Identity of the Design Process:
Digital VS Visual

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ABSTRACT

Architectural activities have gone through different changes in the recent time due to the increase of technological improvement and the need to change the traditional architectural work to the modern lifestyles. but for the concern of the identity on the architecture and the Design process is yet to be cleared out. The definition of identity is considered not cleared in the modern time and in the digital world, the approaches under the design process differ from one project to the another and all are guided by the end result which the designer is concerned with.

In relation to the design process, manual ways were the solution to designing of different types structures and buildings. With the technological introduction in architectural design, digital and visual design has been incorporated in the field of the design process. The practice itself became driven by digital technologies, which is illustrated by the different amusing architectural forms.

This could not have been achieved without the huge change in theories and philosophy which started with the use of the new digital media tools for the manufacturing development and design rather than just representations. Implementation of these tools in the architectural educational Is still something being developed by many sectors and considered a huge challenge because these technologies need to be understood and used right rather than being overwelled by what they can offer.

The use of digital tools in the design process and their rapid advances has opened new ways of exploration and architecture thrives to grow from these tools through theories and different approaches

Case studies and surveys from different countries and aspects have showed that there is a considerable progress made when combining new designing tools into the design process, whether it's in the education at an early stage or in a professional practice, mainly because it opening many ways and discovering more suitable sustainable solutions.

Keywords: Technological Improvement, Identity, Architectural Design, Visual Design, Digital Technologies, Architectural Educational, Design Process

ÖZ

Gectigimiz zamandan bugune mimari calismalar bazi degisimler gecirdi, bunun sebebi teknoloji imkanlarinin artisi ve geleneksel mimari calismalarin modern hayata uygun hale getirilme geregi.

Fakat mimarlik ve tasarimin sahsiyetini belirmek henuz netlestirilmedi. Modern zaman ve yeni teknoloji dunyasinda mimarligin sahsiyet tanimi henuz netlestirilmedi, bu tasarim surecinde her projeye yaklasim daha farkli oluyor ve bunlarin hepsi sonuca bagli sekilde yonlendiriliyor.

Tasarim surecine bagli olarak, bina ve yapilandirmalar onceden el cabasi ile tasarlanirdi. Teknoloji ilerledikce, tasarim surecine dijital, gorsel tasarim dahil edildi. Uygulamalar ve alistirmalar dahi bu teknolojilerle yonetilmeye basladi, bu teknikler zevkli yontemler ile olustulmaya basladi.

Teknolojinin sundugu bu imkanlar ve medya araclari olmadan, sunumlarin disinda, teori ve filosofideki bu buyuk degisimler elde edilemezdi. Mimarlik egitiminde kullanilan arac ve teknikler, bircok sektor tarafindan hala gelistiriliyor, fakat buyuk bir zorluk diye algilaniyor cunki sunacabileceklerinden ezilmek yerine bu yeni tekniklerin dogru anlasilmasi gerekiyor.

Bu digital araclarin tasarim surecindeki asiri hizli gelisimleri yeni arastirma yontemlerine kapi acti, ve mimarlik bu araclar ve teoriler ve farkli yaklasimlar ile buyumeye devam etmek istiyor.

Dunyanin farkli yerlerinde ve farkli goruslere gore yapilan arastirmalar gosteriyorki yeni araclarin kullanimi ile tasarim surecini birlestirince, ister egitimin ilk asamasinda, ister profosyenel calismalarda verdigi kolaylik ve sundugu imkanlar ile epey gelisimin oldugu goruluyor.

Anahtar Kelimeler : Teknolojik Gelisim, Sahsiyet, Mimari Tasarim, Gorsel Tasarim, Digital Teknoloji, Mimarlik Egitimi, Tasarim Sureci

DEDICATION

I am dedicating this thesis to my beloved family, my backbone who have always gave me trust, support and motivation in finishing this work. My parents who always believed in me and wanted me to be successful, my brother who I look up to and my sister that I can't live without. All the support and time you gave me hope I can repay some of it someday.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

INTRODUCTION

Increase of technological improvement and the need to change the traditional manner of architectural work to the modern lifestyles. Architecture is a broad discipline. It comprises of different profession field which deals with different activities. These professions include landscaping, urban planning, restoration research, lighting, art, industrial designing, and many others. Design process, on the other hand, refers to the systematic breakdown of a complex project into simpler units that are more manageable. However, steps under the design process differ from one project to the other and all are guided by the end product which the individual is concerned with. Each design process, however, must entail some key steps that every work of art must follow (Bhise, 2016).

This process mainly comprises of defining the problems associated with the project, collecting relevant information, brainstorming and analysis of ideas, a building of model or what is referred to us as the solution development, presentation of ideas to the relevant users, and making the clarification to the design respectively.

While the identity in architecture had many problems throughout history with many philosophers who were overwhelmed by searching for a term concerned with describing a beauty of a building as a work of art according to the Philosopher Nelson Goodman (Elgin, 1997). Goodman considered the building as an art when it achieves

meaning or symbolizes is some way, however others such as functionalists they identify a building by its original intended purpose by the architect or by the way it's built through its structure.

Under this study shaping the identity of the design process will comprise of making provisions to the manner of designing a structure by use of more advanced means that will help in solving the problems and limitations that were associated with the past architectural designing and the general architectural activities while maintaining the architectural principles.

The Expansion of technology across different sectors especially in architecture concerning all different branches such as planning and designs buildings, it created a new avenue of production of different products. It has enhanced the accuracy of operations reduced, providing reports at an instant speed, improving forecasting of expectations and increased uniformity of operation. This advancement has led to operations being done in a digitalized manner. Manual operations are getting diminished and across different industrial work use of manpower is getting reduced in each day. In relation to the design process, traditionally, manual operations were the solution to designing of different structures.

With the introduction of computer-based operations in this field, designing is now operated with the use of computer-related technologies (Frazer, 2016). With a technological introduction in architectural design, visual and digital design has been incorporated in the field of a design process.

The technology in visual design normally used to the creation of the aesthetic appearance of the idea by the use of different images, colors, shapes, fonts, and other elements. Visual design is comprised of a combination of lines, shapes, color palette, texture, form, and typography. To come up with an appropriate visual design, the architect needs to consider the following; maintain unity of the elements involved to avoid dull or overwhelming the design, ensure equal distribution or what is referred to us as balancing, contrast where the main focus is to ensure that every element is standing out, identification of range sizes, have one element as the focal point, and to ensure that there is coherence or continuity throughout the design.

Shaping design process will imply to coming up with a different means of designing a structure by use of different approach, techniques that will create a significant solution to the past problems that were affecting the design process. This will not mean that the architectural principles such as the educational sector will be avoided but to add more value to the design practice and to enhance its effectiveness in a structural building.

Different computer software have gone a long way in evolution from many aspects to coop with the technological age and their advancements, designing computers were all about adding power or make them more portable affordable for different groups of people and now not so long ago laptops became a very important element in the designers life they have gone greatly more powerful not only by components but also but abilities such as drawing with pen or having gestures and sensors that follows your hand or eye movement and thanks to the pascal and Nano technology you can house a laptop with great power that goes with you .

Combining this advancement with another advancement with the software languages and programs in hand such as the AutoCAD the SketchUp has been created with the main reason of changing from manual based architectural design to the machine-related style that is aimed at changing the traditional perception of understanding that only hand sketching is the most solution to architectural work. Making the process of drafting and preparing blueprints an easier and more precise method.

1.1 Problem Statement

The advancement of technology in architecture have shifted the whole process to a new level, with each new innovation architecture is getting more complex but yet more accurate and sustainable in terms of visibility, complexibility, presentability and understandability.

The design process itself became consisted of many steps to comprehend the outcomes of many different users and to deliver a variety of solutions that weren't possible before. however, with every step taken forward a confusion can be left behind, while these advancements are growing within the architectural understanding, it is not yet well in reach for everyone, neither it is well explained or taught in the right way.

Technological advancements were spread in a pace that was too fast to get well understood for different sectors. This effected the adoption of new methods in architecture while relying on traditional approaches, and the design process that is being given in the early stages of education.

The main problem of this research is to deal with Identity of architectural design, Architectural design as a process and the Perception of architectural design.

In response to this problem, this thesis will examine the understanding of technological advancement in architecture throughout the history, while discussing some of the theories outlined by some of the most successful architects, analyzing some of the changes that happened to design process, and comparing some of their methods to the new digital tools such as the 3D Rendering and Virtual Reality, and how it has been affecting the visual perception in the designing process. And suggesting excepted directions for further developments within the context of this research.

1.2 Aims, Objectives and Research Questions

There is no doubt of how technology changed our life, and it devolved the architecture sector rapidly in the recent years. However, there are still some issues related to the use of such technology in the design process and its impact on the architecture identity. for this reason, this study aims to clarify some design approaches and their future adoptions in order reaching a better understanding of the technology involved around us so that architects may integrate them in their daily practices.

In this thesis we will see the different understating's of architectural identity during different times, and the process of Architectural design within the new technology tools with their integrations and implantations, in addition to the Perception of architectural design in its current form, while answering questions within this context.

- How does the new digital tools effect the design process?

    Since we are aware that digital tools are getting advanced and popular, we are trying to show that integrating them into the design process can take the process to a whole new level.

- What does the technological advancements bring to architecture?

With this we are intending to show the new possibilities of new technology in the architecture industry.

- What are the best strategies of adopting the new tools in the design process?

    Since new tools are being used in architecture, we are trying to show when and how to use these tools in the right context.

- Does the use of new technology eliminate the traditional methods?

    Everything technology reached today is based on the progression of traditional tools, so our intention is reaching a middle point between the two method's.

1.3 Research Methodologies

Qualitative research is used through Data collection and reviews information of the two main topics of the thesis. One, digital by it all means and how it is defined and second is visual. after collecting their information, the two main topics and their data are compared against each other to give a final conclusion on which method is more promising and contributes better for the design process.

The theoretical parts of the thesis are based on Literature review and sources form internet, articles and books. Thus, one of the methodologies followed in this study is descriptively using comparative and historical methods, and it's used to provide information about what is considered digital form the early ages till this time and what it brings to the architecture and its identity.

Literature review also will used to showcase some analysis and observations from published and literature sources to deliver an assessment and summery for certain topics. Finally, there will be some critical observations on digital data sources and surveys from internet pages.

1.4 Limitation of the Study

Limitations in this study discusses the effect of technological advances on architecture in selected aspects, mainly because this thesis focuses on the bases of what design process is about and how valuable it is for architecture as a whole, and in doing so it is important to understand what identity is in architecture and what factors are linked into deciding what it is, in addition to understanding the contemporary understandings of the identity. While it is crucial to explain the methods of past ages and their understanding of technology and how they were using advanced techniques in their time.

Second limitation of the study is the case studies and surveys, many of the data and information collected based on the latest and most common technologies used, may may have some different outcomes from our perspective.

The case studies gave us an insight of how beneficial if new methods are used and integrated into design without eliminating any old approaches and the surveys shows how popular certain technologies are used and shaping the industry. The data were used to compare the main subjects of this thesis in order to give an outcome.

1.5 Structure of the Thesis

The thesis consists of 3 chapters. It will be divided into sub-units and each section will be concerned with the discussion of different architectural related subjects that in cooperatively will help in how the advancement in architecture has helped to solve architectural related problems.

Chapter one is about the general impact of technology on architecture and what it could affect other aspects, and defines the aim and limitations of the study by showing the methodology of the research.

Chapter two is considered with literature explanation of:

1- Identity, the understanding of identity of architecture through different times, and what can be offered to this understanding.

2- Design process in architecture, also the understanding of the design process in the modern times, and the tendencies of the design process in the educational sector.

3- Devolvement the concept of digital and the understanding of that concept throughout the history, while discussing the most influential leaders and architects of that concept.

4- How visual is being produced and what are the contemporary understating of visual through architecture.

Chapter three is about case studies and surveys, analyzed and explained in order to support our ideas and aims, in addition to the conclusion of the thesis study.

1.6 Theoretical Main Streams of 20th and 21st Century

It is important to understand the reality of design process, the involvement in making a deep researched analysis for a defend problem to come up with different concepts and ideas that helps solving a problem and yet having to choose to most reliable one.

Parametricsim lately provides a motivation for a very deep design end reflection. It follows a set of integral methods, which is part of the feature associated with its operations. Some design project can make use of same methods but that and they can

also differ in processes involved. This is because of the fact that design process is open to observation while the design methods are inferred implicitly (Schumacher, 2009).

Informative theory, for instance, is concerned with the description and the explanation of the architectural design. Normative theory, on the other hand, is concerned with the determination of how design ought to be conducted.

For the rational design process to be effective, all the required statements must be provided and the design process should be based on the theory that is aimed at solving the problem and will be linked to the informative processing theory of cognition which transforms the state of a problem. In the past, the architectural experts spend a substantial amount of time in constructing a 3D model to conceptualize the picture of the building or any other structure.

With changes in technology, many have come to realize the essence of technological advancement in using computer-based design software to solve design process related problems. With the use of 3D that is detailed, the speed of completion of any work of art has been facilitated. In addition to the speed of completion of the any work of art, design software has helped in detecting mistakes before they scale the effect such as wastage of materials, labor and time of the entire architectural work (Schumacher, 2011).

It is also important integrating this understanding of the design process into the architectural education, other than introducing many theories and approaches to design process, the introduction to courses that includes perspectives and experiences about the new technologies and 3D tool that changing the reality of design process these days

to enable students interactions between their real time works within 3D environments and the current statues of reality of the architectural profession, By investigating some studies about the including digital tools into architectural education the argument of the way these integrations are included can be made on many levels.

Mainly to the huge challenges it brings on keeping up with the technologies because it's in a constant change, its reflecting to the educational sector on how it should handle the outlines on teaching certain methods of these technologies making it a very important aspect to keep working on the reach an acceptable tire of understanding for both students and instructors (Schumacher, 2011).

Also, by my observations of some case studies of the structural design's creations were based on 2D hand drawings. This was to help designers to draw a picture that will represent the ideas which they have in their minds and then communicate them to the interested clients. This process required much time, due to continuous erasing and refining images and blueprint. In the current world, technology has helped do away with the problems which were associated with designing a structure.

Introduction of Computer Aided Design and Drafting (CADD) in the 1980s led to the total transformation of the construction industry in relation to new standards. plans created by a software such as the AutoCAD by the Autodesk Company. it was mainly aimed for the mechanical engineers to aid them with their creation of blueprints. later It was developed more to include architects civil and electrical engineers. And those who master the ability to work on such software's are called drafters.

The construction industry was the main use of the software of CAD it was a huge success due to the mass adaption by many professionals. But in the beginning most available computer were unable to handle the everyday work of 3D modeling.
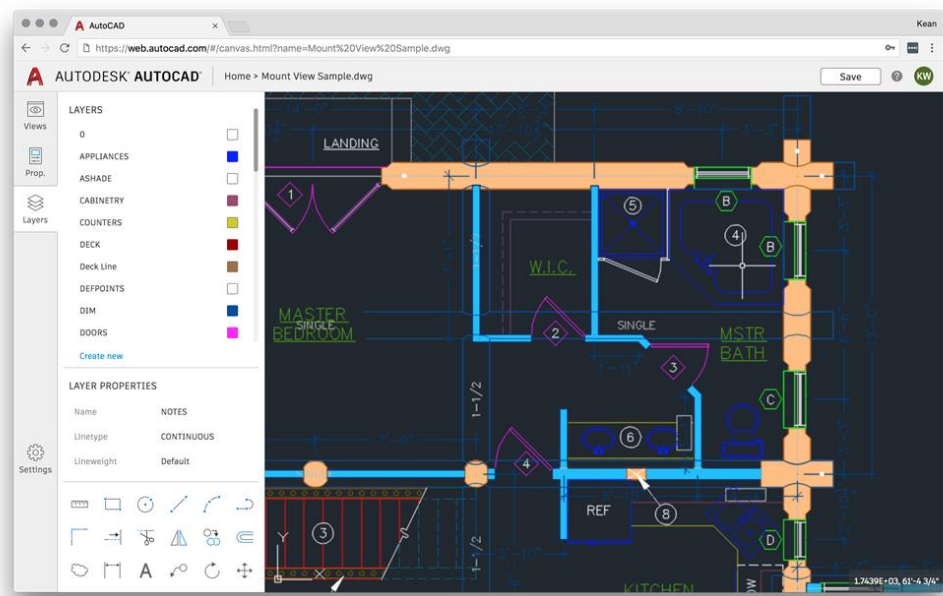
Figure 1 : AutoCAD Program (Autodesk)

AutoCAD was being devolved constantly to coop with the new modeling algorithms analysis and management of products that get created. Designers began to create and design in much faster pace starting in 2007 AutoCAD main objective is to integrate simple direct 3D modeling functions in their products. There was a need for a true communicating in an unambiguous method of imagining.

With their continuous use later on, more limitations and other problems started to show up and affected the functionality of CADD, such as failure to provide maximum efficiency between the designers and project managers, need for other solution arose.

As the problem was not solved, it ushered in introduction of another system; Building Information Modeling which is abbreviated as BIM.

This system has the capability to process data related to geographic, geometry, light, space, quantity and properties of a building are integrated, is a computer revolutionary software that is used by designers to create a 3D model and a structure such as a building. Introduction of BIM has contributed substantially to a maximization of worker efficiency and their productivity can be attained easily (Fukuda, Mori, & Imaizumi, 2015).

Approximation of all the expenses that building will take in the past was a problem. In most cases, the amount that was approximated to the completion of the structure was ridiculous.

BIM appropriately provides estimates costs that will be incurred until the completion of the project with real time materials with their whole specifications like dimensions and cost with different sites that supply whole models for a lot of products to be immediately incorporated to the project.
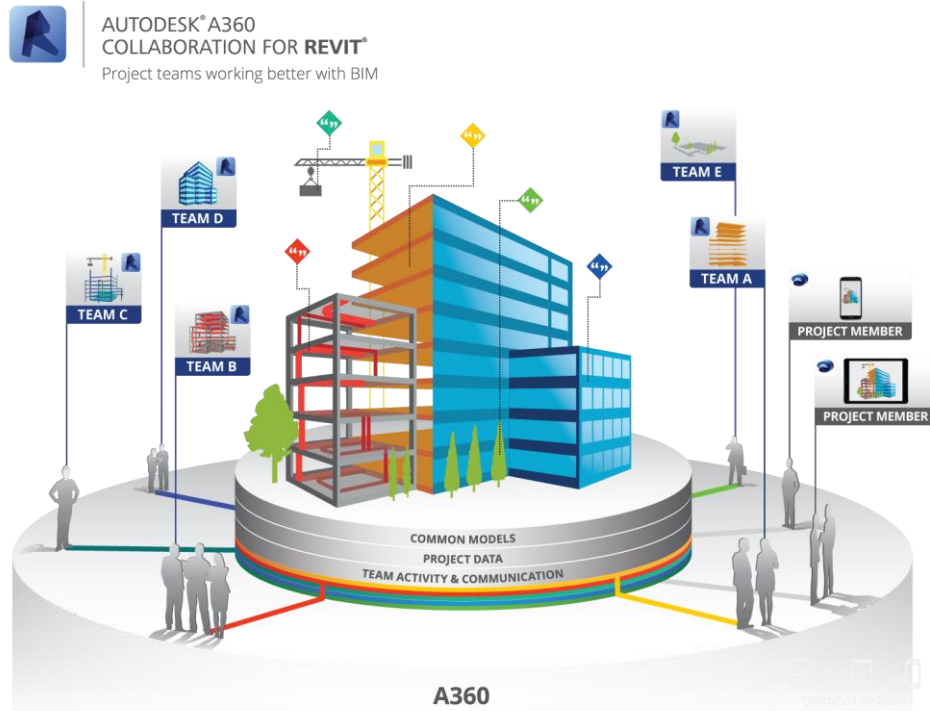
Figure 2 : Revit - Project teams working better with BIM (Autodesk, 2015)

Communication across all the teams in a project is a big challenge. In traditional time, there is to many participants with a lot of interactions between different sectors that could lead to a lot of problems that would increase the period of completing the project, wastage of some resources and may lead to complete disagreement between parties of the project (Rost et al., 2016).

With BIM, sharing of data among the involved individuals has been enhanced thus increasing collaboration of the team in a given project. However, CADD was able to detect some crucial areas that may affect the project; it was not providing these signals at the right time.

With the use of BIM, the involved individuals in the project can readily identify the cautious areas, as the system has the ability to detect, forecast any issue in the project

and most importantly to the joint work of clients, designers, engineers and any relevant individuals within a single process.

Using limited resources with maximum returns is the goal of any individual who is associated with a new structure. Workers who are employed in a given project are not expected to overpay for no appropriate economic. use of design software in architectural design will help in ensuring that communication is enabled, costs are minimized, a mistake is detected and proper measures are initiated to solve them, and forecasting in enabled in the project process.

Architecture has always been able to shape the society through different ages in improving the aspects of lives, and nowadays the ole of architecture is in a constant change phase, it's trying to incorporate new approaches for a better solution in future societies. In this context architecture is having identity issues that causes difficulties in using new technological tools and philosophical foundations, it's an advancement phase that keeps having obstacles by wrong uses and implementations of different tools without knowing the complexity of our world reacting to the misuse of technology.

According to the previous studies, technological changes in the areas of the design process has looked into the application of modern technology in architectural activities in combination with the local elements, congruity with the local constraints and preservation of the cultural values and other principles of architecture as used in the construction of different structures. With this attempt, however, there is no clear evidence that has revealed the influence of technological advancement in enabling the design process in the architectural field. However different sectors concerned about

architecture are trying to find innovative ways to cobranded the new technologies to the modern architecture.

Many have become aware of the necessity to assess the impact of these tools to the identity of modern architecture and the design principles, with the relation to the visual design thinking process and its interactions with digital tools, also how the education how it handles this influence.

Many theorists and researches presented different claims of all types about the modern architecture and no one can have clear picture of the contemporary art and architecture.

The purpose of this study is to clear some uncertainties in using new technologies in making digital modern architecture and discussing a framework that encourages absorption of the new tools with all their associated philosophical indications. in order to do so, will be undertaking some general understandings and analysis of many related areas of architecture. Mainly the ones concerned about the experiences with the use of digital tools and their developments in the current state of architecture. This will allow us to see through some divisions that we usually overlook, and evaluate the true impact of using such methods.

Chapter 2

LITERATURE REVIEW

Within this study the consternation was done on the extensive review of related subjects and material including books, surveys and journal articles in a way to show the need of understanding digital and its comparison to the visual.

The basic stand points started with the 10 books of Vitruvius but it is needed to give the whole understanding of technological advances beginning with the Romans and Greeks. Technological advances in architecture can be traced back to the Romans and Greeks periods.

 The Greeks always take the credit when it comes to building foundation in all of western cultures, mainly because of their innovative contributions in different aspects. And just like any civilization, the Greeks learned from their past and reached new adaptation and ideas when met with other cultures, which later on made them develop their ideas such as the columns, stadiums, mathematics, geometry, medicine and human sculptors which led to a unique world culture (Cartwright, 2017).

The romans managed to learn certain buildings techniques form the era of Etruscans, those techniques included the arches and vaults methods, which eventuality made the roman engineering progress away from the Greeks who preferred post and lintel methods. The vaulting methods the romans learned were based on geometrical forms

16

which had many other forms also such as the segmental vault. They used tiles to cover up the vaults which the basilica of Constantine is a very famous example in Rome (Humphrey, 1998).

The development of the vault led to the creation of the dome which also led to making vaulted ceilings of large public spaces like the basilicas. The romans used the dome methods constantly in their architecture with complex shapes and forms a famous example is the Pantheon (Humphrey, 1998). And their methods got better when they started the development and use of concrete that helped them making larger bridges in their monumental designs, which the Greeks couldn't achieve because of the weight of materials of the large areas in their post and lintel approaches. The romans managed to construct huge walls over many levels that covers massive halls that allows a huge amount of people resulting in creating the great pantheon.

Many of these approaches mentioned were with the help of Euclidean geometry. it uses a system made the by the Greek mathematician Euclid of Alexandria he was known by as the founder of geometry, his works were the most impactful in history of mathematics by forming a base in his book the element that got used by education till early of 20th century. The Euclidean geometry got famous and used for over two decades mainly because it was more convincing than any other geometry (Humphrey, 1998).

Greek sculptors also meant to produce an ideal art form with the ultimate beauty while the goal of a roman artist was to a realistic portrait with the decorative appearance as the main goal (Adam, 1966). Many of Greek objects adorned the utilitarian objects just as the Romans adorned the space. The sculpture such as the Venus de Milo is

associated to Greece while mosaics and frescoes can be associated to Romans. Both of these countries worked in the different medium. For instance, Greek pottery was popular in Italy imports.

The art and architecture of Romans and Greeks provide the history of Western Art. It establishes key concepts styles and techniques that artists and architects are imitating in the current world. This can be seen in carving, casting free-standing structure, buildings which range from the use of marble, bronze, and concrete. Their inputs created a breakthrough to the establishment of new styles and technologies in architecture (Adam, 1966).

With this innovation, the issue of classical orders which help in defining the column style came into operation. During the Greek period (700BC to 323BC), big columns were introduced in Greek and they were used to build great temples such as the famous Parthenon in Athens. In building smaller temples and its interiors, simple iconic columns were used.

In the Hellenistic period (the period from 323BC to 146 BC), Greece builds elaborate structures which mainly secular and temple buildings which had both Corinthian and iconic columns. This period further, Greece was high in ruling Asians and Europeans. After conquering of Greece by Roman Empire, the Hellenistic came to an end. The Roman period (44BC – AD 476BC) the Romans heavily borrowed the construction styles from Hellenistic and Greece while maintaining the ornamentation of their houses. In addition to composite styles and Corinthian columns, the Romans used decorative brackets during their architectural activities. At this point, concrete style helped the Romans to build domes, arches, and vaults.

The basic stand points started with the 10 books of Vitruvius where the first-time technology was presented as a tool for designing buildings based on guides as well as planning and designing other structures of different sizes with precise measurements

Technology of design planning and construction can be traced from the historical perspective. According to Vitruvius Roman architecture, architecture can be distinguished based on beauty, function and the consistency as the main feature. These are part of the considerations which are being put into practice by many civilizations across different regions of the world.

In most cases, architecture is assumed to work in a material form such as a building. Use of a building to enhance the understanding of an architecture under this case, culture in relation to a building is assumed to be a symbol of any work of art. Architectural as a term may also be used metaphorically to mean a design of an organization and abstract concepts.

Vitruvius believed a good building needs to satisfy the three principles. A good a building should have Durability that building needs to be robustly standing remain in a working condition in order to give long-term services. Another principle is the utility. In main stream of this we can assume that a good building needs to offer the services it was meant for (Vitruvius, Rose, & Müller-Strübing, 1867).

Vitruvius believed that incorporation of mathematical principles in architecture is a crucial issue which every construction should be based on. According to his statement, he insisted that there is need to have a symmetrical feature with temples and the only

means that this will be achieved is by incorporation of mathematical principles in every temple construction (Hubka, 2015).

Ten books of architecture got rediscovered again in the renaissance period by Alberti, and Alberti started writing his own books on architecture. And the Renaissance is derived from the concept of roman humanities and the rediscovery of classical communities such as the Greek philosophy. According to Greek philosophy, man is the measure of everything. This was later manifested in the radical change in architectural field, politics, sciences, and literature. The earlier developments can be traced from oil paints and skills of making concrete. Invention of metal movable such as clocks, the effect of the Renaissance was not affected uniformly in European countries.

If we look at the Renaissance period of art and architecture which covered over 200 years between 1400-1660 of paintings drawings modeling and architecture. it was coincided by development of humanism the use of classical elements their way of imagining designs and spaces by creating an accurate representation in three-dimensional sculptor from wood. this led them to perceive problems that could face them in extended periods of time in the current era of architecture. this method reflected the existed institutions and some of these sculptures are kept and preserved in museums in Munich.

