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Roles of Variation in Architectural Programming Approaches in Architectural Designs

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Abstract

Architectural programming is the process of gathering, organizing, evaluating information, and making decisions that identify problems, and different architectural programming approaches. First, the knowledge-based approach, Agreement-based approach, Value-based approach, and Participate- approach. This paper focused on revealing the nature of applying two approaches and comparing them in specific aspects. The application consists of examining the programming process within functionally similar real examples to identify the advantage of each approach of architectural programming and its role in the design. So, the results revealed the similarity (between the applications of Agreement-based and Value-based approaches) in employing specific knowledge based on research and physical facts. Most importantly, the results revealed the difference in considering functions as a start point and a limited sequence of stages and depending on the importance of the facts in decision-making within the Agreement-based approach, which produces a non-integrated relationship with the designer. The value-based approach depends on the most important value and varied sequence of stages depending on the situation, which produces an integrated relationship with the designer, by spiral development, the possibility of developing the client. The ability to invest potentialities of the designer and rely on the most important values in decision-making.

Disciplinary: Architecture.

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1 Introduction

The term architectural programming (Briefing) appeared in information extraction in Germany, as for the term (Architectural programming). It has become common in America as it

expresses methods of collecting, analyzing and synthetic the required data in the design process for decision-making (Kelly et al., 2006).

Also, the architectural designer initially used the intuitive. The importance of architectural programming appears when the complexity of information increases in the sixties of the twentieth century, especially after World War 2. With the development of technology, the need arose to find a way to reduce and evaluate information to reduce its processing (Edith, 1999; Hasnain & Thaheem, 2016; Hershberger, 2017). As well as being a key factor in reducing costs compared to the cost required by the programming process, where the cost of programming is 1.5% of the total cost, and this is considered small if compared to the cost that can be reduced to 80% if you use programming(Al-Dabbagh, 2014; Faatz, 2009). Different architectural programming approaches (with many steps) emerged. Firstly, the knowledge-based architectural programming approach. Secondly, the (Agreement-Based Architectural programming) and (participator) approaches. The value-based approach and the participator approach each with steps (Al-Dakheel, 2006). Then in the sixties of the twentieth century, the Knowledge-Based programming appeared by social and behavioral scientists who be careful with the built environment, so an (environmental sociology approach emerged), followed by Agreement-Based-architectural programming), which is followed one of the most important American programming companies (the Caudill Rowlett Scott (CRS)), and Pena the most famous programmers, and's participator approach (Edith, 1999), The value-based approach that emerged and became popular in Britain as a result of the community's need, then developed by Hershberger who pay attention to contemporary values (Hershberger, 2017).

The research will compare programmers' dependence on the two main approaches in influencing the architectural output. The research will uncover this role by analyzing architectural examples that mention programming literature relying on these two approaches. The analysis will be according to the vocabulary that has been identified (the nature of knowledge, the stages of programming, development, and decision-making), and then drawing the results and discussing them to conclude.

2 Literature Review

2.1 Knowledge-Based Programming Approach

Sociologists developed it, including Edward Hall 1966 and Sommer, who presented personal space and studies on privacy and special needs. It appeared in the sixties by the trend of behavioral and (environmental sociology) drew their attention to the built environment within the organization (EDRA) and its steps:

Determine goals based on research and interviews, and make questionnaires to determine the social requirements

The data are collected, statistically analyzed, and summarized in the program document (Hershberger, 2017)

The disadvantage of the knowledge-based approach:

- Neglecting designer-related problems knowledge approach
- The time spends in holistic thinking time that takes all kinds of facts and analyzes them.

The advantage of the knowledge-based approach

- Helpful in developing new knowledge.
- Provides all necessary information following spiral thinking (Edith, 1999).

