



Exploring the Relationship among Planning Reliability (PPC), Linguistic Action and Social Network Metrics

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Construction industry



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- Information flow and workflow have to be effective
 - Last Planner® System (LPS) helps that
 - LPS improves coordination and workflow during Weekly Work Planning (WWP) in Work Teams
 - Work team provides:
 - Communication
 - Coordination
 - Collaboration
- Deficient information flow within Work Teams creates poor performance in project.

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- Theory assumes that all predecessor activities have been fulfilled and enough resources are available so that all subsequent activities can be performed according to schedule.
 - That not always that case.
 - It is incorrect to affirm that task scopes are fully understood by workers.
 - Success in organizational management is achieved through:
 - Trust
 - Nonpunitive policies
 - Reliable commitments
 - Addressing types of error
- } Last Planner® System (LPS)

General purpose

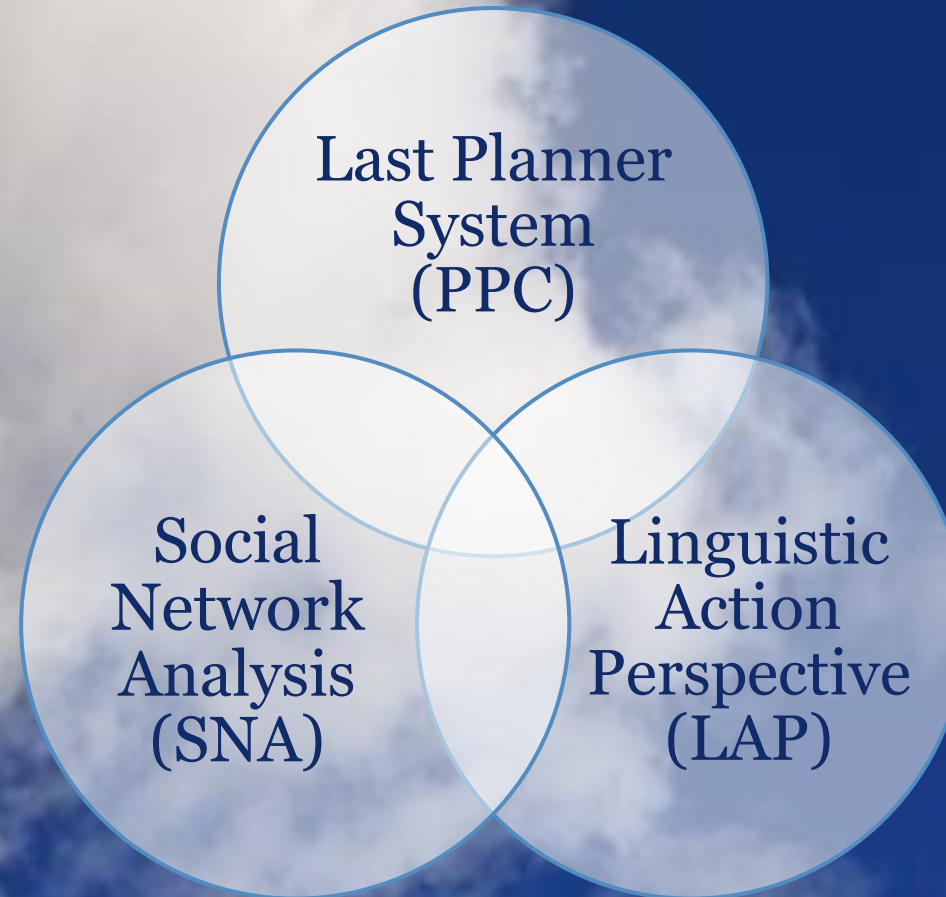


