Explaining the Ratio of Flexibility and Personalization in Design Software[1]

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ABSTRACT

The development and evolution of architectural design software have always impacted the quality of architectural work. Flexible software in architectural design has exacerbated architects' undeniable need for this software. The purpose of this study is to study the flexibility of architectural design software in the process of personalizing architectural designs in architectural design software. The present study has been used to analyze the flexibility of AutoCAD, Archi-CAD, Revit, Sketchup, 3Ds Max, and V-Ray software and their impact on the process of personalization of architectural designs. The data collection method is library and field studies with interview and survey tools. The results of this study show that, among architectural design software, AutoCAD software has the least amount of flexibility and the least impact on the personalization of designs. 3Ds Max and V Ray software have the most flexibility and the most impact on the personalization of designs in the architectural design process. Also, Sketchup and Archicad software have a moderate degree of flexibility and a moderate effect on the personalization of designs in the architectural design process. Therefore, it can be concluded that the greater the flexibility of architectural design in the process of architectural design, the greater the degree of personalization of designs, from the idea to the final design.

Keywords: *Architecture, Design Research, Flexibility, Personalizing, Design Process, Technology.*

1. Introduction

One of the defining points of human civilization is the ability of humans to use objects and surroundings to advance life. The tool and technique of its use distinguished the structure of human life from other creatures. The human tool-maker, the tools he made, had a tremendous impact on all the elements of his life and changed its course. Tools, tectonics and technology have all changed the human world. Building for habitation and architecture is not out of the way either. The tools and techniques of building construction gradually altered the concept of human's habitation. The effects of this technical and technological complex have changed the quality of human life. These technical and technological changes have played a significant role in the construction process and in the drawing and design process.

Since the 1960s, the influence of technologies has been paradigm shifted from construction to design of the construction process, and has set a revolutionary point.

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Computational and digital technologies with the expansion of programming languages, faster and more processing capabilities were able to create tools, devices and machines that link the two zones of construction and design. In the first step, computer aided drawing software was designed that facilitated technical drawing and design drawing, but quickly became computer aided design software. The development and evolution of this design technology has had a significant impact on various aspects of drawing, presentation, design and manufacture of design products during the recent decades of architectural design history. The different effects of computer contribution in the design process today, few and limited studies in this field and in its evolutionary process in Iran are significant, as well as the role and impact of the architect designer as human actor in conjunction with design software and defining the areas of activity of these two together.

The architectural design process is the stages in which program information, analysis, initial ideas and design processing reach the conclusion of the architectural design. Considering the variety of possible responses in defining architectural projects, the impact of the choice and selection of the individual designer or designers as the final decision maker and objectification of personal thoughts and imaginations is logically indisputable on the process of architectural designs. On the other hand, design software entered the field of design and by the various features and capabilities that are defined for them, they are the basis for form-finding, form-selection, form production and form processing, and it may seem that the role and contribution of the designer in creating the project is diminished. Examining the interaction between designer and software, determining the role and position of each and defining the boundaries of the activities of these two together, is crucial for future studies of architectural design and software design. There are very serious studies in the field of flexibility and personalization of vacuum design software, and this sector is far behind the professional sector of architecture. This issue is one of the challenging issues in the field of architectural design process, which of course has advantages and disadvantages and can challenge creativity relatively. Creativity is actually a mental process composed of the power of initiative and flexibility and the design process is based on creative cultivation, which is expressed by using architectural design tools.

Therefore, it is necessary to review the nature, types, position and application of design tools in the architectural design process and their analytical comparison [3]. In architectural software, the ability to produce form and furtherance design is one of the topics that have been less explored in researches; also, the potentials that software in design process makes for designers; makes possible to put ideas and solutions into practice, and to operationalize theoretical and conceptual complexities. But the critical point that can be addressed is the features of software that may provide the ability to produce and build a limited and similar range of products, and the result of the design process is a similar set of products and a repetitive aspect of the design achievements.

But the important thing that can be considered is the features of the software that may provide the ability to produce and build a limited and similar range of products and the result of the design process is a similar set of products and fuel a repetitive aspect in design achievements [2]. In addition, considering that the presence and impact of technology in today's life and the growing digitization of the dimensions of human life in general and in architecture in particular and the common use of architectural software in the world's leading architectural offices and in serious and large projects as well as the undeniable capabilities of computing architecture and the facilities it provides to designers and manufacturers, It indicates that architects are bound to encounter, recognize, analyze, study and use computing architecture and its related tools for architecture in the present and future, and there is no other choice but to join the wave of computing architecture and go along with it [18].

This research seeks to show that common software in design can provide the capability to personalize the design process, and that any designer, design team and even a design project can organize and support unique processes by changing logical patterns, rules and frameworks of the software. The main objective of this research is to identify and explain solutions that can personalize the architectural design process by studying AutoCAD, Archicad, SketchUp, 3Ds Max, Revit and Vray software. The main research question is how to personalize the architectural design process by using the flexibility of architectural software?

