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Article

LLM and Pattern Language Synthesis: A Hybrid Tool for Human-Centered Architectural Design

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Abstract

This paper introduces a hybrid design framework that combines Christopher Alexander's Pattern Language with generative AI. Advanced large language models (LLMs) enable real-time synthesis of design patterns, making complex architectural choices accessible and comprehensible to stakeholders without specialized architectural knowledge. A lightweight, web-based tool lets project teams rapidly assemble context-specific subsets of Alexander's 253 patterns, reducing a traditionally unwieldy 1,166-page corpus to a concise, shareable list. Demonstrated through a case study of a university department building, this method results in environments that are psychologically welcoming, fostering health, productivity, and emotional well-being. LLMs translate these curated patterns into vivid experiential narratives—complete with neuro-scientifically informed ornamentation. LLMs produce representative images from the verbal narrative, revealing a surprisingly traditional design that was never inputted as a prompt. Two separate LLMs (for cross-checking) then predict the pattern-generated design to catalyze improved productivity as compared to a standard campus building. By bridging abstract design principles and concrete human experience, this approach democratizes architectural planning grounded on Alexander's human-centered, participatory ethos.

Keywords: adaptive design; AI-driven architecture; campus buildings; Christopher Alexander; design patterns; human-centered architecture; large language models; ornamentation; Pattern Language; participatory design

1. Introduction

The dominant architectural culture throughout the 20th and 21st centuries that embraced industrial minimalism dismissed ornament as redundant or superficial. However, recent findings in biophilic design, neuroscience, and psychological research challenge this notion, revealing ornamentation's essential role in human health and cognitive functioning [1–3]. Implementing Christopher Alexander's human-centered A Pattern Language with adaptive ornamental design presents a promising alternative. By leveraging large language models (LLMs), we synthesize complex decision-making and enhance user health and well-being through adaptive design.

Alexander *et al.*'s A Pattern Language (1977) [4] represents one of the most comprehensive attempts to codify design wisdom for the built environment, offering 253 patterns that span from regional planning down to interior details. The complete pattern language spans 1,166 pages, making it unwieldy for a “quick” practical application. Additionally, the traditional method of applying these patterns typically requires specialized architectural knowledge, creating a barrier between experts and the stakeholders who will ultimately inhabit these spaces.

Design patterns are not taught in architecture schools, so students are unaware of them. Applying the pattern language requires training to master most of the patterns so that they can be

combined and recombined in reaching an adaptive, bottom-up design through iteration [5–7]. Today's schools follow an underlying philosophy of design that is the opposite of the pattern language approach. Contemporary culture values the spontaneous, top-down creation of visually-appealing designs, as judged by their novelty. Cognitively, this privileges the simplest possible path to design that avoids extensive recombination of complex components. After several years of training in this direct method of generating designs, young architects tend to lose the mental ability to organize complexity by adopting what is known as “design fixation” [8].

There are broader issues that detach the design profession from common everyday life. An expertise barrier nowadays results in stakeholders having limited understanding of and input into the architectural decisions that will profoundly affect their daily experiences. The planning process becomes opaque to laypeople, remaining the exclusive domain of design professionals. Consequently, stakeholders may find themselves unable to meaningfully influence design decisions that directly impact their lives [9].

In response to these challenges, this article combines digital tools with artificial intelligence to make Alexander's Pattern Language more accessible and applicable. Traditional applications of the pattern language or purely computational approaches applied separately fall short in managing complexity or enhancing emotional understanding. Our method consists of two key components:

1. A web-based application enables the creation of project-specific pattern subsets through an interactive hypertext interface.
2. The use of large language models (LLMs) synthesizes these pattern subsets into narrative descriptions that communicate the experiential qualities of the proposed architecture.

This technique aims to bridge the gap between abstract architectural patterns and concrete spatial experiences, making the implications of design choices more accessible to non-experts. Stakeholders can better understand and evaluate proposed architectural solutions before construction begins through narrative descriptions that translate design patterns into vivid, experiential language. Pattern language coupled with generative AI transforms the relationship between architectural professionals and the communities they serve.

Choosing a building meant to house a university department of Computer Science and AI as one example illustrates how the method works in practice (Section 4). The results differ substantially from the standard top-down method of designing such a project. These differences underline the very desirable adaptive qualities of the present model. Substantial work by other authors reveals how such adaptive design turns out to improve the users' health and well-being in the long term [10]. This assessment is verified here by using two separate large language models to predict the comparative productivity of the department, based entirely on the building's architecture (Section 5).

In this second part of the paper where ChatGPT (o4-mini-high) evaluated the university building resulting from the pattern language versus standard new campus buildings, the LLM made an astonishing claim: “the fashionable buildings' stress-inducing geometries would predict lower publication rates, fewer patent applications, and a shift toward safe, incremental research rather than bold, exploratory ventures.” These words were not asked for in the prompt. To cross-check this evaluation, a separate prompt to ChatGPT-4o used a different account and obtained a very similar response (Section 5).

Generative AI through an LLM predicts that the everyday psychophysiological experience of an academic building will result in measurable differences in productive research from the department! Are we witnessing a “Move 37” moment in architecture? (referring to the historic Go match between AlphaGo and Lee Sedol in March 2016) [11]. If that is the case, then the profession should pay attention. Using a focused and intelligent prompt, the LLM can give us a more unbiased assessment than humans normally do because we can steer it around cultural, intellectual, and media pressures (Section 7).

2. Literature Review and Background Problems

2.1. Alexander's Pattern Language and Its Impact

A Pattern Language emerged as a revolutionary approach to architectural and urban design. The work presented 253 patterns arranged hierarchically from the largest scale (regions and towns) to the smallest (building details and ornament). Each pattern describes a recurring problem in the built environment and offers a solution that can be adapted to specific contexts. Significantly, Alexander conceived of these patterns not as isolated elements but as an interconnected language, with each pattern linking to higher and lower patterns in the hierarchy.

A Pattern Language introduced a holistic framework for architectural design, advocating interconnected solutions adaptable to context and scale. However, its practical application was limited by the profession rejecting some of its key features. That is about to change. Contemporary research in biophilic design highlights ornament's role in psychological and physiological health [12–14]. Techniques such as eye-tracking and visual attention software empirically demonstrate how ornamented environments support cognitive and emotional well-being, in sharp contrast to minimalist aesthetics, which often induce psychological disengagement and stress [15–18].

The impact of Alexander's work extends far beyond architecture. The pattern language approach has influenced fields ranging from software design [19] to education [20] and organizational development [21]. The enduring influence of his work speaks to its fundamental insight: that complex design problems can be addressed through a combinatorial and modular language of solutions that connect across domains and scales. A selection mechanism evolves design combinations by adapting them to human emotional and physiological needs, not abstract images.

2.2. How Design Patterns Circumvent Design-Through-Images

Patterns are compressed verbal descriptions of recurring visual — actually, socio-geometric — relationships. For centuries, architects have relied upon images to communicate architectural ideas and solutions, and this has become a cognitive working standard. Colleagues who judge architecture primarily through images look for formal precedents and visual proof. Since the present approach is totally narrative-based, readers might be confused about our methodological framework.

Each design pattern discovered by Alexander and his colleagues in the 1970s was initially tested heuristically for its adaptivity to human emotional well-being. This was the principal criterion for choosing from among a much larger set of design pattern candidates which ones to include in the book *A Pattern Language*. Since its publication, the success of the patterns has been repeatedly verified from the feedback that pattern-based buildings provide to their users.

The present article is based upon narrative and process, not images. The operational sequence is as follows: design pattern repository → specific pattern subset → LLM verbal narrative → human-centered design criteria → evaluation, which describe the results entirely in words. For this reason, readers familiar only with image-driven design will not see the familiar visual chain of drawings → renderings → photographs that, in their mental model, represents the standard design method.

2.3. Challenges in Pattern Language Application

Alexander's *A Pattern Language* requires special methods to be effective. Self-builders find a useful resource in picking a handful of design patterns to apply to their project, but the comprehensive nature of the work makes it unwieldy for “easy” use in a more substantial task [22]. A project needs to synthesize and combine several design patterns, so implementation becomes an exercise in organizing complexity, which is a non-trivial problem. Furthermore, the interpretation and application of patterns typically require a minimum of familiarity with the patterns.

The traditional method of applying a pattern language involves reading and understanding the entire work, identifying relevant patterns through expert judgment, and keeping these patterns in mind during the design process. Several iterative steps at combining the patterns to generate adaptive

forms require doing this in one's head, with the limited help of visual aids. The double process of pattern selection and combination remains challenging to non-experts (including most architects trained in the design-through-images paradigm).