Reaching Palladio who managed to create the term "Palladianism". Palladio made his own interpretation of the earlier movements. he introduced the concept of a roman architecture that adapts to all social classes and was very popular in designing villas

and houses for the aristocrats (Kerley, 2015). Palladio glorified these results from Alberti leaving messages for the baroque.

The Baroque was not a style used on everything or was meant for all classes of people, it was mainly for churches and palaces. It included curved forms, a group of elements gathered, using distortion on certain design elements and the use of long columns and large volutes to increase the interplay of shadows and lights between them (Przybylek, 2018).

The messages of palladio also got transferred to the Neoclassicism, the rebirth and restoration of Classicism, even that the main reason this movement appeared was about literature and poetry but it had effects and inspired a variety of artists. Neoclassicism continued to feature Rationalism and it continued till the first opening of the architectural academy in France (Rafiq, 2016).

Age of reason were people started to institutionalized the knowledge. It is when enlightenment became a part of the architecture in the encyclopedia. Influenced by the Enlightenment, the Romanticism managed to house many influenced styles from Gothics, Greeks, Neoclassical and baroque. It was meant to be a reaction to the increasing rationalism around the age of enlightenment which also were against the excessive Baroque and Rocco style (Bhamvani, 2014).

Technology as a term has entered into the contemporary literature of architecture in the recent time. Despite the fact that this term has been used widely and in significant areas, there is considerable ambiguity and inconsistency that has been confirmed relating to the use of this terminology, technology refers to the study that deals with

the use of methods, tools, and approaches that can be used to change the available resources into useable products. Others have also defined this term as the systematic application of science in the issues of an industry that can be generalized with other non-industrial operations (Zanni, Soetanto, Ruikar, & Management, 2017).

With these definitions, four main factors of technology come into play. These are technology consists of tools which can be in form of human, information, foundation, and technological tools itself. This, therefore, will mean that these factors will interact with each other in a coordinated manner to bring about an impact on technology.

It is important to note that the elements that are inherent and the reason for studying technology are classified into three categories; foundation, skills, and data. Skills emanate from the human mental ability that can be used to do a specific task (Gage, 2016).

Gothic and late Gothic architecture that lasted from the mid-12th century to the 16th century, the architectural style of buildings had a specific feature that got characterized by depth of spaces. And it solved many problems related to the tall structures (Britannica, 2009).

These features and style later on had a huge impact on the basics of the technological development of the renaissance period, one of most famous artists that featured in the renaissance period is Filippo Brunelleschi , he was the first to produce free standing sky holdings without any supporting's, and with vertical crowns for shifting the walls on top of the building , it got achieved with his masterpiece the dome of the Florence cathedral (Editors, 2014).

Another Technological advances that shaped architecture is the industrial Revolution which was an influential time that changed the way architects design their structures till the 19th century. during the time in the industrial Revolution it witnessed the revival of old traditional architectural elements and forms such as the classical design gothic and renaissance, however it was still unique how the architects started innovating and integrating new designs with the new materials that got available to them.

This movement focused on looking at the future with the new designs rather than the aesthetic of the past styles. The main characteristic in the visual element was shown in the mill buildings and modern factories. they were made of wood or stones straight forward with repetition of forms with openings that goes with the form. As for the longer buildings they fit with surroundings into the landscape. these first mills had the technology of their time like the fire safety and workspace safety. The Crystal Palace designed by Joseph Paxton, which had the Great Exhibition of 1851, a first early example of glass and iron and construction design (Jevremović, Vasić, & Jordanović, 2012).

Before the invention of electricity these buildings should have natural sun light as much as possible. it was design long and narrow and to host machines and workers as much as possible because it allowed the light to come to the center of workspace and enables the machines it to work on both sides of the building and to be powered by a single central shaft. the design of these buildings is simple it reflected their nature, in the earlier times buildings used to be reflecting their social level of importance unlike the royal structure churches which used a lot of ornament (Jevremović et al., 2012).

Albert Kahn had a famous example of this design is the Packard Building No 10 the first automobile factory to be made from reinforced concrete with span of 10m which provided flexibility in the interior design and made the many openings in the celling to allow more sunlight with concrete frames the exposed the insides and interior spaces. He made all of this to improve the manufacturing process so that the exterior reflects the interior (Hyde, 1996).

Adolf loss also with his founding's and contributions to the Bauhaus the simplicity of buildings expressed by the exterior design they were important to the industry (Hyde, 1996).

The term "Arts and Crafts" was a movement that started in around late 18th century to revive the handicrafts and to inspire the bungalow styles and Craftsman. one pf the founder's English reformer William Morris he was bored of the repetitive style of the Victorian architecture and the machines industrial age, Morris aimed to return to the handmade a pre-industrial society and to make custom made furniture available and in reach for everyone.

The key elements of this movement was the use of natural materials like the houses are made of wood bricks and stones, custom made and built in furniture like the cabinets are made to match the house that it got built for, the use of fireplaces in the living rooms with a chimney because it represented a symbol in the Arts and Crafts movement, porches with round supports , low roofs with wide edges and eaves, making the columns inside the house exposed with an open floor kind of plans like the Victorian houses (Munce, 1960).

In addition of making high quality natural products, solving space related issues was also an important factor, St. Francis Court built by Sylvanus Marston an architect who studied the crafts movement well who managed to solve problems related to density by creating an illusion in the space.

It's also worth mentioning the Deutscher Werkbund their main goal is to improve the quality of German manufactured designs it is mainly based from arts and crafts but it got the intention of German most influential architects Walter Gropius, Mies van der Rohe (Munce, 1960). In addition, two of the most famous well influential industrial buildings came to existence. AEG Turbine Factory designed by Peter Behrens and the Shoe Last Factory designed by Walter Gropius and Adolf Meyer both are regarded as a "temple to industrial power".

The Bauhaus School became the biggest impact on modern architecture founded by Walter Gropius. The main aim of Bauhaus was uniting different aspects of arts and design (Pierre, 2018).

More modern approaches began to rise with the modernism and the international style. The beginning started with Louis Sullivan and his approach of form follows function, the continuous understanding Frank Lloyd Wright (Condit, 1973). Late Modernism after that tried to conclude modernism and rejects what is hated to make a better understanding of that era.

Understanding of architecture and how it has been influenced by technology, theories come into play. However, not all theories may bring out the real picture of architecture.

This is because of the fact that some theories may miss out some vital components that any architectural discipline needs to have.

For instance, a theory that assumes the cohesive of a system of communication may not properly provide an understanding of what really architecture is and therefore may be viewed with suspicion. Relevant architectural theories, therefore, will have the Ability to grasp, appreciate the pervasive reality of great and distinctive entities what commonly referred to us as the unities that will provide societal structures communication. In addition, these theories will have to shed light to community virtues, bring out the achievement of differentiation and atomization in the very community (Harman, 2018).

Theoretically architecture was described as the cohesive entity from the point of view but it is made up of independent identities which work cooperatively to aid the process of communication (Gross, 1985).

This theory has contributed much to the understanding of architecture by providing the components bases, the principles behind the functionality of architecture and further scaling up the architectural levels in the current world. And Humanism focused on the big value of values and ethics of humans in their communities partially the critical thinking, and it had many meanings that raised and made some movements about it succeed specifically in the 19th century, Also the Platonism named after the Greek philosopher Plato who had an institution for written dialogues in different form in philosophy (Gross, 1985).

Human thinking process is a state that starts with our assessment of the world around us though our senses and the thinking part is where we manipulate and play with information to make ideas and concepts or to get involved in finding a solution, while reasoning process is where we take the evidence that sounds more acceptable to from some form of a conclusion.

For instance, psychologist Jean Piaget started the theory of cognitive development that tries to explain the behavior of humans by understanding their thought process through patterns of what they know and what they experience to be transformed to constructive thoughts.

It was adopted in many research studies and many simulations tried to implement it computerizes is as a relative to the human version of a problem-solving process. Integration of such a framework within the boundaries of architecture needs a fundamental conceptual change. It dictates that the human or the machines which stimulate human activity is substituted by the social systems of communication as the main reference to the theory.

While some could argue that architecture can be seen as decisional in the design process, still architectural decisions address architecturally significant requirements by taking the right decision in the right moment and these decisions are not mainly presented in the final end product (Fowler, 2003).

It gives an explanation of the complexity impact and influence on how the design process can hinder changes on convincing concepts of the design process rationalities which are mainly affected by the increased complexity of the design work and the

continuous changes of innovation. In addition, the shift of the traditional expectation in the design process can also be influenced by recent proliferation and the rapid evolution digitalization of the design process making many to embrace the new technology in design. However, there were critics that faced the increased embracement of this design changes (Kusno, 2014). According to Ali Rahim, new techniques in design are essential as they create new advances in the design. He added that new techniques however good they are, they are associated with risks which can fuel tremendous problems.

To avoid such problems, it will be the task of the involved manpower to forecast the cost-return effect each technique will be associated with the project. according to Ali Rahim's Recent mainstreams in understanding architecture designs shows a possibility that the design theory detects changes and investigates the stabilization of normative potentials within the maturing avant-garde and the risk of techniques becoming routine and static over time in which these techniques are led by a process. an evolving process that makes the design process a non-stable practice (Schumacher, 2011).

It affected the inability to give sufficient attention to the recent proliferation of new techniques. It is only concerned with the degree of the extent technique drive, that contemporary avant-garde can develop a methodology which can match with its increased inordinate desire. What is assumed here is that the avant-garde which is contemporary is changing to a new stable hegemonic style and to determine the extent to which the contemporary design can exclude any change to convincing concept design process rationalities. For this to happen, there is the need for architectural autopoiesis to provide a framework so as to enable the functionality of the upgraded design process in giving criteria that do not depend on styles.

2.1 Identity

It is assumed architecture held a single identity through different periods of time. This approach can be seen used within the traditional architectural design, and other areas like preservation and history and some literature related subjects that gives value and meaning to architecture.

Portraying these ideas in the built environment can show the architectural identity as constructed physicality, mostly the designer's idea in that scenario is what giving privilege to express architectural history as a continuous portrayal defining the historical advancements of built across time. Therefore, these ideas and representations of architecture which can be accounted as traditional are representing the architectural identity as permanent and stable entity (Tran, 2010).

Even that traditionally it is accepted that these different ideas and beliefs of identity are problematized when showing on the social and post structural values with new ideas on the historical and cultural formations.

We discussed before identity by definition it's the features that a certain object or a person has. by referring to 1600 Gottfried Wilhelm Leibniz who is German philosopher who defined the terms of identity in case of an object can be distinguished from another, if the first object shares absolutely every characteristic of the second object, including positions shape size and expense in time and space, then these two objects are identical and they have bond and the relation of identity (Forrest, 1996).

But identity in architecture often is shown as a historical related existence, persevered within the design of a building that considered as heritage or is a history and literature.

These concepts of detentions are expressed by many theorists such as Bourdieu, Foucault and Barthes. it suggests the meaning of architecture is by what has been built essentially it is reflected by the intent of the designer, this meant architecture had a conclusive identity that through history it progresses with a perfect statue with time (Tran, 2010).

Identity in architecture can be also identified in another way, for example it can be the identity of a certain architectural style or movement which is reflected in also structures and buildings which also effects the social values that it creates around it. Architectural identity of a certain cultural is represented by the built environment produced by a community that kept accumulating their efforts over time to hold such meanings (Nooraddin, 2012).

The basis of main ideas that prompted and influenced architectural identity becomes not clear, shifted and questioned. even it was accepted these concepts of identity had problems when forecasting social and post structural proposes into the cultural historical transformation of meaning onto an architectural context. Theorists mentioned above offered a substitute way in grasping built form related to cultural historical relations.

By doing that it means the identity of architecture is adaptable through history and culture and gets transformed in nature, this proposals challenges illustrations of what got built and presents a lot of questions to the justifications of concepts that considered not transformative in architectural values (Tran, 2010).

2.1.1 The Contemporary Understanding of Identity

Within the context of architecture and its identity and with the recent technological advancements we can assume the possibility from the previous definitions and statements that the identity can be reflected by the style begin used.

The modern architectural identity in nonwestern countries are influenced directly by the Western architecture. The implementation method of this architecture was done through decision making with a little local participation. Moreover, many of these countries are influenced by the same system which enabled elite groups in deciding the identity of architecture in these countries in a certain time. Many have speculated if the whole concern of architects is to focus on the mass of the building or modifying their designs to meet the elite groups visions and demands (Nooraddin, 2012).

Channing the city architecture has been also linked by changing the elite groups. It was done through history with different methods like rebuilding or restoring buildings and changing the layout of the city to make a new city with new architecture. Examples of such movements are the street planning's of Aleppo and Damascus city during the Greek age to uneven shapes and irregularities during the Islamic period. Washington is also got their layout changed and submitted in 1791 and made a huge change in the western society that faced 3 revolutions through their history (Nooraddin, 2012).

Further more modern architectural movements have managed to create more elite groups, these elite groups are the famous architects, and each single group tries to make the perfect architectural identity with the assistance of emerging movements and styles. other aspects such as architectural education contributed greatly to keep this tradition to keep achieving the goal of controlling the identity (Nooraddin, 2012).

31

However, the architectural identity had moved from being a reflection of the local traditions and aspects to more of an abstract reflection using different lines, materials, shapes and masses as elements to shape their architectural identity. And as a result there is many cities that got transformed into scene of many architectural identities like Paris, London, Dubai and Hong Kong (Nooraddin, 2012).

The main challenge was how to apply a certain architectural style or to ensure a certain identity is used while at the same time considering the nature of local identity and cultural realities of the city. This conclusion prevented the architectural identity from becoming not only a product but also becoming a living process (Nooraddin, 2012).

In this chapter it was discussed the origin of two important items:

1- Identities: the meaning of existence persevered within the design in architecture

2- Styles: the current identity reflected by a technology in a universal language of a certain period of time (Hastings, 1910).

Later (chapter 2.3.1) It will be discussed further and shown the origins of multiple styles and identities as what is considered a technology in each of the styles within their period.

So, when the investigations about shaping the identity started, it's fair to talk about the current state of the identity. Even the current of the identity is obviously hard to locate, however the understanding of contemporary style can be sufficient explanation of the current state of identity.

The architectural style is distinguished by the features that identifies a building or

making him a monumental notable historically. Most styles include many marks that identifies a regional identity such as methods of buildings and their forms. architecture is also considered to have a chronology of styles that have changes by time and that change gets applied to believes and religion of that time, in addition to the emerge of new concepts and ideas or the innovations of new breakthroughs that helps making a new style. therefore, styles are made from a reflection of society in an historical era making many styles could be the trend of a certain time, and architect of that time adapted to these new ideas (Tran, 2010).

We can propose that the current style of architecture can be assumed is the contemporary architectural style which refers to the architectural structures which were built after 21st century. Across all architects, there is no single style that is dominating in any region. Different styles are merging from postmodern and high technology architecture to highly conceptual styles.

These different styles comprise tube structures which allow construction of houses which are lighter and are lighter than those that were constructed during the 20th century. Mainly, these structures ate build it the aid of computer aid design that allows houses to be built on 3D models (Fukuda, Mori, & Imaizumi, 2015).

Some of the features of these structures include the use of glass or alluvium screens, symmetrical facades, and the cantilevered sections. Traditionally, the monuments were only concentrated in United States of America and Europe only, the contemporary styles are spread globally.

Important new buildings have been built in India, Gulf state Middle East, Russia among other countries. Landmarks of contemporary architecture are the small groups of architectures who operate on the international scale. Striking work of contemporary styles are the museums, which provides a good example of sculpture architecture and they represent the astonishing work of architects. For instance, the building which was designed by Santiago Calatrava, a Spanish architect. The building is composed of wings which are about 66 meters long and they can open up during the day and close during the night time or bad weather.

Essentially, contemporary styles are associated with features such as the use of different forms across the world architectural activities, compositions of different shapes, use of various building materials, different sizes of windows mostly those that are wide, and incorporation of environmental considerations.

Architectural modernism is a term is used to refer to architectural styles that started to exist at the beginning of the 20th century and it can be traced from the concept of space. This is a product of the history of architecture on the other side stands contemporary mainstreams Parametricism and parametric design.

If we face these tendencies that belongs to the past with the newest tendencies theoretical and applicable like Parametricism it creates a differentiation of fields and is also characterized by distinctive values and sensitivities which started to appear before computation set in. Avant-garde can only be understood better as the hypothesis concept which matured in the last 15 years. This style is taking the proportional claim avant-garde hegemony (Harman, 2018). It has succeeded the modernism by changing the physiognomy of the global, however; the social systems theories are still remaining

the overarching framework of the theory of functional differentiation in the community.
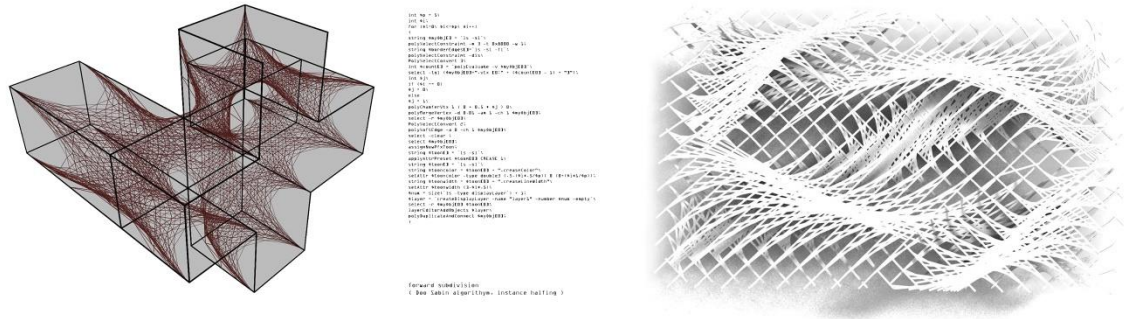
Figure 3: Model sketches and process of Parametricism (Peter Vikar)

Parametricism is the style within the boundaries of avant-garde architecture which came after the postmodern architecture and the modern architecture. The origin of Parametricism can be traced from Parametricism design in architecture which is constrained in the parametric equations (Schumacher, 2012).

It relies on programs computer manipulations, and the algorithms for the purpose of designs. The aspects of Parametricism have been used in architectural designs, interior designs, and the urban designs. The main characteristic of Parametricism is that all the elements of a design parametrically variables and they are mutual adaptive.

Parametricism can be said to self-referential or an autopoiesis system. The reason behind this is that all the elements are interlinked and any change that will happen to any of the element it will alter the entire set. It rejected the series repetition and the pure difference what is commonly referred to us as the agglomeration of unrelated elements in relation to differentiation and correlations between the key constituent's values. The aim of this rejection is to build up more spatial complexity while

maintaining the intensity between the gaps and to adapt the legibility of connections. This will influence the architecture to link the complexity of contemporary processes in the society (Schumacher, 2012).

Parametricism provides functionality and formality of the heuristic based on formal abstract rules which are distilled from complexity avant-garde that spans over a period of more than 15 years of continuous innovation in communication (Frazer, 2016). The functioning of heuristic Parametricism has both negative and positive principles which are responsible constituting the unifying of heuristics. The negative principle is responsible for avoiding the prescriptive program types such as the functional stereotypes. The positive principle, on the other hand, includes the functioning of parametric tasks of all spaces and events.

Just like functional heuristics, formal heuristics are responsible for distinguishing the Parametricism from another style of architectural activities. The negative principles under this case are responsible for.

All these theories are exerting weight to increase levels of articulated complexity through the rich panoply of the parametric design techniques. It is also valuable to note that in the present design process, new styles of operations are being initiated and not only the new techniques of operation. Adaptation of the animation technique for instance and formation off finding tools in addition to the modeling and scripting, there is emergent of inspiration of new collection of movements which are radically new ambitions and values in the society. As a result, new system of connected design-related problems that are being handled on a competitively within the global networking.

We can conclude that the way of how the modernism became a style and a product which was the result of continues development of previous styles, is begin used as a foundation in the process of making new concepts. Furthermore, just like modernism learned from history, new contemporary style is using their algorithm's and data processing with the goal of achieving adaption of social and architectural values.

2.1.2 A Unified Framework for Architecture

It is in this context that architecture is experiencing a bit of an identity crisis whose causes confusions in the discipline's attempt to assimilate and use the new technological and philosophical bases and constructs now being developed or refined. This situation present itself as aesthetic principle obscured by technological metaphors as well as engagements with the unprecedented complexity of our world leading to technological misapplications

Architecture has been part of society for ages. The ability for the art to shape society, improve the lives of people in society and prove self-efficient is what is most amazing about this art. Architecture over the years has changed to try and incorporate new approaches that will help to generate a greater life expectancy for the society (Shah, 2012) . an interview held with some of the great mentionable names in the field of architecture to try and establish the basic knowledge and facts on architecture. The most crucial of information was based on the ability of architecture as an art to impact society, to help grow itself and to help grow individuals in society. Richard Rogers during this interview suggests that Architecture:

> Serves society and improves the quality of life. It's a physical manifestation of a society's wishes to be civilized (Shah, 2012).

Further information provided looks at the ability of architecture to grow itself as opposed to growing just the society. The many people influencing change in this field have done so through the continued input of research (Shah, 2012) . Over time, this research has been used to develop better outlines and guidelines to the dos and don'ts in the field. Other than that, the continued input through research has helped develop better ways of achieving the end goals of architecture in society. This way, architecture has continued to widen its reach, its approach to social development and improvement of life. This has reflected also in the kind of trends that society has adopted in regards to architecture (Shah, 2012) . Both ancient and recent styles of architecture have been influenced by the need of the human race to leave an imprint on the face of the earth with each passing generation.

How we can recognize the boundaries between art and architecture? The question on the self-sustenance of architecture has been a huge part of the discussions on growth of architecture as an art. The battle between differences in styles of architecture and their imprint in society has for a long time haunted the field as a whole, (Shah, 2012) .

Autopoiesis therefore looks at the differences in the styles of architecture with the aim of determining the most suitable approach to architecture in terms of sustainability. Autopoiesis in architecture will therefore refer to the basic differences in the styles of architecture and the ability of each style to have impact on the sustainability of architecture (Salingaros, 2013). Understanding each of these styles is crucial mainly because the aim of Autopoiesis is to try and come up with a unifying theory on and for architecture with the aim of creating balance in the styles.

In conclusion architecture is in a continuous attempt to impower societies through different times, communication is vital for both sides to advance. And there were always attempts to work as a whole for a unified method for architecture to use which is being done extensive research, however it was forgotten that architecture is not only a shaping process, it involves art and with art there are many crucial elements that needs to be considered for better developing of the social aspects of society. And together art and architecture are aiming for a sustainable yet suitable way for progressing, it is where the autopoiesis is created to find the right balance.

2.1.3 Unified Theory of Autopoiesis [1]

In this research the term Unified theory is used as an attempt to explain the previous identity issues it faced to relate to the new tendencies in architecture which are being discovered and improved in modern architecture.

Creating balance in each activity being conducted in the field is important. It is also important that each and every individual in the field be held to a certain standard in that each of understands their role in the growth of society and in the growth of architecture as a whole (Salingaros, 2013). The need for a unified theory is therefore evident since every individual involved in the field needs to understand the brittleness of architecture and the different ways in which architecture can affect the growth of society and people in society. Advantages of a unified theory are based on the manageability of each element in the field and this somewhat stresses the importance of the theory as a whole (Salingaros, 2013).

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[1] *Schumacher, P. (2011). The Autopoiesis of Architecture, Volume I: A New Framework for Architecture (Vol. 1). John Wiley & Sons.*

One of the most common examples for the need of a unified theory in architecture is based on the ability of individuals to create and develop designs. The Unified theory helps to guide this creation eliminating possibilities of future contradictions (Schumacher, 2011). A Unified theory will help to eliminate the possibility of an artist having too many approaches to understanding the work he or she is doing.

By creating a guideline, the unified theory stands to benefit society in such a manner that artists or architects will have to adhere and stick to certain standards and guidelines. These guidelines will improve the standards set, the ability of the artists to abide by the rules and the ease of understanding architecture as a whole.

> The need for a unified theory is first of all to eliminate contradictions within one's own efforts (Schumacher, 2011).

With this in mind, it is evident that there are basic standards that need to be established in the field of architecture to provide uniformity and grace in the work being carried out in architecture. Each artist needs to ensure that the guidelines set out apply to their day to day ways of living and the manner in which they approach architecture as a whole. The Unified Theory extends its reach to the social standards that need to be adhered to. The social environment is vast and delicate and as a result, there is the need to come up with means to adjust and live up to the expectations of the social environment (Schumacher, 2011).

The Unified theory therefore steps in to impact the social environment by creating a boundary that helps to evaluate the social environment and one that goes ahead to provide guidelines to protect the social environment (Schumacher, 2011).

Architecture has come a long way to grow into what we have in the current times. Ranging from visual to sound, architecture has adopted different technological imprints which have helped to change the different ways in which we view or understand art and architecture. Visual architecture is mainly based on the ability of art to be displayed in such a manner that it catches the eye (Guevin, 2011).

Architecture has for a long time relied on this approach and has successfully impacted sites that have been the pride of different societies over the years. The ability of art to impress and have an effect on perception is through sight is what the visual architecture is mostly about. Visual architecture has continued to grow and with architects getting better as a result of the competitive environment, visual architecture is only bound to get better with time (Guevin, 2011).

2.1.4 Chapter Summery

The identity of architecture was defined by an idea, a concept of a designer which later became a historical tradition to preserve, a historical tradition that holds the culture and traditions of a certain country within time. Many theoreticians portrayed the identity of architecture in the historical buildings and monuments. Later on the identity started to be proved as the style or movement of a certain time and everything is done through these two methods belongs to the identity of that time (Tran, 2010).

But what influenced such movements is different element and it's not a constant stable aspect. However, it is meant by the designers that the identity should be adaptable through time, it raises a lot of challenges but it serves the original purpose.

While identity in architecture is trying to become adaptable, the ideas behind it were also in constant progress. Identity in architecture became a method to be used through

a decision-making system, a system that decides what's eligible and suitable for each country to choose what should the identity house of local traditional aspects. It was discussed that this method in applying the identity in architecture were used in changing city's layout and then changing its architecture (Nooraddin, 2012).

The decision-making system created an elite group of architects that dealt with making the next identity for a certain city. The elite group got a lot of support from the emerging new moves and the architectural education schools, both helped reaching the goals of the elite groups. therefore, the whole process of identity changed from being a reflection of a culture to the adaption of certain style elements which led some cities in housing many identities. Making the identity as a process and a product to achieve (Nooraddin, 2012).

In modern architecture it is possible to assume that the identity in architecture is hard to locate. Since many styles have different elements it's hard to locate the exact identity used in the design. however, most of them nowadays are falling into the category of contemporary architectural styles. And many famous architects have already managed to make monumental buildings that represents their identities, and these styles are coming up with new uses of materials and combining their designs with futuristic solutions (Nooraddin, 2012).

When comparing the new tendencies with the traditional methods we would see a gap consist of distinctive and sensitivities values. A style like the Parametricism can be understood as a hypothesis concept taking the Avant Gard design to a new level. It relies on computer manipulations and complex algorithms, and it falls under urban and interior spaces designs. It was introduced as an autopoiesis system, all the elements

are interlinked and any change that will happen to any of the element it will alter the entire set (Schumacher, 2011).

It is from here theories about complexity in design started to rise. And there was a need for a more unified framework to work with, that unites different aspects. The autopoiesis of architecture became more aware of this, after all the whole aim was creating balance in architecture. There can be difference within unity and that form powers function. This was an important aspect to consider, a unified theory was introduced and it started to explain the identity issues that it faces (Schumacher, 2011)..

