

ROAD CONSTRUCTION LABOR PERFORMANCE CONTROL USING PPC, PCR AND RNC DURING THE PANDEMIC

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AGENDA

1. INTRODUCTION
2. METHOD
3. RESULTS
4. CONCLUSIONS

1. INTRODUCTION

The **construction industry** has been criticized and compared to other industries due to the **reduced evolution of labor performance** and the **few tools established to control and improve it**, which leads to wastes in the processes causing cost overruns and decreased productivity (Bølviken and Koskela, 2016).

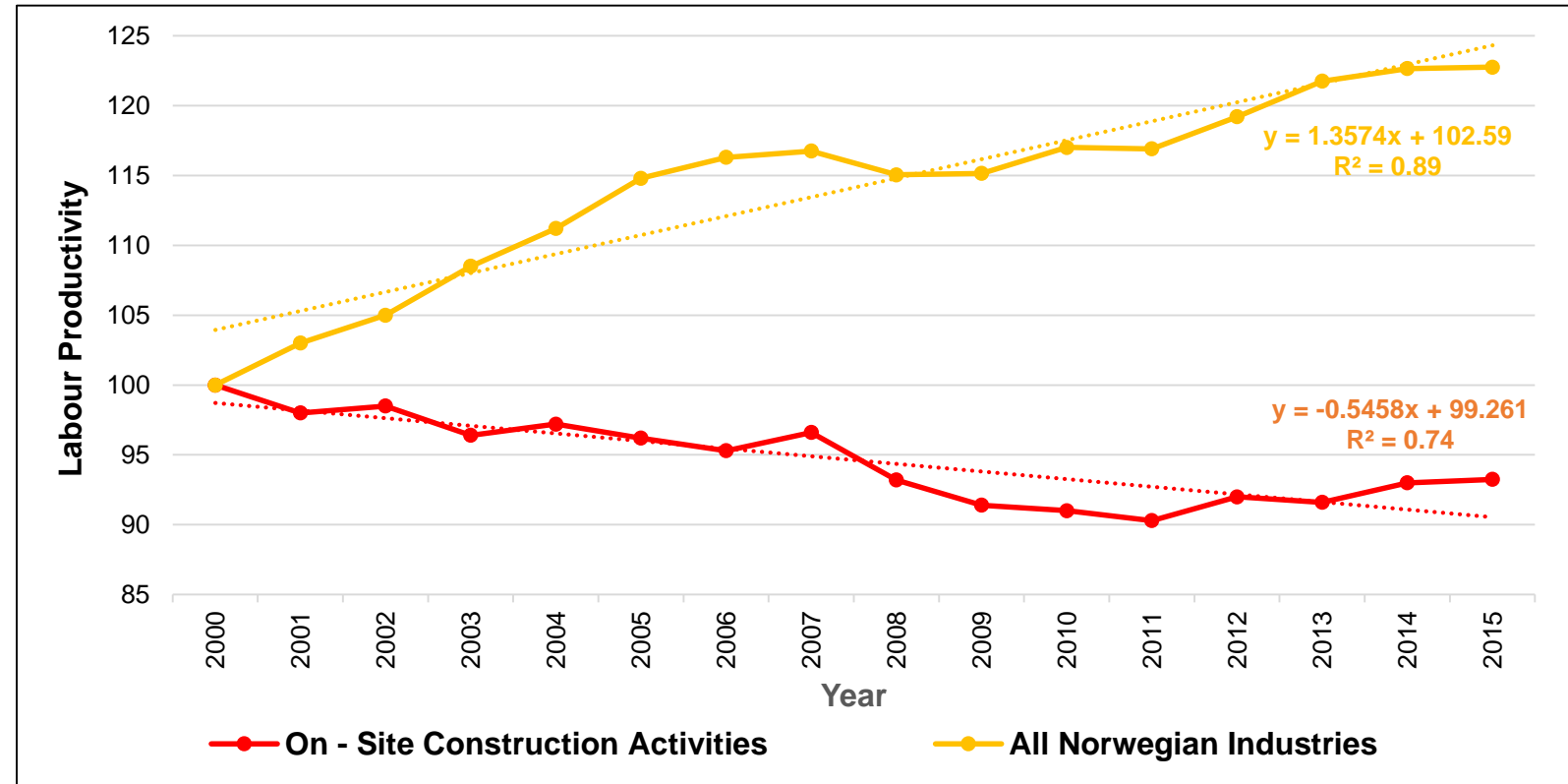


Figure 1. Labour productivity of on-site construction (Figure 15 in Ahmad et al., 2020)

1. INTRODUCTION

This defect is **more frequent in road works** due to its longitudinal nature; which leads to a **large number of interferences** that must be identified in a timely manner so as not to interrupt the **work flow of resources**, such as **work force**.



Figure 2. Road construction site

1. INTRODUCTION

Within the context of the pandemic, the low performance of labor has been strengthened, due to the nature of the execution of its activities involving of numerous specialized work force teams working together and to the increase in working hours spent on non-contributory time (TNC).