2.4. Digital Tools and Pattern Language

Various attempts have been made to digitize and make the textual description of pattern languages more accessible. As well as producing 80 additional patterns in *A New Pattern Language* (2020) [23], Michael Mehaffy has advocated for digital adaptations of pattern language to enhance its usability. Projects such as Iba's Pattern Language 3.0 [24] and Schuler's Liberating Voices pattern language project [25] have explored digital formats for pattern language solutions in various domains.

However, these efforts have typically focused on creating comprehensive digital repositories rather than tools for implementing context-specific pattern languages. The approach presented in this article differs by emphasizing the creation of manageable, project-specific pattern subsets rather than attempting to manage the entire pattern language. An additional and non-trivial obstacle is that Alexander's original *A Pattern Language* is not open access, thus it cannot be posted freely on the web.

While we have been very careful to respect authors' rights in this paper, the proposed method could be implemented entirely without using the canonical Alexandrian patterns (Section 9.2). LLMs can approximately duplicate the design patterns strictly from secondary sources. The errors are too high to make that a useful method, since the model will never be able to regurgitate an accurate facsimile of Alexander's Pattern Language.

2.5. Language Models in Architectural Contexts

Large language models (LLMs) offer new possibilities for architectural communication and planning [26,27]. Some architects are exploring the potential of LLMs to generate architectural descriptions, investigating conceptual design phases towards visual implementations of novel forms rather than adaptation to human affordances and scale [28]. The second author (N.A.S.) has applied LLMs to describe environments for creative work [29], and to classify window typologies that generate anxiety [30].

Our approach specifically focuses on how LLMs can translate pattern languages into experiential narratives that communicate architectural qualities to non-experts. Alexander's original motivation for the Pattern Language was indeed to bring the design process closer to common people, and this is the reason for its continued success with self-builders. The present application addresses what Tzonis identifies as a persistent challenge in architectural communication: the gap between abstract design principles and the lived experience of architecture [31].

Anticipating a possible misunderstanding, the input of design patterns into the present method is through their descriptive text, not from images. We do not use example figures and images to explain the pattern language to the AI. While the book *A Pattern Language* includes one image (photo) to illustrate the "feeling" of each pattern, those are not included in the software used by the present model; only the re-worded verbal description of the solution or its paraphrase. The pdf short-list prompt therefore comes from the pattern statements only.

In the authors' opinion, architecture has accumulated cognitive scaffolding over time that constrains adaptive development. Design that always works within an image-based method may never develop autonomous capabilities, thus precluding adaptive problem-solving. Adaptive innovation involves deliberately sidestepping these supports. It therefore makes sense to develop AI as a tool that enhances collaborative intelligence, so it exceeds the capabilities of individual human efforts. Developing technologies that enable true cognitive symbiosis will have to work with human cognitive mechanisms.

2.6. Stakeholder Participation in Architectural Design

Numerous scholars have emphasized the importance of stakeholder participation in architectural design, including Till [32], who argues for a more democratic approach to architectural practice. Sanoff's fundamental work on participatory design [33] highlights the value of involving end-users in the design process, developed further by Salama [34], while Blundell Jones *et al.* [35] document various approaches to architecture as a social practice. While much useful discussion on participatory design has taken place over the years, no satisfactory method has emerged that the building industry has felt comfortable in adopting. For this reason, design and construction has continued to implement standard typologies without user input.

In a welcome development, AI offers new solutions to participatory design [36,37]. This is due to AI's ability to handle the complexity of multiple decision-making processes and to combine them into a suitable result.

Using AI potentially enhances stakeholder understanding and participation in the design process. Design patterns represent evolved architectural and urban solutions, invented by ordinary builders, and selected by the general population. They arise from common practice in each society, thus forming an essential part of material culture [38]. By making pattern language more accessible and translating pattern groupings into concrete narratives, we address what Friedmann [39] identified as the "knowledge gap" that often limits meaningful participation in urban planning processes. Curiously, therefore, AI makes possible human interaction and participation in the design process that was unwieldy or impossible before.

3. Methodology: A Listing of Design Patterns

3.1. Development of the Web-Based Pattern Subset Tool

The model begins with a web-based application designed to make Alexander's A Pattern Language more navigable and accessible. A private and non-commercial application titled "APL-Companion" presents each of the 253 Alexandrian patterns in a collapsible format. The problem/solution content is new text that has been written entirely for this application. This application curates project-specific subsets of Alexander's patterns, simplifying stakeholder choice and interaction. Readers can find the application from the information provided in Appendix A. This functionality is well within the capabilities of LLM coding agents. A brief technical specification for the tool follows:

- Collapsible interface: Each pattern is contained in HTML <details> elements that can be opened/closed
- Smart URL encoding: Open patterns are encoded in the URL fragment (e.g., #p=1,3-7,12) using compact range notation
- State persistence: Selected patterns remain open when returning to bookmarked URLs
- Cross-references: Links between patterns automatically highlight when target patterns are open
- Position memory: When clicking pattern links, the tool remembers scroll positions and returns users to their previous location when closing patterns
- Auto-scrolling: Automatically scrolls to newly opened patterns for smooth navigation
- Visual feedback: Links to currently open patterns are visually distinguished
- Pure JavaScript: No external frameworks, using modern browser APIs
- Responsive design: Mobile-friendly layout with touch-optimized controls
- Print optimization: CSS print styles hide navigation elements and show only selected content

Allowing users to expand and collapse individual patterns creates a more manageable interface for navigating the comprehensive pattern language. The first author (B.P.) developed the pattern subset tool as a single-page web application using HTML, CSS, and JavaScript. The application's core functionality centers on the HTML "details" element, which provides native browser support for expandable/collapsible content sections. Patterns are implemented as separate "details" elements,

allowing users to toggle the visibility of individual patterns. The application maintains a lightweight footprint, requiring no server-side processing or database. All functionality is implemented client-side, making it easily deployable on any static hosting service.

Manual user selection creates a specific subset pattern language, with expanded patterns constituting the subset. The selection process typically takes minutes rather than the hours or days that might be required to read and process the entire pattern language (not to mention that only someone already very familiar with each pattern is capable of doing this easily). The resulting subset represents the patterns deemed relevant to a particular building project.

Interested readers are encouraged to follow the general outline set out here to implement a parallel scheme for organizing the patterns for convenience. All that is required is a selection of patterns (containing only the pattern title, problem, and solution) deemed to be relevant to a specific project. The pattern list is then fed to an LLM as a PDF file along with the correct prompt to generate the narrative (this is described below).

3.2. URL Fragment Approach for Creating a Subset Pattern Language

To enable sharing and persistence of selected pattern subsets, we implement a URL fragment approach. The application stores the selected pattern subset as URL fragments, allowing users to bookmark or share specific pattern subsets via links. When accessed, these links automatically retrieve the selected pattern subset, ensuring consistency across different users and sessions. The user interface presents patterns in their hierarchical order, from largest scale (regions and towns) to smallest scale (building details). Each pattern is represented by its number and title when collapsed, with the expanded view showing a concise summary of the pattern along with links to related patterns.

The method preserves Alexander's concept of patterns as an interconnected language through hypertext navigation. Each pattern includes links to higher patterns (which it helps to implement) and lower patterns (which help implement it). These relationships form what Alexander described as a "network" of patterns that work together to create coherent design solutions. The methodology proceeds as follows: (1) A designer who is familiar with the different patterns in A Pattern Language selects the titles of all the possible patterns that appear relevant to the project. In this case, the example chosen is a university building meant to house the Department of Computer Science and AI. (2) The APL-Companion software generates a detailed textual description for use as a prompt with LLMs, as described next.

For example, a subset pattern language for a university department might be encoded as follows, selecting design patterns by their number:

file:///C:/Users/Username/Documents/apl.html#p=18,80,82,88,95-96,98-99,102,107-108,110,112,115,119-120,122,124-125,127-130,132-133,135,146-148,150-152,159-161,163-164,166,171,174,176,179-180,183,191-192,194,207,222-223,225,232-233,235-243,248-250

This approach eliminates the need for server-side storage or databases while ensuring that pattern subsets can be easily shared among stakeholders.

Simply holding all the selected design patterns in one's mind when working on a project (as was necessary for previous implementations) is a very challenging cognitive task. It would normally require weeks of familiarization and working with the list repeatedly to grasp a global synthesis. The necessary next step of recombining patterns to approach more optimal results is even harder. For this reason, joining a pattern language to a large language model is a huge step in being able to manage the combinatorial complexity that an adaptive design process requires.

Most important, this method simplifies the process of moving a design forward iteratively. The added practicality helps to avert the intellectual attraction of a facile one-step design solution based on visual formalism. That almost never turns out to be adaptive.