It created more balance in the new movements emerging, it was trying to have a guide lines for designers to follow to be more adaptive to the current identity. It learns from different methods and tries to reaches a more suitable solution and to adapt to the social standards. Architecture after all riled on developing through the years through learning from previous styles and movements.

2.2 Design Process

Design process consists of several steps and stages that provides a solution-based method to solving problems, and it is important the human needs involved by creating different scenarios and making tests and prototyping to reach the optimum result.

Design process follows a set of integral methods. Some design project can share same methods but that can differ in relation to processes. This is because of the fact that design process is open to observation while the design methods are inferred implicitly. For the rational design process to be effective, all the required statements must be provided and the design process should be based on the theory that is aimed at solving

the problem and will be linked to the informative processing theory of cognition which transforms problem states.

Information processing theory of cognition by Newell and Simon was adopted to be the framework for many studies which were computer simulations. To a problem-solving process as part of the measure that was geared towards solving the design related problems in the architectural field. Integration of this framework within the boundaries of architecture needs a fundamental conceptual change. It dictates that the human or the machines which stimulate human activity is substituted by the social systems of communication as the main reference to the theory. The work of Newell and Simon can, therefore, be assumed as the work of psychology. This is because of the fact that the theory is aimed to analyze the design problem-solving process as information manipulation (Schumacher, 2011).

There are still formal atheistic problems that need to be solved in order to streamline the functioning of the design process. According to Reitman, a system is associated with problems of providing satisfaction when it has been provided with a description. For the system to provide the appropriate result, a clear-cut has to be made between the work environments because it is described by task observer and environment immediately it is discovered by the information processing system which is meant to solve the problem.

It is also important to understand that there are also different ways that can be used to observe measure and describe the expected inputs and what is referred to us as the frog visual system. Under this, the intended theory needs to remain general, abstract

without any explicit of pre-assumptions about styles that may be incorporated in any concrete project (Schumacher, 2011).

Modern functionalism method which sometimes refers to us as the function to function method sticks to the geometrical aesthetic criteria. The states associated with the form to form method are then tested to verify their functional fitness. Classical architecture, on the other hand, pre-constrains both aesthetics, and geometry where the functional accommodation is left as the later selection criteria that will determine the final choice of among the readymade aesthetic of geometrical states such as Le Corbusier's villas.

Parametricism has not fully penetrated into the mainstreams. They are still in the avant-garde phase. The computation techniques have radically shown the compelling instances of the analytical power. The analytical power can be used to enhance the rationalities of the design process in architecture.

The new computation technique has superior importation over the previously used computation. It has the capability to combine the exploration power that can surprise discoveries with guaranteed adherence. Parametricism can be said to have great influence on this new computation technique. This is because of the fact that it has advances that can readily affect these new changes. Contemporary based design process allows the establishment of higher ability design process; Parametricism (Kusno, 2014). As a result of this new changes, the simulation and combination result to increase in both the constraining energy and generative power of each design cycle and further increases solution search in each design cycle (Schumacher, 2011).

2.2.1 Design Theory in Architecture

Architecture is an extensive field. It seems to be anachronistic but it still has great importance in the current world. Understanding of architecture may be enhanced by the theories.

> The architectural theory should not entirely be assumed to be objectively correct (Schumacher, 2011).

However, not all theories may bring out the real picture of architecture. This is because of the fact that some theories may miss out some vital components that any architectural discipline needs to have. For instance, a theory that assumes the cohesive of a system of communication may not properly provide the understanding of what really architecture is and therefore may be viewed with suspicion (Schumacher, 2011).

Relevant architectural theories, therefore, will have the Ability to grasp, appreciate the pervasive reality of great and distinctive entities what commonly referred to us as the unities that will provide societal structures communication. In addition, these theories will have to shed light to community virtues, bring out the achievement of differentiation and atomization in the very community.

The theoretician theory describes it as the cohesive entity from the point of view but it is made up of independent identities which work cooperatively to aid the process of communication. These theories have contributed much to the understanding of architecture by providing the components bases, the principles behind the functionality of architecture and further scaling up the architectural levels in the current world. This has been possible because of the capability of theory through its guiding premises,

closures, and turns of argument that diffuse into the ongoing evolution levels of architecture.

People need places to live in, work, play or worship. These places may in form of a building or a structure that is enclosed. To come up with this structure, there is need of design it decides on what the structure will be consisted off and how construction will be done. Mainly, this is conducted by the architect.

In reality, the assumption is to postulate the necessities of the theory that it works as the channel of communicating about the potentials of innovation derivations from the traditional architectural practices.

Other theory can be used to bring out the understanding of theoretical function which is aligned with the constructivism. Such theories may include the cross-programming theory by Tsunami. Understanding the perception and orientation has not yet been understood fully.

This is because of the fact that use of visual permeability as the core player (Kusno, 2014). Different techniques are therefore needed to bridge the existing gap of understanding the postulations of theories.

Use of some theories may not clearly help to understand the real picture of the technology and how it correlates with the design process and architectural activities in general. For instance, the generative and analytic theory does not bring out the level and the extent of reflection of avant-garde styles. The theory of functionalism further was aligned with the modernist style (Schumacher, 2011).

The graph theory is an example of the visual permeability used by Christopher Alexander in the 1970s to formalize the structure of design problems and their process. later on, he proposed to use the mathematical structure in analyzing urban spaces. By dividing problems and smaller parts and components then using these components and solving them individually.

This will, therefore, mean the use of this style may not help in bringing out the proper understanding of the traditional technologies and their influence in the architectural field. This will, therefore, mean that that use of one of the theories will not help in understanding the role of architecture in the society (Alexander, 1977).
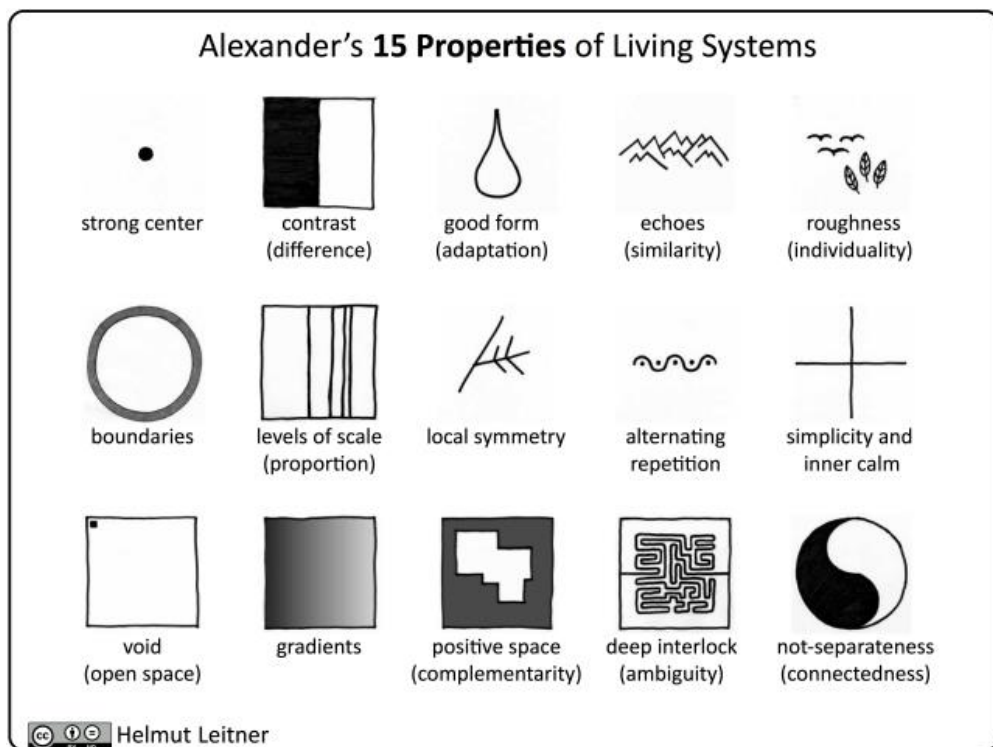
Figure 4: 15 Principles of Wholeness from Christopher Alexander, Introduction of "A New Theory of Urban Design" (Helmut Letiner).

There is need to understand the inherent development of the discipline of internal strategies and values. This will not be possible if either of the architectural theories

will be applied in isolation of the other. All the three theories will, therefore, be applied so as to forge suitable avant-garde that has the credibility to aspire and to gain the hegemony within the avant-garde segment.

Architecture can be equated to ideology. It is the necessary dimension in the social activities and its developments. This, therefore, will mean that as the ideas are important to the development of the society, architecture is also having the same value to influence the community lives. Any theory, therefore, will be evaluated by how well it can elaborate its initial theoretical decision, and the inherent consequences and whether it will have the capability to absorb the current experience in the real world. In addition, their willingness to demonstrate and how they can create a coherent among different technological instances.

Design theory takes actual communicative practice into account based on the actuality of the manner in which the contemporary projects are achieved, observation and understanding how design should be conducted. Further, the exploration of the actuality can promote potential gain credibility that may result in the building of other theoretical efforts. It is important to note that a sustainable design theory emerged during the period of the mature stage which created a clear difference between the traditional design and the new advances in architectural design (Kusno, 2014). However, a lot of questions were raised based on its functionalist foundations and the other priorities and values, it never considered where many thoughts about the suitability of theory during the cumulative time bound.

Parameterized style (Parametricism) has been advancing for more than 10 years within the architectural avant-garde and its advances are getting into the mainstream but there is still need to re-advance the architectural field (Schumacher, 2011).
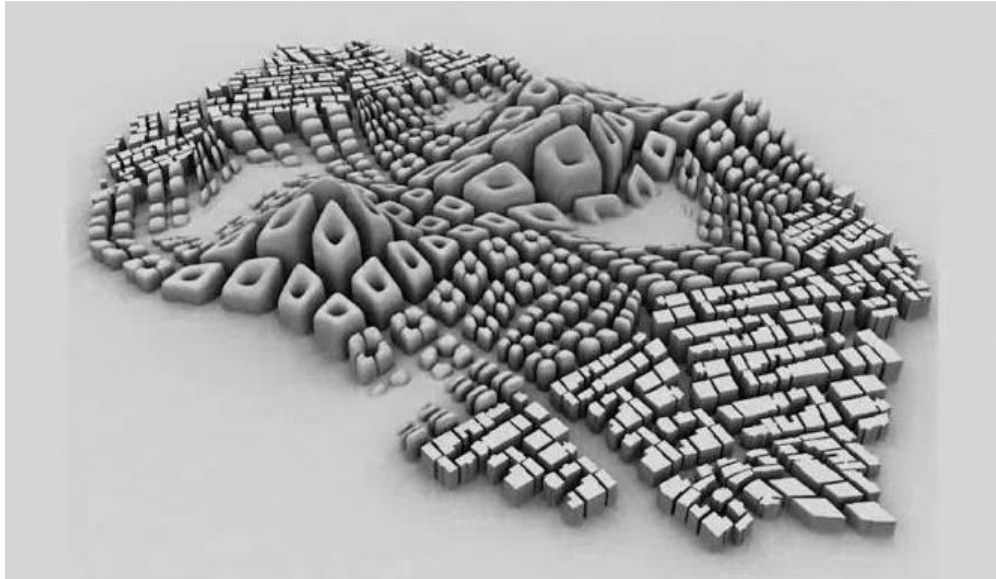
Figure 5: Parametricism style (Patrik Schumacher)

A new theoretical style needs to put into practice in design process with the main reason for upgrading the contemporary design methods within the auspices of parametric. We assume that actions made within the design process is a decisional. It needs to make the complexity of the design process how it can hinder changes on convincing concepts of the rationalities which are mainly affected by the increased complexity of the design work and the continuous changes of innovation.

In addition, the shift of the traditional expectation in the design process can also be influenced by recent proliferation and the rapid evolution digitalization of the design process making many to embrace the new technology in design. However, there were critics that faced the increased embracement of this design changes. According to Ali Rahim, new techniques in design are essential as they create new advances in the

design. He added that new techniques however good they are, they are associated with risks which can fuel tremendous problems.

The design theory is essential in architectural design. It detects changes and investigates the stabilization of normative potentials within the maturing avant-garde. However, it does not give sufficient attention to the recent proliferation of new techniques. It is only concerned with the degree of the extent technique drives, that contemporary avant-garde can develop a methodology which can match with its increased inordinate desire (Zanni et al., 2017).

What is assumed here is that the avant-garde which is contemporary is changing to a new stable hegemonic style and to determine the extent to which the contemporary design can exclude any change to convincing concept design process rationalities. For this to happen, there is the need for architectural autopoiesis to provide the framework to enable the functionality of the upgraded design process in giving criteria that are independent of any style.

It is possible to assume that architecture As any other discipline, has a protective discourse which protects the architecture by means of management boundaries and prevents the interference of the other effects such as engineers and artists who may invade the known laid down architectural boundaries and distinctive of architecture such as the American Institute of Architects (AIA) in the USA that constantly tries to unite architects and to empower their message to people about what they do in order to build a better community through leaders and influential companies .

2.2.2 Design Process as a Problem Solving Process

The specialty of the design process is always geared in a direction of solving design related issues and it can be considered as a special type mainly because it has a structure of decisions to use. Before the advancement in architectural design, architects had various problems such as increased costs and communication inabilities. With the introduction of new technologies such as the BIM, a design has been enhanced and thus solving the problems that had a great influence on the functioning of the architectural field.

Communication usually take a place within a social entity and there are many lighter forms of communications, from that sense we can consider the designing a project as smaller communication system with the architecture design process. Design process is involved with concepts about most effective approaches using different unconstrained instructions and encourages self-independence and creativity for the learner to discover many ideas (Stevenson, 1992).

Through many tests it gets clear that a different set of solutions could be reached but some can be more effective than others but it implies that there are many ways to reach success in solving a problem.

The problematizing theory provides the basis of problem formulation while the generative theory is concerned with the provision of general solutions by means of expanding of the morphological and special repertoire such as asking simple questions as who made this statement? Analytical predicative theory on the other hand will provide the analysis and the predictions of events through performance, data gathering and machine learning in addition to deep learning of algorithms. It predicts certain

patterns and behaviors and its more commonly used in marketing, retails, social networks and many fields.

To combine these theories [2], the comprehensive architectural theory is used to integrate them. The reason behind the integration of these three theories is to provide coherent and effective guidelines to the designer. However, these three theories are rare and they are not commonly used (Schumacher, 2011).

A good design is usually a group of elements that got a lot of analysis and went through many levels of thinking. and since the word design itself refers to reaching a goal through a thoughtful process to get improvements over a certain situation or to form a new working idea (Friedman, 2003). In contrast the scientific approached in problem solving consists of focusing on determining the problem and finding a single solution.

This difference was done by the psychologist Brian Lawson in 1972 after making an experiment involving architects and scientists and their objective was to make a structure from colored pieces of blocks. He had a set of rules to follow and observed their work and how they approach it.

The architects made their focus on finding a satisfying solution and then they tested it to see if it followed the rules of the experiment. It concluded that scientists get solutions through process of analysis while architects and designers get their solutions through deep synthesis, however other proofs suggested that in the end architects and designers use both ways of finding a solution to their problems making it design thinking. it is done by getting as much initial solutions in the beginning to a problem,

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[2] The Problematizing theory and the Analytical predicative theory (Schumacher, 2011).

53

later on a more scientific approaches are applied to narrow down the solutions to the best one.

2.2.2.1 Design Thinking

Design thinking in architecture is concerned in finding solution through clear intervening points, Herbert Simon an American psychologist proposed an approach that starts with : defining the problem as much as possible before initiand a solving approaches, gathering data and researching about the problem to be infirmed of all aspects, forming concepts of solutions without considering their usefulness until many ideas are gathered, after that is done eliminating any concept that look useless or impractical, then making a simulation of proposed concepts with feedback from users about their values, selecting the best idea suitable as a solution, finally outputting the solution and test the end result with the users to make sure of solving the problem (Meng, 2009).
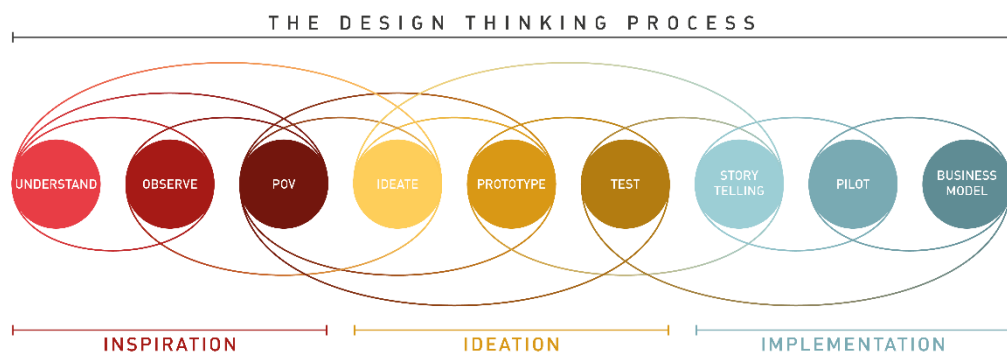
Figure 6: The design thinking process (Dam, 2019)

The are many other thinking processes approaches by many theorists which most of them consists of the above with the addition or subtraction of some steps. Plattner and Meinel in their book about design thinking they underlaid four principles of design thinking, considering humans in all of their design duo to the social nature of it, the

preserving of transparency and quality in their design thinking, any design process is redesigning of an already exist process from before only with a better result, making the process more physical for a better presenting of a design. also, these principles are independent from the design approaches such as researches and interviews (Leifer, Meinel, & Plattner, 2011).

Design thinking does not necessarily use graphical approaches in getting solutions its only commonly used by architects and designers as their method of reaching their ideas visually through drawings and sketches even models, this is done mainly because it's hard to express an idea through a couple of words while it's much easier to project your idea, it is something can be tricky for those with a scientific way of thinking.

Since design thinking is not the main issue, it will be used in conclusion for the main purpose of this research which is that design thinking is a flexible iterative collaboration between users and designers with the main aim of providing ideas from a user perspective to simulate their experience and needs.

Design thinking can have different approaches got introduced by theoreticians, however we assume that they achieve the main goal of design thinking. understanding the user's needs, creating ideas in brainstorming sessions, adopting a more interactive methods in concept designing, defining and reshaping problems from a user perspective, and finally devolving a solution that portrays the solution to the problem in hand (Dam, 2019).

2.2.2.2 Advanced Architectural Design

To consider the further development of the thesis we have to understand the meaning of advanced architectural design as stated by Carnegie Mellon University School of

Architecture, it is the engaging of new emerging methods of designing and manufacturing through architectural design to explore more methods of practicing architecture, making better construction methods and emerging with the culture of the built environment (Ficca, 2018). And in this research, it will be considered as the new way of designing with the new technological advancements using new digital tools while reaching futuristic solutions.

By advanced architectural design we understand:

1-BIM: Building Information Modeling is intelligent 3D model-based process that gives different professions such as architecture, engineering, and construction professionals the insightful information and tools for a better efficient planning, constructing, designing, and managing buildings and infrastructure (Autodesk).

2-VR: Virtual Reality is using computer power technologies to create a virtual simulated environment (Bardi, 2019).

3-AR: Augmented reality is the integration of digital information with the user's environment in real time (Rouse, 2017).

1- The architectural design process is begin rapidly becoming the building information specially with the Virtual Building solutions coming to light and Building Information Modelling (BIM) being the most popular because the implantation of BIM could shape the construction and design processes even further, making the architects in the end as master planers and builders.

Application of BIM in the design process, costs have been reduced substantially. In addition, other benefits have been accrued in the field of architecture due to use of

technological advantages. As the project continues, mistakes may be made unknowingly thus making the project to run at an increased cost. As the project progresses, there is the need for the interested parties to get a proper update of the stage in which the project is, what will be expected after the current stage. use of design software in architectural design will help in ensuring that communication is enabled, costs are minimized, a mistake is detected and proper measures are initiated to solve them, and forecasting in enabled in the project process (Autodesk).

2- The appearance of virtual reality implications for architecture has been the big talk among technology recently. The discussion that in the future it will become a primary element in the presenting stage and along with the design process as well. A lot of anticipation for the implications and usages of VR technology in architecture since the first VR system lunched in the 60s. the term VR became popular in late 80s and 90s and found a lot of good implications like medicine video games and flight simulators, as for architecture it was imperceptible.

The success of VR in architecture mainly has been in the exploratory and passive and applications and at the current time the cost of VR technology depends on the usages and realism wanted and the level of immersion but these features still don't guarantee a decisive design decision. Still, through this thesis it will showcase the inherent potential and promise of VR technology and the impact it could have with the current situation of its limitations. It's becoming a trend that increases commonly as more architects integrates virtual reality (VR) in architecture to their designs and practices (EasyRender, 2018).

3- Augmented reality (AR) gives the designers the power to push the boundaries of visualization allowing for other colleges students clients new ways to understand an architecture space or building and help them experience it before its actually built (Gallagher, 2018). And one of the big challenges the architect have with their design when showcasing them for their clients is to convince them that the finishing product will look and feel like the 3D representation, no matter how talented the designer is, it's still a huge challenge to shape the imaginations from the client and get it in the design process. Architecture is no different form that concept and AR could help close this gap. So, the AR allows the architects to not just transmit their designs but also to feel them. AR it is an Immersive technology, it will give users an interactive 3D environment, allowing them to explore a virtual representation of a design concept or a particular space or a building.

In addition to all that digital architecture has recently combined new algorithms and Smart Geometry in Artificial Intelligence. This breakthrough in digital development has also helped the creation of 'smart buildings' which are environmentally-friendly and energy efficient.

> The use of digital modeling 3D and animation 4D software has opened new territories of formal exploration in architecture, in which digitally generated forms are not designed in conventional ways. (Kolarevic, 2003).

The impact of digital media tools and technology information on architecture and the design process is increasingly obvious and apparent, all the design process practices construction and fabrications are progressively aided by digital technologies. The rapid increase of computers and digital tools in practices and educations has resulted in a huge fundamental change and a reorientation in conceptual and theoretical approaches that are considered in the traditional practices.

With the technological introduction in architectural design, visual design has been implemented in the design process. This technology is normally used to the creation of the aesthetic appearance of the site by the use of different images, colors, shapes, fonts, and other elements.

It is important to mention the gestalt psychology because many of the new techniques started from a similar concept and got influenced by it. The gestalt psychology being distinguished for the other Decomposition theoretical elemental approaches like the structuralism and it sides up with the like of holism and contexts. the Gestalt psychology was founded in the 1920s by Max Wertheimer, Wolfgang Köhler, and Kurt Koffka .

Gestalt is a psychology definition that means "Unified Whole". in 1940 the Gestalt psychology got applied to the visual perception to shape a perception. Their goal was to get results from investigating the process involved when you try to apprehend a structure in the environment and its surroundings, it was mainly used to see the human vision of a group of structures and objects and the ways the human perceives them and if he focuses on the parts the consist of these objects in relation to the whole group.

This led to creating "the gestalt laws of perceptual organization." And the explanation of this psychology is that our mind in constant move of trying to fill the missing gaps and information influenced by the whole is greater than the sum .Most of these laws are used in the interaction design community to come up with an appropriate visual design, the architect needs to consider the following; maintaining unity of the elements involved to avoid dull or overwhelming the design, ensure equal distribution or what is referred to us as balancing, contrast where the main focus is to ensure that every

element is standing out, identification of range sizes, have one element as the focal point, and to ensure that there is coherence or continuity throughout the design.

In this research we are showing how Shaping the design process will imply to creation different means of designing a structure by use of different approach, techniques that will create a significant solution to the past problems that were affecting the design process. the Formalism that emerged in the 1950s and got more popular in the 1960s. it was a style that featured classical elements from previous styles including the very strict symmetrical elevations and the classical columns the colonnades in addition to the scale and proportions.

The style is a simple example of how the concept of new digital methods are trying to achieve in their own way, it was mainly used for the high class cultural institutional buildings because of the rich materials that were used in the buildings like the granite marbles as well some handmade detailed compositions and also it contained specific features of concrete that helped achieving some unique forms like the umbrella shells folded plates and waffle slabs. it aimed to achieve modern monumentality with the Delicacy of details.

To conclude on advanced design methods, the digital tools has fundamentally reshaped the relationship between production and design, making a digital link between what we can imagine and produce to be built the file to factory method process of computer numerically controlled (CNC) fabrication (Pittman, 2003). One aspect of digital architecture is the ability to make and produce constructional information directly from the design proposal.

The Introduction of Computer Aided Design and Drafting (CADD) in the 1980s led to the total transformation of the construction industry in relation to new standards for architects, engineers, and graphic designers when it comes to construction of buildings and other structures. With limitations and other problems which affected the functionality of CADD, such as failure to provide maximum efficiency between the designers and project managers and need for other solution arose. This problem was not solved until the introduction of Building Information Modeling (BIM). BIM a system that has the capability to process data related to geographic, geometry, light, space, quantity and properties of a building are integrated, is a computer revolutionary software that is used by designers to create a 3D model and a structure such as a building.

Moreover, tools such as Virtual Reality and Augmented Reality became another way of designing imagining and experiencing, they are advancing in a way that lets you interact with the design before the compilation process, in addition to opening up a lot of new opportunities for new tools to collaborate with.

2.2.3 Design in Architectural Education

It is important for the purpose of this research to mention the different types of schools, shaping the identity of the design process, and the design process is determining what kind of education is given in which school.

Design in architectural schools can have different profiles and types, it depends on the nature of courses and degrees but mainly their main point of interest, there is design oriented schools that pay attention into the concept of designing, others architectural schools focuses on research-based architecture in addition to schools that have a digital as their main point of designing. There are also architectural engineering schools for a

more general understanding and collaboration between the two sectors.

For example, the school of architecture in Carnegie Mellon university offer a master program in advanced architecture design. And the program focuses on the design fabrication, computational design, architectural robotics, and ecological thinking as method for knowledge acquiring and speculation (Ficca, 2018).
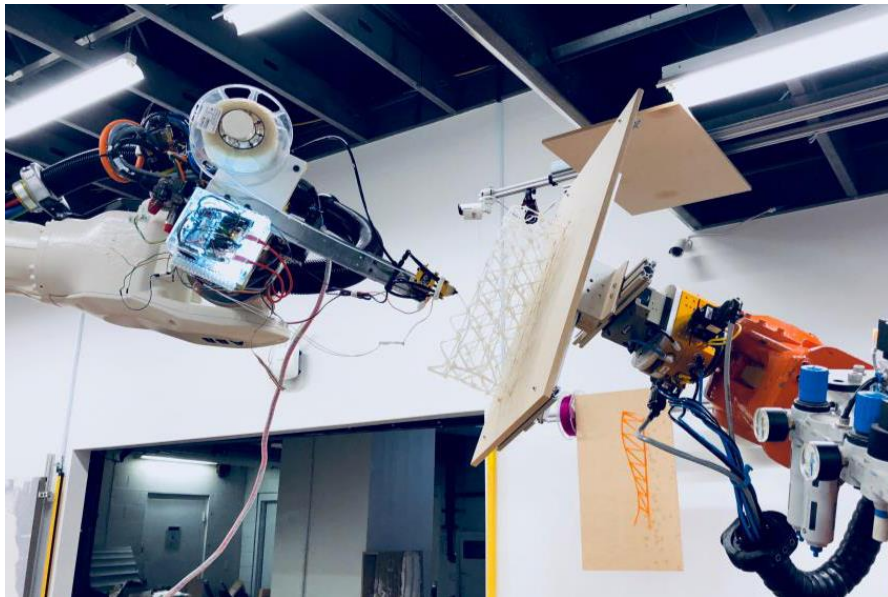
Figure 7: Advanced Architectural Design (Ficca, 2018).

One of their main methods of advanced architecture design is the use of Design Fabrication Laboratory (dFAB) . a spacious laboratory that includes to industrial robot arms that are capable of supporting subtractive, additive, and transformative processes at a large scale.

