# Improvement of Re-order Point Resupplying Method of a Fluctuating Productive System

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**Abstract** – The aim of stock optimization is insuring the supply of production system without breaking, with saving a minimum stock level. Several methods of resupplying, classics and other developed are proposed to reach this objective. Most of the various production systems follow the re-order point resupplying method, because of its economic properties and its flexibility. But, various constraints influence the production systems, provoking from time to time a desynchronization between the stock level and the effective needs. This desynchronization expressed by leading breaks of stock in case of raise rate production and surplus in case of production rhythm decrease. The envisaged research allows improving this method (re-order point resupplying) to avoid these last two problems. A new proposed approach considers the value of the re-order point resupplying as a variable dependent on the production rhythm $(C_{mean})_i$, at every immediate period between the receipting moment of the last command $(t_r)_{i-1}$ and the current moment $(t_i)$,by preserving the same principle of resupplying

**Keywords**: Re-order point, economic quantity, Resupplying, Stock discontinued, Stock gesture.

## 1 Introduction

Several constraints causing the production system irregularity, which avoid the uniform continuity of the production process. In particular, we can quote:

- -The market constraint which influences the work cadence;
- -The various stops constraint (breakdowns, preventive maintenance, timer…..)
- -The insufficiency space constraint for work in process and the final products;
- -The logistic constraint (transport).

These constraints and others results two not desirable situations to well stocks manage the stock: the shortage and the existence of an excess in stock, especially for those who follow the re-order resupplying method.

According to Hubert (2013), the provisional uncertainty is important in any decision based on estimates of the future demand, as planning decisions of the production and the flows piloting. By this reason, the domain of flow management is rich by many works, interested to improve the various methods of resupplying, what encourages Giard and Sali (2012) in their work extended to that of Huang et al (2003) to give a general idea on the various articles being interested on this subject.

According to Lambert et al (l998): Within the main purpose of stock managing: maximize the company profitability by minimizing the storage cost, while satisfying the customer service requirements. Brown (1959) is among the first ones who began to study the uncertainty and its influence on logistic chain efficiency. There forfeits influence on the cost price of the finished product, what confirmed by Ben ammar (2013), in his work mentions, that the production planning and the supply are uncertain in an uncertain environment. He concluded that the problem resolution depends not only on the method of resolution and on the level number, but also on the break in finished products. In the article of Sgren Glud and Anders (1998), the authors propose a method of emergency resupplying, the aim of their method is avoiding stock shortages, this method is based on rush orders to face the uncertainty of the request.

In the same sense and with the same idea, Sven (2007) proposes a management procedure, for a system of inventory mono level. Based on a persistent follow-up of the stock, applying the re-order resupplying method for validation, however Springer and Kim, (2010) distinguish the various policies of restocking must be adaptive, moreover Childerhouse et al.(2008) show that an unsuited management of restocking causes progressive disturbances on the supply chain. So, Croson and Donohue (2005) recommend combining the various policies of management according to the situation of each phase in order to reduce the level of stock and to avoid its rupture. In the work of Chen G (2009), the author makes an analysis on the effect of various policies synthesis of resupplying on the logistic chain performance, Lee et al (2005) presents his control mode; a continuously inventory replenishment, he considers the delays, the breaks number and replenishment policies. The work of Babai and al (2009) is among the best work interested in the study and analysis of replenishment methods. The authors propose extensions methods for the conventional methods; the control point and completely methods. The supply mode of stocks by this new approach is based on the future needs of consumption. Considering the forecast uncertainty, where they offer continuous monitoring of forecasting, so monitoring in the re-order level. However, in the work of Buzon et al (2008), the authors found that the overall achievement perfection of the logistics chain is linked to the effectiveness; to the information movement flow mode and exchange inter company. They have proposed a model in this sense. In the work of Ben Moussa et al (2009), the authors present a practical method for the deployment of the process

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approach within a logistics. They propose their method to decompose the replenishment system and to extend the strategic objectives along this structure.

For achieving an optimal cost, Giri and Dohi (2009) were making an analytical study between the various replenishment policies. Which provide a balance between the reliability requirements and economic requirements. To this effect, they have the privileges of each policy in relation to the other. Selda and Emmett (2010) have been examining the procurement systems, which undergo seasonal variations causing significant disturbances, which prompted the authors to propose a model for determining the optimal order quantity.

