

CHILEAN CONSTRUCTION INDUSTRY: WORKERS' COMPETENCIES TO SUSTAIN LEAN IMPLEMENTATIONS

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ABSTRACT

Lean implementations, especially Last Planner System - LPS, are facing various barriers along time losing opportunities to visualize its complete impact. The previous situation could be associated with lacking a more holistic approach; companies commonly deployed Lean tools from an operational point of view, without a clear vision of the future in complementation with strategic objectives. In a group of seven Chilean construction companies doing research in collaboration with the Production Management Centre of the Catholic University of Chile we observed these conducts. Research activities included four workshops with General Managers and Human Resources Departments, and semi structured interviews with some key positions. The present research's results provide competencies identification and definition for four key positions: Project Manager, Building Manager, Site manager and Technical Office, which will be part of a Competencies Dictionary. This instrument will work as a foundation for a training plan's development that companies will use as a backing of Lean tools' sustainability over time, especially Last Planner

INTRODUCTION

Based on Toyota's production system, Lean at construction sector seeks to make processes more efficient, design production systems that minimize resources losses, and face the issue of stagnation and low productivity in this industry. In Chile and the world, authors have identified that Lean implementations, LPS mainly, over time are facing barriers (Ballard and Kim, 2007; Hamzeh, 2012), slowing down its progress and provoking a setback to traditional practices. A possible reason is that companies implement Lean tools from an operational point of view, lacking support and without a clear vision of future

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aligned with their strategic objectives. In short, they do not consider a holistic perspective in the implementation of the new management's approach (Barros and Alves, 2007). The previous adds to common problems such as lack of knowledge (Sarhan and Fox, 2013), lack of training (Brady et al., 2009; Cerveró-Romero et al., 2013; Porwal et al., 2010), educational levels (Jara et al., 2009; Mossman, 2009) and the organization's lack of strategic maturity (Chesworth et al., 2010). A group of Chilean construction companies belonging to the Collaborative Group "Building Excellence" – GEPUC participated in a research, which focus was Lean practices' sustainment over time, particularly LPS, which was the common tool to all of them (Salvatierra et al., 2015). Results showed that although most managers considered Lean philosophy as central to the development of companies, the employees' skills have not been adjusted to this new thinking up to this day; also, there is no continuous training. Therefore, stage two of the research and this study shows it has as objective describe competencies for Lean tools' sustainability over time. For this purpose, we collected social competencies to design a dictionary for key positions: Project manager, Building Manager, Site Manager and Chief Technical Officer to be used by companies' Human Resources departments. Intending to visualize the associated competencies to the positions, we will take as an example the competency of planning; being this one to all companies a common activity. Furthermore, this competency highlights, as previously mentioned, that LPS is a common tool to the companies that participate in this study.

COMPETENCIES

WHAT ARE COMPETENCIES?

There is a varied literature about this notion yet it is difficult to define the concept since there is no unique definition (Serpell and Ferrada, 2011); this can be attributed, among many causes, to the models diversity and theoretical approximations on this matter (Pucheu, 2012). Based on recent meta-analysis, it is possible to say that a competency is a series of behaviors that are key to the achievement of specific performances or results (Bartram, 2002; cited in Bartram, 2005). Most definitions agree that these are behaviors implicating a conceptual or theoretical (to know) component, a procedural component (know to do), and an attitudinal or motivational component (know to be) (Optimal Education, s.f). Competencies are divided in two categories: of "threshold" and "distinctive", in accordance to the job's predicted performance criterion. *Threshold competences* are the essential characteristics (knowledge or basic skills) that someone needs in a job to be minimally effective; whereas *distinctive competences* refers to those skills that distinguish a person over others due to a superior performance, in contrast to the average (Spencer and Spencer, 1993).

HOW TO USE THEM?

Competencies' notion allows managing under a common language for all Human Resources systems, so its use allows managing in several ways a specific company's human capital. This notion enables an integration of diverse activities in People's Management matter (selection, training, others), and in turn, an integration of the

department itself with the company's strategy, corporate values and business key processes (Soderquist et al., 2010). In other words, management by competencies allows to aligned Human Resources' practices with business strategy. We can use competencies in different contexts (for instance compensations) but for the present investigation's purpose, we will describe them to be used in the following contexts: Position profile settings, recruitment and selection, training and performance management, and career development. To sum up, it is possible to note that:

Position profile settings: the position profile is a description that includes the main functions and tasks of a specific position, plus the key competencies to perform properly (Rodriguez et al., 2002). Hence, the competencies dictionary enables us to update and perform settings in the position profiles selected and analyzed.

