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LIMA, PERÚ - 29TH ANNUAL CONFERENCE
INTERNATIONAL GROUP FOR LEAN CONSTRUCTION

Combining lean methods to improve construction labour efficiency in renovation projects

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AGENDA

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- Construction Labour Productivity
- The four cases
- Lean Implementation Degree
- Correlating Lean and Productivity
- Three key take aways

CONSTRUCTION LABOR PRODUCTIVITY

- CLP has a significant impact on construction projects
  because construction labor costs constitute 40-60% of the total project costs (Buchan et al. 2006; Kazaz et al. 2008; Smith 2013)
- Grow, steady state, decline ?
- Improve CLP by focusing on resource use, aka Construction Labour Efficiency (CLE)
- Minimum of time spent on Non-Value Adding Work (NVAW).

- The WS method has proven itself to be able to create valuable insights on DW and NVAW time in the flow view (Neve et al. 2020) of the Transformation-Flow-Value theory (Koskela 2000) in which, the production resource is time (Bølviken et al. 2014).

RESEARCH AIM

- Limited research have investigated how DW can be increased:
  - Examples are the Activity Analysis (AA) method (CII 2010) proven itself to be able to continuously improve the time construction laborers spend on DW (Gouett et al. 2011; Hwang et al. 2018).
- CLE is measured by means of Work Sampling
- Improving DW by means of Lean

- "What impact does the use of lean construction have on construction labour efficiency?"

THE FOUR CASES

	Case 1*	Case 2**	Case 3***	Case 4****
Contract type	General	Turnkey	General	Turnkey
Duration	5 years	4 years	4 years	3 years
Apartments	291	297	601	470
m2	22,800	23,700	46,500	41,000
Stories	Basement to 2	Basement to 2	Basement to 3	Ground to 1
Originally built	The 1950s	The 1960s	The 1950s	The 1970s

*WS data previously used in Neve et al. (2020b); Neve et al. (2020d); Teizer et al. (2020)

**WS data previously used in Neve et al. (2020b); Neve and Wandahl (2018); Teizer et al. (2020)

***WS data previously used in Neve et al. (2020b); Teizer et al. (2020)

**** WS data not previously published.

EXAMPLE CASE

LEAN IMPLEMENTATION DEGREE

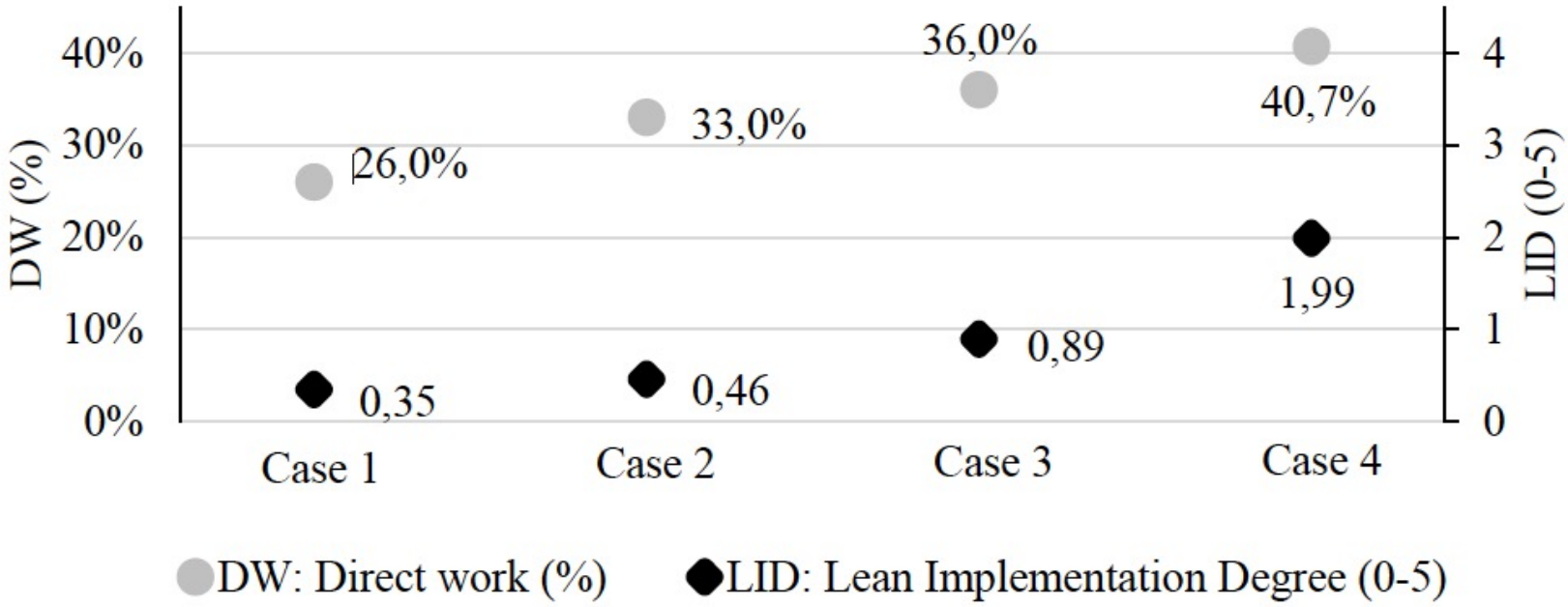
Category	Item
F: Location Based Scheduling (LBS)	6f-Process planning/ Pull planning/ Takt time
	5f-Lookahead planning phase
	4f-Control Action
	3f-Forecasting
	2f-Progress tracking
	1f-Overall sequencing/Master plan
E: Last Planner System (LPS)	8e-Learning Process/ 5xWhy
	7e-Workable backlog
	6e-lookahead Plan is formalized
	5e-Causes for non-compliance based on PPC
	4e-PPC measured on a weekly basis
	3e-Process planning/ Pull Planning/ Takt time
	2e-Weekly workplan formalized into a plan
	1e-Weekly meetings with foremen
D: Just-in-Time (JIT)	10d-JIT-A3
	9d-JIT-5S
	8d-JIT-kaizen
	7d-JIT-TQM-TQC
	6d-JIT-SCM (Material Delivery)
	5d-JIT-Production Layout
	4d-JIT-TPM
	3d-JIT-SMED
	2d-JIT-Small batches
	1d-JIT-Kanban
C: Holistic use of lean	3c-Degree of a lean/Kaizen culture
	2c-Empowering employees to create continues
	1c-Is TFV theory as a common understanding of
B: General knowledge level	4b-Location Based Planning
	3b-Last Planner System
	2b-Just-in-time
	1b-General Lean
A: Training provided by company	4a-Location Based Planning
	3a-Last Planner System
	2a-Just-in-time
	1a-General Lean

LEAN IMPLEMENTATION DEGREE

	Case 1	Case 2	Case 3	Case 4
A: Training	0.5	0.75	1.12.	1.75
B: Knowledge	0.5	0.75	1.5	2.25
C: Use	0	0	0	1
D: JIT	0.1	0.1	0.2	0.4
E: LPS	1	0.5	1.25	3.38
F: LBS	0.00	0.67	1.17	3.17
LID	**0.35**	**0.46**	**0.86**	**1.99**

CORRELATING LID AND CLP

	Case 1	Case 2	Case 3	Case 4
DW	26.0%	33.0%	36.0%l	40.7%
N	29,884	3,927	13,682	861



CONCLUSIONS

Work Sampling is useful to assess Construction Labor Efficiency

1

The combined use of LC tools did correlate with improved Construction Labor Efficiency

2

Study is limited in sample size, thus more cases would be need to increase reliability

3

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THANK YOU!

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