Innovation of Adobe Material in Construction Companies

Henríquez Jaramillo Alfonso Darío¹, Martelo Raúl Jose² and Acevedo Diofanor³

¹ IPAITUG Research Group
University of La Guajira, Colombia

² Faculty of Engineering, INGESINFO Research Group, GIMATICA Research Group, University of Cartagena, Colombia

³ Faculty of Economy, NUSCA Research Group
University of Cartagena, Colombia

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Abstract

The objective of this research was to analyze the technological innovation of the adobe material in Construction Companies of the Department of La Guajira - Colombia, the type of research was Descriptive with field design, not experimental - transversal. A Likert scale questionnaire was used as data collection instruments. The results show that technological innovation models are almost never used for the adobe material to obtain a concrete molecule. It is concluded that the current situation in Colombia with the construction of adobe houses is affecting the community because if it rains constantly the families can be affected by landslides, falling of complete houses, floods among others. Finally, it is recommended, among other aspects, to carry out an inspection of the technology used by the construction companies, to build the adobe so that it obtains molecular dosage of concrete.

Keywords: Housing, Concrete, Adobe, Construction, Molecular Dosage

Introduction

Innovation is a synonym of change, evolution, doing new things or offering new
processes, products or services. Its incorporation into construction companies offers competitive advantages in an increasingly demanding and globalized market that requires infrastructures able to satisfy increasingly all interested parties, including the environment and future generations. However, despite the efforts, innovation in the construction industry has been relatively slow [1]. This is because its application is not a simple task, despite the importance of this sector in the development of any country. However, new cutting-edge technologies are required, due to the limitations of existing technology [2].

In this sense, the construction companies aim to projects for which they must adapt their processes and resources on each occasion. One of these processes is the selection of construction materials, which is one of several factors that can affect the durability of a project [3]. For example, the durability of buildings made of earth is often a concern for construction authorities and potential homeowners [4]. However, a large number of mud buildings still exist in many parts of the world and constitute an important part of the international cultural heritage. Even historic adobe and vernacular buildings are found in regions of moderate and high seismic risk, such as the eastern Mediterranean, southern Europe, northern Africa, the Middle East, South Asia and Central and South America [5].

Adobe brick is a material composed of uncooked earth and, often, natural fibers have been used for the construction of masonry since the Neolithic era [6]. Today, the use of adobe bricks for the construction of contemporary structures is limited, but they offer a particular architecture with very attractive geometric features while incorporating natural materials as well. However, the behavior of these structures is deficient under horizontal loads, such as those induced by an earthquake, which endangers their structural integrity and human lives [7]. For this reason, a solution must be sought through technological innovation to offer a balance between durability and sustainability.

Although several investigations have focused on innovation assessment models in general, little research is regarding the evaluation of technological innovation in the construction sector [8]. However, some studies are rescued, for example, in [9] technological innovation is explored and a model is applied to an innovative ICT solution, to identify the tools that professionals need to make decisions on the adoption of new technology. Likewise, in [10] it is analyzed how the addition of natural fiber and recoverable textile components can lend to the construction of compressed earth blocks, structural resistance and more predictable material qualities in relation to human comfort and durability of construction.

For the above it is important to analyze the technological innovation of the adobe material to obtain the molecular dosage of concrete, because around 30% of the world population live in adobe buildings, around 50% of the population in developing countries, including most rural areas, and at least 20% of urban and marginal areas, lives in buildings built with adobe [11].
Methodology

The present investigation is located within the descriptive studies, since it analyzes information related to the aspects of the variable under study, information related to the actual state of the persons, objects, situations or phenomena is collected, as they are presented at the moment of their collection [12]. In terms of design, this study responds to the criteria of non-experimental, cross-descriptive design. Cross-sectional investigations, perform a perpendicular cut of a situation at a given moment [13], therefore, the information collection instrument was administered in a single opportunity.

As for the population, it was made up of architects, engineers and construction masters from the construction companies of Riohacha and Uribia located in Colombia, whose labor characteristics are based on similar profiles, with the objective of analyzing the technological innovation of the adobe material so that it obtains the molecular dosage of concrete. Due to the size of the population, the sample was considered as a population census. In Table 1, the reporting units are observed.

<table>
<thead>
<tr>
<th>Reporting Units</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Builders</td>
<td></td>
</tr>
<tr>
<td>Investments AWA real estate</td>
<td>6</td>
</tr>
<tr>
<td>Avila Limited</td>
<td>11</td>
</tr>
<tr>
<td>Uribia Via Vive Foundation</td>
<td>4</td>
</tr>
<tr>
<td>Sauwoma Foundation</td>
<td>5</td>
</tr>
<tr>
<td>Grand Total</td>
<td>26</td>
</tr>
</tbody>
</table>

With the purpose of gathering the indispensable information about the variable under study, observation by means of a survey was used as a technique in this investigation.