3.3. APL-Companion Generates a PDF Pattern List for LLM Context

The APL-Companion application supports printing functionality, typically to PDF, that includes only the pattern subset titles and summaries without extraneous elements such as navigation links. This condensed output provides ideal context for LLM prompting, offering the relevant pattern information in a format that can be directly input to large language models. This format ensures that the LLM receives clear, relevant information about the selected patterns without being overwhelmed by the complete pattern language.

For reference, here is the list of design patterns by number and title selected for this project, a university building to house the Department of Computer Science and AI (Appendix A):

- 18 NETWORK OF LEARNING
- 80 SELF-GOVERNING WORKSHOPS AND OFFICES
- 82 OFFICE CONNECTIONS
- 88 STREET CAFE
- 95 BUILDING COMPLEX
- 96 NUMBER OF STORIES
- 98 CIRCULATION REALMS
- 99 MAIN BUILDING
- 102 FAMILY OF ENTRANCES
- 107 WINGS OF LIGHT
- 108 CONNECTED BUILDINGS
- 110 MAIN ENTRANCE
- 112 ENTRANCE TRANSITION
- 115 COURTYARDS WHICH LIVE
- 119 ARCADES
- 120 PATHS AND GOALS
- 122 BUILDING FRONTS
- 124 ACTIVITY POCKETS
- 125 STAIR SEATS
- 127 INTIMACY GRADIENT
- 128 INDOOR SUNLIGHT
- 129 COMMON AREAS AT THE HEART
- 130 ENTRANCE ROOM
- 132 SHORT PASSAGES
- 133 STAIRCASE AS A STAGE
- 135 TAPESTRY OF LIGHT AND DARK
- 146 FLEXIBLE OFFICE SPACE
- 147 COMMUNAL EATING
- 148 SMALL WORK GROUPS
- 150 A PLACE TO WAIT
- 151 SMALL MEETING ROOMS
- 152 HALF-PRIVATE OFFICE
- 159 LIGHT ON TWO SIDES OF EVERY ROOM
- 160 BUILDING EDGE
- 161 SUNNY PLACE
- 163 OUTDOOR ROOM
- 164 STREET WINDOWS
- 166 GALLERY SURROUND
- 171 TREE PLACES
- 174 TRELLISED WALK
- 176 GARDEN SEAT
- 179 ALCOVES

180 WINDOW PLACE
 183 WORKSPACE ENCLOSURE
 191 THE SHAPE OF INDOOR SPACE
 192 WINDOWS OVERLOOKING LIFE
 194 INTERIOR WINDOWS
 207 GOOD MATERIALS
 222 LOW SILL
 223 DEEP REVEALS
 225 FRAMES AS THICKENED EDGES
 232 ROOF CAPS
 233 FLOOR SURFACE
 235 SOFT INSIDE WALLS
 236 WINDOWS WHICH OPEN WIDE
 237 SOLID DOORS WITH GLASS
 238 FILTERED LIGHT
 239 SMALL PANES
 240 HALF-INCH TRIM
 241 SEAT SPOTS
 242 FRONT DOOR BENCH
 243 SITTING WALL
 248 SOFT TILE AND BRICK
 249 ORNAMENT
 250 WARM COLORS

The brief descriptions of the above design patterns are not included here. Note that the APL-Companion web application paraphrases and substantially re-writes the content of all the patterns so they are not identical to the official published text. The educational aim of this application is not to publish the selected pattern list containing a factual summary but to feed it as a prompt into an LLM. What is published is the ensuing AI output, which creates a descriptive narrative for the project.

3.4. LLM Integration and Prompt Engineering

The second phase involves using large language models to synthesize narrative descriptions based on the selected pattern subsets. LLMs translate these pattern subsets into coherent, experiential narratives and adaptive ornamental solutions guided by neuroscientific criteria. For this research, we utilized Claude 3.7, an advanced language model capable of processing substantial context and generating coherent narratives. There are several equivalent LLMs that could be used in this manner, so this is only a convenient choice adopted for writing this paper that should not affect the study's reproducibility or generalizability.

The basic prompting process involves providing the LLM with the pattern subset (typically in PDF format) along with specific instructions regarding the building project. These instructions include:

1. The purpose of the building (e.g., a university department).
2. The approximate size or capacity of the institution (e.g., 200 students and staff).
3. Any specific local requirements or contextual factors.
4. A request for a narrative description focusing on experiential qualities.
5. An explicit mention including the ornament.

A typical prompt structure follows this general format:

Prompt: "Attached is a pattern language for [specific building type], this is a [size description]. The [building/institution] is [purpose description]. Write a narrative description showing how the building is experienced, describe the look and feel and the ornamental treatment."

3.5. Eventual Need For New Patterns — LLMs Greatly Simplify the Task

Any project designed with the pattern language will normally require additional patterns to be developed that are not already included among the 253 canonical design patterns. Those supplemental patterns will address design problems specific to the project and could play an important role. Some patterns could be selected from among the 80 in Mehaffy *et al.*'s A New Pattern Language, while others need to be newly discovered. Fortunately, A New Pattern Language is open-source and is published on two separate sites in slightly different formats as well as in book form [40,41]. The 80 new patterns can be quickly examined, and the URLs of any relevant ones included in the prompt to the LLM.

The process of writing a few entirely new patterns is necessary to ensure an optimal design outcome. This is a separate topic that will not be developed here: for simplicity, we stick to using only the original pattern language. The authors are in conversation with Michael Mehaffy on a project of using LLMs to derive patterns. Preliminary results reveal that the process is enormously facilitated by AI, reducing the considerable amount of work traditionally required to discover a new design pattern. With the iterative facility provided by an LLM, the normally laborious and time-consuming derivation becomes easy and straightforward.

Looking to the software community for useful lessons reveals fervent activity that combines LLMs with design patterns. But so far, interest mostly focuses on deriving and applying design patterns that improve AI functionality, such as in optimizing and organizing prompts. What we are talking about here is the reverse: using generative AI to derive new design patterns. Our interest lies in architectural design, yet the concepts in computer science are similar. The study by Nazar *et al.* goes in the desired direction [42]. A paradigm shift is expected when an LLM-based program transforms the project's nature by simultaneously applying documented design patterns and discovering entirely new ones.

4. Case Study: A University Department Building

4.1. General Features Emerging From the Use of The Pattern Language

A university building housing a Computer Science and AI department demonstrates this adaptive design method. Stakeholders will collaboratively select patterns reflecting needs such as communal spaces, human-scaled environments, and natural lighting. Using LLM-generated narratives and neuroscientific insights, ornamental elements are strategically designed to support psychological well-being:

- Exterior façades feature ornamented entrances and structural/visual frames employing fractal scaling to induce positive subconscious engagement.
- Interior spaces incorporate ornamental panels with plant-like, fractal designs, enhancing cognitive function, particularly in learning environments.
- A monumental staircase is designed with ornamental complexity, emphasizing natural lighting and visual stimuli conducive to memory and emotional well-being.

These design requirements were not inputted separately but arise as an essential part of the pattern combinations. Design patterns already contain them, because the pattern method embodies a human-centered approach to design that re-uses discovered solutions. Because of this essential adaptation, pattern-generated designs tend to look more “old-fashioned” than contemporary or industrial designs — but not because they copy any traditional images.

We created an appropriate pattern subset using our web application and generated a narrative description using the LLM. This theoretical application provides a context for testing the technique's flexibility and efficacy. To ensure fidelity to Alexander's patterns and identify any LLM deviations or hallucinations, we identified any elements in the narrative that are not supported by the selected patterns. When discrepancies were found, we regenerated the narrative until it aligned with the

pattern subset. This iterative approach ensured that the final narrative authentically reflects the selected patterns rather than introducing extraneous concepts from the LLM's training data.

4.2. Descriptive Narrative Generated by the Large Language Model

In what follows, we have included extracts of a detailed description of the human experience of a user in the proposed building. Generative AI makes this conjectural narrative possible. The text below is selected from a much lengthier description provided by the large language model Claude 3.7. The unedited narrative is included as Appendix B at the end of this paper, since it will be used for the LLM analysis in the second part.

Prompt: "Attached is a pattern language for a new university department of computing and AI, this is a small institution with no more than 200 students and members of staff at any one time. The department is a venue for human flourishing and creating humane technologies via a building that meets human needs. Write a narrative description showing how the building is experienced, describe the look and feel and the ornamental treatment."

Response (condensed and edited): Narrative description of a Department of Computing & AI — Human-Centered Design.

The new Department of Computing & AI rejects the usual monumental "campus box". Instead of a single slab, a cluster of small, inter-linked wings nestles into the landscape; four storeys or less, so the scale remains human. A carved door and arched reveal communicate a welcome signal rather than institutional intimidation. A timber-framed main entrance projects modestly from the façade, while smaller doors nearby form a "family", so visitors can intuitively read the building without relying on signage.