2. Literature Review

Few studies have been done in relation to this research, among which Esri (2023) in a book entitled "ArcGIS System Architecture: The Best Methods" explained this issue by using a qualitative and descriptive-analytical method that the architecture of ArcGIS is designed in a way that is extremely flexible. and demonstrates flexibility through flexible patterns and approaches and expanding reach. Cichock et al. (2019) in an article "Algorithm optimization through design optimization tools" using quantitative research method and computer simulation tools concluded that parametric design is one of the areas in which personalization of the design process is manifested, and this possibility for the designer is provided to bring his desired quality components into the field of design. One of the most useful tools for generating designs is to convert ideas into abstract forms. The integration of the quality criteria included from the architectural design with the formalized and spatial requirements remains a problem in the computational design process and this is due to the difficulty of converting abstract objects into fundamental parameters that can be presented algorithmically; Cuevas et al. in the paper "an introduction to meta-heuristic methods in meta-heuristic algorithms in power systems", using quantitative method and computer simulation tools, concluded that form commands and meta-heuristic methods are useful tools for investigating form and spatial relationships. However, these approaches do not represent the social, environmental and semantic level of the final product. The use of syntactic discourse analysis to encode historical items and user needs allows the designer to reveal logical topologies in design systems based on the social constraints of architectural designs; Caetano and Leitao (2016) in their paper "Application of Processing with 3D Modelling of Architecture" using the quantitative method and the computer simulation tool (AutoCAD) concluded that the processing developed in AutoCAD software is suitable for producing a 3D model in BMI; Agirbas and Mimar in their article titled "Using Digital Construction as a Design Tool in the Process of Architectural Design", concluded that it is clear that architecture students acquire the basic thinking of materials and materials, time management, production methods and various soft skills. Asefi and Imani (2017) in their research titled "Analytical Study of the Effect of Digital Software Application on Promoting

Creativity in Architectural Design Education" using qualitative-quantitative method concluded that organizing proper use of digital software in the process of architectural design by systems development method, from the type of phased model and strategic planning to dynamic and purposeful structures can be useful to promote creativity in architecture education. Ronaghnejad and Omidiannia (2017) in their research titled "Studying Freehand Design and Computer Design in the Process of Architectural Design" using mixed research method and field studies concluded that both hands-free design and computer design, if used in the right place and at the right time in the design process, will be used in the design process of the architect and bring him to the desired goal very suitable and it will be acceptable. Hashemnejad et al. (2013) in their research titled "Effects of Sketchup Software on the Process of Drawing Architectural Sketches" using statistical tests and SPSS software, concluded that drawing methods of sketching are effective on students' performance. Also, according to the mean scores of students in the three groups participating in the sketch test, the sketch group achieved the highest mean scores using hand tools (paper, pen and drawing board). Therefore, it was observed that Sketchup software still cannot be a suitable replacement for manual tools in the early stages of the design process. Gharibpour (2013) in his research titled "Analytical Comparison of Drawing by Hand and Computer in the Process of Architectural Design" by using Analytical - Comparative Method concluded that drawing by hand due to direct relation to creative mental activity, is more efficient in the mental parts of design and drawing with computer plays a more useful role in the stages that are more introductive and final.

Considering the background and studies that have often dealt with the discourse of the field of architecture, it is clear that so far, no research has been done on the flexibility of architectural software and addressing their personalization approach in AutoCAD software (2022), ArchiCAD (version 26), Sketchup (2022), 3DsMax (2022), Revit (2022) and V-ray (2022) and the present study is one of the first steps of this process.

3. Theoretical Framework

The early stages of the architectural design process are the stages that architects after studies and defining the needs to come up with the idea and

design of the original design concepts. Initial choices are produced in the early stages of determining and analysing the design problem. In conceptual design, architects create a micro-idea and continue it until it is complete and verifiable. These micro-ideas are usually lacking in detail and there are always leaps from one idea to another at this stage [20]. Conceptual design is done when the designer is trying to understand the problem and adjust the conditions for subsequent processes. Conceptual design is a stage that has the richest range of ideas, issues, and creativity. Architects draw in the early stages of the design process to help themselves observe, reason, and understand the forms used, as well as to research functional ideas and solutions in architectural design software. As the architectural software design process progresses, drawings become more abstract and more realistic. The design in this software represents the thought process [15]. In general, with the introduction of computer technology to the design process, challenges, changes and revolutions have been undeniable in the process. Designers generally use AutoCAD computer tool software only in the final stages of the design process, especially for final presentation of the design and also for the design details stage. Since the activity of drawing architectural ideas and schemas should not be separated from the remainder of the design stages, the process of architectural design in architectural design software allows designers to integrate all stages of the design process from sketching the idea to creating a virtual 3D model and also to producing a physical 3D model [12]. Today's technologies such as Sketchup, Archicad, 3DsMax, V-ray and Revit have provided designers and architects with a wide range of possibilities to prepare their ideas in the virtual environment.

