



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)

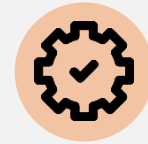
- Waste;
- Low productivity;
- Delays;
- Restricted safety;
- Insufficient quality.

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 1 – Categories of making-do waste

Category	Description	Authors
Access/movement	Relative to space, environment or position to perform the tasks	Sommer (2010)
Adjustment of component	Unexpected adjustment of construction components or elements to perform tasks	Sommer (2010)
Working area	Reference to the work area or the support area during the activities performed	Sommer (2010)
Storage	Organization of materials or components in places not prepared for their receipt	Sommer (2010)
Equipment/Tools	Creation or adaptation for use during activities	Sommer (2010)
Water and electricity supply	Existence of infrastructure to perform tasks.	Sommer (2010)
Protection	Use of protection systems	Sommer (2010)
Sequencing	Alteration of the construction process	Fireman (2012); Leão (2014)

Making-do as a waste classification

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

Table 2 – Necessary prerequeriments for starting an activity

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

Research method

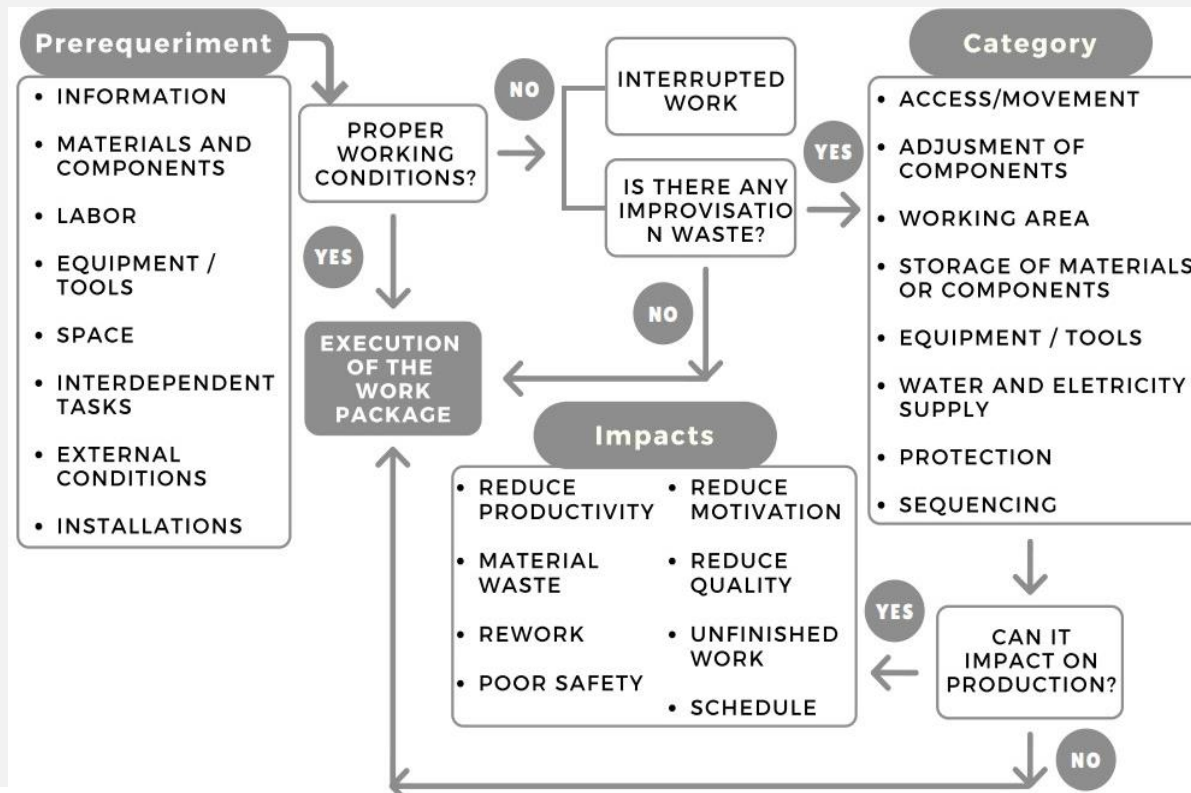


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- Method of identifying making-do waste in construction sites, proposed by Sommer (2010):



Data
collection



Data
processing

- Surveys;
 - Interviews;
 - Photographic records;
 - Documents analysis;
 - Technical visits.
-
- Database;
 - Creation of spreadsheets

Research method

○ Data collection and Data processing:

Table 3 – Characterization of construction companies

Company	A	B	C
Description	High standard multifamily building	Commercial center	High standard multifamily building
Current phase of execution	Structure and installations	Masonry, Structure and installations	Finishing and installations
Total execution area (m ²)	26.341,54	11.062,88	12.706,83
Type of labor	Own and Outsourced	Own	Own and Outsourced
Number of stories	38	6	28

Database model

Company	Current phase of execution	Prerequeriments	Description	Possible causes	Image	Team	Categories	Impacts	Other waste	Date
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Matrix for risk assessment using severity and probability parameters (Fireman, 2012)

PROBABILITY	SEVERITY				
	Very High - I	High - II	Moderate - III	Low - IV	Very Low - V
A - Unlikely					
B - Extremely remote					
C - Remote					
D - Probable					
E - Frequent					

Results

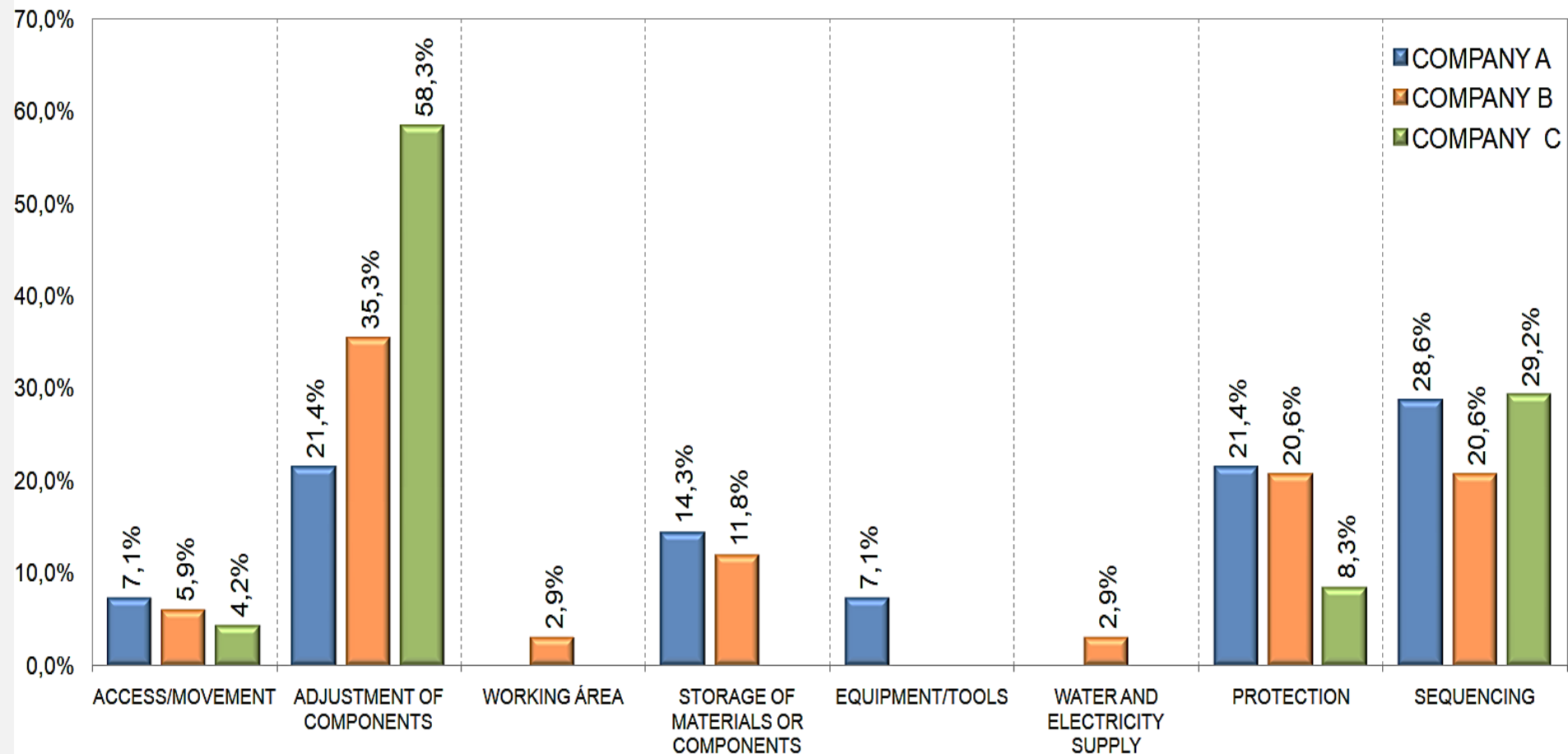


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○ Categories of making-do waste for each construction company:



Results

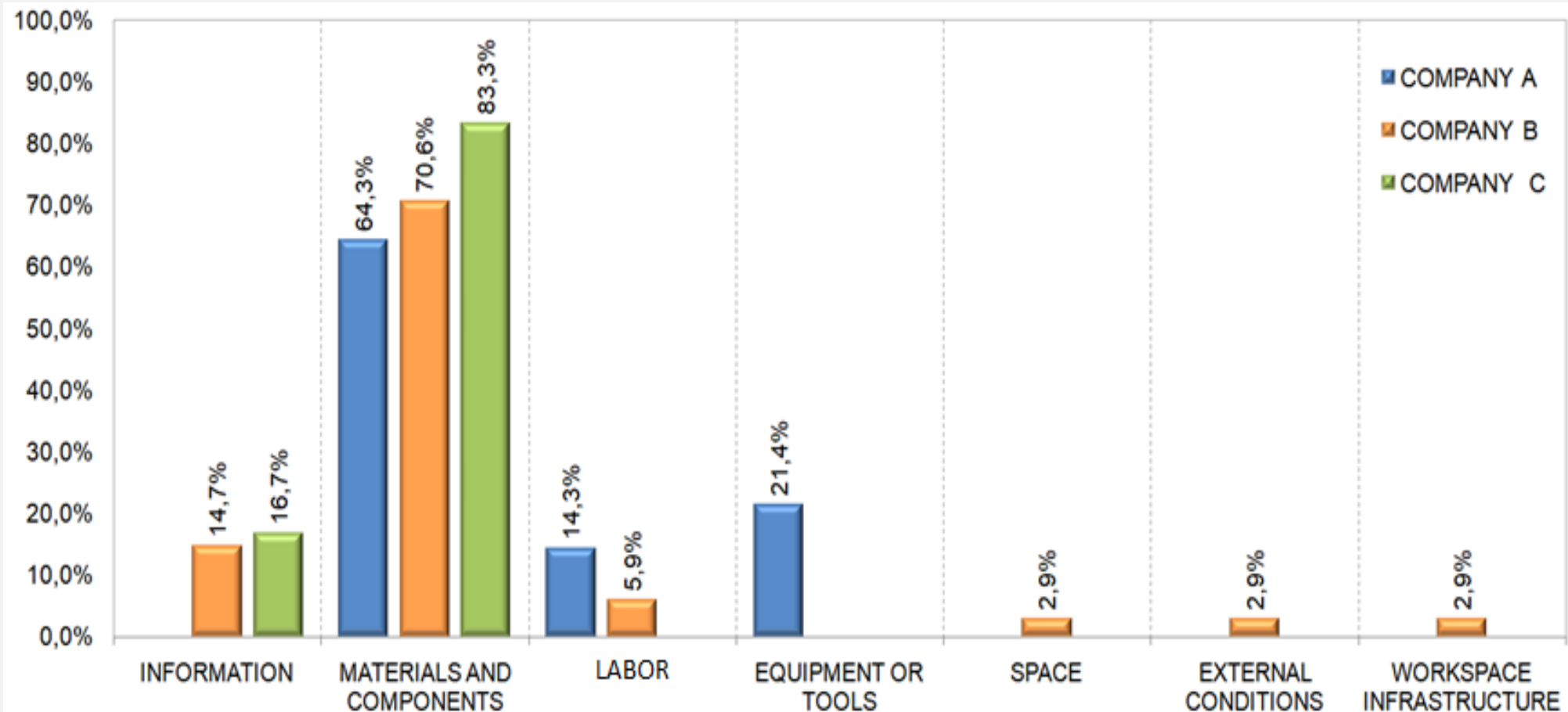


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Causes of making-do waste for each construction company:



Results

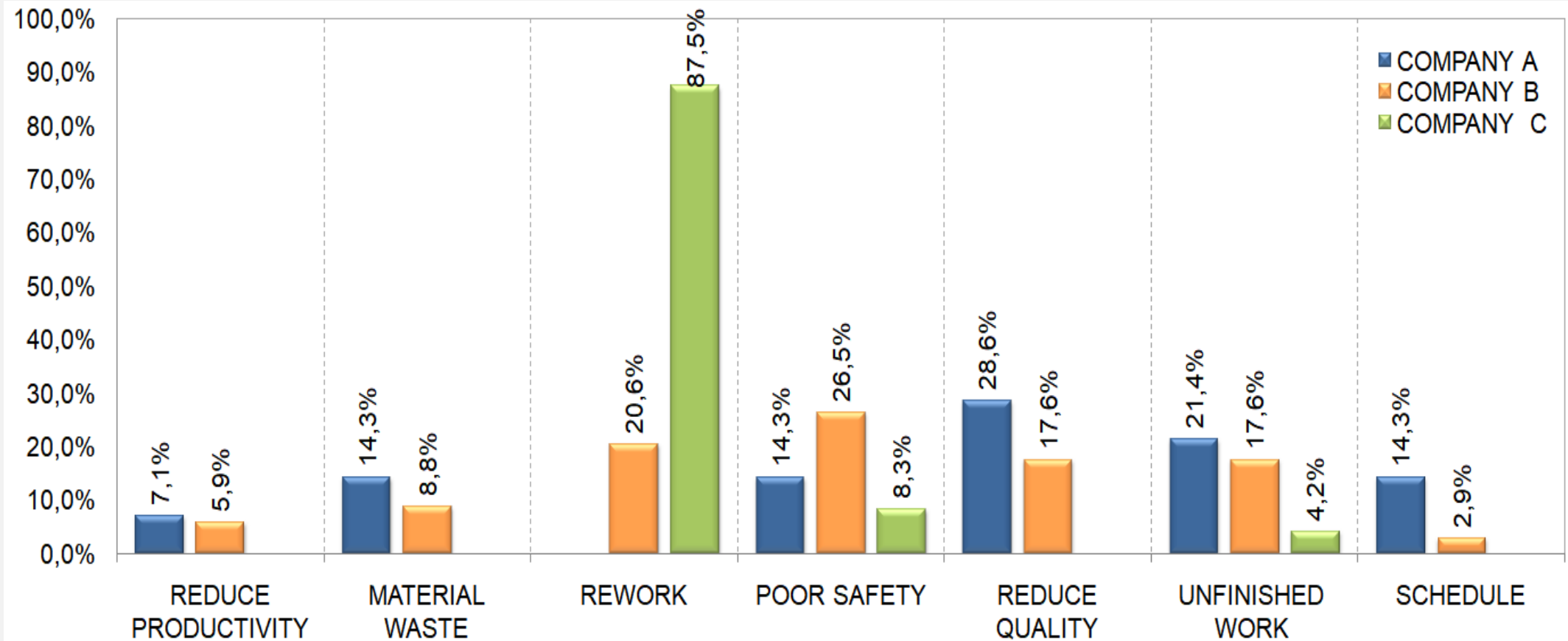


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○ Possible impacts of making-do for each construction company:



Results

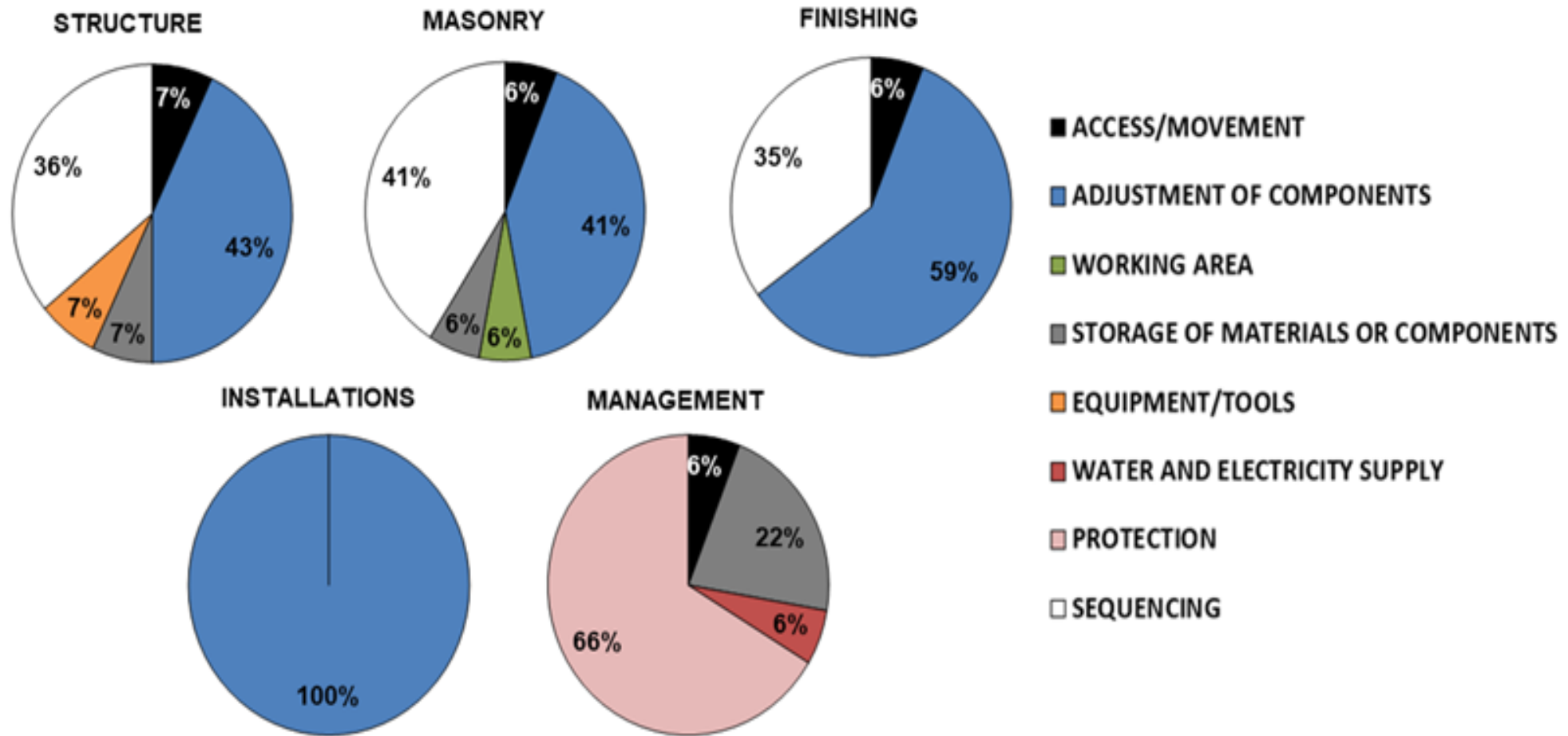


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○ Categories of making-do wastes by stages of execution:



Results

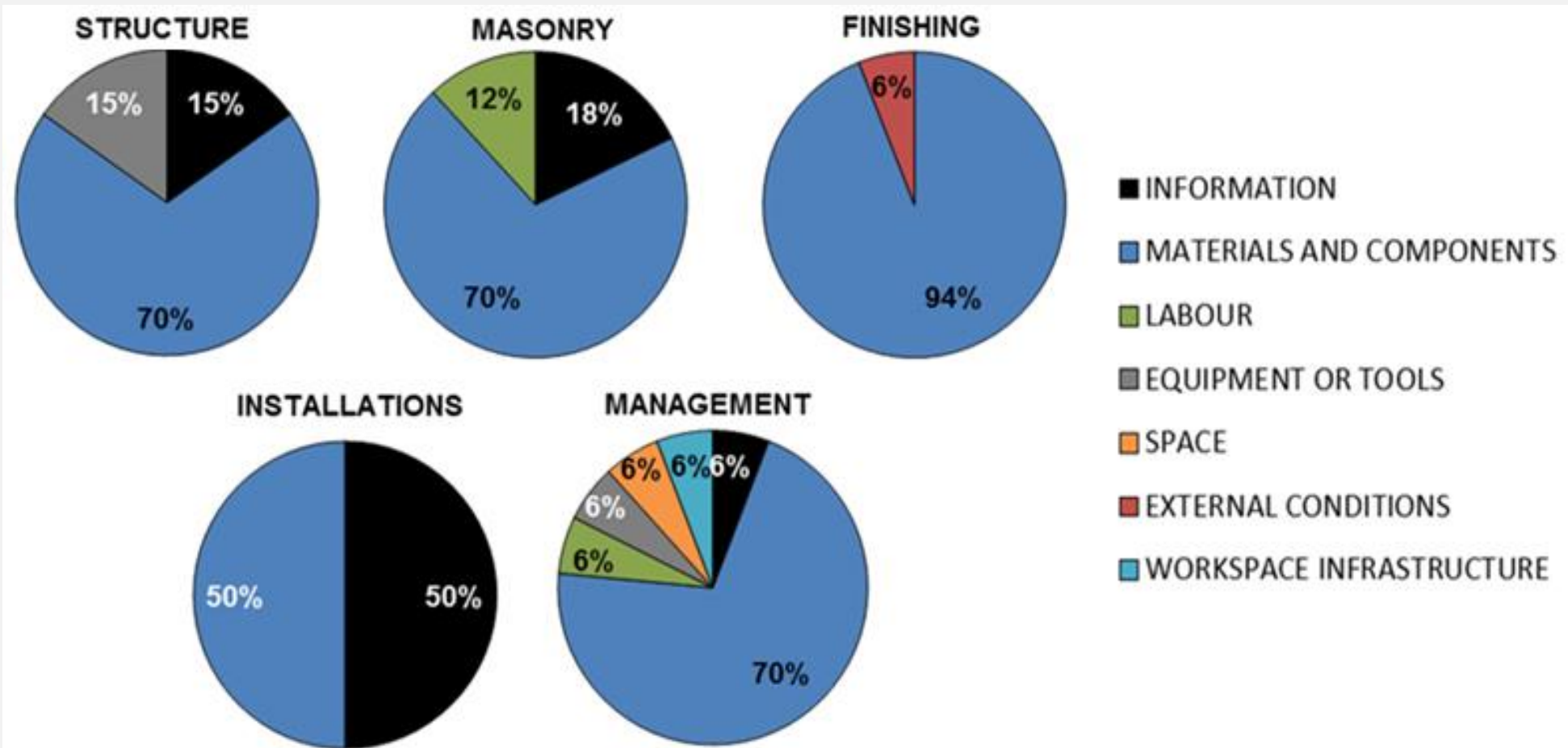


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Causes of making-do wastes by stages of execution: Prerequeriments:



Results

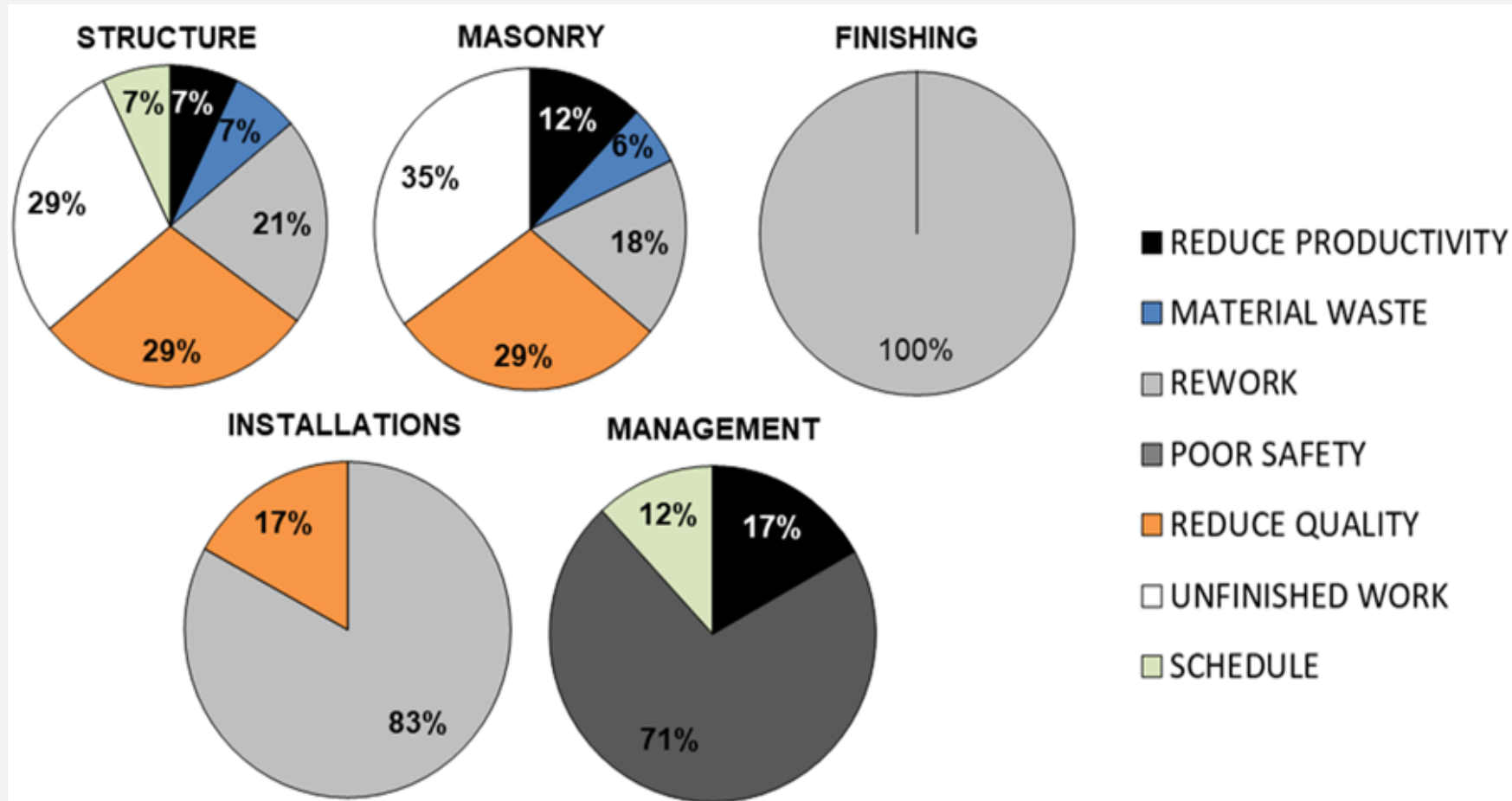


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○ Impacts of making-do wastes by stages of execution:



Results

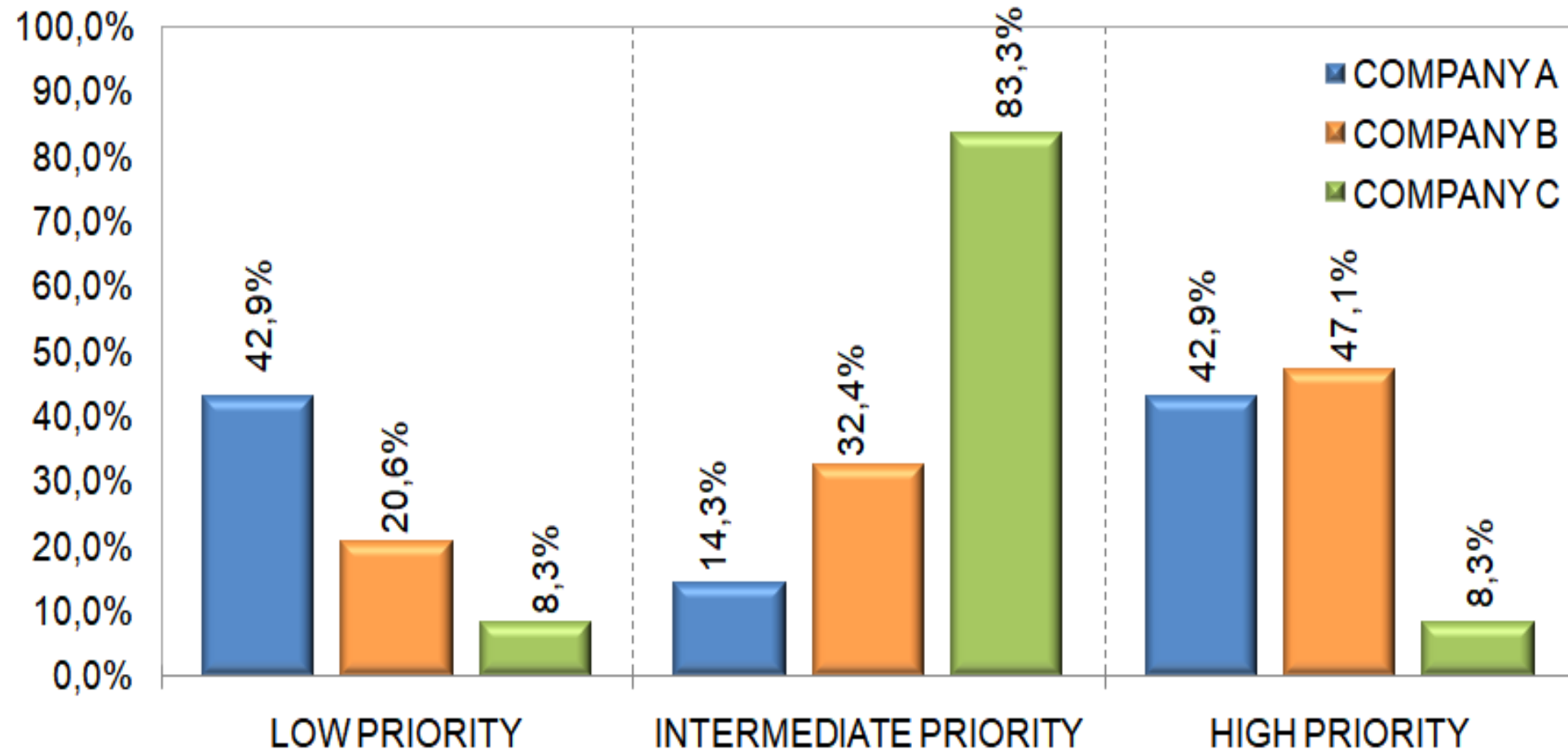


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○ Risk analyzes of making-do waste:



Results



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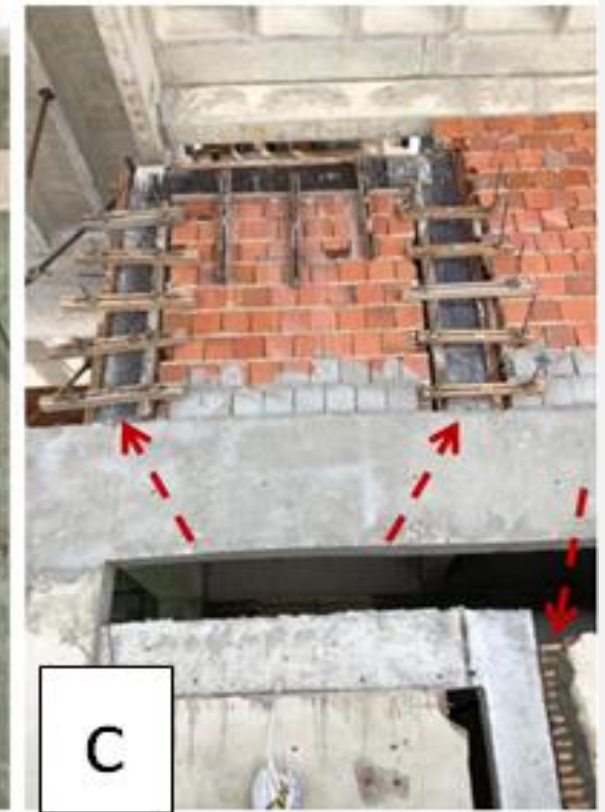
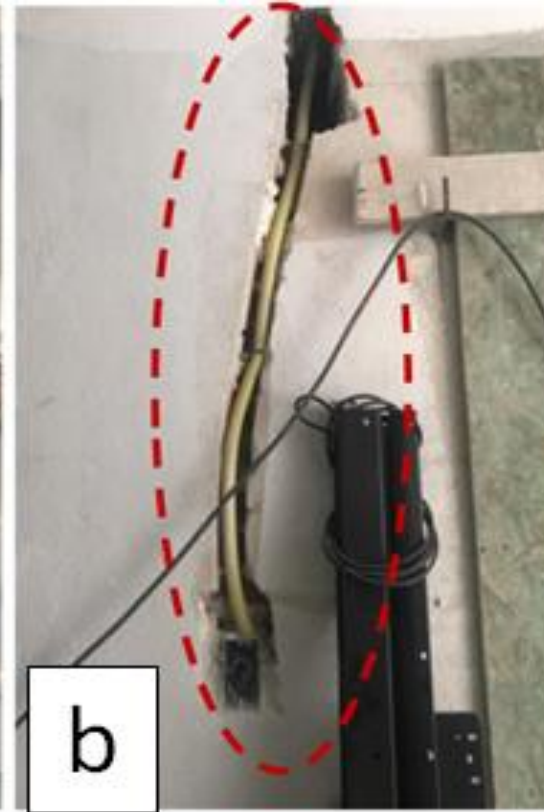
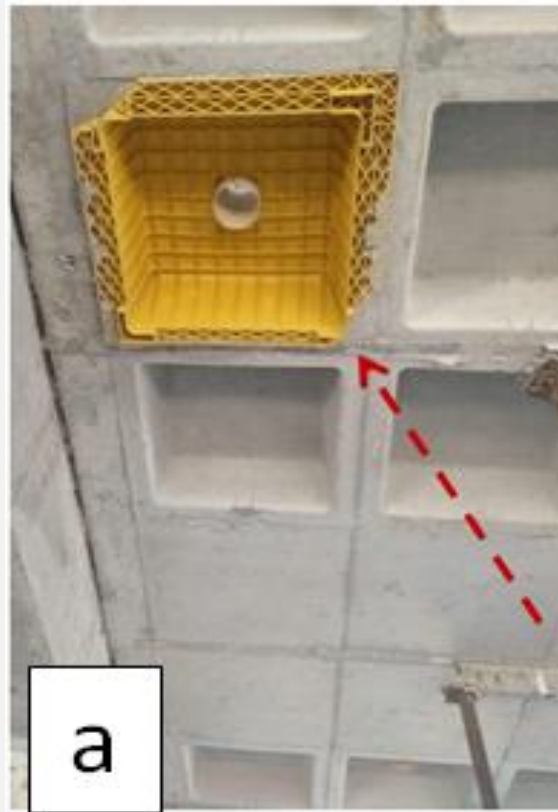
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○ Example of identified making-do waste:

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.

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Thanks!

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