While, Department of Architecture in Eastern Mediterranean University offers design courses that focuses on the overall process of design within the built environment through brain storming sessions and information gathering , in addition to master courses that specialized in research or on a particular specialist approach (EMU) .

The aim of this and any educational approach in architecture is to improve the design process statues and to learn more in the academic and profession section , the education in architecture today is what Bruner called "folk pedagogy" guided by indirect assumptions but it's not related to any theory or someone's experience (Olson, Bruner, & development, 1996).

Nowadays it is considered that if someone grew up with digital technologies that they can handle anything new presented to them like a special talent but these assumptions often led to spaces and gaps in architectural approaches as digital tools are used in a wrong way and mostly misunderstood.

Yet a main reason why there is always a confusion when its related digital design in the educational sector is because the misunderstanding of the values it have when it's beyond the teaching tier of skills, and educational research made a progress by redefining the aims of the learning stages, back in the early days before any theories about these advances, schools only focuses on developing base skills like the memorizing of certain dates or the reading information like facts in a history class (Doyle & Senske, 2016).

The approach of this assumption was it was enough of a teaching method to be able to solve problem or report them and then produce some kind of a research about it. Yet as it was easy for some students to present tangible findings for a problem the educational sector found many other barely had a clue about they learned and found difficulties in applying anything from the skills they learned (Clement, 1982).

These tier of skills and abilities will always be important to learn for students but

nowadays education focuses more on the deep learning to address more meaningful questions (Council, Cocking, Brown, & Bransford, 1999).

Deep learning does focuses on the bases of principles and strategies and structures to help developing skills and gain knowledge, deep learning is more recognized as transferable learning and more productive because it have different conditions from the normal methods, yet not many course can achieve this kind of learning and design studios is an example to these deep learning methods (Doyle & Senske, 2016).

In contrast, design studios lately with the current state of digital design tools it's not yet oriented to keep up with the deep learning methods , it doesn't support it and most students learn is a combination of certain actions to make a safe reliable concept , and most students can use digital tools easily with great pace but it still seems that most of them don't have a deep leaning about these principles (Senske, 2014). that results in their being out of context, like we talked about how teachers can elaborate on certain skills and cores, they expect the students on having a great result while using the digital tools and applying them with their designs which makes a gap in learning.

Basically, students are learning new tools with not enough guided expertise to develop a deep knowledge and then they are not learning any new strategies on how to handle the new digital tools with the design process, they are falling to understand these digital tools methods because the pedagogy the method and practice of teaching is not in bar with the deep learning goal. Which leads to criticism of the digital tools productions of projects done by students as divertive. this is of course with the assumption that such an aim is recognized by the education (Doyle & Senske, 2016).

The National Architectural Accrediting Board (NAAB) they use certain rules and protocols to set a certain objective for learning. However, they don't specify the value of digital design process and these rules are varied resulting in students having different abilities from different schools, so students are facing less obligations to improve their skills of digital design because of the nature of the universally being considered as not that much meaningful.

This makes it difficult to advance within the education sector and will also affect their career. Failing to define the base principles of digital tools and addressing structural problems makes it harder for students to learn within the constant change of technology (Doyle & Senske, 2016).

2.2.4 The Learning Objectives for Digital Design

Learning objectives sometimes can be blurred and not clear and usually misunderstood, but they are straightforward, it describes what the student will gain the knowledge of and what skills will earn from performing certain tasks.

Moreover, learning objectives can support a far better learning and houses a common framework for different schools to make a more unifying act to improve the education, and digital architecture lacks of pre-agreed criteria to agree on whether on the productions are successful. Relating to this matter, learning objectives do improve the learning given to a certain school curriculum, and for this reason many universities have standardized their curriculums and syllabus to define the learning objectives. The University of Carnegie Mellon we mentioned before is an example of the universities that standardized their curriculums.

These learning objectives can consist of 3 parts:

1- A measurable act related to the intended a cognitive process. Traditional methods tend to emphasize the learning through different types of tasks using different tools till reaching designing with digital tools, but it doesn't acknowledge the steps taken into making the student learn the needed ways and skills of digital tools (Doyle & Senske, 2016).

A simple known example is the task given to the students to make a topographic model from a contour map. the condition is the layers of counter lines and the evaluation is an acceptable model. the main goal of this is to focus on the final outcome without a certain method followed. it's not attended to make a unified classroom using the same steps. the instructors should have flexibilities to their approaches as long the goals of this task are met. Learning objectives are helpful for the instructors to help them to plan the contents of tasks. in addition, it allows the instructors to make useful evaluation of the performances (Doyle & Senske, 2016).

2- A strict condition for the action to be performed is also important to make distinct clarification about the objectives for digital design in their goals and their outcomes, according to (Ferguson, 1998). a goal is a statement to end result of a performed activity and the learning objectives are contributor to these goals, to be clearer the description of a course should state the task with a clear measurable outcome for example : "students will be tested using different digital technologies" it has a goal but without an evaluation tools but when we say "each student will gather data to create a specific scaled model using 3D software's" this objective statement clearly mentioned the result (model) a condition (gathering data) and the method (3D

digital technologies) and the evaluation can differ as successful use of these tools and it will lead to asses which techniques are more suitable or if the model is corrected. When these objectives are this clear and untestable it will outline the level of tier needed for this certain activity (Doyle & Senske, 2016).

3-An outline to evaluate the performance which is quite familiar. Lastly these learning objectives at their state are not normally assessed, other courses depend on grades as a formative assessment which is typical to grade the level of designed work. But again these objectives don't fall in the same level of normal assessments therefor they may not be graded fairly, as these projects when they are submitted may not allow the student to evaluate their skill specially that it may not even allow both the student and instruct to give a useful feedback to get close to achieve the goal intended mainly because the produced outcome and the thinkable process indistinguishable when you look at the result . also research showed that the ability to a complete a task doesn't mean that the student was able to explain what he did or for what reason (Doyle & Senske, 2016).

We can't also say that instructor shouldn't make a grading system, it is effective when it comes to the degree of creativity shown or in solving a certain problem specially when it's in a higher level of classes. learning objectives should give the student an opportunity to respond with a changed behavior and performance.
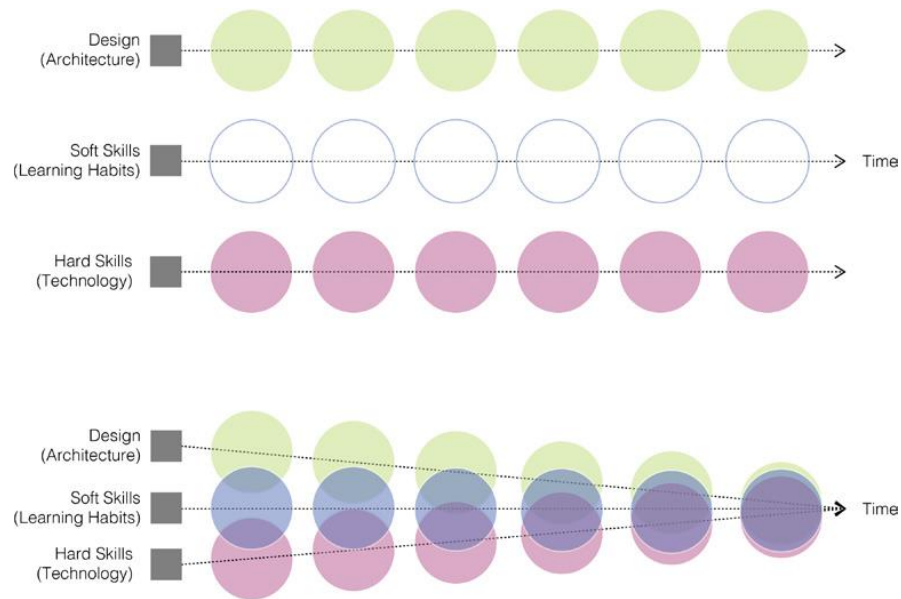
Figure 8: at the top the diagram shoes a curriculum where design, learning habits and technology are usually taught. diagram at the bottom illustrates how learning habits makes the bridge between the design and the technology. In time these skills support each other equally (Doyle & Senske, 2016).

The real challenge isn't that there aren't any objectives available for the digital design but it's more of a misused. during the creation of learning objectives, it is crucial for the instructor of design studios to admit that learning happens through many developmental stages.

While abilities shown on design works and production such as creativity are considered a higher tier skills , these type skills are gainable and more independent and varies between students, but still research shows it is important to match the objectives to the proper level of students (Doyle & Senske, 2016).

In addition to guarantee the progress of such a course is to provide certain tests but, in this case, a hand-written test won't match the effectiveness of such course so it has been on the same alignment with each other.

2.2.5 Chapter Conclusion

Design theories field is filled with different theories, many of which can be hard to understand. According to Bill Hillier, most architectural theories are prescriptive in nature and are tilted to the generative side. They lack precision on the analytical evidence when it comes to the provision of guidance to the designer when predicting the functionality effect from the configuration (Hillier, 2007).

The theory of Bill Hillier; space syntax which is based on science and focuses on the human approaches that has connections with spatial layouts and various social occurrences. provide better understanding and therefore provides the solution to this inherent problem concerning the aspects of organisms. The insight and techniques of this theory needs to be integrated within the boundaries of the contemporary design study, an agenda that is backed by the theory of architectural autopoiesis.

While some may use science and human understanding, Others have used basic math and visual permeability like Christopher Alexander did to analyze certain parts in design and urban spaces. And neither of those two theories assumed it can understand the technological change of design process because in the end they won't be sued together.

Introduction of new mathematical explanations and logical structures such as the explicit rational design methodology by Christopher Alexander, reached some achievements which have been made in solving the design-related problems. The main achievement of Alexander was the identification of complexities that exist between requirements as the basic problem which creates a burden to modern designs.

Whatever modern design is bringing to the design process and theory, the education sector can still suffer from blurred learning objectives. Students are trying to coop in their own way to keep up with the design process and its demands.

However, we mentioned that it's important to have an understanding of the objectives that digital design needs in their goals and what they can offer. Design and the digital design both the combined their methods with algorithms which opened new paths of creating. New trends which some of them can be normal to be around like BIM and virtual reality are contributing heavily to the design process, however, virtual reality can be used for exploring and trying new ways rather than a creator tool.

And with our digital world most of us are used to new digital tools of different aspects, but with designing on a big scale with many design approaches combined it may not be easy to everyone. Because for students if there was a certain outline for a successful use of any new tools, we would have seen a progress in their leaning skills with a grading system that defines top tier skills. It's about finding solutions and sometimes it's the method of how the solution got created.

2.3 Digital

Today when we try to define what digital is, there isn't a necessary right term to exactly describe it, digital can be defined by referring to its context, if we only define it as a term it means any kind of system that has a combination of two binary code with a value of 1 and 0, this system may generate or store and process data based on those codes (Rouse, 2005). So, to many it considered as technology, and this technology can differ on its aesthetics looks, for instance digital could be a way of handling certain activities with customers making data stored in digital not tangible format, or digital

can be a physical product like digital communications through modems and satellite transmissions.

It is important to have a proper meaningful definition of what digital means or stand for through any business and specially in architecture (Edelman, 2015). In this main stream and relating to architecture we can assume that a proper definition of digital means it's the way things get done rather than its physical substance.

Digital in architecture is not considered a style, but there are branches that defines a certain type of architecture. However, this research tries to answer what digital is in architecture, it is a discipline, an advanced method used and applied to a problem or to find a solution in architecture.

And this advanced method (digital) can be traced back to the roman architect Vitruvius, who managed to find these advanced methods in his 10 books of architecture, but not necessarily in a digital format rather it was a philosophy that was a result of an advanced thinking.

Even that we always see digital is related to data analytics and application programing interfaces but the real essence of the digital is in its way in approaching and redefining the solution in the design process and refocusing the attention to the real experience and advancement that digital reached.

2.3.1 Development History of the Term Digital Within Architecture

2.3.1.1 Humanism Renaissance and Enlightenment

In architecture rather than being strictly a method, digital it is also a philosophy an ideology can be traced back to the first printed book in the early 15th century from

roman theoretician Vitruvius and his De architectura, dedicated to emperor Caesar Augustus,to be used as a guide in building projects, which influenced Leon Battista Alberti on writing his ten books also about architecture and it was the first theoretical book about the Italian renaissance (Vitruvius et al., 1867).

The book was almost dissertation that had 10 parts known also as the Ten Books on Architecture with each part specialized with an aspect of architecture and it had a huge variety of different sources and Alberti's adoptions, each part had a detailed description of principles such as symmetry, proportions, harmony and the design of monumental buildings such as temples and the use of different ornaments on public and private buildings and the process of restoration , with the ability to deliver high quality finishing's to the interior spaces in addition to the use of materials.

This was digital in terms of methods tools and guidelines on building projects (Restorations, delivering quality furniture's and interior spaces) but at that time it was a philosophy, a philosophy of digital in history without technological support. Andrea Palladio had also a philosophy, his influences and designs still effective till today. Palladio designed his buildings based on the values of Greeks and traditional roman architecture set by Vitruvius.

Palladio is considered one of the best architects in the history of western art, he is known for designing villas and palaces. Palladio was an inventor (restorations , Palladian Villa Design) he developed three main sorts of palaces and deployed the use of Corinthian columns to surround the main court (Tavernor, 2005).

Palladio restored many churches and buildings specially with his revival of the

Vicenza's medieval town hall which is known as the Basilica Vicenza. he imagined how contemporary Rome will look like. even that many of his approaches depended on the classical architecture roots like with his design of the villas in Veneto back in 15th century, it was more symbolic fortified with towers and rooftops with the addition of gardens to the outside areas. mainly he was characterized using symmetric three part facades (Essley, 2014) .

Also Palladio wrote a series of books (Palladio, 1980) where he shared his theories about architecture and its development . In his 4 books on architecture he showed his house design layout, displayed a unified collection of works that had a single theme, the paladin villa design with each plan arranged symmetrically, inside and out with a gallery and a hall in the middle surrounded by rooms in different sizes.
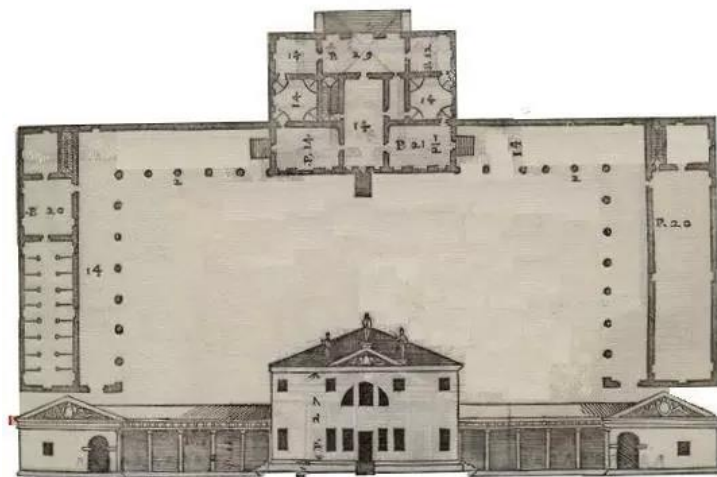
Figure 9: Palladian House by Andrea Palladio (Essley, 2014).

Most villas were two story that were near villages and small towns with spacious stairs, and many of these villas he designed were intended to be used as farms

Palladio evenly had such an influence that later architects continued to admire and

used and imitate his style Palladianism. the style was revived again later in Europe and north America. There is a lot of examples of his work across Europe while Palladianism had a big influence on shaping American architecture (Essley, 2014) .

At the 16th century back in Italy a style was emerging that had nothing calm or rational even geometric, a new understanding of the digital at that time was emerging. it twisted the elements of buildings to enhance shadows and lights and show its curves with some wavy walls, and with time it made a quick strong connection to the design of catholic churches, the style knows as the baroque style. The style spread through Europe and it was changed a bit in every country (Przybylek, 2018).
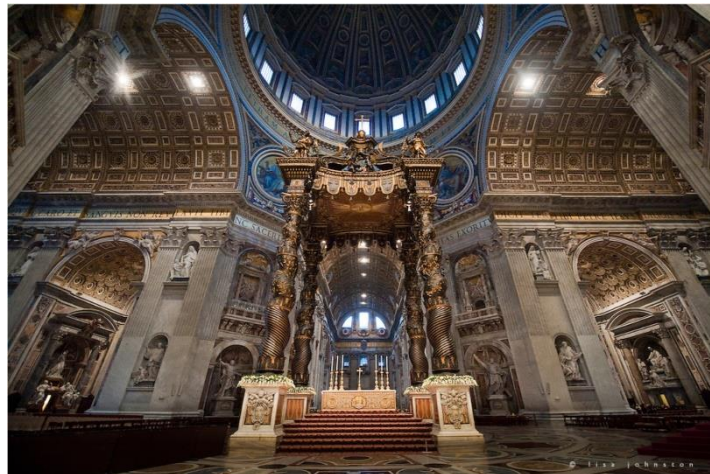
Figure 10: St. Peters tomb, designed by Gian Lorenzo Bernini

The style mainly was used for the rich people and for the churches and palaces, and style rejected any geometric shapes from the renaissance. It usually consists of curved and organic forms which includes oval shapes and convex forms that make the walls seem they have a motion, while on the outside there is mass elements in groups like the columns and decorative ornaments.

An important feature is the distortion with shapes and forms being broken of manipulated in contrast to make a clear statement. Buildings will have different columns with sculpture and elements on top, it is done to make an interplay of the light and shadows, which it is a form of digital but in an approach used in the baroque style (Przybylek, 2018).

As we mentioned that the baroque style was spreading through Europe with some little changes, when it reached France it was between 17th and 18th century, with baroque being a reflection of the rich, the king sees himself as a ruler with all the power in his hand, the reign of Louis XIV saw no easing up on spending resources to make a project as the king wanted. With every new palace built luxurious, architects had to design the rooms to make a stunning representation of the visitors. the baroque style was an architecture of gloriousness, dominance and luxuriousness (Juliao, 2018).

Other aspects the baroque considered for promising artists is the opening of French academy in Rome. Funded by Louis XIV the academy from the 17th to 19th century remained the finest place to study for the artists. It also organized exhibitions and salons for the art works and sculptors to be viewed (Galitz, 2003).

Figure 11: Palace of Versailles

In the Romans and Greeks to the renaissance period, we can assume it wasn't untouched (digital) but rather the advancement of tools presented at that period and Their tools reflected their use of technology, their progress in making domes, arches and buttress even reaching the long spans with what was available at their time (Humphrey, 1998).

The Renaissance period had many technical advancements like as printing press and handling iron and producing it rapidly in higher quality, it also witnessed the Scientific Revolution which was a series of events about what is known as the modern science that included chemistry, physics, mathematics, and human anatomy.

But more importantly they used technical drawings that had a great influence, for example Filippo Brunelleschi presented the first technological plan in theory and history of architecture and Leonardo da Vinci managed to use it as an instrument to portray mechanical devices in that period (Klotz, 1988)The usage of drawings and sketches of that period gave us a clue of their technological progress even if they were not produced or done.

2.3.1.2 Enlightenment to Modern

Age of Enlightenment influenced a lot of ideas in Europe as we mentioned like what Filippo Brunelleschi did with his approach in making technical plans but when it comes to philosophical movements in the 18th century. It witnessed the rebirth of science, Its highlighted reason, individualism and skepticism and many more. institutionalized the knowledge.

It came as a result of the 30 years of destructive war At that time rococo style was being used and soon there was a demand for a new style emerging from the power given to people influenced by the Enlightenment movement, neoclassicism a new instructive art movement that got inspired by artist Nicolas Poussin, which favors the line over the color to reach a logical clarity within order, mortality instead to temporary (Zakai, 2018).

Also, as an example the Encyclopedia which was published in 28 volume over 21 years that consist of at least 70,000 articles done and contributed by 140 among many of who influenced the French Enlightenment. The main goal of it was to provide a collection of human knowledge to be passed through generations, also to contribute to the evolution of human society, and what made it work is the shared purpose among the intelligent and intellectuals who belong to the French Enlightenment. (Bristow, 2017).

It does reflect the science characteristic of the Enlightenment period which reminded us that it was their sense of digital at that time but in reason. the Enlightenment period was similar to the Baroque as a style and it got considered as an alternative. The main goal was to show the rational aspects of their times though symmetry and simplicity

which they got from the high standards used by the technological advancements and tools of Romans and Greeks as guidelines for building.

the Enlightenment is considered linked to the French revolution, people started to hate how things are being done under the French crown and the unfair wages and advantages in addition to the economical gap between people, they demanded changes and revolted against the crown. The revolution inspired two artistic styles Neo-Classicism and Rococo (Eriksen & Thornton, 1974).

Neo-Classicism created to perceive purity form the art works of Rome and many architect got influenced from the works Étienne-Louis Boullée and Claude Nicolas Ledoux, also it was influenced by the French revolution The style was popular from 17th till 18th century and it had kept its identities independent by having each part of the building different from the other. The style was liked by the public because of romanticism and its revolt against the ordinary social values of Enlightenment (McKenzie, 2013).

While the Rococo style started as vengeance move against the Baroque and it wasn't related or connected to any religious or dramatic movements. it heavily depended on ornamental elements and decorative works. the style was based on using pastel colors and on using simple delicate forms and the style got famous because of its use of lighter elements with natural patterns and curves (McKenzie, 2013).

While the American revolution that happened before the French revolution also have been influenced by the Enlightenment, also it got influenced by the British and political values at that time (Stern, 2017). The Americans resisted laws about taxes and power

enforcement and demanded the natural rights and freedom, which were influenced as we mentioned from the Enlightenment movement.

Thomas Jefferson was one of the founding fathers and an architect who tried to make a new style of architecture that expresses the new republic after the revolution. he managed to design the capitol building after the roman temples, by doing that he made an incent building for modern use. Jefferson had a big impact on making monumental buildings with neoclassicism style that replaced Georgian architecture and colonialism. And later on, neoclassicism was not only exclusive for governmental buildings but it got spread to all different types of buildings, and they all used a common material such as concrete, iron and glass.

It is necessary to talk about what Enlightenment achieved and influenced long after its time, to relate to our main topic the digital, just like the Enlightenment reached to many regions and made impacts on its social economical and architectural values, the industrial revolution have also changed the economy that was based on agriculture and handcrafts, and changed the society and increased the wealth, also the inventions of steam engine, machines, electric motors, and the light bulb in addition to henry ford and his production of automobiles (Rafferty, 2019).

The industrial revolution had a lot of inventions and breakthroughs such as the railroads and production factories, in architecture it had a lot of growth in bringing new materials to the construction process such as the iron, steel and glass. Neo-Classicism and Rococo style were used a lot till the second half of 19th century when there was a lot of criticism of how hideous the new urban districts and the new factories and workers are looking within the wealth and rich population.

Age of machine was the theme of the industrial revolution, many materials like the furniture were made in mass productions to meet the demands, although that meant the lack of handmade goods which led to people missing individual skills to produce these products. Materials and products were available in cheap prices but there was no individuality or artistic value that appeals to people. there was a reaction to the industrial revolution, the arts and crafts movement that involved a lot of designers, architects, poets and musicians (Rafferty, 2019).

They wanted to spread back the artistic values and quality that were missing from the manufactures and William Morris was one of the most influential designers involved in this move, he believed that designing as a whole is coordinated art. Another similar movement was Art Nouveau which depended on having organic lines and forms that was used in interior spaces, jewelry and glass designs in addition to architecture, but mostly it was about modern art and design of everyday life. It tried to create a new style free from the traditional approaches that took over the past centuries (Augustyn, 2019).

In America the industrial revolution influenced many remarkable movements and styles. The Chicago school of architecture started in the late 19th century by a group of engineers and architects such as Louis Sullivan. Its identified as the devolving architecture of high-rise buildings and skyscrapers. They were many reasons why Chicago school had a big interest in high-rise buildings, to start with, the city was expanding and the population was increasing which led to higher property prices specially in the retail district of the town. This led to build more floors rather than more buildings which meant more space upwards more profit (Condit, 1973).

The Chicago school had many breakthrough designs, it had an interest in devolving the structural foundations to support the tall buildings. Later on when they started building the high-ris projects using traditional load baring walls of stone and bricks they realized they can't support the tall buildings which led the designers In the Chicago school to invent the use of metal skeleton frames which led to easier use of thin curtain walls that frees more space inside, while applying glass on the exterior to use less artificial lights on the inside and more natural light form the outside. All of this enabled the building of high-rise buildings (Condit, 1973).

In conclusion of the last two subchapters in defining the understanding of digital, it started with Vitruvius with his guidance in his books of architecture, it inspires others such as Alberti to continue the advancement in what is reached as a technology at their times. the digital understand of that time depended on using symmetry and proportions and delivering high quality finishes.

Moreover, it continued to develop also as a philosophy, with Palladio and his 4 books on architecture he made his own concepts and style based on the previous approaches. palladio was an influence also to many architects. and in the 16th century Italy had styles that were emerging form geometry and previous understanding of advancements at that time (digital). baroque style the style that focused on consist use of curves and organic forms, in addition to the interplay of light and shadows. the baroque was spreading in Europe and it reached France and became a reflection of that gloriousness, dominance and luxuriousness.

In age of reason (enlightenment) Europe got influenced by many ideas from famous architects like Filippo Brunelleschi. Their advancement wasn't only focusing on the

technological part but also on the philosophical aspect. This led to the birth of science individualism and skepticism and many more.

It featured also the Encyclopedia with a goal to provide a collection of human knowledge to be passed through generations. And many consider the Enlightenment is linked to the French revolution since they became more aware.

The revolution inspired many other movement and styles like the Neo-Classicism and Rococo that focused on purity and beauty which later on led also to the romanticism. But the Rococo style tried to stay against the baroque and didn't want to be connected to any religious or dramatic movements.

The Enlightenment had a lot of long-lasting effects and influenced a lot of movements. It reached the social economical and architectural values of many regions. the industrial revolution in another example of how a movement inspired other and made significant effect. it changed the economy that was based on agriculture and handcrafts, and raised the awareness of society and increased the wealth, not mention the inventions of steam engine, machines, electric motors, and the light bulb and automobiles.

Moreover, it influenced in the Americas many remarkable movements and styles. The Chicago school of architecture started by group of engineers and architects such as Louis Sullivan. It was known that it was the era of devolving architecture of high-rise buildings and skyscrapers.

2.3.1.3 After World war II

In this period the understanding of digital was in the form of discovering new constructional methods to support the tall buildings that characterized that era. The repeated process of tall buildings with steel frames was the beginning of styles like the modernism and the international style, but it was also the time were early modernism was being formed. Louis Sullivan with his famous understanding of form follows function it explained the idea of the approach of the that era with alongside Frank Lloyd Wright (Alton, 2017).

The right timeline of the begging of the early modernism, modernism and the international style, were special with war that have affected these styles. With the start of early modernism there was a rejection of Victorian thinking, they focused on the reflection of social values of many cultures. Buildings became taller with more complex and innovative designs in terms of interior spaces.

Figure 12: Schocken department store, Chemnitz, 1930 (Eric Mendelsohn) RIBA Collections

This change on many levels became known as the Modernism, it was considered a

radical break from the past and later it became philosophical movement at the end. Rejecting ornaments and embracing the minimalism approaches, many characteristics that defines it like the cube or rectangles shapes, open plans with flat roofs covered in white color buildings built by reinforced concert with a steel frame and large window spaces (RIBA, 2017).

International style and the Modernism style were among the known styles and they were quite related. International style got defined after the world war I and it has similar characteristics with Modernism such as the use of rectangular shapes with minimal ornaments, light taunt surfaces with no decorations, open plans, the use of cantilevers glass and steel with less visible structural reinforced concrete and later on we will discuss and elaborate on some famous examples and great architects that had a big influence in innovating in relation to the digital concept of their time (open plan, minimal ornaments, use of glass and steel, minimal visual appearance of structure) (Blumberg, 2019).

