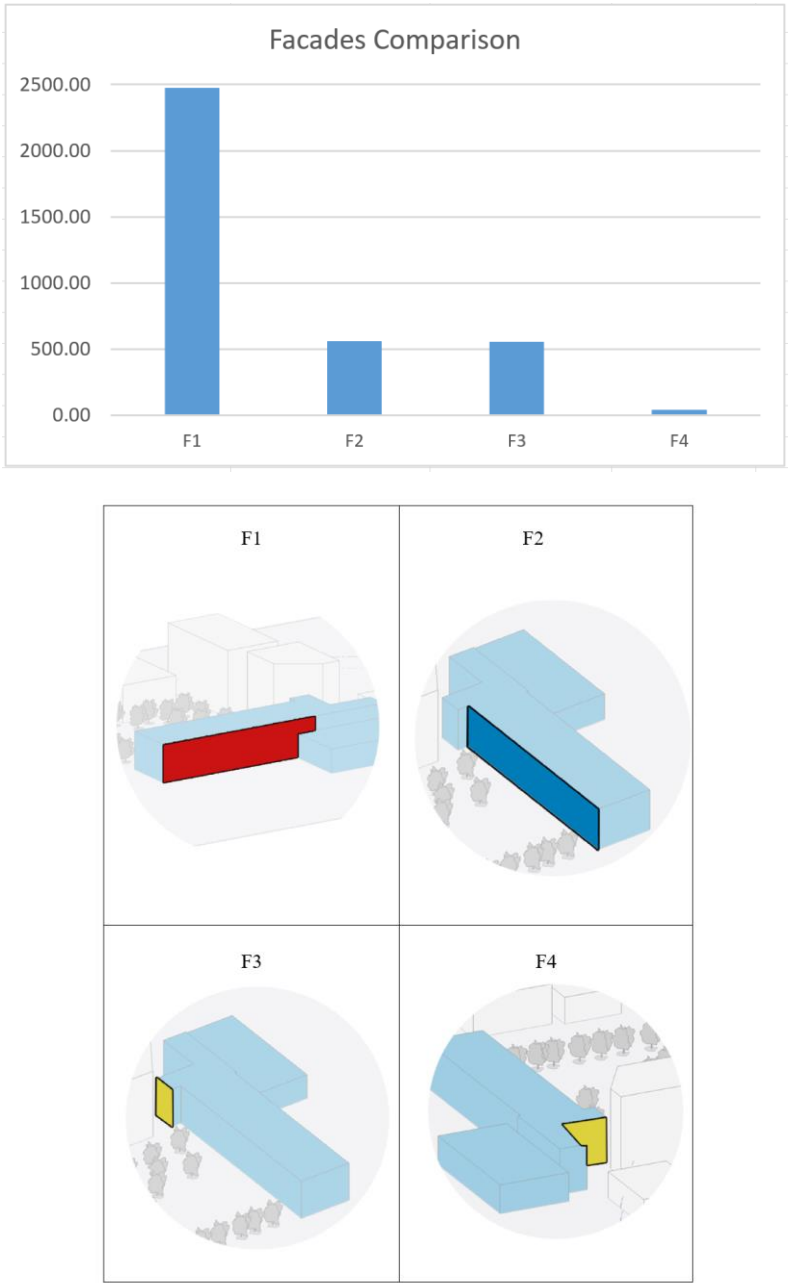


Figure 56. Facades comparison.

5.4.4 Navisworks

Exporting a Revit file

In this huge concept of BIM, Navisworks is an essential tool to clearly link the design to the construction site, which are standardizing on the Navisworks platform, as the one of the most effective collaborative workflow tools. It manages to add multiple models, and then assemble them in one single Navisworks model. It allows the user do conduct construction activities, such as clash detection, construction sequences, animating, MEP analysis, data sharing and rendering.

There are several ways how to open and export a Revit file to Navisworks. The positive aspect of such tools is that you can work with Revit directly. First of all, we have to create a NWC file, we can make any changes in revit and then update the model in Navisworks with ‘refresh the model ‘.

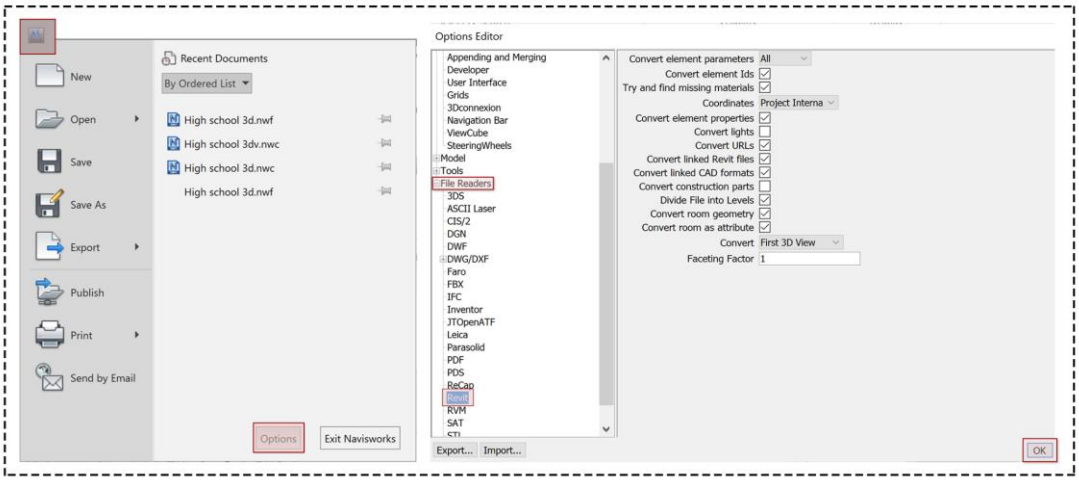


Figure 57. Exporting to Navisworks.

In navisworks, navigation through walking, is one of the most used command that offers the ability to walk through the model inside out and vice versa. It allows to navigate from one space to another one, checking and controlling the elements, or

doing specific measurements. Also, certaing viewpoints can be saved and named according to the purpose.

5.4.5 Sectioning and Measuring

Sectioning can be enabled within the view point. There are several ways how to present sections in Navisworks, according to the plane alignment capturing the view with the elements you are interested in. Gizmo allows to push and pull the model into the prefered view from all the sides of the building.
As the dimensions from Revit are not translated into Navisworks, there is always a need to take our own measurements while navigating in Navisworks. It offers six different kings of measurements, and in this case study there were mostly used the 'select point to point, accumulate, or point line'.

