VSM FOR IMPROVING THE CERTIFICATE OF OCCUPANCY PROCESS IN REAL ESTATE PROJECTS – A CHILEAN CASE STUDY

Andrés Covarrubias[1], Claudio Mourgues[2], and Paz Arroyo[3]

ABSTRACT

Obtaining a Certificate of Occupancy (CO) for real estate projects in Chile is a bureaucratic and confusing process, which often causes delays in the final reception of projects, postponing the occupation by future owners, and impacting the financial flow of developers. This research aims to reduce the duration of the city´s CO process for housing projects in Chile. The research questions are: (1) what are the most relevant inefficiencies in the CO process? (2) What improvement strategies can be used to reduce its duration? (3) Can lean methods be used to reduce this duration? The research method is based on 3 stages: (1) conduct surveys to practitioners involved on the CO process of Chilean housing projects to collect the current inefficiencies and potential improvement strategies, (2) develop a current and future state Value Stream Mapping (VSM) considering the survey information, and (3) implement the future state in a case study through action research. This research´s first contribution to knowledge is a list of inefficiencies and improvement strategies related to the CO in Chilean housing projects. The second contribution is to provide evidence that VSM can be successfully used to reduce the duration of this process in housing projects. The study is limited to housing industry under the Chilean regulatory framework. However, the authors believe that similar results can be obtained in other types of projects dealing with administrative processes such as permitting, and other city and regulatory agency approvals.

KEYWORDS

VSM, Value Stream Mapping, Project Management, Reception Process, Certificate of Occupancy, Real Estate Projects, LEAN Management, LEAN Project Delivery.

---

[1]   Graduate Student, Construction Project Management Program, Engineering Dept. Pontificia Universidad Católica de Chile; acovarrubias@uc.cl

[2]   Assistant Professor. Pontificia Universidad Católica de Chile, Chile. Phone +56 22354-4244, cmourgue@ing.puc.cl.

[3]   Assistant Professor. Pontificia Universidad Católica de Chile, Chile. Phone +56 22354-4244, parroyo@ing.puc.cl.

Andrés Covarrubias , Claudio Mourgues , and Paz Arroyo

INTRODUCTION

The Certificate of Occupancy (CO) corresponds to a certificate or approving resolution issued by the building department that certifies that the work carried out is true to the building permit granted and therefore has faithfully complied with the law, applicable building codes, as well as the General and Local Ordinances. This occurs after a slow and bureaucratic process of reviewing records, documentation and visiting the site. Once the documentation has been approved and the site visit carried out, the architect or professional reviewer from the building department approves the project and then the rights can be paid and the approving resolution signed. The certificate allows the construction or building to be inhabited or used as was previously determined. A considerable delay in this process negatively impacts the profitability of a project as well as a company's cash flow, which, in the worst-case scenario, can lead to bankruptcy. In less serious cases, delays in handing over properties to clients may result in fines or the market's loss of trust in the real estate company. As a result, there is an important opportunity to use Lean tools to improve this final process of obtaining the CO. Koskela (1992) considers that efforts should be made to eliminate or reduce activities that do not add value, to then move on to improve the activities that do add value.

An important methodology for these efforts is Value Stream Mapping (VSM), which has been widely used to identify opportunities for improvement in the construction industry. This study applies VSM to construction projects' administrative processes, as opposed to the majority of applications that center on the productive processes of design and construction. This tool has been adapted, evolving to more complex characteristics (Braglia et al. 2006; Duggan 2002), with more random demands, number of processes, types of processes and motives that make the flow much more complex and complicated to analyze and diagram. This improvement is fundamental in the Chilean construction industry, as the process to obtain the CO is slow and bureaucratic, but above all it is unsystematic and uncontrolled; negatively impacting the economic viability of projects as well as the trustworthiness and image of the real estate company.

This paper also presents a case study where the improvement strategies identified using VSM are applied. The case study included part of the improvement plan, for the sake of time, but shows the impact on reducing delays in the first stage of the certification process.