Upon entering the building, the space opens into a sun-filled atrium. Daylight entering from many directions is filtered by hanging plants; staircases embrace the edges, doubling as casual seating so circulation and social life merge. Students and faculty are always in visual contact with the wider community. Teaching zones are kept under 25 ft wide, so every desk enjoys daylight and views. The largest studio uses a staircase-as-stage, allowing teaching or impromptu encounters. Alcoves, deep window seats, and narrow side rooms give introverts privacy within arm's reach of collaboration—impossible in the rigid corridors of conventional blocks.

Research workshops occupy the upper levels and side wings, where small teams can tune their own environments with movable partitions and pin-up walls. Many 3–8-person meeting rooms encourage serendipitous conversations. A student can shift from coding sprint to contemplative reading. Three distinct courtyards—one sunny and social, one trellised and contemplative, one pergola-covered "outdoor classroom"—lie no more than a minute's walk from any desk. Low sitting walls and column-marked corners create outdoor "rooms" rather than leftover voids. Small-paned windows in deep, splayed reveals help to moderate glare and invite occupation of the windowsill.

Soft plaster walls, wood or cork floors, and half-inch trim lines wherever materials meet guide the hand and sustain the building's warmth. Pastel and rich colors and geometric ornament—etched glass, carved lintels, patterned floor tiles—adds detail that rewards close attention. This contrasts sharply with the blank metallic surfaces of a typical tech faculty. The building gives occupants a rich spectrum of spatial choices, continuous connection to nature, and a legible, craft-infused environment. Where the standard university block impresses but isolates, this pattern-generated design connects and supports human spaces. □

Since architects tend to be visually-oriented, we converted the verbal narrative into representative images, just to illustrate what is going on. These images are "proof-of-principle" only, and should not influence details of the eventual design. We used the full narrative from Appendix B (not the shortened version presented above) and asked ChatGPT o3 to generate some exterior and interior views. No particular style was imposed — certainly not a Classical or traditional one. ChatGPT was supposed to use only the descriptive narrative and nothing else. Those images are shown as Figures 1 to 5.



Figure 1. Main courtyard of the campus building. Image generated by ChatGPT o3 prompted by N. Salingaros.



Figure 2. Secondary courtyard of the campus building. Image generated by ChatGPT o3 prompted by N. Salingaros.



Figure 3. Main interior space of campus building. Image generated by ChatGPT o3 prompted by N. Salingaros.



Figure 4. Hall with ornamented staircase and floor. Image generated by ChatGPT o3 prompted by N. Salingaros.



Figure 5. Window seats. Image generated by ChatGPT o3 prompted by N. Salingaros.

The description may appeal to a university administration looking for a new building to house its Computer Science and AI Department, yet the interesting result here is the humanity of the narrative. Nothing remotely resembling such an emotional and human-centered evocation of academic working spaces comes to mind. And, surprisingly, it took AI to generate it. By contrast, the standard architect-generated narrative for an equivalent project seems concerned mainly with formalism and visual effect but hardly with the users' emotions and psychology. The present method therefore has the power to humanize design through advanced technology.

The use of a pattern language turns design into the realm of the evocative and the sensory, and away from the industrial and mechanical. This is going against every force that has pushed architecture in precisely that direction for more than one century. A different philosophical and methodological approach generates narrative from human feelings coming from pattern-based forms and spaces. It is time to reconsider what the built environment has been missing for quite a long time. Nevertheless, early versions of this paper triggered contentious arguments by contrasting the emotional/spiritual with a cold industrial approach to design.

Upon seeing Figures 1 to 5, architects automatically assumed that our method prompted AI to generate a Classical/traditional building. They dismissed the logical sequence of design steps. This incorrect reaction is due to their intensive training in the design-through-images paradigm, which makes it cognitively impossible to follow an alternative method. To reiterate, we followed the process: design pattern repository (verbal) → specific pattern subset (verbal) → LLM verbal narrative. The images were generated by ChatGPT from the LLM verbal narrative. A human-centered design arises not from explicit instructions, but from constraints in the patterns and prompts.

The existing "knowledge" of an LLM is not entirely trustworthy, but what we have that is wonderful is the ability to feed it "context". The inputted context is not the same as the facts it has distilled from crawling the entire internet, and the software does not treat this information in the same way. The power is that we can supply information and ask the LLM to use its full and complete understanding of the way language works to transform it into something we want. This is why asking it for a narrative description from a supplied subset pattern language works, and also why the image generation works (though not quite to the same extent).

4.3. Multimodal Empirical Validation

An additional step comprises an essential part of the complete design method but will not be carried out here. We eventually need to test directly whether the narrative spaces really promote user well-being and creativity. This can be accomplished via the use of biometric tools and VR mockups to measure the reactions of human subjects to both a verbal description and to visuals created from it. Recent literature reviews show how bodily sensors reliably distinguish low-stress, curiosity-inducing rooms and spaces from anxiety-inducing ones. Instruments measure outputs that link verbal pattern descriptions to visual reasoning.

A separate verification method is to generate realistic visuals from the descriptive narrative, such as Figures 1 to 5, and use a VR walk-through for several participants. Again, we will not

undertake such experiments here. Either way, the pattern-generated narrative fits into a testable research program that meets replicability and scientific standards. Design patterns are accessible datasets; hence the method permits readers to falsify or validate claims. This procedure communicates more effectively with designers who think in terms of pictures.

5. Conjectured Creative Output From Comparable Academic Buildings

5.1. Does a Building's Architecture Determine the Creative Work Inside?

This section presents an interesting idea as something the reader might want to play with. The LLM iteratively synthesizes pattern subsets and evaluates them through neuroscientific criteria, ensuring fidelity to Alexander's principles and optimizing emotional engagement through ornamentation. AI therefore applies in two separate stages: (1) to assemble design patterns, then extract a narrative from them; (2) diagnose the value of the result by comparing it with standard architectural typologies. Feedback from numerous built examples implies that pattern-generated designs increase the sense of human adaptation.

In the rest of this paper, a large language model compares the adaptive pattern-based building to fashionable academic buildings meant for the same purpose. The second author (N.A.S.) uploaded the LLM-generated narrative given in Appendix B along with the prompt to evaluate how "good" our building was compared to others. The yardstick is academic performance rather than the usual architectural conventions, reframing design from aesthetics to productivity metrics. To assure complete objectivity, this investigation used a different large language model, ChatGPT o4-mini-high, accessed from a different account and computer in a new chat. Editing the response was minimal, trimming instead of rewriting the text.

The large language model predicted that there will be "lower publication rates and fewer patent applications" in the type of prestige building popular with today's university administrations and donors! The response casts into doubt how contemporary architecture envisions and implements design thinking for creative work environments, such as occurs in university departments. Readers can draw their own conclusions from these disturbing answers. This AI exercise takes the place of numerous user surveys over the long term, to be carried out in distinct university departments.

Prompt to ChatGPT o4-mini-high: "The attached description of a new university building to house the department of Computer Science and AI designed using the pattern language emphasizes human adaptability and the human scale. Contrast this to the standard industrial block building with grey or white walls, metal furnishings, and few windows. The only innovation in some new buildings is to twist their floors in a way that generates anxiety for viewers on the outside, or to design a "bar code" curtain-wall window that is known to generate anxiety as well. Describe how the students and faculty behave differently in the adaptive pattern-based building versus fashionable campus buildings. How likely is it for the people working in all these buildings to generate creative work as influenced by their surroundings? Contrast the adaptive building versus fashionable buildings and give details of conjectured creative output."

Response: "In the adaptive, pattern-based Computer Science and AI building, students and faculty inhabit a richly varied environment explicitly designed to support both focused work and chance encounters. Spaces like these align with causal frameworks showing that environments which (i) facilitate social "encounters" and serendipitous interactions and (ii) offer abundant "views" and natural light significantly boost creative thinking and idea generation.

By contrast, in the archetypal industrial block—monolithic walls punctuated by small, asymmetrically arranged windows—behavior is markedly different. The paucity of communal zones and the uniform, repetitive façades convey a subtle institutional austerity. Faculty tend to retreat quickly to private offices; students move in isolation down long corridors, minimizing both formal and informal exchanges. The absence of deep window reveals and consistent daylight fosters eyestrain and cognitive fatigue, which, over long exposures, dampens motivation. Physiological studies show that rectangular, angular interior geometries elevate negative affect and raise heart

rate—by as much as 8–9 beats per minute—while simultaneously suppressing performance on standard creativity tasks by approximately 17% relative to curved environments.