Recruitment and selection: management by competencies offers a way to evaluate a person's potential performance in a much complete manner than mere credentials revision (Rodriguez et al., 2002). In that sense, this study's competencies dictionary could serve as an initial step for selection tests production, such as the generation of assessment centers or individual and groups interviews.

Evaluation and performance management: This includes how it is measure employee performance, as well the necessary tools to increase it (Muchinsky, 2002). We can use the competencies dictionary to construct a questionnaire that permits evaluating and managing performance. Therefore, it is necessary to know what to do with high performance workers in terms of retention, and in low performances to offer opportunities to supply the areas for improvement.

Training people: comprises both workers' skills identification and strategies' formation necessary to developed these in accordance to the position requirements (Muchinsky, 2002). To be able to perform training plans that can be strategic with the business, it is necessary to establish the critical skills for the different positions. (Salas et al., 2012). In this way, the competencies dictionary allows establishing critical skills for a particular position, identifying who needs training based on pre-established levels.

Career development: It is a process where Human Resources' Management reaches a balance between the workers' growth needs and the company's needs. This is accomplished by establishing positions families and identifying the requested competencies among the different positions (Rodriguez et al., 2002) and the gaps between one position and other, recognizing necessary measures to supply the gaps in case of promotions. Therefore, this study designed' competencies dictionary allows to observe similarities and differences at skills levels among the studied positions being able to establish gaps in case of possible promotions.

SAMPLE AND METHODOLOGY

The sampling included seven companies of construction industry, from areas such as building extension, building height, industrial construction and mining operations – that currently are working in Lean tools implementation, mostly LPS. The total sample comprehends 26 professionals corresponding to the positions of Project Manager, Site

Manager and Chief Technical Officer. For a comprehensible description of the developed activities in this research, Figure 1 shows graphically the complete study process.

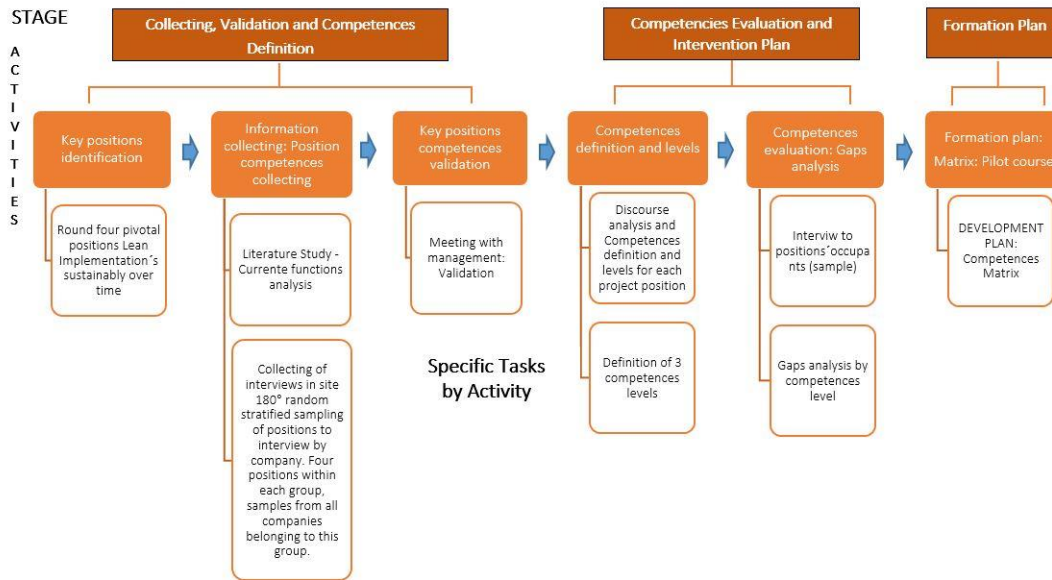


Figure 1: complete study process

Some methodological considerations of competencies mapping

At the start of the research, we considered relevant to analyze competencies by grouping the participating companies according to field and size, assuming meaningful differences among them. From this division, it was conducted a stratified random sampling of the company's positions to be interviewed. For this, we interviewed four positions within each group with samples from all the companies in that group, differentiating it by functions and required responsibilities for the position by the organizations. In these interviews, it was included the required competencies' perception by the superiors for the position's occupant, peers and subordinates. After interviews and bibliographic analysis, we held a management meeting with each company, with participation of Human Resources' members and projects participants and, in some cases general managements. This meeting aimed at sharing preliminary outcomes of competencies associated to each position, seeking to validate and amplify or include competencies. The collected information in interviews and the management meetings help to decide that even though companies belonged to different areas (Construction, Engineering, and Installation) and were of diverse size, there were no differences in the described competencies. Because of this, the research team made the decision of considering competencies by positions and not by type of organizations. From this point, we obtained the desired behaviors, definition and levels of each competency, searching a common language.

