

# **COLLABORATIVE IMPLEMENTATION OF LEAN PLANNING SYSTEMS IN CHILEAN CONSTRUCTION COMPANIES**

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## **ABSTRACT**

This paper describes the strategies applied by the research team of the Universidad Católica de Chile to implement the Last Planner System in twelve construction companies. The paper reports the results obtained, analyzes critical factors, barriers found in the organization and strategies to manage them in order to strengthen the implementation process. Twelve Chilean construction companies are currently developing a collaborative research and implementation effort to improve their competitiveness in the local and international market. The strategies followed for implementation include some key elements such as: training for action, collaborative sharing among companies, coaching and action research. All these aspects are part of an overall strategy to introduce principles of lean construction and better practices in the organizations. The incremental nature of the implementation, has made it possible to observe, analyze and identify the impacts of individual changes in the planning process and in the project/production management practice of the companies. The paper discusses some important aspects of the Last Planner implementation, including human and organizational aspects that seem to be key for a successful implementation.

## **KEY WORDS**

Last Planner; lean construction; production management; human resource management.

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## **INTRODUCTION**

Researchers of the Production Management Program (PEGPRO) from the Catholic University of Chile are leading a collaborative research project that includes participation of twelve construction companies and the Chilean Chamber of Construction. The general objective of the project is to allow companies, to reach higher levels of efficiency in the competitive comparison of the expected benefit from the future business process in the Chilean construction market through systematic actions of research and implementation of changes in management practices. These companies have committed to work together on several activities: a) The implementation of methods to identify and reduce waste in construction projects (Alarcon 1997), b) The development and implementation of a performance measuring system for internal and external benchmarking (Alarcon 1996) (KPI, 2000) (Alarcón et al. 2001), and c) Implementation of the “Last Planner” (Ballard and Howell 1998) concepts in their project planning systems.

This paper describes the strategies applied by the research team to implement the Last Planner System in the companies. The strategy used is based on a collaborative effort between the companies, and it was selected in order to reduce implementation barriers and get flexibility in the implementation process. To introduce permanent changes in management practice, training was one of the main aspects of the strategy, this training was basically developed in field, where practical materialization is essential. The training activities are described in terms of contents, impacts and timing. Also, the organization that gave better results to companies is described.

Critical factors are analyzed in detail, like the lack of time, lack of conceptual knowledge at different levels of the organization, changes in the organization to be considered at the beginning of the process. Also, human barriers are described and some solutions in order to deal with them and transform these problem into an opportunity for the companies are discussed, and finally, the problems due to parallel implementation with other management improvements are addressed.

Some implementation results are also shown, including important improvements in productivity in four companies as an example of the impact of the changes in the planning process.

## **INTERACTION BETWEEN PEGPRO AND COMPANIES**

The PEGPRO promotes long term research and implementation alliances among companies to pursue common goals. The Chilean Chamber of Construction is a Contractors, Designers and Suppliers organization that represents the interests of these actors within the industry and it has been a key facilitator of these alliances. The companies undertake their improvement programs working as a group, around common topics and with a common work agenda, this permits that problems and solutions to the individual processes of improvement may be shared.

The collaborative work scheme includes different forms of interaction among the representatives of the companies and the PEGPRO, all of them seek to achieve competence in the participants for the autonomous development of the implementation under way, once the specific research and implementation goals have been achieved.

In the following paragraphs there is a description of the activities developed under this scheme:

### **PERIODIC MEETINGS**

These meeting allows for coordination among companies, training of internal leaders and development of a collaborative spirit for the research.

### **WORKSHOPS**

Training sessions that use a methodology based on learning in action that enables step by step implementation of the concepts and tools.

### **PLENARY SESSIONS**

In this activity each one of the participating companies shares with the group its experience of implementation, including successes and failures and the results reached. This is another way to formalize the exchange of experiences among the participating companies and to develop the collaborative work spirit.

### **SITE VISITS BY THE RESEARCHERS**

These visits enable the researchers to monitor implementations and assure the correct direction of the improvement process.

