Lean concepts and tools in a distribution center

Miguel Calapez

Department of Engeneering and Management, Instituto Superior Técnico

Abstract

The current social economic environment triggers a sense of urgency in organizations. The fast moving consumer goods market behavior is changing, quickly challenging existing paradigms. Companies acting in this business have to find solutions in order to recover their competitiveness, along with greater operations flexibility allowing them to meet consumer and costumer needs, without jeopardizing health and safety, environment sustainability and high product quality.

Nestlé has therefore the need of becoming more flexible, delivering what costumer and consumer define as value. In this context Nestlé has the possibility of identifying improvement and waste reduction opportunities, developing processes and tasks which add value, by studying and implementing the lean production model.

This dissertation's main goal is to study the possibility of adapting and applying lean concepts and tools, usually studied and developed within a production environment, to the transport planning team's daily work, in a distribution center, understanding the opportunities it unveils as well as its limitations. The result is evaluated not only in terms of direct impact on a given key performance indicator but also in the motivational increment it brings to the planning team members.

Key words: distribution, planning, lean, waste, value, standardization, jidoka, visual management

1. Introduction

The world is facing big paradigm changes. Emerging markets are now developed ones, others seen as mature and stable are going through a huge crisis. It is therefore needed a constant and fast mindset and way of working change in order to deliver what costumers and consumers expect.

There is therefore a need of producing a this mindset change achieved by exploring processes

from raw and packaging material supply to delivering the goods to a costumer, instead of looking at specific problems isolated from the complete chain. This is one of the fundamentals behind lean production model.

The lean production model is of difficult and complex definition since it comprises different concepts and approaches to production. According to Womak and Jones (1996) this methodology delivers a way for specifying what is value, align value adding activities in the best sequence, preforming them with no interruptions every time someone asks for them, in the most efficient way. Later, Saha and Ward (2007) defended that lean production is a multidimensional approach using a wide variety of management practices, in an integrated system.

A company's supply chain has a large role in its structure, being the route for delivering its goods to the costumer. It is paramount that the mentioned change in mindset and way of working is strongly embedded in its distribution, increasing operations' stability and optimization.

Even though lean principles were born in production, they have universal application. The challenge relies on translating, shaping and applying them to our particular situation (Denis, 2007).

Lean thinking can help every company (including services) to identify and eliminate every form of waste and therefore improve business' processes and results. The first step is to understand that the waste is there and that there is the need for making changes on the existing way of working. Nevertheless, very often, people and companies don't understand that there is the need to go through a change. They don't identify what to do or change, how to do it or how to make it permanent (Kotter 2007).

Changing to a lean management requires the combination of a committed management team, the proper training and development of all involved and an environment that allows companies to be sustainable in the way they change and implement improvements (Jaca et. al. 2011).

2. Case Study

Society is suffering deep changes that, when looking at companies like Nestlé, translate in a behavioral change not only from its consumers but also its competitors.

In order to adapt to these changes, the company is evolving into a new culture, which comprises a continuous improvement mentality with high preforming teams, working together, fully committed in reducing waste.

Avanca's warehouse is the first Nestlé's distribution center in Europe to embark on this journey, using lean's concepts and tools to change its workers mindset into a teamwork continuous improvement one, being this the challenge studied in this paper.

Avanca's Distribution Center is the main warehouse for distributing Nestlé's goods in Portugal, located next to Nestlé's factory at Santa Maria de Avanca, Aveiro, Portugal. This is a 21.465 square feet unit, with a warehousing capacity of 43.700 pallets, with two separate areas for both human and animal nutrition. It has an outbound daily average of 35 trucks direct from distribution center to costumers, 3 as main leg for cross docking at a third party and 12 containers for Portuguese islands of Madeira and Azores and Exports, being processed every day more than 300 deliveries for the distribution of 1100 skus, for more than 2000 delivering points.

In this paper it is studied the possibility and benefits of applying lean's concepts and tools to the administrative team of transports planning, part of the distribution center's structure,

considering the impact this team's work has on logistics, both on cost and service.

