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INDICATORS FOR OBSERVING ELEMENTS OF LINGUISTIC ACTION PERSPECTIVE IN LAST PLANNER® SYSTEM

Luis A. Salazar¹, Glenn Ballard², Paz Arroyo³ and Luis F. Alarcón⁴

ABSTRACT

The implementation of the Last Planner® System increases the reliability of planning and performance levels through the management of commitments. So far, the conversations during which commitments are set at planning meetings have not been analyzed in sufficient depth. However, this analysis is essential to generate reliable commitments that reduce the uncertainty and variability of projects. The research reported in this paper moves toward this analysis by developing indicators of commitments based on the Linguistic Action Perspective, developed by Fernando Flores. Indicators of commitments (i.e. definition of roles and responsibilities, declaration of the relevance of each commitment); requests and promises (i.e. making the deadline explicit); and foundations of trust (i.e. reliability), were developed and tested based on the methodology "Design Science Research". To verify the feasibility of measuring these indicators, a pilot test was conducted, which consisted of a Villego® Simulation applied to a group of students. Given the nature of this simulation, only part of the indicators could be verified, while the remainder is currently being verified through observation on site. The indicators that were validated are a useful tool to measure, control and improve the management of commitments in planning meetings, as they provide fast and specific feedback on these aspects, which undoubtedly enriches implementation of the Last Planner® System.

KEYWORDS

Linguistic Action Perspective, Last Planner® System, Commitments Management, Villego® Simulation, Planning meetings.

¹ PhD candidate, Department of Construction Engineering and Management, Pontificia Universidad Católica de Chile, Researcher – GEPUC, Santiago, Chile, +56 2 2354 7165, lasalaza@uc.cl

² Research Director of the Project Production Systems Lab., Univ. of California, Berkeley, CA 94720-1712, USA, +1 415 710-5531, ballard@ce.berkeley.edu

³ Assistant Professor, Department of Construction Engineering and Management, Pontificia Universidad Católica de Chile, Santiago, Chile, +56 2 2354 7165, parroyo@ing.puc.cl

⁴ Professor, Department of Construction Engineering and Management, Pontificia Universidad Católica de Chile, Santiago, Chile, +56 2 2354 7165, lalarcon@ing.puc.cl

INTRODUCTION

The main problem of the construction industry is that the productivity factor has not increased as in other industries over the last fifty years (Eastman et al. 2011). To improve productivity, efficiency must be increased through better planning and control of projects, standardization and strengthening of the technical and operational capacities of workforce (McKinsey & Company 2009).

Therefore, it is necessary to generate changes in behavior and training in the use of Lean tools and concepts in the construction industry (Salem et al. 2006), mainly because it differs from manufacturing due to its structure, which presents greater complexity and uncertainty (Ballard and Tommelein 2016). Last Planner® System developed by Glenn Ballard and Greg Howell in the 90's (Ballard and Tommelein 2016), is one of the methodologies that has led the introduction of concepts and principles of Lean Production in construction (Daniel et al. 2015).

LAST PLANNER® SYSTEM AND PERSPECTIVE LINGUISTIC ACTION PERSPECTIVE

LAST PLANNER® SYSTEM

Last Planner® System (LPS) is a methodology of planning and control of commitments, based on the principles of Lean production philosophy and oriented to increase reliability of planning and levels of performance (Ballard and Tommelein 2016), which in turn reduces uncertainty and variability of projects. Reliability of production is affected by the effectiveness of the control of dependencies and fluctuations between activities (Goldratt and Cox 2013). An example of reliability measure is variability (O'Brien et al. 2008), understood as the potential changes in execution time or duration of a process (Alves and Tommelein 2003). Uncertainty is due to the existence of non considered variables, such as: availability of suppliers, unclear or incorrect designs, availability of labor, and administrative problems, among others (Rodríguez et al. 2011).