The actions previously described are the base of the principle of “Learning from Action ” where a practical materialization of all the concepts and tools learned is essential, along with monitoring and feedback obtained from the individuals and their processes. The PEGPRO researchers only play a coaching role for the companies, without a direct intervention in their developments and decisions involved in the improvement process

### **DESCRIPTION OF THE IMPLEMENTATION STRATEGY**

Most implementations were started in projects already under execution. This was a challenge because the availability of time that project personnel had for the implementation was very limited, this was in addition to difficulties of diverse nature that already lived within the organization of the projects (Alarcon and Diethelm 2001). Also, in many cases the master program was not fully developed in a way convenient for the implementation of the LP system. All these aspects became, at the beginning, an important barrier for the process, and therefore, they obliged the definition of a strategy that could deal with all these elements and achieve satisfactory results.

Previous studies had identified a strategy of implementation based in four phases (Alarcón and Cruz 1997), this strategy was initially considered by the research team but it was found that it limited the existing possibilities. The solution adopted considers the previously proposed strategy but centers greater attention in the identification and reduction of barriers and it also works with the different limitations of each project. Figure 1 shows that this is achieved by simply developing a change in the sequence of the introduction of new elements.

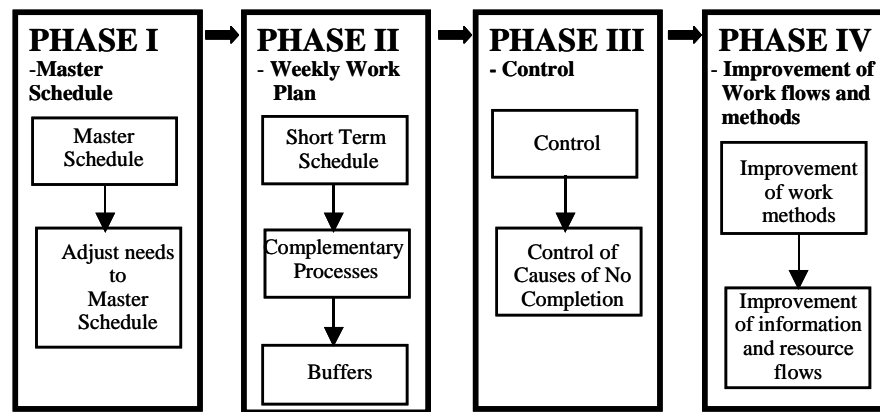


Figure 1: General Strategy of Implementation

Considering that the implementation is based on training workshops, it was fundamental to define the time elapsed between workshops, since this should allow the development of the activities defined in the previous workshop and to reach a maturity about the topics treated to enable a positive implementation of the future actions. On the other hand, if this period was extended in excess, the implementation could lose momentum, the process could deviate or people could start making a wrong use of the system. The result could be a false start and loss of the credibility of the system. The experience obtained showed that, at the beginning, the activities should be more intensive to assure a good dynamic for implementation, considering the limited complexity of the initial actions. The initial activities generate a change in the human relations that are established. During this period there is a need for more support due to the radical change in the number of participants in the planning process. As the implementation advances, the time for maturity of the concepts and to implement new tools grows. Therefore, the time which elapses between workshops can also increase, but a constant monitoring and tracking should be maintained, to choose the right time for the next training session to assure a satisfactory implementation.

In organizational terms, initially the companies adopted different structures, but with time, they evolved into the generic solution that is presented in Figure 2. An element that has turned out fundamental in the implementation at a company level, has been the Internal Coordinator. This person gives support to the projects, becoming the driver of the process.

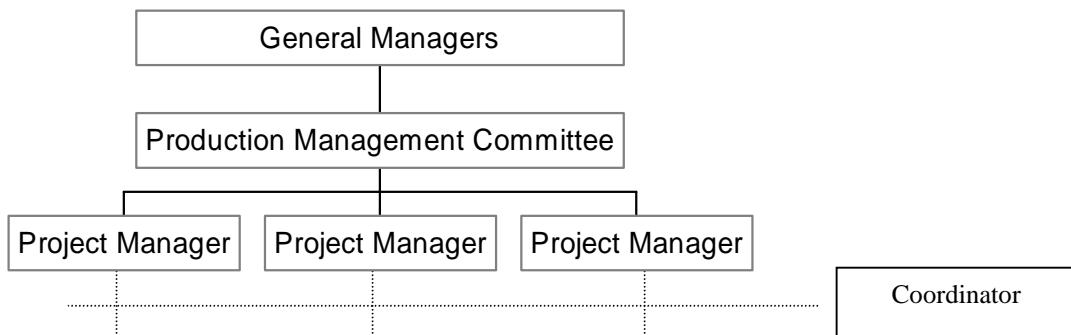


Figure 2: Generic Organizational Solution

The training workshops were effective in producing a change in the vision of the actors in the process. Table 1 presents a detailed sequence of implementation. It describes contents of each workshop, tasks that were established at the end of each training session, impacts observed in the different projects and the timing in which the activity was developed. The information that is presented was obtained from direct observations developed by the research team and from indicators collected by the participating companies.

