ARTIFICIAL INTELLIGENCE, COLLABORATION AND BIM IN THE METHODOLOGICAL PROCESS OF ARCHITECTURAL DESIGN: USING THE ARCHITECHTURES TOOL

INTELIGENCIA ARTIFICIAL, COLABORACIÓN Y BIM EN EL PROCESO METODOLÓGICO DE DISEÑO ARQUITECTÓNICO: USO DE LA HERRAMIENTA ARCHITECHTURES

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The field of artificial intelligence (AI) has been considered as a means capable of promoting significant changes in the dynamics of the architectural design process. This paper presents methodological questions and reflections, as well as cultural and financial challenges related to the feasibility of adopting the Architechtures generative AI tool, which is aimed at collaboratively proposing volumetric architectural parties and floor plans for preliminary studies. The focus is limited to the Brazilian design field, which has traditionally been peripheral and/or outdated compared to foreign technological advancements and applications. Integration with the BIM environment is sought to address local challenges and explore design possibilities. The assessments include the development of high-rise residential building projects, positioning AI as an active partner or co-pilot in the design process, as well as the Avaliação Pré-Projeto methodology for the qualitative dimension. The results highlight both positive aspects and shortcomings, but they suggest a promising future given the possibilities in the field of AI.

architectural design, artificial intelligence, BIM, Brazil, collaboration, methodology

El campo de la inteligencia artificial (IA) ha sido pensado como un medio capaz de promover cambios significativos en la dinámica del proceso de diseño arquitectónico. Este artículo presenta interrogantes y reflexiones metodológicas, así como desafíos culturales y financieros, relativos a la viabilidad de adoptar la herramienta de IA generativa Architechtures, que tiene como objetivo proponer de manera colaborativa partidos arquitectónicos volumétricos y planos de planta para estudios preliminares. El foco se limita al campo del proyecto brasileño, que tradicionalmente ha sido periférico y/o anticuado en comparación con los progresos y aplicaciones tecnológicas extranjeras. Se busca la integración con BIM para abordar los desafíos locales y explorar posibilidades de diseño. Las evaluaciones incluyen el desarrollo de proyectos de edificación residencial de gran altura, en los que se posiciona a la IA como socio activo o copiloto en el proceso de diseño, así como la metodología Avaliação Pré-Projeto para la dimensión cualitativa. Los resultados resaltan tanto aspectos positivos como deficiencias, pero sugieren un futuro prometedor dadas las posibilidades en el campo de la IA.

diseño arquitectónico, inteligencia artificial, BIM, Brasil, colaboración, metodología

INTRODUCTION

The field of artificial intelligence (AI), while still having considerable room for development and application given its known and imagined potential as a new digital revolution not yet fully understood, has increasingly been recognized—especially by the general public since 2022—as a means of driving significant changes in the dynamics of the architectural design process, both operationally and methodologically. Although the expectations for AI's impact are not the same for everyone (despite the global technology), its potential for generative, analytical and multiple information management opportunities emerge alongside challenges, uncertainties and peculiar notions of authorial responsibility and those linked to sustainability (Bernstein, 2022; Chaillou, 2022; Leach, 2022).

The current moment is crucial for the discipline, as it represents a theoretical and conceptual paradigm (Kuhn, 2010). Despite its potential—much like other technologies introduced into the field of architecture—in practical terms, AI faces challenges such as cultural and financial barriers to acceptance and implementation, with nuances depending on local contexts (Carpo, 2017; Leach, 2022).

The sources reviewed highlight the need to discuss the implications of AI for the profession and how it can support the architectural agenda, especially in light of the increasing autonomy of programming.

From a critical perspective, it is essential to question this paradigm as a way of understanding the contemporary, even when partially addressing aspects of temporality such as rhythm, fluidity, multiplicity, uncertainty and complexity (Morin, 1999, 2005). This questioning also extends to the worldview (Abbagnano, 2007) of humanism, referred to by the German term *Weltanschauung*, as understood by the German philosopher Wilhelm Dilthey (1833-1911). This involves examining aspects—including scale—linked to the themes discussed earlier in this paragraph, or even the lack of historical perspective or distance (panoramic view) due to the current situation. However, it is argued that these questions can contribute to the development of the proposed thought within the present moment.

