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The Use of 4IR by Architects in Prevention of Pre-Construction Project Delays in South Africa

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Abstract

The purpose of this article is to examine how 4IR affects architects' abilities in South African pre-construction project development planning. The study will examine the competencies needed by architects in the early phases of project development, with an emphasis on their capacity to conceptualize, design, and schedule projects in a way that satisfies client needs, complies with legal requirements, and advances sustainability objectives. In addition to a thorough literature review to determine the body of knowledge already in existence on this subject, the research will include an overview of the potential application of 4IR technologies to improve the competencies of architects. Data will then be gathered from architects employed by various South African architectural firms through a quantitative survey. The results will show where architects now stand in terms of pre-construction project development planning competences, point out areas where they lack expertise, and make recommendations for professional development and architectural education initiatives in Uganda and South Africa. The goal of this research is to improve architectural practice and the general sustainability and efficiency of the building sector in South Africa.

Keywords: *pre-construction, delays, architects, competencies, and 4IR.*

1 The Overview and Context

Architects are just one of many experts that must be involved in the complex process of developing construction projects. Early on in a project's development, especially during pre-construction project planning, architects are extremely important [1]. The purpose of this proposal is to examine South Africa's architect workforce's proficiency in pre-construction project development planning [2]. The research aims to fill in any knowledge, skill, or ability gaps and advance architectural practices in South Africa by analysing the knowledge, skills, and abilities needed for architects in this setting [3].

The process of developing a project is normally divided into six stages in both South Africa [3]. Project start-up, pre-design, design, procurement, construction, and project close-out are some of these phases [4]. Every phase is distinguished by distinct tasks and benchmarks that enhance the project's overall achievement [5]. But several difficulties appear during the pre-construction phase, frequently leading to major delays [6]. The three pre-construction stages—project initiation, pre-design, and design—tend to move slowly in South Africa, despite the importance of each step being equally important [7]. Any delays at these points could have a ripple impact on the project's overall schedule, raise expenses, and aggravate all parties concerned [8]. To overcome these obstacles and raise the effectiveness of the project development process, it is necessary to comprehend the capabilities of architects in pre-construction project planning [9].

Considering this, the purpose of this study was to examine the abilities of architects in South Africa regarding pre-construction project development planning, as well as the potential benefits of utilizing 4IR technologies to improve these abilities [10]. The research attempts to offer insights and suggestions for improving architectural education and professional development programs by identifying potential gaps and limits [11]. In the end, this study's conclusions may help to advance architectural techniques as well as the general effectiveness and sustainability of South Africa's building sector.

2 Review of Literature

There are three (3) branches in each of South Africa's national, provincial, and local administrations (Du Plessis, 2020). The province government oversees carrying out service delivery projects, such as building infrastructure for elementary schools and primary healthcare facilities. The development of South Africa's infrastructure is hampered by these diverse aspects of government [1]. The supply of such infrastructure takes on average, 2 to 5 years to complete the pre-contract working stages, even if it would only take a year or less [2].

Enhancing preconstruction planning is the goal of South Africa's National Building Regulations. guarantees the efficient application of planning regulations, as competent execution is necessary to guarantee the efficacy of applications and procedures [3]. The main rule for building design planning, the South African National Building Regulations, has been revised to include professionalism in its practices and applications [4]. Despite the improvements to the National Building Regulations (NBR), it was also observed that the incompetence of building design professionals contributed to the delays in South Africa's building construction permit approval processes [5,6,7,8,9].

Feasibility studies and conceptual design take up less than 15% of the time of a working architect on average [10]. The remainder of their working hours are devoted to overseeing construction sites, addressing planning requests, settling contracts, drafting technical specifications, and exchanging emails [11]. Therefore, it makes sense to develop and use AI to handle the tedious, repetitive, time-consuming, and mandated jobs. For instance, AI may be used to review designs for compliance with building standards, streamlining, and expediting the approval process [12]. Technology's past demonstrates that fresh innovations have always had greater promise than real-world applications [13]. Over time, the technologies that were once costly and had significant limits, such as credit cards, mobile phones, the internet, and electric cars, have become increasingly helpful and usable in supporting our daily lives [14]. As a result, the potential, and opportunities for 4IR to improve architects' competencies are virtually limitless.

Considering the, it is recommended that this study investigate an architect's talents in South Africa's pre-construction project planning. The study will look on the roles and practices, knowledge needed, and architect education and training necessary to manage pre-construction project development planning in South Africa. Remedial measures for the planning delays in South African building projects will be provided using the secondary data from the analysis. It is expected that the solutions discovered will speed up the development and execution of building projects in South Africa and increase efficiency.

3 Methods/Approach

3.1 Research design

A systematic explanation of plans for the gathering and analysis of data that allowed the researcher to obtain answers to the questions addressed [21]. This study was positioned within the functionalist paradigm [22]. This study employed a mixed method research design [23]. As a result, the research design contains presumptions and reflections that guided a particular conceptual framework of procedures towards the use of measures to collect empirical data to achieve the desired study objective [24]. A mixed methods research design was used for this study because it enabled the researcher to gather data and use the analysis to meet the study's goals [25].

3.2 Population and Sample framework

The study examined civil engineering and building projects in both the public and private sectors, as well as various facility kinds (such as commercial or educational ones). To limit and maintain uniformity and to make sure that the findings represented the overall trend in South Africa, the study concentrated on construction projects carried out within the country of South Africa. The construction employees in South Africa's construction industry made up the research population. Practicing architects, contractors and property developers, consulting engineers and quantity surveyors, scholars, representatives of municipal and provincial/federal governments, experts in the built environment employed by the government, and 50 to 100 operatives/construction industry workers made up the targeted demographic.