LITERATURE REVIEW

Obtaining a CO is a relevant issue in many countries where they have to deal with bureaucracy and potential delays. Some studies have looked at the process of obtaining CO, such as Daramola and Aina (2004) in Nigeria and Rutakyamirwa et al. (2002) in Tanzania. Both studies looked at improving the process of obtaining CO, but they present cultural differences.

Several studies have applied VSM to improve construction processes, both onsite and offsite (Bulhões et al. 2011; Fontanini et al. 2008; Moghadam and Al-hussein 2013; Pasqualini and Zawislak 2005). Some studies have focused on the design process such as Lima and Rolim (2010), which applied VSM for architectural executive design in a governmental organization, and Leite and Barros Neto (2013), which applied VSM for Housing Design. However, few studies demonstrate the implementation of lean methods, including VSM, for improving administrative processes in construction such as obtaining CO, building permits, or other types of certifications. Alarcon et al. (2011) demonstrate the

implementation of lean tools and methods in the permitting process for the Castro Valley Hospital in California, the research shows how the integrated team worked hand-in-hand with representatives of the state permitting agency to develop strategies and work methods to implement a new option called the Phased Plan Review, where the team and the agency could pursue in unison to result in permitting for construction of this healthcare facility. The paper mentions the use of visualization strategies, but does not mention the use of VSM. Alves et al. (2016) demonstrate the use of several lean strategies for managing submittals and requests for information (RFIs), and Pasadena et al. (2014) implements lean strategies for submittals, this study also points out the lack of transparency in administrative processes, such as unknown durations and lack of indicators to manage processes. In Chile, one previous study has applied VSM to the process of project evaluation by the social Chilean housing agency (Yuraszeck, 2007).

This research is based on the adaptation of the VSM methodology applied to the field of administration (Tapping and Shuker 2002). It is based on a study of real cases of a company in the industry whose objective is to define the type indicators with which the present state of VSM to improve the process of obtaining a CO will be modeled.

METHODOLOGY

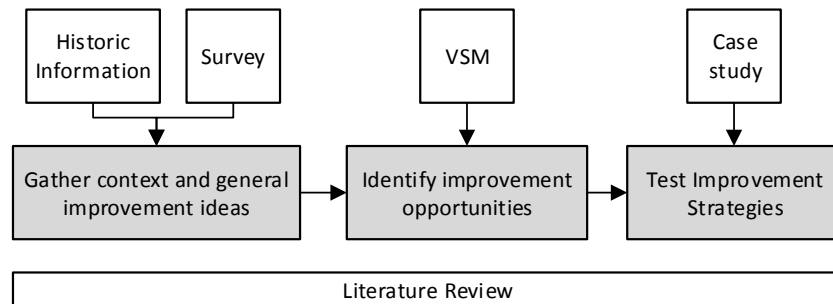The research is structured in 3 stages (Figure 1).

Figure 1. Research methodology

1. Gather context and general improvement ideas: This stage included reviewing the historic information of 16 projects from a real estate developer to identify the main indicators, actors and activities in the process of obtaining the CO. This contextual information guided the design and application of a survey to capture the perception of construction professionals regarding the process being studied and potential ideas for improvement.

2. Identify improvement opportunities: The results obtained in the survey helped to create VSM diagrams of the current and future state of the process to obtain the CO. The future state presented a set of improvement strategies.

3. Test improvement strategies: The researchers used a case study to test the identified improvement strategies. The case study is a 10-story housing and commercial building, located in the downtown area. Due to time limitations and specific characteristics of the project, not all strategies could be implemented.

The following sections detail the application and results of the survey, the VSM and the case study.

SURVEY

The survey included 3 sections: (1) context variables; (2) current situation from a market standpoint, which is divided into 2 parts, the current situation and alternative solutions; and (3) improvement opportunities, which is also divided into two, opportunities for improvement and obstacles.