For this purpose, the stock supply must be synchronized with the production state system, despite the data, which are regarded as constants (percentage of rupture risk, the quantity economic and the lead-time of a command). It follows the stock level, which triggers replenishment, is a variable that must be determined during each period in case there is a change of production rate.

The aim of this work is to give a new approach to avoid the out-of-stock production systems fluctuating, as well the existence of quantities greater than the economic one, from a continuous monitoring assisted by the computing tool, which based on the instant dynamic consumption.

## 2 Presentation of the new approach

The production irregularity of a production system is apparent in the form of:

- Decrease of Consumption
- Increase consumption
- Reduction and increase iterative and random consumption.

### 2.1 Consumption decrease

Suppose the example (1) of stock evolution, figure (1) on the following diagram:

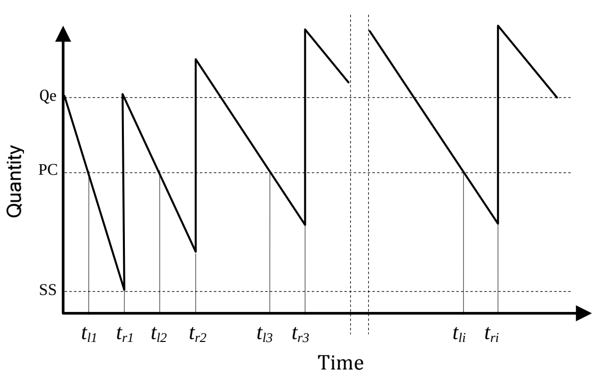


Fig. 1. Stock evolution in case of consumption decrease

Where the:

$$PC = C_{mean} \, . LT_{mean} + SS \qquad (1)$$

PC: reorder point

$C_{mean}$: mean consumption

$LT_{mean}$: lead time of command(i) [Duration between $t_{ri}$ and $t_{li}$]

SS: security stock

$$t_{ri} = t_{li} + LT_i \qquad (2)$$

$t_{li}$ : Time to launch the order of the command *(i)*

$t_{ri}$ : Time of order receipt *(i)*Launched at $t_{li}$

$LT_i$: lead time of command *(i)* [Duration between $t_{ri}$ and $t_{li}$]

If it is considered that $LT_i$ is constant, and equal $LT_{mean}$ ;

$$t_{ri} = t_{li} + LT_{mean} \qquad (3)$$

When receiving a command, the quantity stored is greater than the economic one ($Q_e$);

Quantity procreated surplus in the stock for an extended duration (duration of the irregularity), and therefore the increase of cost storage.

To this effect, to keep the same optimization parameters (economic quantity, total storage cost), and consequently the advantages of the method of the re-order point replenishment. It is enough to consider the re-order point *(PC)* as a variable that depends on the snapshot production rate and therefore the stock consumption:

$$(PC)_i = (C_{mean})_i . LT_{mean} + SS \qquad (4)$$

With $(C_{mean})_i$ : Average consumption during the period between $t_i$ (current moment) and $(t_r)_{i-1}$ ( time of receipt of the previous command (i-1) )

With this procedure, obtains theoretically the new model shown in the following diagram despite the disruption to production:

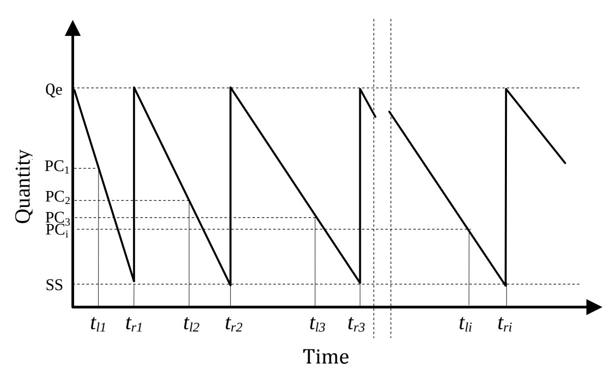


Fig. 2. Stock evolution in case of decrease of consumption by the new approach

The stock evolution presentation (inputs and outputs) following the proposed approach, clearly shows the total disappearance of the quantities above the economic quantity, during the production period.