The study looked at building and civil engineering projects in the public and private sectors, along with different types of facilities (such commercial or educational ones). To ensure consistency and limit the findings to the broader trend in South

Africa, the study focused only on construction projects that were completed domestically. The research population consisted of construction workers in South Africa's construction sector. The targeted demographic included 50 to 100 operatives/construction industry workers, practicing architects, contractors and property developers, consulting engineers and quantity surveyors, scholars, representatives of municipal and provincial/federal governments, and experts in the built environment employed by the government.

4 Results

In South Africa, construction projects are normally produced in six stages: concept and feasibility, design development, construction, tender documentation and procurement, and project launch and briefing. handling of building permits and project completion. The remaining consultants for the various tasks are hired, channels of communication are set up, a plan for the development of documentation is made, design documents are integrated to meet accepted standards of quality, all building and planning laws and regulations are facilitated in compliance with statutory requirements, and health and safety requirements are facilitated and integrated. The activities are mostly connected to the planning stage of preconstruction project development by the South African Council for Project Management (SACPCMP) and South African Council for Architects (SACAP), as indicated by table 1 below and the focus of this research.

Table 1: Preconstruction project development's planning phase (SACPCMP/SACAP, 2006)

Work stages	**Description**	**Activities**
1	Project Initiation and briefing	The activities will include: a clear project brief development is facilitated, procurement policy is established, different consultants for different tasks are appointed, site information together with statutory requirement for design is established, an initial viability assessment of the project is made, project initiation program is made, and the client is facilitated to agree and approve all the activities of initiation and briefing.
2	Project Concept and Feasibility	The activities will include more different consultants for different tasks are appointed, health and safety consultant is appointed including identification of other statutory planning requirements, all the consultants are given the project brief, the concept design and viability assessment is made, cost management plan is made, project initial cost estimate is made, initial design and construction programme is made, and integration of the concept and viability solutions for the clients' acceptance and approval of all the activities in this work stage is facilitated.
3	Project design development	The activities will include: all the remaining different consultants for different tasks are appointed, communication channels are established, documentation development programme is made, design documents are integrated to match quality and accepted programme, facilitation of all planning laws and building regulations in line with statutory compliances is achieved, facilitation and the integration of health and safety requirements in the design, and the improvement of cost estimates and confirmation of project budget for clients' acceptance and approval of all the activities of this work

		stage is achieved.

Research on design delays throughout the concept and feasibility, design development, and project start, and briefing phases of construction project development appears to be lacking. During the three pre-construction work stages—initiation and briefing, concept and feasibility, and design development—land should be used for development in an efficient and environmentally responsible manner. It will be essential to successfully abide by the environment, the land use plan, and all legal requirements throughout the three work stages. In South Africa, preconstruction planning permissions go quite slowly.

The regulations controlling land development seem to have a major role in the problem of building project development planning delays in South Africa. These are organized by different organizations, relate to a range of businesses, and occur across multiple governmental domains. Two significant fields are planning and the environment. Laws in these two sectors regulate land development processes in two ways: first, by employing distinct land use plans, and second, by securing permissions or authorizations from decision-making bodies tasked with accepting, evaluating, and deciding on the merits of land development applications. Planning and the environment have rarely been successfully integrated; instead, they have always operated in parallel. This seems to show a lack of cooperation and vision across the many planning laws and construction rules in South Africa.

Artificial Intelligence encompasses various fields, including computer vision and image processing, natural language processing, machine learning, deep learning, neural networks, and knowledge base export systems. AI can advance into more precise and practical technologies that improve the skills of architects, just like a student learns over time thanks to this machine learning characteristic. The types of work tasks used in project concept and feasibility, project design development, and project initiation and briefing are as follows:

1. Extraction of relevant, pertinent, and project-related information from papers, such as legal requirements, compliance standards, and specifications. To analyze these documents and extract important data points and clauses in a matter of seconds, it is possible to set up ICT digital search platforms with built-in AI, machine learning, and image recognition software. This would limit the amount of time that would be required to review such documents literally or manually. The data collecting, analysis, and evaluation tasks required for the creation of feasibility studies, reports, and program designs could also be completed by this AI.
2. Facilitating communication and engaging clients in meetings. Here is where virtual reality assistants can be used to help with work-related chores including correspondence, communication, and scheduling meetings with reminders, all of which can improve client engagement efficiency.
3. Design and drawing production in architecture. Emerging AI systems can take written descriptions in plain language and turn them into realistic visuals and artwork. For graphic designers or clients without an architectural experience, such AI systems could be helpful in conveying their ideas to the architect, who would then take them further. However, there isn't now an AI system with architectural intelligence that can perform detail design or space design. Though it is questionable if AI will ever be able to completely replace architects, there is a genuine chance to develop AI systems that can produce working or detail drawings from schematic design drawings in a third of the time it would have taken draft technicians to do the task.

5 Conclusion

Feasibility studies and conceptual design take up less than 15% of the time of an average practicing architect. The remainder of their working hours are devoted to overseeing construction sites, addressing planning requests, settling contracts, drafting technical specifications, and exchanging emails. Therefore, it makes sense to develop and use AI to handle the tedious, repetitive, time-consuming, and mandated jobs. For instance, AI might be used to review designs for compliance with building standards, streamlining and expediting the approval process.

Technology's past demonstrates that fresh innovations have always had greater promise than real-world applications. Over time, the technologies that were once costly and had significant limits, such as credit cards, mobile phones, the internet, and electric cars, have become increasingly valuable and applicable in supporting our daily lives. As a result, the potential and opportunities for 4IR to improve architects' competencies are virtually limitless.

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