

LAST PLANNER SYSTEM[®] AND LEAN APPROACH PROCESS[®]: EXPERIENCES FROM IMPLEMENTATION IN MEXICO

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ABSTRACT

This paper addresses seven pilot projects in the implementation of Last Planner System[®] (LPS) in Mexico initiated by one general contractor. The work concerns reflections during nine months in the construction process.

Firstly, applying action research, preliminary data is presented from Lean Approach Process[®] (LAP) and LPS implementation. All the data has been gathered through various methods including surveys, interviews and observation.

Secondly, benefits of the LPS implementation in terms of improving production planning and control process are presented. However, barriers and difficulties exist that prevent the implementation of the system.

Finally, proposals are identified for further improvements in the implementation of LPS in Mexican culture.

KEYWORDS

Last Planner, Lean Approach, Production Planning and control, culture, Mexico

INTRODUCTION

The chronic problems of construction are well known: low productivity, poor safety, inferior working conditions, and insufficient quality (Koskela, 1997). LPS, the most developed tool of Lean Construction, stresses the relationship between scheduling, planning and production control in order to produce predictable workflow (Adamu & Howell, 2012) and it was developed by Ballard (Ballard, 2000).

The literature shows many lean construction and LPS implementations in many countries (Itri Conte, 2002) (Johansen & Porter) (Alarcón, Diethelm, Rojo, & Calderón, 2005). The basic starting point for lean thinking is value (Womack & Jones, 2003). However, a successful implementation requires a proper adaptation to both the country's culture and the company that runs it. Considering these two factors our aim is to find ways to add value during implementation while respecting the culture of the country and the company.

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In addition, Research on Lean and LPS shows no evidence into its practical application within construction industries in Mexico.

This study exemplifies the implementation of LPS considering customer value and respecting their cultural habits. To understand the process we will attend to the Lean Approach Process® (Napolitano, Lean Approach Process, 2011). Through seven case studies the benefits of the implementation, the CSF and barriers within the Mexican culture will be shown.

The paper concludes sharing the results, outcome and reflections of the LAP and LPS implementation in the Mexican construction industry.

RESEARCH METHOD

Seven case studies on an action research mode and consulting work were conducted to examine the impact of LPS on improving construction planning practice in the Mexican company.

Data was collected by:

- Interviews with participants to understand the current situation in planning management
- Survey questionnaire to evaluate the management practices in the company and the relationship between departments in the planning process
- Interviews with stakeholders during the implementation of LPS
- Observation attending the Pull Sessions and the weekly meetings

LEAN APPROACH PROCESS ® IMPLEMENTATION

DESCRIPTION OF THE COMPANY

MARHNOS is a private company founded in January 12, 1954, a company that is among the ten major construction companies in the United Mexican States, with leadership in the field of integrated development.

It participates in the market as a general contractor. It is a construction company specialized developer and a manager of real estate, as well as a concessionaire of infrastructure projects. Nowadays, the company is proposing a transformation of the organizational culture.

IMPLEMENTATION STRATEGY

The Lean Approach is a process (LAP) developed by Paulo Napolitano (2009). This process (Figure) helps to start the lean transformation in an organization, project or process. It contains the elements to follow the Lean Roadmap. It has been successfully tested by several organizations that went through the Lean training at Herrero Contractors Company in California.

LAP is based on the five elements of Lean Thinking: (1) Identify customer value (2) Identify chain of value (3) Flow (4) Pull (5) Perfection. Combined with Scientific thinking, Systemic thinking and Constancy of purpose the organization will achieve operational excellence. It is also aligned with Edward Deming's PDCA Cycle (Plan, Do, Check, Act).

Phase 1: Identify customer value in the organization, project or process. Customers follow up a matrix of values where they explain what is value for them and what it means. Through an affinity diagram of these values we obtain the True North Indicators (TNI's). However a Relationship Diagram (RD) is needed in order to understand which TNI has the biggest impact on the others. This impact defines which TNI is a driver and which one is a driven. A Key Performance Indicator (KPI) is related with each TNI to measure if the organization, project or process is adding these customers' values.

