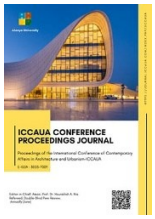

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Patri_Patter; Digital Portal with Adaptative Paradigms for the Recognition of Architectural Heritage

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A b s t r a c t

This summary deals with the proposal of an original method for architectural knowledge. The subject matter is architectural elements and their recognition as adaptable paradigms; interpretable and reusable. Our methodological scheme is heuristic and groups a morphogenetic protocol in synchronicity with a spatio-temporal process of narrative semiotics. It includes a morphological analysis of the genetic environment of the city under study (Blida), and the environment, the demonstration of adaptive use according to passive design and the evaluation of solar flux.The aim is to propose a design tool suitable for the sketching phase of sustainable projects. The result is the digital portal Patri_Patter, which corresponds to the ontological protocol (data, information, knowledge). Patri_Patter contains analytical, evaluative and interpretative sheets according to three levels of significant reading, namely referencing, adaptation and validation. They are available to actors who are committed to the added value of neighbourhoods and the improvement of social life.

K e y w o r d s : architectural heritage; morphogenetic protocol; ontological process; adaptive paradigms; digital portal.

1. Introduction

Apart from its cultural significance, the recognition of architectural heritage is a challenge for sustainable urban development. Indeed, the rehabilitation of old buildings helps to limit urban sprawl by reducing the carbon footprint through the use of resilient heritage and, above all, by improving the quality of life of residents. In addition, their enhancement in the design of contemporary projects improves the image of traditional neighborhoods and ensures harmony between modernity and tradition. To this end, technological progress has enabled the development of digital portals dedicated to the recognition and enhancement of architectural heritage. They play a key role in public awareness and scientific research by enabling better documentation, accurate modeling and digital preservation of historic buildings. However, their accessibility and the updating of data pose significant challenges that require ongoing investment and extensive study. The problem addressed in this article is how to recognize conceptual values for the interpretation of architectural heritage from usable data on historic buildings based on their genetic contexts and morphological characteristics. The hypothesis is that reading an architectural language through adaptive paradigms according to the principles of narrative semiotics, translated through an experimental didactic method, can achieve the knowledge of an architectural heritage. The aim is to create a digital database for the rehabilitation and conceptualization of contemporary projects in a context of high historical value. It must allow the use of architectural elements in situ to ensure functionality and adaptability to the expected use. The research methodology is heuristic and combines a morphological and environmental analysis with a semantic digital model following a spatio-temporal protocol of language reading. The importance of this research lies in the creation of an innovative, recursive and adaptable adaptive heritage knowledge method; allows the use of architectural paradigms taking into account the cultural identity and climate of a region in an evolutionary perspective of a cultural landscape and the preservation of a local architectural language. This document is divided into four parts. The first chapter sets out the theoretical context of the concepts used. The second chapter gives an overview of the tools and methods used in this field, as well as the design methodology of the Patri_Patter portal and the presentation of the adaptive patterns applied to the city of Blida and its historic center. The third and fourth chapters examine the results and discuss the main contributions of this article. The integration of adaptive patterns in the preservation of architectural heritage helps to ensure continuity between history and contemporary requirements. Inspired by the theories of Christopher

Alexander and narrative semiotics, this approach is based on the identification of recurring structures and principles in traditional architecture to guide rehabilitation and design strategies.

2. The use of patterns for the design of new projects in a heritage site

The application of architectural patterns in the design of new projects in a heritage site helps to ensure aesthetic and functional continuity between past and present. This approach is based on analysing the local architectural features, the materials used and the principles of spatial composition to ensure the harmonious integration of new constructions. Architectural patterns can be used to design buildings that respect the scale, proportions and visual rhythms of the surrounding historic buildings. The use of courtyards, local stone façades or gently sloping roofs, for example, can help to strengthen the identity of the site without disturbing its historic character. By integrating modern and sustainable solutions, such as natural ventilation systems, organically grown materials and reversible construction technologies, it is possible to design spaces that meet today's requirements while respecting the architectural heritage. The use of patterns in urban and architectural planning therefore makes it possible to combine innovation and heritage conservation.

