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COMPUTER AIDED SELECTION OF MATERIAL HANDLING EQUIPMENT

Catrina CHIVU
Transilvania University of Brasov, Romania

Abstract. Implementing automated material handling system improve the productivity and profitability of a company. Despite these advantages, implementing such a system implies investments thus the increase of the product's cost. Thus, it is imperative to understand the many aspects related to such a system before purchase one. In the literature there are some principles that should be followed before choosing a material handling system but there are few software designed for this. Present paper present such a software design for choosing the appropriate conveyor system based on the plant facility design and manufacturing system characteristics.

Keywords: material handling, manufacturing system, conveyor

1. Introduction

Material handling is the function of moving the right material to the right place, at the right time, in the right amount, in sequence, and in the right position or condition to minimize production costs [1].

Material handling system is strongly correlated to plant facility design. The material handling equipment selection should include new trend in actual facility, modernization of the manufacturing flow and manufacturing of new products.

There are three levels [2] of implementation of material handling equipment, related to spatial facility, relationship between plant's departments (Figure 1).Thus:

- Level 1 defines the materials movement from/ to warehouses and plant; either is raw materials or finished products, the spatial area for this level is normally very expansive.
- Level 2 covers a smaller area and is part of the plant, defining material handling between plant's departments (materials moved is raw material, tools, semi-finished products or finished products).
- Level 3 defines the smallest area and is related to one department, especially a manufacturing flow, material handling equipment should manipulate raw material, semi-finished products between work-stations inside the flow (is a so called point-to-point movement within a fairly restricted are).

Choosing the appropriate equipment should consider the above three levels, that defined the complexity of the equipment, but also some principles, basically cost defined.

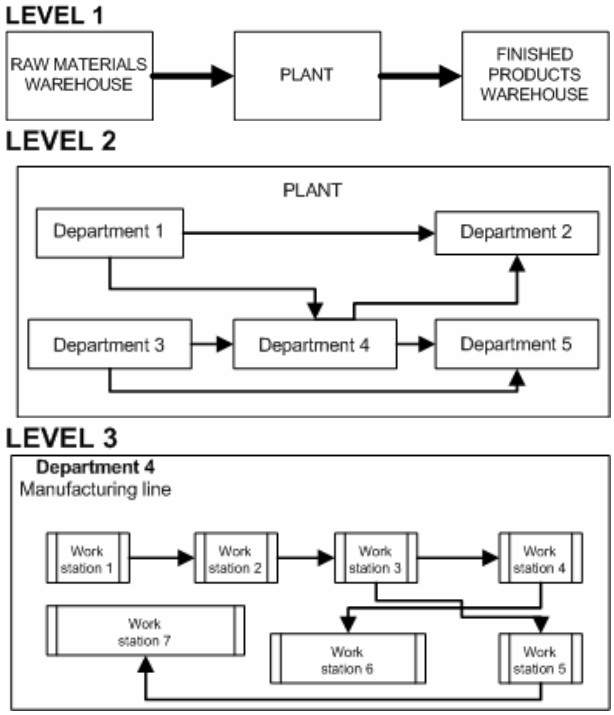

Figure 1. Levels of movement in a plant

Thus, if it is considered purchasing some new equipment it should be also considered the following [3]:

- usage of standard equipment;
- minimize the types of equipment within the facility;
- reduce energy consumption;
- ensure that spare parts are available;
- system has operational flexibility;
- system has expansion capability (relative to space and financial resources).

2. Input data

Selection of material handling equipment can be done either based on type of equipment or based on application. It is very difficult to implement in software all the application that may appear during a manufacturing process [2].

The literature [3] offers three type of classification for the material handling equipment. Thus, there is a classification based on [3]:

- input load: unit load (U) or bulk load (B);
- transfer mechanism: on top of the floor (T), overhead (O) or embedded in the floor (I);
- output of load: accumulating (A)-queue up on the device or workstation, or non-accumulating (N).

Based on the above classifications, Garcia-Diaz [3] defined a tree structure for material handling equipment (Figure 2).