Research instruments

As an instrument, a questionnaire of thirty-nine (39) structured items with closed questions referring to the Technological Innovation variable was elaborated, with reagents that correspond to the indicators that measure the variable object of study, the Likert scale with five (5) Multiple response alternatives: always (5), almost always (4), sometimes (3) almost never (2) and never (1). The validation was made taking into consideration the opinion of five (5) experts in the methodological area and management of Research and Development projects, which reviewed the items, confirming their relevance to the dimensions and the study variable, through a format. To establish the reliability of the instrument, the
Cronbach’s Alpha coefficient was applied to the results obtained from a pilot test (Formula 1). The participants in this pilot test were not part of the final sample.

\[ \alpha = \left[ \frac{n}{n-1} \right] \left[ 1 - \frac{\sum_{i=1}^{n} s_i^2}{s_T^2} \right] \] (1)

Wherein:
- \( n \): Number of items that the instrument has
- \( \alpha \): Reliability coefficient
- \( s_i^2 \): Variance of the scores of each item
- \( s_T^2 \): Variance of totals

When applying this formula, replacing the values obtained a result, in 0.89, whose value is interpreted as very high reliability.

**Data analysis**

To process the information obtained by the instrument, the data were first ordered and tabulated, placing them in a double entry matrix. Also, for the description of the variable, descriptive statistics by quantitative type, tables of frequency distribution were used, calculating the arithmetic mean and standard deviation, by indicator, dimension and variable, with the use of a statistical package SPSS, where they classified according to the corresponding category. Precisely, as indicated [14], the scale allows identifying the attributes of this measure of central tendency, in that the arithmetic average by distribution, is a measure only applicable to measurements by intervals or a ratio; for which the range, interval and category will be addressed in the design, based on alternative answers that are four (04), as shown in Table 2.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Interval</th>
<th>Categories</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>3.01 &lt;=4.00</td>
<td>High</td>
<td>Total agree</td>
</tr>
<tr>
<td>II</td>
<td>2.01 &lt;=3.00</td>
<td>Medium</td>
<td>Medium agreement</td>
</tr>
<tr>
<td>I</td>
<td>1.00 &lt;=2.00</td>
<td>Low</td>
<td>Intense disagreement</td>
</tr>
</tbody>
</table>

**Results**

In Table 3, the results are presented according to the variable, dimension and indicators, with their corresponding analysis, they are summarized in absolute frequencies, percentages and arithmetic averages.
Table 3. Results of the variable: technological innovation

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Indicators</th>
<th>Always</th>
<th>Almost</th>
<th>Sometimes</th>
<th>Almost</th>
<th>Never</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>af %</td>
<td>af %</td>
<td>af %</td>
<td>af %</td>
<td>af %</td>
<td>af %</td>
</tr>
<tr>
<td>Current Strategic Situation</td>
<td>Internal Analysis</td>
<td>5 19</td>
<td>10 38</td>
<td>8 31</td>
<td>3 12</td>
<td>0 0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>External Analysis</td>
<td>7 27</td>
<td>11 42</td>
<td>5 19</td>
<td>2 7.7</td>
<td>1 3.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>6 23</td>
<td>11 40</td>
<td>6.5 25</td>
<td>2.5 9.6</td>
<td>0.5 1.9</td>
<td></td>
</tr>
<tr>
<td>Models of the Innovation process</td>
<td>Lineal</td>
<td>3 12</td>
<td>6 23</td>
<td>5 19</td>
<td>8 31</td>
<td>4 15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marquis’s</td>
<td>2 7.7</td>
<td>4 15</td>
<td>5 19</td>
<td>9 35</td>
<td>5 19</td>
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</tr>
<tr>
<td></td>
<td>Kline’s</td>
<td>3 12</td>
<td>4 15</td>
<td>4 15</td>
<td>10 38</td>
<td>5 19</td>
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<tr>
<td></td>
<td>Average</td>
<td>2.7 10.6</td>
<td>4.7 18</td>
<td>4.7 18</td>
<td>9 34.7</td>
<td>4.7 18</td>
<td></td>
</tr>
<tr>
<td>Types of Technological Innovation</td>
<td>Incremental</td>
<td>4 15</td>
<td>5 19</td>
<td>4 15</td>
<td>12 46</td>
<td>1 3.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Modular</td>
<td>5 19</td>
<td>5 19</td>
<td>5 19</td>
<td>10 38</td>
<td>1 3.8</td>
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</tr>
<tr>
<td></td>
<td>Architectonic</td>
<td>7 27</td>
<td>5 19</td>
<td>3 12</td>
<td>9 35</td>
<td>2 7.7</td>
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<td></td>
<td>Radical</td>
<td>4 15</td>
<td>4 15</td>
<td>6 23</td>
<td>11 42</td>
<td>1 3.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>5 19</td>
<td>4.8 18</td>
<td>4.5 17</td>
<td>10.5 40.3</td>
<td>1.3 4.8</td>
<td></td>
</tr>
<tr>
<td>Structures</td>
<td>Molecular</td>
<td>4 15</td>
<td>5 19</td>
<td>5 19</td>
<td>11 42</td>
<td>1 3.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Competitive</td>
<td>5 19</td>
<td>4 15</td>
<td>4 15</td>
<td>12 46</td>
<td>1 3.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Environment</td>
<td>3 12</td>
<td>4 15</td>
<td>4 15</td>
<td>13 50</td>
<td>2 7.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Normative</td>
<td>5 19</td>
<td>4 15</td>
<td>4 15</td>
<td>12 46</td>
<td>1 3.8</td>
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<td></td>
<td>Average</td>
<td>4.3 16.3</td>
<td>4.3 16</td>
<td>4.3 16</td>
<td>12 46</td>
<td>1.3 4.8</td>
<td></td>
</tr>
</tbody>
</table>