3. Lean in the transport planning team

3.1. Basic stability

The initial approach for the application of lean concepts and tools to the transport planning team was the mapping of all its activities, from delivery cut-off (from costumer service to transport planning) to truck loading from the distribution center to costumers.

In this first exercise some opportunities were identified in order to improve process stability and reduce waste. Regarding deliveries, the cut-off hour was revised, points of contact between customer service and transport planning re-established and a process was defined to deal with urgencies and exceptions. Regarding organization, some visual management 5S principles were applied to the planning office. Planning tools also suffered a revision as was the case of a complete redesign of one of the major outputs from the planning team which is as outbound schedule document to be shared with shift supervisors.

Besides these first implementations considered as quick wins, it was clear during the mapping stage that a planning standard was missing, having planners working differently from each other, completing their tasks with no specific order nor timing, with no alignment with operation's regarding the needed time for picking and shipping for delivering in time to costumers. Some opportunities relate to the complexity of the planning activity with the tools available, different capabilities and knowledge form all planners and unnecessary interruptions and distractions that jeopardize the quality of the work made by this team.

Another opportunity was pointed out when estimating the number of pallets to be loaded in each truck as the proposal by the planning system tool doesn't match the real number of pallets produced by pickers, making the planning and resulting truck occupation rely more on experience than on accurate data. This was identified as an opportunity for using the jidoka concept by the development of a tool somehow compatible with the definition of poka-yoke.

3.2. Transport Planning standardization

By standardizing the planning's team work the expectation is to define the average time per task, how many planners are needed, which planner should do which task, what is the best planning sequence and what are the starting and ending times to be accomplished.

3.2.1. Performance indicator

The lean concepts and tools application to the work of the transports planning team at the Avanca distribution center is measured by evaluating the implementations impact on the most important performance indicator for this team which is the planned truck occupation.

Truck occupation is calculated as follows:

Ocupation (%) = max [Ocupation in volume(%); Ocupation in pallets (%); Ocupation in weight(%)]

- Ocupation in volume (%) = vehicle utilization in volume divided by the vehicle's maximum volume capacity;
- Ocupation in pallets (%) = vehicle utilization in pallets divided by the vehicle's maximum pallet load capacity;

- Ocupation in weight (%) = vehicle utilization in volume divided by the vehicle's maximum weight capacity;

3.2.2. Data collection and analysis

The following different tasks were considered for data collection, measuring the daily duration, the number of trucks planned and the number of parts into each task was divided:

i) Direct shipments to customers in the south of Portugal; ii) Direct shipments to customers in the north; iii) Shipments from Carnaxide warehouse; iv) Shipments from Porto warehouse; v) Shipments via cross docking with lead time of 48h; vi) Shipments via cross docking with lead time of 24h; vii) Specialized distribution channel for pet food; viii) Shipments to 3rd party co-packer; ix) Planning information and truck scheduling with carriers; x) Special picking requests and pallet identifications; xi) Daily transport Schedule for shift supervisor; xii) Information preparation for cross docking logistics operators.

In table 1 are registered the average times for each planning activity.

Direct shipments to south are planned in an average of 5 minutes per truck, being this task divided in three steps, done by different planners. North's are done in 4 minutes per truck. For shipments from Carnaxide's warehouse the team takes an average of 2,5 minutes, time spent even if no deliveries are to be planned.

