Paper 14 Procedia Manufacturing Integrated PS model

by The Jin Ai

Submission date: 22-May-2019 09:02AM (UTC+0700)
Submission ID: 1134155539
File name: Paper_14_Procedia_Manufacturing_Integrated_PS_model.pdf (274.62K)
Word count: 3736
Character count: 17804

Available online at www.sciencedirect.com

ScienceDirect

Procedia Manufacturing 4 (2015) 184 – 191

Procedia MANUFACTURING

Industrial Engineering and Service Science 2015, IESS 2015

An integrated production system model for multi supplier single buyer with non-conforming item and product warranty

Slamet Setio Wigati[a]*, The Jin Ai[a]

[a]Department of Industrial Engineering, Universitas Atma Jaya Yogyakarta, Yogyakarta,55281, Indonesia

Abstract

This paper develops a multi supplier single buyer integrated production system model. Several suppliers transform raw materials into semi-finished goods or components with constant production rates in order to supply a single buyer. The buyer processes components from the suppliers into finished products with a constant production rate. Non-conforming item and product warranty are also considered in this study. There are non-conforming items in the supplier production lot, in which the number of non-conforming items for each lot is probabilistic and the non-conforming items are reprocessed before they are delivered to the buyer. The result is that a buyer does not bear the cost of non-conforming item. Supplier provides component warranty to the buyer while finished product warranty to the customer is provided by the buyer. Component warranty period from the supplier (W_i) is shorter than finished product warranty period from the buyer (W), which is given and fixed. If a finished product is experiencing a failure in the end customer within the warranty period, a minimal repair will be done. If failure occurs after W_i, the supplier does not bear any warranty cost, but the buyer does which covers the customer transportation cost and the repair cost. If failure occurs before W_i, the supplier should pay the repair cost and the transportation cost to the buyer while buyer only pays the customer transportation cost. A mathematical model is proposed to determine optimal number of delivery lots in order to minimize the integrated total relevant costs of both buyer and supplier. The cost of the supplier covers the setup cost, holding cost, rework cost, and the product warranty cost, while the buyer cost covers order cost, holding cost and product warranty cost. Approaches to solve the model are also being proposed in this paper, altogether with a numerical example.

© 2015 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
Peer review under responsibility of the organizing committee of the Industrial Engineering and Service Science 2015 (IESS 2015)

Keywords: Production System Model;Non-conforming Item; Product Warranty; Integrated Total Cost

* Corresponding author. Tel.: +62-274-487711; fax: +62-274-485223
E-mail address: yayan@mail.uajy.ac.id

2351-9789 © 2015 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
Peer review under responsibility of the organizing committee of the Industrial Engineering and Service Science 2015 (IESS 2015)
doi:10.1016/j.promfg.2015.11.030

1. Introduction

The classic economic order quantity (EOQ) model determines the economic ordering lot size to minimize the sum of the ordering and the material holding costs. The classic economic production quantity (EPQ) model determines the economic manufacturing batch sizes to minimize the sum of the manufacturing setup cost and the finished goods holding cost [1,2]. In traditional inventory management systems, the economic order quantity for a buyer and the economic production quantity for a supplier are managed independently. As a result, the EOQ of buyer may not result in an optimal policy for the supplier and vice versa. To overcome this problem, researchers have studied joint economic lot size (JELS) model where the joint total relevant cost for the supplier as well as the buyer has been optimized. Banerjee proposed an integrated vendor–buyer model where the demand rate of the buyer is constant and the manufacturer's production schedule is to produce the same amount of inventory as ordered each time [3]. Goyal modified Banerjee's paper on the assumption that vendor may possibly produce a lot size that may supply an integer number of orders to the buyer [4]. Kim and Ha also proposed an integrated single supplier single buyer to determine the optimum lot size and optimum delivery frequency to buyer of a production lot size [5]. Some studies discussed the integration of suppliers/vendors and buyers have also been carried out, both for the single supplier/vendor and single buyer [6,7,8,9,10,11] as well as the single vendor multi buyer [12,13].