The questions should be linked to a specific location, as this defines the contextual conditions, legitimacy and standpoint. Furthermore, to understand how to effectively integrate AI (with real possibilities for implementation) in this context, it is important to focus on the Brazilian architectural design field, which—on a broad scale—traditionally tends to be peripheral and/or outdated compared to foreign technological advancements and applications (Câmara Brasileira da Indústria da Construção [CBIC], 2023; Gomes, 2023; Meirelles et al., 2023) in areas such as economy, finance, culture, among others.

An alignment with the discussions highlighted by the aforementioned authors is sought, along with contributions to this demand for reflections, which are important for some of the contemporary themes in architecture and urbanism, even when considered from a local perspective.

Focusing on the seemingly positive aspects of this technological design paradigm and recognizing the initial demand or deliberate desire to transform the inventive dynamics within the Brazilian professional context, the feasibility of a collaborative design process assisted by generative AI is questioned, particularly regarding some proposals for volumetric architectural parties (Lemos, 2003), during the preliminary study phase.

Integration with the building information modeling (BIM) environment (Estévez, 2005) is also pursued, given that it is a platform familiar to architects—even if not deeply understood or fully mastered by them (Agência Brasileira de Desenvolvimento Industrial [ABDI] et al., 2022; CBIC, 2023)—. This pursuit is driven by the conditions of use (Brazil, 2020, 2024), the opportunities in the initial design phases demonstrated by the MacLeamy curve (Araújo, 2020), which can be optimized by AI, and the potential for continuities into the execution phase through file interchangeability.

The question of feasibility initially involves operability, the formation of volumetric geometries and plans, collaboration and financial considerations. A problematic issue arises because, despite the fact that many popular AI tools today—such as text-based ones—assist architects in various decision-making processes (Rane et al., 2023) and others focus on rendering images with strong graphic appeal (Radhakrishnan, 2023), which can contribute to the inventive act, these tools do not create three-dimensional geometries.

There are some processes for transforming two-dimensional images into volumes, such as photogrammetry, point cloud (Leach, 2022) or the recent Gaussian splatting technique (Tang et al., 2023). However, based on tests conducted, these methods often fail to provide high-quality geometric and/or topological formation, especially for buildings of any scale. Additionally, there is no connection to a central data model, nor do they facilitate intricate generations with the representational systems of plans and sections (spatial arrangements of environments and horizontal and vertical circulations) conditioned by a program of needs. There is no opportunity for real-time online collaborative work to study architectural parties, nor is there consideration of the implementation and urban morphological relationship (Quaroni, 1987), along with careful processes to select the most suitable proposals. There are no means to elaborate preliminary studies.

After extensive research—conducted online via search engines and tested locally as part of a doctoral thesis—24 AI tools were identified that are available to the general public and capable of providing some active partnership with architects in the three-dimensional design process. Among these, one offers viable resources to start the planned study: Architechtures, developed by Smartscapes Studio.

The hypothesis is that this tool can at least partially meet the design scope outlined here, as a potential option among others, despite being restricted to the residential typology and having other current limitations.

The objective of this paper is to reflect on the feasibility of the AI tool Architechtures (in its pro version, which has more features than the student and view-only versions) from a methodological perspective. This includes examining meta-processes in generative active society with the machine, collaborative and operational aspects, acceptance and incorporation (cultural and financial challenges or barriers), as well as the quantitative and qualitative artifacts aimed at developing preliminary studies for the implementation and formation of volumetric architectural parties with typological plans. This focus is limited to the residential typology due to the tool's limitations, with an emphasis on high-rise buildings as a more complex design type than houses, thus providing more input for the objectives.

In the context of national design, another objective is to contribute to understanding the opportunities that generative AI offers in the early stages of design—including plausible solutions—and how it can transform inventive dynamics and integrate with a BIM platform (e.g., Autodesk Revit). This AI is examined as an active partner or co-pilot for Brazilian professionals. Would such a tool, in its current state, be a viable agent for the architectural agenda even in a peripheral and technologically mismatched condition?

The theoretical and conceptual approach is developed through a literature review (Lakatos & Marconi, 2019). The evaluation of the tool and the generated architecture, aligned with the previously mentioned objectives as part of the protocols, is conducted by selecting three distinct sites and designing buildings with three different types of plans.