Table 1: average time for each planning activity

Row Labels	24-06-2013	25-06-2013	26-06-2013	27-06-2013	28-06-2013	01-07-2013	02-07-2013	03-07-2013	04-07-2013	05-07-2013	08-07-2013
01. Pl. Directos CDA - Sul											
Duração	02:35:00	02:55:00	02:25:00	02:18:00	04:10:00	00:52:00	00:31:00	01:05:00	00:36:00	00:50:00	01:37:00
Número visturas	26	23	20	23	39	12	20	17	8	16	12
Partes	3	3	3	3	3	2	4	3	1	6	4
02. Pl. Directos CDA - Norte											
Duração	01:35:00	01:45:00	01:35:00	01:33:00	01:55:00	01:05:00	00:55:00	00:40:00	00:41:00	00:57:00	01:25:00
Número visturas	15	16	22	17	29	20	23	17	11	10	35
Partes	1	1	1	1	1	1	1	1	4	3	3
03. Pl. Carnaxide (Dir + Cap)											
Duração	00:04:00	00:02:00	00:02:00	00:03:00	00:01:00	00:02:00	00:05:00	00:01:00	00:02:00		00:03:00
Número visturas	2	0	0	0	0	0	0	0	0		0
Partes	1	1	1	1	1	1	1	1	1		1
04. Pl. PPO (N+S) (Dir + Cap)											
Duração	00:15:00	00:30:00	00:29:00	00:06:00	00:35:00	00:08:00	00:09:00	00:05:00	00:20:00	00:04:00	00:20:00
Número visturas	3	3	5	6	2	1	2	1	2	1	1
Partes	1	1	1	1	1	1	1	1	1	1	1
05. Pl. Capilar 48h (N+S)											
Duração	00:58:00	00:50:00	00:43:00	00:41:00	00:45:00	00:34:00	01:25:00	00:50:00	00:33:00	00:40:00	00:42:00
Número visturas	2	3	2	3	2	2	3	2	2	2	2
Partes	1	1	1	1	1	1	1	1	1	1	1
06. Pl. NPPC Especializado											
Duração	00:11:00	00:15:00	00:16:00	00:20:00	00:13:00	00:17:00	00:16:00	00:35:00	00:25:00	00:15:00	00:11:00
Número visturas	1	2	3	3	3	1	2	4	4	2	1
Partes	1	1	1	1	1	1	1	2	1	1	1
07. Pl. CoPacker (CDA + Ovar)											
Duração						00:17:00	00:09:00	00:03:00		00:04:00	
Número visturas						1	1	1		1	
Partes						1	1	1		1	
13. Pl. Capilar 24h											
Duração	00:05:00		00:22:00	00:13:00	00:13:00	00:20:00	00:25:00	00:15:00	00:11:00	00:35:00	00:07:00
Número visturas	1		1	1	1	1	1	1	1	1	1
Partes	1		1	1	1	1	1	1	1	1	1

Table 2: data collection for administrative tasks

Row Labels	Column 24-06-2013	25-06-2013	26-06-2013	27-06-2013	28-06-2013	01-07-2013	02-07-2013	03-07-2013	04-07-2013	05-07-2013	08-07-2013
08. Informação Transp. (tlf+mail)											
Duração	00:48:00	00:30:00	00:48:00	00:16:00	01:31:00	01:07:00	01:29:00	00:51:00	00:31:00	01:07:00	00:39:00
Partes	3	2	3	1	3	3	7	4	3	9	4
09. Info. Estivas / Identificações											
Duração	02:00:00	01:45:00	02:10:00	01:14:00		00:06:00		00:25:00		00:33:00	01:06:00
Partes	2	2	2	1		1		1		3	4
10. Info Administrativa (MADs)											
Duração	01:27:00	00:58:00	00:49:00	00:50:00	00:54:00	01:35:00	01:13:00	01:22:00	01:29:00	01:19:00	01:05:00
Partes	7	5	5	4	4	8	10	10	9	12	9
11. Prep. Info p/ Operador Log.											
Duração	00:21:00	00:22:00	00:14:00	00:23:00	00:19:00	00:05:00	00:11:00			00:22:00	00:31:00
Partes	2	2	1	2	1	1	1			1	2

Regarding shipments from Porto the planning shows high variability, having been considered as average 20 minutes each day. Regarding deliveries via cross docking in 48h, although data collected shows an average of 47 minutes, it was considered only 20 minutes for this task since some improvements regarding sap easiness of utilization were done.