The good thing is that all the measurements are saved as viewpoints and can be viewed any time. Also, the program allows to write down notes and address a problem or work to another person who is working with the project**.**

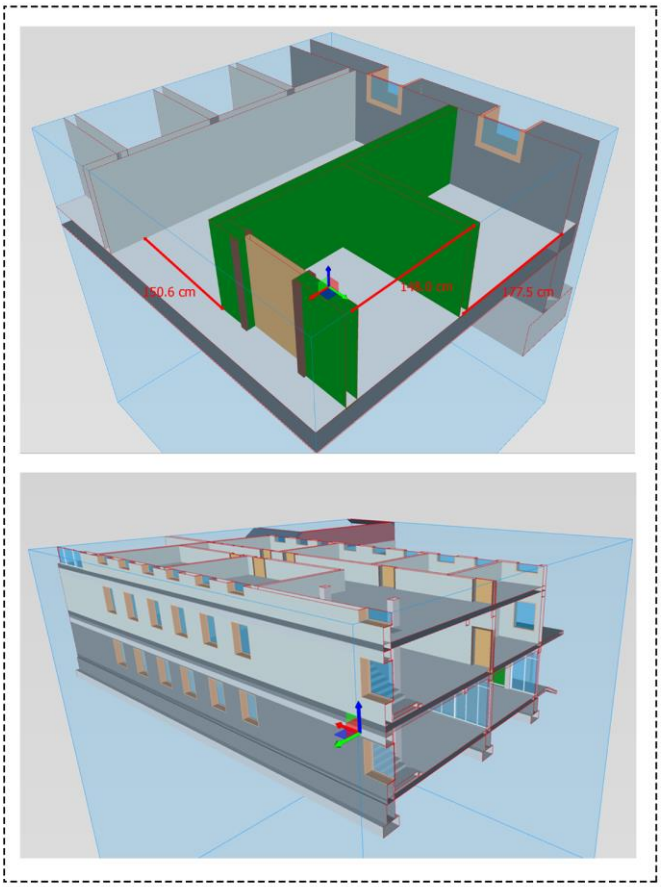


Figure 58. Measuring, sectioning.

5.4.6 Clash Detection

Navis works is a powerful tool, which allows access to construction before it actually begins on on site. Architects and engineers can make so many more decisions before making a wrong one, while fully useing the power of BIM.

The objective of using Navis works in this BIM pilot project is to find out the clash detective that are creted from the 3D model in Revit, create a clash test and look at the options we will need to configure. By clicking the Clash Detective in home tab, a table where the tests are defined appers. The program shows the number of clashes, which clasesh are new after reloading the project, the ones that are active, reviewed or approved before from another one, as shown in ***Figure 59***.

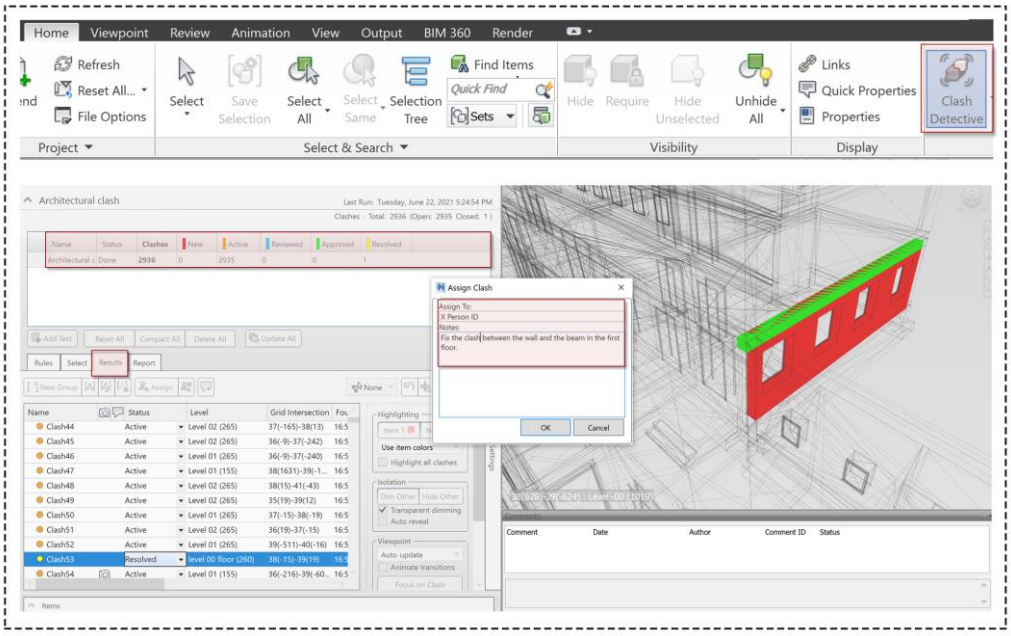


Figure 59. Clash detection analysis.

When resolving clashes, it means that you address a certain one to another person working with the project, to angage into solving the problem by leaving a comment. It helps towards a highely efficient time managing and fosters the coolaboration with the team members. In case of having a various similar clash, we can group and reduce the number of them. In the figure ***Figure 60*** is presented a clash happening

between a wall and a beam. Navisworks generate the status, level and the grid intersection.

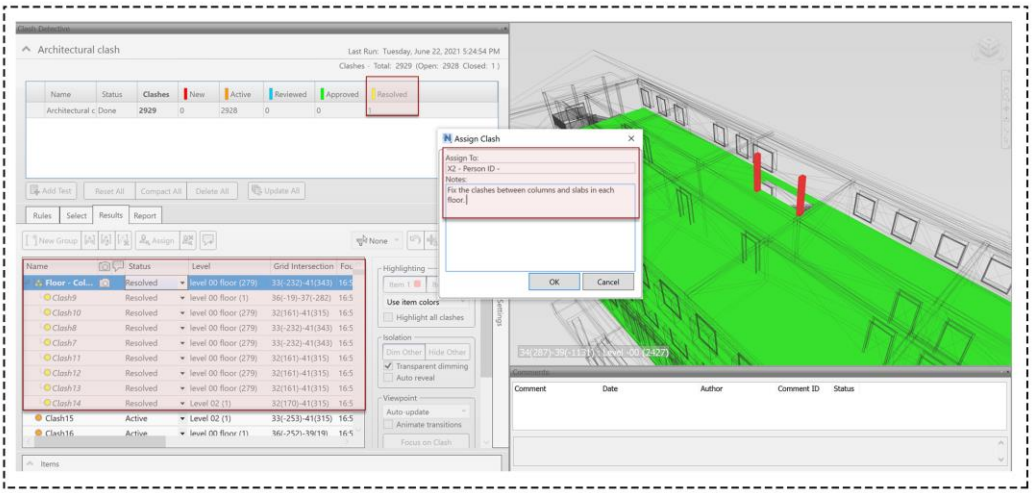


Figure 60. Assigning and resolving the clashes.