As $(PC)_i$ depends proportionally on former consumption (the average between $t_i$ and $(tr)_{i-1}$), it takes less values when there is a production lowering pace, which defers the order of launching as well as the reception, at that purpose it avoids surplus quantities in stock

## 2.2 Production Increase (consumption increase)

Suppose the second example, stock evolution figure in the following diagram:

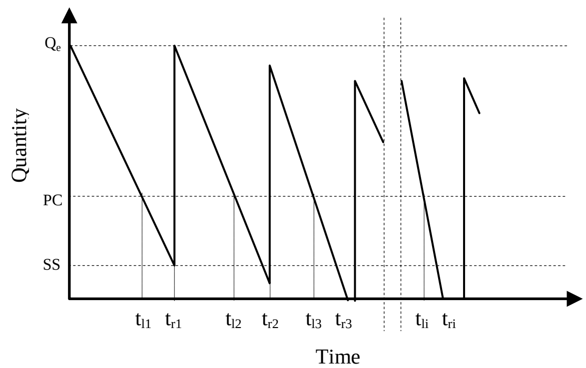


Fig. 3. Stock evolution in case of consumption increase

If it is considered that $LT_i$ is constant, and equal to $LT_{mean}$ ;
$t_{ri} = t_{li} + LT_{mean}$

With time, during the production, it follows the existence of several stock ruptures as well to production.

To avoid this situation, we must apply the same previous procedure, considering the re-order point value as a variable $(PC)_i$ , it is determined after each receipt, as a function of production rate, during this new period. For this purpose, we are proposing the model shown in the following diagram:

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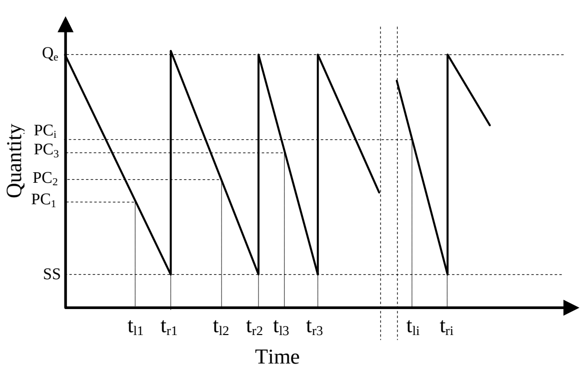


Fig. 4. Stock evolution in case of increase of consumption

With the $t_{ri}$ calculated as $t_{ri} = t_{li} + LT_{mean}$

We note that after the application of the new method (consider the re-order point as a variable), It is no more out of stock, and not even the start of safety stock (consider the means lead time as a constant). By adapting the replenishment system to the production rhythm; PC)i takes higher values than when there is an increase production rate and advanced reception; thus, it prevents the stock breaking

## 2.3 Case when Lowering and increase iteratively consumption (periodically)

Let us suppose the example (3) of stock evolution figure in the following diagram:

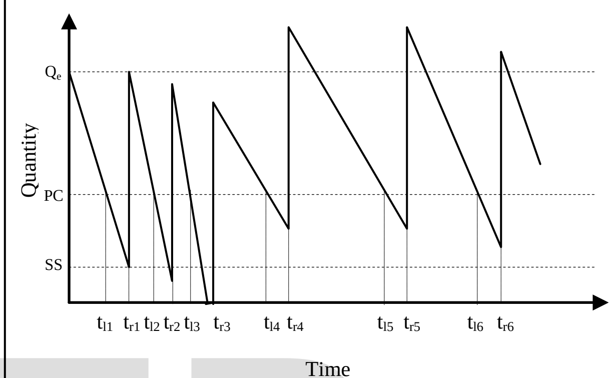


Fig. 5. Stock evolution in case of increase and decrease consumption

In this example, we note the existence of two not desirable phenomena at the same time:

- A stock rupture, because of the increase production rate during the concerned periods;
- A surplus Quantities compared to the economic quantity ($Q_e$) due to a decrease in the production rate during these periods.

