Analysis of making-do waste at construction site in Fortaleza, Ceará, Brazil

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Paper organization

- Introduction
- Making-do as a waste classification
- Research method
- Results
- Conclusions
Introduction

Construction industry
- Significant contribution to the Brazilian economy

Current economic scenario (Rosenblum et al. 2008)
- Increasing degree of competition amongst companies;
- Increasing level of demand from consumers;
- Reduced availability of financial resources;
- Need to optimize processes.

Problems frequently in construction industry (Koskela 2004)
- Waste;
- Low productivity;
- Delays;
- Restricted safety;
- Insufficient quality.
Introduction

Waste (Formoso et al. 1997)
- Occurrence of material waste and the execution of an unnecessary task;
- Additional costs;
- Do not add value to the product;
- Decrease of productivity and control in construction site.

Making-do waste
- New waste category suggested by Koskela (2004);
- Occurs when a task initiates without the necessary resources or when these items are not suitable for the execution of an activity;
- Quality reduction, lack of terminality and rework.
Objective

Investigate and analyze the waste by making-do in three construction companies in Fortaleza, classifying them and identifying the possible generated impacts.
Making-do as a waste classification

- Categories of making-do waste:

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access/movement</td>
<td>Relative to space, environment or position to perform the tasks</td>
<td>Sommer (2010)</td>
</tr>
<tr>
<td>Adjustment of component</td>
<td>Unexpected adjustment of construction components or elements to perform tasks</td>
<td>Sommer (2010)</td>
</tr>
<tr>
<td>Working area</td>
<td>Reference to the work area or the support area during the activities performed</td>
<td>Sommer (2010)</td>
</tr>
<tr>
<td>Storage</td>
<td>Organization of materials or components in places not prepared for their receipt</td>
<td>Sommer (2010)</td>
</tr>
<tr>
<td>Equipment/Tools</td>
<td>Creation or adaptation for use during activities</td>
<td>Sommer (2010)</td>
</tr>
<tr>
<td>Protection</td>
<td>Use of protection systems</td>
<td>Sommer (2010)</td>
</tr>
<tr>
<td>Sequencing</td>
<td>Alteration of the construction process</td>
<td>Fireman (2012); Leão (2014)</td>
</tr>
</tbody>
</table>
Making-do as a waste classification

Categories of prerequisites that, if not met, could cause the making-do waste:

Table 2 – Necessary prerequisites for starting an activity

<table>
<thead>
<tr>
<th>Prerequisites</th>
<th>Description</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information</td>
<td>Availability of adequate information regarding work plans.</td>
<td>Sommer (2010); Koskela (2004)</td>
</tr>
<tr>
<td>Materials and components</td>
<td>Availability of materials and components with quality, quantity, and within the specifications of the project and standards.</td>
<td>Sommer (2010); Koskela (2004)</td>
</tr>
<tr>
<td>Labor</td>
<td>Availability of necessary human resources, in number, or qualification.</td>
<td>Sommer (2010); Koskela (2004)</td>
</tr>
<tr>
<td>Equipment/tools</td>
<td>Availability and functioning of activities.</td>
<td>Sommer (2010); Koskela (2004)</td>
</tr>
<tr>
<td>Space</td>
<td>Availability of work area, circulation or storage of materials.</td>
<td>Sommer (2010); Koskela (2004)</td>
</tr>
<tr>
<td>Interdependent tasks</td>
<td>Activities with high interdependence compromise the execution of subsequent tasks.</td>
<td>Sommer (2010); Koskela (2004)</td>
</tr>
<tr>
<td>External conditions</td>
<td>Wind, rain or extreme temperatures.</td>
<td>Sommer (2010); Koskela (2004)</td>
</tr>
<tr>
<td>Installations</td>
<td>Availability of provisional electrical and hydraulic installations, site security facilities, scaffolding, closures, and isolation of stock areas.</td>
<td>Sommer (2010)</td>
</tr>
</tbody>
</table>
Research method

Method of identifying making-do waste in construction sites, proposed by Sommer (2010):

- Surveys;
- Interviews;
- Photographic records;
- Documents analysis;
- Technical visits.

Data collection:
- Database;
- Creation of spreadsheets.

Data processing:
- Surveys;
- Interviews;
- Photographic records;
- Documents analysis;
- Technical visits.
Research method

Data collection and Data processing:

Table 3 – Characterization of construction companies

<table>
<thead>
<tr>
<th>Company</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>High standard multifamily building</td>
<td>Commercial center</td>
<td>High standard multifamily building</td>
</tr>
<tr>
<td>Current phase of execution</td>
<td>Structure and installations</td>
<td>Masonry, Structure and installations</td>
<td>Finishing and installations</td>
</tr>
<tr>
<td>Total execution area (m²)</td>
<td>26,341,54</td>
<td>11,062,88</td>
<td>12,706,83</td>
</tr>
<tr>
<td>Type of labor</td>
<td>Own and Outsourced</td>
<td>Own</td>
<td>Own and Outsourced</td>
</tr>
<tr>
<td>Number of stories</td>
<td>38</td>
<td>6</td>
<td>28</td>
</tr>
</tbody>
</table>

Matrix for risk assessment using severity and probability parameters (Fireman, 2012)

Database model
Results

- Categories of making-do waste for each construction company:
Results

Causes of making-do waste for each construction company:
Possible impacts of making-do for each construction company:
Results

Categories of making-do wastes by stages of execution:
Causes of making-do wastes by stages of execution: Prerequisites:
Results

Impacts of making-do wastes by stages of execution:

- **Structure**
  - 29% Reduce Productivity
  - 29% Material Waste
  - 21% Rework
  - 7% Poor Safety
  - 7% Reduce Quality
  - 7% Unfinished Work
  - 17% Schedule

- **Masonry**
  - 35% Reduce Productivity
  - 18% Material Waste
  - 12% Rework
  - 6% Poor Safety
  - 6% Reduce Quality
  - 6% Unfinished Work
  - 12% Schedule

- **Finishing**
  - 100% Reduce Productivity

- **Installations**
  - 17% Reduce Productivity
  - 17% Material Waste
  - 83% Rework

- **Management**
  - 12% Reduce Productivity
  - 17% Material Waste
  - 71% Rework
Results

Risk analyzes of making-do waste:

- **Low Priority:**
  - Company A: 42.9%
  - Company B: 20.6%
  - Company C: 8.3%

- **Intermediate Priority:**
  - Company A: 14.3%
  - Company B: 32.4%
  - Company C: 83.3%

- **High Priority:**
  - Company A: 42.9%
  - Company B: 47.1%
  - Company C: 8.3%
Results

● Example of identified making-do waste:

a) Forms present in the ribbed slab cells;

b) Tears for the passage of pipes;

c) Broke the completed masonry
Conclusions

- “Adjustment of the component” was the most significant category of making-do waste, with 40.3%.
- The categories of making-do waste depend on local occurrence.
- The prerequisite that generates most making-do wastes, among the construction companies studied, was “materials and components”, with 73.6% of occurrence.
- “Rework” was the most significant impact with 38.9% in the wastes categories, being very expressive mainly in the finishing and installation stage.
- “Schedule” is a new impact could be seen during visits because improvisations significantly interfered in the activity cycle period.
- Due to the limitation of the analyses, the results cannot be generalized for the city of Fortaleza, Brazil, and more studies are needed to obtain more representative parameters about making-do waste.


Thanks!

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