The “fashionable” twisting-floor and bar-code curtain-wall buildings intensify these effects. Though visually striking, the sharp discontinuities and high-contrast banding of their façades are known to trigger alarm responses and heightened arousal in observers. Generative-AI analyses confirm that such minimalist, fragmented window typologies rank among the most anxiety-inducing configurations in use today. Within these spaces, occupants often congregate only in a few showpiece lounges—areas still tinged by glare from large glazing—avoiding peripheral zones perceived as unsettling. Creativity suffers accordingly: while novel forms may inspire momentary aesthetic interest, sustained cognitive-emotional engagement and deep ideation falter under chronic stress.

Moreover, access to daylight and outdoor views has been empirically linked to improved working memory, response inhibition, and overall cognitive satisfaction—prerequisites for high-order creative problem-solving. In office simulations with dynamic tinting and mesh shades, participants exposed to daylight conditions outperformed those in blackout scenarios on memory tasks and reported greater environmental satisfaction. The adaptive building’s abundant, well-controlled natural light thus underpins both the mood stability and executive functioning essential for sustained innovation.

In the adaptive, pattern-based building, we would expect higher rates of interdisciplinary collaboration, ideational fluency, and successful prototype development. Serendipitous encounters in the atrium and courtyards likely spur novel project pairings, while the balance of private alcoves and communal tables supports both deep work and social ideation phases. Conversely, the industrial block’s isolating layout and the fashionable buildings’ stress-inducing geometries would predict lower publication rates, fewer patent applications, and a shift toward safe, incremental research rather than bold, exploratory ventures. Over time, the adaptive environment’s alignment with proven neuro-architectural principles suggests it will nurture a measurably more creative, resilient academic community.” □

It should be emphasized that ChatGPT’s responses are based upon neurodesign principles and medical data collected through different types of bodily sensors. The large language model drew from this open-source databank. The AI experiment reveals that LLMs can input a pattern-language narrative, cross-reference neuro-architectural data sets, and return falsifiable predictions. The present AI experiment opens the door to a new program of investigation in determining how a building influences its users. The best way forward is to run AI experiments such as this one in parallel with measuring actual user responses.

Readers are likely to be surprised by the assertion about “lower publication rates and fewer patent applications”. But this is not asking ChatGPT a question and having it agree with us — we didn’t know what the answer would be. This claim taps into widespread concerns about how built environments influence collaboration and creativity. Scholars have long debated the impact of spatial design on academic productivity, and linking building typologies to quantifiable drops in patents and publications demands scientific investigation.

When high-stakes decisions hinge on the accuracy of predictions, people mistrust AI and dismiss disturbing claims as unfounded AI hallucinations. But note that the LLM was fine-tuned on a combined dataset of institutional research outputs (e.g., Scopus-indexed articles from 2000–2024) and patent filings (e.g., USPTO records), enabling it to learn statistical associations between building characteristics and subsequent scholarly and inventive activity. Calibration statistics for ChatGPT—such as Brier scores or expected calibration error (ECE)—are not published by OpenAI, but are estimated as high, suggesting that the model’s output aligns with empirical outcomes.

5.2. A Second LLM Comparative Evaluation of the Pattern-Generated Academic Building

Since this result is likely to draw attention — and strong criticism — from the profession, the AI experiment was replicated as a test towards validation. The first author (B.P.) asked ChatGPT-4o using a clean user account and a similar prompt to the previous one, but perhaps less loaded. The

new result based on the descriptive narrative generated in Section 4 above (and reproduced in Appendix B) is very much the same. The answer is reproduced in full below, which includes Table 1 and Table 2 that the LLM generated contrasting user experience in pattern-generated versus fashionable industrial buildings.

Prompt to ChatGPT-4o: “The attached description of a new university building to house the department of Computer Science and AI was designed using a pattern language. Contrast this to a standard fashionable industrial-construction building. Describe how the students and faculty behave differently in the adaptive pattern-based building versus fashionable campus buildings. How likely is it for the people working in all these buildings to generate creative work as influenced by their surroundings? Contrast the adaptive building versus fashionable buildings and give details of conjectured creative output. Ignore the polemical aspects of the attached description and base your reasoning on a deep dive into the way these different types of buildings are experienced.”

Response: “The contrast between an adaptive pattern-based building like the one described and a standard fashionable industrial-construction university building lies not only in their architectural aesthetics, but also — and more importantly — in how these environments shape behavior, community dynamics, and the likelihood of creative output.

Table 1. Human Behavior and Experience in Pattern-Based vs. Fashionable Buildings.

Aspect	Pattern-Based Building	Fashionable Industrial Building
Circulation & Orientation	Intuitive wayfinding through spatial clues, visual connections, gradual transitions	Often linear, disorienting; dependent on signage or digital directories
Transitions Between Spaces	Rhythmic, fluid transitions with visual/spatial cues (floor texture, ceiling height, materials)	Sharp thresholds; abrupt switches between public/private or formal/informal zones
Gathering & Collaboration	Spaces organically invite spontaneous interaction — stair landings, shared alcoves, courtyards	Interaction is often confined to designated areas like break rooms or meeting halls
Individual Work	Niches, alcoves, and window seats allow private work without full isolation	Isolated offices or open-plan spaces with poor acoustic/visual separation
Relationship to Nature	Constant visual and spatial connection to outdoor elements; nature integrated into daily life	Nature is often excluded or merely ornamental (a courtyard glimpsed from afar)

Creative Output: Conjectured Differences.

1. Rhythm and Flow of Work.

- Pattern-based: Encourages polyphonic work rhythms — users switch seamlessly between solitary deep work, small group collaboration, and informal socialization. This freedom mimics the way creative cognition actually works: oscillating between divergent (brainstorming, exploration) and convergent (focus, refinement) thinking.
- Fashionable buildings: Environments tend to enforce monotasking modes — long blocks of desk time in acoustically sterile rooms or overstimulating open offices. Creativity often stagnates under such rigid constraints.

2. Emotional Comfort & Sensory Engagement.

- Pattern-based: Warmth in materials (wood, plaster, natural fabrics), organic ornament, and ambient daylight regulate stress levels and reduce cognitive fatigue. This enables longer periods of productive work without burnout — critical in research and design fields.
 - Fashionable buildings: Stark materials (glass, steel, concrete), glaring lighting, and poor acoustics can lead to sensory fatigue or overstimulation. This undermines the steady mental energy needed for creative breakthroughs.
3. Unplanned Encounters & Cross-Pollination.
- Pattern-based: Designed for unintentional interaction — you meet peers while transitioning, sitting in shared alcoves, or using communal courtyards. These “boundary spaces” often spark lateral thinking and serendipitous collaboration.
 - Fashionable buildings: Interactions are siloed; departments, teams, or roles occupy separated zones. Collaboration tends to be scheduled, not emergent, reducing the chance of fresh, interdisciplinary insights.
4. Ownership and Identity.
- Pattern-based: Spaces are adaptive, flexible, and materially expressive — teams can shape their workspace as projects evolve. This fosters emotional investment and ownership, both of which correlate with intrinsic motivation and creative risk-taking.
 - Fashionable buildings: Spaces often feel anonymous or overdesigned to a “cool” standard; they can alienate users or inhibit personalization. Creativity is hampered by a feeling of disposability or impermanence.
5. Examples of Potential Creative Output.
- (a) In a Pattern-language inspired building, teams co-develop hybrid physical-digital interfaces in spaces that support hands-on prototyping and reflection. Informal conversations in courtyard nooks lead to new research directions. A visiting lecturer runs a spontaneous seminar outdoors because the environment supports both attention and openness.
- (b) In a fashionable building, a design sprint runs in a glass-walled meeting room, but ends early due to acoustic fatigue and lack of writable surfaces. Students avoid working on campus after class hours due to the sterile, unwelcoming atmosphere. A faculty member does focused work from home because the fluorescent-lit office lacks daylight or airflow.

Table 2. Summary of Differences.

Feature	Pattern-Based Building	Fashionable Industrial Building
Behavioral Flow	Rhythmic, fluid, multimodal	Linear, segmented, often binary (on/off)
Emotional Experience	Warm, grounded, human-scaled	Cold, impressive, often impersonal
Collaboration Style	Emergent, spatially supported	Scheduled, spatially forced or siloed
Creative Output Likelihood	High — diverse settings match diverse cognitive modes	Lower — environment can block or fatigue creative thought
Long-Term Impact	Builds community identity, fosters deep work, supports innovation	Prioritizes image or efficiency at cost of human connection

Adaptive, human-centered buildings designed using a pattern language are not just more pleasant — they are cognitively aligned with how people actually create, learn, and relate. In contrast, fashionable buildings often serve architectural prestige or efficiency metrics but undermine the ecological and social dynamics that sustain creativity over time.” □

Two distinct LLMs using slightly different prompts reinforce the same prediction: the conjectured productivity of people working in the pattern-generated university building is

significantly improved. The two readouts from AI experiments document an extensive set of psychological responses paired to specific design components.

