Rossiti, I.S.M., Serra, S.M.B., and Lorenzon, I.A. (2016). "Impacts of Lean Office Applications in the Supply Sector of a Construction Company." In: *Proc. 24th Ann. Conf. of the Int'l. Group for Lean Construction*, Boston, MA, USA, sect.8 pp. 63–72. Available at: <www.iglc.net>.

IMPACTS OF LEAN OFFICE APPLICATION IN THE SUPPLY SECTOR OF A CONSTRUCTION COMPANY

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ABSTRACT

Studies considering the impacts of implementing the Lean Office in a supply sector are of high importance for construction companies, because such companies depend on the consolidation of their businesses and efficient management strategies; they also depend on suppliers of materials and services external to their organization. Thus, the use of Lean Office as a management tool gives construction companies a competitive edge in the present market situation. The purpose of this research is to apply Lean Office tools in a construction company - supply sector, evaluating the impacts in the sector after this implementation. The method used in this work was the case study research. A small construction company contributed with information required by this study. Initially, a description of the business is done with the preliminary design of the supply sector; from this, the current state value stream map is prepared. Then, the value stream map is created for the future state, applying the improvements identified while studying the company. The results led to the identification of faults and opportunities for management improvements. Action plans (Kaizen plans) were prepared aiming for the improvement of the production processes. This research is restricted to a specific company in the industry. One of the researchers is part of the company's staff and had access to information needed for the study. This work aims to contribute spreading the use of lean tools to improve the management of companies, regardless of size. After applying the kaizen plans in the supply sector, new indicators, such as cycle times, lead time and added value, were checked and compared to the previous state of the company.

KEYWORDS

Lean construction, lean office, supply sector, Kaizen plans, Value Stream Map.

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INTRODUCTION

The market shows itself more and more competitive. Because of this fact, companies have been searching for efficient strategies for the improvement of their production processes (Alves 2007). One of the ways to improve the production system of a company is by means of the lean thinking.

Liker (2004) asserts that this mentality or system was highlighted in the 80's, because of its quality and efficiency, becoming a model of competitive production. This fact caught the attention of many researchers and companies, bringing prominence to the lean thinking and disseminating this philosophy to the administrative areas of offices (lean office) and constructions (lean construction) (Womack et al. 2007).

The lean office philosophy, addressed in this article, represents the use of lean concepts in office environments. According to Greef et al. (2012), this is different from the lean manufacturing, because the focus is not the productive planning; in the lean office the strategies are focused in the administrative processes.

Considering this difference, the resources (value) for the lean office are: the supplies or products that are necessary for the office activities and information, which can be in the digital, printed, electronic, oral or graphic form (Lago et al. 2008). In this sense, applying the lean office in the supplies sector is relevant, since this sector is responsible for the efforts that link corporations to their customers, distribution networks and suppliers aiming for advantages in the market, which is more and more competitive (Chen and Cox 2012).

According to Al Maian et al. (2015), the management of the supply chain in civil construction considers the complexity involved in the companies and presents unique challenges, creating a network of independent contractors, sub-contractors, and suppliers that often span the globe. For these authors, there is a continuous challenge in guaranteeing coordinated planning of the diversity of equipment, goods and materials that are necessary throughout the development of the company.

In this way, this article reports a case study, carried out with a construction company using the lean tool, of the value stream mapping for the supply sector of the company. It is intended to evaluate which are the cycle times and waiting times in the production processes that compose the sector; it is also intended to create an action plan with the purpose of reducing the lead time, by means of changes in deficient administrative routines, resulting in optimized efficiency for the sector.

LITERATURE REVIEW

LEAN OFFICE

The lean office corresponds to the use of the lean thinking modified for administrative environments or offices. For Chen and Cox (2012) can be more difficult to bring the concept of Lean into the office environment than a manufacturing area because of a lack of understanding, a lack of cooperation between departments, and a lack of directive from the top.

According to Monteiro et al. (2015), this philosophy primarily aims to reduce costs, eliminate reworking, minimize communication problems, eliminate unnecessary activities, increase productivity, improve the efficiency of the administrative functions and use the workspace in the best way in the office environment.