Some JELS research assume all products to be produced are perfect quality. Although one of the assumptions of several production system models is that items produced are all of perfect quality, it is not common in industrial practice. Recently, researchers have considered manufacturing strategies that deal with imperfect production processes. Rosenblatt and Lee [14] study an Economic Manufacturing Quantity (EMQ) model with imperfect production processes. Hariga and Ben-Daya [15] extend the EMQ model of Rosenblatt and Lee to consider general shift distributions.

Few researchers consider the warranty cost to their JELS research. Products are sold with warranty will require additional costs in case of a claim from a consumer. Yeh et al. [16] consider the warranty cost in this model to determine the optimal production cycle lengths, which minimizes the total cost. In the Yeh's model, the defective product within the warranty period will receive minimal repair. Minimal repair is to fix product into such conditions shortly before it breaks [17]. Wang and Shue [18] investigate the influence of the warranty cost to economical batch sizes.

2. System description

This paper develops a multi supplier single buyer integrated production system model. Several suppliers transform raw materials into semi-finished goods or components with constant production rates in order to supply a single buyer. The buyer processes components from the suppliers into finished products with a constant production rate. The cycle time of arrival component for all suppliers is assumed equal. In other words, goods from each supplier are sent at the same time, just a different amount, depending on the need of each of these components to make a product. The buyer orders products to the respective supplier of D_i units per period in accordance with the use of unit component i to produce one unit product (f_i) and the buyer demand (D), $D_i = f_i\, D$. If Q is the production lot of buyer, so the delivery lot of supplier i, $Q_i = f_i\, Q$.

Non-conforming item and product warranty is also considered in this study. There are non-conforming items in the supplier production lot, in which the number of non-conforming items for each lot is probabilistic and the non-conforming items are reprocessed before they are delivered to the buyer resulting in that the buyer does not bear the cost of non-conforming item. Supplier provides component warranty to the buyer, while buyer provides finished product warranty to the customer. Component warranty period from the supplier (W_i) is shorter than finished product warranty period from the buyer (W), which is given and fixed. If a finished product is experiencing a failure in the end customer during warranty period, a minimal repair will be done. If failure occurs after t, the supplier does not bear any warranty cost, but the supplier does, i.e. the customer transportation cost and the repair cost. If failure occurs before t, the supplier should pay the repair cost and the transportation cost to the buyer while buyer only pay the customer transportation cost.

Products from suppliers are repairable and sold to a buyer with Free Failure Warranty t. Each failure product will be repaired with minimal repair, so the condition of the product after fixing the same such as the condition of the components shortly before the failure occurs. Thus, damage to the product within the warranty period can be assumed to follow the process of the non-homogeneous Poisson process (NHPP) with a failure rate λ.

A mathematical model is proposed to determine optimal number of delivery lots in order to minimize the integrated total relevant costs of both buyer and supplier. The cost of the supplier covers the setup, holding, rework, and the product warranty costs, while the buyer cost covers order, holding and product warranty costs.

This paper develops a multi supplier single buyer integrated production system model considering non-conforming product and product warranty. In the supply chain context, considering integrated supplier and buyer simultaneously is leading to smaller cost. It may increase the competitiveness of the supply chain due to cost effectiveness, i.e. smaller customer price when it is compared to competitors.

3. Model formulation

3.1. Notation and assumptions of the model

Notations

Q_i	Delivery lot from the supplier i in unit
Q	Production lot of the buyer in unit ($Q_i = Q\,f_i$)
f_i	Number of component i from supplier i to produce 1 unit product of buyer
D_i	Demand component i in unit per period
D	Production rate of the buyer in unit per period ($D_i = f_i\,D$)
P_i	Production rate of supplier i in unit per period
Hp_i	Holding cost component i by suplier i in \$/unit/period
Hb_i	Holding cost component i by the buyer in \$/unit/period
K_i	Buyer Setup cost to ordered component i in \$
Cs_i	Setup cost of supplier i in \$
Cm_i	Minimal repair cost by supplier i for repaired failure component i before W_i in \$/unit
Cg_i	Minimal repair cost by buyer for repaired failure component i after W_i in \$/unit
Ct_i	Transportation cost by the buyer to send the failure product before W_i to the supplier i in \$/unit
W_i	Warranty period for component i from supplier i
W	Warranty period to the customer, $W > W_i$
$r_{1i}(\tau)$	Hazard rate conforming item from supplier i with α_{1i} and β_{1i} parameter.
$r_{2i}(\tau)$	Hazard rate non-conforming item from supplier i with α_{2i} and β_{2i} parameter.
θ_i	The percentage of defect products at supplier i when out of control
TC	Expected Integrated total cost in \$/period