*Table 1: Detailed Training Actions and their Impacts*

Workshop N°	Contents	Tasks	Impacts	Week N°
1 4 hrs	<ul style="list-style-type: none"> <li>Differences between traditional focus and LP.</li> <li>Impacts of variability</li> <li>Description of LP system</li> <li>Discussion on Barriers</li> <li>Meaning of PPC</li> <li>Importance of Commitments</li> <li>Analysis of causes of plan failures</li> </ul>	<ul style="list-style-type: none"> <li>Develop Meetings</li> <li>Consolidation of Master Program</li> <li>Measure PPC</li> <li>Register Causes of plan failures</li> <li>Select a Performance Indicator</li> </ul>	<ul style="list-style-type: none"> <li>Change of Vision</li> <li>Incorporation of more actors to the planning process</li> </ul>	1
2 3-4 hrs	<ul style="list-style-type: none"> <li>Analysis of collected Information</li> <li>Revision of Concepts</li> <li>Discussion of Barriers</li> </ul>	<ul style="list-style-type: none"> <li>Consolidate initial Tasks</li> <li>Inculcate Lookahead plans</li> </ul>	<ul style="list-style-type: none"> <li>Decrease of Variability</li> <li>Better Protected Production</li> <li>More reliable promises</li> </ul>	3 to 5
3 3-4 hrs	<ul style="list-style-type: none"> <li>Study of Planning meetings</li> <li>Analysis of cause of plan failures</li> </ul>	<ul style="list-style-type: none"> <li>Correlate information of Indicators</li> <li>Take actions about Causes of plan failures</li> </ul>	<ul style="list-style-type: none"> <li>Eliminations of negative practices in the system.</li> <li>Elimination of almost all the barriers.</li> <li>Beginning of continuous improvement .</li> <li>Increase of Productivity</li> </ul>	6 to 8

## **IDENTIFICATION AND ANALYSIS OF THE CRITICAL FACTORS OF THE IMPLEMENTATION**

During the phase of implementation, diverse factors influenced the implementation of the Last Planner system. These factors did not depend exclusively on the field conditions. Factors coming from the upper administration and external agents to the project also influenced the effectiveness of the implementation. The factors were identified through direct observation and with the aid of two surveys applied to all the participants at different stages of the implementation. The factors identified are discussed in the following paragraphs.

## TIME

The main difficulty in the implementation, according to the participants, was the lack of time for implementing new practices in the projects that were already under way. Meetings, training activities, preparation of forms, etc., were not usual activities and surpassed the capacity of the project personnel. This condition became more critical in the extent that these activities were relayed exclusively to the field administrator. These professionals usually assumed administrative tasks, such as quotation of materials, personnel problems, etc., tasks that distract them from managing production. The lack of time for implementation affected the rigor and extent of implementation. As a result, partial implementation, intermittent implementation and insufficient preparation of the planning meetings was often a problem. This situation had an impact on the effectiveness of the system and increased the need for more time for implementation.

One of the surveys carried out to investigate implementation barriers showed that 40% to 45% of time was dedicated to unanticipated problems as is shown in Figure 3. This situation generated a clear opportunity for improvement for most projects and led to a more accurate study of the functions of the project professionals. As a result, many administrators redefined their functions to allow for greater dedication to management activities and were able to control in a better form the field problems.