Figure 3. Workmen within the context of the pandemic

1. INTRODUCTION

Due to the problem of labor performance control in the context of a pandemic and the higher incidence of variability in road projects, this study aims to **validate the use of PPC, PCR and RNC indicators as a mechanism for monitoring labor performance in road construction within the new normal.**



Figure 4. Case study project

2. METHOD

Figure 5 represents the methodology used for the control of the labor performance of a road project within the context of the new normal using as a mechanism the PPC and PCR indicators and RNC for decision making oriented to continuous improvement.

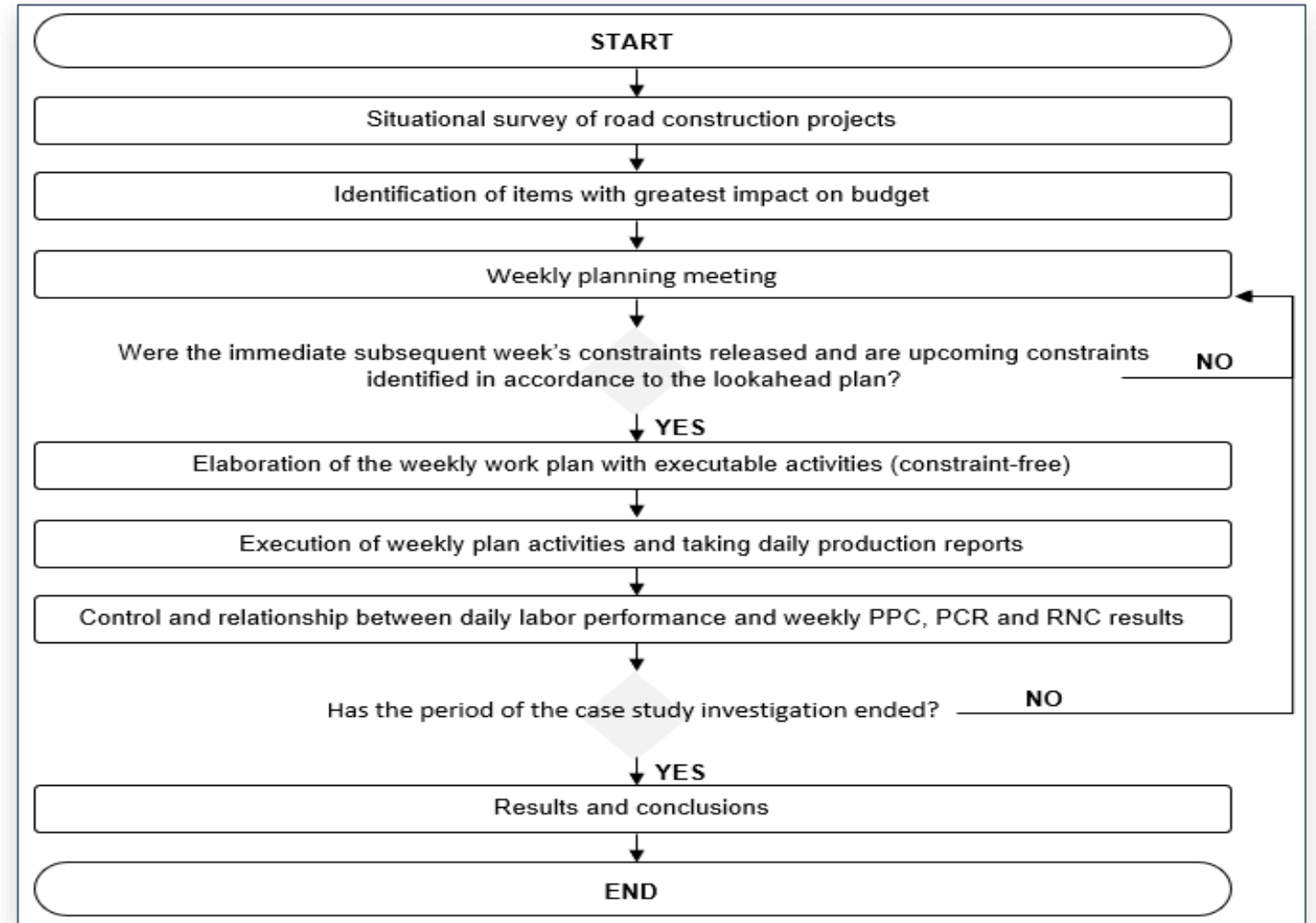
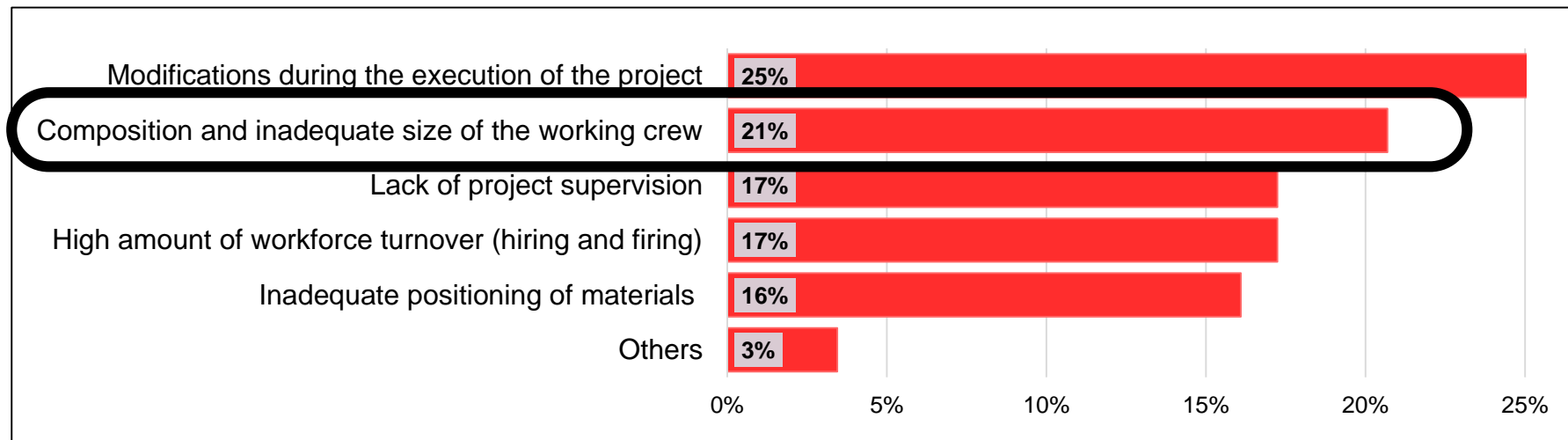