Tapping and Shuker (2003) describe the necessary steps for the implementation of the lean office, they include: (1) committing to the change: this represents communication and flexibility in the application of tools, with the acquisition of support from the high administration being essential for the change; (2) choosing the value stream: for the lean office, the flow of information in a given administrative sector is generally chosen; (3) learning about lean: the concepts and terms associated with the lean thinking must be well understood by every person involved in the process; (4) mapping the current state: the map of the current state exposes the units of the production process (processing time and transmission of information) by using a set of symbols and icons; (5) identifying actions for lean development: these are action plans created from the use of lean tools and from the elimination of unnecessary activities for the production process - this step aims to develop a plan of continuous improvement of the stream; (6) mapping the future state: three phases must be employed for the correct drawing of this map, they are: the phase of understanding the customer demand, the phase for implementing the continuous stream so that the value desired by the customer is established and the leveling phase (equally distributing the work); (7) creating Kaizen plans: this step does not require the creation of a new future state map, however, many modifications should be done on the map in order to obtain continuous improvement in the production processes (kaizen); (8) implementing of kaizen plans: to practice the action plans developed and to observe the results.

MANAGEMENT OF THE SUPPLIES SECTOR IN CIVIL CONSTRUCTION

The supplies sector is responsible for the management of materials and resources with time; it significantly influences the maintenance of the financial flux and in the satisfaction of the customers. However, for Vrijhoef and Koskela (1999), construction supply chains are still full of waste and problems caused by myopic control. The acquisition of materials in the civil construction is usually done with urgency; this can cause delays in the delivery of such materials and, consequently, delays in the chronogram for the delivery of the project.

In order to avoid this scenario, Khutale and Kulkarni (2013) points out some important factors regarding the acquisition of materials, they are: compliance with the quality and necessary parameters for the items guaranteed by the suppliers; maximum negotiation with the suppliers, in order to guarantee the best possible conditions for purchasing/employing; evaluation and maintenance of partnerships with the suppliers, in order to guarantee the continuous improvement of the process.

According to Al Maian et al. (2015), the managers are challenged to improve the Supplier Quality Management (SQM) in an environment with limited resources. Hence, the managers must identify efficient practices for the SQM and choose the one that can bring the most benefits and assure quality for the supplier and materials.

In order to improve the management of the chain, Wibowo and Sholeh (2015) suggest the definition of key indicators for the development, such as: Perfect order fulfillment, Order fulfillment lead time, Production flexibility, Supply chain management cost and Inventory days of supply. According to the authors, the contractors must have a strategic plan for the acquisitions, because it is complicated to substitute a supplier during the development of the project.

According to Safa et al. (2014), the procurement and management of construction materials involve challenges related to reducing inventory, speeding delivery, and increasing the control of materials, decreasing the overall project cost. The authors also state that a variety of project-specific criteria are involved in the supplier selection process, including price, lead time, cash rebate, and supplier performance.

METHOD

The method used in this work was the case study research. A small construction company was identified that contributed information needed to do the study. One of the researchers is part of the company's staff and had access to the various data needed for research. A construction company selected that did not have the lean philosophy in its administrative environment, or in its supplies sector. Initially, a description of the business is done, the preliminary design of the Supply sector and from this it is prepared to present value stream map. Then the value stream map is created in the future state, applying the improvements identified in the study in the company.