Phase 2: Identify chain of value; in this case LAP® is applied for the planning process, one of the many goals is to eliminate waste. In order to effectively see what waste needs to be eliminated within a process, first, a map of the process to understand current state is needed applying Value Stream Mapping concepts(Rother & Shook, 1999). The A3 report is used to understand and assess the current situation, identify the problem analysing the root cause, present the target condition practicing problem solving, the implementation plan and the assessment to follow the implementation.

Phase 3: Flow; to create this flow, LAP uses a matrix of flow where the responsible agent and what he needs to generate this flow are identified. With an Andon System this matrix shows if the person responsible for creating the flow is doing it, and if not it shows why.

Phase 4: Pull; now the process is ready to create flow trough a pull system.

Phase 5: Perfection; the whole process is tested. Contra measures are used to improve the process continuously.

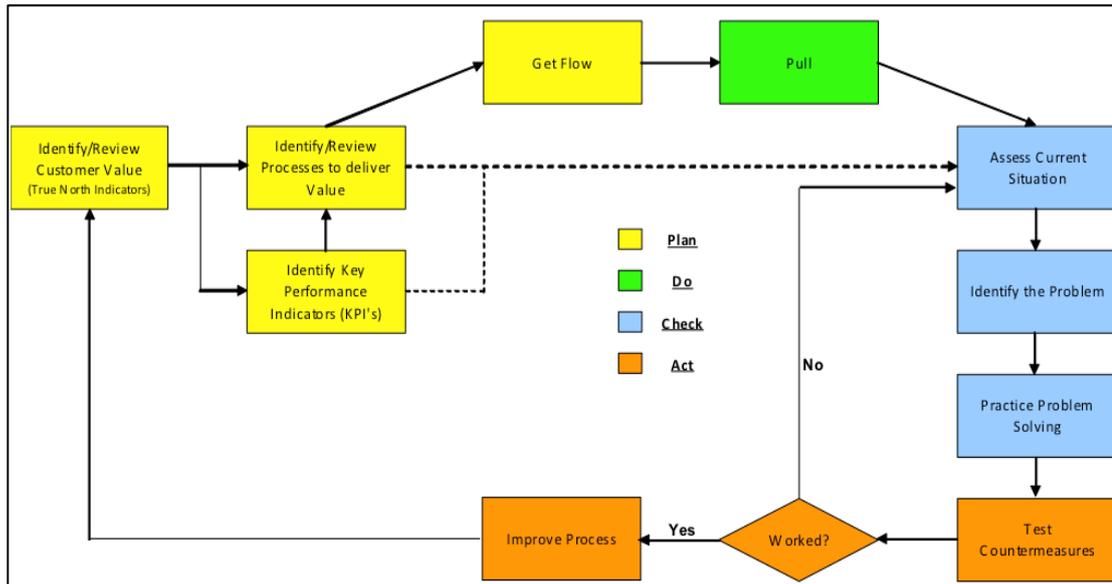


Figure 1: The Lean Approach Process (Napolitano, Lean Approach Process, 2011)

LAST PLANNER SYSTEM® IMPLEMENTATION

DESCRIPTION OF THE PROJECTS

Table 1 shows some general details about the projects on which LPS is being or has been implemented. To define general details of the projects Table 1 is used according to (AlSehaimi, Tzortzopoulos, & Koskela, 2008)