The assumptions used in this study are as follows:

- There were no stock out inventory system supplier – buyer.
- Components are "repairable".
- The capacity of the warehouse, production capacity and capital is not limited.
- Each cost is known and is constant.
- Each product failure occurs always result in warranty claims.
- Product defect percentage is constant

3.2. Mathematical model

TCp and TCb represented expected supplier total cost per period and expected buyer total cost per period, the expected integrated total cost per period (TC) is

$$TC = TCp + TCb \tag{1}$$

The expected supplier total cost covers setup, holding, rework and warranty costs.

a. Supplier Setup Cost (Csp)

Setup required at the beginning of each production cycle while it will start producing a lot size, so that the cost of setup is the multiplication of the number of setups with the setup cost. Supplier setup costs are the sum of all supplier setup charges. This cost can be expressed mathematically as follows:

$$Csp = \sum_{i=1}^{n} \frac{D_i}{Q_i} Cs_i = \frac{D}{Q} \sum_{i=1}^{n} Cs_i \tag{2}$$

b. Supplier Holding Cost (Cip)

Holding cost is multiplication of expected product inventory with holding cost per unit per period. Supplier holding costs are the sum of all supplier holding cost. This cost can be expressed mathematically as follows:

$$Cip = \sum_{i=1}^{n} \frac{D_i Q_i}{2P_i} Hp_i = \sum_{i=1}^{n} \frac{f_i^2 DQ}{2P_i} Hp_i$$

$$Cip = DQ \sum_{i=1}^{n} \frac{f_i^2}{2P_i} Hp_i \tag{3}$$

c. Rework Cost (Crp)

Number of defect product in one production cycle is

$$N = \begin{cases} 0, & x \geq t \\ \theta P(t - x), & x < t \end{cases} \tag{4}$$

Expected number of defect product in one production cycle is

$$E[N] = \int_0^t \theta P(t - x) f(x) dx \tag{5}$$

Where t is production cycle, $t = Q/P$

If out of control event is exponentially distributed, i.e. $f(x) = \lambda e^{-\lambda x}$, after some algebra we get

$$E[N] = \frac{\theta}{\lambda}\left(Pe^{\frac{-\lambda Q}{P}} + \lambda Q - P \right) \tag{6}$$

Expected product defect per period for supplier i is $(D_i/Q_i)E[N_i]$. Hence, the expected rework cost for supplier i is

$$Crp_i = Cr_i \frac{D_i}{Q_i} E[N_i] = Cr_i \frac{D_i}{Q_i} \frac{\theta_i}{\lambda_i}\left(P_i e^{\frac{-\lambda_i Q_i}{P_i}} + \lambda_i Q_i - P_i \right) \tag{7}$$

Expected rework cost for all suppliers is:

$$Crp = \sum_{i=1}^{n} Cr_i \frac{D_i}{Q_i} E\left[N_i\right] = \sum_{i=1}^{n} Cr_i \frac{D_i}{Q_i} \frac{\theta_i}{\lambda_i}\left(P_i e^{\frac{-\lambda_i Q_i}{P_i}} + \lambda_i Q_i - P_i\right) = \frac{D}{Q}\sum_{i=1}^{n} Cr_i \frac{\theta_i}{\lambda_i}\left(P_i e^{\frac{-\lambda_i Q_i}{P_i}} + \lambda_i Q_i - P_i\right) \tag{8}$$

