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Transformative Potential of Biomimicry for Sustainable Construction: An Exploratory Factor Analysis of Benefits

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INTRODUCTION & AIM

- ❑ The construction industry (CI) globally is known to be a major contributor to environmental issues.
- ❑ Tackling these environmental issues necessitated the clamour for the adoption of sustainability principles in the sector.
- ❑ Few of the sustainable construction practices adopted and implemented include Biomimicry, Lean Construction, Value Engineering/Management, Nature-Based Solutions, Biophilic Design and Ecological Economics, among others.
- ❑ Biomimicry entails providing solutions to various human challenges by emulating the forms, functions, processes, strategies and operations of nature within their ecosystem.
- ❑ Within the built environment, the practice of biomimicry, despite its novelty, has gained traction over the years with numerous examples and solutions.
- ❑ Hence, this study explores the benefits of biomimicry towards the sustainable transformation of the CI using exploratory factor analysis (EFA).

METHOD

❑ APPROACH & DESIGN

- ✓ Quantitative, descriptive survey-based study.
- ✓ Structured questionnaire as primary tool

❑ RESEARCH AREA

- ✓ Gauteng & Western Cape provinces (construction hubs & biomimicry organisations)

❑ RESPONDENTS

- ✓ Certified biomimicry professionals
- ✓ Construction practitioners (architects, engineers, project managers, quantity surveyors)

❑ SAMPLING & DATA

- ✓ Random probability sampling
- ✓ 120 questionnaires distributed, 104 valid responses (87%)

❑ DATA ANALYSIS

- ✓ Mean Item Score (MIS)
- ✓ Exploratory Factor Analysis (EFA)
- ✓ Reliability & validity tests
- ✓ Non-parametric tests for robustness

❑ ETHICAL COMPLIANCE

- ✓ Voluntary participation
- ✓ Anonymity & confidentiality maintained
- ✓ Approved by the University of Johannesburg Ethics Committee.

RESULTS & DISCUSSION

❑ DESCRIPTIVE ANALYSIS RESULTS (top-ranked benefits were):

1. Create markets for green products and services (MIS = 4.56)
2. Protect biodiversity (MIS = 4.48)
3. Conserve natural resources (MIS = 4.43)
4. Restore natural resources (MIS = 4.41)
5. Reduce global warming (MIS = 4.40)
6. Improve air quality (MIS = 4.38)
7. Reduce waste streams (MIS = 4.38)
8. Expand green product markets (MIS = 4.28)
9. Optimise life-cycle economic performance (MIS = 4.22)
10. Improve water quality (MIS = 4.19)

❑ FACTOR ANALYSIS RESULT (four clusters):

i. Cluster One: Improved quality of human life
ii. Cluster Two: Environmental protection & friendliness
iii. Cluster Three: Improved human productivity
iv. Cluster Four: Markets for green products & services

❑ DISCUSSIONS:

- ✓ Biomimicry reduces ecological degradation by conserving resources, restoring ecosystems, cutting emissions, and improving air/water quality. These align with global sustainability goals and South Africa's urgent need for greener infrastructure.
- ✓ It opens new markets, reduces operational and maintenance costs, and improves life-cycle performance, creating competitive advantage in construction.
- ✓ By improving productivity, reducing absenteeism, and enhancing health and well-being, biomimicry contributes to a higher quality of life.

CONCLUSION

- ❑ Biomimicry offers clear environmental, economic, and social benefits for the construction industry.
- ❑ It promotes biodiversity protection, resource conservation, and waste reduction; drives green markets, innovation, and job creation; and enhances human productivity, health, and quality of life.
- ❑ Overall, biomimicry provides a holistic pathway to sustainable construction, aligning the industry with global sustainability goals while strengthening competitiveness and resilience

FUTURE WORK / REFERENCES

- ❑ Integrate biomimicry into construction curricula and professional development programmes.
- ❑ Increase client, stakeholder, and industry awareness of biomimicry's sustainability benefits.
- ❑ Support R&D to improve the availability and affordability of biomimetic materials and technologies.
- ❑ Encourage multi-disciplinary partnerships.