Besides generating forms, the software primarily provides quantitative aspects related to the design. Both these quantitative and qualitative aspects will be evaluated using the Avaliação Pré-Projeto methodology (Oliveira et al., 2023; Ono et al., 2018). As the nomenclature of this methodology depends on actually being in a design (project) phase, there are guidelines—anchored in the architectural agenda and Brazilian regulations—to assist in the reflection on the generated architecture and in decision-making.

Since those evaluations depend on representation or modeling, such as digital twins, rather than real artifacts, certain inaccuracies and/or limitations arise. However, these do not diminish the relevance of the studies and tests conducted during the design process, as explained by the authors. Methodological biases were also identified, especially in the qualitative aspects related to the subtle and sensitive dimensions of the spatial experience, human relations (sociocultural factors), integration with the landscape, notion of belonging, among others. (Heidegger, 2015; Pallasmaa, 2012, 2013; Pallasmaa & Zambelli, 2024). Nevertheless, the Avaliação Pré-Projeto methodology offers a plausible direction for achieving the objectives, mainly because it supports the construction of a meta-process suited to contextual characteristics.

The main role of architects involves sensitive and intuitive skills, in addition to technical expertise, to negotiate objective and abstract dimensions in relation to the needs and desires of clients or users. It is assumed that machines are not capable of solving ill-defined and/or wicked architectural problems (Kaplan, 2016; Mitchell, 2008). Thus, AI does not replace humans but can work together with them (Zhang et al., 2021).

The mentioned skills and competencies are integral to the methodology used to develop the intended reflections and questions. As for the operational analysis, a speculative perspective is built concurrently, considering known generative and analytical computational methods and techniques, which are considered adaptable or incorporable into AI.

DEVELOPMENT

To establish a theoretical and conceptual background for the research presented in this paper—and to contribute to a broader discussion within the field of architecture and urbanism—the understandings and distinctions of certain terms are discussed. This conceptual precision is required, given that the current literature employs polysemic, imprecise or author-dependent terminology, which reflects another contemporary condition.

According to Speaks (2013), the inventive act is methodologically conceived as a meta-process. Unrestricted by prescriptive styles and theories, this approach allows for freedom in both the production of the artifact and the configuration of the dynamics of the design process.

Operating within non-linear, heuristic movements, it engages with small or plausible truths of each context (site and design). These conditions are associated with fuzzy logic (Dubbeldam, 2006), characterized by imprecise or ambiguous paths, similar to some intelligence processes, where intermediate possibilities exist between true and false, or between 0 and 1, rather than a strict binary or Boolean logic.

From a methodological perspective, AI could be positioned as an agent in this dynamic: not merely as a linear generative entity producing outputs but as an interactive collaborator with the architect, as an active partner (Chaillou, 2022; Leach, 2022) or even as a co-pilot (Blaas et al., 2023). Leach (2022) claims that an interesting strategy involves promoting synergy between human and artificial intelligence, where the latter acts as an extension of the former, effectively serving as an augmented intelligence. It is suggested in this research that BIM technology could function as an integrative platform, connecting data and geometric solutions while providing a collaborative environment.

This paper does not aim to precisely define AI. It starts from the incomprehension of what intelligence itself is, since many processes remain obscure. Nor does it seek to differentiate complex algorithmic programming from AI, relying instead on the manufacturer's claims. However, it works with a broad understanding of AI's main characteristics: analyzing data sets, whether from closed or open (dynamic) systems, learning from them and taking self-regulated actions toward specific objectives (Campo, 2022; Kaplan, 2016; Leach, 2022; Teixeira, 2023).

The term *digital twin* encompasses two meanings according to the reviewed literature. Leach (2022) refers to a model that interacts, in real time, with sensors arranged in a physical environment. These monitor the movement of people and/or the flow of cars, for example. In this study, it refers to the BIM digital twin (Grieves & Vickers, 2016), a central data model with physical attributes that is entirely digital: there is no real-time physical interaction, although it is possible to send information for digital fabrication.

Bernstein (2022) highlights the growing need to deal with big data, from conception to execution and management of the building lifecycle and urban planning relationships. Therefore, the interest in a human-machine collaboration is evident, from the early inventive stages, due to the central data models linked to physical attributes. However, beyond BIM, this research also focuses on organizing multidisciplinary teams during the design process. In both situations, online digital platforms offer significant collaborative potential, especially when AI integrates data models and enhances cloud processing power (Leach, 2022). Under these conditions, Architechtures offers a partially implemented solution with prospects for future development.