Table 1: Description of Projects implementing LPS

| PROJECT | CONTRACT | ESTIMATED DURATION | IMPLEMENTATION TIME | SUBCONTRACTORS |
|-----------------------|------------------|---------------------------|-----------------------------------|---|
| GDL | 700 Million Mxp | 12 Months | 9 Months | Structural ,Electrical, Mechanical, Finishes |
| Torre México | 600 Millions Mxp | 17 Months | 14 Months | Structural, Electrical, Mechanical. |
| Monterrey | 90 Million Mxp | 4 Months | 4 Months | Civil works |
| Celaya | 140 Million Mxp | 12 Months | 4 Months | Civil works, stormwater facilities |
| Mérida | 400 Million Mxp | 12 Months | Pull session (Master schedule) | Civil works, structural, finishes, Electrical, Mechanical, specials intalacions |
| Cabos | 400 Million Mxp | 12 Months | Pull session phase (Mas schedule) | Civil works, structural, finishes, Electrical, Mechanical, specials intalacions |
| Torre México 2 | 70 Million Mxp | 12 Months | 2 Month | Civil works, structural, finishes, Electrical, Mechanical. |

LPS IMPLEMENTATION

Firstly, before starting with the LPS implementation, the current state of the planning process in the company through the Lean Approach Process ® (LAP) (Napolitano, Lean Approach Process, 2009) was analysed. Following the steps of LAP, a target condition. Secondly, an introductory training in Lean Construction and a complete Last Planner System training for implementation leaders were developed. Thirdly, PHASE 1: The Introductory training in Lean Construction and Last Planner System leaders deployment.

PHASE 2: Analysis of the current planning system in the company through the Lean Approach Process ® (LAP) (Figure). Using surveys and further analysis looking at improving the True North Indicators (TNI) for the planning process.

PHASE 3: Start of implementation in some projects by the implementation leaders.

PHASE 4: Analysis of the critical points for the implementation in projects.

PHASE 5: Contra measures to improve the LPS implementation.