"Sketchup" software is used in a wide range of areas of interior design architecture, mechanical engineering, computer game design, etc. The primary purpose of this software was to three-dimensional buildings and put their model in the "Google Earth" software. However, its many positive features in 3D modelling and design made it a special place among design software for architects and designers. The software is deliberately designed in a very simple way for both professional and novice users and offers the user a limited set of basic geometric shapes. The reason for the popularity of this program is its user-friendly environment, along with the smooth transition of the design from the modelling stage, the architectural expression of the designs and simplicity in its application [12].

"Archicad" is one of the best software for modeling buildings and preparing building plans quickly, efficiently and with high-quality. Volumetric modeling in ArchiCAD software is easy and similar to Sketchup software uses the "Push and Pull" feature. In this software, 3D designs of building structure and drawing 3D data in Archicad is well done and accuracy of the structure is possible. In addition, it performs a good energy assessment of the building's energy consumption and provides accurate results according to the building's climate and wall specifications.

3Ds Max is a 3D modeling software used to create 3D animations, games, models and images. The advantages of this software can be high-speed, compatible with other software and easy learning, the possibility of personalization and planning it. This software does not provide the data of the structure and execution of the plans to users, and the main aspect of its processing is because the employer and the designers view the three-dimensional volume and physical details of the building in full. V-ray is one of the most useful add-ons in 3D Max, which is a great extension for architects, designers and artists to implement their mental ideas. V-ray software provides a place to create real images and like a plug-in for the main program such as Sketchup, Maya, 3D Max, etc. It is also possible to use this software for other architectural design software such as Revit and Archicad. This software plug-in is also used for other design software and rendering engine is done with V-ray. Revit software is the main software in the field of competition with similar software such as Autocad and Archicad. The software is versatile for 2D and 3D projects and produces project outputs including modeling, rendering and two-dimensional construction documents. In this software, instead of creating lines, walls, ceilings, beams, columns and other building components as well as physical features of the building such as windows and doors can be used.

In general, the environment of these software is very capable of simulating architectural representations. This means that it is able to adjust scenes in such a way that a variety of common drawing methods are used in architectural expression of images, texture and material, lighting and shadow, and dependencies related to the actual position of the site. The ability

to walk the observer in the software environment enables the user to control the 3D scenes and helps visualize him in designing and ideation, and the ability to visualize models and the ability to easily produce a variety of forms and volumes in this software is suitable for basic Volumes based on Euclidean geometry. However, there are many limitations regarding the production of free forms with non-Euclidean geometry as well as rigid volumes. In general, these software are more intuitive in architecture and allow the user to search for similar samples and load them in their design at the same time. These software provide a lot of potential at the stages of the design process. It should be noted that software such as "3D Max and Sketchup" are involved in 3D modelling that the 3D model may be prepared in order to simulate the behaviour and physical reactions of objects, to create real objects by 3D printers, or to produce 2D images during the final process. Now it should be stated that the design of texture and material is the creation of texture and colour appropriate to different materials in the real world to mathematical models. The final finishing of the arrangement and manipulation of mathematical representations of dots and pages in a virtual world seeks to create a schema of a 3D model. In this regard, V-Ray is a final finishing engine and complements 3Ds Max, Sketchup and Revit [11].

3.1. Flexibility of design software

Many influential components have been mentioned in relation to software flexibility and the diversity of these components indicates the extent of scope and field of study related to this issue [23]. Topics such as algorithmic architecture, heterogeneous architectures (irregular forms), issues related to productivity and conformance of related methods, data diversity, interface object design, interface composition (user login page) are also in this area [8]. Primary design data types include physical data, abstract data, field data, simulation environment, and data on principles and regulations [14]. In the field of computer-aided architectural design, the understanding and analysing of this problem, processes were analysed, one of which deals with the design of the interface object [16], This means that in the design process, the software allows the designer to achieve the initial product by designing the interface object and in a brainstorm, before the designer forgets the design ideas [21]. This initial product represents the ideas of the designer's mind in the early stages of the design, but does not have the

usual details and acts as an intermediate object between the idea and the initial concept and the final product of the design [16].

3.2. Personalization and design of algorithms in architectural software

When it comes to architectural personalization, the product personalization comes first [18]. But the specific and unique methods of people reaching the product are in the architectural design and creation of the final product are desired [21], In architectural design personalization the designer's mental features and options are evaluated and analyzed and converted into objective features [17]. Personalization is the medium by which people act on their own imagination and also offer the possibility of experiencing it to other people [7]. Hence, personalization is the factor of introducing the designer personality to others, which can be divided into five categories: Standardization, Segmental Standardization, Personal Standardization, Need-Dependent Personalization and Pure Personalization [13]. In the process of personalizing algorithms in architectural software, there is a lot of possibility in relation to interface with the user, workflow and speed of parametric modeling environments considering augmented functional enhanced intelligence [4].