2.1. the use of architectural patterns in contemporary architecture

When we look at the architectural productions of the 20th and 21st centuries, we notice countless designed objects that only have a superficial effect. The question is how we can integrate these more resilient qualities into our failing contemporary technologies. The buildings constructed at the end of the 20th century represent the adaptation of tools to an essentially industrial visual aesthetic rather than to basic human needs. The result is a limited architectural vocabulary with repetitive variations of the same outcome. However, some contemporary architects have endeavoured to convey a message that recalls the history of the site, such as Peter Marino and the Souk of Beirut, Jean Nouvel, and the Louvre Museum in Abu Dhabi, Dubai. Jean Nouvel has created a new paradigm for the interpretation of traditional local architectural models in sustainable contemporary architecture. The architectural project becomes a branded product through its design. The trap, however, is to create a misleading advertisement that is nothing more than a myth of a fake identity. This is where the need to create contextualised paradigms that correspond to the characteristics of a particular place becomes apparent. Indeed, the greatest design renaissances in history have employed processes of creative transformation. The solution is that if we want a living environment, we need new design skills and methods to change and improve the degree of complex order.

2.2. Paradigmatic reading of architectural language versus textual language for meaningful design

To understand a language, patterns must be present at all levels to connect to natural processes. The model languages of a civilisation are often synonymous with its technical and cultural heritage. Models provide a necessary database for any design solution that seeks to connect with people. Otherwise, the constructed form becomes incoherent. Language is the means of expression through sign systems. It is the gestural language defined by syntactic codes that go beyond mass communication. Indeed, architecture represents a persuasive message that contains heuristic and inventive aspects. It goes beyond the symbolic aspect and is the expression of a dialectic between sign forms and codes of interpretation (Softaoğlu, 2024). It is the characteristic mediator between materiality and a narrative virtuality, between spatiality and temporality. The algorithmic character of the project cannot be reduced to the process of a designer automaton. It must interact with forms of thought that spring from creative intuition and articulated patterns (action and perception). From horizontal to vertical articulation, the diagrams in narrative semiotics utilise a basic syntax structured by the logic of the constraints and contradictions of the generational context. On this theoretical basis, we have developed a holistic structure that reveals a spatio-temporal linearity for reading the architectural language and its interpretative elements. The analysis of current digital instruments and tools will allow us to develop a suitable method for the analytical and evaluative transcription of the reading of architectural language, highlighting its morphological characteristics and adaptive conceptual values.

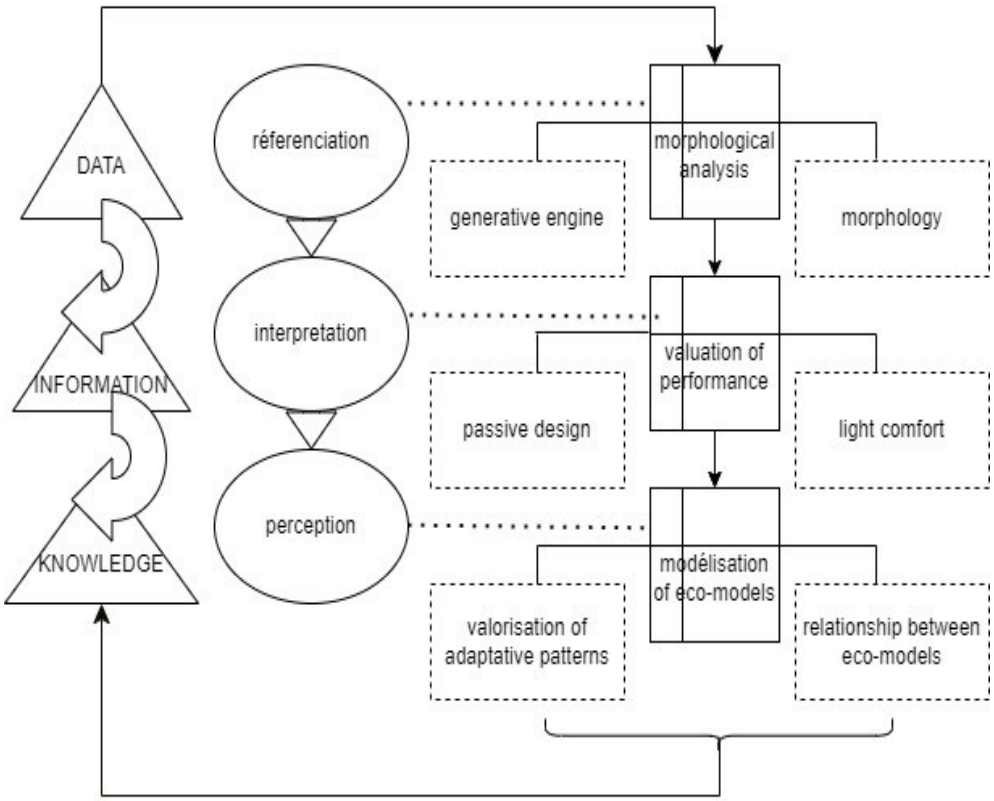

Figure 1. structural diagram of the methodology (Author, 2024).