COMMITMENT MANAGEMENT IN LAST PLANNER® SYSTEM (LPS)

Due to the importance of achieving an adequate management of commitments, to reduce the uncertainty and variability of construction projects, it is necessary to strengthen the commitment management system in weekly planning meetings, because a coordinated action is achieved through a complex network of requests and promises that may well be the only viable method of coordination under dynamic conditions (Ballard and Tommelein 2016). In this sense, Howell et al (2004) propose the Linguistic Action Perspective (LAP) developed by F. Flores as a referential framework or paradigm suitable to understand the functioning and effectiveness of LPS.

LINGUISTIC ACTION PERSPECTIVE (LAP)

Linguistic Action Perspective was developed by F. Flores (2015) and it is basically an application of Speech Act Theory (e.g. Austin, 1971; Searle, 1969) to organizational management. F. Flores (2015) argues that conversations do not simply precede action, but

rather constitute actions themselves through the commitments that emerge. This way, language is the primary means for creating a common future, for the coordination of human action, or in other words, for cooperation (2015). This idea refers to the founding work of Austin (1971) and the notion of illocutionary acts, or the actions we carry out when we say certain words. For example, by saying "I promise" I change the world, both the actions I take and those taken by others expecting me to do what I promise. This idea was later developed by Searle (1969), who proposed a taxonomy of speech acts.

Understanding "conversations for action" as those conversations whose purpose is the coordination of actions, Flores proposes a basic and universal structure, based on the performance of certain speech acts (2015). Thus, every conversation for action includes four basic speech acts: 1) request or offer, 2) promise or acceptance, 3) declaration of compliance and 4) declaration of satisfaction. These speech acts, in Searle's taxonomy, correspond respectively to directives (request), commissives (offer, promise and acceptance) and declaratives (statement of compliance and declaration of satisfaction), which are precisely those that modify the possibilities of action in the future, or in other words, those that modify the state of affairs through words (Searle 1975). Flores also uses these acts to define four stages of a conversation for action, in which a network or chain of commitments is established: 1) preparation of a request; 2) negotiation and agreements; 3) execution and declaration of compliance; and 4) acceptance and declaration of satisfaction. It should be noted that variations in basic movements may occur, such as declining a request, revoking a previous commitment or making a counteroffer: this, according to Flores, does not decrease the reliability but increases it (2015). For more details see Figure 1.



Figure 1: Network or Chain of Commitments Source: Own elaboration, based on (F. Flores, 2015)

PRACTICAL PROBLEM THAT IS BEING ADDRESSED

Although, as previously suggested, LAP has been proposed as a suitable framework for understanding the effectiveness of LPS (e.g. Howell et al., 2004; Macomber & Howell, 2003), until now there are no quantitative instruments to measure specific elements of LAP. A first effort to provide empirical evidence on the usefulness of LAP to understand LPS are works of Viana, Formoso, & Isatto (2011, 2016). The first of these works (Viana et al. 2011) proposes, based on a case study, a descriptive model of the networks of commitments in LPS, as well as a detailed analysis of planning meetings. The second study (Viana et al. 2016) is built on the previous one and specifically contributes to identify interruptions (breaks and failures) that occur in the stages of a conversation for

action (Flores 2015), as well as quantify how participative the environments are, measuring the times dedicated to the different activities during the planning meetings.

However, the analysis offered by the aforementioned works does not explain the relation between the way in which the commitments are established and the compliance of those commitments, measured by percent plan complete, and therefore the effectiveness of the LPS. In this sense, our proposal for measurement and control of commitment management seeks to reduce the uncertainty and variability of the projects.

RESEARCH METHODOLOGY

PROCESS OF DESIGN AND CONSTRUCTION OF THE INDICATORS

To fulfill the objective, the research methodology was based on Hevner's "*A Three Cycle View of Design Science Research*" (2007). The following steps were carried out:

1. To study the Linguistic Action Perspective, to generate a *Knowledge Base*, based mainly on F. Flores (2015).
2. To identify the elements of this perspective that were potentially quantifiable, creating a list of concepts and data to be measured.
3. To develop indicators that could measure and control the previously identified elements, to generate the *Design Science Research*.
4. To discuss with a panel of international experts the feasibility of measuring and controlling these indicators, which allows improving the initial design.
5. To validate proposed indicators, verifying the feasibility of observing these indicators by means of a Villego® simulation applied to a group of students as a pilot test, to validate them through the *Environment* in a controlled situation.