d. Supplier warranty Cost (Cgp)
Suppliers applyfree-minimum repair warranty policy, for all the failure products within the warranty period. By using the assumption that the f product failure both conforming and non-conforming follow nonhomogeneous process with intensity $r(\tau)$, so the expected number of warranty claim for supplier i in warranty period W_i is $\int_0^{W_i} r_{1i}(\tau)d\tau$ for conforming product and $\int_0^{W_i} r_{2i}(\tau)d\tau$ for non-conforming product. Expected number of warranty claim for supplier i during W_i is

$$\frac{D_i}{Q_i}\left[E\left[N_i\right]\int_0^{W_i} r_{2i}(\tau)d\tau + \left(Q_i - E\left[N_i\right]\right)\int_0^{W_i} r_{1i}(\tau)d\tau\right] = \frac{D}{Q}\left[E\left[N_i\right]\int_0^{W_i} r_{2i}(\tau)d\tau + \left(f_i Q - E\left[N_i\right]\right)\int_0^{W_i} r_{1i}(\tau)d\tau\right]$$

If Cgp is expected warranty product cost for all supplier during W_i, so

$$Cgp = \sum_{i=1}^{n} Cgp_i = \frac{D}{Q}\sum_{i=1}^{n} Cm_i\left[E\left[N_i\right]\int_0^{W_i} r_{2i}(\tau)d\tau + \left(f_i Q - E\left[N_i\right]\right)\int_0^{W_i} r_{1i}(\tau)d\tau\right] \tag{9}$$

By summing all the components of the cost of the supplier (Csp, Cip, Crp, Cgp), then the expected supplier total cost can be determined.

The expected buyer total cost covers setup, holding, warranty transportation and warranty costs from W_i to W period.

a. Buyer Setup Cost (Csb)

$$Csb = \sum_{i=1}^{n} K_i \frac{D}{Q} \tag{10}$$

b. Buyer Holding Cost (Cib)

$$Cib = \sum_{i=1}^{n} \frac{f_i Q}{2} Hb_i \tag{11}$$

c. Warranty Transportation Cost (Ctb)
If the failure product occurs before Wi, buyer pay the transportation cost to send the failure product to the supplier.

$$Ctb = \frac{D}{Q}\sum_{i=1}^{n} Ct_i\left[E\left[N_i\right]\int_0^{W_i} r_{2i}(\tau)d\tau + \left(f_i Q - E\left[N_i\right]\right)\int_0^{W_i} r_{1i}(\tau)d\tau\right] \tag{12}$$

d. Buyer Warranty Cost (Cgb)
Warranty costs incurred by the buyer is the minimal repair cost because of the failure productoccurs after W_i. This cost is a multiplication of the minimal repair costs incurred by the buyer with expected number of warranty claims from W_i until W period.

$$Cgb = \frac{D}{Q}\sum_{i=1}^{n} Cg_i \left[E[N_i] \int_{W_i}^{W} r_{2i}(\tau)\,d\tau + \left(f_i Q - E[N_i]\right) \int_{W_i}^{W} r_{1i}(\tau)\,d\tau \right] \tag{13}$$

By summing all the components of the cost of the buyer, then the expected buyer total cost can be determined. The expected integrated total cost as a function of decision variable Q is:

$$\begin{aligned} TC = {} & \frac{D}{Q}\sum_{i=1}^{n}(Cs_i + K_i) + \frac{Q}{2}\left(\sum_{i=1}^{n} \frac{f_i^2 DHp_i}{P_i} + f_i Hb_i \right) \\ & + \frac{D}{Q} \left[\begin{aligned} & \sum_{i=1}^{n} Cm_i \left[E[N_i] \int_0^{W_i} r_{2i}(\tau)\,d\tau + \left(f_i Q - E[N_i]\right) \int_0^{W_i} r_{1i}(\tau)\,d\tau \right] \\ & + \sum_{i=1}^{n} Ct_i \left[E[N_i] \int_0^{W_i} r_{2i}(\tau)\,d\tau + \left(f_i Q - E[N_i]\right) \int_0^{W_i} r_{1i}(\tau)\,d\tau \right] \\ & + \sum_{i=1}^{n} Cg_i \left[E[N_i] \int_{W_i}^{W} r_{2i}(\tau)\,d\tau + \left(f_i Q - E[N_i]\right) \int_{W_i}^{W} r_{1i}(\tau)\,d\tau \right] \end{aligned} \right] \end{aligned} \tag{14}$$