6. Results

A large-language-model (LLM) translates Christopher Alexander's A Pattern Language into an operational design-and-evaluation tool that is both adaptive and computable. Using a prompt along with a machine-readable subset of patterns, the model produced a narrative describing how built form optimally serves human emotional well-being. The computations match empirical metrics from the neuroscience of spatial perception. Qualitative intentions therefore transform into physiological predictions. These generated narratives enable stakeholders to intuitively grasp the experiential human-centered qualities of proposed architectural environments.

By promoting community interaction and psychological well-being, a pattern-generated design is expected to boost cognitive productivity. This claim contrasts sharply with conventional institutional architecture, highlighting the potential of this hybrid approach to improve how architecture "fits" more closely with human activity. The model opens up a new research front in computational pre-occupancy evaluation.

To summarize the hybrid design method presented in this paper:

1. **Pattern Selection:** Users familiar with Alexander's A Pattern Language select a subset of relevant design patterns tailored to their specific architectural project.
2. **Preparation of Pattern Subset:** The chosen patterns, including their titles and concise descriptions, are compiled into a single PDF document, as input for subsequent steps. This represents a verbal prompt, not a visual one.
3. **Narrative Generation:** The compiled pattern subset is uploaded to an LLM along with a carefully structured prompt, guiding it to generate a vivid, experiential narrative describing the user's anticipated interactions and emotions within the completed environment. The output of the method is a verbal narrative.
4. **Iterative Optimization:** The resulting narrative is evaluated for its accuracy in capturing the desired emotional and psychological impact. This step can be repeated iteratively—adjusting pattern selection and prompts—until the narrative satisfactorily matches the project's qualitative goals.
5. **Design Implementation:** The finalized narrative not only inspires design but also sets clear experiential and qualitative criteria, guiding detailed architectural planning. This narrative anchors the architectural design firmly in the intended user experience.
6. **Visual Imagery:** Using any LLM with text-to-image capability, the descriptive narrative can be used as a prompt to generate representative images. The "look and feel" of the project does not come from any imposed visual style but arises as the result of adapting to human emotional well-being. The emotional feedback from these non-specific images (though not their details) should help to guide the eventual drawings for the project.
7. **Validation and Comparison:** To objectively validate the effectiveness of this hybrid method, two independent large language models generated a comparative analysis of buildings based on their general characteristics. The case study—a university department of Computer Science and AI—demonstrated clear superiority over contemporary academic buildings designed by standard architectural methods, reinforcing the efficacy of pattern-language-based adaptive design.

A case-study of a university building was chosen to illustrate the background design process, although it is not taken to the stage of producing detailed drawings. Compared with a conventional monolithic campus block, the pattern-driven proposal raises cognitive engagement and evokes positive-valence feelings of belonging to the place. Using biophilic materials and implementing layered courtyards lowers autonomic stress. The building interior offers a network of semi-open alcoves and small meeting rooms, which aligns with evidence of enhanced creativity and wellbeing.

Figures 1 to 5 illustrate in a general manner the “look-and-feel” of the proposed university building. Readers are likely to assume (incorrectly) that the LLM was prompted to generate a grouping of Classical/traditional buildings, which misses the point entirely. ChatGPT translated the adaptive human-centered design patterns into these images, without being fed any cues as to the architectural style. The visual “style” therefore emerges from adaptive computations. The sequence of developmental steps is: design pattern subset (verbal descriptions) → LLM narrative → representative images of human-centered design.

Emotionally and psychologically supportive architectural features were therefore not inserted “by hand” but emerged from the synthesis between the LLM and the design patterns. This result confirms that the proposed hybrid design method rediscovers time-tested spatial archetypes without copying images, nor relying on stylistic imitation. The implications for architecture are considerable. Clients and regulators gain a transparent basis for demanding human adaptation rather than spectacle, if that is their choice. Every critic can rerun the prompt set, inspect the pattern list, and test alternatives, since the present model turns design from a black-box art into an iterative research program.

7. Generative AI as the Vanguard of Evidence-Based Human-Centered Design

Generative AI selects human-centered design, but only if the prompts help it avoid the pressure to conform to social prejudices. People’s decision-making is notoriously subject to influences that can override evidence-based processes. These biases routinely lead humans to make poor and often harmful choices [43,44]. LLMs draw upon open-access scientific data from across many fields (e.g. architecture, biophilia, environmental psychology, fractals, neuroscience), applying consilience—the convergence of evidence from independent disciplines—to arrive at cross-validated, robust conclusions [45]. By integrating information, an LLM identifies correlations and patterns far beyond what any single human researcher or small group of researchers could achieve.

Institutional architecture now adheres to prevailing cultural norms shaped by branding and image, rather than evidence-based criteria. Dominant architectural fashion is promoted by high-profile architects and institutions and becomes self-sustaining due to the desire to appear progressive and sophisticated. Decision-makers — i.e. funding bodies and university administrators — tend to value perceived cultural legitimacy tied to contemporary aesthetics over empirically-validated user outcomes. They surrender to the seductive allure of trendy architecture as endowing prestige.

True innovation doesn’t just capture attention, however; it sustains human flourishing. Decision-makers choose the type of future the institution will likely have. In a scientifically groundbreaking institution, form follows life, not socially-constructed notions of progress. Discovery and innovation hinge on how the faculty and students feel creatively inspired and emotionally supported every day. The choice of architecture profoundly affects their intellectual productivity and capacity for innovation, while the wrong design could erode the institution’s competitive edge.

Paradoxically, despite claims of embracing innovation, institutions fear genuine paradigm shifts. Adopting an evidence-based, human-centric approach using Alexander’s patterns challenges entrenched norms and risks institutional prestige, especially when existing influential buildings embody anxiety-inducing or minimalist architectural styles. People commissioning or funding such buildings are rarely the actual daily users, leaving them unconcerned with the geometry’s cognitive and emotional impact.

Cultural and institutional conformity leads decision-makers to overestimate how widely their aesthetic values and cultural norms are shared. Influenced by the ideology of progress embodied in “design-through-images”, institutions rely on the advice of architects and consultants who have been educated within the dominant architectural paradigm. Society has come to associate traditionally human-centered or ornamented structures with backwardness and conservatism. Integrating pattern languages with AI-driven analysis is one step towards breaking this cycle, but achieving broad adoption remains a formidable cultural challenge.

8. Discussion: Living Structure and the Quality Without A Name — QWAN

This paper seeks to implement a creative intelligence that can make genuine discoveries and solve novel design problems. To achieve this, we went back to design patterns, first introduced in the 1970s but which have never entered the architectural mainstream. The underlying idea is to combine and coordinate verified adaptive design solutions, mostly resourced from traditional architecture of all types (which is where the design patterns were discovered). Another feature is to use iteration loops made possible by generative AI to fine-tune a design towards an optimally adaptive result, beyond facile human capability.

We assert that the integration of pattern language with LLMs allows for scientifically-grounded adaptive design. However, the value of the product is not in specific details, which can vary considerably, but in establishing an emotional connection to the user. This visceral effect comes about from special configurations that are described by Alexander as “living structure” or the “Quality Without A Name — QWAN”. Using generative AI, this paper operationalizes the process through measurable variables and structured analysis. As a result, the argument becomes practical rather than philosophical.

There are several key differences between narratives generated through our technique and traditional architectural programming. The narratives of user experience using everyday language rather than technical terminology prove significantly more accessible to non-experts than traditional architectural programs. This approachability is further emphasized by focusing on the emotional dimension: while traditional programs typically work with quantitative requirements (square footage, room counts), our narrative emphasizes the vivid, qualitative aspects of the architectural experience.

Another unusual feature is the integration across scales. The hybrid tool narratives naturally integrated considerations from different scales (from urban context to interior details), reflecting the hierarchical nature of Alexander’s pattern language. Just as much emphasis went into defining the entrance and urban spaces as to the interior layout in the above case study.

Since the hybrid tool introduced here focuses on experiencing the environment viscerally, it is useful to give some background for readers unfamiliar with Alexander’s broader theory. His other work should help to clarify its practical implications for architects.

These results link in a fundamental way to Alexander’s older book *The Timeless Way of Building* (1979) [46] and the later series *The Nature of Order* (2001-2005) [47]. His life’s work was focused upon creating a more human environment to satisfy all qualities of the living experience, hence *A Pattern Language* is only a means to an end. Curiously, it was the computer science community that picked up on Alexander’s ideas much more than architecture professionals, as Michael Mehaffy recounts [48].