**Dimension: Current Strategic Situation**

The results coincide with [15], who says that technology is the set of empirical knowledge, skills, experiences, organization that are needed to produce, distribute, market and use goods and services. It also includes theoretical-practical knowledge, physical means, know-how, methods and procedures for production, management, organization and identification, assimilation of successes and failures, capacity and skills of human resources.

**Dimension: Models of the Innovation process**

In general, it can be indicated that the results agree with the results obtained in [16], where it is shown that the inverse relationship between efficiency and creativity is more pronounced if R & D represent innovations that change paradigms instead of incremental innovations.

**Dimension: Types of Technological Innovation**

For the results presented in Table 3, it was determined that this dimension presents with weakness for the technological innovation variable, because in the innovation process, ideas are transformed into new products or services, new process
technologies, new structures of organization, or new approaches to management and therefore greater competitiveness [17]. Similarly, the interaction between sustainability and adopting different types of innovation is important or necessary to support various sustainable aspects of operations of an organization [18].

Dimension: Structures
It was established, by the results, that this dimension is handled with weakness in the technological innovation variable. These results do not coincide with the postulates made by [19], which indicate that innovation management is the ability to operate on key dimensions of different systems and processes, not only in new products and processes, but also new ways of organizing.

Summary
It is inferred that there are weaknesses regarding the technological innovation of the adobe material so that it obtains a concrete molecule. However, certain characteristics of the sector can explain this behavior; because companies invest less in R & D than in other sectors, so traditional indicators of innovation evaluation do not reflect the true magnitude of their innovative activity [10].

Guidelines
The following strategic guidelines are oriented to analyze the technological innovation of the adobe material so that it obtains the molecular dosage of concrete. These arise in response to the main problems identified in the analysis of the results of this research work.

1) Develop and apply managerial and engineering skills in the design, creation, management, development, strengthening and innovation of adobe material technology so that it obtains concrete molecular dosage, with a systematic and sustainable orientation, for effective decision making.

2) Design and innovate administrative structures and processes, based on the needs of organizations to compete efficiently in global markets for the molecular dosage of concrete for adobe.

3) Apply quantitative and qualitative methods for the analysis and interpretation of data and modeling of systems in technological innovation processes in the adobe material so that it obtains molecular dosage of concrete for continuous improvement, meeting global quality standards.

4) Design, evaluate and undertake new business and business projects that promote sustainable development and social responsibility in a competitive market.

5) Analyze and interpret financial information to detect opportunities for improvement and investment in a global world, which affect the profitability of the business for technological innovation, in addition to interpreting and applying legal rules that affect the creation and development of technological innovation in the adobe material so that it obtains molecular dosage of concrete.
6) Interpret and apply legal rules that affect the creation and development of technological innovation in the adobe material to obtain the molecular dosage of concrete.

7) Promote scientific and technological independence in order to achieve higher levels of scientific and technical sovereignty necessary to build an endogenous model of technological innovation.

8) Develop a science and technology for social inclusion where the actors of society are subject of action in the formulation of public policies in science and technology and participants in the new scientific thinking that gestates the technological innovation in the adobe material so that it obtains molecular dosage from concrete.

9) Generate greater national capacities in science, technology and innovation, referred to the formation of talent, the creation and strengthening of scientific infrastructure and the set of technological platforms required in the country for technological innovation in adobe material to obtain molecular dosage of concrete.

Conclusions

Regarding the diagnosis of the current situation of the technology of the adobe material so that it obtains molecular dosage of concrete, reference can be made to the type of material that is used in the construction companies, relating the technology to the current developed situation and giving greater importance to the construction of houses with mud adobe without taking into account the duration of the adobe. On the other hand it is possible to conclude that the current situation in Colombia with the construction of adobe houses is affecting the community, because if it rains constantly the families can be affected by landslides, the fall of complete houses, floods among others. Likewise, it is concluded that there are different types of technological innovation, which is why it should be applied to the adobe material to reinforce its consistency. It is also concluded that the structure with which the adobe is formed is not in conditions to be able to withstand the time and its use within the construction. Likewise, it can be concluded that some guidelines related to adobe will be taken into account, and that the community and the construction companies will be given alternatives to make a more resistant adobe.

References


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