Reducing Construction Waste through Prefabrication during Design Stage: A Simulation Approach

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Outline

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02 Model Development
03 Results and Discussions
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Introduction

- Background
- Aim
Background

1. Increasing amount of construction waste

2. Socio-economic and environmental benefits of prefabrication methods

3. The design stage can reduce construction waste from the source.

4. Limited previous research
Aim

Develop a model for assessing the potential of prefabrication on construction waste reduction using a system dynamics approach.
Model Development

- Identify main variables
- Causal-loop Diagram
- Stock-flow Diagram
- Model verification
Identify Main Variables

- Generation of construction waste
- Behavior
- Attitude
- Policy
- Ability

System boundary
Causal-loop Diagram
Stock-flow Diagram
Model Verification: Extreme Condition Test

Construction Waste Reduction

- S1 (ARPC = 5.4%)
- S2 (ARPC = 25%)
- S3 (ARPC = 50%)
- S4 (ARPC = 75%)

Time (Month) vs. Waste Reduction (Unit)
## Model Verification: Extreme Condition Test

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>S1(ARPC=5.4%)</th>
<th>S2(ARPC=25)</th>
<th>S3(ARPC=50)</th>
<th>S4(ARPC=75)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reduction(ton)</td>
<td>Reduction(ton)</td>
<td>Reduction(ton)</td>
<td>Reduction(ton)</td>
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<tr>
<td><strong>Concrete waste</strong></td>
<td>0.27</td>
<td>1.27</td>
<td>2.55</td>
<td>3.84</td>
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<td></td>
<td>6.1%</td>
<td>28.5%</td>
<td>57.3%</td>
<td>86.3%</td>
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<tr>
<td><strong>Brick and block waste</strong></td>
<td>0.019</td>
<td>0.089</td>
<td>0.179</td>
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<td>6.1%</td>
<td>28.5%</td>
<td>57.3%</td>
<td>86.3%</td>
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<td><strong>Mortar waste</strong></td>
<td>0.014</td>
<td>0.067</td>
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<td>6.4%</td>
<td>30.4%</td>
<td>57.7%</td>
<td>86.8%</td>
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<tr>
<td><strong>Metal waste</strong></td>
<td>0.029</td>
<td>0.136</td>
<td>0.273</td>
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<td>6.1%</td>
<td>28.7%</td>
<td>57.4%</td>
<td>86.5%</td>
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<tr>
<td><strong>Wood waste</strong></td>
<td>0.049</td>
<td>0.231</td>
<td>0.464</td>
<td>0.699</td>
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<td>28.5%</td>
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<td>86.3%</td>
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<tr>
<td><strong>Rework waste</strong></td>
<td>0.053</td>
<td>0.245</td>
<td>0.493</td>
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<td>4.9%</td>
<td>22.6%</td>
<td>45.4%</td>
<td>68.6%</td>
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<td><strong>Overall CW</strong></td>
<td>12.04</td>
<td>55.74</td>
<td>111.4</td>
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<tr>
<td></td>
<td>22.6%</td>
<td>104.7%</td>
<td>209.2%</td>
<td>341.3%</td>
</tr>
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</table>
Results and Discussions

- Increase investment on professional training of designers
- Policies strengthen
Professional Training of Designers

Construction Waste Reduction

![Graph showing construction waste reduction over time with different lines for different values of PIDPT (0.05, 0.10, 0.15, 0.20, 0.25, 0.30)].
Policies Strengthen

Construction Waste Reduction

B1 (SP=0.25)  B3 (SP=0.65)
B2 (SP=0.40)  B4 (SP=0.80)
Conclusions
Conclusions

An increase in the value of prefabricated components exerts a strong effect on CW reduction especially for concrete waste during design stage. Two strategies, increasing investment on designers’ professional training and strengthening policies, are efficient in promotion of prefabrication method and increase CW reduction during design stage. Increasing the investment on designers’ professional training is not always useful as for the upper limit of designers’ skills.
THANKS FOR YOUR LISTENING!
Q AND A