After calculating all the clash detections that can be assigned to all the architects and engineers, the results can be viewd in a report that is controlled via HTML which can be opened as a webpage ***Figure 61.*** Going down through each clash, the comments, statuss, element ID, date and time when this clash and comment was assigned. This clash report, together with the folder, can be send to anyone else who wants to see tha clashes, go through and make their own decisions.

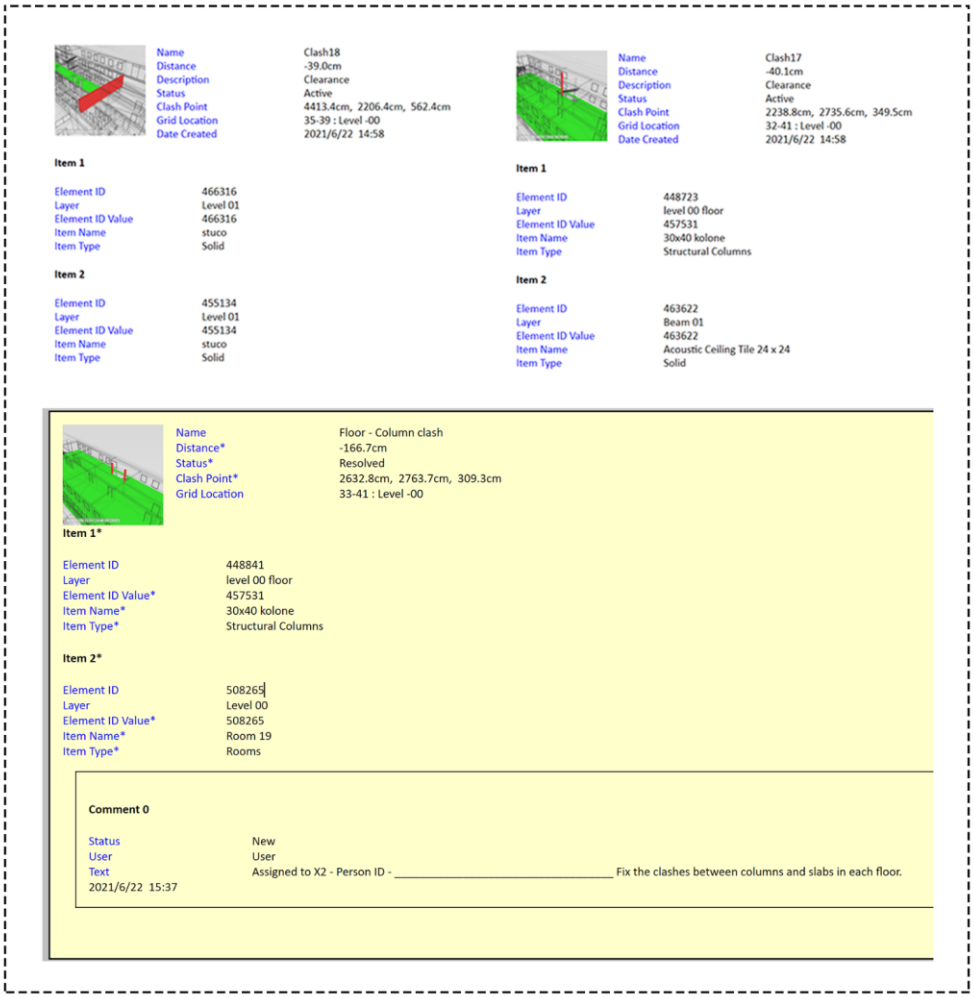


Figure 61. Clash report.

5.4.7 The Timeliner

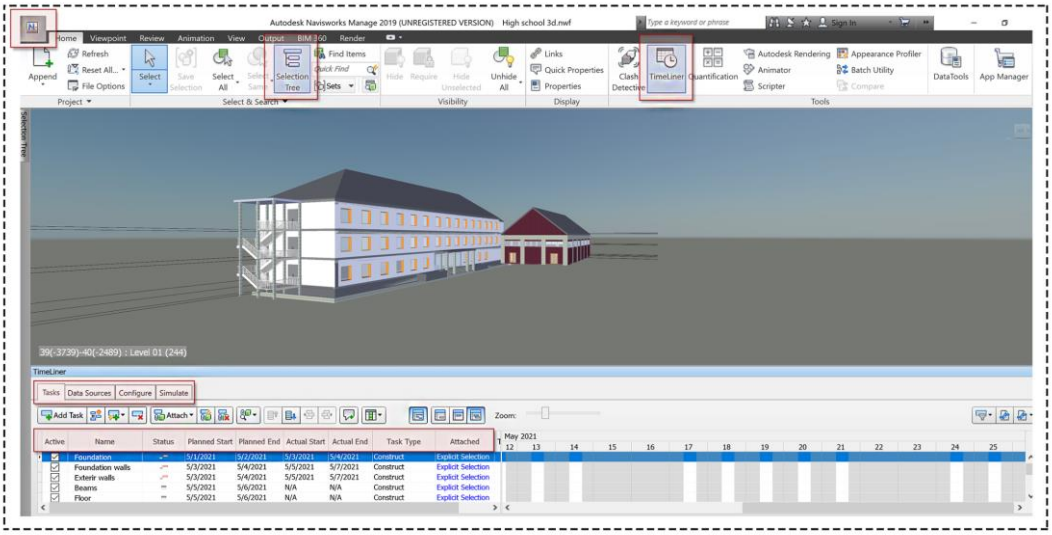
Timeliner in Navisworks is an option which helps the architects and engineers for construction sequencing. After adding a task, the timeframe that it is going to accour is set up, notifying the type wheather it is an existing, demolished, adder or existing to remain element. The appearance configuration of each of them is is showed in different colors and transparency values.

5.4.7.1 What is 4D Modelling and Appearance Configuration?

CPM is now a traditional planning method, and bar graphs are found to be of no positive effect. As problems are observed in using the traditional scheduling methodology, it is recognized that the 4D BIM visualization can improve the planning task and making it more efficient. The meaning of 4D BIM can be explained in a practical manner as the 3D model is lined with the desired schedule through other softwares such as Navisworks, which provide a synergistic environment to review, modify, evaluate the 3D model.

In this project, the Revit file (rvt) is grabed to navisworks and the timeliner is turned on. The configuration started step by step from the strip foundation which is an existing to remain element, then the floor the structural walls, beams, interior walls, and openings such as doors and windows.