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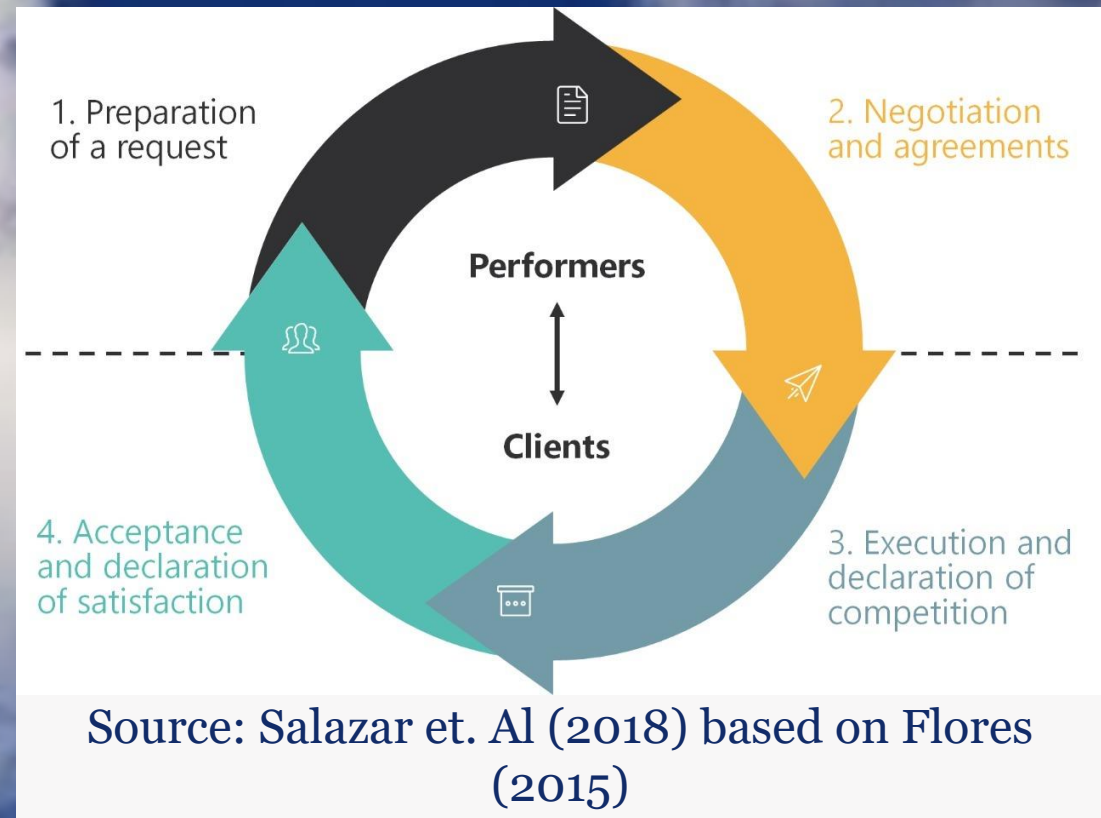
Relationship



In four projects

Linguistic Action Perspective (LAP)

- Tasks are generally assumed to be fully understood by the team
 - Tasks cannot be completed without considering worker's importance
- Flores (2015) proposes a basic and universal structure, based on the performance of certain speech acts, called “Conversations for Actions”



Linguistic Action Perspective (LAP)



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- Salazar et al. (2018) proposed indicators
- These indicators were validated in Chilean projects during 2019 (Salazar et al., 2019)
- Constructors validated the importance of providing reliable promises
- Diehl (2019) concludes that a more empirical approach to the analysis of Social Network, is using the Linguistic Action Perspective.

Social Network Analysis (SNA)



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- To measure connections between participants: Social Network Analysis (SNA)
- SNA provides:
 - Personal interactions
 - Information Flow
 - Planning
 - Problem Solving
 - Collaboration
 - Trust
 - Learning

Source: Based on Phelps (2012); Viana et al. (2011)

Social Network Analysis (SNA)