APPLIED STUDY

THE COMPANY

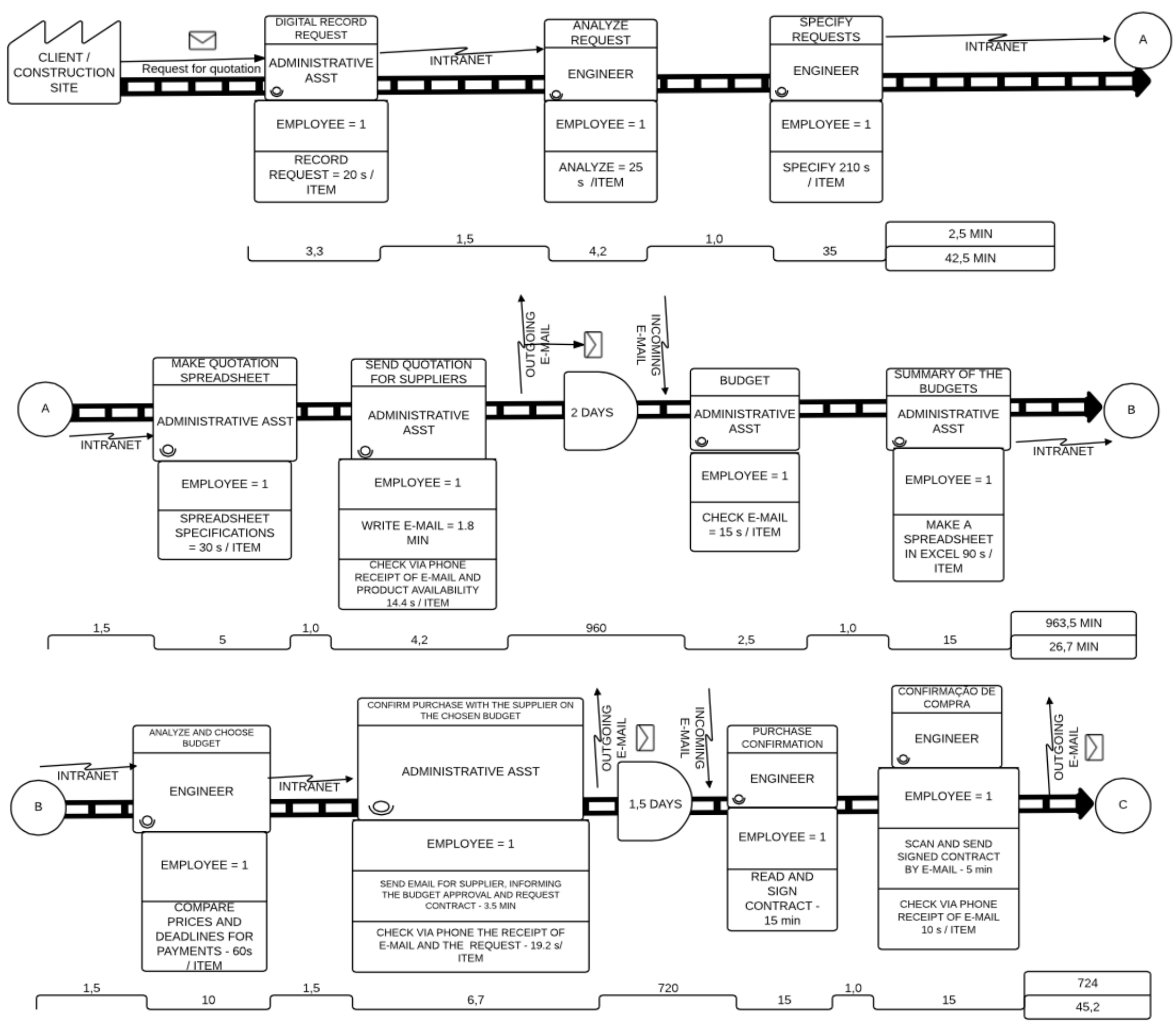
The studied corporation is a small construction company, localized in Tiete, São Paulo, Brazil. The company manages and carries out different projects for commercial, industrial and high standard residential enterprises. As the company is small, it does not have formal departmentalization. The organizational structure of the company consists of seven employees: three civil engineers, an architect, an administrative manager, a trainee (auxiliary civil engineering) and an administrative assistant. However, it is possible to observe certain collaboration among its employees. The supply sector is managed by a civil engineer, advised by administrative assistant.

CURRENT STATE VALUE STREAM MAPPING

According to Tapping and Shuker (2003), the principals concepts the Value Stream Mapping (VSM) are described as: *Cycle Time* (CT) – It is represented by the time that passes from the beginning to the end of an individual activity or process; *Total Cycle Time* (TCT) – It is understood as the summation of all cycle times of the individual activities or processes inserted in a stream value; *Waiting Time* (WT) – This concept is attributed to the time that a work unit will wait until the next process is ready; *Lead Time* (TLT) – Represents the summation of the total cycle time and the total waiting time; *Added Value* (AV) – It is obtained by the ratio between the total cycle time and the lead time. This concept is obtained as a percentage and can be described as: the percentage, inside the lead time (total time for processing an order), used in activities that add value.