To solve these two problems simultaneously, by using the proposed approach, the results presented in the following figure:

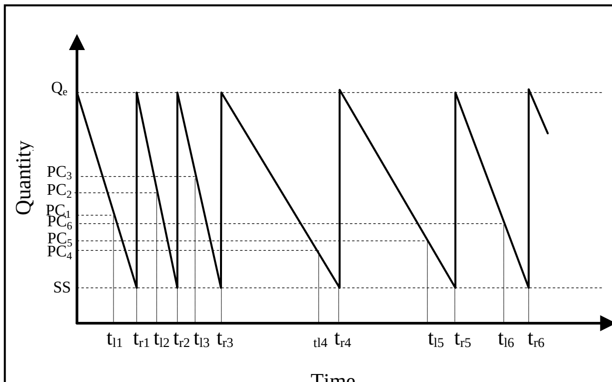


Fig. 6. Stock evolution in case of increase and decrease of consumption by the new approach

The different breaks and the different surplus cases in stock presented in figure (5) have disappeared after the application of the new approach (dynamic re-order point resupplying method). by adapting the latter to the various fluctuation situations of the productive system. The value of the control point (CP) i varies with the production rate, it takes less values of pace of work to avoid surplus quantities and takes higher values during the increase in the production rhythm to prevent the stock shortage.

## 3 Application for Validation

On the tubes manufacturing company "ALFAPIPE", whose manufacturing system functions in continuous irregular way 24h/24h, causing a similar situation for the Resupplying system by the raw material "reels" which follows the classical order point method, The company supplier "Arcelor Metal" is informed by the total quantity of reels necessary for a given period, with the various characteristics of each project. Because of the storage space insufficiency, the delivery is done along the production duration by batches of 150 reels after 08 days of each request. During three successive months, the stock evolution of the of reels is followed according to the used method which is recorded it in tables (1,2,3).

In parallel, the method proposed is allotted challenge, and announced the various movements and necessary calculations registered in the same tables, the stock evolution coming from each method is supported by a presenting graph , by two distinct curves.

For the classical Re-order Point Resupplying method, the calculation is done as follows:

We have: $PC = SS + C_{mean}.LT_{mean}$

By knowing that:

$SS = 50$ reels;

$LT_{mean} = 8$ days;

$C_{mean} = 15$ reels/day;

From where $PC = 170$ reels

And for the suggested approach; calculation is done as follows:

$(PC)_i = (C_{mean})_I \cdot LT_{mean} + SS$

$(Cmoy)i$: is calculated from the day consumption corresponding to the last reception until the moment $(t)_i$

### 3.1 Results

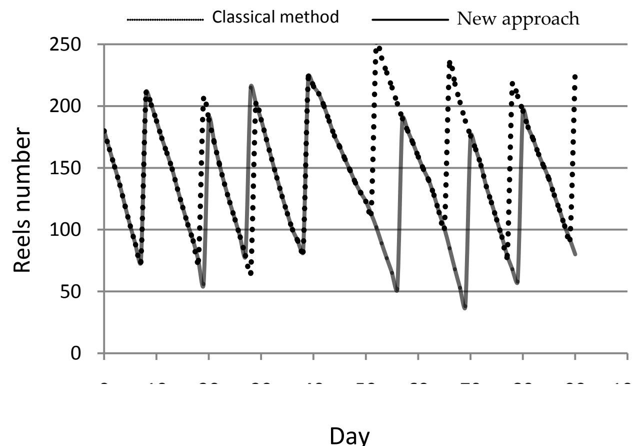


Fig.07. Stock evolution by both methods of resupplying during three months.

### 3.2 Discussions

We notice that the graph presents three different cases:

1. Cases where both curves are stacked: it is visible for the two periods:

-The period from 1 to 18 days: where the indicated average consumption is almost equal to the real average consumption, what results orders of launch in the same days by both methods. Days (1, 12) for the classic method, and (1,13) for the new approach.

-The period from 29 to 51 days: this superposition is due to real average consumption at the first time, which tends towards that indicated, and with the reception coincidence in the 39ème day.

During these two times, the production system is in regular operating condition.

2. Case where there exists a small shift between the two curves coming from the difference between the previous receptions. This small dephasing does not have any negative consequence. it appears in the interval of 19 to 28 days, and the production system is in regular operating condition.

3. Case where two bend taken away in summits (from 52 to 90 days): For this period, the real average consumption is lower than that indicated. We notice, there is a surplus of reels in stock during every reception by Re-order Point Resupplying. As opposed to this, the surplus is disappeared by application of the new approach (Re-order Point Resupplying), because of its adaptation to the rhythm variation of the production and the irregularity of the productive system.

## 4 Conclusion

The irregularity of operation production system, according to the re-order point resupplying method, causes breakage or the surplus in stock. The application of this new approach allows us to make a supply system, adapted to the production system without losing the main properties of the re-order point resupplying method.

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