3. Material and Methods

3.1 Digital methods for Building Heritage Patterns:

Developing an experimental method that meets the desired objectives requires an analytical analysis of the methods, approaches and tools that address the research topic or related topics. The choice of analogue and digital methods in the field of cultural heritage and sustainable design is not accidental. It stems from the desire to compare the two families of methods and to gather the necessary elements for the development of a knowledge tool in the field of sustainable design and rehabilitation of cultural heritage. Three methods and tools are analysed with the aim of identifying the positive and negative aspects and selecting the most appropriate tools to respond to our generative process and enable the materialisation of adaptive patterns.

The study of a methodological approach based on morphology provides satisfactory results for the selection of the architectural corpus. This study allows us to refine the selection of artefacts to be studied.

3.2 Constitution of the experimental process for knowledge:

(a) Evolutionary process according to spatio-temporal linearity:

Inspired by the genetic algorithm used in the development of the digital tools under study (Ecogen), we tested the first phase of our experimental protocol, which corresponds to the methodological approach to the study of architectural language. We have therefore defined three analytical engines: the generative engine (generation), the morphogenetic engine (evaluation) and the performance evaluation engine (interpretation).

✓ The generative engine:

We chose the original traditional house of the city of Blida, the house in the courtyard. And the European single-family house, which is ubiquitous in the city of Blida and which we have already demonstrated in our results during our master's thesis (Tiar 2013). These two parents are generated according to their location in their natural and artificial environment, i.e. their respective neighborhoods in relation to the traditional fabric of the historic center of Blida.

✓ The morphogenetic machine:

This is the phase of problem coding. We have proceeded to characterize the individuals on the basis of criteria. These are divided into two categories. The first concerns criteria related to the morphology of the artifacts. As we defined it in The spatio-temporal process of the first phase, the transfer, it is determined by the study of architectural form. To this end, we have determined the geometry, the dimensioning and the spatial organization of the individuals. The second category, which we have called the genetic environment, is defined on the basis of criteria relating to their urban or natural location and size. They are generated from existing structures based on in situ measurements and their respective conformations.

✓ The performance evaluation engine:

To evaluate the performance of our individuals, we used two engines. The first is the material engine. It consists of cross-referencing the genomes of the parents according to their materiality and tectonics. Materiality concerns the properties of the building materials and the building system. Tectonics explains the opacity and compactness of the

element. The environmental engine deals with the energy dimension of the element. For this purpose, an evaluation of the illumination rate is a complementary operation to our genetic algorithm. In order to obtain meaningful results that are useful for the construction of our semantic model, we used numerical evaluation software.
(b) Iterative synchronization for a numerical formulation:
The second step of our protocol consists of integrating these three engines into an iterative knowledge process. It is divided into three phases: Data collection, information analysis and knowledge acquisition. Indeed, if we look at the structure of the semantic web in the cultural heritage domain, we notice a unique procedure that relies on the attributes of objects according to the digital annotations described by the observation, the data collection phase. These attributes allow the use, segmentation and modification of the shape according to the user's needs. [Messaoudi p. 154] This qualitative information is called semantic and quantitative information, which refers to a general geometric nature. This concerns the analysis and evaluation phase of the information (morphological analysis and environmental assessment and validation of models). This information can be quantified and documented in order to obtain understandable representations with a semantic aspect that can be used by heritage professionals for design or rehabilitation actions on a site of high historical value. The final step is therefore the knowledge formulated through three types of files containing the components studied: analytical, evaluative and interpretative. They also enable the consensual definition of knowledge, which is formalized in glossaries with controlled vocabularies. Each concept in this formalization is knowledge acquired by the scientific community.