Since the company did not have any indicators about how many requests were made per day, a quantitative analysis was carried out considering a month of service. For calculating these indicators the following were considered: the business hours practiced by the office, which are from Monday to Friday, from 8 a.m. to 5 p. m., with one hour for lunch, summing 8 hours of work daily, or 480 min; the average number of requests in a day. This resulted in 5 requests per day; the average number of items per request, which resulted in 10 items per request.

With these indicators established, it was possible to draw the current state value stream map (Figure 1), in which every process existing in the supplies sector and their respective times can be observed. After the determination of each time indicator, calculations were carried out in order to determine the TCT, the TLT and the AV. For elaborating the map, the construction company has also provided some relevant data such as the time for deliveries and for receiving feedback from the suppliers.



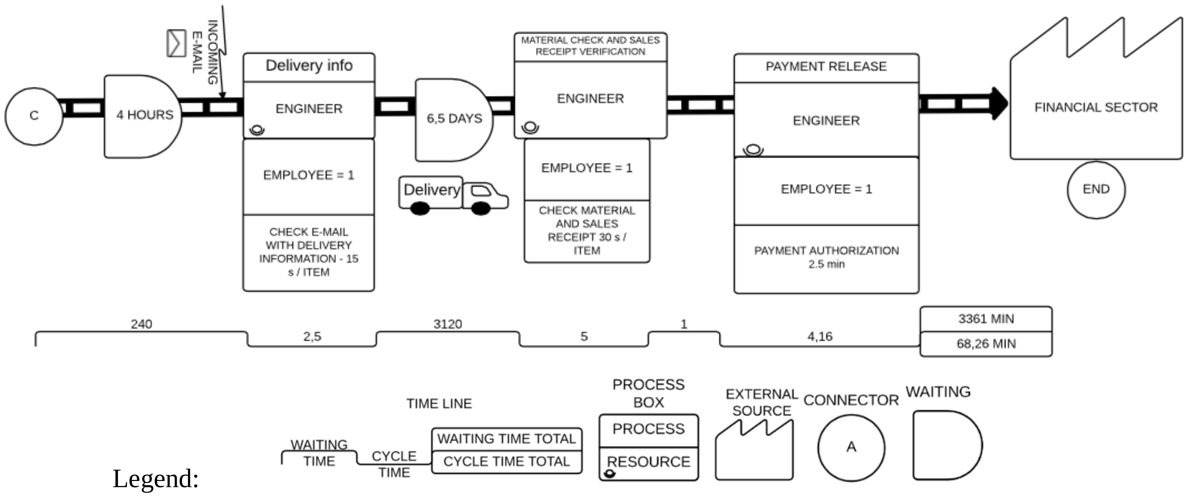


Figure 1: Current state value stream mapping.

In summary in Figure 1, the process develops as follows: the communication between the construction and the procurement department is done by telephone, technical visits and e-mails. On average, 10 requests are sent to the supply sector by telephone, e-mail or by purchase requisition spreadsheets. The information is received and digitized by the administrative assistant and it is sent, through intranet (internal network message), to the engineer in charge of the sector that verifies the request. The next procedure is the detailed specification of the product (model, code, color, quantity, unit etc.). Next, the administrative assistant creates requisition spreadsheets with quotation and prepares the e-mails for the previously established suppliers. With the quotations received, an e-mail is sent to the chosen supplier confirming the acquisition and contract (when necessary). After organizing the contract documentation, the company waits for the materials; it takes about 6.5 days for the products to arrive in the construction site. When the requested materials arrive in the construction site, the engineer in charge verifies the invoice and the integrity of the products. Having received the material in perfect conditions, the engineer authorizes the payment. This information is transmitted to the financial department via intranet.

Looking at Figure 1, the following results were obtained from the current state VSM for the supply sector: total cycle time of 116 minutes, lead time of 10.8 days and added value of 2.24 %, that is, only 2.24 % of the activities add value to the production process of the sector. The remaining represent waiting activities, which can be divided in the times for receiving feedback from the suppliers and for delivering the materials.

PROPOSAL OF AN ACTION PLAN

This plan intends to verify each bottleneck present in the current state VSM and to verify the best options for changing that can be applied in order to reduce the waiting times, that is, the lead time.

