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## Approach to Reducing Production Lead Time to 1/20 in Small-scale Corrugated Cardboard Factory

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### Abstract

In response to population decline in Japan, the production demand has shifted from mass production to quick production of multiple products in small lot since 2005. In this paper, we delineate the method that conducts production in one-twentieth (1/20) of usual lead time (hereinafter referred to as L/T), which is revolutionary short, is able to respond to the needs of the users concerning delivery, among QCD (quality, cost and delivery). This proposed method is energy efficient, and it is designed for the companies that strive to be the top company in the region. It aims for development of corrugated cardboard makers and optimum efficiency of management.

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Peer-review under responsibility of the organizing committee of the 12th EMSES 2015

*Keywords:* Corrugated Cardboard; Innovation in Production; Outstandingly Fast Delivery; Reduction of Stock

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### 1. Background of JPACKS production system – maximum reduction of l/t

As of 2015, it is said that there are approximately 3,000 corrugated cardboard companies in Japan, meaning there is extremely tough competition, and small and medium size companies with small capital are especially always in straggle. However, there are ways compete with large businesses through innovation and repositioning within limited resources.

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When examining the three most important elements of business, namely Quality, Cost and Delivery, it is apparent that, though quality and cost are equivalent with those of the large companies, small companies can be in a highly advantageous position when it comes to delivery [1-5]. In this paper, we will delineate the “Jpacks Production System” which is able to reduce delivery time without excessive pressure on the production, centered around “Production method of preferentially proceed of purchase order with multiple processes”, “Production Method with Every Processes Conducted in Parallel” and “Single Unit Flowing Production” developed by JPacks.

**2. Production method of preferentially proceed of purchase order with multiple processes**

It is a method where arranging purchase orders in the descending order of processes and starting the production from the order with the most steps, which is why it is named “Production method of preferentially proceed of purchase order with multiple processes”. Normally, in the first process of corrugated cardboard production which is printing, it is common to produce the board with the same color all at once in a large quantity in order to reduce ink loss when changing color. However, the cost of ink loss is very small and negligible in relation to the entire operational cost of the factory. In fact, in the production method of preferentially proceed of purchase order with multiple processes, waiting time of the workers during the 2<sup>nd</sup> to the last steps is significantly reduced, hence a major improvement can be expected. The delay in the production process cannot be theoretically regained, and moreover influence all the way to the last process. Therefore, how to reduce the delay in processes is extremely important for L/T shortening.

*2.1. Simulation*

We simulated the common production method (Table 1) and production method of preferentially proceed of purchase order with multiple processes (Table 2) under these conditions.

- 15 lots are produced per day.
- 3 types of lots (1<sup>st</sup> process, 2<sup>nd</sup> process, 3<sup>rd</sup> process) are mixed, each of 5 kinds with different colors.

Table 1 **Common Production Method**

Lot	The 1st Process	The 2nd Process	The 3rd Process	Set Change	Operation Time
①	○			5	10
②	○	○		7	20
③	○	○	○	12	30
④	△			5	10
⑤	△	△		7	20
⑥	△	△	△	12	30
⑦	□			5	10
⑧	□	□		7	20
⑨	□	□	□	12	30
⑩	×			5	10
⑪	×	×		7	20
⑫	×	×	×	12	30
⑬	⊙			5	10
⑭	⊙	⊙		7	20
⑮	⊙	⊙	⊙	12	30

  

Measurement Change	15 Times				
Color Change	5 Times				
Waiting Time		50	100	120	
Operation Time					300
Working Time					<b>570</b>

Unit is minute  
The gray color in the table is the waiting time

Table 2 **Production method of preferentially proceed of purchase order with multiple processes**

Lot	The 1st Process	The 2nd Process	The 3rd Process	Set Change	Operation Time
①	○	○	○	15	30
②	△	△	△	15	30
③	□	□	□	15	30
④	×	×	×	15	30
⑤	⊙	⊙	⊙	15	30
⑥	○	○		10	20
⑦	△	△		10	20
⑧	□	□		10	20
⑨	×	×		10	20
⑩	⊙	⊙		10	20
⑪	○			5	10
⑫	△			5	10
⑬	□			5	10
⑭	×			5	10
⑮	⊙			5	10

  

Measurement Change	15 Times				
Color Change	15 Times				
Waiting Time		0	0	150	
Operation Time					300
Working Time					<b>450</b>

Unit is minute  
The gray color in the table is the waiting time

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