2.2 Agreement-based Programming Approach

CRS follows it under the guidance of Williams Pena (seeking the problem), where the mission was to complete a matrix of physical information that includes five stages on the assumption that each problem falls within four determinants (functional, formal, economical, and time), (Alomari et al., 2013; Edith, 1999) taken from the sessions with the customer, then he determines the pragmatic ideas that pertain to the building and facilities, then the design requirements (Pena, 1977)as well as the possibility of discovering and adding facts extra and pragmatic ways to deal with problems he puts a fifth column that represents the comments of the design team representative to ensure that the customer and the engineer understand the problem (Alomari et al., 2013)

The role of the programmer is first to define the goal within the four determinants by testing the size of the most significant information that relates to it(Peña & Steven, 2012), so the knowledge adopts a linear thinking style that reduces the possibility of feedback and thus the development of the client and the designer, and in this way, it is he emphasizes the separation between the programming and design process (Edith, 1999; Hershberger, 2017), and he does not take all the samples as he emphasized that programming is an analysis of information and the installation process is within the design stage and as William Pena said "programming is an analysis and design is synthesis" (Edith, 1999)

Third, value-based programming approach: developed by programmer Robert Hershberger, as he expanded the circle of values and linked them to a set of contemporary facts and the approach tries to collect and develop the information related to the most important value of the goals (the highest value at the lowest cost), (Hasnain & Thaheem, 2016), but the values are variable according to the evolution of time and change of place, the most famous of which is the eight values that Duerk used, it tries to discover and analyze the most important value of the project and translate it into design facilities by completing a matrix, that begins by defining the goals and then collecting facts related to the most important value and then defining the design requirements either for the client or designer, where he tries to meets the users, he discovers the most important values (Hershberger, 2017), as for the phases of the curriculum, the value approach emphasized the integration between programming and design by combining valuable ideas with physical design ideas, the programmer extracts information from the client through the interview, in order to define goals, budget, site analysis, climate and external influences, this enables him to define the project issue in the early stages of programming in an attempt to search for the purposes for which

facilities originate. Also, this approach adopts spiral thinking methods that allow feedback and then develop client and designer information (Edith, 1999); as for the decision-making mechanism, it is based on values and priorities considered to assess and reduce information.

2.3 Value-based Programming Approach

It is adopted by Durek and developed by programmer Robert Hershberger, as he expanded the circle of values and linked them to a set of contemporary facts (Hershberger, 2017). The approach tries to collect and develop the information related to the most important value of the goals. Thus it reduces the detailed wasted information (the highest value at the lowest cost (Hasnain et al., 2016), but the values are variable according to the evolution of time and change of place. The most famous of which is the eight values that Duerk used, it tries to discover and analyze the project and translate it into design facilities by completing a matrix, that begins by defining the goals and then collecting facts related to the most crucial value and then defining the design requirements either for the client or designer, where he tries to meets the users, the value approach emphasized the integration between programming and design by combining valuable ideas with physical design ideas. The programmer extracts information from the client through the interview to define goals, budget, site analysis, climate, and external influences; this enables him to define the project issue in the early stages of programming to search for the purposes for which facilities originate. Value-based programming may adopt knowledge-based methodological measures at some stages. Also, this approach adopts spiral thinking methods that allow feedback and then develop client and designer information (Cherry, 2009); as for the decision-making mechanism, it is based on values and priorities considered as means of assessing and reducing information.

2.4 Participator-Based Programming Approach

It is a development of the Agreement-Based Architectural programming approach, and one of's most widely adopted approaches is to use pragmatic analyses. The types of knowledge collected are the physical and social facts that can be obtained from building, analysis, site, and client. The aggregate approach is based on six phases, the first being research on the project pattern. Then defining the goal and issue of the project, defining strategies, calculating quantitative requirements, and completing the program (Edith, 1999; Kelly et al., 2006) thinking patterns within the inductive and deductive approaches (Cherry, 1999) and emphasizes that programming must continue to the design stage (Edith, 1999). The process of evaluating depends on social and physical information and defining the most important goals and issues (function, form, economical, time) (Faatz, 2009).