Considering the results obtained from the current state VSM, six action plans (Kaizen plans) were created and deployed, which intend to optimize the supply sector. They are:

- Elimination of incorrect steps of the production process. Processes that do not add any kind of value to the supply chain;
- Change of collaborator in specific processes. It was observed that, in some processes, the collaborator responsible for that step should be different. This decision was made intending to reduce the number of steps related to the transmission of information, reducing in this way the waiting time between processes;
- Addition of one collaborator to a specific process. In steps having high cycle times, a new collaborator (Trainee) was added in an attempt to reduce the cycle time;
- Automation of confirmations for email messages, that is, when the email is received by the suppliers, a message confirming the delivery is automatically sent to the construction company;
- Implementation of partnerships with suppliers. The partnership aims to reduce the waiting times for receiving email answers with contracts and budgets;
- As implied by the current value stream map, the delivery of the material in the building site is the activity demanding more waiting time; 6.5 days, which corresponds to 60.3 % of the total waiting time. This happens because the company considers an average of the times for delivering materials without making a difference between them. In this way, this plan suggests that the materials should be separated in 4 groups, these are: routine materials, representing 66 % of the total required materials and taking 1 day, on average, to be delivered; leverage materials, representing 21 % of the total with an estimated delivery time of 3 days; strategic materials, representing 8 % of the total and having an average delivery time of 15 days; bottlenecking materials, representing only 5 % of the total and having a delivery time of 30 days.

FUTURE STATE VALUE STREAM MAPPING

Primarily, the takt time was calculated for drawing the future state value stream map. For calculating this parameter, it is necessary to establish a standardized unit of measurement. This unit was defined from the daily demand of requests. The calculation of the takt time per unit of requests was carried out as follows:

$$\text{Takt time (requests)} = \frac{\text{Total available operational time}}{\text{Daily demand (requests)}} = \frac{400}{5} = 96 \text{ minutes/request}$$

When we compare the calculated value of the takt time (requests) with the cycle time of the process (T_{cycle} = 116 min), a difference of 20 minutes is observed; that is, the daily demand is higher than what the process can produce, generating delays in the supply chain. Considering this discrepancy, it is necessary that the cycle time of the processes are reviewed, so that their sum is less than or equal to the takt time of the requests. In Figure 2, the future state value stream map can be observed.