Figure 5. Flowchart of Research Process

2.1 SITUATIONAL SURVEY OF ROAD CONSTRUCTION PROJECTS

The survey was conducted among 40 professionals from 16 construction companies specializing in road projects during the new normal.

Survey results provided a situational overview of road works and guided the PPC and PCR indicators towards a controlled labor performance within the context of the new normal.



21% of the respondents, according to their experience, believed that the inadequate composition and size of crews is a factor that negatively impacts labor performance.

Figure 6. Factor of variability of the labor performance

2.1 SITUATIONAL SURVEY OF ROAD CONSTRUCTION PROJECTS

22% of the professionals rated **Waiting or Downtime** as the waste with the **greatest impact** on **labor performance**.

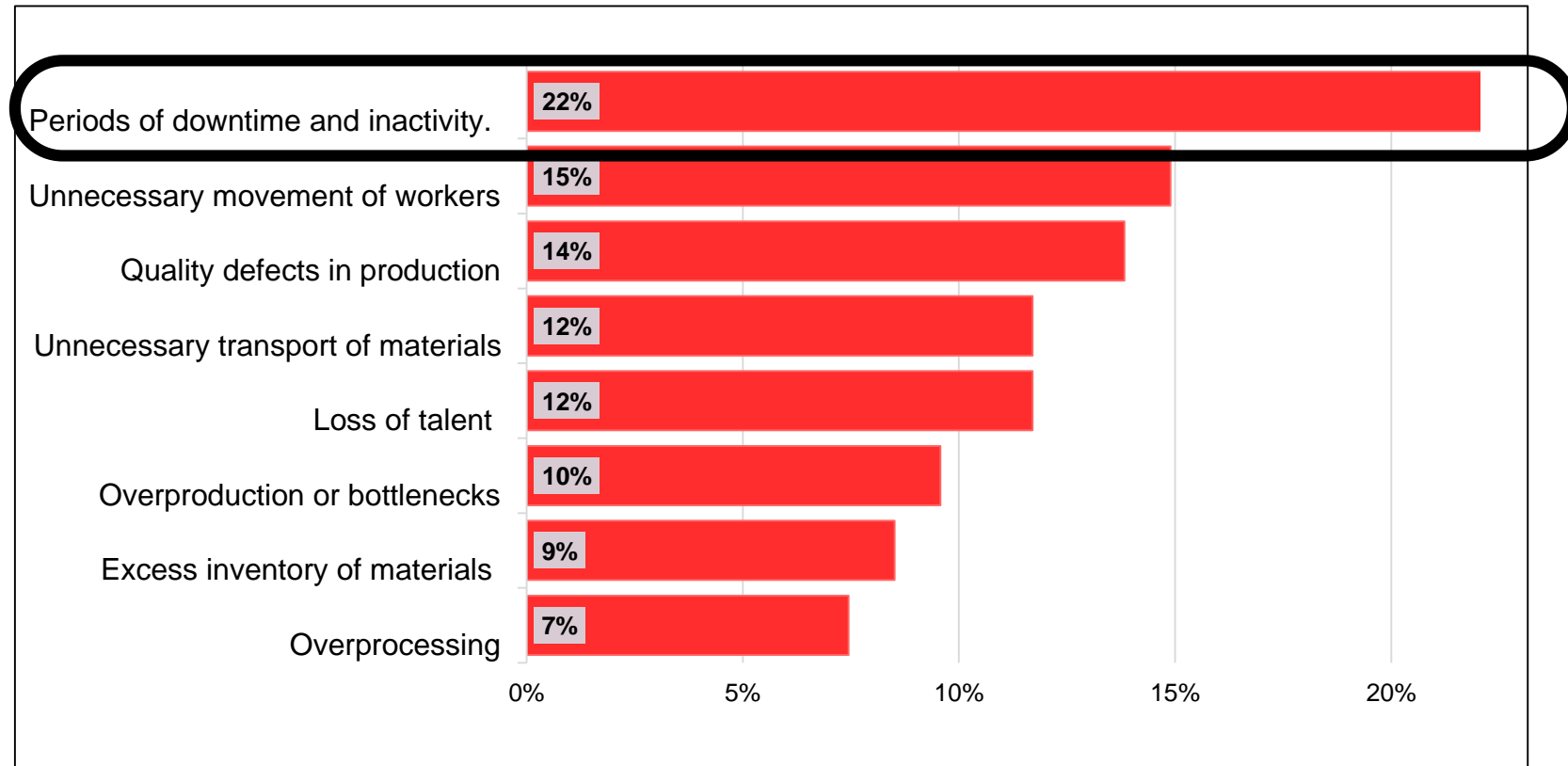


Figure 7. Waste with the greatest impact on labor performance

2.1 SITUATIONAL SURVEY OF ROAD CONSTRUCTION PROJECTS

The **average Productive Time (TP)**, i.e., that which the time that workers add direct value to production of executed activities., **represents 50.45% of the activities performed at the construction site.**