2.5 Differences between the Value-based Approach and the Agreement-based Approach

Comparing the value-based approach and the agreement-based approach, the differences are

1. (resource of knowledge). It is possible to combine the values of the designer and the client in one matrix within the value-based approach, while in the Agreement-Based approach, it is difficult to combine the values of the designers and clients in one matrix.

2. (Development). The Agreement-Based approach establishes a list of goals, facts, and concepts, and the appropriate needs for each consideration, followed by a summary of the problem. However, the value approach avoids developing programmatic concepts, presents the problem in a scalable way and assists in developing the design and client information.

3. (kind of knowledge). The kinds of facts obtained in the Agreement-based approach are physical, but in the value approach are valuable information. The value-based approach uses the two modes of linear and total Thinking, a helical thinking approach.

4. (Decision making). The programmer must define the most important variables, as in the Knowledge-based approach. The Agreement- based approach defines the most important variables within four considerations. The Participatory-Based approach tried to reduce information by collecting social variables and translating them into considerations. The value-based approach reveals the most important values and translates them into the design facilities.

5. (Relationship with the designer). The Agreement-Based approach is segregated to design, where the programming process separates between programming and design and follows linear thinking methods that do not allow the feedback process and do not include all information. In contrast, the value-based approach is an integrative approach to design and uses helical Thinking that includes all the information(Edith, 1999).

3 Method

This study uses the quantities method with the following steps.

Table 1: Checklist illustrating vocabularies, variables, and defined values to compare the four approaches.

Vocabulary	Variable	Defined values	Knowledge-Based approach Institute(EDRA)	Agreement-Based approach (Pena)	The value-based approach (Duerk & Hersh- Berger)	participatory approach (Cherry & Faatz)
The nature of knowledge	Inclusiveness	Comprehensive	☐			
		Specific		☐	☐	☐
	Source of Knowledge	Client		☐	☐	☐
		Designer			☐	
		Researches	☐		☐	☐
	kind of knowledge	values			☐	
		Physical facts	☐	☐	☐	☐
		Social facts	☐			☐
Programming stages	Starting point	function	☐	☐		☐
		The most important value			☐	
		Social considerations			☐	☐
	Sequence of considerations	Specific	☐	☐		
		Depending on the issues			☐	☐
	Relationship with the designer	Integrative	☐		☐	☐
		Non-integrative		☐		

Development	The nature of development	Linearity	☐	☐		
		Helical			☐	☐
	The possibility of developing the client	Not possible	☐	☐		
		Possible			☐	☐
	Investing the designer's capabilities in creativity	Not possible	☐	☐		
		Possible			☐	
Decision making	Evaluation	Depending on the most important values			☐	
		Depending on the size of the facts	☐	☐		☐

- Delineation of the main vocabularies that define each approach by observing its variables and its defined values and collecting them in a checklist table to hold a comparison between them; (Table 1).

- Choosing two approaches; "Agreement-based" and "Value-based" approaches.

- Analyzing architectural case- studies that programming literature mentions their relying on these two approaches. According to the matrix of each approach and its measuring, the semantic analysis will be according to the vocabularies identified (nature of knowledge, stages of programming, development, and decision-making). These case- studies are functionally similar to exclude the functional impact on results.

- Drawing the results and discussing them to draw conclusions, which identify the advantages of each approach of architectural programming and its role in the design.

4 Result and Discussion

The observing vocabulary and variables from the approaches' literature review are shown in table No1, and the case studies analysis according to its matrices is shown in Tables 2 and 3.