While Late Modernism is an architectural style that appeared after the world war II. Late Modernism encloses the overall productions of recent art after war and early 21st century, even there is similarities with post Modernism but they are yet different. any art done in the 1950s is considered contemporary not necessarily modernist or post-modernist and the same got applied to the artists of those eras. The difference is that late Modernism rejects some points and aspects of Modernism, but both have same purpose about art (Lange, 2017).

2.3.1.4 Follow up of the American Modernism

Following the understanding of digital of the American modernism, it is important to discuss great architects that had a big impact on architecture and its development in our concept in defining and explaining what is digital.

Frank Lloyd Wright was one of the most influential Avant Gard architects that was always a head of his time, many architects used to always get influenced by his works weather it was during educational times or after we became architects , his vision of architecture being something different than the traditional approaches at his time, he had his own way that defined him of handling materials and their functions or spaces with their surroundings, Constructing principles that are still being used in architecture till now with his buildings that still looks related to the modern architecture today (Eisenhuth, 2014).

Wright managed Throughout his career to set principles that can keep up with technological progress to stay updated with new experiences, with that in mind he did prove his goal to the current state of which is the way design is being done and produced. This leads us to think of what will be using in almost 10 years from now? What method could possibly match the digital progress of technology for the next 10 years? From the perspective of this thesis Wright's thinking in his time could differ from our current time if we compared them, back when he lived at the Victorian era, that time the American architecture were embraced by the classical approaches from Europe.

Buildings were full of ornaments that reflects the wealth, houses were considered statues, interior spaces were made without consideration for space quality or function,

Wright was always against complexity and adding details for the sole purpose of showcasing. That's when he identified a need for a new architecture, when he managed to reach his methods America got a new architectural movement through the Prairie School, it served a very thought purpose and every detail was done and planned precisely, it defined the aesthetic style.

Another example of his methods can be seen in the Frederick C. Robie House. The cantilevered roofs and eves that shades the areas of the house through summer and shelter it in winter, it was a defining feature of this house and of its aesthetics.

Wright payed attention to the details that serves a purpose with engaging experience of its use without complexity to the design or excessive use of visual elements for decorations. Wright had a special treatment for materials such as selecting the ones who matches the criteria and strengths for his projects (Eisenhuth, 2014).

Wright didn't like how other architects treated the selection of martials by counting them like they are all the same regardless of their nature, which is what Wright tried to look for, the nature of the materials like taking selecting wood for their natural color and the ability to carve into them or paint over them in a simple manner.

Wright used to combine materials to satisfy his clients demands for instance the Administration Building in Racine, Wisconsin the clients needed to have more flow and reduce traffic within the buildings and he managed to solve that through creating an enclosed environment with a more open layout to observed the natural light in an indoor space with multiple light columns. these columns had narrow bases and very wide tops making them look they are floating, Wright's knowledge in the materials he

picked made him succeed in making this structure, which reflected on the space quality of the building and the work rate of the office increased the employee's efforts and productivity, which has influenced a lot of digital tools on having more realistic reinterpretations of this aspect of materials to bring reality when applying (Eisenhuth, 2014).

Figure 13: The Prairie School house by Frank Lloyd Wright (Andy Olenick)

Wright's designs in the prairie houses had open layouts from a central point, as we mentioned at that time the Victorian era used to create traditional spaces with pointless usage.

Wright always wanted an open layout to have mixed use spaces with careful designs to manage the flow of movement for people within the spaces. This resulted in having the spaces more active and had a lot of natural elements like light and air, it enabled the sense of unity within the whole design. When he needed to separate two areas, he used a furniture element that can be manipulated because in Wright's approaches open spaces were more human, making less space for the structure pf the design. Even in an interview it got stated that many clients said that the open layout had an impact on their

lives.

With digital being questioned we mentioned before how Vitruvius had set a detailed principle and if we look closely many of his ideologies exists now. Wright's approaches are heavily influenced by the same concept of his mentor Louis Sullivan who followed what is known and got famous by acknowledging that the form of a building always determined by its functionality, which is traced back to Vitruvius. And Wright got back a remastered this statement in an interview to Form and function should be one joined in spiritual union. That gave him more angles to explore in his designs. (Eisenhuth, 2014).

It was obvious in his prairie houses the need to provide closeness yet open sheltering from different conditions of the season. He achieved that be relating to human proportions like lowering the roofs, rooms were located carefully with maximized distribution of windows for more natural light to enter the main sections of the house. Distributed less important spaces to the first levels such as the bedrooms while the main rooms were more open and closer to the kitchen.

The whole house was almost on the shape of a cross or an L. mainly because he believed that all spaces are related to whole design and vice versa including the surroundings, Wright always wanted his designs to be admired before exploring its spaces that's why we can see some of his main entrances could be hidden as Wright's said "To approach the building was to be embraced by it long before one reached the entrance." (Eisenhuth, 2014). To give the audience a chance to understand the purpose of the building.

Wright also wanted always a harmony between his designs and the surroundings with its topography's, like an extended environment and most of his works follow this philosophy. Most famous example is the Fallingwater house making the waterfall the structure and the buildings blends with the nature of surroundings like the huge rocks on the cliff. So, there was a mix of harmony that follows the indoor spaces with the light, glass and walls with the outside areas to bring its environment inside.

2.3.1.5 American German Follow ups

With digital being discussed an honorable mention is the American-German architect Ludwig Mies van der Rohe one of the most influential leaders in modern architecture and the director of Bauhaus. He inspired a whole generation of architects, from designing iconic office buildings to memorable furniture's. many of his designs reflected his famous line "less is more" even that he meant to have a very minimal clear designs, he had a rich love of creating top notch details, textures and materials to show his creative approach in all his designs "God is in the details".

Mies van der Rohe had an equal impact as a teacher in architecture Back in Germany with him being a director of the influential school of Bauhaus till it closed under pressure from German forces (Rawn, 2014). Mies returned to America and led another architectural school in Chicago and went on to create a new style in architecture that reflects modern times just like previous styles such as gothic and classical did in their eras. Mies style that represented the 20th century with simplicity and clearness. He used to say about his buildings "skin and bones" many of his designs such as the office buildings showed his love for using steel and glass with minimal structural elements to give more freedom for interior spaces, a minimal framework to allow free flowing in space.

Mies wanted a creative process of architectural design, a process that shoes the spirit and emotions of the new age. However, many architects refused his approaches after his death, describing his approaches as boring, but still his methods are being taught till today as well.

In relation to the digital Mies reflected his admiration about the use of glass while industrialism was being the main topic (Rawn, 2014). Mies always wanted the building to be a statement represents its time, just like digital tools are being considered now. He innovated the design of skyscrapers with steel and glass, with his mentality that we mentioned about having an open fluid space with less structural elements like the columns, the glass was an absolutely necessary part in his philosophy

Famous example of Mies philosophy was his design of the Illinois Institute of Technology where he applied the fluid spaces concept, while in his design of Barcelona Pavilion he used partitions of movable glass to flex the use of spaces as needed, making these partitions as simple structural elements.

The use of glass enabled a harmony in the modern designs with structure and the surrounding landscape, making the environmental greenery the limits of visual contact of interior spaces. As one of Mies visions was to make his designs close and integrated with nature to form a high unity. Mies added: "If you view nature through the glass walls of the Farnsworth House, it gains a more profound significance than if viewed from outside. That way more is said about nature - it becomes a part of a larger whole." (Rawn, 2014).

Figure 14: Illinois Institute of Technology by Ludwig Mies van der Rohe (Davide Adamo).

Mies insisted that it is also important to know how to handle the implantation process of materials in a meaningful way and considering the fundamental aspects of architecture. Mies invented a technology like the use of glass but he knew how to use it carefully to show it importance in showing spaces and reflecting outside potential. Something that is it common with Wright's philosophy which is something the digital is concerned about as well.

In conclusion Mies van der Rohe director of the Bauhaus influenced a generation with his famous design of less is more, minimal design with maximum efficiency and attention to details. When he returned to the Americas, he introduced a new style the reflects modern times with clarity and minimal structurer elements for more freedom of the interior spaces. While others architects refused his methods describing them as boring, no one can deny the innovations and advancements he brought in designing modern buildings. He insisted that using materials such as glass in a meaningful way while considering fundamental aspects of architecture.

Figure 15: The Barcelona Pavilion by Ludwig Mies van der Rohe (Maciej Jezyk)

2.3.1.6 International Modernism

To continue in the context of digital that we are getting close to relate to in our time, many architects brought in the 19th century greatly contributed to the modern architecture. Two of the main representatives of international modernism will be analyzed;

1- Le Corbusier

2- Walter Gropius

Le Corbusier is also one of the great architects of the 20th century, a radical campaigner for new visions and ideas on modern urban planning and managed to influence many figures with his designs, philosophy and writings. He is well known for his five points of architecture which can be briefed as:

- Raising the building on pilots to free the walls of any structural element

- Free walls will lead to free plan

- Façade will be also free to design

- Horizontal windows made by the free façade should allow natural light to the rooms equally

- Roof should be straight flat with greenery to use the space of the roof

Figure 16: Villa Savoye by Le Corbusier (Andrew Kroll)

Le Corbusier released also a book "Towards a New Architecture." Which he explained his vision and ideas for a new architecture in the modern era, and applying to the base principles of automobiles and plans to the buildings. It is from here he claimed that "machine for living in," summarizing his approaches in designing and defining the bases of modern architecture. Corbusier completed many projects a very famous example of Le Corbusier is Villa Savoye where he applied his five points (Stott, 2018).

Walter Gropius was a highly regarded architect and a founding father of the modernism, he is also the founder of the Bauhaus that adopted elements of architecture, art and industrial designs. Gropius was interested in the mechanical side of work and the new utilitarianism of the factories. He worked alongside Le Corbusier and Mies

van der Rohe. Gropius was one of the first of his friends to put his modern ideas into practice, alongside Adolf Meyer he designs the Fagus Factory. Consisted of steel cube form covered with glass, which saw a new invention of the glass curtain wall.

Figure 17: Fagus Factory by Walter Gropius (Carsten Janssen).

Gropius felt that the exterior of a building should reveal the logic construction of a building, he also expressed his ideas that train stations, retail stores and factories should not look traditional rather it should evolve to match its time in social and cultural values which he insisted that they are important to the architectural design. It is also important that improving the working environment and conditions increases the overall work production. These claims and theories guided him in designing the Fagus factory (Pascucci, 2018).

And later in 1919 he took over the School of Grand-Ducal Saxon for Arts and Crafts in Weimar as the master and promoted it and transform it into the Bauhaus. The school became Europe most developing and influential schools of design. It heavily influenced the current modern architecture and art. Gropius also published a lot of

writings about his Bauhaus manifesto and what is the role of artists in his relation to his work. Gropius continued his Bauhaus teaching even after his emigration to united states at Harvard university (Pascucci, 2018).

From the perspective of this thesis the architects of 19th and 20th century we mentioned, shaped the architecture of regardless of the technology or the digital concept they provided, at their time it was about reaching a new architecture (international modernism) and it was done by many different approaches. Some may have left a bigger impact because of how it got implemented into architecture like the Bauhaus with Walter Gropius and Mies van der Rohe. Their ideology was not reaching a certain point but to spread it through time and developed it for more generations.

They shared their theories and approaches of certain designs and what it should be considered for the current time and keeping up with what's new, which is an almost similar definition to our digital concept. Le Corbusier was also having the same purpose, he had a vision of the new era and proposed principles of how architecture could advance. It wasn't about architecture it was about social, urban and technological aspects. Others such as Frank Lloyd Wright preferred to go forward to produce a new concept with many logical reasons backing many aspects of their approaches with keeping mind the traced origins that goes back to Vitruvius.

2.3.1.7 Post Modernism

Post modernism appeared as the reaction to the modernism and the international style, which many said they lack diversity, formality, ornaments and ignoring the history and cultural values, and they mean by that is what Le Corbusier and Mies van der Rohe offered at that time. They also criticized the capabilities of architecture in changing and solving social issues (Willette, 2012).

With the use of logic and reason. The life in the postmodernism period got more supported by science and technology. It shaped he general public life, people started changing their self and their societies for the better. Although Postmodernists in general they don't believe in the progress of human through the faith in science like what happened in the Enlightenment. However this led Postmodernists to keep the approaches of knowledge by natural reality, and this knowledge can be supported and justified by reasonable immediate evidence without any philosophical foundationalism since Postmodernists rejects them (Duignan, 2019).

Postmodernism didn't last much and it was introduced by architect Denise Scott Brown and theoretician Robert Venturi when they released their book "learning from Las Vegas". They talked about vernacular landscape and how the surroundings are important to architecture. Venturi also directed his attention to the world and its environments, stating that learning from existing landscape can be revolutionary for the architect (Willette, 2012).

He wanted to make an architectural style suitable and hosts new materials of the new century. Unlike with previous style where they dropped the traditional approaches without using any decorative elements and striping away the structure like what mies said less is more. modernist architecture in its white simplistic colors ignored the environment, more independent just like Villa Savoy by Le Corbusier, the project stood alone like a sculptor surrounded by greenery to show its dominance over its surroundings.

In the end Postmodernism was more of an attitude towards a certain style that ignored its environment, while Postmodernism did think and respected the past which makes

it the main characteristic of this style. It didn't try to revive nor it was an analogy that helped leading buildings to become a knowledge for others and it ended with its famous example the world trade center that collapsed in September 11, 2001 (Willette, 2012).

2.3.1.8 New Era of Communication and Digital

Architecture nowadays have many movements that might follow or influenced by late styles, most important styles that emerged are:

1- Deconstructivism

2- High tech architecture

3- Neo-futurism

4- Parametricism

1- Deconstructivism which is almost a branch from Postmodernism. Deconstructivism gives that feeling of fragmentation of the building, usually it has no harmony, symmetry or any continuity (Miner, 2017). It employs chaos from placements and random disjointed elements and gets that from the cubism. its name comes from the semiotic analysis that got developed by Jacques Derrida, although many architects that made projects based on that style rejected its name sucsh as Peter Eisenman, Frank Gehry, Bernard Tschumi and Zaha Hadid. The Guggenheim Museum designed by Frank Gehry in Spain is a famous example of this style.

Figure 18: The Guggenheim Museum designed by Frank Gehry

2- Other movements that can be considered as late modernism was the High-tech architecture which is also known as the Structural Expressionism. And from its name the style is to include high technologies in the design of a building (Miner, 2017).. High-tech architecture was meant to be a revamped modernism, a new version that helps in technological advancements.

The form of this style was close to Postmodernism but it emphasized on its structural elements inside and outside like columns and beams, and also adding elements to these structural parts. Many of the main themes of High-tech architecture style was used also in the Neo-futurism style, which rejected pessimism and looking for more positive future visions.

It is considered as an avant-garde movement because it has certain fascinations with science when using futuristic aesthetics. When it's considered avant-garde, it meant also its experimental which is why some of its designs challenges some traditional principles of architecture. As an example, instead of designing a tall skyscraper it would twist the building like a spiral to the top.

3-Neo-futurism did inspire architects to become more innovative with their designs showcasing their talent and own individual visions. Zaha Hadid could be considered one of the best neo-futuristic architects. Hadid designed many award-winning projects. Her designs test the boundaries of design, a futuristic vision.

Figure 19: The Jockey Club Innovation Tower by Zaha Hadid (Kothawade, 2017).

With her design of Jockey Club Innovation Tower with a traditional approach while looking like an iceberg with the exterior inspiring to behold, moreover the interior space design is impressive to say the least, designed to promote simple connectivity and interaction between many disciplines hosted in the tower (Kothawade, 2017).

With the growing interest in technology in design, parametric design offers a new way in architecture though digital design techniques. Parametricism becoming more popular as a tool that designers use to alter their designs. Patrik Schumacher an architect and a director at Zaha Hadid company mentioned in his Parametricist Manifesto back in 2008, the style became more mature within the innovative architecture, and ever since the term Parametricism has been getting a lot of attention into details questioning its true strengths (Cilento, 2010).

4-Parametricism suggests that architectural elements and different complexes are workable and malleable. This concept offers a huge shift within the basic compositions of elements of architecture.

Instead of the traditional classical geometrical forms (cubes, rectangles, pyramids) the new concept of Parametricism is the animating of different geometrical entities. it aims to organize and increase the various complexity of spatial order with the use of scripting to coordinate the elements in a system of design (Schumacher, 2010)

Schumacher also adds that a style in architecture should be disregard as matter of how it looks and focuses more on the understanding behind the research that led to it just like science research (Schumacher, 2009).

Even so, appearance and looks is something critical in architecture and there isn't much we can reduce to lower the importance of the appearance of a style.

New styles have many connected problems that some of them are being confronted at different parts of design process, after all it's the debate and discussions of problems of certain styles that explains the use of this style. Schumacher point that architecture of today is more worldwide discussed and easily compared to any other project, Schumacher stated they do compare projects when trying to figure who did a better job in designing (Cilento, 2010).

Parametricism still offers flexibility in its components to edit and manipulate which leads to many results, without being strict to certain forms like previous styles have tried. However, architects such as Peter Eisenman and Bernard Tschumi Represents

specific architectural theory standings. Bernard Tschumi has many radical theories for constructed situations (post-structuralist architecture)

Bernard's understanding of the architecture still being practiced by him, he argues that there is no space without an event (Keskeys, 2016). His reaction to the digital way his designs are meant for the users no matter the nature of use of the space, not repeating the principles or symbolic of design. And a lot of his work got criticized because it favors his intellectual purposes and needs rather than social and human needs.

Peter Eisenman shares similar approaches most of his work is often referred as formalist or deconstructive. And at the moment he is a professor at Yale School of Architecture teaching theories and advanced design studios. In an interview Eisenman said that the core architecture lies in the architectural education, "We do not have a disciplinary model that suits the students and paradigms of today," says Eisenman (Keskeys, 2016).

he continued to mention that he teaches the past rather than the present mainly because of what problems we are facing nowadays, the importance of sketching how they reflect the attitude of the idea of the architecture which will become as a historical trace. He wanted to create an architecture based on attentiveness, for the people to think about what kind of architecture that gets close to them rather than it looks powerful. He argued on it achieving its absolute purpose and getting more of an art, which he said "Art is beyond power." (Keskeys, 2016).

In the end He criticized the use of digital tools in architectural schools and showed his dislike of the parametric approaches of design by saying the tools are aggressive, its

limits the student from becoming creative by offering solutions through algorithms removing the self-judgment perk.

Eisenman added that in order to be a successful architect you have to be well educated and self-learned not reliable on technology that can't be around in a deserted place. Favoring the books which is something is being overlooked in the current time regarding the digital.

In conclusion, this thesis believes that modernism in its many variations did managed to achieve its goal somehow that was common between all moves, having a style that goes with its technological advances of its time and meeting the social demands. Architects like Le Corbusier and Mies van der Rohe did managed to share their thoughts on how they see the architecture of tomorrow with all its cons and negative sides to society, because a part of this thesis assumes that a part of their visions is to be perceived by others and try to build on it to develop it for a better understanding (Rawn, 2014).

High-tech architecture style for an example is not a common style or named a lot to many projects that built with its concept, but it does align without digital concept but it is considered a step-in development with its technological time.

sometimes it is necessary to have different approaches even if they were outdated or functioning without a human reason like what Bernard Tschumi was trying to accomplish by understanding the science behind animal behaviors (Keskeys, 2016). The importance of such differences to show how thinking and finding progress is influenced and effecting on shaping any parts of what we can call future.

Digital tools in all of their formations are built with principles that gets updated with each and every new concept, many of we mentioned that Mies an der Rohe and Frank Lloyd Wright worked with, thus leads us to see how a movement is seen, evolved, and understood leading us to choose what is really important and right.

As stated by Le Corbusier, he refers this technology of house construction as the `living machine`. Under this, he believed that the only way architecture can be advanced is through the advancement of technology (Stott, 2018).

Then came new concepts like the Parametricism, a totally different approaches within the digital world that melts the previous geometrical forms through series of scripts within a system to produce a huge amount of results. The uses of such styles do provide an edge to architecture by time, because it evolving just like the concept of digital (Cilento, 2010).

This research assumes there is a clear cut between the architecture of past times and the modern one as the survey in the next chapter will show us. The difference between these architects is not measurable. For instance, the modern architects are associated with lots of defects in relation to unnecessary spaces, non-functional and unwelcoming addons.

Architects such as Frank Lloyd Wright had a clear vision of how architecture should evolve to, his principles made architecture progress to another level, his buildings are considered an inspiration to everyone while Mies an der Rohe managed to innovate the use of materials on how it emphasizing the fluidity of interior spaces while reflecting what the buildings is representing at a certain time.

On the other hand, the architects would try to combine both technology and expertise to come up with a building which is characterized by compatibility and consistency of different parts of the building. Yet it may not be the sole aspects are used other architects we mentioned like Bernard Tschumi whom he wanted to align his designs and works in a scientific studies of animal behaviors, he is motivated by that was and known for his intellectual purposes.

While Peter Eisenman preferred having an architecture of paying close attention to what it really matters, to make people wonder, close to an art, in designing using a more traditional ways but most importantly to be well educated (Keskeys, 2016). However, compatibility, stability, and permanency were taken as the core factors during the traditional architecture, there was a blur that was associated with the architectural design and architecture in general and then a new principle came and provided more depth to clear what are the real purposes of design such an entity in architecture. how there is certain tools for each time to look after when designing, although it can be misleading or mis informative but it's considered important and progressing by time.

2.3.2 Digital Architecture

We mentioned in the intro what digital is considered. a discipline that uses an advanced approach then uses it to find solutions. digital with design in architecture equals to innovations with a computer and special architecture tools (Kazemi, Borjian, & Proceedings, 2015).

To fulfil the demands of this research pointed to the digital, it is necessary to talk about digital architecture through these necessary tools:

1-   Design thinking

2-   Design process

3-   Contemporary mainstreams

1-As stated by Tim Brown: Design thinking is a human-centered approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success. Tim's definition of design thinking is reliable to innovation. Design thinking is not necessarily a method, there are and always been different design thinking implementations with close steps of process.

2- Design Process we mentioned before (chapter 2.2.2) that is always aiming to solve design related issues and depending on the circumstances we can see many different approaches to having a solution especially now with the possibilities of digital incorporated into architecture, mainly because according to many research's and studies the traditional and old ways are not keeping up with todays complicated problems (Cross, 2001). The need for higher quality overcomes the traditional ways that lack this feature nowadays.

3-Contemporary mainstreams refer to the different reactions of the architecture nowadays which most of us refer to modern to imply it's still fashionable, of course it means somethings new. No style is preferable and many technologies are used in the design and construction process, and its designed to be seen noticed and being inspired by the possibilities of what they can achieve. started by a group of architects, Mies van der Rohe that we talk about earlier was one of the most influential architects of this move and director of Bauhaus, he always wanted to guide the creativity of architecture design process to show the essence

of the modern approach era. Other important pioneers of this move are Zaha Hadid.

Contemporary mainstreams in architecture nowadays are based on digital architecture, and not necessarily defined as digital rather than it's a trend associated with the features that bring to architecture. Private sectors and companies are supporting this move and searching for architects are familiar with digital calling them digital architects to back their projects, and when we look at what makes an architect classified as digital architect there isn't a very clear answer to that (Akyuz, 2017).

Job requirements from these firms doesn't seem too different from a normal architect with only difference is the use of some terms of modern technology related to architecture. As we mentioned above that there are different architects with different views for new architecture, and digital architecture is not a new type or style, it's just more a way of handling the current ideologies a discipline applied to the design process to find solutions.

It is true that we can see some integration of applications with data analysis in making digital tools that sometimes defines the digital approaches to find the solution and leads to making an experience a priority. that being so architects who seek to gain the digital architect known are required to adopt this methodology. There are many traits and perks of digital architecture in the design process, they are some of them considered common architectural principles and qualities while some may suggest how a digital method should be treated (Akyuz, 2017).

In traditional ways the architect needed specific requirements so that he can find design

to solve a problem. This might create some isolation between the architect and customer as a solution was found by a given requirement but without a consideration of actually matters for what clients are demanding. As it will be followed by the answer and a survey in the next chapter, a basic question can be asked here on how can we deliver a solution that is creative and unique and at the same time achieving satisfaction?

As an answer to our question about a creative sustainable solution, concluding a new method or solution with effectiveness can be an easy process, the language of numbers and science can backup and prove the effectiveness of any new approaches suggested, but in reality, integrating, applying and achieving such a concept can be a very complicated process. Digital architecture can be demanding and its interpreted differently by the public.

So, what can be understood as Digital architecture? From the perspective of this research digital architecture is integrating the new digital tools with the design process, it can be approached through a cooperative process that combines needs and experience. It can be done with using new digital tools and design thinking. because design thinking can handle complicated or unexpected issues.

A proper understanding of the new aspects of architecture from past inspiring architects and exporting them to face challenges of today, modeling them in today's digital era would result in a satisfying result. after all it is Still considered that the main feature of digital is the experience, the continues impression before and after the end product. A continues life cycle of the end design is something sought and thought a lot recently, with the ability to self-solve certain issues that accrues. It's an important point

that architects should consider in having this continues experience more than just meeting the requirements.

2.3.3 Chapter Conclusion

It was important to go through history of many different eras, movements and styles to try and explain what is the concept of digital weather it was a philosophy or a tool used or just a vision on how it could be. Highlighting architects that influenced architecture and shared their theories and principles gave us a clue of each time how it tried to perceive architecture and tried to go further in developing the future. It may not be enough to discuss the mentioned topics but it did manage to help us to define digital as a concept through time.

From the perspective pf this research in our current time, the digital tools that are available offer us different combinations of solutions. Weather it was about calling it art or architecture both are heavily influenced by the digital. There aren't any certain protocols to refer of how we should use digital in our life but just like the architecture of past times there is always a point as a foundation to go back to and get influenced from, it could be a certain style or an ideology of an architect, we mentioned how Mies managed to use the glass as a reflection of the interior with his close attention to details and trying to remove structural elements in designing spaces to allow fluidity and making an open space to be discovered.

There are many examples but it's about how a certain idea can be progressed to become an innovation by itself. just like Mies did he believed that he can achieve more it is indeed something to get influenced by for many generations.

Adding to that Wright's concerned with logical and necessity of designing elements,

there is no need for details without a purpose a statement that we see it a lot in contemporary designs nowadays.

Designers and artists can be influenced by what they see represented today, and todays architecture is mainly built on the foundations of the past architects who had the vision to design for the future, other architects supported this claim without the intervention of digital tools as they may blur the true purpose of designing.

Parametricism as an example of what digital became and evolved in its different forms, what it offered managed to impress. The future today is heavily equipped with digital tools, making creativity easier to express but sometimes harder to understand when being though without a logical structure.

Time is changing and there is fluctuation in demands in architecture that sometimes considered complicated and requires many integrations of ideas to achieve certain solutions. Digital in all its forms and tools are without a doubt a huge step in architecture with a carefully conducted survey shows (chapter 3), it's all about the logical methods followed and applied that can guarantee a successful experience for our time

2.4 Visual

Visual in definition is a process of detailed information about what the eye can capture. It is also a process, and many factors are involved in that process which makes the visual process more of a user-based experience that differs from a person to another. Visual can also be the object in sight that is used as an effect or illustration or any visual form of aesthetic purposes.

Visual as a method can be a mean of communication, a language to deliver ideas and concepts. And in order to achieve that there are skills needed to make the ideas more clear, tangible and visible (Pingale, 2017).

Visual as a design element is about strengthening the users experience which involves the knowledge of some fundamental basis like the gestalt principles we talked about (Chapter 2.2.1) such as unity, closure, similarity and so on.