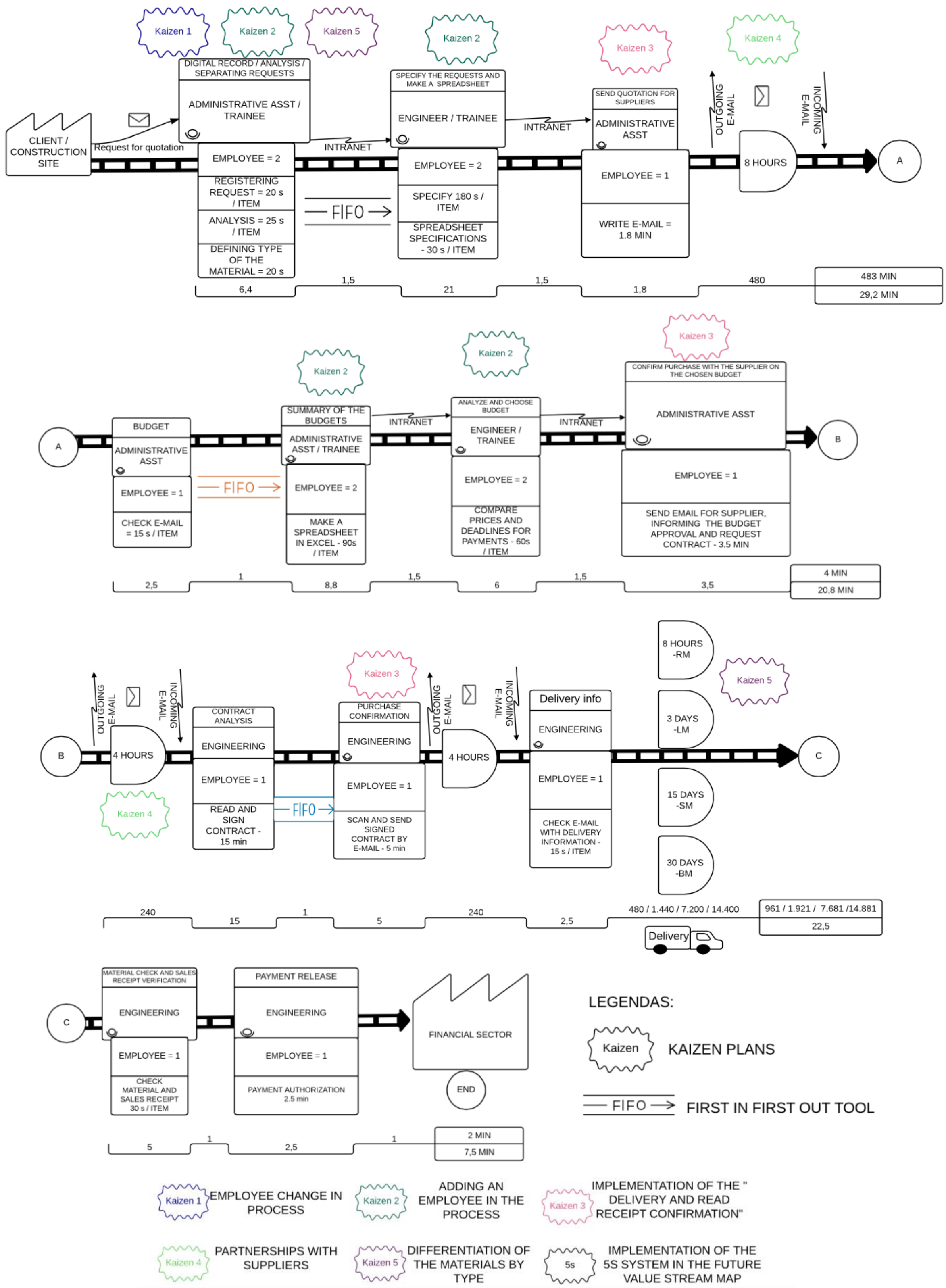


Figure 2: Future state value stream mapping.

After this calculation, it was established which are the lean tools to be used in the stream; they are: (1) the “5s process” (sometimes referred to as the Visual Work Place) is about “a place for everything and everything in its place” (Salem et al. 2005) - in this case, aims to reorganize the administrative processes in a simple way; (2) the “first in first out” tool, which establishes order for the logical information processing (Greef et al. 2012), in the case of this construction company, ordination for the requests.

With all of the indicators calculated and with the changes made to the current state map, measurements of the new processing times were carried out and the future state map was drawn. In Figure 2, the future state value stream map can be observed.

The results from the future state value stream map are as follows: the total cycle time was 80 minutes; the lead time and added value were separated for the different material categories. The results for the takt time and added value were, respectively: routine materials – 1,530 min, 5.2 %; leverage materials – 2,490 min, 3.3 %; strategic materials – 8,250 min, 1.0 %; bottlenecking materials – 15,450 min, 0.5 %.

CONCLUSION

Considering the cycle time, there was an improvement of 31 % or 36 minutes when comparing with the same index in the current state map. This result is satisfactory, considering that the takt time for the production process of a request is 96 minutes, that is, higher than the cycle time in the future state. In this way, it can be implied that there will not be any delays in the supply chain related to processes carried out by the office.

The separation of the materials in four distinct groups enabled four different indicators in the future state map, for the waiting time, lead time and added value. For comparison of these indicators with the ones obtained from the current state value stream map, the materials that are requested more frequently were considered, that is, the routine and leverage materials, which represent, together, 87 % of the requests. For the strategic and bottlenecking materials there was no improvement due to the deficiency in the waiting time indicator used by the company.

The lead time in the future state map for routine materials was 1530 minutes. When this value is compared with the same indicator in the current state map, an improvement of about 70.3 % was observed in the performance. For leverage materials this optimization was of 51.8 %. Regarding the indicator for the added value for routine and leverage materials, the improvements were, respectively, of 3 and 1.1 %. The reasons by which the evolution in these parameters was not great were: reduction of the cycle time in the future state map; the waiting times for the delivery of civil construction materials are generally high (8 hours minimum).

By the end of the case study, it was verified that the results from the application of the lean office in the supply sector was favorable, since there was reduction in the cycle and waiting times. This optimization was possible due to: commitment and understanding of the collaborators regarding the lean philosophy; development of a strategic plan applied to the current state stream value map; correct use of lean tools. Finally, it is important to always review and improve the VSM, in order to guarantee the fullest operation of the lean philosophy in the administrative sector of the construction company.

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