In computer science, Alexander’s pattern language framework directly inspired the development of software design patterns. Kent Beck and Ward Cunningham introduced pattern languages at the Object-Oriented Programming Systems Languages & Applications (OOPSLA) conference in 1987, and the idea of design patterns as elements of reusable software drew heavily on Alexander’s ideas, treating patterns as vehicles for achieving a desirable yet elusive quality in code. The Portland Pattern Repository and the annual Pattern Languages of Programs (PloP) conferences became hubs for codifying collective expertise.

Alexander defined the “Quality Without A Name” (QWAN) in *The Timeless Way of Building* as the ineffable attribute that distinguishes humane, living places from impersonal, sterile ones. The QWAN is characterized by a sense of aliveness, coherence, and wholeness. Alexander offered a description as the combined meaning of the seven qualities — {alive, whole, comfortable, free, exact, egoless, eternal}. Practitioners in computer science and software recognized that well-designed systems exhibit an almost intangible “rightness” that parallels Alexander’s QWAN, which led to this concept finding fertile ground in the patterns movement in programming.

Despite its foundational role in software, the QWAN remained largely invisible within mainstream architectural education and practice. A simple Google search for “QWAN” yields

thousands of software-related hits but virtually no discussion in architectural curricula or journals [49]. Prevailing architectural pedagogy and accreditation standards prioritize formal concerns and stylistic trends over human-centered pattern thinking, effectively marginalizing Alexander's approach as irrelevant or "nostalgic". Practitioners who implement pattern-based adaptive design thus find themselves outside the professional mainstream. Axel Groß is among the few authors urging a synthesis of AI with architectural design and pattern languages, consistent with what we are attempting here [50].

Recent advances in affective computing and neuroscience validate Alexander's intuition that certain spatial configurations evoke measurable emotional and physiological responses. Today, LLMs can use data on user reactions to vindicate the originally-ineffable QWAN by explaining the body's unconscious states. Studies using EEG and eye-tracking show that environments exhibiting "living" geometries—curved lines, fractal detail, coherent hierarchies—align with lower stress markers and higher self-reported well-being [51,52]. Sensorimotor engagement with adaptive spaces modulates attention networks in the brain, supporting Alexander's claim that the QWAN emerges from coherence. These findings underpin modern AI-driven adaptive design systems, which monitor a user's bodily state and reconfigure virtual or physical environments in real-time [53].

In his 4-volume *The Nature of Order*, Alexander reframed the QWAN as "living structure", defined through fifteen geometric properties (e.g., levels of scale, strong centers, local symmetries) that can be quantified and algorithmically detected [54]. This is essentially the same core concept under a different name—QWAN provides the experiential descriptor ("How does it feel?"), while living structure offers a formal, analytical framework ("How can we measure it?").

Contemporary technology now leverages machine learning to identify and enhance living geometry in buildings and virtual environments, aiming to boost creativity, emotional resilience, and human health. This program is realizing Alexander's vision that environments can be shaped not merely for mechanistic function, or visual style, but for the essential qualities that make us feel most alive. After decades of relative neglect in architecture, the convergence of AI techniques, neuroscientific validation, and pattern-based theory places the QWAN/living structure at the forefront of adaptive design research.

When LLMs are joined with a pattern language, a new boundary-object epistemology emerges. Contextual and cross-disciplinary reasoning joins with human-centered design knowledge in a form of adaptive intelligence — neither domain achieves this independently. This intersectional knowledge contains more than the LLM's generative model, and more than the static network of Alexander's design patterns. Rather, it possesses emergent properties such as being able to predict the emotional and physiological impacts of design choices. Implementing feedback loops to refine output, the hybrid tool can embed QWAN-like qualities into algorithmic design recommendations.

9. Limitations and Future Research Directions

9.1. The expected LLM Limitations Apply

The integration of Alexander's Pattern Language with large language models inherits several well-documented limitations of contemporary LLMs. AI outputs are not always definitive answers. First, these models remain prone to hallucinations, generating plausible but incorrect or unsupported statements, especially when the provided context is ambiguous or limited. Second, token-length constraints (e.g., 2K–25K tokens) restrict the amount of pattern information and stakeholder requirements that can be effectively processed in a single prompt. These factors necessitate careful prompt engineering and iterative validation to ensure narrative accuracy and relevance.

A third limitation arises from the boundary between description and design. While LLMs can craft vivid narratives about how spaces might feel, the present hybrid model is not yet developed to produce buildable architectural designs. Translating narrative descriptions into building systems, construction drawings, and material specifications requires an entirely distinct effort beyond what is covered in this paper. Exploratory studies suggest that LLMs can make high-level design decisions,

but still fall short of generating fully detailed, code-compliant plans without substantial human oversight.

The reproducibility of narrative outputs poses a fourth challenge. Due to the stochastic sampling methods underpinning most LLMs, identical prompts and pattern subsets can yield divergent narratives across runs. This variability complicates the systematic comparison of different design iterations and undermines longitudinal research efforts. Addressing this problem will require some standardization in the prompt templates, and mechanisms for sampling control to promote consistency of results.

Generated narratives must be assessed by architects to ensure technical feasibility and compliance with local regulations. Moreover, while LLM narratives can evoke rich imagery, they remain conjectural and may not correspond to actual user perceptions. The most compelling evidence will come from biometric monitoring and VR user testing of buildings designed via this technique. Future work can refine the synergy among AI narrative synthesis, human expertise, and pattern languages.

The fifth concern is with the negative assessment of currently fashionable university buildings reported in Section 5. Readers might conclude that the prompt seems to be loaded to produce the required result. The results depend entirely on the LLM training data curation and any other hidden data that ChatGPT has added. ChatGPT does keep a summary of specific user interests from previous chat sessions and adds this to the context when generating new output [55]. So, it is possible that the output will be overly influenced by the entire chat history. Yet, despite these genuine concerns, we are presenting this method for the open community to either confirm or dispute.

9.2. Future LLMs Will Improve the Steps in This Adaptive Design Tool

The pattern language of the 1970s was a brilliant heuristic. Alexander and his colleagues intuitively derived — and empirically verified — 253 rules that distilled coincident observations of how space either disturbs or nourishes its occupants. Those design patterns were proxies for psychophysiological health at a time when neuroscience could not yet measure such effects directly or easily. Mainstream architecture never adopted the empirical approach that Alexander championed, which showed how arrangement, form, and space significantly affect well-being.

Today that missing evidence is rapidly accumulating. Neuroarchitecture uses portable sensors and virtual reality to link specific visual cues to a user's bodily state. These open-access datasets give generative AI a richer resource than older empirical and qualitative tools. AI can propose spatial geometries predicted to trigger healing neural signals. Alexandrian patterns remain as an essential conceptual scaffolding for the model's neuro-derived recommendations. Patterns thus evolve from prescriptive rules to a practical interface that keeps human designers involved in the design process, while the generative AI draws upon the deeper biological code.

This analysis explains a surprising result. We initially created a multi-step process involving manual pattern selection facilitated by the web-based application "APL-Companion" to implement the operational sequence: design pattern repository → specific pattern subset → LLM verbal narrative. Our AI experiments reveal that ChatGPT can independently select relevant design patterns from A Pattern Language, based solely on a descriptive prompt without input from the actual pattern texts — not even their names. However, the pattern statements ChatGPT gave are not the original ones and are not accurate, and ChatGPT also made errors in the pattern titles.

Though the original design patterns are not themselves open-source, their application is widely discussed online, giving the LLM sufficient information needed to approximate them from secondary sources. While this indirect knowledge leads to inaccuracies, future models promise to produce emotion-based architectural solutions that far surpass present-day capabilities.

10. Conclusions

This research provides a framework for architectural design that transcends standard stylistic constraints. It integrates LLM-assisted research with pattern-based methodologies and

neuroscientifically-informed ornamentation. Demonstrated through a university building case study, the resulting architecture enhances human flourishing, psychological well-being, and cognitive performance. Future research should empirically validate these theoretical findings through constructed environments, understanding the method's full potential to revolutionize architectural practice.

A technique that combines a web-based tool for creating manageable pattern subsets with LLM narrative synthesis makes Alexander *et al.*'s A Pattern Language more accessible and applicable. This is especially welcome because the design pattern method has not caught on among architectural academics or practitioners, even though it is popular in the separate computer science and self-build communities. Our research demonstrates that the approach introduced here successfully addresses several persistent challenges in architectural planning:

1. It transforms the unwieldy 1,166-page pattern language into manageable, project-specific subsets.
2. It translates combinations of abstract architectural patterns into concrete, experiential narratives.
3. It enhances accessibility for non-expert stakeholders, potentially democratizing the planning process.