3.3 The case study and the choice of sample

Blida is a city known for its cultural and civilizational melting pot. This is due to the different historical eras it has experienced within and outside the walls of its historical center. This has given the architectural landscape a rich stylistic diversity that is still little known and misinterpreted. However, the city is suffering from the massive destruction of its historic buildings in favor of new, oversized structures whose architecture is at odds with its cultural landscape, as the sale of real estate continues to increase. The use of architectural models that are representative of the city's architectural heritage and cosmopolitan culture offers an alternative to experimentation, according to rules that respect heritage protection laws and protected or listed areas.
Three criteria for the selection of the corpus: the location in relation to the historic center, the architectural ideology and style, and the environmental design , whether architectural or architectonic elements. The corpus consists of: Traditional Andalusian or Ottoman houses: courtyard house in the El Djoun neighborhood and Riwak house in the Douiret neighborhood; European houses: neoclassical courtyard building, neoclassical single-family house and neoclassical building; Art Deco corner building and Art Deco bazaar building; Art Nouveau family house, Axial single-family house, Detached house with porch; Neo-Moorish houses: Patio house, patio house with glass roof, mosque, school, hammam; Hybrid houses: courtyard house with verandas and courtyard and riwak house; Adapted housing: Cité Ourida and Cité Montpensier.

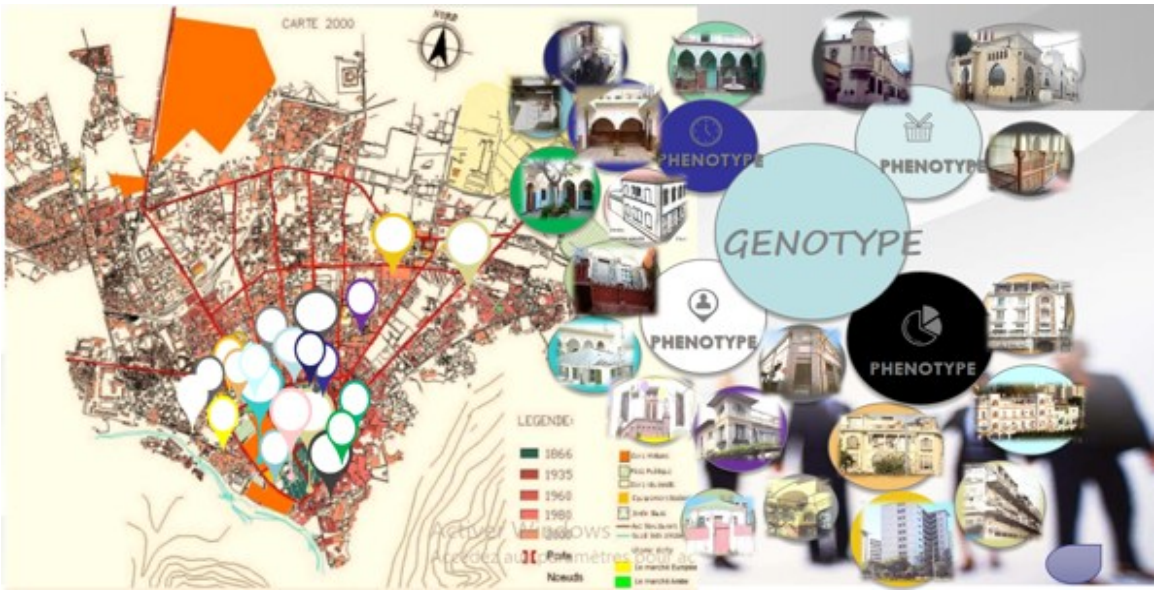

Figure 2. positioning of genotypic and phenotypic artifacts (Author, 2025).

3.4 Analytical studies to interpret the information

This is divided into two phases following the experimental protocol for knowledge, namely: the analysis of the artifacts and the validation of the patterns. The specification of the analyzes is defined according to the spatio-temporal process for reading the language of architectural heritage. Three experimental phases correspond to three analytical studies, namely the morphological analysis, the environmental assessment and the validation of ecomodels. The morphological reference is based on the morphology, i.e. the evolutionary form of the building since the time of its construction. The generative engine makes it possible to read the factors of the environment in which the artifact was built. It has a direct influence on its shape and thus on its morphology. The environment is either natural or urban. The natural environment has an influence on the study of the orientation of architectural elements and their positioning. The urban environment is related to the shape and morphological characteristics of the artifacts studied. The tools used to obtain information are analog (architectural survey, photo reportage and in-

situ information through exchanges with residents). The digital tools used are 3D drawing and simulation software: AutoCAD, Revit and 3DSMAX.
The environmental impact assessment includes the study of the passive design and the evaluation of the natural light flow. This includes the physical and mechanical properties of the materials and the building system. In addition, the conceptual design of the architectural elements and their use in relation to climate adaptation (lighting and ventilation) is examined. The evaluation of the natural light flow within the artifact spaces is also measured. The manual tools used are observations and physical data on the resistance of the materials. The digital tools used are meteorological and geographical data, Revit and Ecotect software.
The final analysis is the validation of the eco-models obtained from the first two studies, namely the morphological analysis and the environmental assessment. A third evaluation is carried out using three parameters: problem, solution and constraint, to which we have added a fourth parameter: Interpretation. The latter is a suggestion for a future projection of the element through a contemporary project.