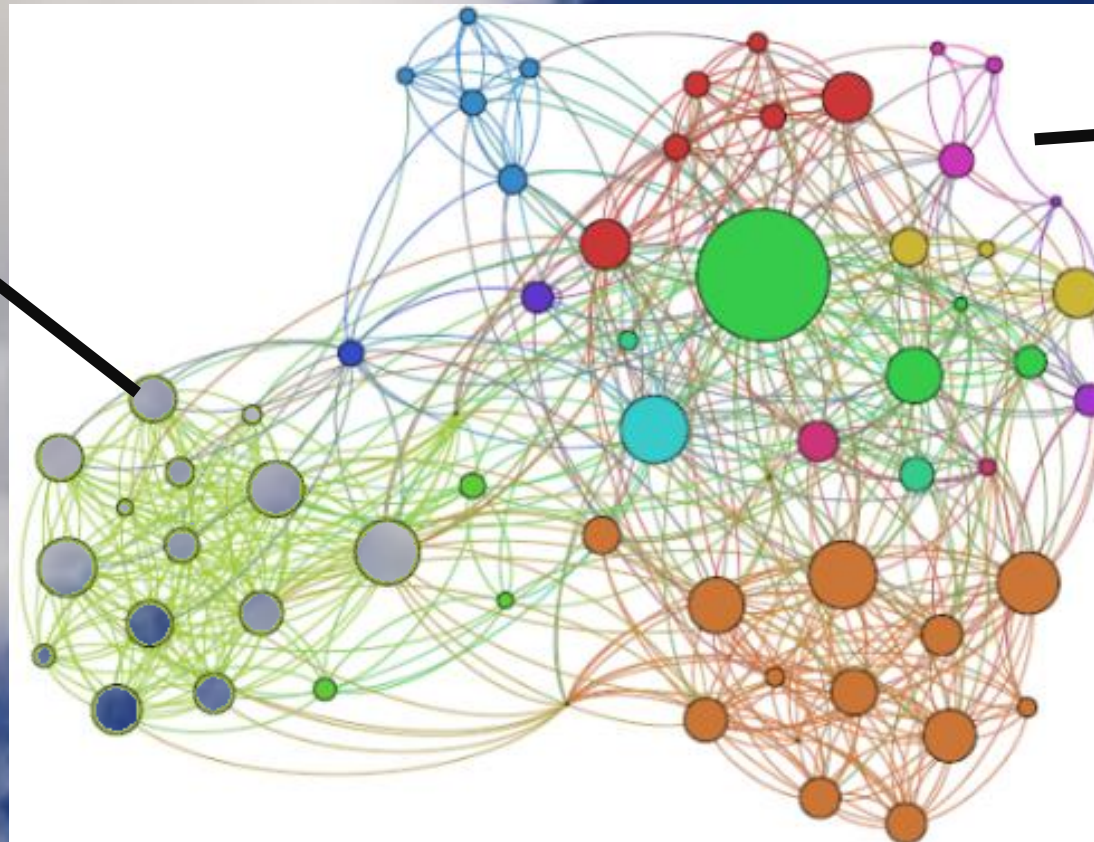


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Node = Person



Connection
between nodes

Source: Alarcón et al. (2013)
Gestión de la Producción, Asesorías SpA

Shared Understanding



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Source: Cash et al. (2017); Kereri & Harper, (2019); Herrera et al. (2020)
Kleinsmann et al. (2012); Viana et al. (2011)

Research Methodology



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- Selection of projects were with companies belonging to the Engineering and Construction Management Research (INGECO – Colombia) and Collaborative Group of the Center of Excellence in Production Management (GEPUC – Chile)
- Two colombian projects and two chilean projects.
 - Last Planner® System
 - Tall building projects
- Metrics
 - Linguistic Action Perspective: metrics according to Salazar et al. 2018 and video-recording in WWP
 - Social Network Analysis: Surveys for each Project about
 - Knowledge of roles and responsibilities
 - Collaboration
 - Planning and problema solving
 - Learning
 - Trust
 - Requirement negotiation

Research Tasks



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Surveys and
indicators
selection

- Current indicators validated by Herrera et. Al (2020) for SNA and Salazar et al. (2019) for Linguistic Action Perspective

Instrument
application

- 4 non-consecutive weeks for each project
- Surveys for SNA and video recording for LAP to validate results

Analysis

- Differences between each Project for each SNA metric
- Analyze the relationship between PPC, LAP, SNA metrics and sociocultural conditions

Discussion
and
conclusions

- Cause-and-effect análisis of each dataset collected

Case Studies (PPC)



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Location	Project	Dates were measured	Percentage Plan Completed (%)				
			Week 1	Week 2	Week 3	Week 4	Average
Santiago, Chile	A	April 30th to June 11th. 2019	71.79	78.95	71.43	70.59	73.19
	B	May 8th to June 5th, 2019	35.71	52.94	50.00	30.77	42.36
Bogota, Colombia	C	October 1st to October 29th	69.39	84.35	54.93	73.24	70.48
	D	September 30th to October 28th, 2019	67.22	67.60	69.29	69.29	68.35

Case Studies (LAP indicators)