The process is done for each floor with the starting and ending date specified accordingly with 2 to 3 days for each task. On the right side of the Timeliner is the Gantt Chart and we can see the days that he task is going to span through ***Figure 62.***



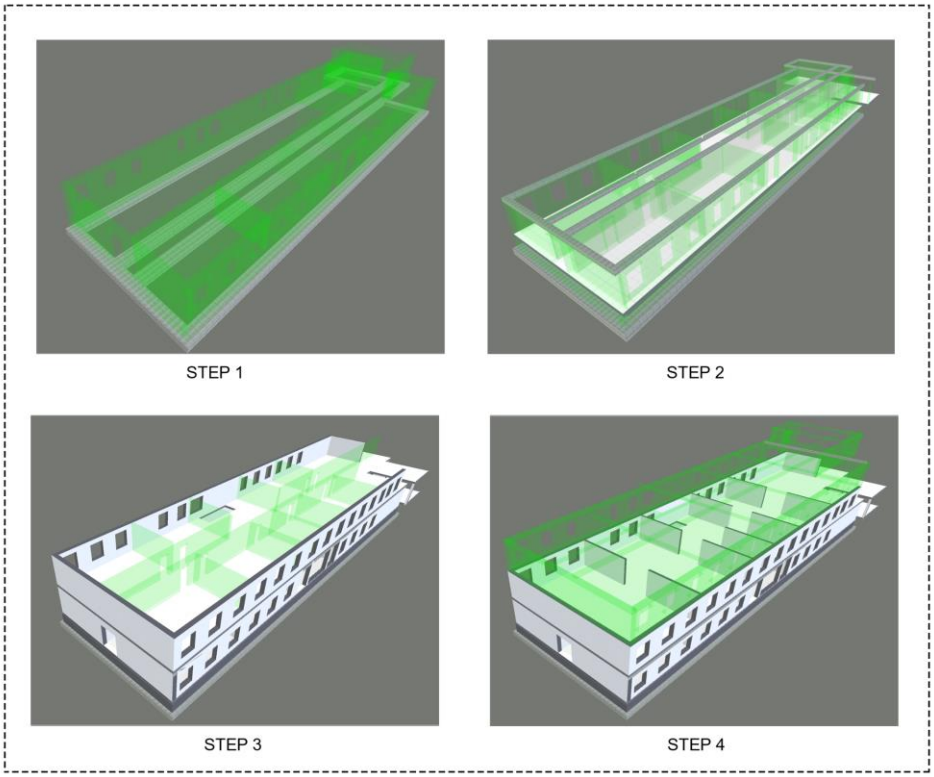


Figure 62. Assigning the timeliner in various steps.

Generating such a detailed working plan, help the team members coordinate with each other. Also, different from the traditional method, it is possible to view the virtual model in various sequences of time, making so the changes, avoiding errors and better manage the time one the Actual and the Planned time is analysed in Gantt Chart. All the members can be linked into the file and keep up with the process. ***Figure 63.***

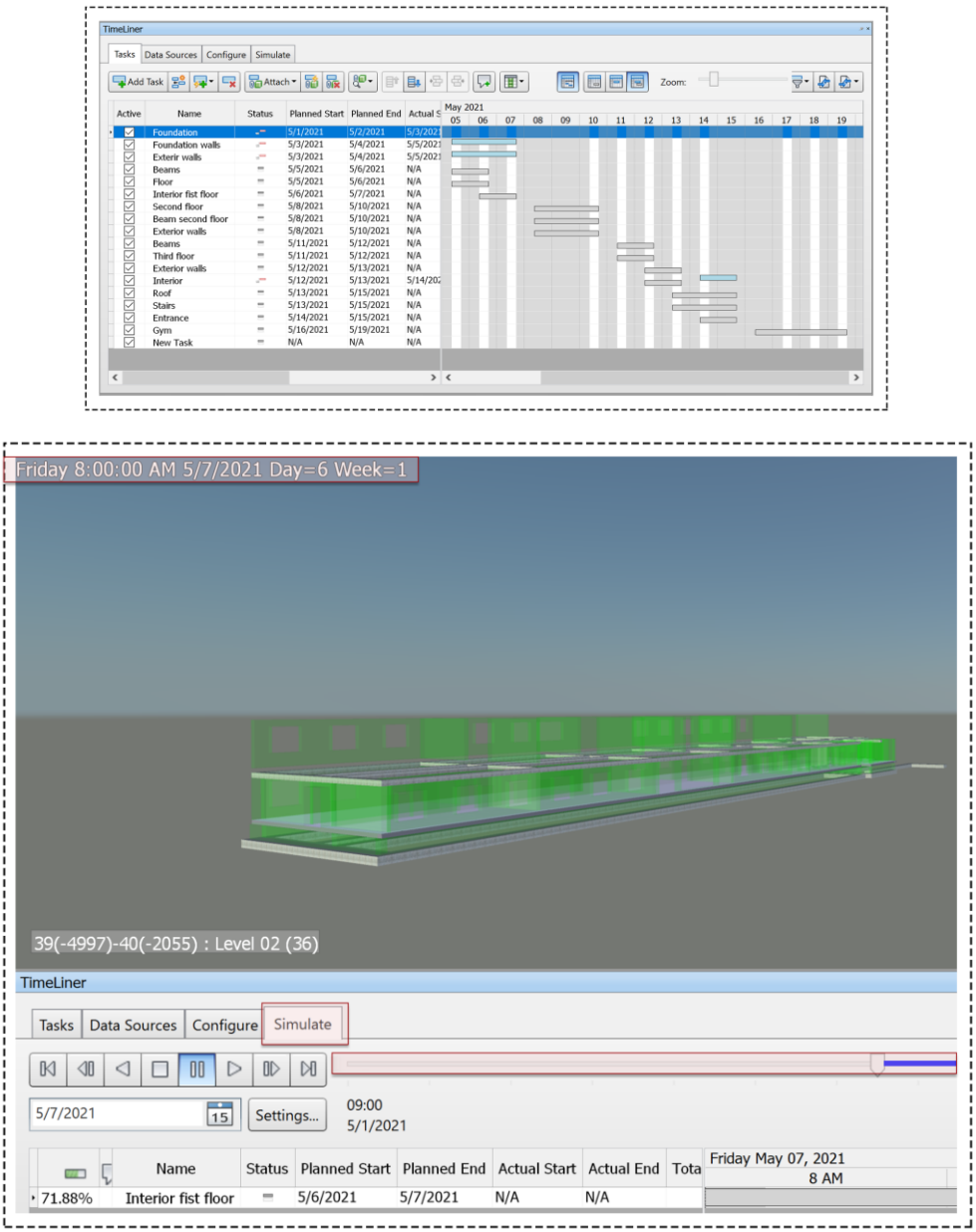


Figure 63. Simulation of the Planned and Actual start date of the project.

To sum up, 4D BIM is really an essential tool when it comes to cost and time optimization of the project. In ***Table 7*** is shown a list of major 4D BIM benefits and limitations of its implementation in Albania.

