A Framework Of Organization Performance Assessment In The Construction Industry Using Fuzzy Approach

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• Rationale for the Study
• Overview of Previous Literature
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• Assumptions, Limitations and Delimitations
• Conclusion
Overview
Rationale for study

• The attention of organizations is usually focused on improving the efficiency of its tangible assets as they can be measured and evaluated (Hauser & Katz, 1998).

• Organizations often do not consider the invisible and intangible assets that impact the overall performance.

• A good metric systems empowers organization (Hauser & Katz, 1998).

• Existing performance benchmarks mostly address metric requirements for the manufacturing industries rather than construction.

• Studies conducted in the construction industry have laid more emphasis on the measurement of project performance rather than company performance (Isik, Arditi, Dikmen, & Birgonul, 2010).
Overview of Previous Literature

- Existing studies primarily focus on factors influencing project success
- Earliest studies on Construction Organization success date back to 1989 (Pinto & Covin, 1989)
- Research works are primarily Qualitative in nature
- Literature review has been conducted in **three** phases
  - Identifying the Key Performance Indices (KPIs) that impact organization performance
  - Existing metrics for evaluating performance
    - Balance Score Card (BSC) (Bontis et al. 1999)
    - Performance Prism (Neely et. al. 2001)
  - Modelling Techniques
Overview of Previous Literature

Understanding Employee Perspective

Understanding Stakeholder’s Perspective
Overview of Previous Literature

Organizational performance
- Effectiveness
- Efficiency
- Relevance
- Financial viability

Organizational motivation
- History
- Mission
- Culture
- Incentives or rewards

Organizational capacity
- Strategic leadership
- Human resources
- Financial management
- Organizational processes
- Program management
- Infrastructure
- Interinstitutional linkages

External environment
- Administrative and legal
- Sociocultural
- Technological
- Stakeholder
- Economic
- Political

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Overview of Previous Literature

Factors that impact organization performance

• Understanding stakeholder expectations and interests
• Identifying critical success factors
• Categorizing critical success factors
  • Tangible vs intangible assets of organization
  • Financial vs non-financial assets
Research Methodology

- Literature Review
- Data Collection
- Model Development- Fuzzy Logic Approach
- Validation

![Diagram](image-url)
## Factors selected from literature

<table>
<thead>
<tr>
<th>Administrative &amp; Legal</th>
<th>Technical</th>
<th>Management</th>
<th>Market &amp; Finance</th>
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</thead>
<tbody>
<tr>
<td>• Clear, Vision, Mission &amp; Goal</td>
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<td>• Competition Strategy</td>
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<td>• Organization Structure</td>
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<td>• Political Conditions</td>
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<tr>
<td>• Number of Full time Employee</td>
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<tr>
<td>• International Standard Usage</td>
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<tr>
<td>• Availability of knowledge</td>
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<tr>
<td>• IT Usage</td>
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<tr>
<td>• Business Experience</td>
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<td>• Product Maintenance</td>
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<td>• Employee Culture Environment</td>
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<td>• Employee Compensation &amp; Motivation</td>
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<tr>
<td>• Applying Total Quality Management</td>
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<td>• Training</td>
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<td>• Quick Liquid Assets</td>
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<td>• Feedback Evaluation</td>
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<tr>
<td>• Research Development</td>
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<tr>
<td>• Market Conditions</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>• Customer Engagement</td>
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</tbody>
</table>
Data Collection

- Questionnaire was prepared to determine impact of 18 factors.
  - Actual vs Ideal

- Construction organizations across different countries, i.e., Canada, Egypt, France, Greece, Germany, USA, Saudi Arabia and United Arab Emirates.