For cross docking in 24h it was considered an average of 22 minutes. The planning of the specialized channel for petfood takes 17 minutes. Finally, planning of shipments to the co-packer shows also high variability having been considered 15 minutes per day for verifying need and planning transports.

In table 2 is the data related to the time taken doing other support administrative activities.

3.2.3. Planning sequence

The period observed showed that no sequence was followed by any of the planners. In fact, each planning task can be divided in two or more steps, by the same or different planners, with no apparent organization nor coordination with the operational team. Therefore, for the definition and implementation of a standard it was discussed and negotiated between the transport planning and operational teams which should be the sequence and the timetable for delivering the daily transport schedule to the shift supervisor.

3.2.4. Standards implementation

Considering all the above, a new standard was developed for having the planning work being done every day the same way, at the same time, in the same sequence with more stable results. The standard is showed in tables 3, 4, 5, 6 and 7.

Table 3 - standard for first planning stage

1st Planning stage, planner 1	Beginning	End
Cliente M Sul planning	11:00	11:30
Schedule Cliente M Sul	11:30	11:40
Cliente M Sul truck request	11:40	11:45

Table 4 – standard for second Planning stage

2º Planning stage, planner 3	Beginning	End
Cliente A Planning	11:30	12:00
Schedule Cliente A	12:00	12:10
Cliente A truck request	12:10	12:15

Table 5 – standard for third planning stage, planner 1

3º Planning stage, planner 1	Beginning	End
Diretos sul 1st block (5/6 trucks) Planning	13:30	14:00
Diretos sul 2nd block planning	14:00	14:45
Capilar 24h Planning	14:45	15:15
copacker Planning	15:15	15:30
Capilar 48h Planning	15:30	16:10

Table 6 – standard for third Planning stage, planner 2

3º Planning stage, Planner 3	Beginning	End
Purina especialized planning	13:30	14:00
Porto Planning	14:00	14:20
Carnaxide Planning	14:20	14:30
Diretos norte Planning	14:30	15:30
Client P Planning	15:30	15:40
copaker Schedule	15:40	15:50
overflow Planning	15:50	16:10
capilar 48h + 3pl cross docking data file	16:10	16:30

Tabela 7 – standard for third Planning stage, planner 3

3º Planning, Planner 3	Beginning	End
Purina especialized Schedule	14:00	14:10
Specialized schedule 3pl data file	14:10	14:30
diretos sul 1ª part schedule	14:30	14:40
diretos sul 1ª part truck request	14:40	14:45
Porto schedule + truck request	14:45	14:55
Carnaxide schedule	14:55	15:00
diretos sul schedule + truck request	15:00	15:35
cap 24h data file + schedule	15:40	15:55
diretos norte + PP + schedule + truck request	16:00	16:30

These standards are coupled with a rotation plan for the three planners so that every planner has the knowledge and capabilities to do every sort of planning with the same expected results.

According to these standards the planning activities are concentrated in two planners, having the third planner the responsibility of dealing with support tasks with lower added value. This way planners 1 and 2 will keep better focus, suffering less with interruptions, leading therefore to better and more consistent results.

3.3. Jidoka in transport planning

One of the opportunities identified was the creation of a tool for helping transport planners to better estimate the amount of pallets to be loaded in one truck and, therefore, reduce their uncertainty buffer.

In the following charts it is possible to understand the amount of the correction that needs to be considered in order to properly make the conversion between theory and reality.