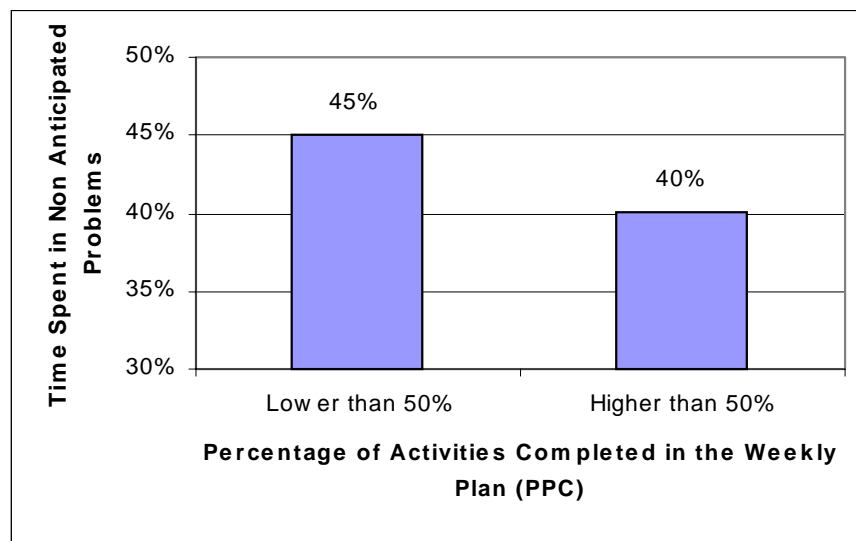


Figure 3: Percentage of Time Dedicated to Non Anticipated Problems.

## TRAINING

According to the studies carried out, the third difficulty, in order of importance in the implementation, was the lack of training. The training activities seek to deliver the necessary knowledge to allow project personnel to carry out implementation. These activities had an additional importance. According to the persons involved (Alarcón and Seguel 2002), they were key in conveying motivation and commitment to the process.

The training performed was initially oriented to provide a solid conceptual base. However, during the development of the first workshops a tendency for the participants to focus their attention only on the utilization of Worksheets and forms was observed. They

initially saw the LP system only as a “micro planning system” and did not fully appreciate the conceptual aspects that support the real innovation in the management practice. As a greater comprehension of the conceptual base was achieved, these ideas disappeared, but the focus on the utilization of Worksheets persisted. This situation became difficult, challenging the adaptation of the system to the realities of each project.

The training activities performed were key in the success of the implementation. In order to respond to the individual needs of each sector of the organization, distinct training activities were carried out, directed to different actors, and with different modalities and objectives. One key activity was the training of facilitators to prepare people within the companies to support the implementation in order to achieve some autonomy and to diminish the need for external aid. The role of these people has reinforced the implementation and consolidation of the Lean planning tools in the companies.

### **ORGANIZATION**

To respond adequately to the challenge of implementing the LP, it was necessary to create or fortify some organizational elements. The internal organization for a company implementation requires the active presence and involvement of upper management in some of the key activities. The formation of an internal committee, including some top executives and people with leadership skills, became a requirement. This committee responds to the need to create an implementation strategy at the company level that includes control and monitoring mechanisms to introduce and consolidate the new practices. At the project level, the total support and leadership of the project administrators turned out to be a fundamental aspect that made the difference between success and failure in the efforts of implementation.

An adequate organization at the project level is a must to undertake the challenge of performing planning meetings in large projects, where a meeting that gathers project managers, foremen, subcontractor, and other participants, can become not viable due to the high number of participants.

### **PARALLEL IMPLEMENTATION WITH OTHER IMPROVEMENT PROGRAMS**

Parallel improvement efforts in lean planning and other improvement programs such as quality management, risk prevention and reduction of environmental impact usually run in competing tracks. The LP implementation was mainly effected in companies that were making parallel efforts to implement LP and quality, getting to the point where one of the companies was obliged to abandon the LP program. However, companies where other improvement systems functioned, or those that had participated in similar programs before, were better able to deal with the implementation by doing an integration effort of both programs.

### **PROBLEMATIC PROJECTS**

In some specific fast track projects, the last moment changes in the specifications, during the execution of the work, complicated the implementation. The constant changes introduced a great deal of variability and uncertainty to almost all the planned activities.

## **THE HUMAN ELEMENT: BARRIERS AND OPORTUNITIES**

During the application of LP, diverse human factors became important barriers that obstructed the efforts of implementation and affected the team synergy. However, some of these weaknesses were used to enhance the implementation in early phases. The barriers identified in this environment are discussed in the following paragraphs.

