2019

13th International Conference on Industrial Engineering and Industrial Management

XXIII Congreso de Ingeniería de Organización

Organizational Engineering in Industry 4.0

BOOK OF ABSTRACTS

Gijón, 11th-12th July 2019

Book of Abstracts

"13th International Conference on Industrial Engineering and Industrial Management" and "XXIII Congreso de Ingeniería de Organización (CIO2019)"

Book of Abstracts

"13th International Conference on Industrial Engineering and Industrial Management" and "XXIII Congreso de Ingeniería de Organización (CIO2019)"

COORDINADORES

DAVID DE LA FUENTE GARCÍA

RAÚL PINO DIEZ

PAOLO PRIORE

FCO. JAVIER PUENTE GARCÍA

ALBERTO GÓMEZ GÓMEZ

JOSÉ PARREÑO FERNANDEZ

ISABEL FERNÁNDEZ QUESADA

NAZARIO GARCÍA FERNÁNDEZ

RAFAEL ROSILLO CAMBLOR

BORJA PONTE BLANCO

Servicio de Publicaciones de la Universidad de Oviedo
Campus de Humanidades. Edificio de Servicios. 33011 Oviedo (Asturias)
Tel. 985 10 95 03 Fax 985 10 95 07
http: www.uniovi.es/publicaciones
servipub@uniovi.es

I.S.B.N.: 978-84-17445-38-6
DL AS 1875-2019

Imprime: Servicio de Publicaciones. Universidad de Oviedo

13th International Conference on Industrial Engineering and Industrial Management
XXIII Congreso de Ingeniería de Organización
Gijón, Spain, July 11-12, 2019

Solving the Order Batching and Sequencing Problem with Multiple Pickers: A Grouped Genetic Algorithm

Cano JA[58], Cortés P[59], Campo EA[60], Correa-Espinal A[61]

Keywords: Grouped genetic algorithms; order batching; sequencing; multiple pickers; heterogeneous load capacity

1 Introduction ("H1" style)

The order picking problem is in charge of retrieving the set of items from storage locations to fulfil customer orders, while pickers walk or drive a picking device through the warehouse (Cano et al., 2017). The order batching groups customer orders into batches with a maximum fixed capacity, then the batches are assigned to a picking device and batch sequencing determines the picking scheduling and the completion time of all possible batches (Henn and Schmid, 2013). Therefore, the order batching and sequencing problem with multiple pickers (OBSPMP) is pivotal to enhance the efficiency and customer service (Zhang et al., 2017).

Group genetic algorithms (GGA) support the successful application to grouping problems because important information from the chromosome is preserved and is correctly transferred in the crossover operators (Koch and Wäscher, 2016). Metaheuristics such as genetic algorithms have not been found in the literature to solve the OBSPMP, as well as no OBSPMP models considering picking devices with heterogeneous load capacity.

[58]Jose Alejandro Cano (✉e-mail: jacano@udem.edu.co)
Facultad de Ciencias Económicas y Adminsitrativas. Universidad de Medellín. Carrera 87 # 30-65, Medellín, Colombia.

[59]Pablo Cortés (e-mail: fjlexample@pittsburg.org)
Escuela Superior de Ingeniería. Universidad de Sevilla. Camino de los Descubrimientos s/n, 41092, Sevilla, Spain.

[60]Emiro Antonio Campo (e-mail: eacampo@unal.edu.co)
ESACS – Escuela Superior en Administración de Cadena de Suministro. Calle 4 # 18-55, Medellín, Colombia.

[61]Alexander Correa-Espinal (e-mail: alcorrea@unal.edu.co)
Facultad de Minas. Universidad Nacional de Colombia. Av. 80 # 65 – 223, Medellín, Colombia.

2 Objectives

This study shows the application of a GGA for the OBSPMP, considering picking devices with heterogeneous load capacity in order to minimize the maximum completion time (makespan).

3 Methods

The proposed group-oriented encoding scheme represents the assignment of orders to batches and the sequencing of batches in picking devices. Due to each gene represents a batch in a picking device; the chromosomes are of variable length. To create the initial population of size P, we follow an order group procedure that uses an order pool to place orders that have not yet been assigned to a batch. The fitness function represents the objective function of the OBSPMP, which is minimizing total completion time. The proposed GGA use the crossover, survival, immigration, and mutation operators.

The experiments are configured combining different values for number of customer orders, number of items per order, and warehouse layouts. The results of the GGA are compared with six benchmark rules called FCFS-LH, FCFS-HL, SLOS-LH, SLOS-HL, LSOS-LH, and LSOS-HL.

4 Results

The proposed GGA saves on average between 14.3% and 23.5% of total completion time when compared to the benchmark heuristics. Likewise, the GGA saves on average 18.3% the total completion time when compared to the six benchmarks; thus, the proposed algorithm improves the efficiency of order picking significantly.

5 Conclusion

By means of several experiments, it was shown that the GGA generate solutions superior to those generated by rule-based heuristics. Implementing these solutions can improve profit margins by reducing the regular working hours of the order pickers, and improves customer service by reducing picking service times.

References

Cano JA, Correa-Espinal AA, Gómez-Montoya RA (2017) An evaluation of picking routing policies to improve warehouse efficiency. *Int J Ind Eng Manag* 8(4): 229–238.

Henn S, Schmid V (2013) Metaheuristics for order batching and sequencing in manual order picking systems. *Comput Ind Eng* 66(2): 338–351. DOI: 10.1016/j.cie.2013.07.003.

Koch S, Wäscher G (2016) A Grouping Genetic Algorithm for the Order Batching Problem in Distribution Warehouses. *J Bus Econ* 86(1): 131–153. DOI: 10.1007/s11573-015-0789-x.

Zhang J, Wang X, Chan FTS, et al. (2017) On-line order batching and sequencing problem with multiple pickers: A hybrid rule-based algorithm. *Appl Math Model* 45(1): 271–284. DOI: 10.1016/j.apm.2016.12.012.