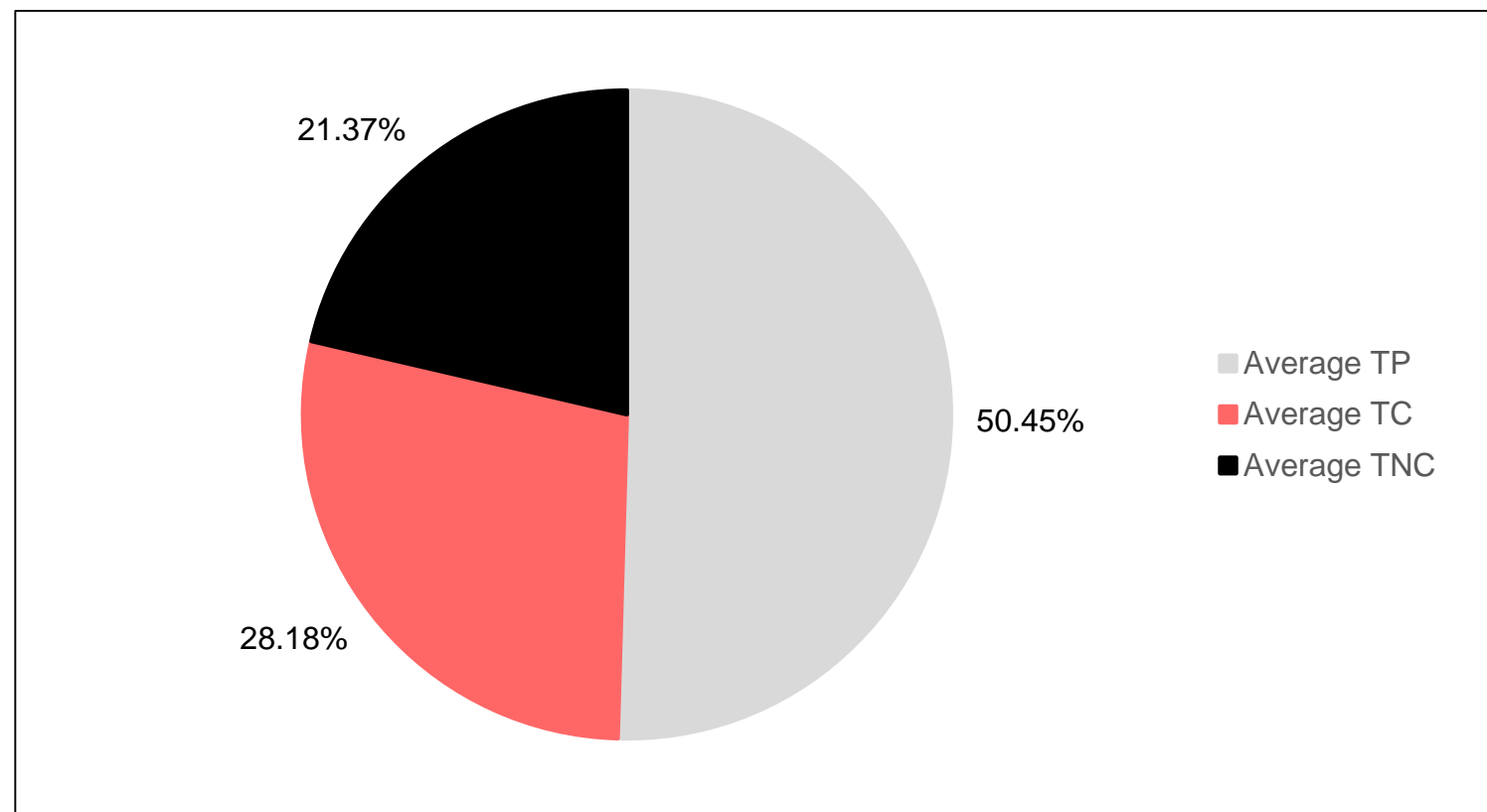


Figure 8. Distribution of types of work times in road projects in the context of new normality

2.1 SITUATIONAL SURVEY OF ROAD CONSTRUCTION PROJECTS

Regarding the causes and consequences of variability provided by road project specialists, they coincide in mentioning causes attributed to **external variability factors**.

And on the the consequences, these coincide in **waiting, delays, low productivity and labor performance rates, cost overruns, and missed deadlines**.



Climate change not allow to asphalt or pur pavements



Underground interference in urban areas conduce to Halt of work due to new activities which require resolution



Incompatibility between technical file and field reality


Not having a complete report of interferences

2.2 IDENTIFICATION OF ITEMS WITH THE GREATEST INCIDENCE

N°	Item description	% impact on budget
1	Rigid Pavement	34.76%
2	Granular Sub-base H=20 cm	5.66%
3	Concrete Sidewalks	4.40%
4	Pavement painting	2.99%
5	Asphalt Contraction Joint Sealing	1.50 %
6	Excavation to subgrade in Loose Material	1.20%
7	Demolition of Flexible Pavement	1.18%

Table 1. Control items

2.3 WEEKLY PLANNING MEETING

Weekly planning meeting agenda																																									
Week 2																																									
Lookahead 2 @ 4														Lookahead 3 @ 5																											
Week 1							Week 2							Week 3							Week 4							Week 5							Week 6						
M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
							Executed Week Review (Week 1)																																		
							Compliance of activities																																		
WEEK 1 REVIEW							Calculate PPC														WEEK 1 PLAN																				
							Determine RNC																																		
							Corrective actions for RNC																																		
							Calculate PCR																																		
							Labor performance curves																																		
							Corrective actions for delays in critical activities																																		
							Immediate Post Week Planning (Week 2)																																		