### **RESISTANCE TO CHANGE**

One of the main obstacles to overcome in order to achieve a successful implementation, is the fear of change. This problem was made evident by symptoms such as the early refusal to assume commitments, refusal to include subcontractors in planning meetings or negative reactions to the theoretical concepts of LP and to its application in the project. Research to identify the elements that motivate change is currently being carried out, in order to facilitate the implementation of lean techniques (Alarcon and Seguel 2002).

### **LACK OF SELF-CRITICISM**

The lack of self criticism impeded a clear view of project problems and limited the capacity to learn from errors since only part of the problems was perceived. Initially, the problems of not completion, associated exclusively with subcontractors and owners or designers, were fully identified. This situation didn't allow taking advantage of the opportunities to take improvement actions within the own contractor organization. In this case, self questioning can be transformed into the first occasion of improvement.

### **SHORT TERM VISION**

Short term vision doesn't allow people to visualize problems with enough time to make the right decisions. This was an obstacle to implement the look-ahead plans in several projects. However, in projects located at a long distance from the provision centers, the real benefit of Look-ahead plans was really appreciated. In projects in these conditions, due to the distance and accessibility of means of transportation, the make ready process had to start at least six weeks ahead. This experience served as an example to the other companies that had been slow in implementing Look-ahead planning.

### **MISINTERPRETATION OF THE PPC INDICATOR**

Many companies tried to use the PPC indicator to measure the physical progress of the works changing the form of calculation. Also, the use of this indicator as a form of controlling and evaluating the individual completion of tasks affected seriously the implementation and generated barriers at every level of the organization of some projects. These projects focused all the efforts of implementation on the value of the PPC. However, this focus served to prompt the implementation and the PPC measures were used by project administrators for their benefit in negotiations with owners and company upper management. For instance the PPC measures helped to justify requests for time extensions, to justify investments, and other documented requests, breaking more easily the initial inertia of the implementation of the LP system.

## **RESULTS OF THE IMPLEMENTATION**

One of the main results of the implementation is the adoption and definition of the previously described approach. This approach has been applied to different types of



projects, in different phases, and has been used to break diverse barriers reaching positive results in a short period of time.

The implementation of LP has modified the management styles of projects, developing a flatter organization and a greater commitment of all the actors to the planning process. Positive evolution of the Percent of Planned Activities Completed (PPC) has been observed during the implementation as shown in Figure 4. This is a clear reflection of the increase of reliability of the planning system.

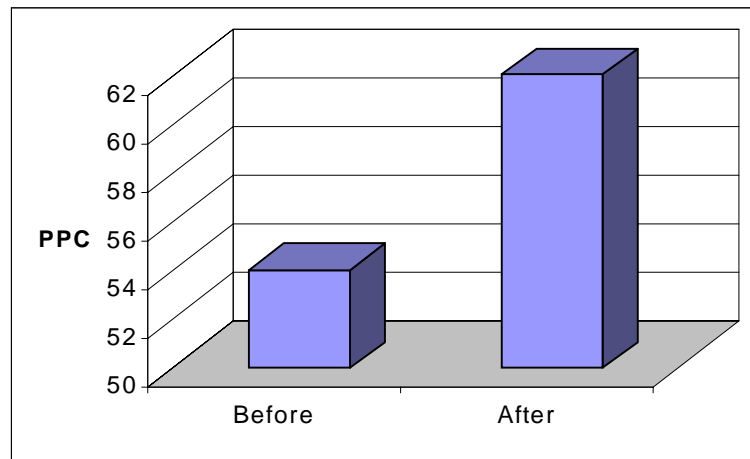


Figure 4: Average PPC Before and After the Implementation of Last Planner

Also, decreases in the variability of the PPC have been measured. Figure 5 presents the variability before implementing key aspects of LP and compares it with the late phases of the implementation, where the system already was adopted to a larger extend.

