

Table of Contents

1	Introduction	5
2	Model types and their modelling	8
2.1	Models and processes	8
2.2	The need for modelling warehousing processes	12
2.3	Model types	17
3	Warehouse process characteristics	21
3.1	Structure of warehouse process	21
3.2	Main phases of warehousing	25
3.2.1	Receiving	25
3.2.2	Put-away	26
3.2.3	Storage	27
3.2.4	Replenishment of the picking locations in the order picking area	27
3.2.5	Order Picking	28
3.2.6	Material dispatch	30
3.2.7	Co-packing	30
3.2.8	Shipment of materials	31
3.2.9	Cross-docking	31
3.3	Basic configurations of the warehousing process	32
3.4	Strategies for implementing the warehousing process	33
4	Modelling of the warehousing process	42
4.1	Introduction to modelling	42
4.2	The model of the warehousing process	45
4.2.1	Model Structure	45
4.2.2	Structure of transshipments at the entrance and exit from the warehouse	49
4.2.3	Means of internal transport and machinery	50
4.2.4	Human work	50
4.2.5	Mapping of the warehousing process	51
4.2.6	Decision variables and restrictions	51
4.2.7	Functions and evaluation criteria of the warehousing process	64
5	Warehousing process – selected procedures, algorithms, methods of implementation	66
5.1	Processing customer orders	66
5.2	Preparation of picking lists	69
5.3	Delivery receipt	74
5.4	Entry into storage	77
5.4.1	Assortment classification for the purposes of allocation to storage locations	77
5.4.2	Sequencing of storage locations for the allocation of materials to them	86
5.4.3	Placement of material units in the storage zone	88
5.5	Order picking process	89
6	The issues in generating warehouse operation routes	94
6.1	The issue of searching for the routes of transport cycles in warehouses	94

6.2 The model of the optimization of transport cycle routes in warehouses96

6.3 Heuristics of generating transport cycle routes in the warehouse99

6.3.1 General remarks99

6.3.2 S-shape method100

6.3.3 Return Method.....102

6.3.4 Comprehensive Method (Composite Heuristic).....103

6.3.5 Midpoint Method103

6.3.6 The Largest Gap Method.....103

6.3.7 Aisle-by-aisle Method106

7 References107