The survey was carried out using an online form, with 3 questions regarding context and 15 on content, open-ended and multiple-choice. Distribution was over electronic mail and 66 universal responses were received from a multidisciplinary public from a wide range of job titles. Of the responses, 33.3% correspond to real estate companies, 22.7% to construction companies, 30.4% to architecture studios and independent architects, and the remainder from public bodies and companies that offer products and services for architecture and project development. The main results were:

- Important delays in the process exist, 54.6% of the companies claim to comply with their deadlines between 50% and 90% of the time. At the same time, 56.1% determine that the main delays fluctuate between 2 and 3 months.

- Delays are related to difficulties with public processes but internal management is also responsible. 68.2% of the people surveyed said that the delays can be attributed in a 10-25% to the company and in a 75-90% to the building department of the local government (municipality).

- Large public organizations are those that generate the most issues. 58 surveys marked this answer, with an 87.9%.

- The process is planned but standardization is missing during follow-up. 36.4% state that they always use planning tools, versus 19.7% who state they never use them for these processes.

- These delays affect profitability.

- Companies in general believe they can reduce the time it takes to receive the CO.

- Respondents reported opportunities to improve and willingness to change, but also barriers that make implementation difficult. 48.5% of the respondents think that definitively there is room for improvement; as opposed to the 12.1% who think that the process is complex and that it cannot be improved.

- Respondents identified improvement ideas but the know-how to implement them is missing. 47% are completely willing to change the way the process is carried out, 15.2% in large projects, whereas 6.1% say they are not willing and 15.2% say no but perhaps with concrete proposals for improvement they would be willing.

VSM FOR THE CO PROCESS

VSM allows graphically organize the interactions between the tasks of a process. Before beginning a Lean Manufacturing process it is necessary to map out the current state, showing the flow of processes, input and information. In their book *Lean Thinking*, Womack and Jones (1996) explain that modeling comes after surveying and graphically expressing all the actions

that happen in a process. This process, in the VSM framework, is called flow and will be realized based on a family of processes.

The modeling process requires a series of 7 steps to be correctly applied: (1) define the process families involved in the product development. These process families establish the parts of the process, the sequential order and the characteristics of each box. Next begins (2) the timing of the diagram, defining the relevant indicators to measure. We used a survey of actual data on a timeline that considers the overall process, including the times between the different stages and within each task the time of the cycle, projected time, number of cycles for each activity, person responsible and number of indispensable people who participate in the task. This research considered it fundamental to include the industry's perception and opinion in detecting problems and applying improvements, so as to have real input when analyzing and creating the future model. The opinion was gathered through a perception survey. With all of the aforementioned and the designed data, we proceed with (3) modeling the current state. This current state is modeled based on the adaptation of the application tables to the specific requirements of measuring tasks of an administrative process towards a production process. This table establishes the tasks of the process and analyzes them through a value window. Then a condition is assigned to it (transformation, transport, control, wait). This condition will help the researcher to develop a reorganization of the tasks, according to the same table, for the future proposal.

Taking the diagram of the current state as the starting point, the researcher carried out an (4) analysis, using once again the value window to detect opportunities for improvement, but incorporating the responses obtained in the perception survey. This resulted not only in problems in timings and process order, but also in the planning. The planning problems included the way of carrying out the planning, responsibilities, fulfillment of commitments and overall monitoring of deadlines and process steps, as well as clarity with respect to the requirements to carry out the steps in the required time. This survey also showed results regarding opportunities for improvement. The analysis generated a series of changes in the order and structure of how tasks are fulfilled, but also in the way of establishing commitments and managing the process. These preliminarily conclusions were then validated through personal interviews with two on-site building managers.

(5) Using this procedure, a diagram of the future state was designed using the researcher's experience, technical knowledge from the onsite teams, survey responses and the current state analysis. Once the future state model was developed, we gave way to the (6) opportunity proposal. A set of tables and a checklist were developed as a proposal for planning and monitoring. Lastly the process gave way to the (7) improvement implementation. This is not a simple or quick step, as it involves changes from the start of the project, the signing of the contracts and the initial planning. It also involves changes in the culture on a company level and for each of the individuals that participate in the process.