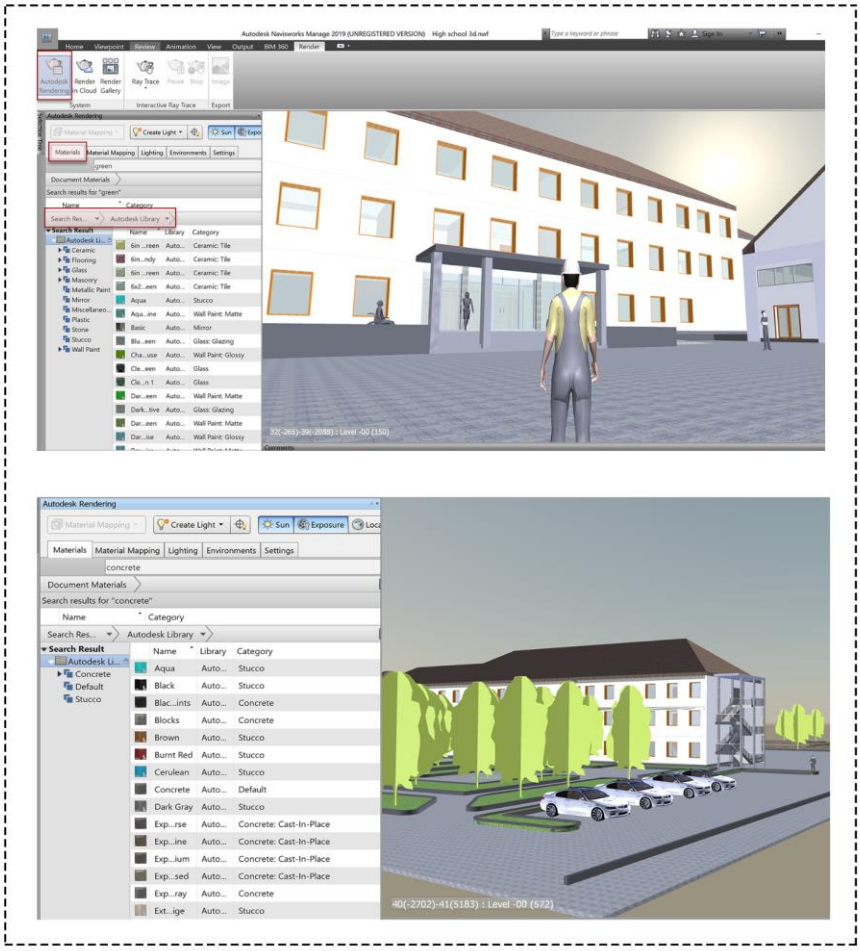
Table 7. Benefits and Barriers of using BIM Navisworks in Albania.

4D BIM Benefits	4D BIM Barriers

• **Exact detailed working plan:**
  • Produce precize work plan,
  • Visualization of the whole project,
• **Working with sequences**
  • Provides a virtual view of the project status
  • Better understanding of the construction progress
  • All the stakeholders can see the process in an animated video
• **Better communication beteween all the stakeholders**
  • Good communication between planners and clients
  • Keeps them updated with the process and changes during the project
	• **Running cost of 4D implementation**
	  • The high initial cost of purchasing the software as it can not be downloaded for free
	  • Costs for training the staff
	  • Lack of Albanian industry standarts
	• **Lack of experience and skills**
	  • Various stakeholders used with the traditional methodology need extra training
	  • Lack of access to the new technology
	• **BIM tools (programs) being too complex and advanced**

5.4.8 Rendering

Navisworks is a practical tool when it comes to generating various analysis and then rendering the 3D model. It offers a library with materials and specifications, and lighting variations in term of artificial and natural lighting with the desired exposure and location. Meanchile 3D components can be added from Revit and then reloaded to Navsworks such as equipements, landscape, or people ***Figure 64***.



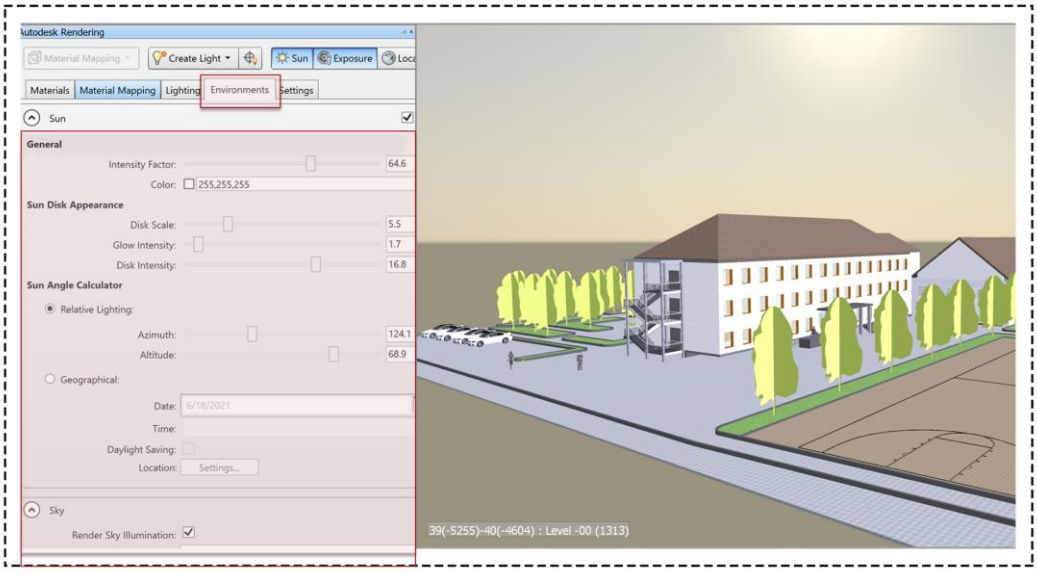


Figure 64. Renderin in Navisworks.

5.4.9 Discussions

As previously explaned, a clash happens when two ore more elements of the 3D model, intersect with each other. In this case study project, the clashes were identified between surfaces with different characters such as: a clash between a wall and a beam occupying the same space, wall and the floor or floor and column.
Positive advantages were visible while using Navisworks for clash detection:

1. Helps to clearly identify the interferences beteween elements in the project.
2. Linked directly with Revit file (rvt), it was time efficient while refreshing the models and exporting the changes on time.
3. The quality of the model is improved anytime that errors are found.
4. It is helpful for the public sector to avoide errors before building on site, while making continuous checking, reducing so extra and unpredictable costs.
5. It can be shared with other stakolhers like architecs, engineers, MEP system specialists to work on the attached problems addressed to them.
6. Also, other sophisticated clashes can be detected: Mechanical, Plumbing, Electrical Lighting components, Water Piping or Fire Suppressions System.