3.3. Ideas and Components of Personalization of Designs in Architectural Software

Identifying and categorizing the primary generators based on the way they are manifested and the way they are presented are:
- Design schemas and ideas.
- esearch and design (design through research) [9].
- Utilizing the familiar element to create new content that is used in architectural design [18].

To determine the personalization components of architectural design software, productive digital design methods and tools are used to overcome software constraints and thus give designers more freedom by using computing power to address issues of speed, accuracy as well as complexity. This is used when the speed and accuracy of the designer and the architect are improved and can make the work of more complex forms and relationships workable. It should be noted that performing calculations by architectural design software in some cases helps to increase creativity. This is mainly possible by increasing the number of design changes, but also by increasing the scope of changes that result in unwanted results becoming desirable design

decisions. Additional benefits include design repeatability and reusability through encoding of architectural design software that, if time is saved, potentially gives you the freedom to do other things things again (Table 1).

4. Method and Process of Research

This research is a type of qualitative-quantitative research. In this study, experimental and survey methods were used. In the present study, software (Autocad, Sketchup, Archicad, 3Ds Max, V-ray and Revit) was used to evaluate the ratio of flexibility and personalization in architectural design software. It should be noted that the statistical community of the study consisted of 120 architectural design professionals, and sampling was purposefully done among this statistical community. In this research, due to the dispersion of the statistical population, the snowball method was used in targeted sampling, and the first expert was requested to introduce other experts in this field. Until they reached 120 samples. All the selected examples had special characteristics, including that they were all architects and all used architectural software in their architectural offices and all had their own style. After selecting the statistical community, these people were divided into groups of 20 people according to their expertise compared to each of the selected software, and the same pattern was distributed among each of these groups and they were asked to design based on the software with their own customization capabilities. Then, in the next step, interviews and surveys were conducted among 20 experts who were familiar with all selected software. Finally, after conducting the tests and interviews, the results of both stages were
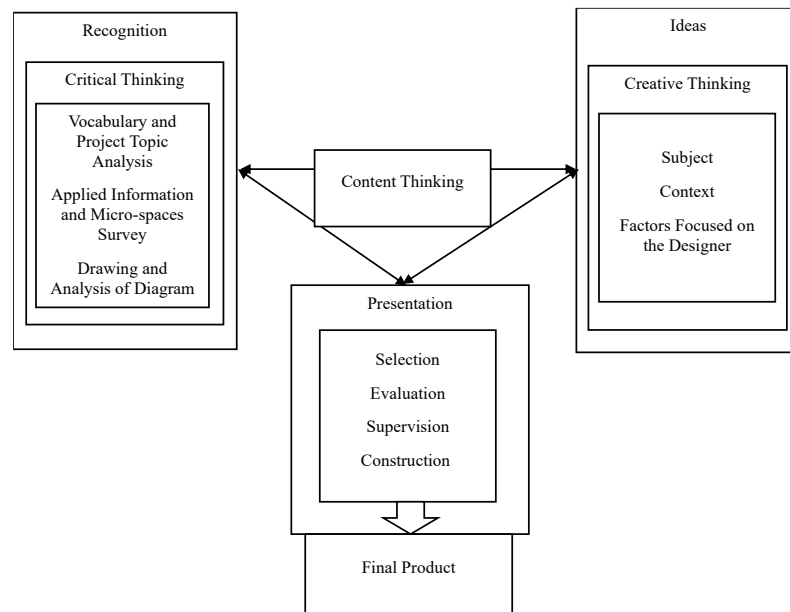
Fig 1: The process of interaction of architectural design in software in order to take advantage of the designer's potentials in order to personalize designs and create innovative ideas

Table 1: Architectural Design Software Personalization Components

	Architectural Design Software Personalization Components
1	Designer training and academic experiences
2	Years of work and experience of past projects
3	Personal social identity of the designer
4	Designer's philosophy of thought

analysed and compared. For the reliability of the research, the most reliable books in this field have been used. These books have enough reliability due to more than 30 years of writing and numerous printings. In this research, logical argument analysis and content analysis methods have been used. It should be noted that the Delphi technique was also used to rank the indicators proposed by the experts.