3.3. Model analysis

Model analysis performed to obtain optimal production lot size (Q^*) that minimize the expected integrated total cost. Q^* can be obtained by setting the first derivative of the expected integrated total cost (TC) with respect to Q (dTC/dQ) equal to zero. For this research, the time between failure is assumed following Weibull distribution with parameter α and β.

$$\begin{aligned} \frac{dTC}{dQ} = {} & -\frac{D}{Q^2}\sum_{i=1}^{n}(Cs_i + K_i) + \frac{1}{2} f_i \left(\sum_{i=1}^{n} f_i\, DHp_i / P_i + HB_i \right) - \\ & \frac{D}{Q^2}\sum_{i=1}^{n} Cr_i \theta_i / \lambda_i\, A_i + \frac{D}{Q}\sum_{i=1}^{n} Cr_i \theta_i / \lambda_i\, B_i - \\ & \frac{D}{Q^2}\sum_{i=1}^{n}(Cm_i + Ct_i)\left[\theta_i / \lambda_i\, A_i\, w_i^{\beta_{2i}} \alpha_{2i}^{\beta_{2i}} + \left(f_i Q - \theta_i / \lambda_i\, A_i\right) w_i^{\beta_{1i}} \alpha_{1i}^{\beta_{1i}} \right] + \\ & \frac{D}{Q}\sum_{i=1}^{n}(Cm_i + Ct_i)\left[\theta_i / \lambda_i\, B_i\, wi^{\beta_{2i}} \alpha_{2i}^{\beta_{2i}} + \left(f_i - \theta_i / \lambda_i\, B_i\right) w_i^{\beta_{1i}} \alpha_{1i}^{\beta_{1i}} \right] - \\ & \frac{D}{Q^2}\sum_{i=1}^{n} Cg_i \left[\theta_i / \lambda_i\, A_i \left(w^{\beta_{2i}} \alpha_{2i}^{\beta_{2i}} - w_i^{\beta_{2i}} \alpha_{2i}^{\beta_{2i}} \right) + \left(f_i Q - \theta_i / \lambda_i\, A_i\right)\left(w^{\beta_{1i}} \alpha_{1i}^{\beta_{1i}} - w_i^{\beta_{1i}} \alpha_{1i}^{\beta_{1i}} \right) \right] + \\ & \frac{D}{Q}\sum_{i=1}^{n} Cg_i \left[\theta_i / \lambda_i\, B_i \left(w^{\beta_{2i}} \alpha_{2i}^{\beta_{2i}} - w_i^{\beta_{2i}} \alpha_{2i}^{\beta_{2i}} \right) + \left(f_i - \theta_i / \lambda_i\, B_i\right)\left(w^{\beta_{1i}} \alpha_{1i}^{\beta_{1i}} - w_i^{\beta_{1i}} \alpha_{1i}^{\beta_{1i}} \right) \right] \end{aligned} \tag{15}$$

Where

$$A_i = P_i e^{-\lambda_i f_i Q / P_i} + \lambda_i f_i Q - P_i$$

$$B_i = -\lambda_i f_i e^{-\lambda_i f_i Q / P_i} + \lambda_i f_i$$

For $Q \to 0$, dTC / dQ has the negative value and for $Q \to \infty$, dTC / dQ has the positive value and $\frac{d^2TC}{dQ^2} > 0$, which means there is a unique value of Q that minimizes the expected integrated total cost.

4. Numerical example

This section discusses the numerical example for a model that has been developed with number of supplier (n) equal to 2. This step is to illustrate the optimum solutions and to study the behavior of the model that has been made by setting some parameter values. The parameters used can be seen in Table 1.