3.5 Procedure and protocol of the platform to support the experiment

(a) Choice of digital platform:
Technological progress has significantly changed the uses and approaches of the various sciences in the face of this new digital universe. The social sciences and humanities are increasingly using these tools, which encourages the creation of new systems (Linked Data 2024). Indeed, paper-based logic and relational databases are completely inadequate. The openness of the semantic web allows the cultural heritage field to explore data in an intelligent way and link them together without intervention. Our overall goal is to create and use a digital prototype to support our methodology and experiments. We have therefore chosen to realize this tool through the semantic web, embodied by platforms such as WordPress, Wix and Jimdo. All of these platforms offer website design to create, manage and develop an online presence. Each platform has its own specific features and technical and material terms of use.
We opted for the Jimdo platform. It is a cross-platform web content management system that allows you to create a website, blog or e-store without any knowledge of HTML. This platform uses WYSIWYG (What You See Is What You Get) technology; what you see is what you get. With the Jimdo system, you can use different modules (text, images, videos, widgets, etc.) and create layouts or design suggestions or set up a personalised design. (Jimdo 2024). This platform even offers the possibility to create your template with an HTML/CSS editor. However, this remains limited in terms of flexibility and depth of functionality. We have therefore decided to host our digital portal on this platform.
(b) Design of the model according to the experimental protocol:
According to the experimental process, the construction of the digital model takes place at three levels of knowledge understanding, namely the Data level, the information level and the knowledge level.
At the data level, the corpus generation, three generative transformation phases were identified: the genotypes, the phenotypes of the first tournament and the phenotypes of the second tournament. After examining and analyzing the study corpus, we were able to identify two superordinate genotypes, namely the Moorish house and the single-family house. The first parent, the Moorish house, is identified by two variants, namely the Ottoman house and the Andalusian house. The second parent, the detached house, is identified by the classical house. During the first tournament, phenotypes by parallel crossing occur, namely the patio house, the courtyard house and the riwak house. The phenotype by crossover is the classic courtyard house.
The phenotypes of the second stage are divided into two groups. The three facilities are: the hammam (facility with courtyard), the mosque (facility with riwak) and the school by crossing (facility with courtyard and riwak). The buildings with a parallel crossing are: the neoclassical building and the neoclassical building with a courtyard and a passageway. In the third round, three groups of phenotypes are identified; two by crossing and the third by chromosomal mutation. The first two groups are identified by: the hybrid house with a courtyard and a riwak, the hybrid house with a courtyard and a veranda, the neo-Moorish house with a courtyard and a glass roof, the adapted building with a passageway and a small courtyard and the adapted building with a passageway and a loggia. The third group consists of the Art Deco house with garden, the Art Nouveau house with garden and the Art Nouveau and Art Deco buildings.