Hence, one major concern of BIM clash detection implementation is the absence of knowledge from memebers, and the cost of the softwares which need to be bought. One of the aims of proposing this BIM pilot project as an example for further developments in Albanian industry, is to identify the potentials that 4D BIM has in the lifecycle of a project. Such project scheduling, pushes the public sector towards more efficient cost and time control, underlining so the immediate need for structuring the guidelines and standarts different from the traditional ones. Hence, this High School case study presents Building Information Modeling as a promising tool for architect and engineers of the public sector, which will boost the need to formulate a BIM Execution Planning and improve the quality of the future projects.

5.5 Conclusions

At first sight, implementing BIM might look a very complex process for those that have a limited or no knowledge in the field of BIM. However, clients, contractors need to look closer the BIM benefits, and transform some of the traditional methods that they are used to work with. New strategies need to be elaborated and a clear plan how the projct is going to be executed.

First of all, after collecting the results from the online surveys delivered to construction and architectural companies, it was seen that the Albanian Industry is already aware for the existence of BIM as a concept and as a vital tool. A considered number of private architectural studios use BIM in the design phase continuing so in the construction phase. Meanwhile, the construction companies are complex organizations with a lot of stakeholders and labours that need to be trained for this new way of working. Still, they have incorporated the use of BIM in the construction phase, improving so coordination, maintenance, quality of the building, controlling time, cost and quality. Even though the private companies are getting used with BIM omplementation, the public ones are still usig the traditional methodology.

Secondly, the case studies choosen for BIM evaluation and profieciency in the three existing buildings in Albania, presented the benefits that they faced while working with such tools. Except the advantages mentioned before, limitations like training the staff, absence of knowledge from labours, and the extra cost of the softwares are still a barrier until we fully use BIM with all its potentials.

In this paper, an existing building was taken as a case study to demonstrate to the public sector how an entire project can be executed through BIM tools. According to other literature studies, two were the softwares used as the excelent ones to manage the High School project. From 2D drawings in CAD, the 3D modeling was constructed in Revit. Plans, sections, facades, phases, scheduling/quantities and solar analysis were generated. Then the Revit file was linked with Navisworks manage to navigate in the project, simulate the clash detection, renderize the model and simulate the timeline. The use of these two superior softwares of BIM, indicate a clear framework of its

necessity for a better presentation of the project, increasing so the quality, simulating the cost, avoiding errors, and controlling the time. It was a case study presenting the potentials of BIM, that its interoperability matters, and can improve a whole project, from the design phase to the post construction. It also gives a clear panorama on how helpful it is to work on reconstruction projects, working with phases, chechking for clashes and building in an efficient way.

All in all, BIM conducts all the task that CAD and other softwares can not do. It simplifies the lifecycle of the project, it is userfriendly, and a necessity to both the private and public sector.

5.6 Future Work

After all the research that was done for BIM implementation in Albanian AEC industry, there is still a need for further investigation to deeply understand the necessity and the value of it.

First of all, in this thesis were studied only three major buildings in Albania, and there is a need to look closer into other construction, reconstruction and future project where BIM is going to be implemented. Also, surveys have to be delivered in a greater number of companies, to evaluate the BIM effects, users and the future premises. Measuring the BIM benefits and disadvantages need consistent time to examine the case studies where it is implemented.

Second of all, BIM education for the actual stakeholders and next generations need to be discussed and addressed to the architectural education curriculum in universities or other private training centers in Albania. How the stakeholders and students are trained, will show the awareness of implementing BIM in future works, and the ability to adapt to new technologies and softwares.

REFERENCES

Kong, S. W. R., Lau, L. T., Wong, S. Y., & Phan, D. T. (2020). A study on effectiveness of Building Information Modelling (BIM) on the Malaysian construction industry. In *IOP Conference Series: Materials Science and Engineering* (Vol. 713). Institute of Physics Publishing. https://doi.org/10.1088/1757-899X/713/1/012035

Gray, M., Gray, J., Teo, M., Chi, S., & Cheung, F. (2013). Building Information Modelling: an international survey. *World Building Congress 2013, 5-9 May 2013, Brisbane, QLD*, (May), 5–9.

Bryde, D., Broquetas, M., & Volm, J. M. (2013). The project benefits of building information modelling (BIM). *International Journal of Project Management*, *31*(7), 971–980. https://doi.org/10.1016/j.ijproman.2012.12.001

Bryde, D., Broquetas, M., & Volm, J. M. (2013). The project benefits of building information modelling (BIM). *International Journal of Project Management*, *31*(7), 971–980. https://doi.org/10.1016/j.ijproman.2012.12.001

Lee, W., Wong, A., & Tong, C. (2014). A Qualitative Study of the Software Adoption of Building Information Modelling Technology in the Hong Kong Construction Industry. *Business and Economic Research*, *4*(2), 222. https://doi.org/10.5296/ber.v4i2.6319C

Ahmad Jamal, K. A., Mohammad, M. F., Hashim, N., Mohamed, M. R., & Ramli, M. A. (2019). Challenges of Building Information Modelling (BIM) from the Malaysian Architect's Perspective. *MATEC Web of Conferences*, *266*, 05003. https://doi.org/10.1051/matecconf/201926605003

Kumar, J. V., & Mukherjee, M. (2009). Scope of building information modeling (BIM) in India. *Journal of Engineering Science and Technology Review*, *2*(1), 165–169. https://doi.org/10.25103/jestr.021.30

Alabdulqader, A., Panuwatwanich, K., & Doh, J. H. (2013). Current use of building information modelling within australian aec industry. In *Proceedings of the 13th East Asia-*

Pacific Conference on Structural Engineering and Construction, EASEC 2013. Hokkaido University collection of Scholarly Academic Papers, HUSCAP.

Karathodoros el al.,2013 Governing the implementation of BIM A construction client perspective

Liu, Y. S., Li, H., Li, H., Pauwels, P., & Beetz, J. (2015). Recent advances on building information modeling. *Scientific World Journal*. Hindawi Publishing Corporation. https://doi.org/10.1155/2015/78659

Forgues, D., Iordanova, I., Valdivesio, F., & Staub-French, S. (2012). Rethinking the cost estimating process through 5D BIM: A case study. In *Construction Research Congress 2012: Construction Challenges in a Flat World, Proceedings of the 2012 Construction Research Congress* (pp. 778–786). https://doi.org/10.1061/9780784412329.079

Turk, Ž. (2016). Ten questions concerning building information modelling. *Building and Environment*, *107*, 274–284. https://doi.org/10.1016/j.buildenv.2016.08.001

Czmoch, I., & Pękala, A. (2014). Traditional design versus BIM based design. In *Procedia Engineering* (Vol. 91, pp. 210–215). Elsevier Ltd. https://doi.org/10.1016/j.proeng.2014.12.048

Kumar, B. B. (2016). Practical Guide to Adopting BIM in Construction Projects. *Language*, 1–10. Retrieved from https://app.knovel.com/hotlink/toc/id:kpPGABIMC3/practicalguideadopting/practicalguideadopting%0Ahttps://app.knovel.com/web/toc.v/cid:kpPGABIMC3/viewerType:toc/root_slug:practical-guide-to-adopting-bim-in-construction-projects/url_slug:common-uses-ben