Visual can go through deeper aspects of contextual examinations and related cultural traditional explanation to produce certain themed visual results. These are required for a better look to be integrated with the whole context and gets easier to understand for the users. Although recent researches suggest we can conclude that visual design compared to the current digital state is becoming rapidly inconsequential. as for the designer who are coming from an art position. (Hashimoto & Clayton, 2009).

To understand visual better, we need to look at the history of visual and its forms. In this research visual will be taken as the manual way of processing data gathered through the users understanding, opposed to what digital is.

We are giving two basic understandings of visual to the appearance of photography and what comes afterwards.

1- Birth of Photography

One could only argue about the exact point that made the visual in all its forms became a more digitalized version and what exactly backed it up and improved its presence in the world , looking back to the early 18th century which was the birth of actual

photography with the first photograph taken by the Frenchmen Nicephore Niepce (Young, 2017). Which he had difficulties in preserving them and he had to make a lot of light adjustments and sensitivities to make sure that he can store them on a pewter plate, after a while he partnered with Louis Daguerre and together they used the heliograph process and improved it for the light conditions which led them to make an immediate success for having a lower cost method and accurate representation of portraits and scenes rather than having them hand drawn by artists , their success led to the opening of a lot of photography studios which made the middle class afford it and they all want their photos taken, later that time an Englishman called William Fox Talbot had success in making negative photos with a similar way to Louis Daguerre which also remained used till 20th century .

in France after the success of photography there was a huge backlash from the artists that found themselves almost jobless, while some of them made a lot of criticism to fight it other artists turned to actual photographers such as Gustave Le Gray who only took photos of close relatives and high end clients, he also tried to tech some of his working methods to other photographers and he succeeded in developing a technique which includes adding some wax to photo papers to make them more receptive, later on he managed to make a glass known as wet collodion that provided a more detailed photos and it was easily reproduced (Young, 2017).

With visual being further explained photography was in a progress, a group of artists called impressionism started in late 18th century and continued till 19th century, it is an art movements consisted of different approach to painting which was about doing more research into the lighting conditions in the painting to produce a more clear image with vivid accurate colors in additions to making an open compositions and taking some

unfamiliar angles (Zelazko, 2019).

Impressionism as an art, it was a style that focuses on the artist capturing the image of an object as if someone took a quick glimpse to it, it consisted mostly of outdoor scenery and adding multiple colors to make the picture bright and vibrant (Zelazko, 2019).

It brought by a group of French artists because their exhibitions brought them some good reviews, but it still brought them hate from community and from other artists who also tried to make their own movements. but the name impressionism comes from the work of French artists Claude Monet which called Impression.

2- Modern Photography

After the appearance of photography, it became possible to capture the reality with the camera and technology, it marked the first time visual and technology became related. In early 1920s, after the world war 1 technology got in consisted change because of its left of the war, as for the new innovations photographers and artists got more famous in dealing with new technologies and using science with them as well (Newhall, 1982). With the new mechanical cameras and their abilities made production process faster for them which had a lot of involvement after the war, during that time it seemed the it made more possibilities for photographers to present new representations of visions and sceneries.

By exploring visual many photographers like August Sander presented different modern types of people from different professions races and classes with showing, he managed to shift the practice of portraits with these images that captured emotions.

Reaching between 1910-1950 modern photography became the trend at that time which photographers started using focus points and reviling formal qualities in their work which was quite famous in America Latin America Europe and Africa. by the 20th century photography was the most impacted innovation by technology mostly because it got used in many aspects of life and for long periods that captured history through many periods, earlier in the 19th century cameras were only owned by professional users such as artists even that it didn't require any kind of license but still it was only bought by businessmen. but art managed to inspire many armature artistes to create their own ways their own vision of how portraits can be done through different methods angles and materials and it got them in many different majors of business such as Advertising Photography to make products look more desirable for people and many other roles.

The visual was an important aspect to Le Corbusier when he stated that got amused by the power photography has because it managed to change the views of the public on architecture and their perception over the century, and how it succeeded in shaping the portrayal of modern architecture and how the photographers had a deep relationship with architects referring to his collogue Lucien Herve who was a photographer but thought he has the soul of an architect (Dezeen Article, 2014).

Photography evolved even more with the digital advances in early to mid-20th century , photographers can be anywhere they differ from many uses of photography either for business or entertainment and equipment's are available to all public at a very manageable cost specially the mobile photography which got devolved a lot by technology like the mobile phones cameras which managed people to capture their memoirs at any time and share them with each other , while DSLR cameras are more

oriented to the more professional enthusiastic photographer at a higher cost but with a higher level of control and technology.

2.4.1 Contemporary Visual Understandings

Moving forward with the visual understanding, with this huge availability to all kind of visual capturing sources (cameras) we reached a dilemma of how we see the reality, is it by artists visualization? Or is it a photograph the show us the reality as it is? Repeating the reality constantly became somehow a nightmare for visual, so photography became the digital to visual. In order to confront Digital vs Visual later on in chapter 3, it is need to understand the nature of visual and explain them through these topics:

1- Visual design or Visual communication

2- Visualization

3- 3D Rendering and Virtual Reality

Visual design is about creating visual impressions of imagery, colors and illustrations on the end products, and the visual design just like the design process have similar principles to achieve such results such as the gestalt theory (Designblendz, 2018).

The field of visual design has increased recently with advancement of technology mainly because the production of many consumer products which takes a lot of designing aesthesis. in addition, it became an important process in making user interfaces in many products and machines. And the success of such visual design depends on the user interest and engaging experience to form a bond of trust (InteractionDesign, 2018).

Designers can control the visual design of a certain product for a certain purpose but also, they might face designing challenges, such as the use of the color red which bears different meaning through different cultures. Meaning designers can control the visual elements to their favors in addressing experiences to get behaviors from users to fit the original purpose of a product
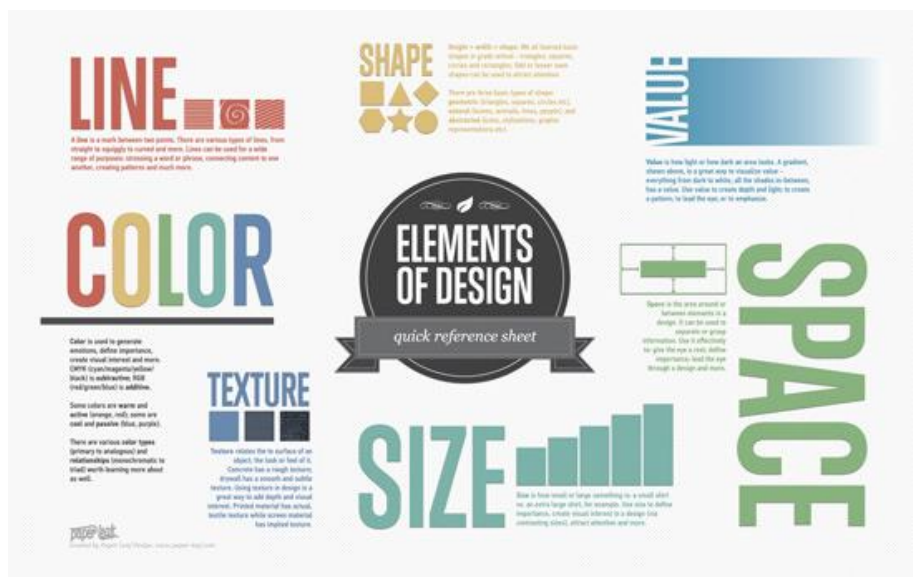

Figure 20: Elements of Design Quick Reference Sheet (Paper Leaf)

Visualization process was always a way of presenting a concept or an imaginary of something as a communicating method, in architecture it was on a phase before the intimal design. It used to make a gap between the designer and the constructer or the client, which could cause misunderstanding.

As we mentioned before we trace this to early ages, to the time of ancient Egypt and Greek geometry while in renaissance it got improved when different artists started portraying their designs like churches. Now in the 20th century the visual process which we refer to it as visualization is updated with various of architectural tools (McGrath, Hsueh, & Shan, 2016).
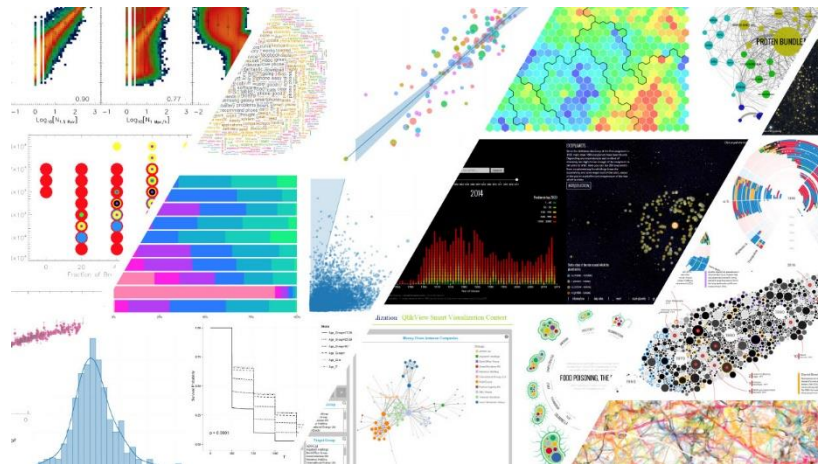

Figure 21: Visualization of different data and concepts (Nadieh Bremer)

The communications became easier when hiring specialized designers or freelancers or having an option in outsourcing the work to another place. It has been always a demanding process that dealt with care, architects, designers, and artists spent a lot of time to perfect their techniques in presentations to appeal to reality as much as possible.

With 3D rendering or 3D visualization becoming the main thing of shaping an idea virtual reality is getting more involved in the process and in the representation, different uses of virtual reality are taking places weather it taking the client in a tour of the design in a virtual environment that portrays the design or making design decisions using that technique in real time. it allowing the designer to reach further options in design.

All of this became possible the approach to reality with the modern tools that got developed by the new technology and different software's impeded with, that were not possible in earlier times. The fact that these tools this new modern visualization used by architectural firms made the designers show their works in a better shape and clearer understanding.

3D Rendering is consisted of a visualization process in a 3-dimension environment, its used to create an image that enables a communicative message and it got evolved to represents a sense of reality. this method has been used since dawn of man as a communication later on Leonardo da Vinci took it to another level with his mechanical drawings. Reaching today's technology, we can see the huge step it reached and how its effecting the architecture in imagining designs (McGrath et al., 2016).

Figure 22: Different steps of 3D Rendering (Chronos Studios)

Rendering in architecture is about making 2D and 3D imagery that explains a concept proposed by an architect. It is used now consistently in the design process and helped the architects in many aspects such as probations and creating light conditions to fit

the scenario and many others. The advancement it reached enabled the artists to create

an equivalent images of real time conditions giving the client an almost identical result

of the end product. Even in interior spaces, materials, and furniture's.

Figure 23: Farnsworth House by Mies van der Rohe, rendered in Lumion 8. (Arch Daily)

3D renderings enabled different engineers, designers and architects to reach a way of

understanding of the challenges they face in a project. Using any 3D rendering

programs artists can easily edit the designs to solve issues regarding of its origin. The

variety of options available makes reaching a very satisfying result well in reach

Virtual Reality it's a complicated process done by a computer to simulate a reality that

responds to your visual and audible senses through a gear headset. The process allows

you to experience an environment as if you exist inside.

Depending on the world or purpose of using the virtual reality there are many different experiences for it. This tech has been around for quite some time only to be more used and progress though other professions that made it more useful and impactful. In architecture, virtual reality became easily appealing for architects, as it enables them to show their designs in a real environment to the clients, it made communication the ideas between designers and clients more easy and clear (EasyRender, 2018).

Figure 24: Virtual Reality with Architectural Design (Champagnesoda)

2.4.2 Conclusion

To summarize, there are many views on the modern architecture and how it looks almost flawless and more real, visual design is an essential part that supports the foundations of other techniques (Designblendz, 2018). And 3D renders bring everything closer to reality more than we ever reached, communicating an idea became easy and it improves the whole designing process, and at that time we thought this is best of what we can reach, till virtual reality became available in many professions and got progressed in architecture. someone would argue if they are that effective why they are not used more frequently?

There isn't a direct answer to this, because the whole process of visualization never stops, it continues aligned with the design process, every time design takes a step it is considered coming from a repetitive visualization process. Both 3D rendering and visualization do not represent the future, rather they are the present tools (McGrath et al., 2016).

Too many disagreements of making the traditional ways such as sketching being forgotten even with the existing of sketchbooks and such but architects where designs and drawings using tools no matter of their origin and time, and the matter selecting such tools can be more personal nothing more, depends on what gets your creativity.

Visualization is kind of in a loop of views and feedbacks, some results will be shown in a survey later. Virtual reality got introduced to designers and what they can make of it, it managed to get people to doubt on what type of information it can provide as some can be acquired through an image or a motion video. But virtual reality enables the designer to at least see a no cost simulation of a design before any decision being made, it does improve the confident of designers to take more brave actions with communicating their ideas which will lead to a better architecture.

Virtual reality has the chance to bring different designers and builders with its communication skills to clear any obstacles. Likewise, it will help architecture reaching a middle ground between professions. Yet it is unclear how certain technologies will be used frequently or what is possible since we are in a continues progress in technology. But it is a sure thing that what technologies like the virtual reality can bring to architecture will be very impactful.

Chapter 3

DIGITAL VS VISUAL

This chapter will be focusing on how visual started to develop with the help and digital, and how digital became a necessity in some fields because of the impact it brought the design process, in addition to the different adaptations and understandings that led to make digital and visual considered different approaches.

In order to showcase some of the examples and case studies about Digital vs visual, this research will be analyzed considering these items:

1.   Visual design

We already mentioned visual design approaches is to create or improve the experience of users, and since it consists of many different processes, in this chapter it is will considered also as the visualization.

2.   Design thinking

The process of reaching solution-based approach using different methods that ranges between visual and digital methods

3.   Digital tools

Tools used in the modern architecture design studios that offer better and consisted results are changing the design process because of the impact and influence they bring.

3.1 How Visual Became Digital

Visual design thinking consists of many recurring process that are being used throughout the requirements of design process, and these requirements are including complicated and complex tasks involved but without a certain order or an ideal way, therefor in the pursuit of knowing such a structure that consists of many different tasks that happen, we have to consider the visual design as a series of events that distinguished by different main habits and activates like the analysis of an object or the synthesis that defines a certain project or even the normal activates such as imagining and perception (Abdelhameed, 2004).

Many scientists and Psychologists discovered that the imagination is formed by our minds by our past life experiences and there is a lot of elements that effects forming the image in our mind and they all different from one to another, our eyes do not function like a camera, our brain rather selects specific parts as a focus points and gets information gathered by our own eye, according to Prof. Margaret Hagen she claims that there is a quite contrast between seeing and perception or awareness , seeing is mainly based on the natural act of enjoying a certain object while perception rely on the interpretation of an expressive perceptiveness (Sukhatme, 2004).

In the same context we can relate to the all of what visual design thinking consist of like the conception and imagining tasks are being reached and made through the knowledge and own personal extraction of information by the individual.

Peter G.Rowe a Professor in Architecture and Urban Design in Harvard University address the design thinking as more of a personal habit for the individual to solve problems related to design , then he proceeded to enlarge on the role of repeating and

practicing that enables the ability to become more fluent in specific ways of designing, through many years of experiences the architect will be able to imagine an impression and representation in real world, the whole entity of making the real models and drawings or even the digital content and relate them to reality and this will be the whole point of design thinking. it will enable the sense of dimensions on certain visual perceptions and getting the accurate scale of everyday life to achieve the user's needs.

Obtaining such an experience is a necessity requirement of the design thinking in architecture, after all architectural work is all about the conditions needed to achieve certain practices and construction programs which will reflect the knowledge gained by visual design thinking (Rowe, 1987).

On the other shaping process, the traditional way may restrict the design on what the designer can achieve by manual ways through hand and models, until digital tools got introduced which had many features such as the higher complexity of geometrical shapes and the extensive level of details in addition to the easy editing of models and drawings comparing to the manual way.

While designing using the digital tools and environment the designer will get hand a different type of approaches that will alter his visual thinking or interduce him to new creative ways in solving problems.

This happened because of the variety the digital tools have and offers through multiple platforms which lets certain designs can only be done through specific tools with the help of digital environment with the effect of the individual personal experience.

In this context these tools allow the designer to form shapes without any boundaries , also the process of adding shapes and dissembling can be done too, it enables the making of models forms shapes floors and stairs which can lead to new paradigms that where impossible to reach through manual ways and it can be adjusted to suite the visual thinking, this can stand for the sketching process that done on papers but only it's in a 3D environment.

This research assumes that this process of designing through a 3D dimensional modeling is the main core of digital design thinking while the normal sketching on paper is the essence of manual way. Besides that, all the new trend of digital tools through this design process does affects the visualizing done through the whole designing process while doing design exploring tasks, and it depends on the architect and his ability to learn perceive and catch through his usage digital tools.

After all there is a clear difference in visual design thinking between the traditional way and the digital environment, with the perception of drawing and papers in hand differs from the 3D modeling-based ones, each has his own limitations and capabilities in the visual designing process

3.2 Case Study 1: Education with Digital Tools

Usually in architectural education there are many syllabus's and curriculums that help develop the representation skills of students in the first year of their studies. with the continues involvement and advances of digital tools it is better to keep them informed and trained to keep up with them rather than making them overwhelmed by the huge number of different tools available today.

For example Graz University of Technology in Austria offered a course about methods

of representations which is about the essential skills in representations by using mixture of tools through learning of the complex geometry of their construction process in additions to analysis of many types of forms and shapes and their hand drawing techniques in presenting them (Stavric, Schimek, & Wiltsche, 2007).

In architectural educational design studios, students' gain knowledge on how to combine their skills of using new digital tools in different means. Mainly, because after the education is finished when the students start to work in the contemporary design studios, they need to have knowledge from verity of digital tools so to be able to respond to the profession. That can be achieved through constant training of a certain tool.

These digital tools changed the way we handle the design process and they became an inseparable side of design. these new technology enables the control of different steps of design process starting with a simple sketch to an augmented reality reaching to a real-life printed model. this process called integrated 3D design it manages to connect directly different tools of Computer Aided Engineering and Computer Aided Manufacturing known also as integrated technology. there are always different effects these technologies offer; it does enable the designer to control the whole stages but it is also needed to know and learn each step.

Generally, in the beginning of the learning process we use the two-dimensional representation software's and it could be both digital or visual such as papers or sketching pads. there was always a huge void in spatial thinking and transferring visualization into a medium (Piegl, 2005). so, the focus is on developing more understanding of the spatial values by using training on different geometry. this is crucial in architectural practice so it is needed in the first year to train on different geometrical forms and visual spatial knowledge. a follow to this stage is starting to integrate these methods into the design process, it is done through a various types of hand drawings and digitalized products (Stavric et al., 2007).
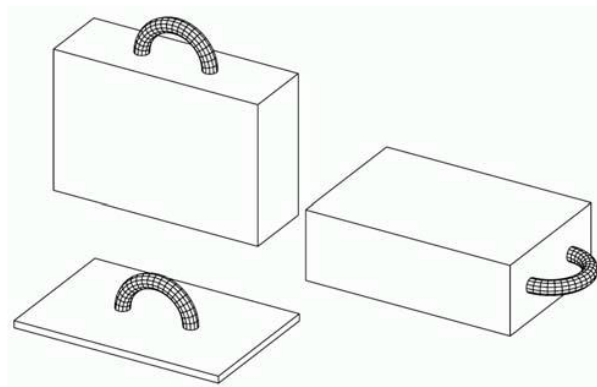

Figure 25: New configurations of the same shapes enable various interpretations (Stavric et al., 2007).

The representation technique and its relation to design can have a big influence of the design overall end result. In traditional ways it was considered through forms and geometrical approaches like the Euclidean geometry (as it was discussed in chapter 1 literature review) were the only things architects can drew is what they can build, and build what they could draw (Mitchell, 2001).

With the new tools of digital it opened new possibilities for non-Euclidean geometry and the matter of how it's going to be built is not a concern (Stavric et al., 2007).

These tools can be developed more threw theories about design and design could be developed through new tools. One of the interesting examples is Zaha Hadid and the way how she used the new tools to make new concepts new breakthroughs and how they were adopted and taken as an advancement like the parametric architecture. therefore, the new console of representation can make new borders and definitions to the design process.

They made sure that they recreate some methods to use these new tools from an early stage and the geometry proved as an essence for design and understanding spatial spaces. So the training will be relating these subjects together, even that geometry is not students first choice when sketching an idea but, the main idea is to instruct hand based geometry through handmade sketching and constructive geometrical spaces and later on elevating to reach higher levels of accuracy to make an advantage for using these tools (Stavric et al., 2007).

Figure 26: Analysis, generation and transformation of freeform surfaces (Stavric et al., 2007).

In the first stage of learning students start by doing simple forms based on geometry and ending with a complex model of a structure. during the whole session's students are asked to give an evaluation of these tools and how much it can be understood to build their structure in making their open ideas later with these tools.

The evaluation of the course showed that at least 75% of the students used the 3D environment for modeling made a better understanding of the two dimensional drawings of a 3D objects , however 80% stated that the hand drawn constructions of geometrical forms had an equal effect in their understanding (Stavric et al., 2007).

Following in the second stage its concerned about design process that built on geometry from the first stage , by making students present their ideas of what they understood from digital tools (Stavric et al., 2007).

This allows the design process to be backed up by the base of geometrical approaches which will help in a better understanding and analyzing of problems. With the complexity of the design process, a problems of a similar scale have been selected to match certain criteria's, organic forms of any objects of daily life such as a flower is given to make a 3D modeling to improve the skills of students while making free forms, starting with a hand drawn sketch of many organic free forms then they are asked to model a 3D form from their choice to prepare for mixture model consists of both of these steps in addition to an extra model design from of their colleagues in the class.
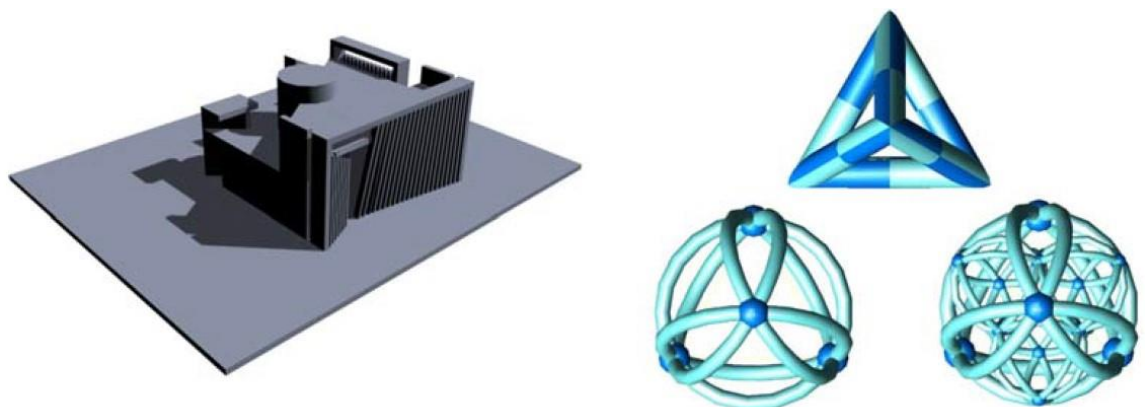

Figure 27: Solid Modelling with standard primitives and "platonic" shapes (Stavric et al., 2007).

Later on, it is constructed to produce such a design into a real-life model with the help of advance digital tools, laser cut machines or 3D printers as the most accurate tools to output great results.

It does improve the involvement and relation with the design process and gives student a motivation to keep working and experimenting different solutions with high quality and accuracy , yet it might not be cost effective but it can be managed when there is a large number of students so serve the great purpose and this technology by time it will become more available handy and reachable to students (Stavric et al., 2007).

Figure 28: Printed ABS-models (Stavric et al., 2007).

The course of methods of representations at Graz University of Technology have been under evaluation on yearly basis and with the results of the past years it showed a huge progress and satisfaction between students because of the major variety it offers of different methods and tools with continues care of the course outlines (Stavric et al., 2007).

3.2.1 Case Study 2: Integrating Digital Tools with Design Course in an Advance Level

There was always an argument in the architectural education section about the integration of teaching methods of digital media to the architectural students in their academic studies, while some according to architectural professor Daniel M.Herbert argues that it is better taught to students by professional architects and applied to their graduate level (Herbert, 1995).

On the other side Nancy Y. Cheng insisted that it is better to be given in from the beginning of the architect's education in a very organized manner which consisted of having playful exercises in a safe ready environment. it is needed that architectural schools are in need to be more clear and explain on the relationship between the teaching methods and the theoretical part on how to deal with the digital media impact (Herbert, 1995).

Professor Daniel M. Hebert had a discussion on the relation of handmade and digital aided tools in the design so he conducted a study on two advanced design studios in the university of Oregon USA in which the students how they incorporated their use between the real time models, hand drawings, digital tools like the scanner, and the 3D environment of the design software's to achieve result's needed. Their work might influence other designers within realistic events and the focus of being able to do multiple uses and interactions in addition to using old computer software's, after showing the details of the designers' approaches, he discussed the theoretical and real implications of this work.

The first characteristics of his work that it focuses on multitasking regarding tasks

rather than having single transactions, because most of the times while workings in a 3D environment it's more of single and one way leads to one change, it does make a unite closer or works it from one medium and makes more open together manual to digital or the other way around. Although his works consist of doing the exact opposite making the manual and digital a more source for interactions with many feedbacks and critics. This way of multitasking and having multiple interactions gives an enhancing result that differ from one to another.

The second characteristics of his work is the settings within a real design process environment. It is important because it shows the range of functionality and effectiveness of multiple interactions of the manual and digital, preparatory research are needed but certainly not quite efficient in making new progress and concepts for the design. The preparatory steps should have been more realistic to give the design a sense of a result for working on such a new technique.

Professor Herbert made sure that the projects were taken by his studies on these two advanced studios were realistic as possible regarding the new techniques and academic studies. Because these applications do present a steady measurement of success between the two methods of manual and digital and their many interactions in all phases of design (Herbert, 1995).

And the third characteristics of his work which is being described as significant is shared with the architect David Week the ease of access on relying on technology everyday with the hardware being is the common place for many tools such as the color printer or the scanner or even an editing program to be used all at the same time, but keeping in mind that it may not be easy always being able to managing these

interactions between all of them together as it needs time and skills to become more practical while using them .

All these characteristics together can form an effective set of protocols to be followed by the designer. the constant interactions between the visual and digital can supply a constructive addition to the traditional ways (Herbert, 1995).

The results of this study which has been done by two of Hebert's students that he supervised showed different details yet almost same approaches. Both students have drawn their ideas with the use of pencil while using the computer software to develop forms mainly because the 3D environment helps imagining the ideas through real perception giving ease to reach their concept with the relation to lines and surfaces.

In addition to other observed behaviors is the lack of symmetry in their designs even in the early sketching stages but still both of the students played with the many possibility of image editing on computer software rather than drawing them. Like the redrawing on printouts to rethink some points or changes or to change a certain surface in a physical model.

Also the students noted that the constant interaction between the two methods allowed them the possibility to explore more ways and approaches for further concepts to enhance details, in addition to that both of them spent a good amount of time doing their own synthesis of the projects on the computer software's rather than going back to the original papers and ideas mainly because the imagining software's enables a more faster method to produce a real time images and renders of their projects . The approaches and techniques used by the students consume more effort and time even

experience and they result in many theoretical aspects.

Figure 29: (a) the physical model of the study; (b) the computer monitors with a scanned picture of the model (c) scanned materials (d) a completed west elevation from printing.

Lately the image editing software's such as Adobe Photoshop managed to developed more interactive way of dealing with images with their system of layers and masks because it adds flexibility of editing different separated parts without the danger of permanently changing an item in addition to many other options with the constant updates the software's gets from many creators and developers.