Regarding the operational dimension of Architechtures, the software requires information about the country and city—an important step for conducting a solar study—. Users can upload a three-dimensional base in a DWG file containing the topography, road systems and surrounding urban buildings. Although some morphological elements are missing, the basics needed to start the design are provided.

The sets of variables presented to the user encompass a fixed residential needs program limited to the main rooms/activities. However, it allows for the manual insertion of total or partial areas with minimum room dimensions and offers some compliance with relevant legislation. It also includes five types of plans (studio units, one- to four- bedroom units), with a percentage allocated for each on the general floor plan;

the total desired number of units; the presence of natural lighting and ventilation in the bathrooms and kitchen; the dimensioning of the stairwell elements, levels and the number of vertical circulation cores and elevators; the thicknesses of walls and slabs; the dimensions of the horizontal section of pillars; the sizes of shafts; the alignment of axes for volume placement and access corridors to the units; and the spatial configurations for window frames and sills.

The prediction of areas, percentages and total units must be carefully calculated by the user; otherwise, the floor plans will not be adequately generated in terms of internal layouts. Once the urban context file is inserted and the lot boundaries are drawn, the building width is defined. The implementation is manual: the length is set by clicking on the screen. Finally, the software presents a footprint (projection area) oriented by the previously selected axis alignment. Up to this point, Architechtures is a passive tool. The user simply inputs preset variables and draws manually.

As a first practical test of the tool, focusing on the area around Av. Rio Branco in downtown São Paulo, Brazil—a densely built region where the lot currently serves as a parking space—a footprint of 20 x 50 m (1000 m² of slab) was established. The typological distribution was set as follows: 25 % one-bedroom units, 50 % two-bedroom units and 25 % three-bedroom units. Each unit was preliminary sized at 38 m², 52 m² and 62 m², respectively, resulting in a total of 322 units across 16 floors. A vertical circulation core with two elevators was also requested.

Upon defining the building's footprint, Architechtures becomes an active partner for the architect, generating a single proposal that includes the typical floor plan and architectural volume.

Critically analyzing the initial variables and the development of the first test before finalizing the architectural proposal, one might consider that the software could act as a co-pilot, offering suggestions. In this sense, some flexibility in the program requirements would be advantageous, according to functional, sociocultural and/or methodological demands, such as space syntax (Hillier, 2007), or even universal designs (accessibility).

From a similar critical perspective, generative text AI could indicate key points in accordance with relevant legislation. While not necessarily intended for generative design, this AI could play an operational role by preparing files for the central data model or conducting analytical studies on wind patterns, solar exposure or energy efficiency. Additionally, it could generate the volumetric urban environment, such as tools like Forma (formerly Spacemaker, now part of Autodesk), which has access to online databases like Cadmapper.

In terms of the architectural proposal, the software handles the pre-dimensioning of wall and slab thicknesses, pillar cross-sections, shafts, levels, frames and the sills. The suggestion of two circulation cores seems to be adequate, considering the floor area and number of units. However, it would be pertinent to incorporate population calculations and evacuation simulations for both emergency and normal situations—a digital procedures that have been in development since the 1960s (Helbing et al., 2002)—.

Other proposed architectural elements and procedures are not satisfactory: the solar shadow study lacks accuracy, even when latitude and longitude parameters of the site are provided. The urban morphology was disregarded by the generative aspect of the machine. Despite the manual implementation of the building design, the software could request some morphological information and propose the implementation of access points, living areas, axes, sightlines (again, space syntax), transpositions, etc. Therefore, the software remains somewhat generic, despite its potential for localized or specific solutions. Typologically, the three-bedroom plan was not generated; instead, studio-type plans (which were not even requested) were included. Kitchens requiring window frames were arranged as protrusions on the facades, lacking spatial, structural or functional coherence. Service areas were oversized and located internally in the plans. Figure 1 shows the horizontal section of the typical floor plan, with the kitchens and service areas highlighted.

Figure 1

Typical floor plan (test 1)

Note. Kitchens are highlighted in orange and service areas in blue.

In a second test, parameter adjustments were made to eliminate the service area in the one-bedroom units and allow kitchen locations inside all types of plans. Figures 2 and 3 show the ground floor and the new typical floor plan. Each floor plan will be detailed later.

