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DETERMINATION BASE INVENTORY LEVEL BY USING GENETIC ALGORITHM

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Motivation

Inventory management is considered to be an important field in company. The amount of inventory is higher than the required level causes raw material cost that lead to increase in inventory cost. The reason of this, the inventory of semi-finished products to be kept according to the experiences of individuals and the base inventory levels of semi-finished products are not determined. In this study, it was aimed to optimize the base inventory level of semi-finished products for the company. A genetic algorithm (GA) is proposed to optimize required semi-finished inventory levels to meet incoming orders as quickly as possible. The simulation is used to evaluate the inventory levels of semi-finished products generated by GA. The effectiveness of the proposed GA (in terms of creating semi-finished base-inventory levels with a minimum delay) is compared with current system inventory levels.

System Description

Stryker produces medical bed group and exports its products to 5 different continents in many countries except domestic market. The company produces a total of 17 different bed models with SV1 and SV2 main models. This study was carried out together with the production and planning department of the company. The company produces the finished product on assembly line when order receives. They procure the necessary materials for the assembly line from two different depots of semi-finished products in the production area.

87 Weldless Semi-Finished Products

16 Welded Semi-Finished Products

The raw materials go to cutting, twisting, punching, drilling and pressing stations for the production of weldless semi-finished products. Each weldless semi-finished product is produced in one or more stations at different operating times and sent to the weldless semi-finished depot.

17	40	30
of weldless semi-finished products are only for SV1	of weldless semi-finished products are common	of weldless semi-finished products are only for SV2

The production of welded semi-finished products, which are necessary for bed assembly, are combined with the weldless semi-finished products. There are 16 different weldless semi-finished products. Mainly form hospital beds, upper chassis, lower chassis main mechanism, foot, calf, back, unloading parts, demounted heading, sustained heading, S. wheel traveler, S. wheel body, pedal sheet. The bed is ready by combining these parts in the assembly line.

4	7	5
of welded semi-finished products are only for SV1	of welded semi-finished products are common	of welded semi-finished products are only for SV2

Machines used in the production process of the bed are Robot Welding (RW), Manual Saw (MS), Sheet Laser (SL), Profile Laser (PL), Drill, Twist, CNC, Guillotine Shear (GM). The production processes and production times of the basic parts of each bed type are different.

The capacity of the weldless semi-finished warehouse is 1000 sets for each weldless semi-finished product (the team expression represents the amount of the semi-finished product used in the finished product, for example, if a semi-finished product is used 2 units, the capacity is determined as 1000 sets as 2000 unit).

Problem Definition

The problem addressed in this project is defined as keeping high levels of welded and weldless semi-finished products based on the experience of the individuals. The high amount of semi-finished inventory is causing inefficiency in production and increasing inventory costs.

Methodology

01 Time Study & Identifying Production Processes

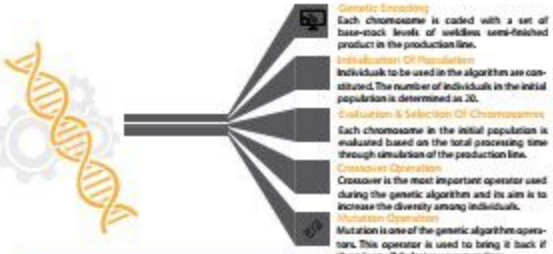
The process of one of the common welded semi-finished product for beds are shown in Figure 1. Weldless semi-finished products required for the production of lower chassis(pedal laser, skid (long, short), 5wheel compatible transmission, 11-hex hexagonal, extended profile (left / right). These semi-finished products are combined to form the lower chassis at Robot Welding 1.

02 Modelling Approach Simulation

The current system of the production system is conceived by using an Arena® simulation model. The model has the following assumptions are the source of supply of raw materials is assumed to have infinite raw material availability & there is no finished product inventory in the company.

The simulation modeled the production processes of semi-finished products and kept their inventory at weldless and welded depots. In addition, the model includes the inventory capacity of each semi-finished product as current system in company. According to one-year sales data, the model produces welded and weldedless semi-finished products and keeps the production time and the number of inventory of each order.

03 Genetic Algorithm



Genetic Encoding
Each chromosome is coded with a set of base-stock levels of weldless semi-finished product in the production line.

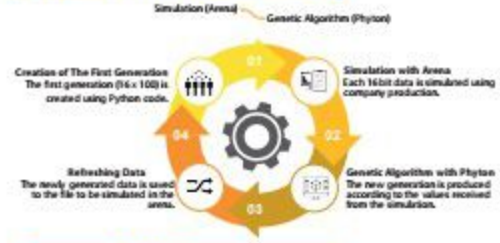
Initialization Of Population
Individuals to be used in the algorithm are constituted. The number of individuals in the initial population is determined as 20.

Evaluation & Selection Of Chromosomes
Each chromosome in the initial population is evaluated based on the total processing time through simulation of the production line.

Crossover Operation
Crossover is the most important operator used during the genetic algorithm and its aim is to increase the diversity among individuals.

Mutation Operation
Mutation is one of the genetic algorithm operators. This operator is used to bring it back if there is an allele lost over generations.

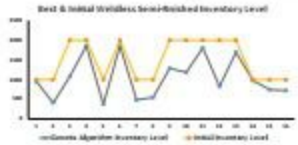
04 System Simulation & Genetic Algorithm



Result

Initial & Best Result Production Times (Min)	
Initial	7584.56
Best Result	5653.44
Improvement	25.46%

Initial & Best Result Production Times	
Initial	15.80
Best Result	11.78
Improvement	4.02



The graph shows the difference between current weldless semi-finished inventory levels of upper chassis and semi-finished inventory levels determined by using genetic algorithm.

Initial & Best Result Inventory Level	
Initial	24000
Best Result	16806
Improvement	30%

Initial & Best Result Average Inventory Cost (₺)	
Initial	6720.00
Best Result	4705.68
Improvement	30%

According to the result of the model, there is visibly improvement in production time and inventory holding cost. This result is for weldless semi-finished products which are required for production of upper chassis welded semi-finished product. The effect of changes in weldless semi-finished inventory levels which are required for the upper chassis in the 30 day running arena model is shown in the tables.
While the current inventory levels of semi finished parts of upper chassis production continue for 15 days, production time is decreased about 4 days based on the genetic algorithm result.
The inventory holding cost decreased about 30% (2.000 ₺) because of the decreasing in the amount of weldless semi-finished inventory levels held for the upper chassis.

References

[1] Goldberg, D.E., Genetic Algorithms in Search, Optimization and Machine Learning, Addison Wesley, Reading, MA.

[2] Radhakrishnan, P., Prasad, V.M., & Gopalan, M. R. (2009). Genetic Algorithm Based Inventory Optimization Analysis in Supply Chain Management. 2009 IEEE International Advance Computing Conference.

[3] Vural, M., (2005). Genetik Algoritma Yönteni İle Toplu Üretim Planlama, Yüksek Lisans Tezi, İ.T.Ü. Fen Bilimleri Enstitüsü, İstanbul.

[4] Whitley,D. (2000). A Genetic Algorithm Tutorial, Computer Science Department, Colorado State University.

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