Stage 1: Collecting, validation and competencies definition:

We conducted a total of four round-tables or workshops with objectives, participants, contents and results as detailed below:

Round-table 1: Objective: Analyze the project participants companies' organizational mission and their alignment with Lean Management. **Participants:** General managements and the participating companies' Human Resources area. **Contents:** Mission analysis and organizations strategies and their improvement opportunities, discussion on the importance of strategic alignment to achieve a successful Lean management implementation. **Results:** Collaborative group's mission establishment, with the purpose to understand how to work in each company's missions.

Round-table 2: Objective: Alignment of the research objectives with competencies. **Participants:** Projects managements and/or Human resources and projects managers. **Contents:** Key position determination for competencies implementation. **Results:** a competencies collection for key positions.

Round-table 3: Objective: Review progress of competencies by position. **Participants:** Projects managements and/or Human resources and projects managers. **Contents:** First revision of competencies dictionary by Company. **Results:** Improvement proposals in the competencies dictionary.

Round-table 4: Objective: Improvements in the competencies dictionary, conceptual revision between competencies and performance. **Participants:** Projects managements and/or Human resources and projects managers. **Contents:** Competencies dictionary revision, conceptual analysis between competencies and performance. **Results:** Definition of competencies importance, improvement in the competencies dictionary.

Stage 2: Competencies evaluation and Intervention plan

To evaluate competencies each company was requested the selection of a project that met with two selection criteria (1) at least 3 months of implementation since its start and 3 months before its conclusion and (2) that the selected professionals in position had at least one-year of experience. We designed a semi-structured interview for each competency oriented to the four positions. From the results, two pilot workshops were designed with the aim of testing development techniques for a posterior formation plan's creation. To evaluate both workshops effectiveness, Kirpatrick model was used (1994; cited in Jiménez & Barchino, 2011), two levels specifically, namely, reaction level one, through a satisfaction poll and learning level 2, through ex ante and ex post polls.

Stage 3: Formation plan

Once performed the pilot workshops, it was designed a Formation plan in accordance with the competencies dictionary, this with the purpose of diminishing the detected gaps by level. We will present results of Stage 3 in a future paper.

RESULTS: COMPETENCIES DICTIONARY

TRANSVERSAL COMPETENCIES

For the purpose of this study, we understand transversal competencies as those valid to all the considered positions, listing, definition and desirable behaviors that are included in Table 1:

Table 1: Transversal competencies definition and desirable behaviors

Competencies	Definition	Desired behaviors
Quality orientation/ continue improvement (Kaizen)	Analyze processes trying to improve in permanent way, seeking to determine and eliminate the problem's root cause.	Analyze data, stage and dates (from planning) of past commitments aiming to find and eliminate the problem's root cause. Resuming each process seeking improvements, even when believed correctly established. Each improvement eliminates newfound wastes.
Change orientation	Flexibility in performing changes in the entire project process/projects, include work methods, adjusting environment conditions.	Adjust production rhythm to demand, when this one fluctuates. Deliver product to extend demanded and when demanded. Adjust programming, fitting to environment changes.
Internal/ external client orientation	Act proactively in front of the client (internal, external or supplier), keeping in mind his needs and incorporating them in the activity planning. (Adds value).	Planning activities based on clients and their necessities. Collecting information of the client's needs and incorporating them in plans and actions. Question during activity. Does it add value to the client?
Innovation	Generate ideas/ new processes or combine the existing ones through experimentation, to make an improvement by affecting the future performance.	Identify the problems affecting performance of one or several processes. Generate new ideas/processes or combine the existing ones creating a novel way to do it. Implement the idea/ new process evaluating the performance impact.

COMPETENCIES BY POSITIONS

Additional to transversal competencies, a set of competencies associated to position were identified (Figure 2). We established three levels with the purpose to categorize professionals and make a proper professional development plan in the companies.



associated to position competencies

Competencies of Planning, an example:

Intending to visualize the associated competencies to the four positions, the competency of Planning is going to be an example, being this one to all companies a common element. Additionally, the competency highlights LPS as a common tool to all the companies in this study. Definitions and associated behaviors of each competency are present from Table 2 to Table 3.