Figure 2

Ground floor plan (test 2)

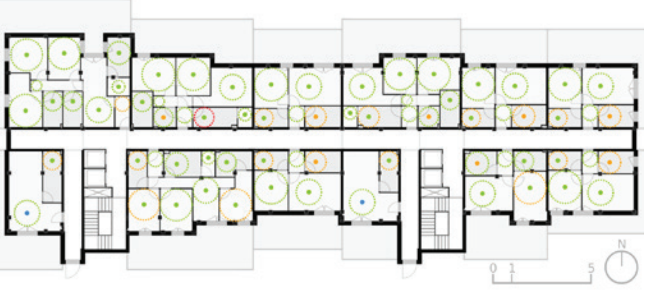
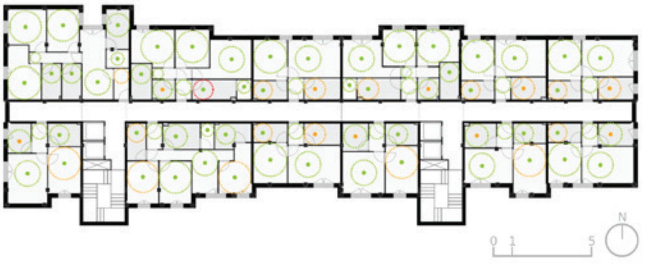


Figure 3

Typical floor plan (test 2)



The final configuration of the units, as suggested by the software, is as follows: 2 studio units (1 %), 134 one-bedroom units (66 %), 34 two-bedroom units (17 %) and 34 three-bedroom units (17 %). The studio measures 34,80 m², while the areas for the other plans vary between the ground and typical floors: one-bedroom units range from 31 to 49 m², two-bedroom units from 45 to 72 m² and three-bedroom units from 61 to 116 m². This totals 204 units and a built area of 12 073 m². This totals 204 units and a built area of 12 073 m². Figures 4 and 5 show enlarged views of the floor plans for each type.

Figure 4

Studio floor plan (left); one-bedroom floor plan (right) (test 2)

Figure 5

Two-bedroom unit floor plan (left); three-bedroom unit floor plan (right) (test 2)

Figure 6

Perspective of the design (highlighted in green) inserted into the urban context (test 2)

Although some formative progress in the architectural approach is evident from test 1 to test 2, several issues persist: the distribution and typological placement on the floors as well as the total and partial areas remain problematic. For example, the studio unit, which was not initially indicated, was included on the ground floor, with part of its area automatically allocated to an external garden.

Some environments fail to meet the minimum dimension requirements. The hall cannot be deleted, and the spatial arrangement of environments becomes geometrically and functionally plausible only if the kitchens are positioned internally, which raises concerns regarding health, safety and legality. Additionally, there is no structural alignment between the pillars, and the technical shaft, positioned next to the oversized stairwell, is challenging to access.

The proposed methodology suggested developing tests in three different urban locations (Figure 6). However, since Architechtures disregards the morphological context, the following tests only evaluate unit distributions in different spatial arrangements, forming other architectural parties. Figures 7 and 8 show the typical floor plans and volumes for tests 3 and 4.

Figure 7

Typical floor plan and general volume (test 3)

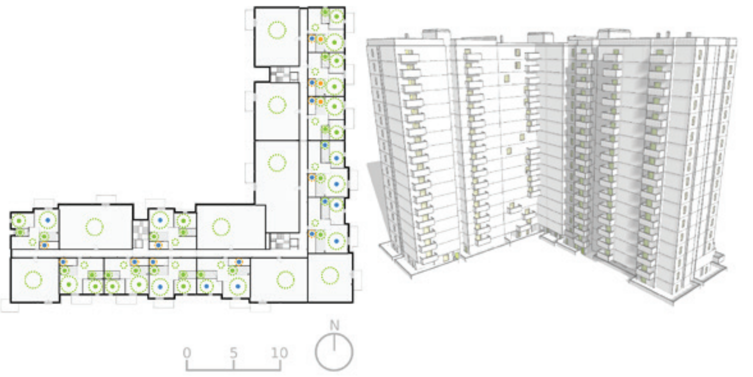
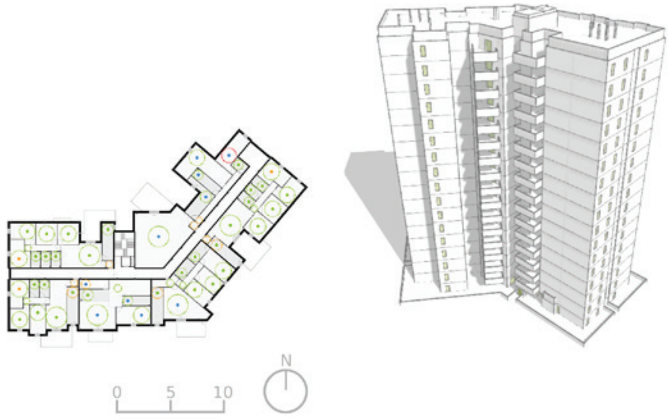