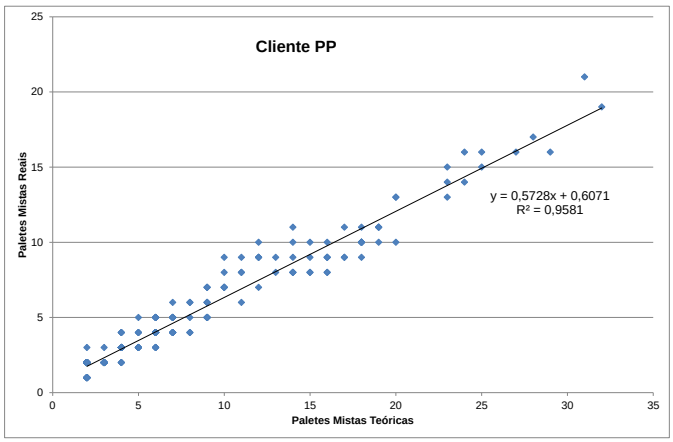

Figure 16 – theoretical vs actual number of mixed pallets to Customer PP

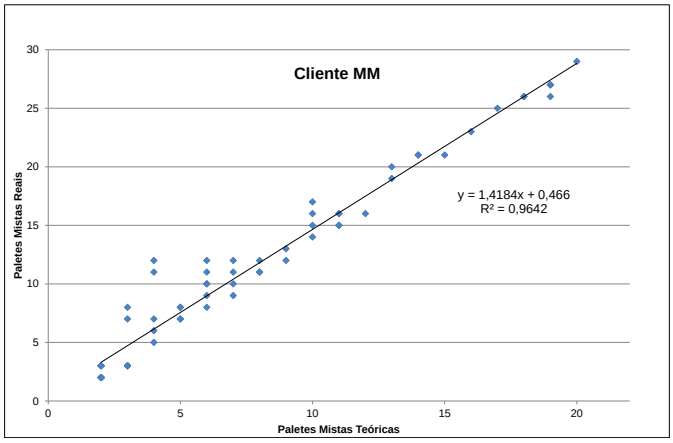

Figure 17 – theoretical vs actual number of mixed pallets to Customer MM

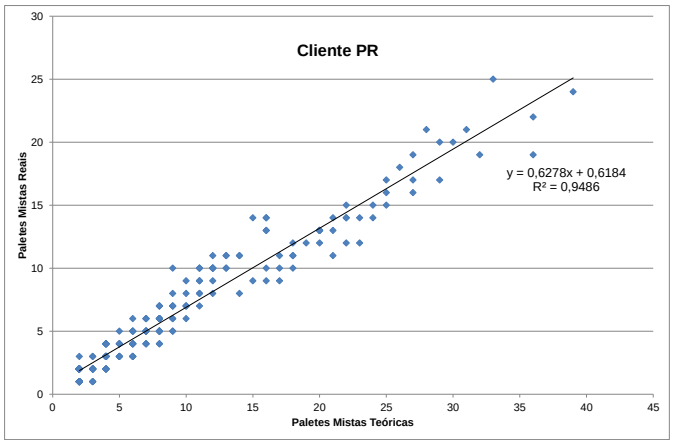

Figure 18 – theoretical vs actual number of mixed pallets to Customer PR

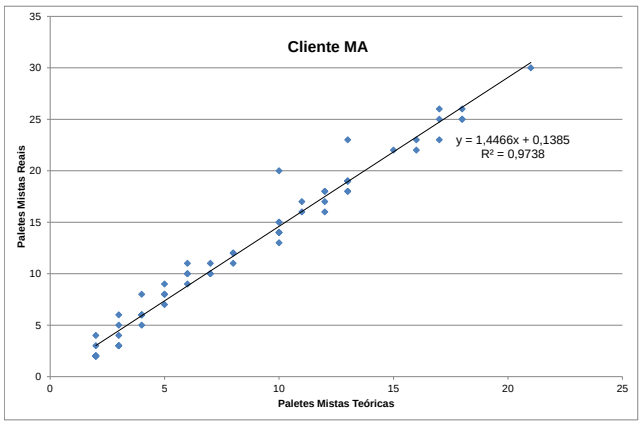

Figure 19 – theoretical vs actual number of mixed pallets to Customer MA

For all the customers analyzed the ratio between what is proposed by sap and the actuals show some variability for quantities higher than one pallet. With the above information an excel file was created as a simple tool to make the conversion from theoretical to real pallets, using linear regressions.