Table 2: Associated behaviors of planning competency for Project Manager

Position : Project Manager			
	Level 3	Level 2	Level 1
Definition	Managing several projects at the same time, considering short-term goals lead to long-term objectives, redesigning the programming if needed with the purpose to meet deadlines, costs and project's quality.		
	Considers that short-term goals leads to meeting long-term objectives, redesigning programming when necessary for better compliance with deadlines , costs and quality . In addition, it takes concern about planning commitments made by posing strict control on them.	Considers that short-term goals leads to meeting long-term objectives, redesigning programming when necessary for better compliance with deadlines Managing multiple projects simultaneously, setting tracking points and control.	Considers important short-term goals only, not visualizing long-term objectives, not able of redesigning programming in opportune moments. Managing multiple projects simultaneously, not capable of setting tracking points and control.
	Managing multiple projects simultaneously, setting tracking points and effective control, and coordinating with deadlines and commitments.		

Table 3: associated behaviors of planning competency for Building Manager

Position : Building Manager		
Definition: Managing the project considering that short-term goals lead to long-term objectives, redesigning their planning as required to achieve its objectives.		
Level 3	Level 2	Level 1
<p>Have a broad vision of the project, minding weekly and intermediate planning, being able to anticipate bottlenecks and reprogramming when necessary, in addition to detecting cases of non-compliance.</p> <p>Managing multiple tasks simultaneously, setting tracking points and effective control, and coordinating with deadlines and commitments.</p> <p>Flexibility in reprogram to problems presented for better compliance of long-term goals.</p>	<p>Have a broad vision of the project, minding weekly and intermediate planning, being able to anticipate bottlenecks.</p> <p>Managing multiple tasks simultaneously, setting tracking points and control.</p> <p>Flexibility to reprogramming when necessary.</p>	<p>Prepare the weekly plan, without taking into account the variabilities associated with the project. It has a short-term vision.</p> <p>Managing multiple tasks at the same time, not being able to establish monitoring and control points.</p> <p>Little flexibility to programming changes.</p>

Table 4: Associated behaviors of planning competency for Site Manager

Position : Site Manager		
Definition: Managing project planning with order and methodology.		
Level 3	Level 2	Level 1
<p>Be neat and methodical in the control and monitoring of project planning, verifying compliance with deadlines, costs and commitments.</p> <p>Ensure and promote throughout the work team the good use of project resources, avoiding material losses, accidents or other.</p> <p>Possess a clear understanding of the work's master program, anticipating medium-term problems, lifting restrictions to achieve a smooth progress, and thinking on specific and innovative solutions.</p> <p>Adapt and efficiently overcome problems not seen in the work planning.</p>	<p>Be neat and methodical in the control and monitoring of project planning.</p> <p>Ensure the good use of project resources, avoiding material losses, accidents or other.</p> <p>Possess a clear understanding of the work's master program, anticipating medium-term problems, lifting restrictions to achieve a smooth progress.</p> <p>Adapts easily to changes in planning due to problems of the project.</p>	<p>Not anticipating to project problems, only reactively.</p> <p>Be neat in the project planning management without taking a rigorous control.</p> <p>Not ensuring project resources.</p> <p>Possess a clear understanding of the work's master program; however, there is no planning or medium-term vision.</p> <p>Not easily adapts to changes in planning.</p>

Table 5: Associated behaviors of planning competency for Chief Technical Office

Position: Chief Technical Office		
Definition: Take control of the project in an orderly and methodical manner.		
Level 3	Level 2	Level 1
Supervise and control the fulfillment of agreed deadlines, always putting in front of difficulties.	Supervise and control the fulfillment of agreed deadlines.	Supervise and control the fulfillment of agreed deadlines, but is not able to control, letting dates pass and delaying the project.
Establishing appropriate priorities differentiating the important from urgent, considering contingencies that may affect planning.	Establishing appropriate priorities differentiating the important from urgent, trying to provide the necessary time.	Not establishing priorities, making activities in a disorderly manner.