INDICATORS: PROPOSAL AND VERIFICATION

INDICATORS

The authors propose a series of *Key Performance Indicators* (KPIs) according to Linguistic Action Perspective to measure and control fundamental aspects of the commitments, requests, promises and foundations of trust.

Within the KPIs that measure and control the commitments, the relevant data to be evaluated are: the network or chain of commitments, roles and responsibilities of the performers, declaration of the importance of the commitment and the availability of the performers (The worker's agenda). On the other hand, to measure and control requests and promises, among the data to be evaluated are: specify the deadline, unnecessary requests, and incomplete promises. Finally, to measure and control the foundations of trust, the main data to be evaluated are: competence of the performer, reliability and engaged participants.

It is worth mentioning that these indicators are designed to analyze the management of commitments in weekly planning meetings, so the frequency of measurement is every 7 days. However, a measurement from at least 2 weekly meetings is required in order to complete the network or chain of commitments, since in the first meeting the request is usually prepared, negotiated and the agreement is reached, while in the second meeting

the execution and declaration of compliance is verified, together with the acceptance and declaration of satisfaction. (The list of proposed indicators can be observed in Table 1.)

TABLE 1. KPI Linguistic Action Perspective in Last Planner® System

Objective	Measure Name	Description	Formula	Means of Verification
Measurement and Control of Commitments	% compliance network or chain of commitments	KPI measures the percentage of compliance with the chain of commitments; that is to say, that the 4 movements for the coordination are fulfilled	$(\text{Number of commitments in which the 4 movements for coordination are fulfilled}) / (\text{Total number of commitments}) \times 100$	That the 4 movements for coordination are fulfilled
	% definition of roles and responsibilities of the performers	KPI measures the percentage of commitments that define roles and responsibilities of performers	$(\text{Number of commitments with defined roles and responsibilities}) / (\text{Total number of commitments}) \times 100$	Roles (Who): Client and Performer Responsibilities (What): Definition of the promise of which the performer takes charge
	% fulfillment of roles and responsibilities of performers	KPI measures the percentage of commitments in which the roles and responsibilities of previously defined performers are met	$(\text{Number of commitments that fulfilled previously defined roles and responsibilities}) / (\text{Total number of commitments}) \times 100$	That the performer (not another) fulfill the promise and declare compliance to the client
	% declaration of the importance of commitment	KPI measures the percentage of commitments that declare the importance (priority) of this, explicitly	$(\text{Number of commitments declaring importance}) / (\text{Total number of commitments}) \times 100$	Declare the importance (priority) of commitment in the first 2 movements
	% compliance with priority commitments	KPI measures the percentage of commitments that were declared important (priority) and that are effectively met	$(\text{Number of priority commitments fulfilled}) / (\text{Total number of priority commitments}) \times 100$	Review of priority commitment review agreed previously
	% verification of availability of performers in agreements	KPI measures the percentage of commitments that verify the availability of performers in the negotiation stage and agreements	$(\text{Number of commitments that verify availability of performers in agreements}) / (\text{Total number of commitments}) \times 100$	Verification of the availability of performers in the negotiation stage and agreements. The executor (workers) agenda can be requested from the foreman
	% verification of availability of performers in execution	KPI measures the percentage of commitments that verify the availability of performers in the execution stage	$(\text{Number of commitments that verify availability of performers in execution}) / (\text{Total number of commitments}) \times 100$	Compliance with the verification of the availability of performers in the execution stage
	% specify the deadline	KPI measures the percentage of commitments that specify the deadline	$(\text{Number of commitments that specify the deadline}) / (\text{Total number of commitments}) \times 100$	Specific deadline: date and time (AM, PM)
	% of unnecessary requests	KPI measures the percentage of commitments that make unnecessary requests	$(\text{Number of commitments that make unnecessary requests}) / (\text{Total number of commitments}) \times 100$	When the client declares that the deadline specified in the request does not correspond to the last responsible moment and / or requested something that was not necessary (does not add value)
	% of incomplete requests and promises	KPI measures the percentage of requests and promises that do not comply with explicit conditions of satisfaction, background of obviousness and / or specific term	$(\text{Number of commitments that make requests and incomplete promises}) / (\text{Total number of commitments}) \times 100$	Explicit conditions of satisfaction, background of obviousness and specific deadline
Measurement and Control of Peditons and Promises	% compliance of the performer's competence	KPI measures the percentage of commitments where the performer is able to perform in the required domain	$(\text{Number of commitments where performer is competent}) / (\text{Total number of commitments}) \times 100$	Performer is able to perform in the required domain (recurring performance according to accepted standards)
	% reliability compliance (*) complementary to PPC)	KPI measures the percentage of commitments where the performer is able to perform reliably and timely in the required domain	$(\text{Number of commitments fulfilled} + \text{number of commitments revoked}) / (\text{Total number of commitments}) \times 100$	Performer keeps his promises on time (PPC); counteroffer or revokes
	% Engaged participants	KPI measures the percentage of meeting participants who are engaged to it	$(\text{Number of participants engaged to the meeting}) / (\text{Total number of attendees}) \times 100$	Participant attends the meeting, arrives at the time and remains in an attitude that suggests concentration (does not interact with the cell phone, looks at the speaker, takes notes, etc) (Failing to comply with any previous aspect, justify it before or during)
Fundamentals of Trust				