							Review of Lookahead 2 @ 4 restrictions														WEEK 2 PLAN																				
							Determine executable tasks (released constraints)																																		
							Define weekly work plan 2																																		
							Submit Lookahead 3 @ 5																																		
							Constraints analysis in accordance to the Lookahead 3 @ 5																																		

PPC: Percentage of Plan completed





RNC: Reasons for Non Compliance

PCR: Percentage of Constraint Removal

Figure 9. Weekly Planning Meeting Agenda

2.3 LABOR PERFORMANCE CURVES

This graph identifies whether the labor resource meets the expected performance (input/output), according to the budget, because if the accumulated performance is higher than the budgeted performance, more man-hours (input) are being used than expected, which translates into cost overruns.

DAILY PRODUCTION REPORT								 			
CONTRACTUAL ITEM:		Pavement painting (m)					SUPPLIER:				
Date:		10-oct-20					PHASE:		100		
Item	Unit	STRETCH	SIDE	INITIAL PROG.	FINAL PROG.	WIDTH	LENGTH	THICKNESS	QUANTITY	OBSERVATIONS	
Pavement painting (m)	m	I	LEFT	1+751	1+879		128		128.00		
									TOTAL M	128.00	OUTPUT
EQUIPMENT		Quantity		Hours							
EXCAVATOR											
FRONT LOADER											
BACKHOE LOADER											
MINI LOADER											
MOTOR GRADER											
SOIL COMPACTOR											
CISTERNE											
DUMP TRUCK											
MATERIALS		Unit		Quantity							
WORK FORCE		Quantity		Hours							
FOREMAN											
OPERATOR		1.0		8.0							
OFFICIAL		1.0		8.0							
GENERAL LABORER		6.0		8.0							
CONTROLLER											
									INPUT		
REFERENCE PHOTO:											
											
COMMENTS:											

*NOTE: This form will be filled out for each item worked on and will be cumulative.

Figure 9. Daily production report

3. RESULTS

At lower the PPC and PCR, the performance is higher, which translates into inefficient use of resources and cost overruns. This is due to the fact that, in the event of non-compliance with the release of constraints, the workflow is interrupted, which implies greater use of man-hours.