Figure 2 shows the process for the implementation of LPS

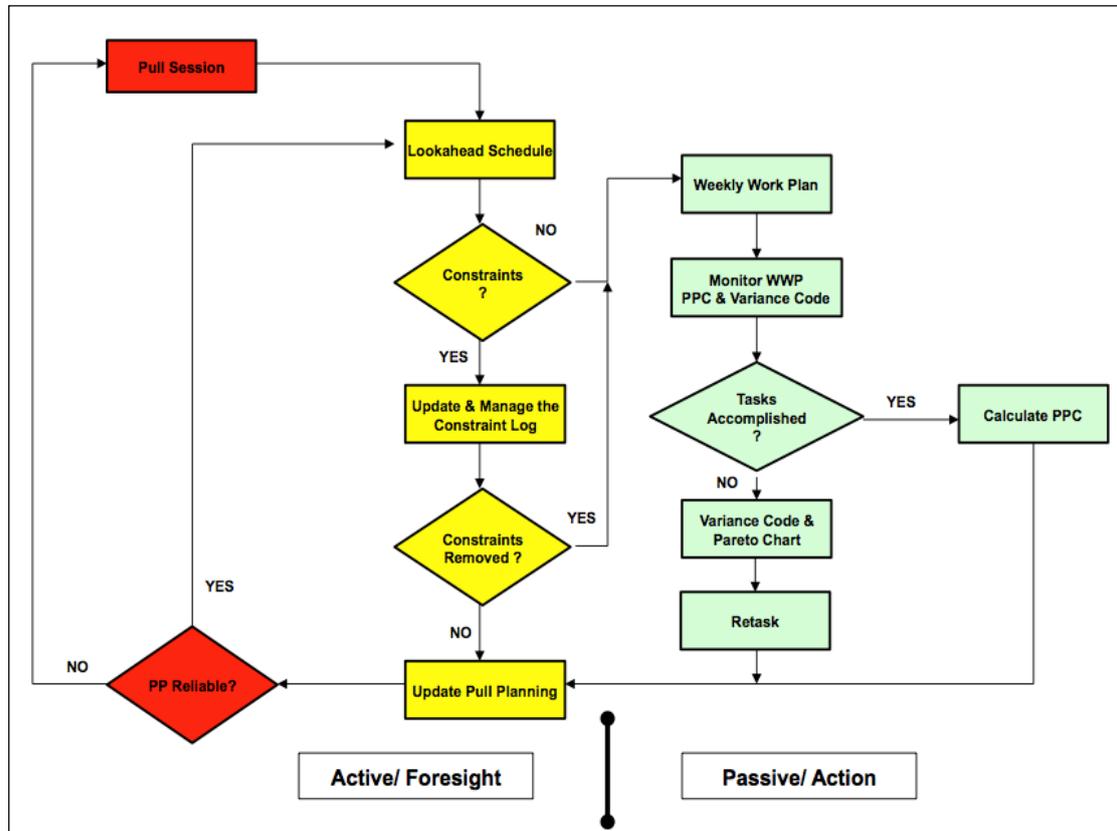


Figure 2: LPS process during the implementation

RESULTS

APPLYING LEAN APPROACH PROCESS ®

As a result of the applied LEAN APPROACH PROCESS ® (LAP), in MARHNOS the KPI's for the planning process were: Contractual commitment, Identification of the Critical Path, Identification of Problems, Realistic planning, Procurement Plan, Identification of Stakeholders, Learning, Risk Analysis, Identification and Management of Resources, Monitoring and Control, Buffer detection and Decision Making.

Attending the results given by the LAP, these factors presented above are the Drivers. These are the main points that have more impact in the planning process according to the customers' values. It is interesting to note that Contractual commitment has the biggest impact on the others in the planning process. Identification of the Critical Path, Identification of Problems, Realistic planning, Procurement Plan and Risk Analysis are in second level of importance and at the same between them.

These KPI's were measured (Figure 3) using surveys during the process for the implementation of the new planning process based on LPS. This assessment shows if

the True North Indicators are being met. Thanks to this assessment, and practicing continuous improvement, the process can be enhanced.

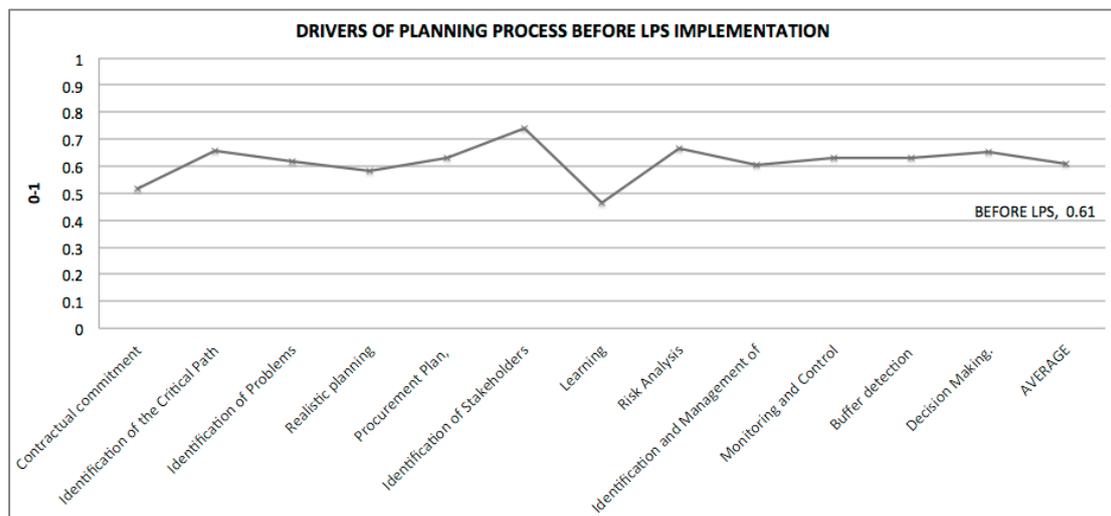


Figure 3: Measure of the drivers of planning process before LPS implementation

APPLYING LAST PLANNER SYSTEM ®

Understanding what is happening during and after the implementation

The main goal of this paper is to understand the current situation of the planning process and understand which are the main factors to achieve a successful implementation of LPS in the Mexican culture. To achieve this, there is the analysis of the points that the authors have considered key and were used by (Mestre, 2013) to understanding how the implementation is being developed in each of the seven projects studied. The results of this study are presented.