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LAP indicator (%)	Project			
	A	B	C	D
Arrives on time (+)	63.4	65.53	87.85	63.18
Take notes (+)	64.25	44.35	38.48	30.98
Check mobile phone (-)	1.48	9.48	14.95	31.60
Mobile phone rings (-)	1.33	4.38	15.20	12.48
Talk by mobile phone (-)	0.00	2.33	5.05	10.08
Leave the room (-)	5.43	10.15	4.90	7.23
Walkie talkie rings (-)	1.33	0.00	0.00	1.43
Talk by walkie talkie (-)	1.33	0.00	0.00	0.00
Does not speak in meeting (-)	13.35	30.58	16.23	19.70
Does not look at the person who is speaking (-)	0.00	3.75	0.00	1.58
Average LAP (“+”) (%)	63.83	54.94	63.16	47.08
Average LAP (“-”) (%)	3.03	7.58	7.04	10.51

Source: Own elaboration

Case studies (SNA Metrics)



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SNA Metric	Project			
	A	B	C	D
Role knowledge density	68%	71%	43%	28%
Planning network density	19%	54%	13%	8%
Collaboration density	23%	31%	9%	6%
Trust indicator	47%	58%	71%	54%
Learning density	23%	47%	26%	13%
Negotiation indicator	68%	59%	41%	39%