5. Findings and Discussion

In AutoCAD, which is the most basic architectural design software, design data is very simple and useful only for general understanding of the idea of the design. AutoCAD software does not have a tool that can meet all the needs of designers and clients. But it is possible to change the programming languages in this software and access its underlying structure so that input data can be changed as soon as possible and new capabilities can be replaced. The software creates two-dimensional geometry and uses BIM, instead of producing simple three-dimensional geometry, to produce parametric objects containing all the information necessary for construction. This information can be extracted at any time during the design process. Including maps, dimensions, estimation of project area, project scheduling and analysis. Therefore, employers and designers can easily change them, reduce and increase the size and ... In addition, the output information from Autocad software is used to support all parties involved in the project in the design and construction processes. One of the main aspects of flexibility in this software is simplifying repeated activities and data that is transformed by entering and manipulating data. This software can change its data and programming language and input its output to 3D software so that 3D software can complement the data of designers. The main problem of this software is in the direction of flexibility that only in two-dimensional levels and design plan, facades and sections of architectural projects, and the designer with his tastes enters the data into the software and uses his creativity, power and mental strength to arrange the data and then

changes the customer tastes, basic information and data. It should be noted that in this host-independent software, geometric models are produced and can access different geometries and different simulation tools and create harmony between them.

Archicad software is compatible with Autocad software in terms of input data and final outputs, and the output of Autocad software can be entered into this software for three-dimensionalization. One of the most important aspects of design flexibility in Archicad software is that any change that the designer is looking for, only by creating in the model and the volume of 3D, is automatically done in all executable files such as facades, plans and sections. Therefore, this software creates harmony between time and drawing and reduces time for designers to approach the final design. In Revit software, due to the fact that the content displays information about all stages of design production, from concept to dismantling, gives a lot of flexibility to users and designers. In this software, input information data is designed first for two-dimensional work and then three-dimensional and finally for maintenance during operation, and each of these data can be changed from entry to finish. The distinction between this software and the software of AutoCAD and ArchiCAD in design flexibility is that Revit is in interaction of two software "AutoCAD and ArchiCAD", but these two software are required to complete and import new data, as well as completing the design and showing the creativity of the designer and details to the client, and creating volumetric structures in these software is not possible. So, Flexibility is only done in the same two dimensions. The quality of processing and rendering in Revit, provides new ideas and ways to achieve the best design for users. In Revit software, it is possible to change the width, composition and structural and structural ability of the designer is easily provided and the designer can easily change details such as slabs, ceiling beams, wall types, etc. to achieve the desired design, a principle that is not available in the

software ArchiCAD and AutoCAD. It should be noted that in Revit software, the user must add all elements from tools and reserves to the software before starting to design and be aware of the type of external and internal structures and all members including user, designer, employer and etc. connected to the project. Hence, the flexibility of this software is so much that the users can change any new component to add to the design that fits their idea. Therefore, the designs that are done with this software have the possibility of continuous changes in accordance with the ideas and input data of users. Flexibility in SketchUp software is not easy. The software emphasizes the visual use of the app, and the user must unconsciously know how to create his idea. This type of design creation, for the user, can be such that the designer can create the design without having specific knowledge in the fields of architecture or structure only with his visualization and creativity. SketchUp has almost no primary settings window, and it is possible for the user to change the dimensions and physical features of the spaces during or after the projection. Therefore, this software is very desirable because the idea of the designer and the architect is first planned and then the possibility of editing data is provided. In this software, it is possible to create a 3D object, with only one action when entering data that is aligned with the designer's visualization. The distinction of this software with Revit software is in the lack of processing to detail that there are no walls, columns and floors in Sketchup. Therefore, in the first stage of architectural projects where only ideas are important, this software is used. In Sketchup, creating structures and internal plans is very difficult and requires a lot of time, and also the user needs to design in multiple layers to provide internal structures. By the way, the software can't calculate any construction part, but it is possible to export a project ready to AutoCAD to track tasks, calculations and file formats. Therefore, in a general expression of flexibility, due to simplification of this software in architectural designs, in the form of initial ideas in the first stage of the architect's idea, and the architect and designer can change parts of the design after presenting the overall design. In comparison to this software with Revit and ArchiCAD in the direction of flexibility, it can be acknowledged that the work and design in ArchiCAD and Revit is automatic and everything is controlled by a mechanism and the only aspect that

is not controlled is the user's performance. But in Sketchup, the design is done mechanically, allowing control of the entire project and understanding of each step. Therefore, each user can choose a more convenient type and method to work.

In the 3D Max software, the input data is entered into the software in 3D form, and in general, the user interferes and monitors the work from the beginning to the end. The flexibility of this software is such that data and changes are possible from beginning to end and the output of the design and all the details of the design output, in line with the culture, taste and synthesis of the user's personalization. The quality of processes and rendering in this software is very popular among users, and this software provides users with new ideas and ways to achieve the best design. V-Ray software, which is one of the requirements of manual work, after doing basic data and primary inputs including lighting, materials, color and generally all physical data, takes "material library" and allows editing any material with changing shades, color reflections, light adjustments, etc. It should be noted that V-ray does not have the contents of the processing of volumes and every component of it must be created in other software, and only the user should pay to the settings and all changes of the user after rendering are observed. So, if the change was a new one, user should do that after rendering. This software has a lot of time because it has to have high quality output. In V-ray software, reflections are done manually and through a special adjustment tool to make the output more realistic. Hence this software is the best software to visualize the real image of a building. So, in general, it can be acknowledged that the flexibility and customization of this software, which is often plug-in, is very high and the user can change them whenever these things don't match their tastes.