Figure 8

Typical floor plan and general volume (test 4)



The software struggles with generating plans featuring "L" and non-orthogonal shapes. In these cases, some units lack compartments: they are just large, multifunctional environments. The last two tests revealed the same positive and negative aspects described above.

Furthermore, the software does not address other project components, such as the roof and permeable green areas, despite the presence of a pre-sizing parameter for these areas. It also does not meet the forecasts for electrical, sanitary and fire protection installations, including additional shafts. Users are responsible for addressing these requirements through alternative means.

As for the analyses based on the Avaliação Pré-Projeto methodology, although there is no BIM digital twin—only a geometric/organizational starting point lacking technical elements, catalog and/or supplier attributes, performance properties, costs, installations, assemblies and teams across the project disciplines and other complementary areas—the interoperability between Architechtures and Revit is satisfactory given the operational dimension and the objective of achieving certain volumetric architectural parties.

The geometries and their respective groupings into families with basic attributes—such as shapes, names, functions, materials and colors of structures, walls, doors, windows, roofs and vertical circulation cores (digital semantic identity)—are automatically generated by the AI tool and recognized in Revit. This process relieves the user from carrying out these final steps within the Revit BIM platform. Another advantage lies in the software's integration and interoperability, as well as collaborative work, by generating neutral and open files (Open BIM) like industry foundation classes (IFC), a system created and standardized by buildingSMART International for storing digital information, which is recognized by other BIM software, including Revit.

In this case study, by working together with BIM technology, it is possible to extract from the central data model the same number of areas for the type and total floors that the AI presented in its interface. The advancement in the design process within Revit lies in the additional possibilities for volumetric structural and sealing calculations, which offer a more detailed understanding compared to what Architechtures provides (based on the relationship between total area and cost per m^2).

Considering other aspects of employing a digital twin within the BIM platform with interoperability using online AI for assisting in decision-making, the following are evaluated: collaboration, analysis and data management.

While it is possible to share files (send, download and upload again), real-time online collaboration in the cloud and accurate solar studies (an analytical procedure) are still under development: currently, these features are only promised on the manufacturer's homepage. The software's analysis is limited to typological distribution graphs across the enterprise. Data management was not performed; only a few central data (parameters) were accessed to calculate areas and volumes (information) and to generate some drawings.

In this way, extremely important dimensions of BIM technology, which are essential to justify its use, remain unexplored—particularly the technical attributes of catalogs and/or suppliers—. However, the interchangeability of models and files, from a methodological integration standpoint, proves to be highly beneficial for certain design concepts, even in primary stages. Additionally, the convenience of transferring geometries between the two environments (Architechtures and Revit) further enhances this process.

Continuing through the Avaliação Pré-Projeto methodology, in terms of the qualitative dimension, the disregard for urban morphology is reaffirmed as a serious flaw. As for horizontal and vertical dimensions (ceiling height), most environments feature a relatively good layout, circulation and equipment—although the software fails to incorporate them into the plans—except for the spatial arrangement of some service areas and the provisions for persons with disabilities (Associação Brasileira de Normas Técnicas, 2021).

The security aspect primarily concerns the units (except for those designed for persons with disabilities), the vertical circulation cores, as previously mentioned, and the access corridors to the units. However, structural and fire protection safety still requires attention and refinements in algorithmic programming, particularly for pre-dimensioning and simulations of structural resistance, using the finite element method (Kolarevic & Malkawi, 2005) as well as building evacuation scenarios.

Habitability aspects—such as tightness; thermal, acoustic and lighting performance (including openings for facades or long-term environments); air quality and roof modeling—were not addressed. Additionally, sustainability considerations—such as material consumption, maintenance, environmental impact and certification verifications such as LEED, AQUA and DGNB—were overlooked. Integrating existing modules from other applications (not specifically AI-driven) into the platform could make these steps possible.