CONCLUSIONS

The study results are one-step more to go forward in Lean practices' sustainability such as Last planner from the participant companies. Past researches presented a gap associated to Human resources' management, where practices such as talent management, incentive structure, measurement system and performance evaluation are lacking a Lean approach, despite these companies are applying Lean tools to some extent. Therefore and accordingly to the results, there are not standardized Human resources management' practices in the participant organizations; being detected a models shortage or continuous training program that allows holistically integrate Lean philosophy. To sum up, it is strongly appreciated the philosophy's instrumentalization at the LPS tool with low incursions on other tools and, in Lean's philosophical and cultural aspects. These results provide the competencies identification and definition for four key positions: Project Manager, Building Manager, Site manager and Chief Technical Office, which will be part of a Competencies Dictionary that will work as a foundation for a formation plan's development that companies will use as a backing of Lean tools' sustainability over time, especially Last Planner. This dictionary includes four generic competencies for the positions: (1) Quality oriented/ continue improvement, (2) Change oriented, (3) Internal/ external client orientation and (4) Innovation; and a competencies set by position based on key positions' different activities. In this paper, we considered planning a transversal competency developed in different levels in accordance to positions. Competencies define areas in which a professional must be competent; these competencies through its interactions potentiate a proper management under Lean parameters. In this case, the dictionary as outcome of this research should be considered a basic tool for human capital's development in each organization. Nowadays, it is necessary to develop reflexivity regarding Lean tools' use and its competencies. For what? What relationship holds with its aims and missions? Accessing tools' use because or by tools? The latter will finally enable greater integration among the philosophy, cultures and technologies accomplishing a righteous convergence towards Lean tools' sustainability over time.

REFERENCES

- Ballard, H. and Kim, Y.W. (2007). Implementing lean on capital projects. Proceedings of the 15th IGLC conference, Michigan, USA.
- Barros, N. J. and Alves, T. 2007. "Strategic Issues in Lean Construction implementation". International Group for Lean Construction, 2007.
- Bartram, D. (2005). The Great Eight competencies: a criterion-centric approach to validation. *Journal of applied psychology*, 90(6), 1185.
- Brady, D., Tzortzopoulos, P., and Rooke, J. (2011) "An Examination of the Barriers to Last Planner Implementation." Proc. 19th, IGLC Annual Conf. of the International Group for Lean Construction. Lima, Peru, 13-15 July 2011.
- Cervero-Romero, F. and Napolitano, P. 2013. "Last Planner System and Lean Approach process: Experience from implementation in México". International Group for Lean Construction, Brasil, 2013.
- Chesworth, B., London, K. and Gajendran, T. 2010. "Diffusing lean implementation & organisation cultural maturity". Proceedings IGLC-18, July 2010, Technion, Haifa, Israel, 345.
- Hamzeh, F. 2012. The Lean Journey: Implementing the Last Planner System in Construction. In: Proc. 20th Ann. Conf. of the Int'l Group for Lean Construction. San Diego, USA, July 18-20.
- Jara, C., Alarcón, L. F., and Mourgues, C. (2009) "Accelerating Interactions in Project Design through Extreme Collaboration and Commitment Management – A Case Study." Proc.17th, IGLC Annual Conf. of the International Group for Lean Construction, Taiwan.
- Mossman, A. (2009). "Why Isn't The UK Construction Industry Going Lean With Gusto?" *Lean Construction Journal* 5(1), 24-36.
- Muchinsky, P. M. (2000). *Psicología aplicada al trabajo*. Thomson-Paraninfo. Óptima Educación (s.f). Perfiles de competencias para docentes directivos. Mapa de desarrollo profesional. Recuperado de <http://www.optimaeducacion.cl/intranet/temp/62105327.pdf> el 9 de noviembre.
- Pucheu, A. (2012). *Desarrollo y Eficacia Organizacional. Cómo apoyar la creación de capacidades en individuos, grupos y organizaciones*. Santiago: Chile: Ediciones Universidad Católica de Chile.
- Rodriguez, D., Patel, R., Bright, A., Gregory, D., & Gowing, M. K. (2002). Developing competency models to promote integrated human resource practices. *Human Resource Management*, 41(3), 309-324.
- Salas, E., Tannenbaum, S. I., Kraiger, K., & Smith-Jentsch, K. A. (2012). The science of training and development in organizations: What matters in practice. *Psychological science in the public interest*, 13(2), 74-101.
- Salvatierra, J.L. , Alarcón, L.F. , López, A. & Velásquez, X. 2015, "Lean Diagnosis for Chilean Construction Industry: Towards More Sustainable Lean Practices and Tools" In:, Seppänen, O.,
- Sarhan, S., and Fox, A. (2013). "Barriers to Implementing Lean Construction in the UK Construction Industry." *The Built & Human Environment Review*, 6(1).
- Serpell, A., and Ferrada, X. (2011). Modelo basado en competencias para formar, desarrollar y certificar supervisores de construcción. *Revista Ingeniería de Construcción*, 21(1), 43-56.
- Soderquist, K. E., Papalexandris, A., Ioannou, G., y Prastacos, G.,2010. From task-based to competency-based: a typology and process supporting a critical HRM transition. *Personnel review*, 39 (3), pp. 325-346.
- Spencer, L. and Spencer, S. (1993). *Evaluación de competencias en el trabajo. Modelos para un desempeño superior*. Bogotá, Colombia: Norma.