

Application of the lean layout planning system in a leather bags manufacturing plant and proposal of an approach to engage the company’s staff in the research of the layout solution

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Appendix A. VALUE STREAM MAPS

Appendix A shows the following figures. The initial value stream map of the leather bags manufacturing plant (Figure 6) and the value stream map obtained after changing the location of the plant and arranging the equipment according to the final layout (Figure 7).

The value stream maps were performed to better understand the waste reduction achieved by applying the proposed lean layout planning approach. The maps summarize the average duration of all the operations carried out in the production process of a bag. For the construction of the maps, it was considered the most produced bag model of the plant under analysis. Both value-added operations (processing times) and non-value-added operations (transporting and awaiting times) were considered. The numerical results used to build the maps were partly measured manually (with a chronometer), and partly derived from the available databases. The measure units used to quantify times were seconds (s) or days (d).

In the maps, for operations that were performed at once, the duration was written above the timeline. On the other hand, for operations that were executed twice, the time of the first operation was written above the timeline, while the time needed to bring the piece back to the machine and execute the second operation was written below the line. In the case of non-value-added times, the total duration was indicated as the sum of two times: the time needed to transport the semi-finished products from one department to the next, and the time needed to wait for the next operation to be carried out. Sometimes, in fact, an operation is performed only if the entire batch of bags has completed the previous one.

In figure 6 the value stream map related to the initial layout of the plant shows the waste that characterizes the initial situation of the company. Transporting and waiting times are very high and this depends on the fact that the company is in a two-floor building and it is necessary to move several times from one floor to another, but above all, it depends on the fact that machines are arranged in a messy way and two consecutive production departments are not always placed close to each other. Figure 6 also shows the waste of time caused by the repetition of

certain processes (such as splitting or fleshing) and linked to a non-linear flow of materials.

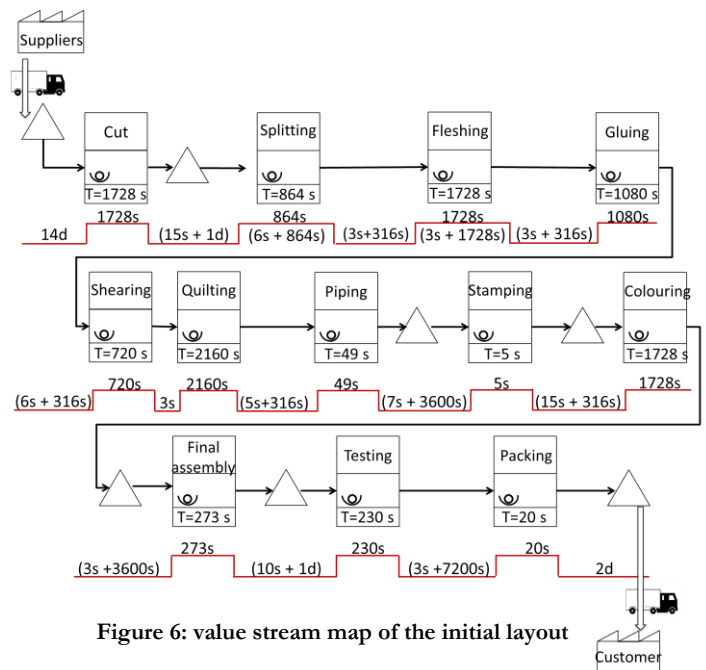


Figure 6: value stream map of the initial layout

Figure 7 shows the benefits in terms of time and waste reduction achieved by using the proposed lean layout planning approach and adopting the final layout. The non-value-added time is reduced: there is a reduction in total transport time of 42 seconds, and a reduction in total waiting time for items in the warehouse of almost 10 days (862.137 seconds). Finally, linear flow of materials is achieved, thus avoiding the following wastes: moving semi-finished products from one workstation to the previous one and moving workers and transport equipment between distant production departments.

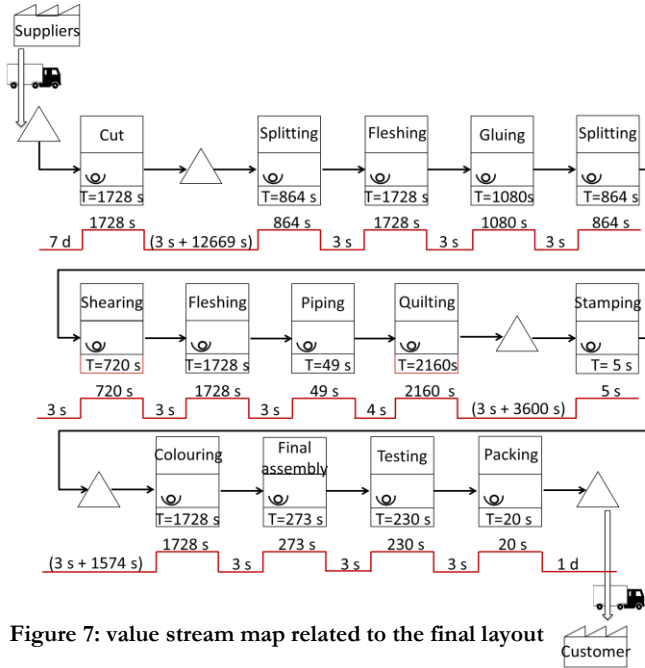


Figure 7: value stream map related to the final layout

Table 1: performance growth in percentage obtained by comparing the final layout with the initial one.

Δ throughput time	Δ throughput rate	Δ WIP	Δ workers moving time [%]
- 54,42%	+ 4,79%	52,23%	- 51,22%

Table 1 summarizes the growth in plant performance obtained by modifying the layout. The final layout is advantageous compared to the initial one. Having measured an initial throughput of 212.50 bags/hour and a final throughput of 222.68 bags/hour, knowing the processing and transport times of a bag (Figures 6 and 7) and using Little's law to determine the WIP, the change of layout results in a halving of WIP, throughput time and workers' moving time. It also leads to an increase in productivity of almost 5%.