From the improvement opportunities analysis, the preliminary conclusions were:

- Rearrangement of the tasks, depending on the deadlines involved.
- Redefinition of the timeline that the process considers.
- Attach the commitments and the certificates required for the process to the contract.
- Plan ahead of time all the actions that take longer in the cycle.
- Parallelize or overlap tasks in the process.
- Designate a process manager in the real estate company who accounts for the site manager and who follows the checklist, commitment table and deadlines.
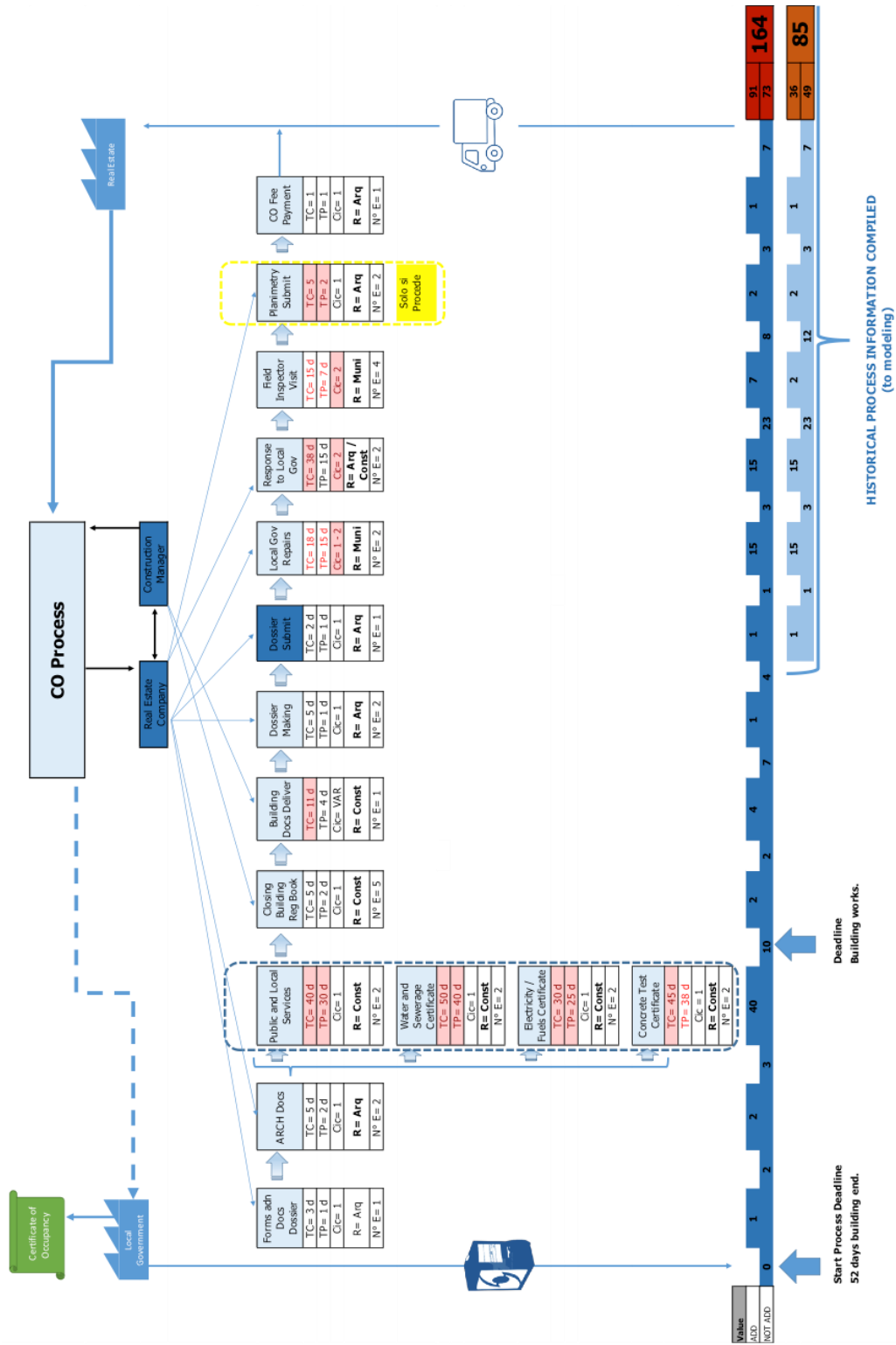
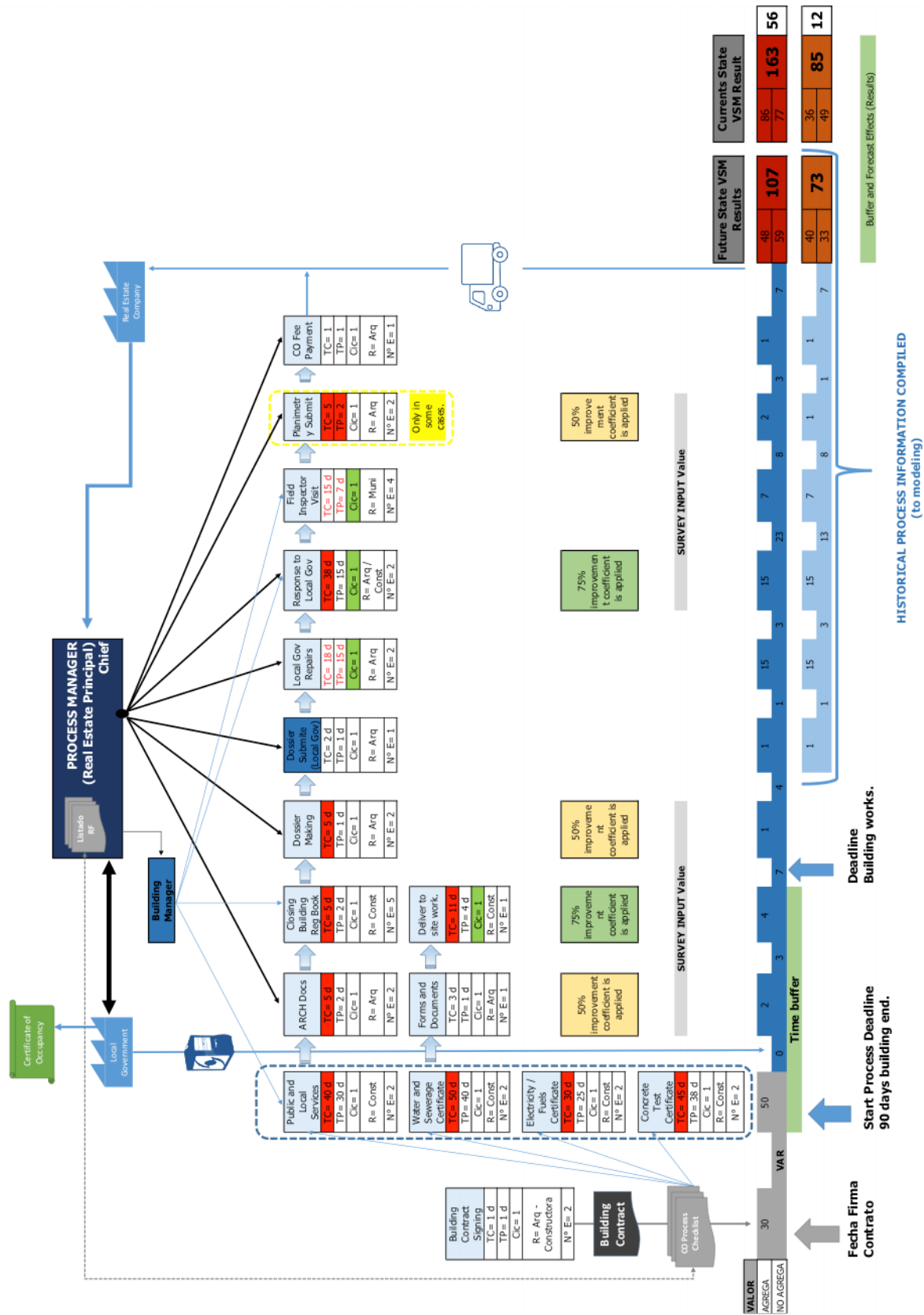Figure 2. Current state, VSM diagram