Table 2: Analysis of case studies according to the Agreement-based approach matrix (based on (Edith, 1999))

Project title	"State record centre" Museum	Fish gallery (Aquarium)	Harley Motor Factory and Gallery.	The expansion of university classes and laboratories
function	Project activities, , So it needs Functional Analysis and review of standers, and the archive is the most important space (Edith, 1999)	Events include the organizational purpose of the project and afunctional analysis of the activities, which includes a pyramid drawing, and the exhibition spaces	The work stages are determined by the activities of manufacturing and displaying.	Facts about the site and vacant space files, an analysis of the ease and clarity of movement, and The possibility of expansion
form	The site is narrow and long, So it needs analysis of the possibility of vertical design more than the horizontal	The biological movement system of the park, so Design facilities should impress visitors and gives the flexibility to view, and analyze the design pattern	Flexibility to change depending on the surroundings, site Impact Analysis This reduces the impact of the entrance, and classification according to the mental image	Express a coherent entity despite expansion it needs Analysis of the regional style (the university's regional style)
economic	the analysis is sufficient to cover operating costs	The spaces, volumes, and budget needed and capable of growth The operating cost is high and can be increased	Analysis of the necessary costs for each space	The solution should be economical, and Funding is currently unavailable
time	The possibility of future internal and external expansion is weak	It is not possible to divide the project into phases, and The building must be able to grow	Technologies must express sophistication and modernity. The work can be divided into stages	The construction period is not limited due to a lack of financing.

Table 3: The analysis of case studies according to the "Value-based" approach matrix

project name	goals	facts	values	The direction of project development design requirements	The formal aspects embodied in it
"Lincoln Museum" (Hershberger, 2017)	Watch the statues freely Expression of the Lincoln era and compatibility with contemporary context	Symbolic Function	Humanity	Analysis of the Lincoln era reign (Expressing the reign of King Lincoln while respecting the contemporary context of the site)	High building Writing the words of King Lincoln on the walls Easy movement system
"The American Pavilion at the Montreal World " (Hershberger, 2017, p. 125)	The desire of the designer To distinguish the internal gallery from the closed structure	Systems	Technological	Analysis of the capabilities of structural systems to express designer goals	Use lightweight steel joists to build the famous geodesic dome
"University of Arizona Krivantos Old Man Building" (Hershberger, 2017, p. 140)	Returning to traditions as a reaction to glass usage, which led to an increase in the operating costs of adapting to climate by benefiting from traditions	Sustainability	Contemporary	Analysis of the traditional means of adaptation and the possibility	Tilted roofs, shaded arcades, the central courtyard, lofts, and traditional building materials, high windows and pavements
Add the College of Aviation Engineering	Adding a new building within the context of the site while expressing the contemporary	Permanence	Contemporary	Analysis of the possibility of expansion and the context of the surrounding buildings	A vertical and horizontal motion system that can be expanded and modern structure
"A fertilizer plant in Northern California" (Hershberger, 2017, p76)	Providing spaces that express the stages of production, expressing the shape of mountains	Symbolic Function	Humanity	Building activity analysis Customer requirements analysis	Segmented formation Each part looks like a mountain

Moreover, the study measures the variables in the case studies shown in Tables 5 and 6. Then it made a comparison between the approaches according to the tables' results (Table 6), (Table 7). Finally, it makes another comparison between Case-studies within the same function (Table 8).

Table 4: Measurement of variables in the case studies of the "Agreement-based" approach matrix"

-*Museum" State record centre"* (Edith, 1999, p. 250) -"The expansion of university classes and laboratories" (Edith, 1999, p. 264) - Fish gallery" An Aquarium" (Edith, 1999, p. 230) -"Harley's Motor Show Factory and Gallery" (Edith, 1999, p. 252)			the Agreement-Based approach
Variable	Vocabulary		Measured values
The nature of knowledge	Comprehensiveness	The programmer's duty to determine information by comparing it with environmental, physical facts and relationships between facilities, for example, in administrative buildings, reflects information about growth, movement, and project activities(Edith, 1999)	specific
	Its resource	Volumes are calculated by reviewing the functional program that depending on the users' need to determine the most influential space (Edith, 1999)	Research and standards
	It is kind	The physical analysis includes building analysis in terms of location, dimensions, interior projection, structural system, mechanical system, operational cost, and architectural pattern (Edith, 1999)	Physical facts
Programming stages	Starting point	The functional goals analysis was the starting point which proved that the archive is the space that requires focus on it (Edith, 1999)	function
	Sequence of considerations	The CRS methodology maintains the sequence of the four categories (Function, form, budget, time) (Hershberger, 2017)	Specific
	Relationship with the design	The programming process does not continue to the design stage) (Hershberger, 2017)	Not integrative
Development	Nature of development	Difficult to go back and adjust information (Edith, 1999)	linearity
	Investing the designer's capabilities in creativity	It is difficult to combine the values and requirements of designers and customers in one CRS programming matrix) (Hershberger, 2017)	Not possible
Make the decision	Evaluation	The amount of information related to a consideration determines the most important consideration (William_ Pena, 1977)	Depending on the size of the facts