6. Conclusion

Overall Comparison of Selected Software Based on Survey Data and Modeling Experience

This enquiry was conducted individually for users of each app. The users of the selected software each only estimated their own software. For each group, there was a list of 10 indices (Intuitive Creation, Exporting Ability, Tools, Speed of Work, No Bugs, Ready Model Understanding, Architect-Engineer cooperation, Own Picture Quality, Price, & Library). All the scores were very diverse, but the average score is very obvious. The following estimations are largely based on this data (Figure 2).

The overall comparison according to users' opinion does not show much difference between programs. However, Sketchup software has a slightly larger average than "Revit and ArchiCAD" due to the percentage of importance of the option "Create Visual Option", but in the options of "Tools" and "Architectural Engineer Collaboration" has failed compared to this two software, and the ability and flexibility of this software is lower than Revit and ArchiCAD. Now in general "V-Ray" software has many capabilities in all options, especially collaboration between engineer and architect, as well as creating visual options in terms of reality and
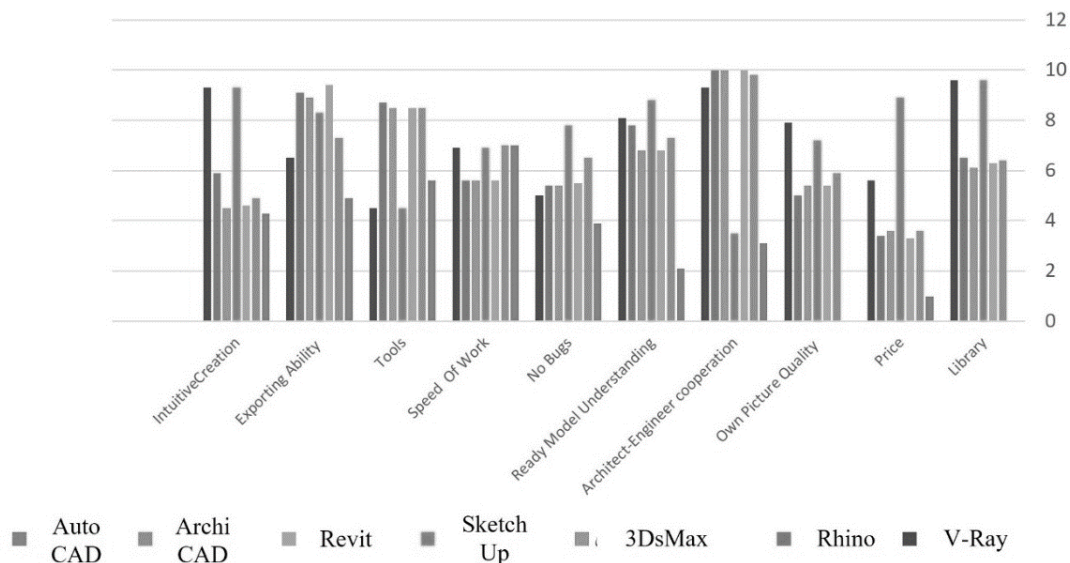
Fig 2: Enquiry data and modeling experience in each selected architectural design software

detail appearance. Therefore, this software has many features such as input data, changes during work, creative three-dimensional design creation, three-dimensional volume visualization, etc. In general, each of these architectural design software has a different percentage of change for each designer and architect, and each software has its own disadvantages and advantages. Therefore, simultaneous use of design software increases the possibility of their flexibility and also personalization of the design. It should be noted that in none of these software are 3D models with full support for organic or free geometry and in all cases, some compromises must be made that lead to the final model and design process. Also, in all design software, the process of data output will be one-sided, because one model is expanded and then transformed by other data and tools. There is no way to synchronize these changes between different programs. But new and up-to-date information may be restored during a project, and the inclusion of it in the original design software model will restart the process. Therefore, the selection of system and software for homogeneous modelling and compatibility with possible changes during design is crucial. Accordingly, it can be generally acknowledged that flexibility in the design process by selected software requires some degree of utility in determining design requirements that emphasizes the need for a flexible behaviour by designers, architects and employers in setting requirements. In a simple approach based on the process of architecture by software, the software first produces the product and thus develops the product with the guidance of the designer's intended architecture. Figure 3 illustrates the relationships between the product, process and architecture designed in architectural software in line with the personalization of architects.