Finally, within the Avaliação Pré-Projeto methodology, the plastic/aesthetic dimension is severely limited. The software only performs a vertical extrusion of the floor plan, making it impossible to insert or transform elements that align with physical and abstract characteristics (e.g., sociocultural aspects) of the context.

FINAL CONSIDERATIONS

In the context of a methodological approach to architectural invention, Architechtures only allows working with the composition of the first half of the 20th century, based on structuring elements and a lexicon that is theoretically, conceptually and tectonically codified. However, it has not allowed working with the project since the second half of the 20th century, which would open up the possibility of inventing elements and forms, including topologically continuous designs and the creation of a distinct lexicon (Boutinet, 2002; Estévez, 2005; Lapuerta Montoya, 1997; Martínez, 2000). This observation does not reveal a problem in itself, nor does it determine the quality of an architectural invention. It merely highlights another limitation of AI in this context.

The results do not constitute a definitive response or resolution; rather, they suggest that AI serves as a viable means to alter or transform the dynamics of the design process, whether operationally or methodologically, within the national context. Although still in its early stages, the machine functions as an active (generative) partner for the architect in formal and quantitative terms, thereby offering input for qualitative reflections.

The AI has successfully generated plans and architectural parts relevant to preliminary residential studies for high-rise buildings. However, it has functioned less as a co-pilot or an extension of the human mind—providing complementary actions such as punctuated speculative insights and others capable of configuring that synergy and as a plausible or admissible agent to assist in the construction of the meta-process—marking it as one of many tools employed (Martínez, 2000). This approach also offers a way to avoid starting a project from a blank screen.

This latter aspect, which supports the hypothesis proposed, may present an advantage for the discipline, more in terms of convenience than the exceptional nature of the proposals, which can be easily created by architects, even manually.

Reflecting on Brazil's peripheral condition or technological mismatch relative to other external contexts, another advantage arises: Chaillou (2022) suggests that AI represents the fourth stage in the methodological development of architectural theory. The preceding stages, in descending order, follow parametric modeling through visual programming, computer-aided design (CAD) and modular grid systematization from the early 20th century. Given that Chaillou does not make a methodological distinction between composition and project (as previously discussed), and considering that the national context has yet to mature in parametric modeling—in reality, it faces resistance to BIM integration (ABDI et al., 2022; CBIC, 2023; Gomes, 2023; Meirelles et al., 2023)—is there an advantage to skipping the third stage in favor of advancing directly to AI?

At the same time, questions and challenges related to cultural acceptance and implementation—arising through learning a new methodology or approaching a design different from current practices—intensify, alongside financial considerations. Architechtures, being a paid online service with a ten-day free trial, faces a barrier in operational costs relative to its limited benefits. However, with the proposed developments and those anticipated by the manufacturer, including alignment with architectural agendas such as energy efficiency and certifications, concomitantly with in-depth integration with BIM technology, the tool can be more easily accepted.

Another significant limitation of this AI tool, both from the methodological perspective of complex inventive acts and as a generative opportunity, is the absence of iterations for geometric (formal and spatial organizational) proposals (attempted solutions). Although a large number of answers are questioned—often based on unclear criteria—which makes it extremely challenging to choose the most appropriate ones, it is understood that iterations or a statistical approach could positively enhance creativity and problem-solving. This could be another advantage in engaging actively with the machine.

It seems that the typological proposals generated by the AI are created by the generative adversarial network (GAN) method. This approach relies on a database containing different types of floor plants as a foundation for generating new designs.

Another part of the neural network, known as the discriminator, carries out the analysis. Through the interaction between these two parts, one challenging the other, the machine is able to learn and propose more appropriate solutions (Chaillou, 2020).

If the aforementioned impression is correct, an examination of the results suggests that the database used by Architechtures is extremely limited or that the discriminator provides only superficial analyses. In addition, machine learning capabilities in conjunction with user interaction were not evident, as the tool seemed to only address the initial parameters. It is recommended that further research employs more powerful GAN tools to evaluate the quality and variety of architectural plan proposals.

It is also suggested that further research consider questioning and testing the feasibility of using other three-dimensional generative AI tools, especially those that promote iterations (learning with the user) and offer greater flexibility. Given the rapid evolution of technology, where the dynamism of new applications opens up possibilities and makes others obsolete in a short time, maintaining a focus on advancements in the field of information technology applied to architecture is essential.

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