Source: Own elaboration

Analysis

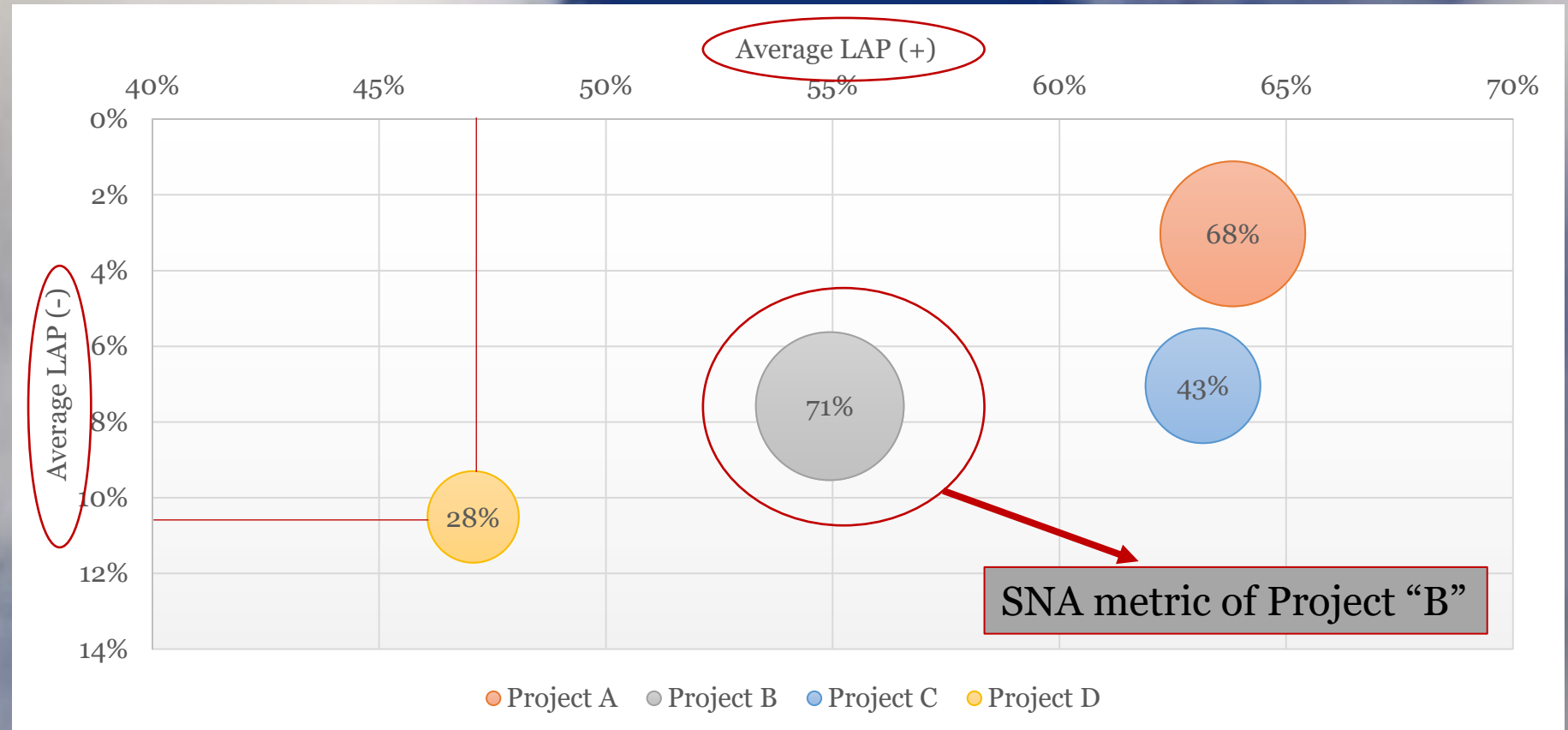


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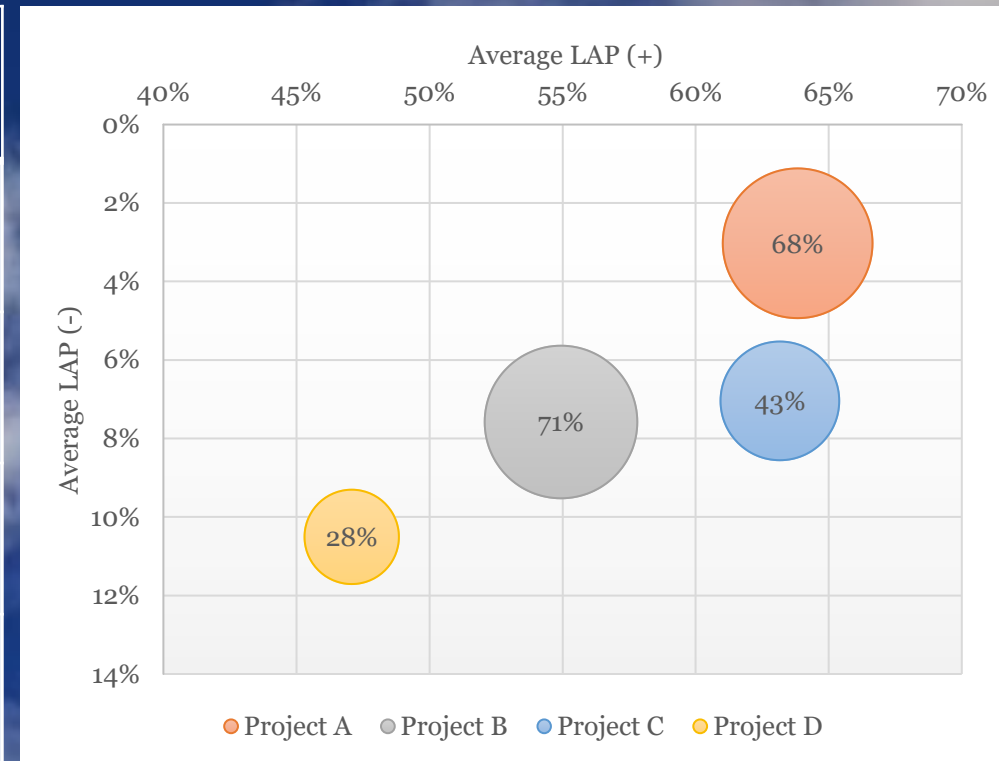
Project	PPC avg (%)
A	73.19
B	42.36
C	70.48
D	68.35



Role knowledge network density

- Project B has the worst PPC indicators
 - 35.71% - 52.94% - 50.00% - 30.77%
 - Unusual behavior between SNA metrics and LAP indicators
 - Many interactions, but they were not talked about next steps. According to videos, only they discussed about technical aspects
- Colombian projects have low percentages
- Chilean projects have better knowledge of roles
- Best knowledge of roles implies better PPC