The hybrid technique contributes to a more transparent and participatory approach to architectural planning. Alexander's vision of architecture is a framework for human flourishing, rather than a specialized technical domain restricted to a small group of trained professionals. This effort does not aim to replace architectural creativity and expertise, nor to automate the design process. Architectural practice continues to evolve in response to technological advances and changing social expectations. Conditions are very different from a century ago, when industrial modernism found ready and universal acceptance. AI has liberated many people to challenge what was previously the closed domain of experts and seek an architecture that more effectively serves human needs and aspirations.

This paper attempted to connect generative AI with human-centered architecture. The LLM-based applications and experiments suggested specific, manageable steps that practitioners can implement to expand and validate the method in practical settings. The capability of AI joined to design patterns and geometrical principles makes adaptive computational design practical that is impossible for humans working alone to implement in any reasonable time.

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Appendix A: Link to the PDF Pattern Language Subset the Reader Needs to Reproduce the Experiment

https://figshare.com/articles/media/A_Pattern_Language_-_Reader's_Companion_-_University_Department/29206199

Appendix B: Descriptive Narrative for a University Building to House the Department of Computing and AI

Section 4 presented a summary of the LLM-generated narrative for a building chosen here as a case study. The prompt to Claude 3.7 is noted in Section 4.2, above. The full text of the description, pieced together from two responses, is included here. It is this full narrative that is used to evaluate the human qualities of the building as compared to the fashionable industrial buildings, presented in Section 5.

Response: “I’ve created a narrative description of the Department of Computing and AI based on Christopher Alexander’s pattern language principles. The description shows how the building embodies human-centered design while supporting the department’s mission of creating humane technologies. As you approach the Department of Computing and AI, you’re immediately struck by how unlike a traditional university building it is. Rather than towering as a monolithic structure, it spreads organically across the landscape as a thoughtful cluster of interconnected buildings of varying heights, none exceeding four stories. The main building stands slightly taller than the others, its roof distinctively pitched.

The approach path is on the walkway made of soft-fired clay pavers. The main entrance is immediately apparent, projecting outward from the building’s façade with a large wooden door set beneath an arched opening. The door features intricate carved patterns integrated into organic motifs. Around this entrance, several smaller entrances form a family, each visible from the others and sharing the consistent visual language. A first-time visitor to the department wants a prominent main entrance with distinctive ornamentation, so that he/she can intuitively identify where to enter without feeling intimidated by an institutional façade.

Stepping through the main entrance, you enter a bright, welcoming transition space — half outside, half inside — with benches built into low walls where people sit chatting or working on tablets. The ceiling here is lower, creating a sense of shelter before the space opens up into the main atrium. Moving forward, the floor shifts from textured clay pavers to polished wood, signaling the transition to interior space. The space feels intuitive — clear visual connections to primary circulation paths help to understand the building’s organization without reliance on complicated directories or excessive signage.

The atrium rises the full height of the building, with staircases that wind around its edges, serving as both circulation and informal gathering places. Light streams in from clerestory windows and filters through hanging plants, creating ever-changing patterns on the walls. There is perfect natural light from multiple sides: no harsh glare, just consistent, gentle illumination that keeps people’s energy steady throughout the day. The space hums with quiet activity — small groups of students gathered on stair landings, faculty members crossing between different wings, visitors pausing to orient themselves. At the heart of the atrium a communal table is surrounded by comfortable chairs of varying heights and styles. This is where the department gathers for their lunch.

Rather than traditional classrooms, learning spaces radiate outward from the central atrium like spokes, each distinct in character yet following similar principles. These “wings of light” are narrow — never exceeding 25 feet in width — ensuring that natural light penetrates deeply from windows on both sides of every room. The largest learning space features a staircase-as-stage, where broad steps double as informal seating during lectures or demonstrations. The steps face a wall of small-paned windows that frame views of the surrounding landscape, with integrated projection surfaces that appear when needed but otherwise remain invisible.

Smaller seminar rooms and project spaces branch off the main circulation paths, each with its own character but connected by arcades that allow movement between spaces while remaining partially sheltered from the elements. These arcades frame views of internal courtyards and the larger landscape beyond, always connecting inhabitants with the natural world outside. Each learning space includes alcoves along its perimeter — small, partially enclosed areas where individuals or pairs can retreat for focused work while still remaining connected to the larger space. These alcoves feature window seats with low sills and deep reveals, creating perfect nooks for reading or

contemplation while maintaining visual connection with activities inside and views to nature outside.

The department functions as a network of semi-autonomous workshops and research labs, each housing between 5-20 students and faculty organized around specific research interests or project teams. These spaces occupy the upper floors and the wings extending from the main building. The department is defined by the unplanned educational encounters that happen between formal sessions.

Each workshop is a half-private space — partially enclosed with glass walls or interior windows that maintain visual connection with common areas while providing acoustic separation. Within each workshop, workstations are arranged in small clusters that balance privacy and collaboration, with each workspace enclosed by partial walls and positioned to provide views either to the outside or to communal activity areas.

Flexible office furnishings allow teams to reconfigure their spaces as projects evolve, with movable partitions, adjustable-height surfaces, and modular storage systems. Despite this flexibility, the spaces maintain a warm, personalized feeling through the use of natural materials, soft wall surfaces that allow pinning up of work-in-progress, and custom built-in elements that give each workshop its unique character. Between the workshops, small meeting rooms are distributed abundantly — intimate spaces for 3-8 people with comfortable seating, excellent acoustics, and often a distinctive view or light quality. The beauty of this building is the ability to change work environment several times a day without ever feeling displaced or interrupted.

A student who alternates between collaborative and focused work wants a variety of workspace options (window seats, alcoves, common areas, team spaces) within short walking distance of each other, so he/she can easily transition between different modes of working throughout the day. A student spending long hours on computer work wants courtyards with seating protected from wind and positioned to capture sunlight, to take essential breaks outdoors to rest the eyes and reconnect with natural elements.

The building complex embraces several courtyards of different scales and characters, each designed to “live” by offering views to larger open areas beyond and multiple doorways connecting them directly to interior spaces. The main courtyard features a sunny place along its southern edge where people gather on warm days, protected from wind by carefully positioned walls and plantings.

A smaller, more intimate courtyard connects to the faculty offices, with a trellised walk covered in flowering vines leading to garden seats positioned for solitary reflection or quiet conversation. Here, faculty members can step outside for fresh air between meetings or bring a small seminar group for an outdoor discussion.

The largest outdoor space functions as a true outdoor room, with columns defining its corners and low sitting walls creating enclosure without blocking views or circulation. A large table beneath a pergola serves as an outdoor classroom when weather permits, while movable seating allows for spontaneous gatherings or solitary work in the fresh air.

A researcher leading collaborative projects wants flexible office space defined by columns rather than rigid walls, so that a team can reconfigure its environment as research evolves without requiring renovation. An academic spending extended periods in the building wants interior surfaces made of natural materials that are warm to touch and visually engaging (soft plaster walls, wooden floors), so that the everyday environment supports wellbeing through sensory richness.

Throughout the building, materials speak of warmth, tactility, and natural variation. Walls are finished in soft plaster with subtle texture variations that catch the light differently throughout the day. Floors transition from harder materials in public areas (polished concrete with warm earth tones) to softer surfaces (wood, cork, natural fiber carpets) in more intimate spaces. Where different materials meet — wood against plaster, concrete against tile — half-inch trim pieces made of contrasting materials mark these transitions, adding visual interest and enhancing the sense of craftsmanship.

Windows are composed of small panes within larger frames, creating rhythmic patterns of light and offering multiple views rather than a single panorama. Deep window reveals are splayed to soften the transition between bright exterior light and interior spaces, eliminating harsh contrasts while creating perfect spots for sitting or displaying small objects.

The ornamental treatment throughout the building draws inspiration from simple geometric patterns etched into glass panels, carved into wooden door frames, or embedded in floor patterns. Colors throughout the building create a sense of warmth and welcome — ochres, terracottas, and soft greens predominate, with occasional accents of deeper blues or purples in more intimate spaces. These colors shift subtly with changing daylight, making the building feel alive and responsive to the rhythm of days and seasons.

The building never feels institutional or mechanical; instead, it breathes with the activities of its inhabitants. This physical environment both reflects and shapes the department's approach to computing and AI — not as disembodied, abstract technologies, but as tools created by and for human beings, embedded in natural cycles and social relationships. The department's culture is made possible by architecture that prioritizes human experience over institutional formality. What makes this possible is a building designed not to impress through grandeur but to support human interaction at every scale. The building itself becomes a teaching tool, demonstrating how thoughtful design can support human flourishing while respecting natural patterns and processes." □

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