The points of each pilot project were analysed by the leader of the LPS implementation.

- **Dedication:** Who is implementing LPS? In all projects, except in one, LPS was implemented by the LPS coordinator. His work in projects is only to implement LPS.
- **Scope scheduling:** Is proper planning done? The master planning has been done in all projects, but there is a big variability between projects in planning and the rest of the concepts of LPS.
- **Learning:** During the implementation process, is the team learning? Three of the projects are getting a good apprenticeship. However, in four of them, learning is still slow.
- **Implication:** How does senior management get involved in the implementation? The instructions are clear in all projects but in most more monitoring is required.
- **Liberation constrains control:** in all projects constrains were not detected properly.

- Relationship between the team: 71% of the projects has a high level of relationship between people.
- Level of commitment: What is the level of commitment of the team? The commitment depends on each project.

The Benefits, Critical Success Factors (CSFs) and Barriers

In addition, as a summary and with the intention to understand what the benefits are, the Critical Success Factors (CSFs) and barriers, in the implementation of LPS in Mexico, Table 2 is presented following the format used before (AlSehaimi, Tzortzopoulos, & Koskela, 2008).

The results of the participants' interviews and the reflections from the LPS implementation leaders show us that the experience of implementation is very successful. *"...At the beginning I had my doubts and fear about it but gradually I realized that it is a very useful tool..."*(Manager, 2012). Collaboration between the teams allows a clear understanding of the planning and the project. Moreover, it reflects support among team members. *"...We take care for one another..."* (Subcontrator, 2012). The most important CSF is the management support and the definition of roles and responsibilities. Barriers are very different depending on the project, but are reflected that in several of them the need to more training for the team.

Table 2: Benefits, CSFS and Barriers

| PROJECT | BENEFITS | CSFs | BARRIERS |
|-------------------------|---|---|---|
| GDL | <ul style="list-style-type: none"> - Integration of all project participants - Clear vision - Tracking program commitments | <ul style="list-style-type: none"> - Definition of roles and responsibilities - Involvement of Project Manager | <ul style="list-style-type: none"> - Common language English vs Spanish. |
| Torre México 1 | <ul style="list-style-type: none"> - It allows a better understanding of the program control. - Provided further insights the variations affecting the construction process | <ul style="list-style-type: none"> - Increased support and monitoring of management and Subdirectorate - Good training in the implementation. | <ul style="list-style-type: none"> - Staff with many years of experience prevents change towards. - Inconsistent WWP review |
| Monterrey | <ul style="list-style-type: none"> - It took control of the closing date. - It allowed the manager to have better leadership in the project | <ul style="list-style-type: none"> - None | <ul style="list-style-type: none"> - Travel Logistics demand better organization with other projects for implementation LPS. |
| Celaya | <ul style="list-style-type: none"> - It allows a better organization of the resources - It identifies the importance of the program of work. | <ul style="list-style-type: none"> - Failed to update and meet the program daily. - Lack of defined roles and responsibilities for monitoring implementation LPS. | <ul style="list-style-type: none"> - There was turnover, stabilize the project prevented - Integration of staff without appropriate plan or training. |
| Hospital Mérida. | <ul style="list-style-type: none"> - Lets you align the knowledge of all participants - LPS prevents contractual | <ul style="list-style-type: none"> - The project does not have all the subcontractors, which forces perform the | <ul style="list-style-type: none"> - Requires planning and organization to train several subcontractors throughout the building |