Figure 3. Future state, VSM diagram

With respect to the information analysis, the global process was improved in 75 days, reducing the duration from 163 to 88, considering from the beginning of the reception process to obtaining the CO. From this improvement, a subset is in the internal processing of the municipality's building department, which was reduced 12 days, reducing its duration from 85 to 73. All of these are theoretical results that reflect the VSM modeling and its considerations. The following section describes a partial application in a case study where important actual improvements with respect to timings were observed.

CASE STUDY

The initial review and compilation of historical information made it possible to determine real timeframes for the company's projects. The compilation of historical information was carried out over 16 projects of various sizes in 5 counties around the country. Information relative to the times from the date the file was entered, observation date, response time, approval time and time the CO was granted was compiled. The results were the following:

- Time to review background information: Minimum 5 days, Maximum 48 days, average 18.25 days.
- Time to respond to observations: Minimum 8, Maximum 72, Average 38 days.
- Observation cycles/Answer: Minimum 1, Maximum 3, Average 1.4.
- Approval time from the response: Minimum 2, Maximum 34, Average 23 days.
- Average 30 days to obtain the CO.
- Total: Minimum 4 days, Maximum 164, Average 79.25 days.

The improvement opportunities depicted in the proposed future state (previous section) were applied to the CO process of a mixed-use (residential, offices and commercial) 10-story building located in Los Andes county in the Valparaíso Region. Due to time restraints, the implementation did not consider all the recommendations identified with the application of VSM, however it included those concerning the formalities for receiving the CO. In this case, the list of certificates was sent to the construction company 3 months before beginning the process so as to speed up the timeframe considered in this process. The list consisted of a total of 36 certificates on behalf of the construction company and 16 for the real estate company. The results of the case study are the following:

- The project was submitted practically complete, with a total of 49 documents and certificates.
- Three visits from the field inspector carried out
- The entire process took 44 days where the historical information review shows an average of 79.25 days.

To obtain these results, the methodology was mainly applied through a process manager from the real estate company who coordinated the process, just as the improvement model proposes. A checklist was also used, but not in the contract stage, so more anticipations could have been foreseen. This specific case had an important delay in the sanitary and elevators certifications. The checklist was applied in December, two months before the programmed final reception. This application, before and during the CO process was a required instrument for the process order and planning as it established commitments from the first day of the process. Using this tool, the internal processes at the municipality's building department were effectively reduced.

CONCLUSIONS

The results of the research show that the process of obtaining the CO in Chile is inefficient and difficult, and that adapting the VSM methodology, from the productive to the administrative processes, is a path worth developing.

It can therefore be interpreted that in the case of real estate construction and management in the Chilean market there is a debt in the Lean Philosophy with respect to the administrative processes. The philosophy has been largely applied to the productive actions on site but its application is lacking for administrative tasks, meaning all the value that is added to the productive process is lost as the administrative process is not managed efficiently. The trend should be to support this vision for all parts of the process, incorporating a Lean contract that establishes shared responsibilities based on the final process checklist to then evolve into a follow-up commitment table. The Chilean market has evolved and is open to the possibility of implementing improvements; it is simply lacking the know-how to do so and thus is facing certain roadblocks to begin to innovate in these processes.

The increase in real estate development in the Chilean market makes it an urgent matter to improve the aforementioned processes. This research works specifically on the process to obtain the CO, but it is comparable to blueprints, building permits, co-ownership permits, among other municipality-managed processes and those managed by companies with a highly complex and bureaucratic internal processes. As this study shows, the theoretical analysis reduces the timelines by reorganizing the flow, reassigning responsibilities and using tools and inputs that support the process. It is also clear that this theoretical application can be used in practice to improve processing times, as it was shown by the case study.