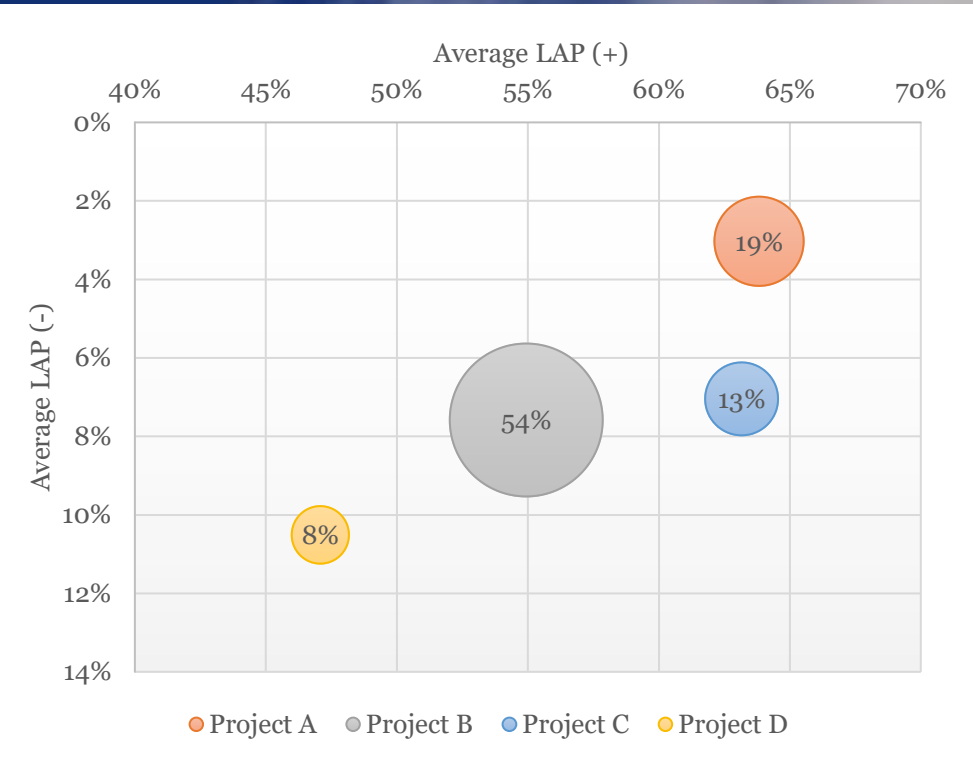
Project	PPC avg (%)
A	73.19
B	42.36
C	70.48
D	68.35



Planning network density

- Project B has the worst PPC indicators
 - 35.71% - 52.94% - 50.00% - 30.77%
 - Videos were watched again and only talk about technical aspects. They were not talk about weekly planning
 - Disorder was generated in LAP (“-”) since it is not proven that more interactions are related to better planning (Herrera et al., 2020)
- Projects A, C, and D have low interactions.
- Chilean projects have better planning reliability than Colombian projects

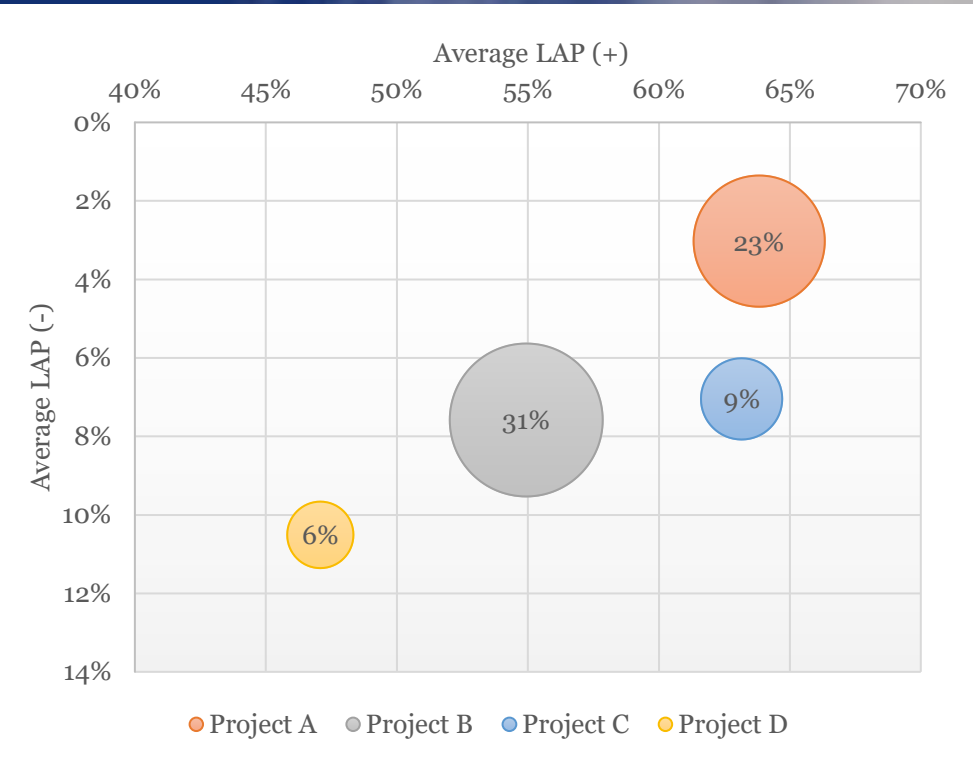
Project	PPC avg (%)
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B	42.36
C	70.48
D	68.35