| PROJECT | BENEFITS | CSFs | BARRIERS |
|-----------------------|--|---|---|
| | communication problems. | implementation of LPS through several stages | process. |
| Los Cabos | <ul style="list-style-type: none"> - Lets you clearly know the critical areas and durations of these - Allows you to provide restrictions on these critical activities with specific order of WWP. | <ul style="list-style-type: none"> - Lacking constancy in planning - Lacking greater commitment by management on the implementation | <ul style="list-style-type: none"> - Roles and responsibilities - Core staff with clear direction for implementation. |
| Torre México 2 | <ul style="list-style-type: none"> - Allows the manager to better visualize the work program - To have identified where gaps are to negotiate with subcontractors\ - It allows you to have knowledge leadership in the project. | <ul style="list-style-type: none"> - There was a lack of integration of subcontractors. - Managers lacked participation. | <ul style="list-style-type: none"> - Space for implementation has not been the most appropriate. |

OUTCOMES AND CONCLUSION

Through qualitative and quantitative analysis, this paper presents few aspects of implementation of LPS and LAP in the Mexican culture.

Firstly, the main factors in the current planning process before the LPS implementation are presented. To be successful implementing LPS, it should be understood the country's culture and company. LAP is a great tool to achieve that understanding. From the point of view of the authors, the success of the implementation depends heavily on the TNI's obtained after application of LAP. Likewise the TNI's assessment, through KPI's, and making corrective actions are key to a successful implementation. One of the main goals of this research is to understand the current situation of the planning process in the Mexican construction industry, and this paper describes it through LAP implementation. The most significant factor and differential of Mexican construction culture is the importance of compliance with the contract commitment between companies. This factor is probably what differentiates Mexican culture from others. Identification of the Critical Path, Identification of Problems, Realistic planning, Procurement Plan and Risk Analysis are in second level of importance and at the same level between them in this Mexican company.

Secondly, the TNI were measured before (Figure 3) and during the LPS implementation (Figure 4). All these TNI represent what value is for the planning process in this Mexican company. Observing the results of the surveys, LPS is adding value for all the stakeholders in the planning process.

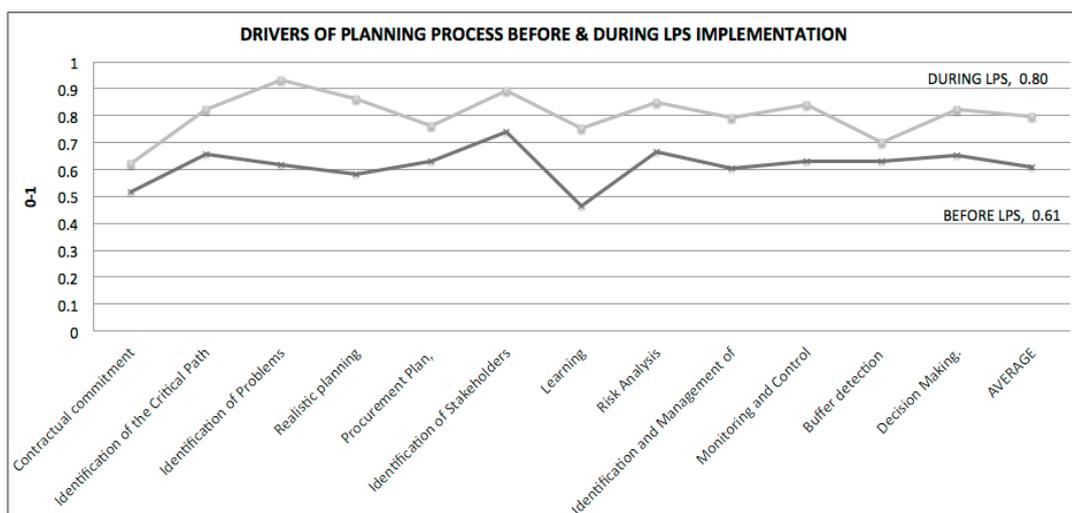


Figure 4: Measuring the TNI of planning process before and during LPS implementation

Thirdly, through Table 2 there are several reasons to believe that the implementation of LPS has large benefits. In accordance with the results of the seven studies, LPS integrates all project participants, improves the planning control, the organization of the resources is better and leadership too. The main critical success factors are a clear definition of roles and responsibilities, the management commitment in the LPS implementation, perseverance to follow the entire process daily and involvement of all stakeholders. Good training in LPS is a critical success factor too. The main potential barriers to the LPS implementation in the studied projects are not using the same language since different companies from different countries are working together. Other barriers are the rotation of the stakeholders, incorporating new agents without proper training as well as the lack of clear definition of roles and responsibilities.