Figure 30: (a) the physical model of the study of a section; (b) a scanned picture of the model with a simulated light from the sky (c) a scanned picture edited and overlaid with drawing of a section.

Figure 31:(a) composite of 3 scanned section drawings; (b and c) pictures edited with materials from working materials to create the east elevation.

Also, there is another way other follow in image editing which transforms drawings and ready drawn material to the software's interface, it could be even normal images

133

with included texts that could be scanned and recognized. another aspect of these software's is that all works done through different platforms can be exports and imported through many other software's when being compatible with each other, with the rise of innovations there are now 3D scanners for objects and they can be automatically converted to a file to be read and edited in software's.
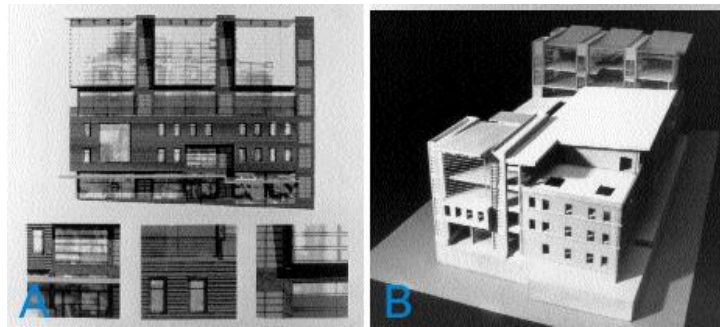

Figure 32: (a) a printed east elevation – compare it with figure 31 above (b) the west facade of study model - compare with figure 29.

Yet from a theoretical perspective when analyzing the work of a designer on projects that they are involved in we can assume that if their project exists in a 3D then the designer will be more efficient while working in 3D too , also the same assumption can be made if the works where drawn in 2D and its able to translate into 3D by computer automatic importation rather than designer manual input to 3D , and both of these theoretical assumptions can make redundancy in the designing process. so, it's generally better if the projects that done by students shows a more interactive connection between the manual and digital tools to generate more ways to form a concept (Herbert, 1995).
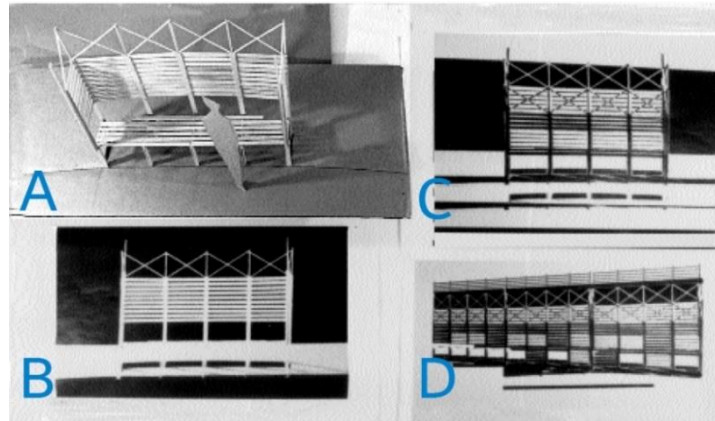
Figure 33: (a) a wood model of lattice and bracing (b) scanned picture of the model (c, d) an edited version of the scanned picture.

This relationship In the main context of digital rising we can say that it's not related to traditional architectural problems such as the economic issues and housing costs or the eco environment mainly because designer do gather a considerable amount of information before starting a project, but the issues being made of the relation of manual and digital methods are in a constant rise specially when they are being faced in earlier stages for the students to trigger a possible loss of consternation of certain aspects of problems that they face.
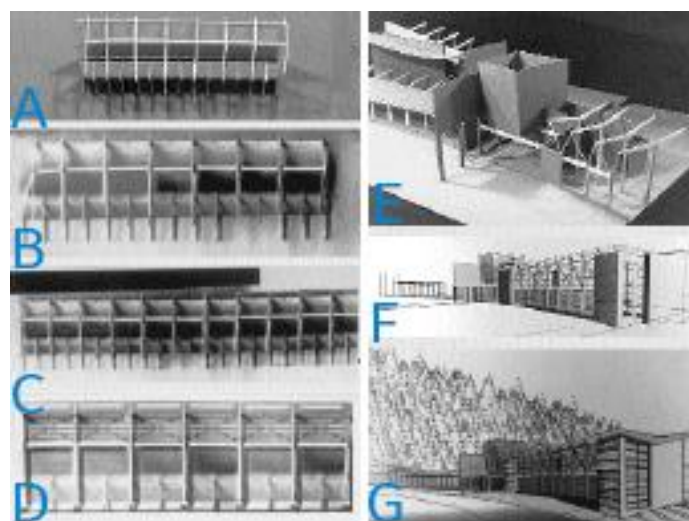

Figure 34: (a) a balsa model of the multiple bays; (b) a scanned picture of the model (c, d) an edited version of the scanned picture. (e) physical study model of entrance area (f) 3D model made by computer (g) the 3D model rendered for the final presentation.

Yet this what differs experienced designer than other the level of awareness of the current situations regarding the digital tools, but rather it could have discovered other issues that were not mentioned before with solutions and forms that were not available before manual ways.

3.2.2 Case Study 3: Digital Tools vs Visual Representations

By investigating the relationship involving digital tools usage and the visual presentations and their effects on the industry and how architects now approach the design process, a recent study done by Yapi Magazine that was publishing since 1973 about architecture designs will be analyzed through collection data through their issues about their types of representations techniques they used through the years, so this study is concerned about the changing development in digital designs in two aspects like the architectural aspect and the graphical representation.

To address this transformation in Yapi Magazine which is considered the oldest publishing magazine in turkey, the publications from 1973 which is the date of first issue till 2012 will be analyzed to have a clear image how the digital tools effected the representations in architecture through different times and many various projects that will allow evidences to be claimed about these advances, such evidences will be collected and read through the representations of architectural projects (Kalay, 2004).

The main reason for investigating the evolution of architectural representations from a publishing source like Yapi Magazine is because till today it still shows a considerable number of projects with a stable publishing schedule which is reaching to many people, and it's not exclusive to architects and students, it is accessible to everyone with ease for anyone who is interested or wants to communicate with someone related to the filed.

Although it might be these publications may reflect an individual view or the editors at the magazine, but the board at the magazine through feedbacks and communications with different editors tries to publish different styles in different times from a different culture with different techniques and tools used in these presentations (Kalay, 2004).

Representations are the reflections of a thought they are used to store information in its core, it is a method in which you present the idea in a different shape. And the representations in architecture are the conveying of those ideas and concepts. According to Yehuda E. Kalay when you are trying to deliver a design idea models, renderings, photographs, perspectives, sketches, and drawings are the most common (Kalay, 2004).

The representations graphics has to be able to explain it self and the main idea behind the design should be cleared through the way its presented. the representation graphics allows the spectator to see information of the design and easily understands it.

When presenting through drawings of plans, sections, models, elevations and charts it makes the project clearer and more explicit. The different they have between each other is the ability to make the spectator more informative and more direct in comprehending the idea (Kalay, 2004).

When we compare todays digital tools with the techniques used in the 70's we can see the impact they made from different tools like printing or rendering, while in 1970 a project was presented only in drawing consisted of plans, elevations and sections. Obviously that time wouldn't allow for more explaining techniques to the technological restriction of tools they had, drawings drawn by hand are referred to as

static by Kalay Meaning there was no other way of adjusting the drawings to the viewer to be more involved in the process (Kalay, 2004).

Not suggesting that these types of drawing are incapable but they can be more enhanced with more graphical materials and tools. The notion is that the representations of a design project became more impactable on how this project will look when its constructed and how it got constructed. So, we have to analyze this big change in the techniques of these representation.

The study included the examining of issues from 1973 till 2012 and to have an approximate estimation of the change on representations graphic's only three issues from each year are analyzed from January may and then September issues so 4 months durations of intervention. the analyzing process of these issues have 3 stages (Kalay, 2004).

First stage is about extracting graphical techniques such as photographs, model picture, sketches, plans, sections and elevations in addition to 3D perspectives, 3D renders, axonometric views and any detailed of certain parts.

Second stage they sorted these graphics into how much they are being used, 3D renders, perspectives, and axonometric views are been sorted to as the other 3D digital tools while any kind of chart was begin evaluated to the purpose it was serving as it is possible considered as development tool.

In addition to this sorting process it included the names of projects and what purpose they serve, in which year, what company they belong to and the page reference in the

issue. This sorting process with keeping records of the projects names and functions can help assess the ways they helped in the function use or the by the project being local or international.

While in the final third stage a qualitatively evaluation of the type of drawing that belongs to a certain type during the 39-year analysis to see their evolving through time (Kalay, 2004).

The results from analyzing these issues from 1973 and 2012 but they were certain years as shown in the figure that couldn't be found or were not containing any architectural content, it's almost till 1990 till the magazine started to be post architectural designs continually. and after 2001 it started to post many projects in the same issue. With a total of 155 design project that used representation techniques.

In the first stage the study shows photographs, model picture, sketches, plans, sections and elevations in addition to 3D perspectives, 3D renders and axonometric views were used in different quantities with time. while in the second stage the study showed a common presentation use of the drawings such plan, section and elevations. However, a real time photographs of the projects were the most used item (Kalay, 2004).

And in 1994 the 3D tools such as renders and charts started to improve the quality of the presentations. figure 1 illustrates how every single graphical representation has a color to represent it and the size of each bar shows the usage amount. We can see the major diversity of colors in the figure used in years 1973 and 2012 (Kalay, 2004).
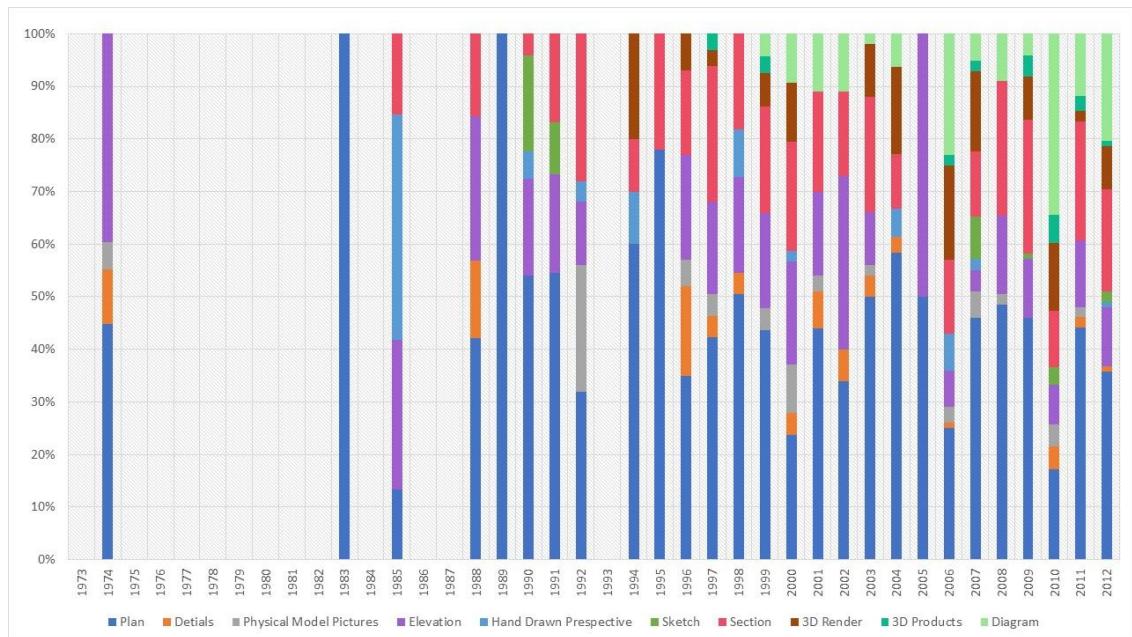

Figure 35: Distribution of Representation Types Among Years (Yapi Magazine, 2010).

In figure 35 we can see that 3D digital renders were introduced first in 1994, and in 1997 first 3D perspective to feature axonometric views even its not realistic, and first chart is encountered in 1999. It's also noted that the use of 3D renders usually gets combined with the use of charts and diagrams which makes them the preferred kind of representations (Kalay, 2004).
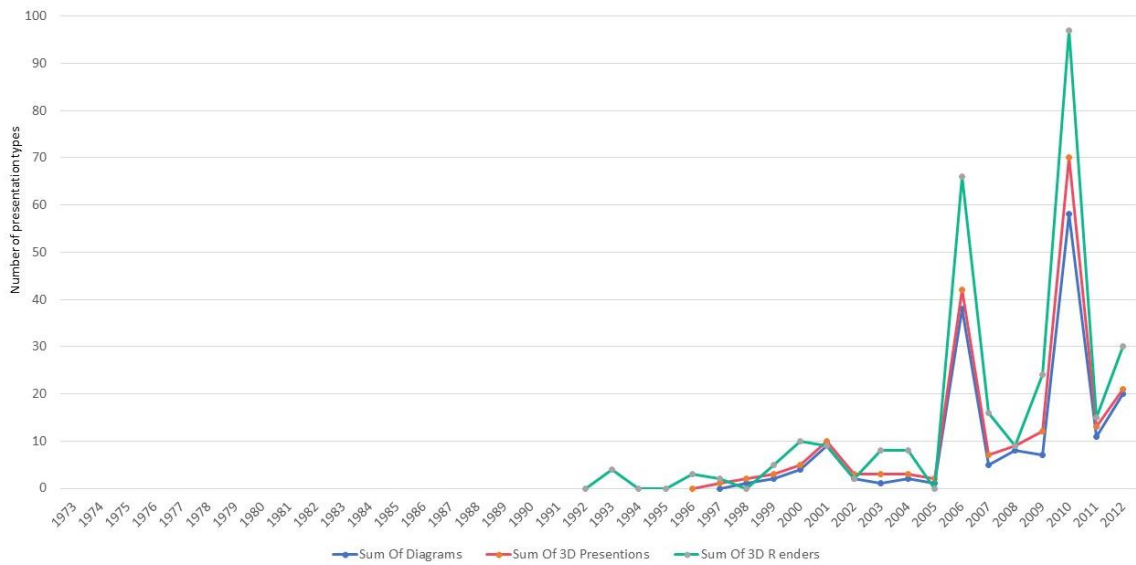
Figure 36: Beginnings of representing with 3D digital media and diagrams (Yapi Magazine, 2010).
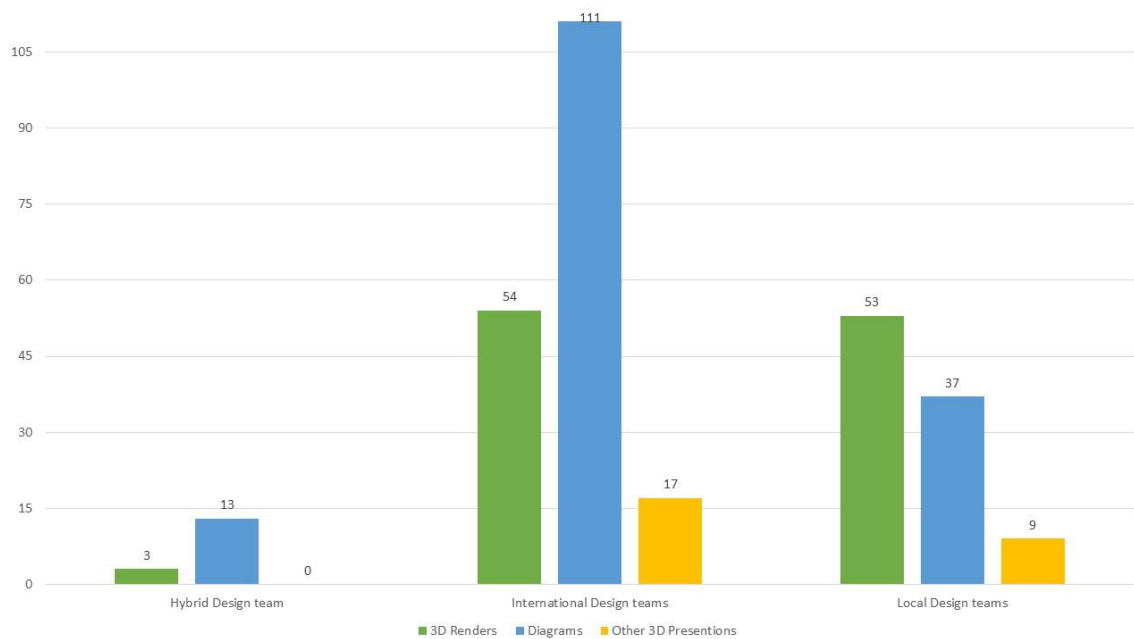

Figure 37: Number of designers in Design Teams (Yapi Magazine, 2010).

These infographics shown related to the designers with the projects they made, the frequent use of 3D tools wad high when designing a new contemporary project.

Although these data are coming from a local magazine in turkey it is expected if this study was done on international range magazine the results will show triple the number of local design teams in using charts and diagrams.

And the number of design teams in international range using 3D digital renders is aligned almost with the local ones. The number of international designers using other types of 3D digital tools as shown is double the ones in local designers (Figure 37).Third stage of the study is an assessment of the quality of attributes of the representations (Kalay, 2004).

The recent advance in technology allowed new ideas in design to be used with new tools that's why the way of ideas got changed than the traditional architectural representations. Following this direction there was many approaches in graphics techniques on drawings such as the simple looking drawings or geometrical based ones even just a sketch with no accuracy and many more through the history of architecture. It was an approach that was understood by all architects at least it got introduced in a language everyone got and nowadays it got more simpler more abstract look with less details (Figure 38 and 39).
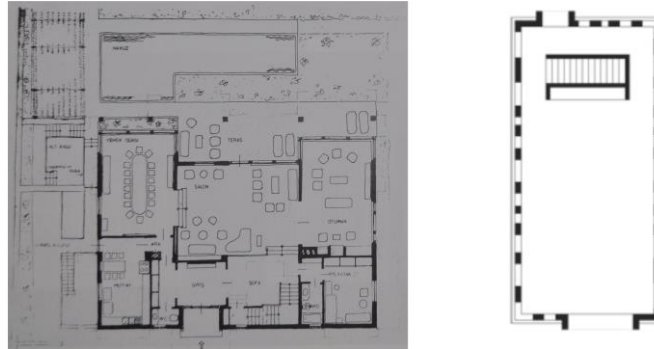
Figure 38: Evolving Representation, Plan in 1990 and 2010 (Yapi Magazine, 2010).

Figure 39: Evolving Representation, Elevation, Section (Yapi Magazine, 2010).

The main method in making an idea into a deliverable message is an abstraction. An abstraction that obtains and refines the content of the message, concentrating on its major features, and the higher the abstraction the better efficiency of helping the spectator attention of the essence of the message which is the designer cares about the most. And the results of the third stage show the more abstract and simpler the drawings are the more they become clearer in (Figure 40) (Kalay, 2004).
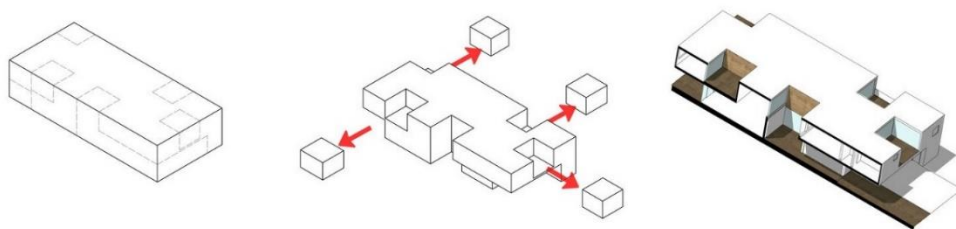

Figure 40: Representations Diagrams

143

3.2.3 Evaluation of Results

What the charts and diagrams tell us is providing a visual communication tool in representation in architecture, it has a language that everyone understands and works through different cultures, they tell the story no matter what's the result, even if the result is not decisive it does tell how it got reached to this point rather than acting as a final report (Kalay, 2004). On the same context Professor Peter G.Rowe from the previous example said the they also used to get deep analysis ideas and that they might help in providing context ideas to be reflected on the designers for further investigations (Rowe, 1987).

On the opposite side to expectations the fields of digital design such as building information modeling (BIM) and parametric designs didn't take a spot yet in the design methods of the magazine as a way to present their projects. This is probably duo to a very similar cause of why aided design software's like CAD were slow to adapt. it was because of the costs of owning such machines that can operate these software's and the majority of slow caution taken by the public.

Although nowadays design firms have a considerable amount of resources of advanced hardware and software to produce high quality designs with the new tools implemented to design.

And this study showed that the data analyzed from the Yapi Magazine through different types may conclude that indeed architects are going for a more processing direction and transparent in showing their designs, more accurate more abstract approaches and more inclusive in their work. It had hopes on seeing some new adaptions of new contemporary design approaches such as parametric design or

algorithmic approaches or building information modeling.

3.3 Survey 1: RIBA and Microsoft

In order to support some of the points mentioned in the previous chapters, this thesis examined some of the surveys conducted relating architecture and the digital, visual tools. In addition to some opinions expressing the challenges and obstacles that faces new technologies from being used or what the public think of such advancements.

The Royal Institute of British Architects Survey (RIBA) in partnership with Microsoft conducted a survey in the United Kingdom about the new adaptions that enables creators delivering better designs for communities and environments (RIBA, 2018). RIBA has been always in support of using new technologies that transforms the ways we make us design better.
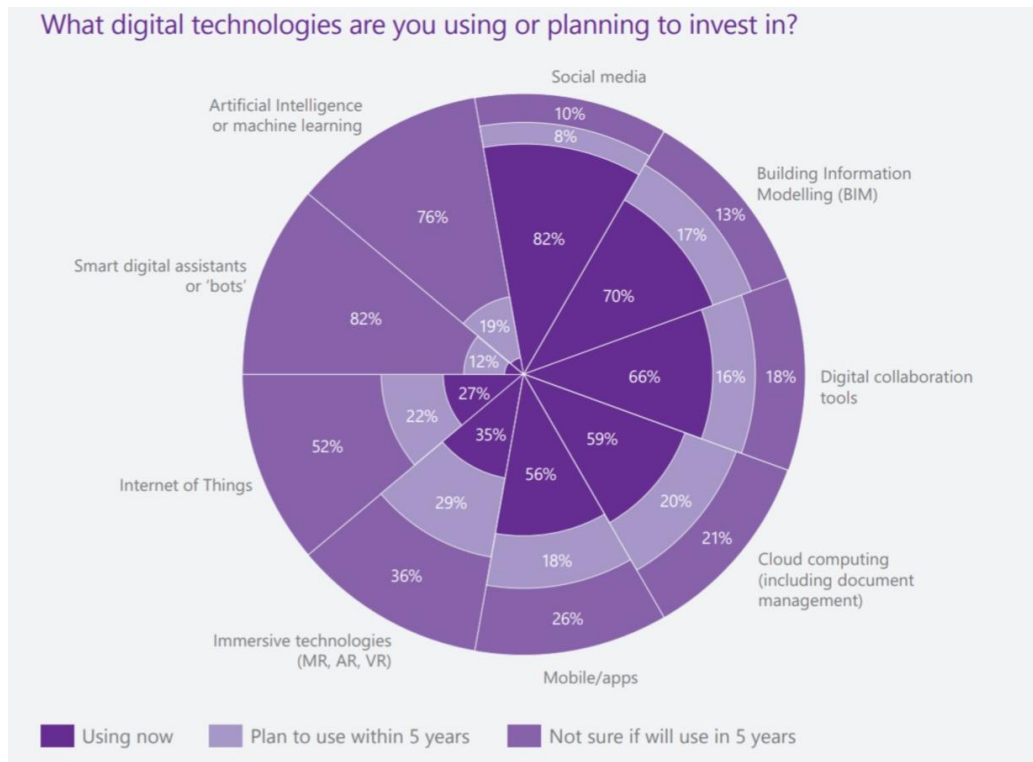

Figure 41: Expected Technology to be Invested (RIBA, 2018).

The United Kingdom has been also always a leader in making the design process more digitalized. The survey provided results from companies and large practices. showing how the UK is in the lead when it comes to technologies that benefits designers and consumers.

The survey had many aspects to consider relating architecture, innovations, cultures and new skills Key findings of their survey:

• BIM is becoming a new platform for starting new projects being used currently by 70%

• Next move in digital advancements sees architects embracing the internet of things which is about a network that connects your daily needs and work through one data mainstream with total of 48% seeing this happening in the next 5 years.

• Virtual reality, Augmented and Mixed reality will become more common also in the same period with 35% already at least using of the name's technologies. While 29% considering it within 5 years.

• Adoption of Artificial intelligence still needs a lot of time to be considered, as the use of them in architecture still not been fully reached with many other technologies taking the spot. With real time co-authoring is a concept getting close which will be supported by cloud services and probably will be limited of use to certain organizations.

• Still cloud services almost used by 60%, it will help independent companies in their costs and make a globalized profession more easy

• Many practices using the social media services by 82% while the use of digital tools is about 66% and on the mobile platform is 56%, these kinds of technologies is affecting the operation of architecture. It will complement and companion each

other in ways we may not expect specifically that there are companies that specially

focuses on these kinds of relations.

As for skills and efficiency, gaining skills originally starts from an education level, and

more with architecture being practiced, while the skill levels could vary because there

are influenced by the company's visions and how they achieve and share their best

practices. RIBA always was concerned about the development of Constructions,

technologies and design. The survey confirms that skills and their development are a

necessary element in succession using digital tools (figure). With BIM being focused

as the most influential introduction according to the previous results, the survey shows

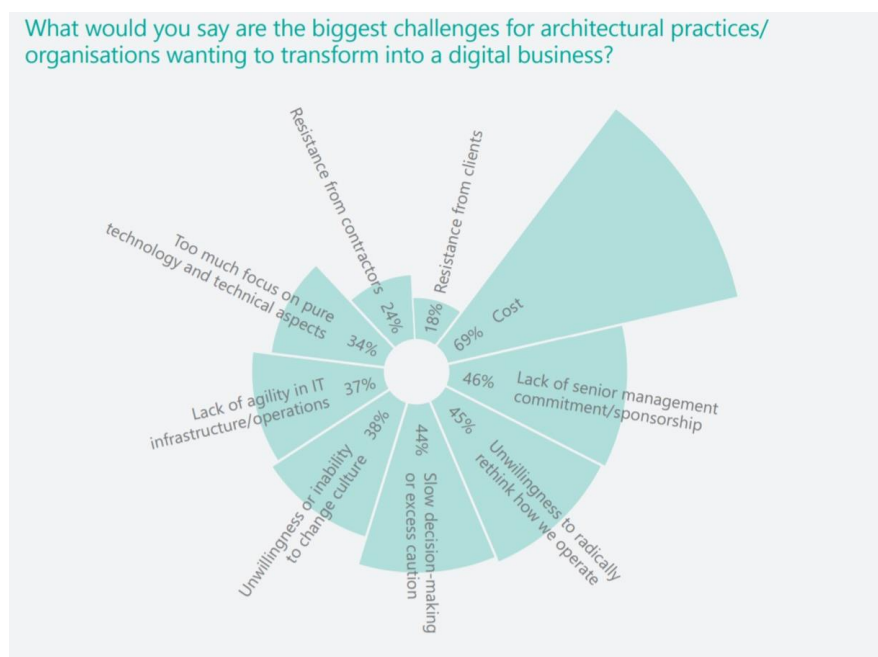also that digital technologies raise the productivity and efficiency.

Figure 42: Challenges and benefits of adopting digital technologies (RIBA, 2018)

Figure 43: Challenges that faces companies into transforming to digital (RIBA, 2018).

The survey also showed the main reason why some companies won't adapt some of the companies is the initial cost. But focusing on the cost can be a bit confusing, it is the not investing approach. The repercussions can be more sever when the whole platform is supported by the cultural there are bigger chances the have a better success and profit

Not all technologies and digital tools are considered game changer and good to use, but tools such as the BIM has a transformative effect.