Architectural design software has changed in terms of processing from the beginning until now, when the advancement of technology and data processing has occurred in this software. The main type of data flexibility in this software has occurred in the data

input section, and the software that initially presented the design in two-dimensional form, now with the transfer of input data and modern processes to 3D designs by providing executive data. In architectural design software, flexibility is such that the architect first prepares a draft—which may have occurred in his mind—and then inserts his initial assumptions into the software as preliminary data, to have a more efficient draft of the plan and to provide the client with the initial designs and documents.

In software such as AutoCAD, the design process was crude and non-intuitive. It was therefore used only for the preparation of structural drawings. The flexibility of this software was done only in the design of the plan, facade, and height of the building, and there was no processing in details. Therefore, the designer's personal ideas in the design process were only possible in these areas, and the architect developed his ideas through designs. With the passage of time and the arrival of 3D design software, the application of the ideas and knowledge of the design of the architect in the design process began, and the architect or designer could use his knowledge in all stages, including two-dimensional, three-dimensional and executive drawings, and the initial design was definitely based on the rules and standards governing the design as well as the

Fig 3: The process of product creation and the relationship between them in architectural design software in line with design personalization by architects

personalization of the architect and designer. In this software, the extent of the architect's involvement and monitoring from beginning to end in this is very impressive. In 3D Max, Revit & V-Ray software, monitoring and involvement of architect and user from the first step by creating 3D volume, providing desired form, materials, colour, lighting, shading, landscaping, etc. Also, this software provides executable details and finally computational data. Of course, this process does not take place in V-Ray software, because this software is used only as plug-in on other software and monitoring and user involvement in it in the processing of physical aspects of the building. Therefore, it should be acknowledged that the areas of human intervention of the designer and his monitoring in software in the computational architecture should be determined and controlled, because today this interference is very high and has removed architectural designs from compliance with standards and regulations and has led to the personalization of designs. This process has changed the final product by adding the analysis and synthesis of the designer's personalization in the process of creating the work.

Therefore, by using the flexibility of architectural software, it is possible to personalize the architectural design process and the final product, adding the identity and personal analytical and synthetic concepts of the designer to the architectural design process, can be seen changes in the architectural design process and the final product, which will be personalized and will be unique for each individual designer. Therefore, it can be explained to the extent of this intervention and monitorability by examining the areas of human intervention of the designer and his monitoring in architectural software. Accordingly, the flexibility of architectural design software is based on personalization of designs as follows (Figure 5).

The results of this study show that, among architectural design software, AutoCAD software has the least amount of flexibility and the least

impact on the personalization of designs. 3Ds Max and V Ray software have the most flexibility and the most impact on the personalization of designs in the architectural design process. Also, Sketchup and Archicad software have a moderate degree of flexibility and a moderate effect on the personalization of designs in the architectural design process. Therefore, it can be concluded that the greater the flexibility of architectural design in the process of architectural design, the greater the degree of personalization of designs, from the idea

Table 2: Results of findings

Design Software	Flexibility Level			The impact of personalization of the designs		
	Low	Medium	High	Low	Medium	High
AutoCAD	■			■		
ArchiCAD		■			■	
SketchUp		■			■	
3DsMax			■			■
V-Ray			■			■

Cognition ⟷ Idea

Identification of Applied Information Change Setting

Content Thinking (Accepted Consciousness)

Aggregate Ideas Options Concept

Critical Thinking (Consciousness Diagnosed)

Presentation

Creative Thinking (Consciousness Produced)