It is evident therefore, that VSM can be used to evaluate administrative processes through small variations in the methodology. In this study, the VSM was applied by analyzing the current state map with the responses from the market. The application was validated by teams on site, but a considerable improvement could be applied if the situation was considered in its early modeling stages with feedback from more direct stakeholders. It can also be concluded that the VSM diagram is applied once, but the application of the improvement that result from the VSM should be complemented with LEAN planning tools like Last Planner, and the actions must be committed to from the beginning through a Relational Contract, for example.

REFERENCES

Alarcon, I., Christian, D., & Tommelein, I. D. (2011, July). Collaborating with a permitting agency to deliver a healthcare project: Case study of the Sutter Medical Center Castro Valley (SMCCV). In Proc. 19th Annual Conf. Int'l Group for Lean Construction (pp. 402-415).

Alves, T., Pestana, A., Gilbert, E., and Hamzeh, F. (2016). "Lean Principles for the Management of Construction Submittals and RFIs." J. Prof. Issues Eng. Educ. Pract. , 10.1061/(ASCE)EI.1943-5541.0000285 , 05016004.

Braglia, M., Carmignani, G., and Zammori, F. (2006). "A new value stream mapping approach for complex production systems." *International Journal of Production Resarch*, 44(18-19), 3929–3952.

Bulhões, I. R., Picchi, F. A., and Granja, A. D. (2011). "Combining Value Stream and Process Levels Analysis for Continuous Flow Implementation in Construction." *19th International Group for Lean Construction Conference: Proceedings*, 99–107.

Daramola, S. A., & Aina, O. (2004). Planning Policies And Affordable Housing In Nigeria–An Analysis Of Abuja Master-Plan Scheme And The Re-Validation Of Certificate Of Occupancy. Covenant University, Ota/Nomadic Housing Research Group, Lagos.

Duggan, K. J. (2002). *Creating mixed model value streams. Practial leantechniques for building to demand*. Productivity Press, New York, NY, USA.

Fontanini, P. S. P., Picchi, F. A., Loureiro, S. A., and Lima Junior, O. F. (2008). "Simulation a construction supply chain - preliminary case study of pre-cast elements." *IGLC 16 - International Grupo of Lean Construction*, 371–380.

Koskela, L. (1992). *Application of the New Production Philosophy to Construction*. Stanford.

Leite, K. P., and Barros Neto, J. D. P. (2013). "Value stream in housing design." *Proceedings for the 21st Annual Conference of the International Group for Lean Construction.*, 419–428.

Lima, M., and Rolim, L. (2010). "Value Stream Mapping of the Architectural Executive Design in a Governmental Organization." *Proceedings for the 18th Annual Conference of the International Group for Lean Construction*, 415–424.

Moghadam, M., and Al-hussein, M. (2013). "Resource optimization for modular construction through value stream map management." *Iglc-21*, 1(780), 503–512.

Pasqualini, F., and Zawislak, P. A. (2005). "Value Stream Mapping in Construction : a Case Study in a Brazilian Construction Company." *13th International Group for Lean Construction Conference.*, 117–125.

Pestana, A., Alves, T., and Barbosa, A. (2014). "Application of Lean Construction Concepts to Manage the Submittal Process in AEC Projects." J. Manage. Eng., 10.1061/(ASCE)ME.1943-5479.0000215, 05014006.

Rutakyamirwa, N. N., Lemmen, I. C., & Tuladhar, M. A. (2002). Modeling of Business Process in Distributed Environment: a Case Study of the Issuance of Certificate of Occupancy in Tanzania. ITC MSc-thesis Thesis, ITC, Enschede.

Tapping, D., and Shuker, T. (2002). *Value stream management for the lean office. Eight steps to planning, mapping and sustaining lean improvement in administrative areas*. Productivity Press, New York, NY, USA.

Womack, J. P., and Jones, D. (1996). *Lean Thinking. Banish waste and create wealth in your corporation*. Touchstone books, London, UK.

Yuraszeck, J. F. (2007). Evaluación de la revisión de proyectos del Fondo Solidario de Vivienda aplicando metodología Lean (Doctoral dissertation, Pontificia Universidad Católica de Chile).