Table 5: Measuring the variables in the case-studies of the "Value-based" approach

-"Lincoln Museum" (Hershberger, 2017, p76). -"The American Pavilion at the Montreal World Exposition " (Hershberger, 2017, p125) -"University of Arizona Krivantos Old Man Building & Add the College of Aviation Engineering" (Hershberger, 2017, p104) -"North California Fertilizer Factory" (Hershberger, 2017, p76)			The value-based approach
variable	vocabulary		Measurement values
The nature of knowledge	Comprehensiveness	The programmer has to define the most important information using the value system criteria (Edith, 1999). In some issues, the symbolic functional issue was deemed to need development (Hershberger, 2017)	Specific
	Its resource	Values and levels related to the client and designer The functional program can be obtained from the user and similar buildings, but there are kinds of values we need to obtain from the designer (Edith, 1999; Hershberger, 2017)	Science research

	it is kind	Physical and human analyzes that relate to the number of users, their activities, their behavior, and their human values and determine the architectural style (Edith, 1999)	Knowledge is physical and valuable
Programming stages	Starting point	Linear Thinking is a step-by-step way of Thinking that is fixed in direction and has a point of direction and has been adopted by Western Americans (Edith, 1999)	Function
	Sequence of considerations	Priorities affect the most important issue identification, so the sequence of considerations is not specified (Edith, 1999)	Not specific
	Relationship with the design	The programming process continues to the design stage (Hershberger, 2017)	Integrative
Development	The nature of development	The approach has the possibility of returning and modifying information (Edith, 1999)	Helical
	Investing the designer's capabilities in creativity	The ability to combine the values and requirements of designers and customers into one matrix (Hershberger, 2017)	possible
Make the decision	Evaluation	The value system determines the most important information and determines the quality of the building (Edith, 1999)	Depending on the most important values

Table 6: Results of Measuring the variables of Architectural Programming

vocabulary	variable	Possible values	Case studies of the "Values-based" approach				-studies of the "Agreement-based" approach			
			Factory of, North California Fertilizer	Expansion of the University of Arizona	The American Pavilion at the Montreal World Exposition	Lincoln Museum	Museum of "State record centre."	Factory and Gallery of Harley Motor	Gallery of Fish and Aquarium	expansion of the university's Classrooms and laboratories
The nature of knowledge	Its Comprehensiveness	Comprehensiveness								
		specific	☐	☐	☐	☐	☐	☐	☐	☐
	Its resource	client	☐	☐	☐	☐				
		The designer researches	☐	☐	☐	☐	☐	☐	☐	☐
	It is kind	values	☐	☐	☐	☐				
		Physical facts	☐	☐	☐	☐	☐	☐	☐	☐
		Social facts			☐					

Table 7: "Results of the comparison between Case-studies within the same function"