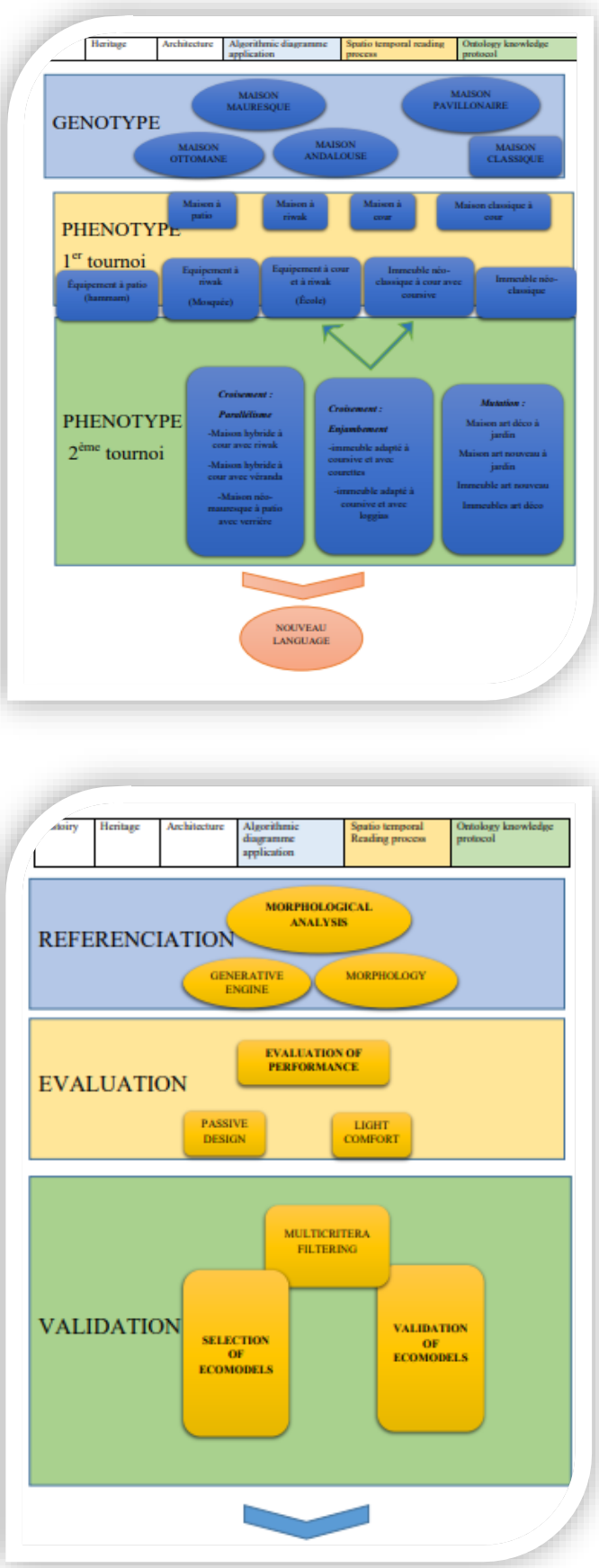

Figure 3. schematics of the model Design (Author, 2024).

3.6 Validation and recognition of patterns

The validation of the patterns allowed us to create summary evaluation sheets that provide all the necessary interpretations of the morphological and ecological characteristics as passive conceptual values. These sheets provide information on the different architectural arrangements present in each case study, corresponding to the historical period and the cultural and urban environment. The first type of data sheet concerns the morphological analysis. It contains all the data related to the genetic environment and refers to the location within the traditional

assemblage (either original or mixed), the position within the block, the shape of the plot and the dimensions. Morphology deals with the shape, dimensions and spatial organization. The second type of data sheet concerns the environmental assessment, which includes analyzes of solar radiation, light comfort and simulations with the Ecotect software.

4. Results

4.1 Creation of the Patri_Patter portal, which supports the experimental protocol and methodological approach

Pattri_Patter consists of three main sections, namely: the preliminary section, which includes three subsections (the "Preamble" section of the main menu on the history of the city, the section "Heritage reading method": "Spatio-temporal perception process"," and the section on the methodological protocol: "Application to the corpus"), the section on the experiments (referencing, interpretation and validation) and the section on rehabilitation.

4.2. design of the section supporting the method

The first main section is a preface about the city and the historical center. It provides an overview of the city of Blida and its historic center, as well as its traditional structures and the architectural elements that make them up. The images are accessible via URL links. The subchapter contains a presentation of the tested method and its theoretical uniqueness, which is based on textual reading based on narrative semiotics, as well as the process of spatio-temporal linearity derived from and applied to the methodology. This section makes it possible to establish a link between material and thought, between the designer and the project in a heritage site. The elements designed in this way are thus the testimonies of a collective consciousness that is the result of a significant perception (culture, senses, memory and imagination). The last subsection, which refers to the application to the corpus, comprises two blogs. The first contains a prospective application of the procedure, namely the identification and taxonomy of the corpus according to the generative procedure. The second contains three sections, each describing a selection phase of the process, namely: problem coding, selection process, and crossover and mutation.