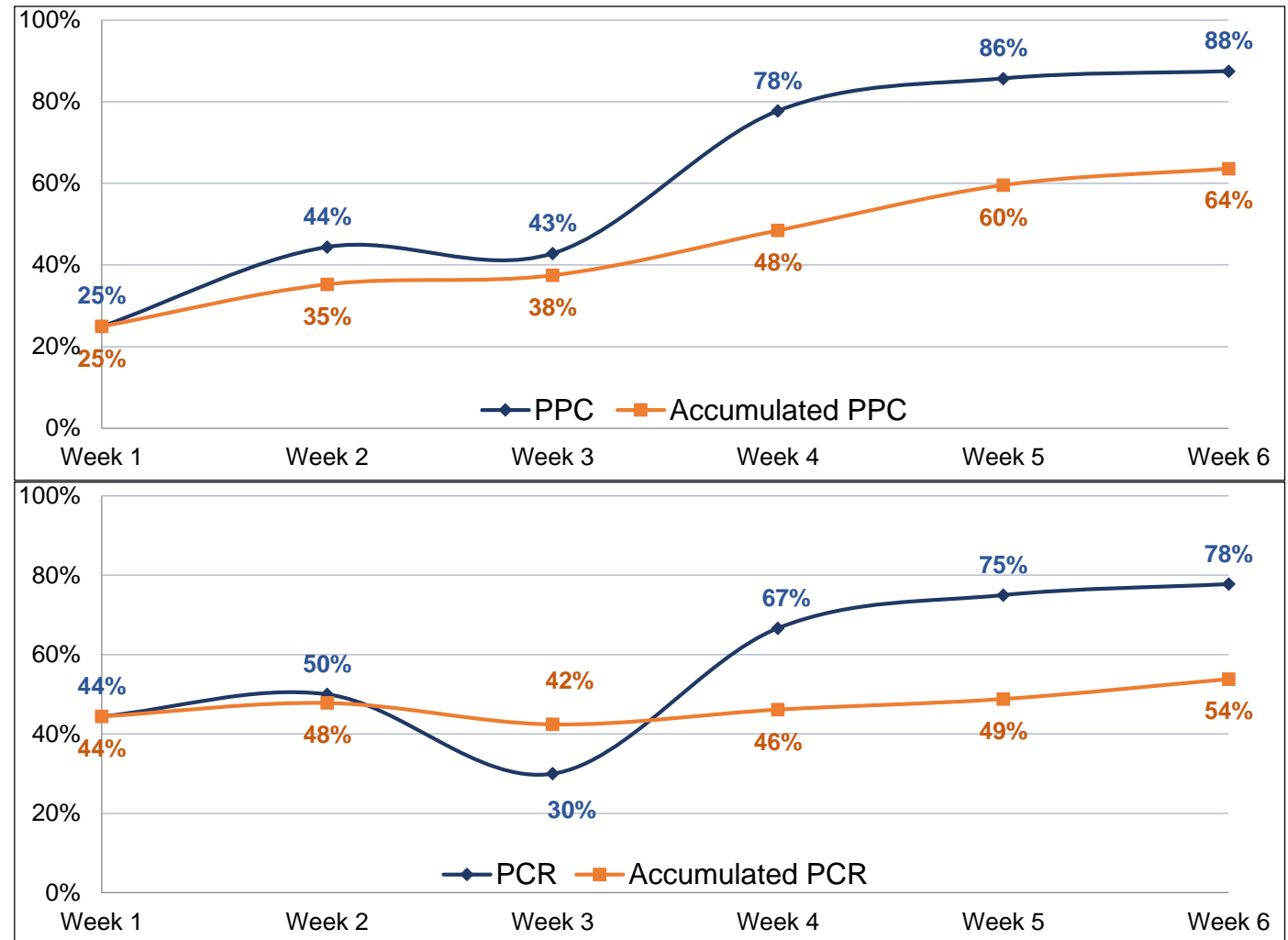


Figure 10. PPC and PCR chart

3. RESULTS

The improvement in **labor performance** begins in **week 3**, at which point the **PPC and PCR tend to rise**, which is explained by timely decisions and actions regarding labor and release of constraints.

