

## Development of Design Algorithm for Delivery Center

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Delivery centers are facilities for making shipment of many kinds of products from factories to commission agents or retail shops. In this research, we deal with a design problem of material flow in the delivery center. The problem can be expressed as follows: determining the sizes of the automatic warehouses, the number of warehouse cranes, that of depalletizers and robots, and the flow volume among these equipments.

Flow in the delivery center is shown in Fig.1: (1) the pallets of the products from factories enter in the automatic warehouse. (2) Depalletizers and/or robots divide the pallets into the cases. (3) The cases temporarily enter in the automatic warehouses for cases, and (4) the demanded number of cases are delivered outside of the center. We propose three time-constant flow models as shown in Fig.2 to Fig.4. Here, the products are divided into rank A and rank B products from the viewpoint of the amount of the delivered products. Flow of the rank A products is again divided into two based on the time slots of transportation: flows during the order and the delivery completion (Fig.2), and those during the delivery completion and the next order (Fig.3). The flows for the rank B products are shown in Fig.4. The design problem is solved by integrating the three flow models, and by solving it as mixed integer programming problem. The algorithm is implemented for an Intel Pentium M 900 computer. The effectiveness of the proposed algorithm is shown by using real transport data. Calculation costs are only about 5 minutes for about 50 various lead time inputs.

*Keywords:* Warehouse management, Material flow, Logistics

### References

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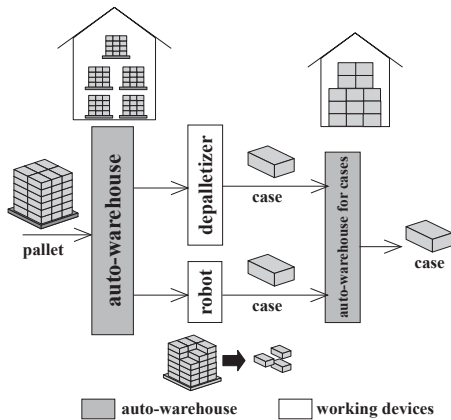


Fig. 1 material flow in the delivery center

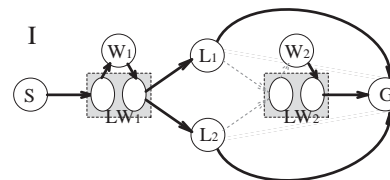


Fig. 2 flow model for rank A product (Order - Delivery)

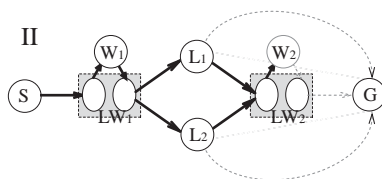


Fig.3 flow model for rank A product (Delivery - Next order)

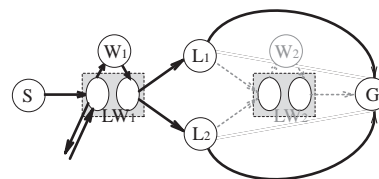


Fig. 4 flow model for rank B product