4.3 design of the section of the experimental protocol

The second main section relates to the experiment and contains the three analytical studies (morphological, environmental and paradigmatic). These are divided into three consecutive subsections. The first subsection is divided into two parts. The left part is for the comments and the right part is for the images. In the annotation section, we have explained the referencing and generative engine phases. In the graphical part, we have entered the analytical sheets with all the morphological data represented by diagrams and drawings and described with explanatory comments. One sheet is downloaded to the interface, and the others can be viewed by clicking on the image. In the second subsection, we have designed the information for the second phase of the experiment. We have entered the explanatory information for the evaluation phase. This first concerns the material analysis. The second environmental assessment concerns the passive design in terms of lighting and ventilation. A check is then carried out using the Ecotect tool to quantify the value of the luminous flux emitted by the openings of the corpus (architectural and architectural elements). In the area reserved for images, we have uploaded the image of an evaluation sheet that represents an example of the case study. If you click on the image, you have the option of displaying or inserting another image. In the gallery you can view the other evaluation forms for all case studies in our corpus. In the third subsection we have provided information about the third phase of the experiment. This phase is the final study of the architectural and architectonic elements. It concerns the validation of the corpus elements according to their conceptual environmental qualities with the help of the digital tool Eco-mode. In the graphic section, we have included an interpretation sheet for a case study. They contain all the architectural and architectural elements recognized as operating paradigms resulting from the experimental and methodological protocol.

The fifth section of the main menu is an additional section that complements all the other sections and presents suggestions for environmental and technical solutions applied to specific cases in our studied corpus.

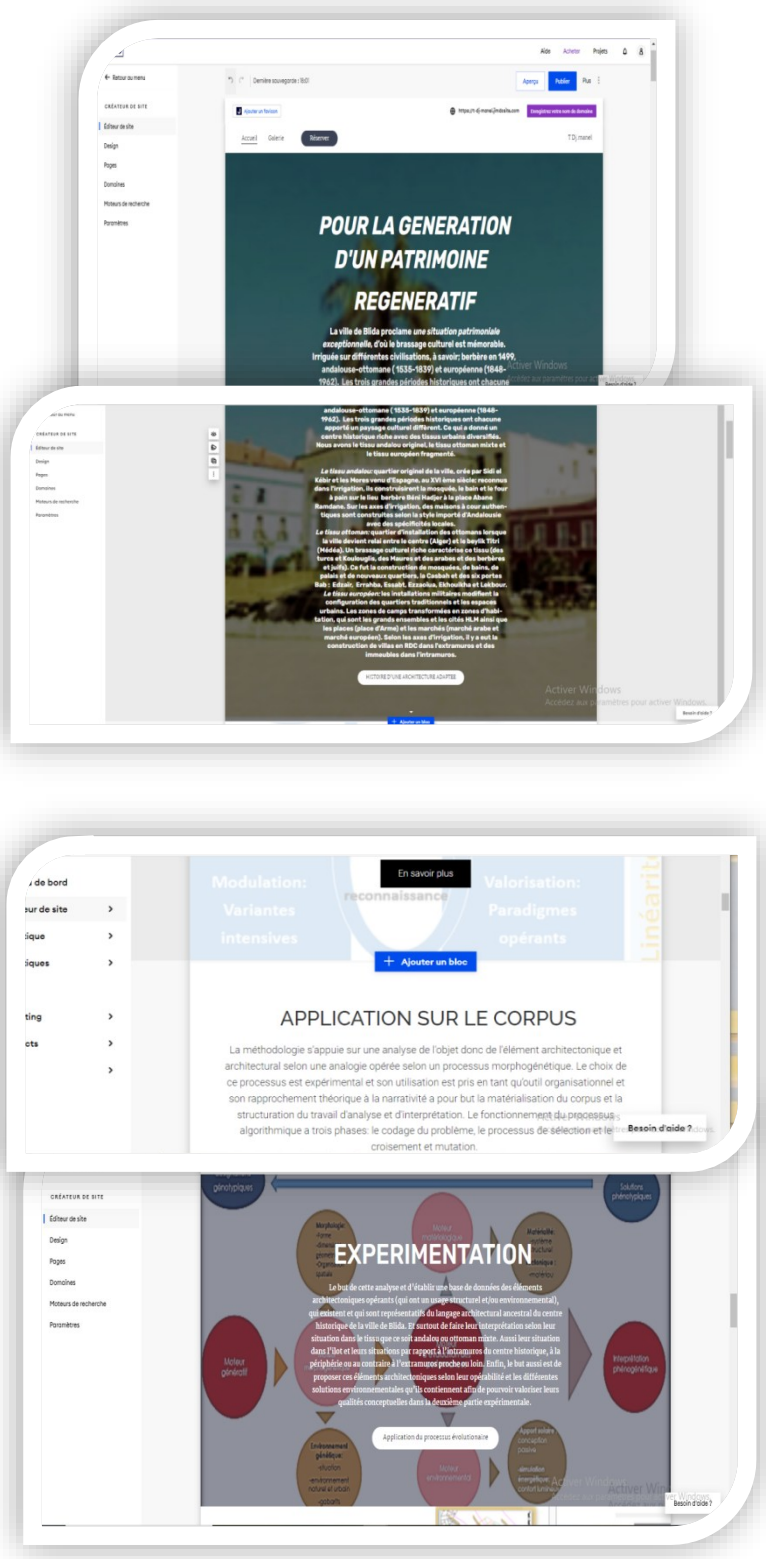

Figure 4. Interface of the section method (Author, 2024).