Table 1. Parameter value for numerical example

Parameter	Unit	value	parameter	Unit	value	parameter	value
D	unit/month	1000	f_1		1	α_{11}	0.1
Cs_1	$	50	f_2		2	β_{11}	1.1
Cs_2	$	10	Cm_1	$/unit	1	α_{21}	0.2
K_1	$	10	Cm_2	$/unit	1.5	β_{21}	1.2
K_2	$	20	Ct_1	$/unit	0.5	α_{12}	0.1
P_1	unit/month	2000	Ct_2	$/unit	0.4	β_{12}	1.1
P_2	unit/month	5000	Cg_1	$/unit	1	α_{22}	0.2
Hp_1	$/unit/month	0.015	Cg_2	$/unit	1.5	β_{22}	1.2
Hp_2	$/unit/month	0.01	Cr_1	$/unit	0.1	θ_1	0.2
Hb_1	$/unit	0.02	Cr_2	$/unit	0.15	θ_2	0.3
Hb_2	$/unit	0.015	W_1	Month	6	λ_1	0.1
W	Month	12	W_2	Month	6	λ_2	0.06

Optimum solution for the example (Q^*) is 1208.16 unit, that means optimum production lot for buyer is 1208 unit and optimum delivery lot for supplier i is f_i times 1208. The second derivative of TC with respect to Q is $0.101457851.10^{-3}>0$, that means the expected integrated total cost is minimum.

Figure 1 shows the relationship between TC and Q with parameter values listed in Table 1. Figure 1 also shows that there is a unique Q that minimize the expected integrated total cost.

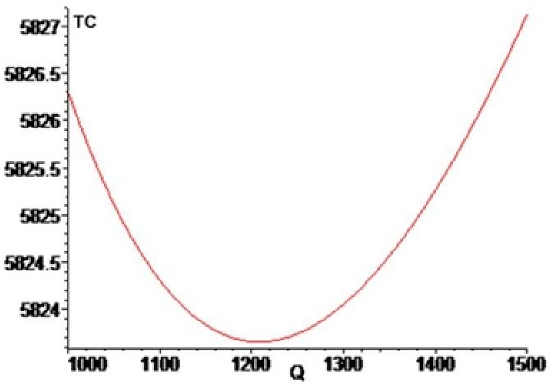

Fig. 1. TC versus Q graph

Table 2 presents the result of Q^* optimal whenever the parameter D, Cs_1, Cs_2, K_1, and K_2 are changed. The results show that Q^* optimal is bigger whenever the values of D, Cs_1, Cs_2, K_1, and K_2 are bigger.

Table 2. Response of the change of D, Cs_1, Cs_2, K_1, and K_2 to the optimal Q^*

D	Q^*	Cs_1	Q^*	Cs_2	Q^*	K_1	Q^*	K_2	Q^*
1000	1208.16	50	1208.16	10	1208.16	10	1208.16	20	1208.16
1100	1231.21	60	1273.93	20	1273.93	20	1273.93	30	1273.93
1200	1251.46	70	1336.52	30	1336.52	30	1336.52	40	1336.52
1300	1269.41	80	1396.37	40	1396.37	40	1396.37	50	1396.37
1400	1285.43	90	1453.80	50	1453.80	50	1453.80	60	1453.80
1500	1299.82	100	1509.09	60	1509.09	60	1509.09	70	1509.09

Meanwhile, Table 3 presents the result of Q^* optimal whenever the holding cost parameter Hp_1, Hp_2, Hb_1, and Hb_2 are changed. The results show that Q^* optimal is decreasing whenever the holding costs are increasing.

Table 3. Response of the holding costs variation to the optimal Q^*

Hp_1	Q^*	Hp_2	Q^*	Hb_1	Q^*	Hb_2	Q^*
0.015	1208.16	0.01	1208.16	0.02	1208.16	0.015	1208.16
0.2	1196.03	0.015	1188.92	0.025	1184.25	0.2	1161.72
0.025	1184.25	0.02	1170.58	0.03	1161.72	0.025	1120.27
0.03	1172.82	0.025	1153.06	0.035	1140.43	0.03	1082.99
0.035	1161.72	0.03	1136.31	0.04	1120.27	0.035	1049.21
0.4	1150.93	0.035	1120.27	0.045	1101.16	0.4	1018.41

5. Conclusion

This research has developed a mathematical model to determine the integrated optimal production lot size between the supplier and the buyer. Optimum production lot size and optimum delivery lot size can be obtained to minimize expectations for the combined supply chain costs. The model can coordinate between suppliers and buyers. This research was conducted with the assumption that the production lot size is equal to delivery lot size. For the next research, it will be necessary to consider multi delivery for single lot production model.