Collaboration network density

- Project B with the same unusual behavior, but 31% is not excessive
- Project A has better collaboration than planning.
 - Team members talk about more aspects than it is necessary
- Chilean projects have lower collaboration than Chilean projects
 - Team members talk about more aspects than it is necessary
 - WWP in Chile have the longest duration

Project	PPC avg (%)
A	73.19
B	42.36
C	70.48
D	68.35





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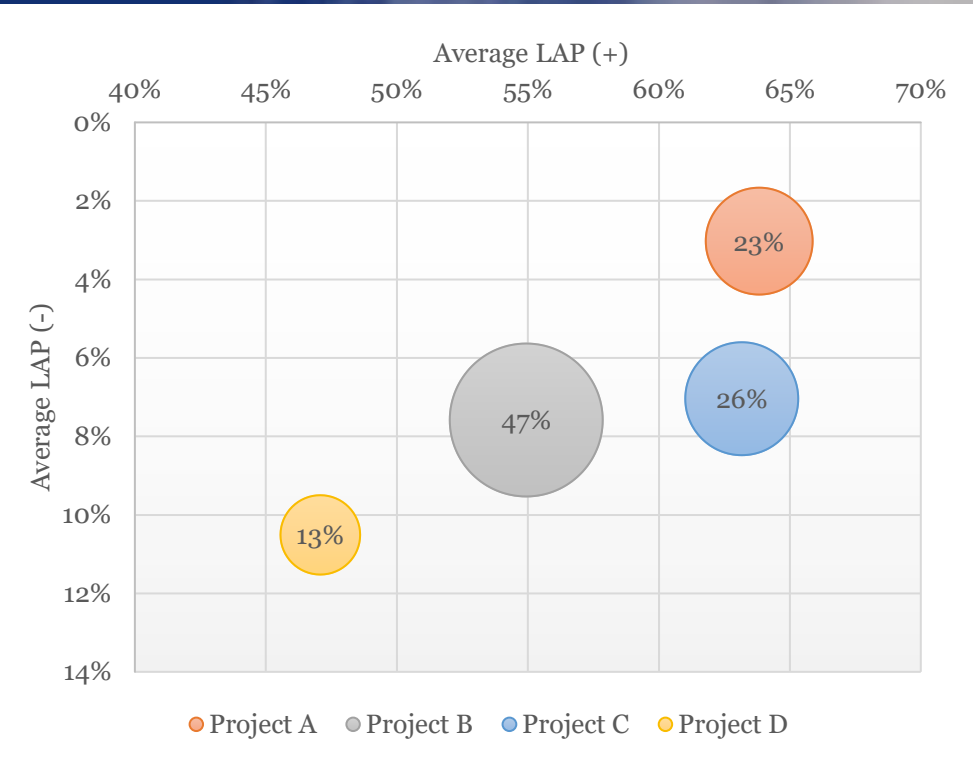
Trust indicator

- People in colombian projects know fewer people than chilean projects
- Colombian workers do not know their peers' roles.
- In Chilean projects are better than those in the Colombian projects in all aspects because Trust indicator reveals the trust that team members generate when requesting different tasks and how they make these requests, avoiding the organizational structure and being more direct in requesting and delivering information among their peers.

Learning Network density

- Project B has the greatest collaboration and planning metrics.
 - The greatest Learning
- Projects A and C have the best LAP indicators and the same behavior in PPC.
- Learning implies better performance in PPC