Figure 5. Interface of the section experimental protocol (Author, 2024).

5. Discussions

5.1 Interpretation of the main results

The study of recent digital instruments and tools aimed at cultural heritage research and sustainable architectural design and their evaluation allowed us to understand the strengths and weaknesses of each method. This confirmed the lack of a unified method or tool that could fulfill our objective. Based on this analysis, we developed our experimental method following the methodological approach, which is the spatio-temporal investigation of the architectural language for knowledge, namely data, information and knowledge.

At the level of data, the morphological study allowed us to identify each morphology according to its genetic environment and to understand the utility of each morphology in terms of climate adaptation. Indeed, this utility has enabled their persistence and sustainability. Their role in climate adaptation in the city of Blida, which has plenty of natural light and a relatively warm climate in summer, confirms their ideas of natural lighting and ventilation.

By interpreting this information, we were able to determine the strengths and weaknesses of the changes and deformations observed in the studied cases during the morphological analysis. Using the "Ecotect" digital tool, the assessment confirmed the observations made previously and, above all, provided a more precise definition of the extent and progression of the lighting in order to propose alternative solutions in the cases in question. To enable

reversibility and adaptation to contemporary life, these elements must therefore be rehabilitated or redesigned according to new architectural techniques and concepts. The results of the semantic study have revealed the validation of environmental patterns according to their situation in context, according to architectural form. This shows their adaptive role in the face of the climate that allows the resilience of traditional houses and buildings according to their morphology and the sustainable solution of the historical and ideological context of each artifact studied. The models studied for their conceptual qualities from the analyzed corpus represent the testimony of a generative constructive and architectural culture that has undergone changes and enrichments over time and use.
At the knowledge level, three learning sheets are formulated: the analytical sheet, the evaluating sheet and the interpreting sheet. The integration of these tools into our digital portal Patri_Patter made it possible to present the architecture and heritage of the city of Blida through its history, its architectural heritage and its lasting significant paradigms in a global and complementary way.

5.2 Implications and outlook

The design of the Pattri_patter portal, based on didactic and informative sections, has made it possible to make a new contribution to heritage research and, above all, to find an innovative and effective experimental method that can transform our urban cultural and historical landscape. Our portal is not the last iterative aspect, as its format needs to be further developed to allow interdisciplinary teamwork with a common computer language.

6. Conclusions

6.1 Implications of the results

The database, developed using scientific methods in a spatio-temporal process that combines various historical, technical and socio-cultural contributions.
The contribution of our approach is to support, raise awareness, visualize and put into practice diverse knowledge at different levels. The promotion of ancestral practices to optimize the comfort of residents is based on a sustainable design that respects the needs of local society, but also takes into account their culture, their memory and the evolution of their current lifestyle. To reconcile this, we have focused our work to date on a perspective of exchange, communication and, above all, networking that brings together different actors in society. To achieve our goal, we have created an prototype of knowledge that supports our methodological approach and our experiments. We can now claim that the architectural and architectonic elements of the city of Blida have proven to be operational and operative paradigms. The experimental approach has allowed us to confirm that the interpretation of architectural language based on referencing, evaluation and subsequent significant validation leads to convincing and consistent scientific results.

6.2 Limitations of the research and recommendations

The purpose of a heuristic and holistic methodology led us to design our digital portal Patri_Patter-Blidsite. Although Patri_Patter-Blidsite now appears to have reached the basic maturity required for use in interpretation and rehabilitation projects, our work remains essentially exploratory and in need of refinement, addition, and generalization. In particular, a comprehensive validation of our approach would require usability studies of the interactive editor and programming library of our digital portal, the implementation of digital applications and a formalization of the reactive model. A tool that saves time and offers relevance for research, sustainability in the design of cultural heritage and an improvement in contemporary social life. The development of the city's image would thus take place while respecting its local values and in line with its significant identity.

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Conflict of Interests
The Author(s) declare(s) that there is no conflict of interest.

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