- Questionnaire asked experts to rate impact of 18 selected factors on five point- Likert scale

- 150 questionnaires were sent to industry experts, 63 responses were received. i.e. 42% response rate
## Data Collection

<table>
<thead>
<tr>
<th>Category</th>
<th>Success Factors</th>
<th>Responses (Scale: 1-5)</th>
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</thead>
<tbody>
<tr>
<td></td>
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<td>Sample #3</td>
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<tr>
<td></td>
<td>2. Competition Strategy</td>
<td>4</td>
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<tr>
<td></td>
<td>3. Organizational Structure</td>
<td>4</td>
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<tr>
<td></td>
<td>4. Political Conditions</td>
<td>4</td>
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<td></td>
<td>5. Number of Full Time employees</td>
<td>4</td>
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<tr>
<td>Technical</td>
<td>1. Usage of International Aspects (ISO)</td>
<td>3</td>
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<tr>
<td></td>
<td>2. Availability of Knowledge</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>3. Usage of IT</td>
<td>5</td>
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<tr>
<td></td>
<td>4. Business Experience (no. of years)</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>5. Product Maintenance</td>
<td>5</td>
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<tr>
<td>Management</td>
<td>1. Employee Culture Environment</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>2. Employee compensation and Motivation</td>
<td>4</td>
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<tr>
<td></td>
<td>3. Applying Total Quality Management</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4. Training</td>
<td>4</td>
</tr>
<tr>
<td>Market and Finance</td>
<td>1. Quick Liquid Assets</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>2. Feedback Evaluation</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>3. Research and Development</td>
<td>4</td>
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<tr>
<td></td>
<td>4. Market Conditions/ Customer Engagement</td>
<td>4</td>
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<tr>
<td>Overall Company Performance (%)</td>
<td></td>
<td>70</td>
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</tbody>
</table>
Fuzzy Logic Approach

- Fuzzification
  - Assign membership to input variables
- Fuzzy Rule Inference & Composition
  - Compute output truth values
  - Generate sets of “Fuzzy Outputs”
- Defuzzification
  - Assign crisp value to Fuzzy output set

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Fuzzy Logic Approach
Fuzzy Decision Rules

• FES computes the task formulated as a collection of fuzzy if/then rules

• They are described as: IF precondition 1 exits AND precondition 2 exits AND precondition 3 exits AND: THEN consequence 1 AND consequence 2 will be the output (Chao & Skibniewski, 1998)

IF Clear Vision, Mission, and Goals is 4,  
AND Competition Strategy is 4,  
AND Organizational Structure is 4,  
AND Political Conditions is 4,  
AND Availability of Knowledge is 5,  
AND Business Experience (no. of years) is 5,  
AND Employee Culture Environment is 4,  
AND Feedback Evaluation is 4,  
AND Research and Development is 4,  
THEN Overall Performance is 70
Fuzzy Decision Rules

• The minimum operator is used to calculate the firing strength of each fuzzy rule.

• The firing strength is directly proportional to the impact on the output. Output membership function maps the height corresponding to the firing strength of rules (Chao & Skibniewski, 1998).

• $F_i = \min(x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9)$

• where $F_i$ is the firing strength of rule and $x_1, x_2, x_3, x_4, x_5, \ldots$ are the parameters representing membership of linguistic variables (Chao & Skibniewski, 1998).
Fuzzy Model Overview
Model Validation

\[ AIP = \left( \sum_{i=1}^{n} \left| 1 - \left( E_i / C_i \right) \right| \right) \times 100 / n \]

\[ AVP = 100 - AIP \]

\[ RMSE = \frac{\sqrt{\sum_{i=1}^{n} (C_i - E_i)^2}}{n} \]

**AIP**: Average Invalidity Percent  
**AVP**: Average Validity Percent  
**RMSE**: Root Mean Squared Error
Conclusion

• Limitations

• The framework for performance assessment model has been based on data responses collected from the experts in industry. The interpretation of questions may vary from individual to individual.

• The participants are not from the same organization or in the same functional role. Hence, the perspectives of individuals will vary from one functional role to another.

• The survey has been conducted for organizations from different countries. The demographics has not been considered.
Conclusion

• Delimitations

  • The Key Performance Indices (KPIs) are shortlisted from the existing literature. Many sub-factors have not been included.

  • Due to scarcity of time and data, data has not been classified as per the type of contracts executed by construction organization i.e. Engineering Procurement Construction (EPC), Design Build (DB), General Contractor (GC), etc. is not considered for this study.

  • The size of organizations, value of projects and specialization works have not been considered in this study. The performance model is based only on the opinions.
References


Thank you!