BIM and Integrated Design: Strategies for Architectural Practice by Randy Deutsch (2011-09-13)

Yan, P., Xie, X., & Meng, Y. (2014). Application of the BIM Technique in Modern Project Management. In *ICCREM 2014: Smart Construction and Management in the Context of New Technology - Proceedings of the 2014 International Conference on Construction and Real Estate Management* (pp. 302–311). American Society of Civil Engineers (ASCE). https://doi.org/10.1061/9780784413777.037

Pärn, E. A., Edwards, D. J., & Sing, M. C. P. (2017, March 1). The building information modelling trajectory in facilities management: A review. *Automation in Construction*. Elsevier B.V. https://doi.org/10.1016/j.autcon.2016.12.003

Zhang, X., Azhar, S., Nadeem, A., & Khalfan, M. (2018). Using Building Information Modelling to achieve Lean principles by improving efficiency of work teams. International Journal of Construction Management, 18(4), 293–300. https://doi.org/10.1080/15623599.2017.1382083

Arayici, Y., Coates, P., Koskela, L., Kagioglou, M., Usher, C., & O'Reilly, K. (2011). Technology adoption in the BIM implementation for lean architectural practice. *Automation in Construction*, *20*(2), 189–195. https://doi.org/10.1016/j.autcon.2010.09.016

Zhang, J. P., & Hu, Z. Z. (2011). BIM- and 4D-based integrated solution of analysis and management for conflicts and structural safety problems during construction: 1. Principles and methodologies. *Automation in Construction*, *20*(2), 167–180. https://doi.org/10.1016/j.autcon.2010.09.014

Xu, S., Liu, K., & Tang, L. C. M. (2013). Cost estimation in building information models. In *ICCREM 2013: Construction and Operation in the Context of Sustainability - Proceedings of the 2013 International Conference on Construction and Real Estate Management* (pp. 555–566). American Society of Civil Engineers (ASCE). https://doi.org/10.1061/9780784413135.053

Chae, L. S., & Kang, J. (2015). Understanding of Essential BIM Skills through BIM Guidelines. In *51st ASC Annual International Conference Proceedings*.

Holzer, D. (2011). BIM's seven deadly sins. *International Journal of Architectural Computing*, *9*(4), 463–479. https://doi.org/10.1260/1478-0771.9.4.463

A. Brignola, S. Frumento, S. Lagomarsino and S. Podesta, " Identification of shear parameters of masonry panels through the in situ diagonal compression test.," *International Journal of Architectural Heritage,* vol. 3, p. 52–73, 2008

Seaman, C.B. 'Qualitative Methods In Empirical Studies Of Software Engineering'. IIEEE Trans. Software Eng. 25.4 (1999): 557-572. Web

Zaker, M. (2019). *Doctoral Thesis: BIM implementation in architectural practices : towards advanced collaborative approaches based on digital technologies*. *TDX (Tesis Doctorals en Xarxa)*. Universitat Politècnica de Catalunya. Retrieved from http://www.tesisenred.net/handle/10803/668050 http://www.tdx.cat/handle/10803/668050.

General Services Administration – GSA BIM Guide Series 01 - 2007 Online.

Knight, M. D. (2008). Teams, contracts & BIM. *ASHRAE Journal*, *50*(9).

Lindblad, H. (2013). "Study of the implementation process of BIM in construction projects: Analysis of the barriers limiting BIM adopotion in the AEC industry." *Unpublished MSc Thesis*, (263), 64. Retrieved from http://kth.diva-portal.org/smash/get/diva2:633132/FULLTEXT01

Lindblad, H. (2013). "Study of the implementation process of BIM in construction projects: Analysis of the barriers limiting BIM adopotion in the AEC industry." *Unpublished MSc Thesis*, (263), 64. Retrieved from http://kth.diva-portal.org/smash/get/diva2:633132/FULLTEXT01

Xu, S., Liu, K., & Tang, L. C. M. (2013). Cost estimation in building information models. In *ICCREM 2013: Construction and Operation in the Context of Sustainability - Proceedings of the 2013 International Conference on Construction and Real Estate Management* (pp. 555–566). American Society of Civil Engineers (ASCE). https://doi.org/10.1061/9780784413135.053

P. Raut, Mr. Swapnesh. (2017). Improve the Productivity of Building Project using Building Information Modelling (BIM) Based 4d Simulation Model. *International Journal for Research in Applied Science and Engineering Technology*, *V*(IV), 53–61. https://doi.org/10.22214/ijraset.2017.4010

Politi, R. R., Aktaş, E., & İlal, M. E. (2018). Project Planning and Management Using Building Information Modeling (BIM). *13th International Congress on Advances in*

Civil Engineering, (September), 1–8. Retrieved from https://www.researchgate.net/publication/327834225_Project_Planning_and_Management_Using_Building_Information_Modeling_BIM

Wong, K. din, & Fan, Q. (2013, February). Building information modelling (BIM) for sustainable building design. *Facilities*. https://doi.org/10.1108/02632771311299412

Xu, Z., & Yuan, J. (2018). A BIM-Based Study on the Sunlight Simulation in Order to Calculate Solar Energy for Sustainable Buildings with Solar Panels. In *Emerging Solar Energy Materials*. InTech. https://doi.org/10.5772/intechopen.7416

Shyamkant, B. G., Patil, A., & Pataskar, S. (2017). Cost and Time Optimization for Construction of Residential Building by Clash detection in Building Information Model (BIM). *International Research Journal of Engineering and Technology*, *4*(1), 550–553. Retrieved from https://www.irjet.net/archives/V4/i1/IRJET-V4I194.pdf

Ashwini, M., Patil, R., & Prof, A. (2016). Standardization of Clash Detection in Bim. *5th International Conference on Recent Trends in Engineering, Science & Management*, 520–525. Retrieved from http://data.conferenceworld.in/PGMCOE/P520-525.pdf

APPENDIX

General Questions

- What is your profession?
- How many years of experience have you had in your profession?
- Where is your current workplace based?
- Have you used BIM on any projects you have worked on?
- How would you evaluate your BIM proficiency?