Source: Own elaboration, based on (F. Flores, 2015)

VILLEGO® SIMULATION

To analyze and validate each of the proposed indicators, it was decided to verify the feasibility of observing and measuring these indicators by means of the Villego® simulation. For this purpose, 11 volunteer students of the sixth semester of Civil Engineering, at the Pontificia Universidad Católica de Chile, were asked to perform the simulation. The authors video-recorded the two rounds of the simulation (simulation of the traditional process of planning and simulation with LPS) to be able to analyze each one of the proposed indicators.

First Round Villego® Simulation

After giving the general instructions of the simulation, students were asked to define the roles and responsibilities that each member would assume in this round, defining the following roles: administrator, quality, technical inspection, security, warehouse, and several subcontractors identified with different colors; gray, blue, white, yellow, green and red.

Second Round Villego® Simulation

After giving the new general instructions of the simulation, the students were asked to redefine the roles and responsibilities of each member, according to the lessons learned from the initial round.

RESULTS VILLEGO® SIMULATION AND COMPARISON WITH ACTUAL EXPERIENCE

To determine the feasibility of observing the list of proposed indicators, the videos of both rounds were analyzed once the simulation was completed. The differences between the results obtained in the Villego® simulation and the expected results (according to preliminary field studies) in a real planning meeting are described below.

1. Compliance network or chain of commitments

- Simulation: the two initial movements for coordination always occurred, but Administrator most of the time "imposes" the conditions and deadlines, without much space for negotiation. Then, the declaration of compliance was taken for granted, simply with the phrase "ready". Acceptance and declaration of satisfaction in general was not made explicit.
- Real: it will depend on the degree of maturity in the implementation of the LPS and the management of commitments that the team has.

2. Definition of roles and responsibilities

- Simulation: roles and responsibilities are defined at the beginning of the simulation. This is intrinsic to the Villego® simulation.
- Real: in general, the role of participant in the meeting should be previously defined (each stakeholder in a construction site has a clear role to perform).

3. Fulfillment of the roles and responsibilities of the performers

- Simulation: all the commitments fulfilled the previously defined roles and responsibilities, since the same foremen perform the work.
- Real: difficult to comply, because generally the last planner is the foreman.

4. Declaration of the importance of the commitment

- Simulation: the importance of commitment was never stated, because it is a simulation, where time is very limited and all tasks are critical.
- Real: it is desirable that there is a declaration of importance, in key commitments of the project, currently this does not happen.

5. Compliance with priority commitments

- Simulation: the importance of the commitment was never declared. Therefore, no further verification was necessary.
- Real: should be fulfilled with the declaration of the importance made, to generate confidence in the team, currently this does not happen.