References

[1] A.C. Hax, D. Candea, Production and Inventory Management, Prentice-Hall, New Jersey, 1984.
[2] E.A. Silver, R. Peterson, Decision System for Inventory Management and Production Planning, John Wiley, New York, 1985.
[3] A. Banerjee, Decision Sciences 17.3, 1986, 292–311.
[4] S.K. Goyal, European Journal of Operational Research 82.1, 1995, 209–210.
[5] S.L. Kim, D. Ha, International Journal of Production Economics 86.1, 2003, 1–10.
[6] D.Y. Golhar, B.R. Sarker, International Journal of Production Research 30.5, 1992, 961–972.
[7] A.M.M Jamal, B.R. Sarker, International Journal of Production Economics 32.2, 1993, 255–260.
[8] L.Y. Ouyang, K.S. Wu, C.H. Ho, International Journal of Production Economics 108.1, 2007, 349–358.
[9] Y.J. Lin, Computers & Industrial Engineering 56.4, 2009, 1597–1606.
[10] C.K. Huang, D.M. Tsai, J.C. Wu, K.J. Chung, European Journal of Operational Research 202.2 , 2010, 473–478.
[11] M.S. Sajadieh, A. Thorstenson, M.R.A. Jokar, Transportation Research Part E: Logistics and Transportation Review 46.6, 2010, 963–974.
[12] Y.Y. Woo, S.L. Hsu, S. Wu, International Journal of Production Economics 73.3, 2001, 203–215.
[13] B. Abdul-Jalbar, J.M. Gutierrez, J. Sicilia, International Journal of Production Economics 108.1, 2007, 246–258.
[14] M.J. Rosenblatt, H.L. Lee, IIE Transactions 18.1, 1986, 48–55.
[15] M. Ben-Daya, A. Rahim, Production Planning & Control 10. 2, 1999, 118–126.
[16] R.H. Yeh, W.T. Ho, S.T. Tseng, European Journal of Operational Research 120.3, 2000, 575–582.
[17] R.E. Barlow, F. Proschan, Mathematical Theory of Reliability, John Wiley, New York, 1965.
[18] C.H. Wang, S.H. Sheu, Production Planning and Control 12.6, 2001, 621–628.

Paper 14 Procedia Manufacturing Integrated PS model

ORIGINALITY REPORT

26%	11%	19%	15%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Institute of Research & Postgraduate Studies, Universiti Kuala Lumpur Student Paper	3%
2	Submitted to School of Business and Management ITB Student Paper	3%
3	www.multisuchsystem.de Internet Source	2%
4	Wen-Na Ma, Dah-Chuan Gong, Gary C. Lin. "An optimal common production cycle time for imperfect production processes with scrap", Mathematical and Computer Modelling, 2010 Publication	2%
5	G.C. Mahata, A. Goswami, D.K. Gupta. "A joint economic-lot-size model for purchaser and vendor in fuzzy sense", Computers & Mathematics with Applications, 2005 Publication	2%
6	K. F. Mary Latha, R. Uthayakumar. "A two-echelon supply chain coordination with quantity discount incentive for fixed lifetime	1%

product in a fuzzy environment", International Journal of System Assurance Engineering and Management, 2017
Publication