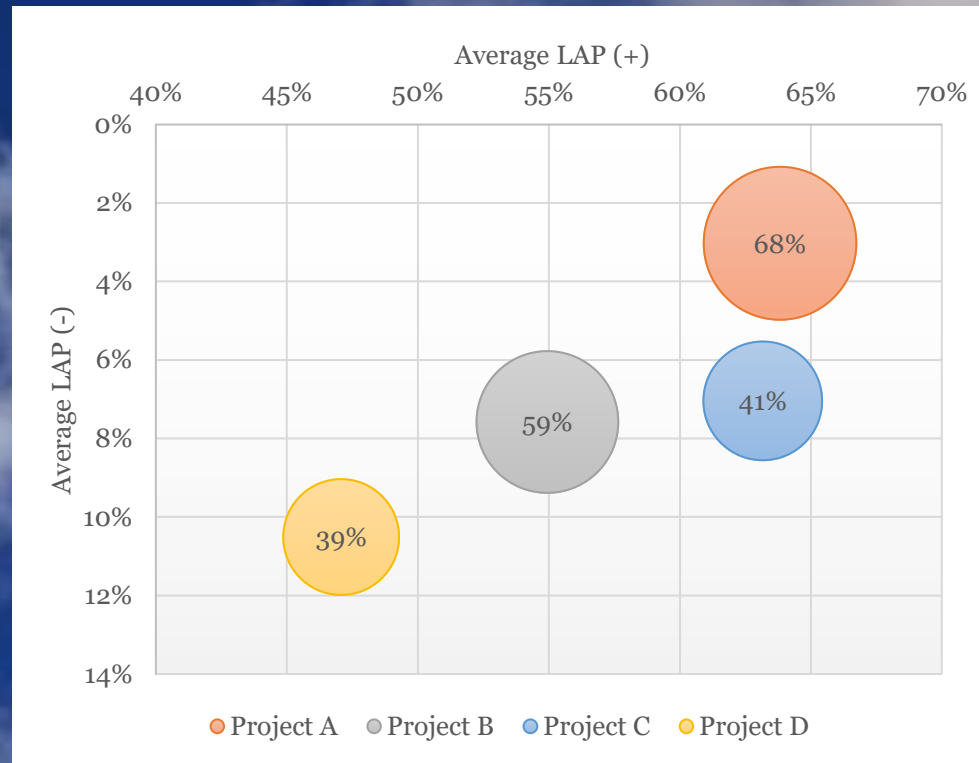
Project	PPC avg (%)
A	73.19
B	42.36
C	70.48
D	68.35



Negotiation indicator

- Bidirectional indicator
- When better LAP indicators are shown, it produces better SNA Metrics and PPC
- Project B is the exception:
 - It has low PPC because of the arguments regarding to the previous metrics.

Project	PPC avg (%)
A	73.19
B	42.36
C	70.48
D	68.35



Conclusions



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- Colombian projects had lower interactions and knowledge between their peers.
 - Importance of culture in the relationship between Project planning reliability and weekly meeting planning may be investigated in future research
- Project A is the best Project: Great PPC, LAP indicators and SNA metrics
- Project B has the worst PPC and Good SNA metrics
- Relationship between Negotiation and LAP indicators is strong
 - In future research, it requires more projects to better show their behavior
- It is important to know the context of each Project
 - Use video recording and stay during WWP
- This research is an approach to establish new ways of measuring between the use of SNA, LAP and PPC, using statistical models for more projects.



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Metrics used in Social Network Analysis



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Network	Metric	Description
Knowledge of roles and responsibilities	Density	Ratio between the number of actual knowledge of roles links existing between nodes and the number of total possible links in the network.
Collaboration	Density	Ratio between the number of validated collaboration links (bidirectional connection) and the number of total possible links in the network.
Planning and problem solving	Density	Ratio between the number of validated planning and problem-solving links (bidirectional connection) and the number of total possible links in the network.
Learning	Density	Ratio between the number of actual learning links existing between nodes and the number of total possible links in the network.
Trust	Trust index	Ratio between the number of trust links and the number of knowledge of roles links.
Requirement negotiation	Negotiation index	Ratio between the number of validated negotiation links (bidirectional connection) and the number of links in which a requirement is realized.

Metrics used in Linguistic Action Perspective



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LAP indicator	Description
Arrives on time (+)	Number of people who arrives on time / Total people in WWP
Take notes (+)	Number of people who takes notes / Total people in WWP
Check mobile phone (-)	Number of people who checks mobile phone at least twice / Total people in WWP
Mobile phone rings (-)	Number of people who it mobile phone rings at least once / Total people in WWP
Talk by mobile phone (-)	Number of people who talks by mobile phone at least once / Total people in WWP
Leave the room (-)	Number of people who leaves the room at least once / Total people in WWP
Walkie talkie rings (-)	Number of people who it walkie talkie rings at least twice / Total people in WWP
Talk by walkie talkie (-)	Number of people who talks by walkie talkie at least once / Total people in WWP
Does not speak in meeting (-)	Number of people who does not speak in meeting / Total people in WWP
Does not look at the person who is speaking (-)	Number of people who does not at the person who is speaking / Total people in WWP