Programming stage	Starting point	Function					☐	☐	☐	☐
		The important value	☐	☐	☐	☐				
		Social consideration								
	Sequence of considerations	Specific					☐	☐	☐	☐
		According to the issue	☐	☐	☐	☐				
	Relationship with the design	Antigravity	☐	☐	☐	☐				
		Not antigravity					☐	☐	☐	☐
Development	The nature of development	Linear					☐	☐	☐	☐
		Helical	☐	☐	☐	☐				
	The possibility of developing the client	Not possible					☐	☐	☐	☐
		Possible	☐	☐	☐	☐				
	Investing the designer's capabilities in creativity	Not possible					☐	☐	☐	☐
		Possible	☐	☐	☐	☐				
Make the decision	Evaluation	Depending on the most important values	☐	☐	☐	☐				
		Depending on the size of the facts					☐	☐	☐	☐

Table 8: The desiccation of the results of the comparison between Case studies within the same function

Case studies follow the Agreement-Based approach	Case studies follow the Agreement-Based approach follows the values-based approach	The issues
Scroll Museum of Manuscripts	Lincoln Museum	In the Agreement-Based approach, the programmer decided to solve the problem of the movement system, then the form expressed by the most important areas, volumes, economics, and work stages, As for the value approach, when determining the most important value extracted from the analysis of the client's desires, the building was expressing the King-Lincoln era model.
The conclusion		It turns out that the analysis carried out by the Agreement-Based approach programmer was a traditional functional analysis. In contrast, the client's values (value) analysis produced an interest in the symbolic aspects.
Fish gallery and Aquarium	The American Pavilion at the Montreal World Exposition	In the Agreement-Based approach, the programmer decided to solve the problem 0f the movement system, then the form. As for the value-based approach, when determining the most important value extracted from analyses of the client's desires to distinguish between the interior hall, the designer tried to take advantage of the technological development of construction systems and thus used two structural systems as a solution.
The conclusion		It turns out that the analysis carried out by the (compromise) programmer was a traditional functional analysis. In contrast, the analysis of the client's (value) desires led the designer to adopt a hybrid construction system, which gave a different solution.
expansion of the university's classrooms and laboratories	University of Arizona Krivantos Old Man Building Add the College of Aviation Engineering	In the Agreement-Based approach, when the programmer decided to solve the desired problem to expand the university, he analyzed (the movement system), then the form, As for the value approaches, when determining the most important value extracted from analyzes of the client's desires in addition to functional and character analyses or character and structural traditions, the designer took advantage of traditions to achieve sustainability, such as the use of patios, ponds, and corridors. , As well as express the context of the local climate of Arizona and contemporary desert using the modern structural structure
The conclusion		It turns out that the analysis was done by the In the Agreement-Based approach, the programmer was a traditional functional analysis, and the solution to the expansion problem was carried out within narrow limits. It turns out that determining the most important value led to the adoption of contemporary values such as sustainability and the modernity of the structural structure, which allowed expansion in both directions.
Harley Motor Factory and Gallery	Factory of, North California Fertilizer	In the Agreement-Based approach, when the programmer decided to solve the problem, which is the factory activities, he analyzed (the movement system) and the necessary equipment, and he determined the form. As for the value approach, when determining the most important value extracted from analyzes of client desires in addition to functional analyzes, the result was a building that reflects the stages of production.
The conclusion		Despite the results' similarity of programming in both approaches (Agreement and value) in the formality appropriate to the job. The question of the relationship with the surrounding context (value) has emerged

5 Conclusion

The "Agreement-based" approach adopted the traditional analysis specific to the function, as physical facts, drawn from studies and research, which excluded the role of the client, and negatively affected the possibility of its development, by excluding the advantages of the designer's creative capabilities, given the fact that the process is linear.

On the other hand, the "Value-based" approach distinguished the programming of function, structural systems, the relationship with the context, and searching for contemporary values and symbolic aspects. As the most important value taken from the client and given that the process is a spiral and includes customer development, this allows reliability with the designer and the possibility of investing his creative capabilities.

Analysis of case studies within the two approaches (Agreement-based and Value-based) confirmed the previous programming literature about the advantages and disadvantages of both, making it easier for programmers to choose the appropriate approach and facilitating its application to obtain the best results.

6 Availability of Data and Material

Data can be available by contacting the corresponding author.

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