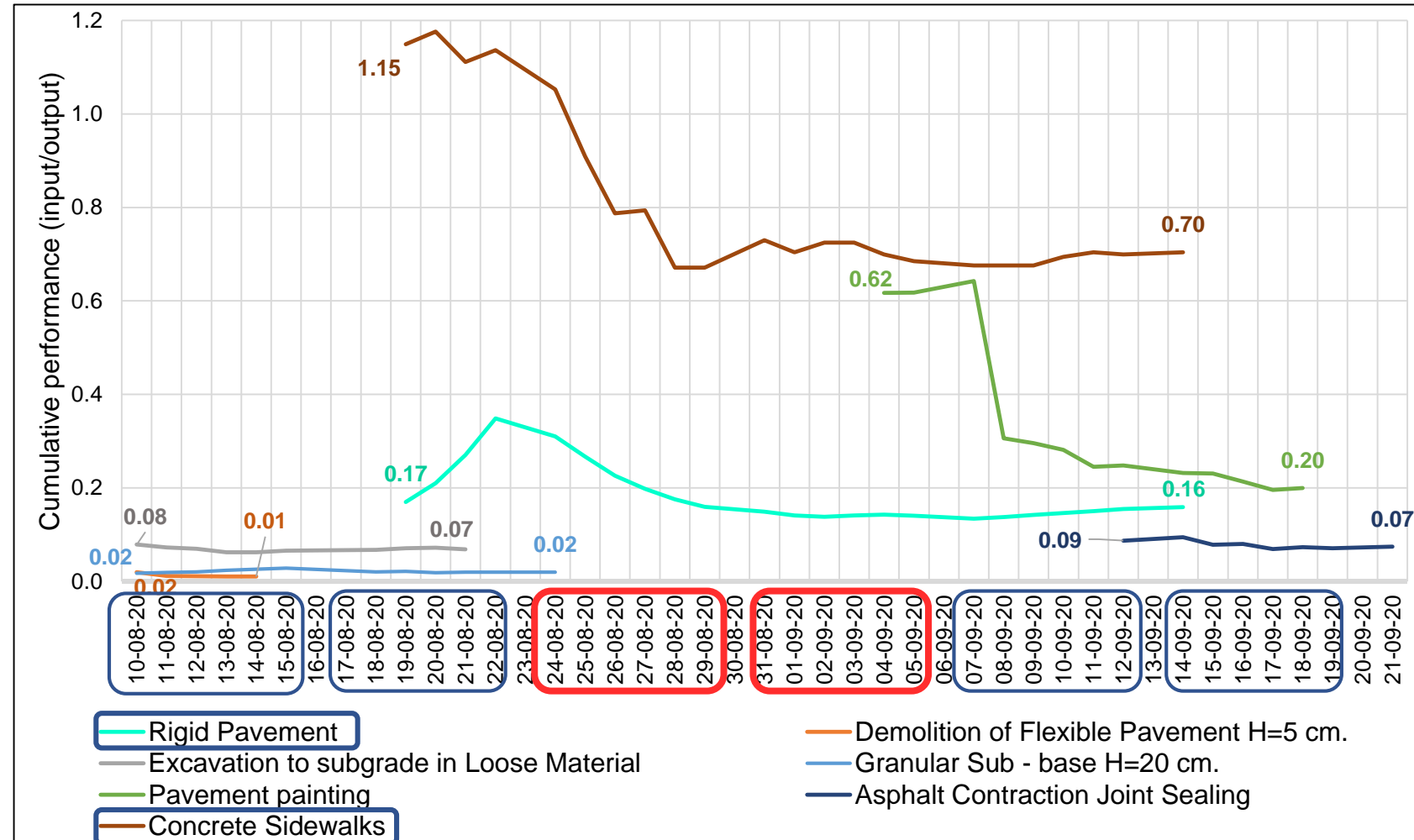


Figure 11. Labor Performance Curves

3. RESULTS

According RNCs identified during the current health situation, the most frequent are the external ones with 42% since roadworks present factors specific to the type of project that can cause interruptions in the work flow throughout its development.