Fourthly, this study has made a useful contribution to construction management practice in Mexico. The application of LAP has contributed to the theory and implementation of Lean Construction concepts showing a process to follow. In terms of LPS, the study has reported the outcome of implementation in an environment different from those implemented so far.

Additionally, a different implementation strategy to understand the planning process was developed. Understanding the current state, applying lean concepts such as adding customers' values, optimizing the process and practising continuous improvement has been for the first time presented in the literature using the Lean Approach Process ®. Furthermore, a LPS process is presented for the introduction of the technique on site. (Figure 2: LPS process)

Finally, the company studied is starting the dissemination of the theory and practice in the Mexican construction industry, both in universities and in companies, through the creation of the Mexican Group for Lean Construction. (Mexican Group for Lean Construction, 2012)

REFERENCES

- Adamu, I., & Howell, G. (2012). Applying Last Planner in the Nigerian Construction Industry. *Proceedings IGLC20*. 2, pp. 731-740. San Diego: Montezuma Publishing.
- Alarcón, L., Diethelm, S., Rojo, O., & Calderón, R. (2005). Assessing the impacts of implementing Lean Construction. *Proceedings IGLC-13* (pp. 387-393). Sydney: .
- AlSehaimi, A., Tzortzopoulos, P., & Koskela, L. (2008). LAST PLANNER SYSTEM: EXPERIENCES FROM PILOT IMPLEMENTATION IN THE MIDDLE EAST. *Proceedings for the 17th Annual Conference of the International Group for Lean Construction* (pp. 53-66). Taiwan: IGLC 17.
- Ballard, G. (2000, .). The Last Planner Production Control. A *Phd Thesis School of Civil Engineering* . University of Birmingham.
- Itri Conte , A. (2002). Lean construction: from theory to practice. *Proceedings IGLC-10* (p. 9). Gramado: Proceedings IGLC-10.
- Johansen, E., & Porter, G. An experience of introducing last planner into a UK construction Project. *Proceedings of the 11th Annual conference International Group for Lean Construction* (p. 7). Virginia: -.
- Koskela, L. (1997). Lean production in construction. In Various, & L. Alarcón (Ed.), *Lean Construction* (pp. 2-9). Rotterdam, Rotterdam, Netherlands: A.A. Balkema Publishers.
- Manager, C. (2012, 06 9). Last Planner System implementation. (P. Napolitano, Interviewer, & F. Cerveró-Romero, Translator)
- Mestre, I. S. (2013). Last Planner System: Un caso de estudio. *Proyecto Final de Grado Escuela Técnica Superior de la Universitat Politècnica de València* . Valencia, Valencia, España.
- Mexican Group for Lean Construction. (2012, 6 4). *Mexican Group for Lean Construction*. Retrieved 3 15, 2013, from Mexican Group for LEan Construction: www.leanconstructionmexico.com
- Napolitano, P. (2009). *Patent No.* . USA.
- Napolitano, P. (2012, 02 13). Lean Approach Process Training. *Lean Approach Process* . Madrid, Madrid, Spain: -.
- Napolitano, P. (2011). *Patent No. TXu001778048* . USA.
- Rother, M., & Shook, J. (1999). *Learning to see*. Brookline, MA, USA: Lean Enterprise Institute.
- Subcontractor, B. (2012, 06 8). Last Planner System implementation. (P. Napolitano, Interviewer, & F. Cerveró-Romero, Translator)
- Womack, J., & Jones, D. (2003). *Lean Thinking*. New York, NY, USA: Free Press.