  1) provide appropriate information to other systems or processes for reporting and calculation.
  2) Physical accuracy of the Model,
  3) IPD Methodology,
  4) Calculation Mentality,
  5) Location Awareness,
  6) Content Creation,
  7) Construction Data,
  8) As-Built Modeling,

- Can you present outlines or standards relevant to the level of maturity in BIM?
- Does your company elaborate BIM experience, skills, expertise?
- Do you use BIM for updating and recording changes and revisions so that you can access it easily in the team?
- How do you use BIM to promote collaboration between the design team and the construction team?
- How precise is your Level of Development (LOD)?
  The definition of Level of Development (LOD) was developed by the American Institute of Architects (AIA). According to the AIA document E202, characteristics of model elements of different building systems should be illustrated at different Levels of Development. This clear articulation allows model authors to define what their models can be relied on for, and allows downstream users to clearly understand the usability and the limitations of models they are receiving.
- How do you evaluate the overall performance of your BIM team?
  The following question is to figure out the contractors' evaluation for their team performance in terms of using BIM.
  Survey, Assessment, Test, Evaluation report, Evaluation Program, etc.

Pre – Design Phase

- Can you identify the personnel in the BIM team of your company?
- Who will be responsible for updating and recording the information in the Pre-design phase?
- What BIM authoring software do you use for program and space validation in the Pre-design phase?
- How do you use BIM to capture target cost?
- How do you use BIM for Energy analysis?
- Describe the requirements of model content with LOD in the Pre-design phase.
  According to AIA Document E202, LOD 100 is "The Model Element may be graphically represented in the Model with a symbol or other generic representation, but does not satisfy the requirements for LOD 200." Models include elements such as 1) Masses and are used for preliminary studies, 2) overall building massing indicative of area, 3) height, 4) volume, 5) location and 6) orientation.
- How much historical data do you apply to a new project?
- How have you recorded the historical data?
- What COBie data should be provided in the Pre-design phase?
- How do you evaluate the performance of BIM in the Pre-design phase?

Design Phase

- Who will be responsible for managing the information in the Design phase?
- What BIM authoring software do you use to design in the Design phase?
- How do you use BIM to develop comparative costs analysis?
- How do you use BIM to promote comparative energy analysis?
- Describe the requirements of model content with LOD in the Design phase.
- Who will be responsible for updating and recording the model files in the Design phase?
- How do you use BIM for Clash Detection in the Design phase?
- Do you understand the process of Clash Detection and Design Review?
  The following is a sample process of tracking collision issues.
  1. Assemble Design BIMs
  2. Clash Detection & Visual Inspection
  3. Create Viewpoint
  4. Team review of all issues
  5. Team members resolve issues
  6. Re-assemble revised BIMs
  7. Re-Clash Detection & Visual Inspection

8. Coordination Complete

- How often do you check interference in the Design phase?
- How do you evaluate the performance of BIM in the Design phase?

Construction Phase

- What are the roles and responsibilities of the Construction BIM managers?
- How often do you usually do a coordination meeting with the design team and the construction team?
- What do you do in a coordination meeting? What is the purpose of the meeting?
  1. Facilitate BIM design review
  2. Clash detection/coordination
  3. Discuss technical discipline coordination issues using BIM models
- What should be addressed in the Construction BIM Management Plan (BMP)?
  1. Construction analysis with BIM
  2. Animation/graphic showing installed major building equipment
  3. Usage of digital fabrication
  4. Updating as-built conditions in As-built/Record BIM
  5. Utilization of 4D scheduling and construction sequencing technology
  6. Strategy for updating and coordinating changes during construction into the final BIM deliverable
  7. BIM qualifications, experience, and contact information
- Who will be responsible for managing the information in the Construction phase?
- How do you use BIM to track and update the information?
- How do you use BIM to manage the project schedule?
- What models will be included in the Construction phase?
  Who will be responsible for updating and recording the Model files in the Construction phase?
- How do you use BIM for Clash detection in the Construction phase?
- How often do you check interference in the Construction phase?
- How do you evaluate the performance of BIM in the Construction phase?

Post – Construction Phase

- What should be provided for closeout from Design Team?
  1. Concurrent As-Built Modes -
  2. Record Document Project Drawings (.pdf)
  3. Record Document Drawings consisting of two sets of full size drawings, Two half size sets
  4. COBie data
  3.O&M manuals (pdf)
  What should be included in Operations & Maintenance (O&M) Manuals?
  1. The make, model and serial number of each piece of installed equipment.
  2. The location of any equipment installed in the building.
  3. Manufacturer's documents including cut sheets, installation instructions, and recommend maintenance tasks, testing or other reports.
  4. O&M manual documents should be independently linked to components and systems within the COBie deliverable.
- What should be provided in a contractor record document Deliverable?
  BIM Proficiency Matrix - BIM Execution Plan - Owner's Architectural Floor Plan (Interim As-Built Drawing & Interim Record Drawing) - Telecommunications Drawings (Interim As-Built Drawing & Interim Record Drawing) - As-Built Field Data Set Scans - Operations & Maintenance Manuals (O&M) - COBie Construction Data - As-Built CAD Drawings by Contractor - As-Built BIM Model(s) by Contractor - As-Built BIM Model(s) by A/E - Record Document CAD Drawings
- Can you specify precisely what information was changed from the "as-designed" information to "as-built" information?
- How do you protect Central model file from being copied or moved?
- What BIM applications do you use for Facilities Management (FM)?
- How do you assess the labor's BIM proficiency after completion of a project?
- How do you rate the success of the BIM project?
- How likely are you to recommend BIM to others?

EPOKA UNIVERSITY

0692959940
ncane16@epoka.edu.al
Niki Cane
niki_s16

Kontakt is a Construction company in Albania, known as a major contributor in a vast numbers of projects. It is founded in 1999 , and the works is managed from around 60 closest full-time administration associates a such as: construction engineers, architects, financials, lawyers, designers, and field agents,

During the last years, in Tirana have been built a huge number of residential buildings, units of service, and the utility and social purposes designed, constructed and funded by the Kontakt company.

Date: 03.04.2021
Role: Architect
Place: Kontakt studio
Interview time: 10am

1. What is your profession?

- Architect

2. How many years of experience have you had in your profession?

- 8 years

3. Where is your current workplace based?

Tirana, - Kontakt shpk –

4. Can you define BIM?

Efficient planning ang management of all disciplines in e project. It reduces time and cost.

5. Has your company been using BIM?

We do not use all softwares of BIM, but we have used Revit in 7 projects; Magnet 2, Phoenix, Marga 2, Kadiu Also we have used Naviswork and Dynamo.

6. What aspects of BIM do you use and how effective has it been?

Clash detection in Revit which has not been very effective, Naviswork has been quite effective but a little but difficult.

7. What is the extent of BIM's implementation within the main stages; design, documentation, phase, maintenance?

It has resulted a high quality in the project development, Time management has been successful. No additional cost has been added for using BIM.

8. Did BIM meet a high level of satisfaction?

Yes

9. Who is charged for co-ordinating the BIM on a project?

Usually, the highest skilled person in BIM softwares and the manager of the project (usually the architects). Both of them play the role of BIM manager.

10. Would you recommend BIM implementation on building projects.

Yes.

11. Do you have any BIM training system in your place?

No, but we keep updated with current developments with tutorials.