6. Verification of availability of performers in agreements

- Simulation: it is redundant because roles and responsibilities are defined at the beginning of the simulation.
- Real: it is difficult to comply, because generally the last planner is the foreman, and the one who performs the action (performer) is a worker dependent on him.

7. Verification of the availability of performers in execution

- Simulation: it is redundant because roles and responsibilities are defined at the beginning of the simulation.
- Real: it should be fulfilled, since once assumed the commitment by the foreman, it should generate an agreement with the worker (performer) in order to verify the commitment previously assumed.

8. Specify the deadline

- Simulation: yes, weekly planning is carried out according to simulation restrictions.
- Real: it indicates the date of fulfillment of the commitment, but not the approximate time, since usually is not even indicated whether the term will expire in the morning or in the afternoon.

9. Unnecessary requests

- Simulation: no unnecessary requests were observed.
- Real: sometimes unnecessary requests are made when a correct weekly planning and an adequate analysis of the executable work inventory are not carried out. The above is due to problems in the implementation of the LPS.

10. Requests and incomplete promises

- Simulation: due to the nature of the simulation, space is not given for this type of considerations.
- Real: a high percentage of requests and promises are incomplete, since the conditions of satisfaction are not always explicit. This can lead to misunderstandings that lead to non-compliance of commitments.

11. Compliance of the performer's competence

- Simulation: a change of roles and responsibilities was performed, according to the competencies that the team could detect from round 1.
- Real: the competence of the performer should be verified through their technical experience (Curriculum Vitae) and their social skills (how they work with their co-workers).

12. Reliability compliance

- Simulation: no counteroffers or revocations were observed, probably due to the conditions of the simulation (shortage of time).
- Real: currently it is difficult to measure because it occurs outside the meeting, it is expected that there will be counteroffers and revocations by the foremen (last planners) and workers (performers). It's considered essential to measure this indicator, since currently the PPC only measures if the commitment was fully complied with and this is associated with the degree of reliability of the commitment.

13. Engaged participants

- Simulation: due to the conditions of the simulation, it was evident that they attended the meeting and arrived at the time (they were there). But, regarding the attitude of concentration, it was verified that not all the assistants fulfilled the required attention: they looked at the cell phone and spoke among themselves (on topics unrelated to the meeting). Also, nobody took notes.
- Real: currently the participants do not arrive at the time nor do they attend the meeting in an attitude that suggests concentration.

CONCLUSIONS

Because the construction industry has not yet reached the productivity levels of other industries, project planning and control must be improved to generate a change in the industry. Last Planner® System (LPS) is a methodology for planning and control of commitments, which seeks to reduce the uncertainty and variability of construction projects by increasing the reliability of planning. In this sense, Linguistic Action Perspective (LAP) developed by Fernando Flores, proposes a basic and universal structure of the conversations by means of which said commitments are established, based on the performance of certain speech acts.

Due to the fact that at the date of the present investigation, there were no quantitative instruments available to measure specific elements of LAP, apart from the work done by Viana et al., (2011, 2016), the authors created and validated a set of *Key Performance Indicators* as a proposal for measurement and control of fundamental aspects of the commitments, requests, promises and foundations of trust.

The methodology used by the team to carry out the indicators was *Design Science Research*.

Given the nature of this simulation, only able to verify the indicators of commitment; compliance network or chain of commitments; definition of roles and responsibilities of the performers; fulfillment of the roles and responsibilities of the performers; specify the deadline; compliance of the performer's competence; and engaged participants. On the other hand, indicators of: declaration of the importance of the commitment; compliance with priority commitments; verification of availability of performers in agreements; verification of availability of performers in execution; unnecessary requests; incomplete promises and promises; and reliability compliance, are currently under verification process in construction projects in Chile.

In addition, the authors propose as future lines of research: apply case studies in weekly planning meetings in construction projects and other industries, worldwide and determine the recommended values to improve communication and achieve a proper implementation of LAP in LPS.

Finally, the authors consider that this first generation of validated Key Performance Indicators are a useful tool to measure, control and improve the management of commitments in planning meetings, as they provide a fast and specific feedback on these aspects, which without doubt undoubtedly enriches Last Planner® System.

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