7	Submitted to Universiti Putra Malaysia Student Paper	1%
8	W LEE. "A joint economic lot size model for raw material ordering, manufacturing setup, and finished goods delivering", Omega, 2005 Publication	1%
9	Submitted to British University in Egypt Student Paper	1%
10	E. Sucky. "A single buyer-single supplier bargaining problem with asymmetric information - theoretical approach and software implementation", 36th Annual Hawaii International Conference on System Sciences 2003 Proceedings of the, 2003 Publication	1%
11	www.iaeng.org Internet Source	1%
12	G. Gulak. "Adaptive Channel SVD Estimation for MIMO-OFDM Systems", 2005 IEEE 61st Vehicular Technology Conference, 2005 Publication	1%
13	link.springer.com Internet Source	1%

Hsieh, C.C.. "Joint determination of production

14 run length and number of standbys in a deteriorating production process", European Journal of Operational Research, 20050416
Publication
1%

15 core.ac.uk
Internet Source
1%

16 Submitted to Universitas Jember
Student Paper
<1%

17 Submitted to Erasmus University Rotterdam
Student Paper
<1%

18 B. C. Giri, T Chakraborty. "Optimal production, maintenance, and warranty strategies for item sold with rebate combination warranty", Proceedings of the Institution of Mechanical Engineers, Part O: Journal of Risk and Reliability, 2007
Publication
<1%

19 Brojeswar Pal, Shib Sankar Sana, Kripasindhu Chaudhuri. "A mathematical model on EPQ for stochastic demand in an imperfect production system", Journal of Manufacturing Systems, 2013
Publication
<1%

20 Submitted to Southern New Hampshire University - Continuing Education
Student Paper
<1%

21 Harshal Lowalekar, Rahul Nilakantan, N Ravichandran. "Analysis of an order-up-to-
<1%

level policy for perishables with random issuing", Journal of the Operational Research Society, 2017
Publication

22	Chih-Hsiung Wang. "The impact of a free-repair warranty policy on EMQ model for imperfect production systems", Computers & Operations Research, 2004 Publication	<1%
23	www.inderscience.com Internet Source	<1%
24	Taebok Kim, Yushin Hong, Soo Young Chang. "Joint economic procurement—production–delivery policy for multiple items in a single-manufacturer, multiple-retailer system", International Journal of Production Economics, 2006 Publication	<1%
25	orsj.or.jp Internet Source	<1%
26	R. K. Mohanty. "A new high accuracy finite difference discretization for the solution of 2D nonlinear biharmonic equations using coupled approach", Numerical Methods for Partial Differential Equations, 2009 Publication	<1%
27	Ji S. Lee, Kyung S. Park. "Joint Determination of Production Cycle and Inspection Intervals in	<1%

a Deteriorating Production System", Journal of the Operational Research Society, 2017
Publication

28 G.N Chattopadhyay, D.N.P Murthy. "Warranty cost analysis for second-hand products", Mathematical and Computer Modelling, 2000
Publication
<1%

29 Lee, W.. "A joint economic lot size model for raw material ordering, manufacturing setup, and finished goods delivering", Omega, 200504
Publication
<1%

30 repository.ntu.edu.sg
Internet Source
<1%

31 Eric Sucky. "Coordinated order and production policies in supply chains", OR Spectrum, 10/2004
Publication
<1%

32 S.P. Sarmah, D. Acharya, S.K. Goyal. "Coordination and profit sharing between a manufacturer and a buyer with target profit under credit option", European Journal of Operational Research, 2007
Publication
<1%

33 Maryam Hamidi, Haitao Liao, Ferenc Szidarovszky. "Non-cooperative and cooperative game-theoretic models for usage-based lease contracts", European Journal of Operational Research, 2016
<1%

Publication

34 El Saadany, A.M.A.. "Coordinating a two-level supply chain with production interruptions to restore process quality", Computers & Industrial Engineering, 200802 <1%
Publication

35 Ateka Banu, Shyamal Kumar Mondal. "An integrated inventory model with warranty dependent credit period under two policies of a manufacturer", OPSEARCH, 2018 <1%
Publication

36 Chao-Kuei Huang. "An integrated inventory model involving manufacturing setup cost reduction in compound Poisson process", International Journal of Production Research, 03/17/2010 <1%
Publication

37 Submitted to University of New England <1%
Student Paper

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	On		