It has many factors that solves some of the costs of architecture like the expenses and efficiency. And such a technology resembles an example foe what's coming next to consider on how it can have a similar if not better effect.

Although The results show some negativity in culture and decision making and thinking or the ability to change. It can be considered conditions for the next transformative tool to have to make a change. However, there is cultural support like we mentioned before of the use of these new tools. 40% agreed they are making a

change to the organizational culture and another 50% hired staff with liability for the new tools. 38% to make team specialized in testing with the new technologies while 34% were hired as specialists in these tools.

It's just further proof that they are backup from culture to promote and encourages the use of new technologies and innovations. Also 53% confirmed integrating new technology into their organization.

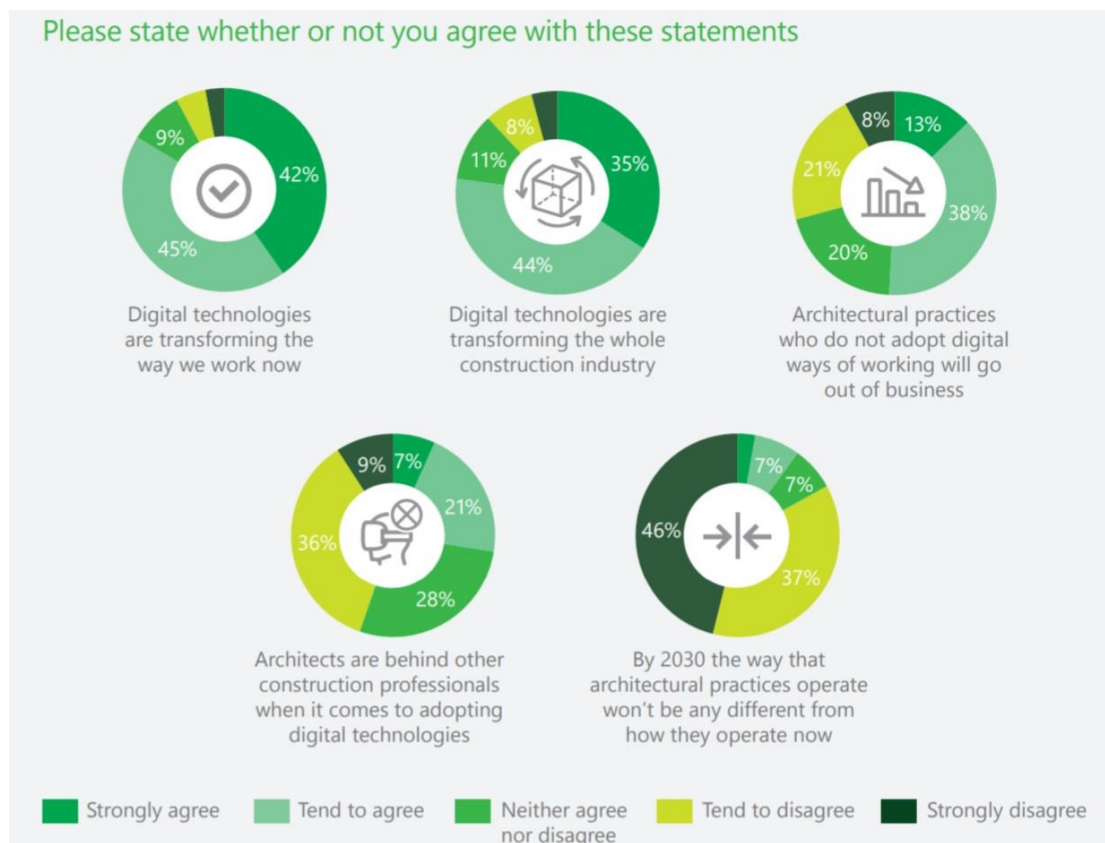

Figure 44: Architecture changing statements (RIBA, 2018).

As for the state of architecture around 80% agreed that technology is transforming the work way. While in the year 2030 many agreed it's going to be different. Some may say that architecture and architects lead the technology in their practices but construction industry is also in level with that and its changing rapidly but what sets

them apart is other aspects such as the pace and scale regarding the communities.

42% say the constructions will be somehow disrupted within the next two years. But equally others say it won't be a big change. And most of them think the change will be from inside the industry, while others say its 66% from project teams or 40% from the software vendors and the rest at 33% think it will be from the outside and a solid 31% think it will be from the architects.

3.3.1 Survey 2: Chaos Group

As for visualization and its implantations, it is in a rapid advancement as well, it is still defining some lines in the industry and trying to become a standard for clients and designers.

Chaos Group is a worldwide leading graphical company they provide and create technology for the designers to have real time images and animations for their designs. Most of their work is based on rendering and having simulation software's, and they are mostly used of architectural companies in addition to cloud rendering services and virtual reality that is shaping the design process.

In September of 2017 they conducted a survey about architectural visualizations to find out which kind of technology they use in their work and what's the down side of it and what they expect technology in the future (ChaosGroup, 2018).

The survey managed to get result from over 70 country, it consisted from independent companies, freelancers and multinational firms. The aim of the survey to see which was the most used technique in architectural visualizations to see which one is having the biggest impact on the industry. The survey had many key findings:

- There is a fast adaption of Building Information Modeling (BIM) and virtual reality, and they did have a big influence on the industry. Companies are looking for fast affordable realistic solutions to compete with other companies and reach certain deadlines (ChaosGroup, 2018).

- Virtual reality made designing as an approach opened many chances for large companies and freelancers. Most architectural companies will start including the use of virtual reality in 2018. The ability of showcasing spaces designs in humanistic experience is adding a new aspect of 3D tools used in the visualization process. It is being considered the fastest adopted technology in all different firms specially when used in many projects (ChaosGroup, 2018).

- While visualization process take place in local work places, another service is getting more appealed in renderings. The cloud rendering services enables you to gain access to rendering process and work with protection of your data. It takes your working files and uploads them to a company server to produce renderings process using much advanced sufficient equipment's to save time, it varies in price and size of the working files but it's grown double in 2017 with an expected growth in 2018.
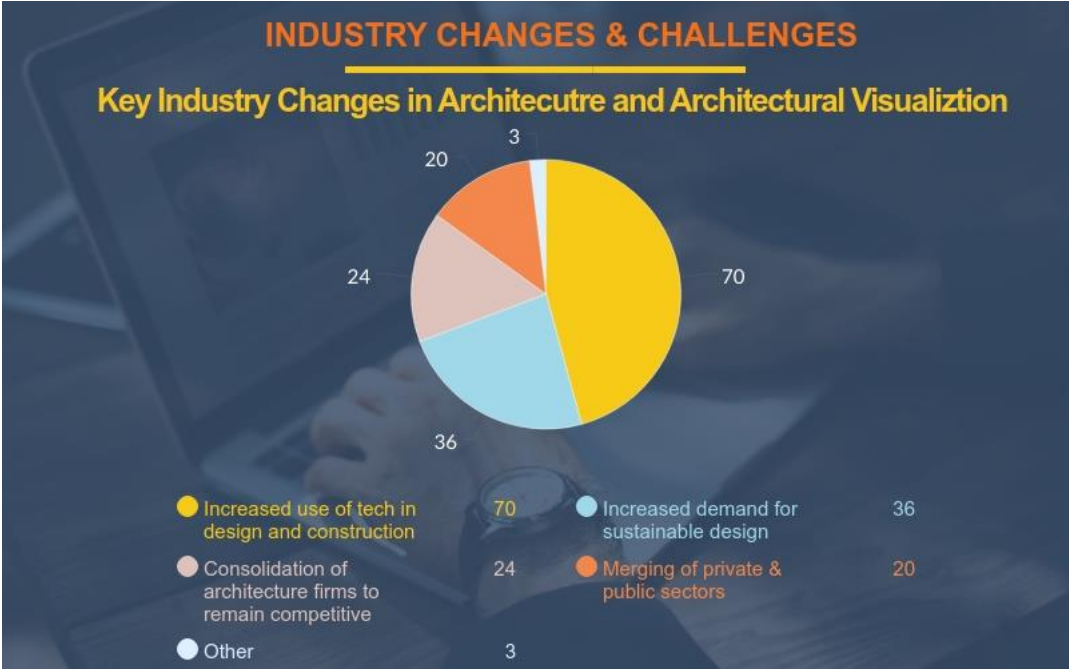
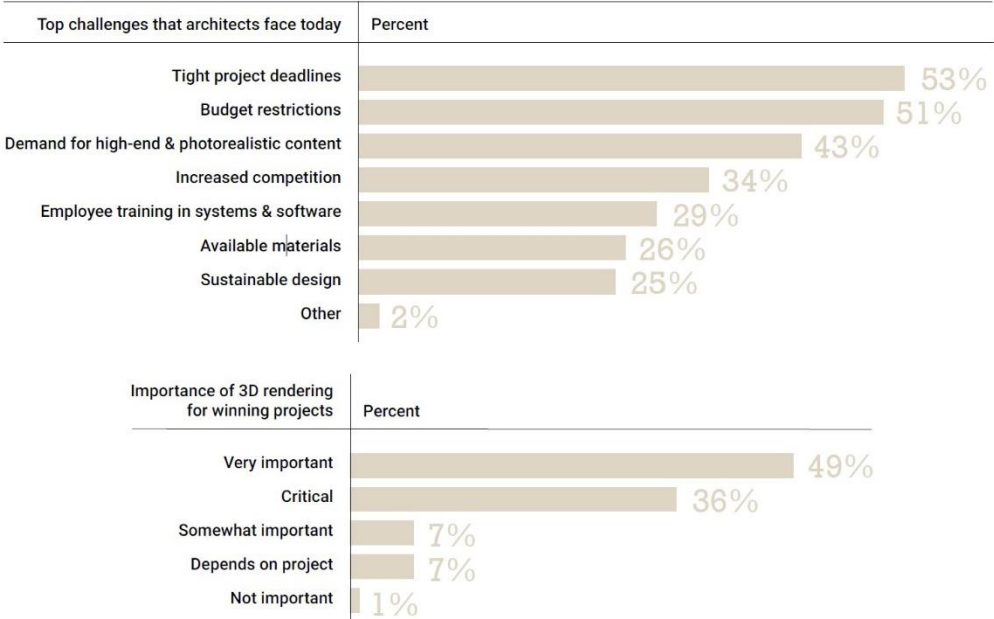Figure 45: Industry Changes and Challenges (ChaosGroup, 2018).

The rapid adoption of virtual reality in architecture

Using VR or plan to use VR in the future	Percent
Yes	28%
Not yet. Currently experimenting.	28%
Not yet. Plan to in next 6 months.	8%
Not yet. Plan to in 7–12 months.	4%
Not yet. Expect to in a year or more.	13%
No. No plans to use VR.	10%
Not sure	9%

The rapid adoption of virtual reality in architecture

Using VR or plan to use VR in the future	Percent
Yes	28%
Not yet. Currently experimenting.	28%
Not yet. Plan to in next 6 months.	8%
Not yet. Plan to in 7–12 months.	4%
Not yet. Expect to in a year or more.	13%
No. No plans to use VR.	10%
No. Not sure.	9%
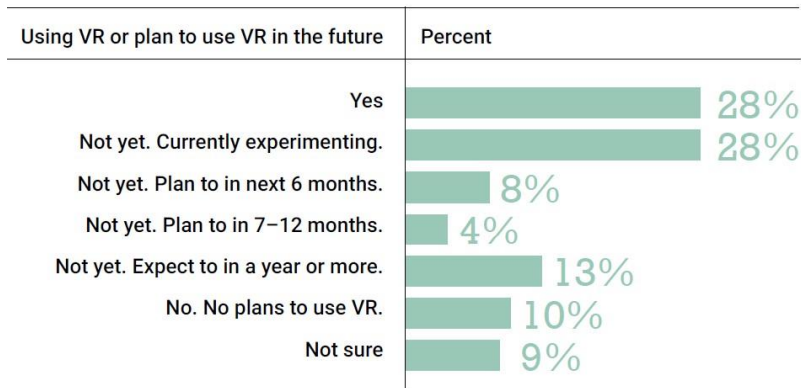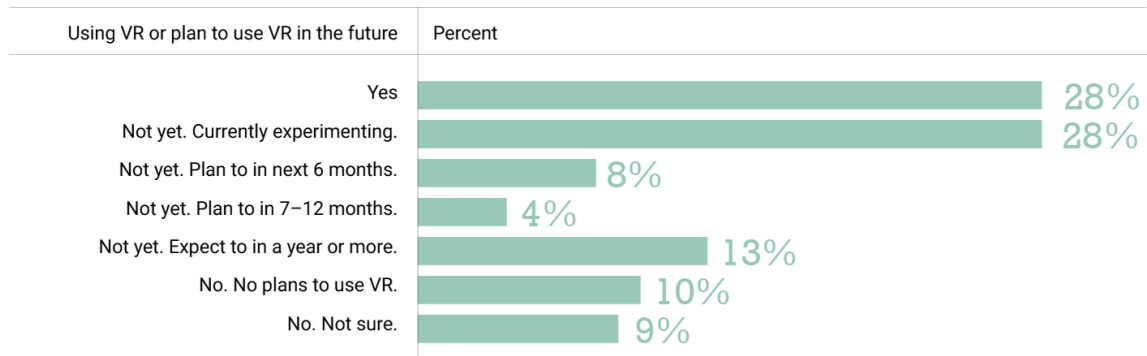
Large firms are leading the adoption of virtual reality

Using VR or plan to use VR in the future	Percent of large firms (100+ architects)
Yes	62%
Not yet. Currently experimenting.	21%
Not yet. Plan to in next 6 months.	3%
Not yet. Plan to in 7–12 months.	2%
Not yet. Expect to in a year or more.	5%
No. No plans to use VR.	4%
Not sure	3%

Figure 46: Virtual Reality Adaptions and Challenges (ChaosGroup, 2018).

Cloud rendering usage is on the rise

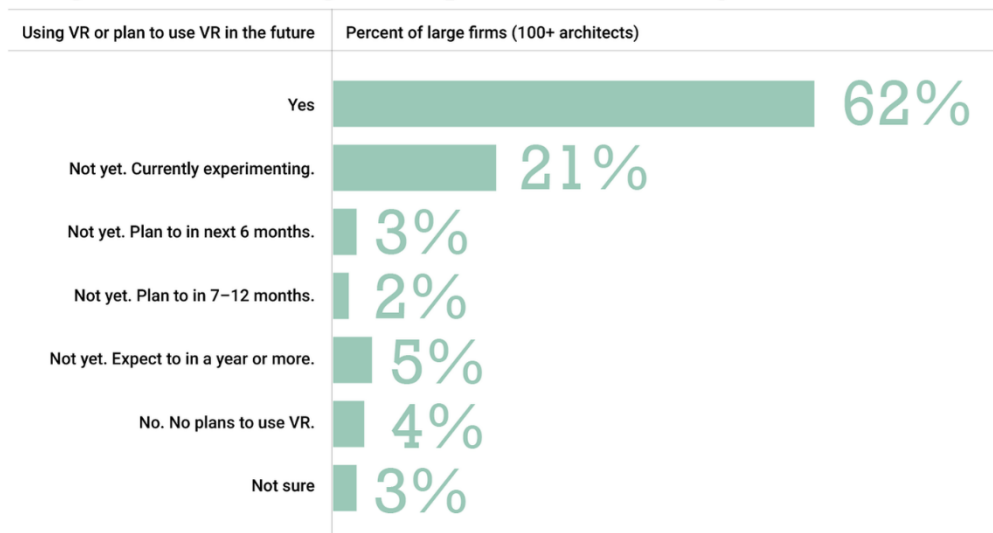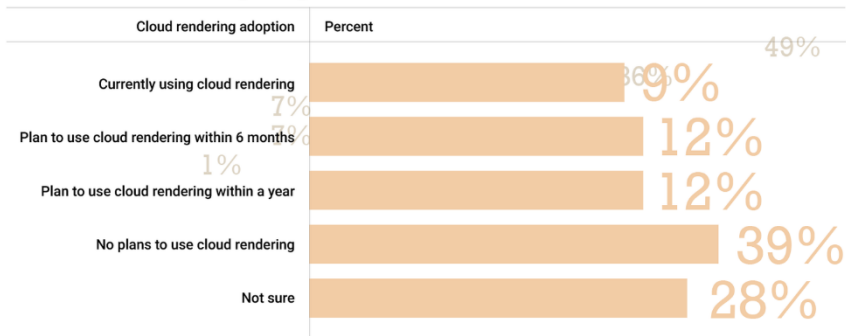| Cloud rendering adoption	Percent
Currently using cloud rendering	49%
Plan to use cloud rendering within 6 months	12%
Plan to use cloud rendering within a year	12%
No plans to use cloud rendering	39%
Not sure	28%

Cloud rendering costs

Cloud rendering costs	Percent
1 — Not a consideration	7%
2	4%
3	9%
4	21%
5	20%
6	17%
7 — Top challenge	22%

Cloud rendering benefits

Reduction in render times	Percent
1 — Not a benefit	4%
2	3%
3	5%
4	15%
5	16%
6	21%
7 — Top benefit	36%

Cloud rendering benefits

Ability to work on more projects & more iterations	Percent
1 — Not a benefit	4%
2	4%
3	8%
4	19%
5	23%
6	19%
7 — Top benefit	23%
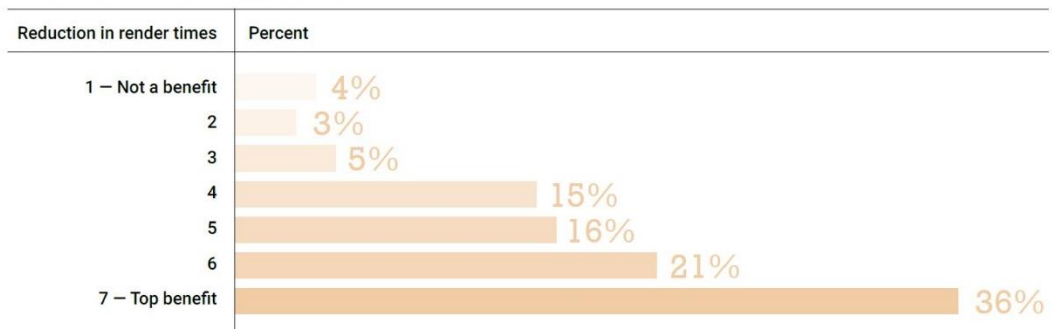
Figure 47: Cloud rendering usage (ChaosGroup, 2018).

3.3.2 Conclusion of the Case Studies and Surveys

In conclusion there is a lot of hope for architecture regarding its progress within technology, in the end the purpose of organizations like RIBA is deliver better sustainable future with stronger communities, and that gets 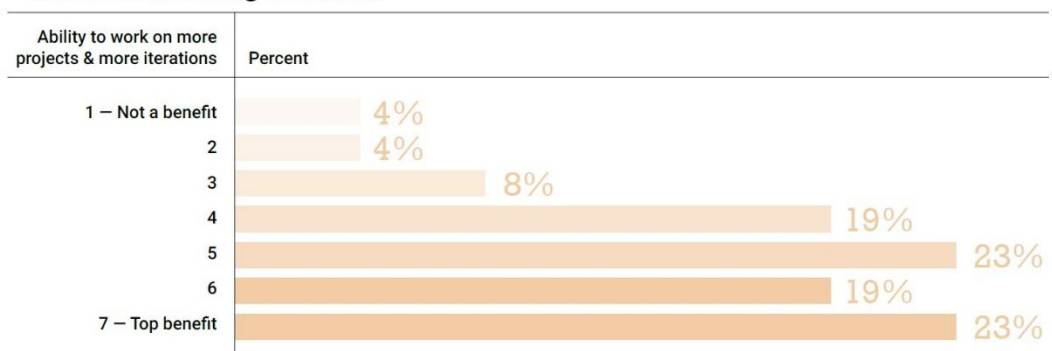done by technology that transforms the way of work while solving issues that were getting in the way. So, achieving goals and outcomes is the success of technology.

As we saw what BIM brought to the architecture, it is safe to say that architecture is leading the way in technological advancements, other industries are competing but it's what making an impact matter. Design and architecture are facing challenges of the future, considering all options and discussing any new technology that bring new to profession so that are ready what about to expect from such concepts and its reports and survey like these helps achieving such a vision.

While companies like the Chaos Group is an industry leading when it comes to integration of new technologies, their creation of such rendering engines and cloud services makes them more that qualified to be leaders in what comes next, virtual reality and its variations like the augmented reality and mix reality are becoming more independent company wise, mostly because the technology can be introduced and used in many ways, but still it is growing fast and being adopted in many projects.

Of course, the steps they reached in creating detailed rich environment with reality close imagery no matter of the tools is something to be looked after. Because its increasing reality what made all this technology more adopted later on it shaped the design process and what came after it the realest of combing both aspects.

3.4 Future Tendencies and Developments

Architecture will feature many trends and movements that will be considered the next step in progressing, many of these movements could be seen as the development of old or existed technologies.

1- Algorithmic design

Like we mentioned the parametric style, it is considered a form of algorithmic design, it is about a massive amount of information, details and dimensions. It is useful for creating complex design forms or unique surface patterns with small amount of data provided. algorithmic design is a progressing stage and developers are still experimenting with what could be the next move in algorithmic design (Krish, 2012).

Figure 48: Algorithmic Design Example (algorithmicdesign).

2- Smart architecture

Combining the different needs of users through smart technology and efficient design. Many companies are delivering products for smart systems to be used in designs such as amazon and google. While the other element in smart architecture is sustainability and flexibility in the architecture built. They are being accomplished through using

smart building materials on the façade, in addition to the reduction of energy and costs used in the whole process while maintaining the fundamental need of security and management, also the approach of using an open layout design to suit all types of business and individuals (Designblendz, 2017).

Figure 49: Smart architecture DTLA's new public park (Testado, 2016).

3- Three-dimensional fabrication and printing

 The interactive approaches between the digital and the physical in the design process in many different scales. This approach could be used through robots, printers, laser cutters, vacuum formers or software's (Ficca, 2018) .
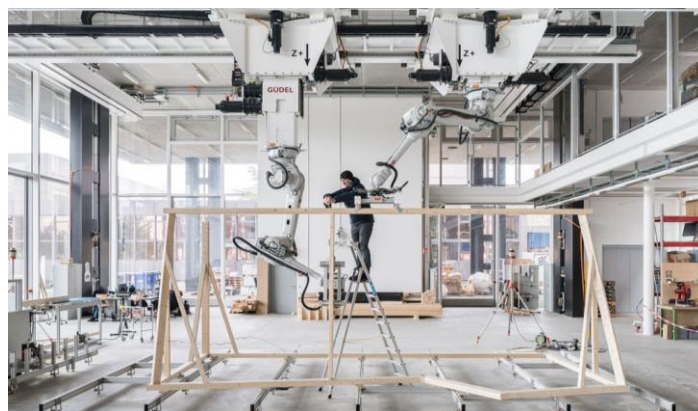

Figure 50: Robotic Fabrication Laboratory (Alexander Walter, 2018).

The understanding of next move in technology can be seen in different methods, so many approaches could be used before but not yet fully discovered. However, many of these tendencies mentioned above are in a developing progressing stage. they are could be assumed also as phenomenon's in the modern era. As for trends that is expected to get more used and perceived, there are many to consider such as:

- Increasing interest in using small scale houses, started around 2018 after the increased costs, ideological situations and urban dense areas, involvement started in the development of innovative small spaces (Mora, 2019).

- Inclusive and universal designs that focuses on low mobile people, elderly and children. It concludes space psychology and visual impairments architecture (Mora, 2019).

- New technologies used in the construction process through the use of BIM and modular constructions, in addition to prefabrications (Mora, 2019).

- Reuse of spaces, recycling and ecological awareness. It helps reducing the carbon footprints and reaching sustainable solutions in the city, with renovations and rehabilitation of spaces through adaptive design approaches (Mora, 2019).

- Local use of materials with sustainable and low costs will increase the environmental awareness (Mora, 2019).

- The use of renewable energy with the concerns of climate change, so it's a response also to reduce the carbon footprint. Many concepts showed the use of that renewable energy or generating it (Mora, 2019).

It is without a doubt there are many ways to see what is next in architecture, Afterall any new contribution that seeks better sustainable solutions is trying to be more inclusive and available. However, there is still more to focus on, since many of the

recent technologies are still experimental and progressing rapidly.

3.5 Chapter Discussion

Table 1: Conclusions of the surveys and case studies in relation to the design process

DESIGN PROCESS		
With Technology	**Without Technology**	
Professional	**Early Education**	**Advanced Education**
3D Renders and diagrams are the preferred kind of representations	Integrate new methods into the design process	Focuses on multitasking regarding tasks
More abstract, simple and clean representations	Developing understanding of the spatial values	Lack of symmetry in designs
BIM is becoming a new platform	Form and geometrical explorations	Constant interaction between different methods
Virtual reality, Augmented and mixed reality will become more common	Improved involvement and relation with the design process	Initial ideas are sketched first then developed by other methods later
Adoption of Artificial intelligence still needs a lot of time	Constant feedbacks between students and department	
Cloud services are getting more popular		
Cost is a very important aspect to consider		

Digital tools now are without a doubt a part of architecture in many stages, the accuracy that improve the ratings of how much of information can be analyzed collected and presented in different ways became a must in the architect profession or in the academic sector, even tools that providing outputs and actual products are constantly becoming more hand and available to everyone, this is leading to self-advancement considering many major professions such as science and medical equipment, this is concerning the printing technology that became an actual building process also in construction companies.

Focusing on the educational aspect in architecture any of these tools can offer a better new point to be taught in the system, different ways to offer students wider range of concepts to think of and apply to their studies.

From the perspective of this thesis, integrating digital tools to the courses of design in early stages of architectural education is a very important step, even it might not yet offer them the ability to comprehend the continues challenges, but it should give them the skill to present new concepts and ideas by different ways of media tools that leads to having an expertise to form ideas.

Of course, the digital tools nowadays differ to the architect himself in case of speed and quality in making ideas from the interactions between his digital tools and the manual ways, which offers these interactions can help in making a better understanding of visual design thinking for students to make them generate their own methods new the introduction of new concepts.

Also, this thesis assumes if digital tools have been used in a more advanced level to show what they can offer a more possibilities will be presented in ways couldn't been discovered before, today the virtual reality did allow us to create a temporary experience of the end result augmented reality is becoming a designer hand in a complex idea forming.

All these tools are in an evolving process and the mobile industry making it more portable and accessible in anytime. And architectural education system should elaborate on some points to eliminate the negative impact of using some wrong tools in forming their visual prospective such as providing the students with certain course

outlines on media tools and how-to Handel the basic problems they face which is the main goal of learning the digital tools. presenting them some advanced examples of the usage of digital tools with real time influencers to give them an idea of forming their own way.

Whereas architecture is progressing in using different and new tendencies, it is becoming important to peruse these trends, many concepts are appearing that solves problems that weren't seen before, modern problems of our current time.

Trends that helps solving problems by reusing spaces helps the city environment in adapting and transforming unusable spaces, so is renewable energy its becoming more needed in designing, mainly because it reduces the carbon footprint and raises awareness of the environment.

As mentioned previously, many of these new trends are in an evolving process, such as architecture, and it is important to keep up with what might bring us a better sustainable future.

Finally, this study is showing the effect of digital technologies on architecture through different times, and what is the main objective (integrating new digital methods into design to reach the best sustainable suitable solution) of designing in the architectural understanding, also, showcasing the effects of combining these technologies in the educational sector in early stages (chapter 3.2.1) like gaining skills and knowledge in using new digital tools with the design process for having better ways and methods of designing,, also comparing traditional methods with modern ones. while, highlighting what is considered the next step in the future of architecture advancements.

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