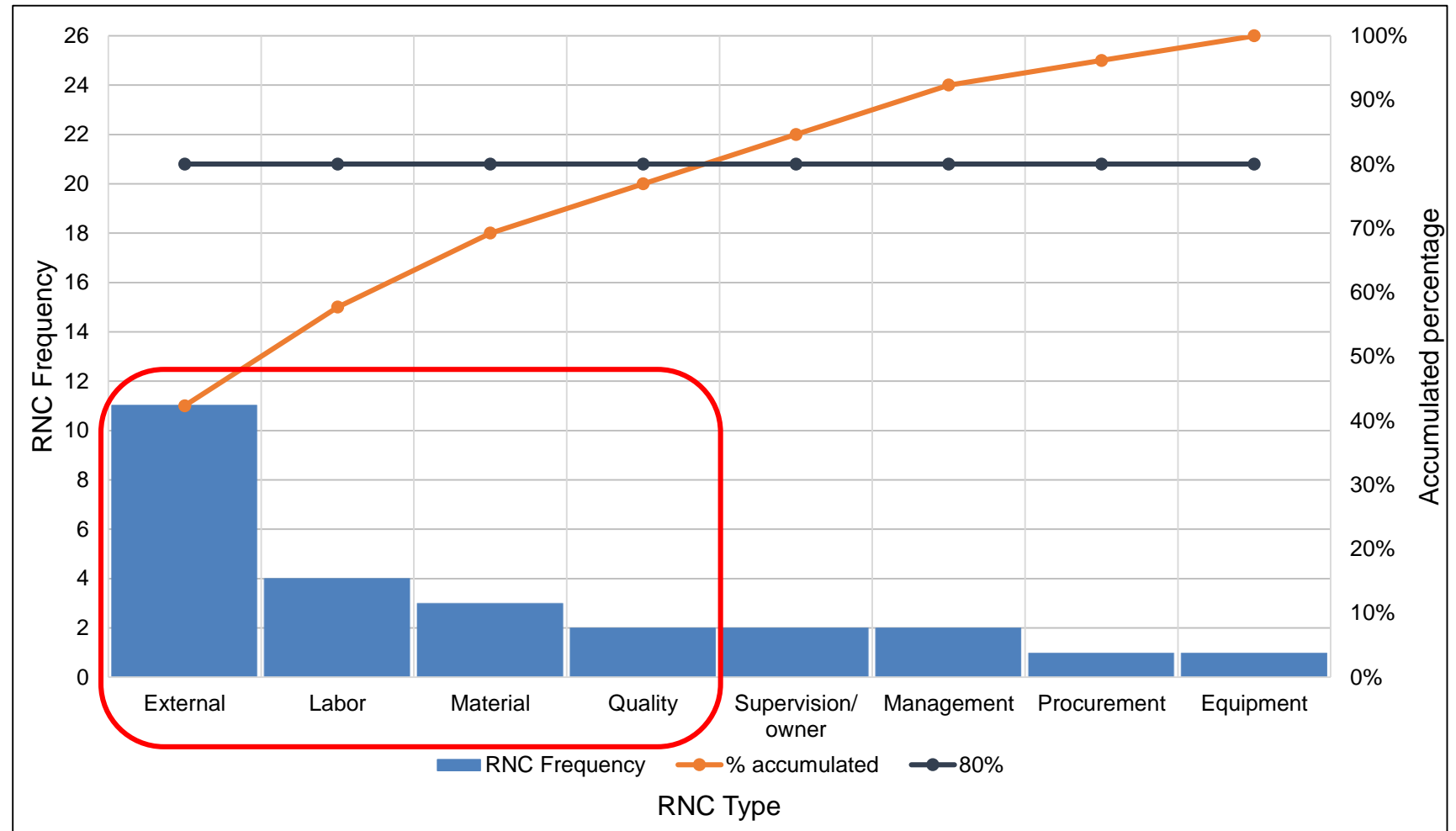


Figure 12. RNC Pareto Chart

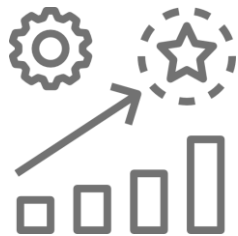
3. RESULTS

Item description	Workmen Nr. (a)	Labor Performance (input/output)			Production speed (output/day)		
		Budgeted	Start (b)	End (c)	Start 1 $\frac{b}{(a \times 8)}$	End 1 $\frac{c}{(a \times 8)}$	Increase
Rigid Pavement (m2)	18	0.16	0.17	0.16	848	905	7%
Demolition of Flexible Pavement (m2)	6	0.19	0.02	0.01	2464	4657	89%
Excavation to subgrade in Loose Material (m3)	3	0.09	0.08	0.07	305	350	15%
Granular Sub-base H=20 cm (m2)	5	0.04	0.02	0.02	2340	2037	-13%
Pavement painting (m)	8	0.64	0.62	0.20	104	320	208%
Asphalt Contraction Joint Sealing (m)	14	1.13	0.09	0.07	1287	1512	17%
Concrete Sidewalks (m2)	7	0.71	1.15	0.70	49	80	63%

Table 2. Improvements in labor performance

4. CONCLUSIONS

It was found that the monitoring of labor performance of road construction projects through the PPC, PCR and RNC indicators generated a positive impact on improving labor performance in road projects developed during the new normal.



Specific external RNCs during the study period were heavy and light traffic problems in the work areas, as well as interference with residential access and domestic public services.

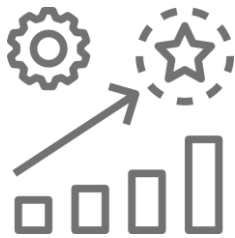


Better PPC and PCR were found to be directly related to a labor performance in line with the Budget

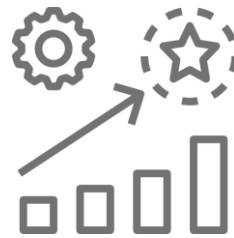


4. CONCLUSIONS

It was found that **low PPC and PCR**, translates into an **inefficient labor performance** which in turn leads to higher cost overruns for the road project



A **24% to 64% improvement in PPC** resulted in **up to 67.74% improvement in the work force performance** of the pavement painting control item.



This study contributes to existing knowledge and practice, in the context of the pandemic, by validating the methodology for monitoring and optimizing the performance of the road construction work force using LPS indicators and collecting RNCs characteristic of the type of work and the health crisis.



THANK YOU!

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