Table 12 – conversion from sap proposal to real estimated

Customer	Equation
MM	y = 1,4184x + 0,466
PP	y = 0,5728x + 0,6071
MA	y = 1,4466x - 0,1385
PR	y = 0,6278x + 0,6184

x: number of mixed pallets proposed by sap
y: real number of pallets estimation

The tool developed is a simple excel sheet where the planner can input the number of pallets estimated in sap and convert it into a real pallet estimation, using the equations above, according to each one of the four delivering destinations.
The objective was to deliver to the transport planners a simple, visual and easy to use tool. By using this estimations based on historical data the buffer considered before is shortened, reducing the probability of errors in planning, allowing the

planner to have a more accurate estimation of the total number of pallets to be loaded and, therefore, having a higher truck occupation. It can roughly be related to the concept of poke-yoke once it is used to avoid mistakes, although in doesn't completely eliminate its occurrence.

3.4. Outbound flow mapping

During the development of the new standards for Planning and the tool mention in 4.3, it was clear that there was the need of mapping the whole value chain, from the moment when Customer service produces the deliveries until the truck leaves the Distribution Centre premises.

It was considered that the appropriate level of detail and type of mapping was of a flow mapping, as a tool to reach the goal of developing an outbound future state with perfect synchronism between transport planning and warehouse operations. This mapping was made with the participation of everyone related to this particular value chain, as operations, transport planning, projects team, customer service, lean team and information systems.

3.4.1. Current state and opportunities

One of the key learnings of this exercise is that no matter how deep you are involved in one process, you don't have a completely clear vision of the steps involved, and not everyone will have the same understanding of the process being mapped.

Although at a first glance it should be easy to map the tasks one does daily, it is interesting to see the doubts and different opinions regarding the details, fact that only reinforces the importance and need of having standards in place.

The discussion was fruitful producing a list of opportunities to revise and improve the outbound flow. Nevertheless, as expected, the most relevant opportunity identified was of developing a greater synchronism between Planning and operations, allowing a better resources utilization and management, less variability of workload during the day, proper estimation of the timeslot during which each customer should be loaded and each supplier should be unloaded, increasing the loading and unloading bays dynamic capacity.

3.4.2. Future state and action plan

A future state was developed in order to close the identified gaps, for which some lean workgroups will be gathered, for big events like the standardization of picking activities, levelling or heijunka for picking, inbound and outbound operations and jidoka also in picking for the elimination of picking errors.

3.5. Results

After the implementation of the standards and tools described in this paper, it was possible to see a positive impact in the performance indicator followed related to the outbound truck occupation but also in the planners' confidence and reduced stress as result of the task redistribution and balance.

Regarding the kpi, data from the month that followed the implementation shows an improvement of 5% in truck occupation.

4. Conclusion

This dissertation's main goal was to evaluate the viability and impact of applying lean concepts and tools in a distribution center, in its transports planning team.

The study comprised a first stage of deeply developing the understanding of these concept and tools, as well as the definition of what is considered as value or waste.

Some of the discussions during this dissertation's development brought some sensible problems to the table, producing some discomfort and anxiety

on the teams. It was one of the conclusions of this paper that no matter how simple on process or workflow change is, everyone's related to that value stream should be involved. Only by putting together actual data and recommendations based on experience one can get the best benefits.

We can therefore assess that it is possible to apply lean concept and tools, through the adaptation of concepts like stability, visual management, standardization, jidoka and mapping, to a distribution center, in this case an administrative team inside a Logistics Operation.

It could also be observed a higher engagement from all teams, better connection between them, breaking the silos in which all seemed to work in. Also an improvement in awareness regarding what is or is not adding value in the whole stream was noticed, bringing a challenging mentality to the team.

Regarding the proposed kpi to follow the improvements achieved, it was registered a 5% improvement in truck occupation after the implementation of the opportunities identified and developed during this dissertation.

All in all we can conclude that lean concepts and tools can bring great benefits to processes other than the ones related to production, both regarding key performance indicators and awareness and engagement by human resources.

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