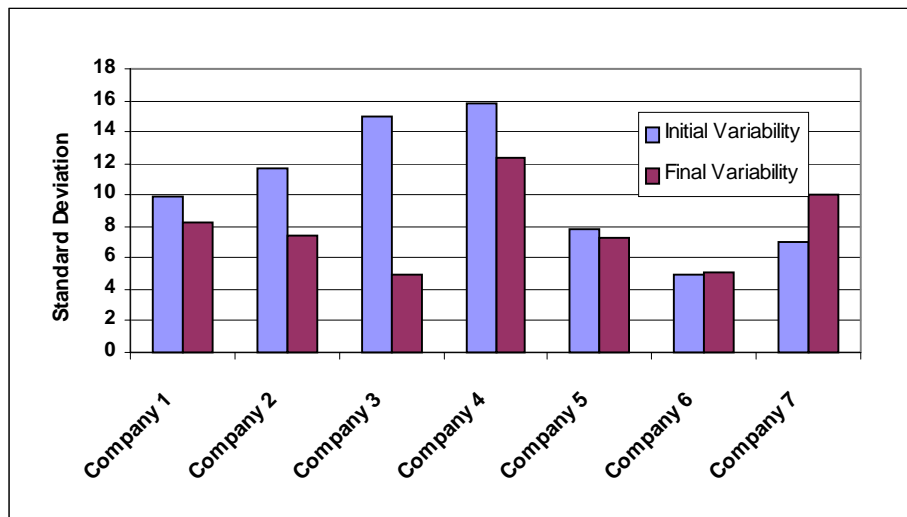


Figure 5: Variation of Variability of PPC Product of Last Planning Implementation

Finally, Figure 6 shows the average variation of performance measured in the projects of each company. One of the difficulties found was to find a common measure for productivity changes, therefore, Figure 6 includes different performance indicators such as direct measures of use of man-hours, productive work from work sampling measures,

measures from resource usage, etc. The changes were normalized as percent variations in order to be placed in the same graphic.

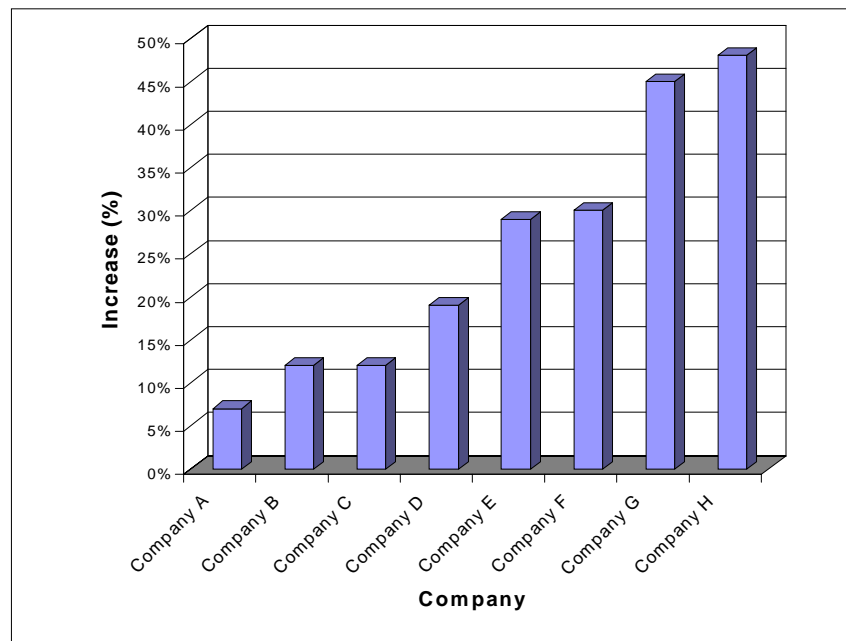


Figure 6: Variation of Performance Measured in the Participating Companies

## CONCLUSIONS

The experience and the results obtained have led to the design of an implementation strategy that has produced good results but it is still evolving. The strategy involves development of systematic training and research actions, a proactive interaction with contractor upper management and project organizations, collaboration among companies and a constant search for new ways to improve the implementation process. There is need to find ways to consolidate changes inside the companies, keep up motivation and persistence in a conservative culture.

Working in a collaborative approach, with different training actions, sharing experiences and information among the companies produces a number of benefits: development of skills for implementation, development of a healthy competition among companies that are working together, fast learning from successes and failures. For instance, companies that fail in their first attempts tend to react in a better way in order to understand the reasons of their failure and to improve their implementation process. They realize that things are possible because always there is a project that did it and they can learn how to do it better the next time.

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