Right Hemisphere
Logical
Verbal
Analytical
Gradual

Selection
Evaluation
Supervision
Construction

Right Hemisphere
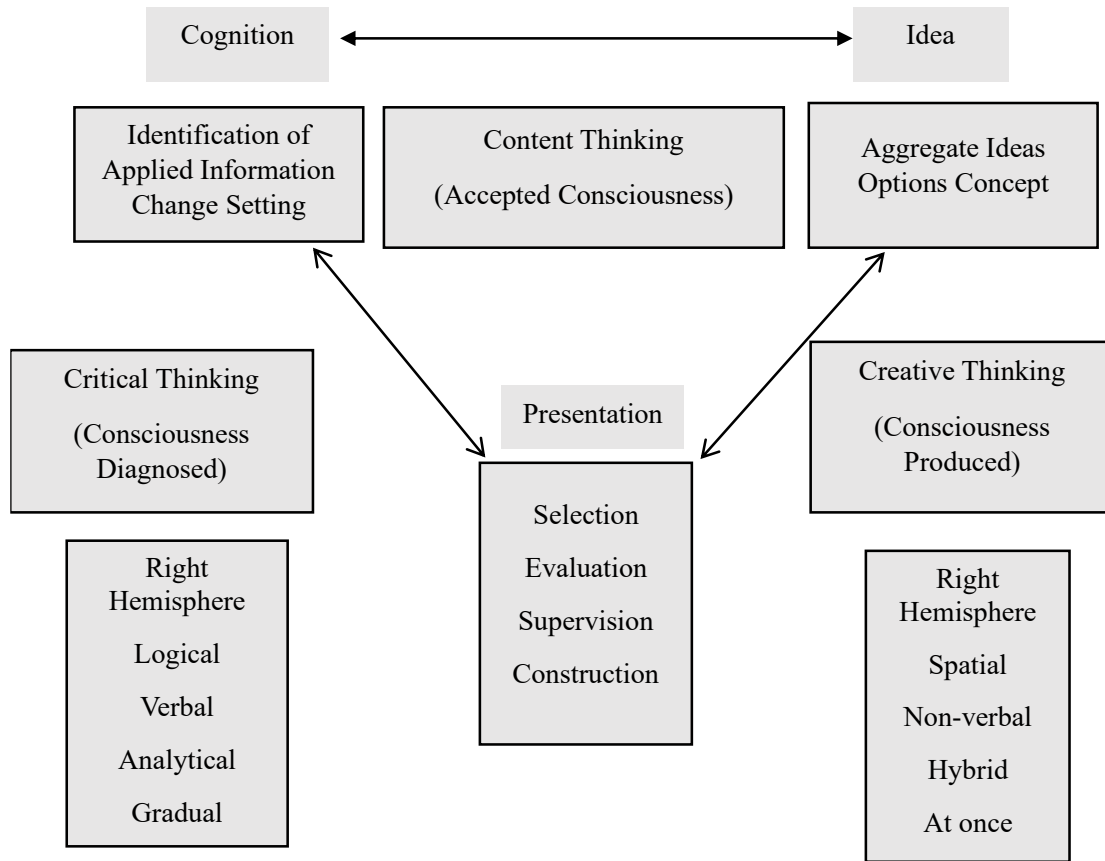Spatial
Non-verbal
Hybrid
At once

Fig 4: Interactive model of design process in selected architecture software flexibly Based on personalization of designs

to the final design. Therefore, it can be claimed that by using the flexibility of architectural software, it is possible to personalize the architectural design process and the final product. And it can be said that this innovation is the present research.
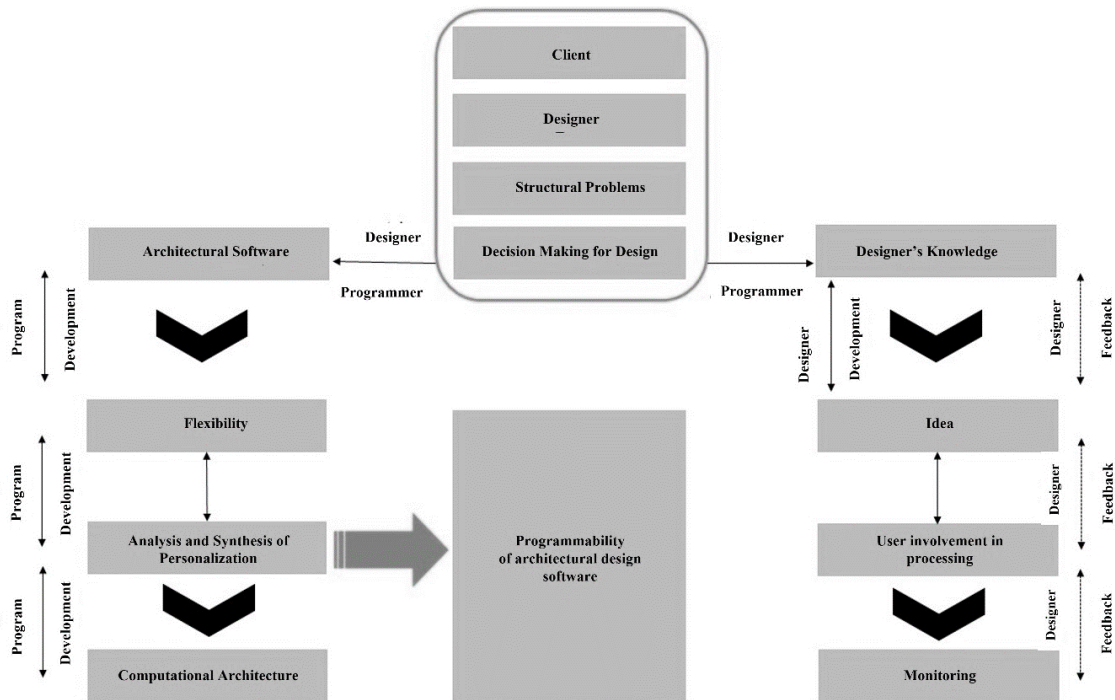
Fig 5: Architectural design process workflow in flexible software and personalization of process

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