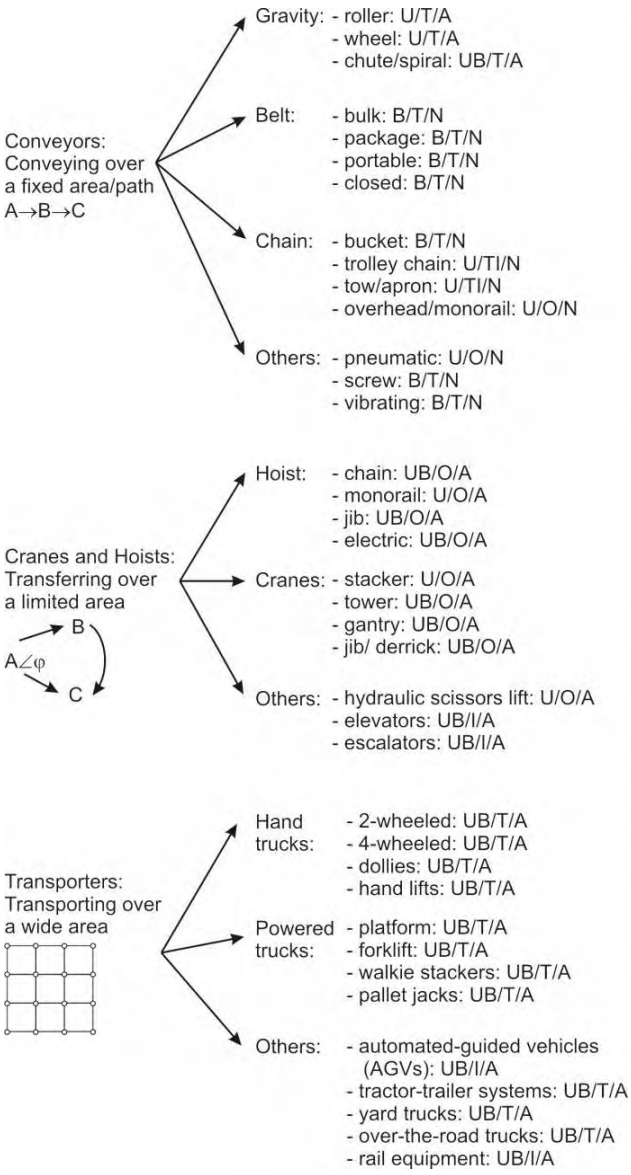

Figure 2. Material handling equipment classification [3]

These classifications will be all included in the selection software. The software will include all the design parameters for these types of equipment and the design equation, thus it will allow to obtain the optimum solution.

There are another five criteria included in the selection software: purchase cost, maintenance cost frequency of use, load moving distance and volume of material that may be transported. Thus, based on the data presented in [4], resulted another classification and, respectively, another selection criterion implemented in software (Table 1).

In Table 1 are classified the following equipment: SCC – spiral chute conveyor; WHC – wheel conveyor; RC – roller conveyor; PCS – pneumatic conveyor system; BC – belt conveyor; CC - chain conveyor; AC – apron conveyor; OM – overhead monorail; HAF – hoist and A-Frame; JC – jib crane; BC – bridge crane; 2WT – two-wheel hand truck; DOL – dolly; PT – platform truck; HLT – hand lift truck; PDHT – power-driven hand truck; PDPT – power-driven platform truck; LT – lift truck; TTT – tractor-trailer truck; NAT – narrow aisle truck.

Table 1. Cost criterion for equipment selection

Criteria	*Lowest*	*Medium*	*Highest*
Initial costs	SCC, WHC, RC, BC, HAF, JC, 2WT, DOL, PT, HLT	CC, AC, OM, PDHT, PDPT, TTT, NAT	PCS, BC, LT
Maintenance costs	SCC,WHC, RC, BC, CC, AC, OM, HAF, JC, BC, 2WT, PT, HLT, PDHT, PDPT, TTT, NAT	LT	PCS
Frequency of use	WHC, RC, HAF, JC, 2WT, PT, HLT, PDHT, PDPT, TTT	SCC, LT	PCS, BC, CC, AC, OM, BC, DOL, BAT
Load distance	SCC, WHC, RC, CC, BC, 2WT, DOL	PCS, OM, HAF, JC, PT, HLT, PDHT, PDPT, LT, TTT, NAT	BC, AC
Volume of material	OM, HAF, JC, BC, 2WT, DOL, PT, HLT, PDHT, PDPT, LT, NAT	WHC, CC, TTT	SCC, RC, PCS, BC, AC

This concept of selection is implemented in the developed software. Thus, the user will be able to choose starting with these types of filters.

Another method for selection material handling equipment is based on the type of products that will be manipulated.

Thus, for example, a conveyor selection may be done different if the product is a baggage, or cans and bottles or metal/ plastic pallets or tires or wooden pallets. Thus, the software includes some logic diagrams based on the type of product as there are presented in [5]. In Figures 3 and 4 are presented two such logic diagrams for loose, bulk material (baggage, bags, bundles, and bales) and, respectively for wooden pallets.

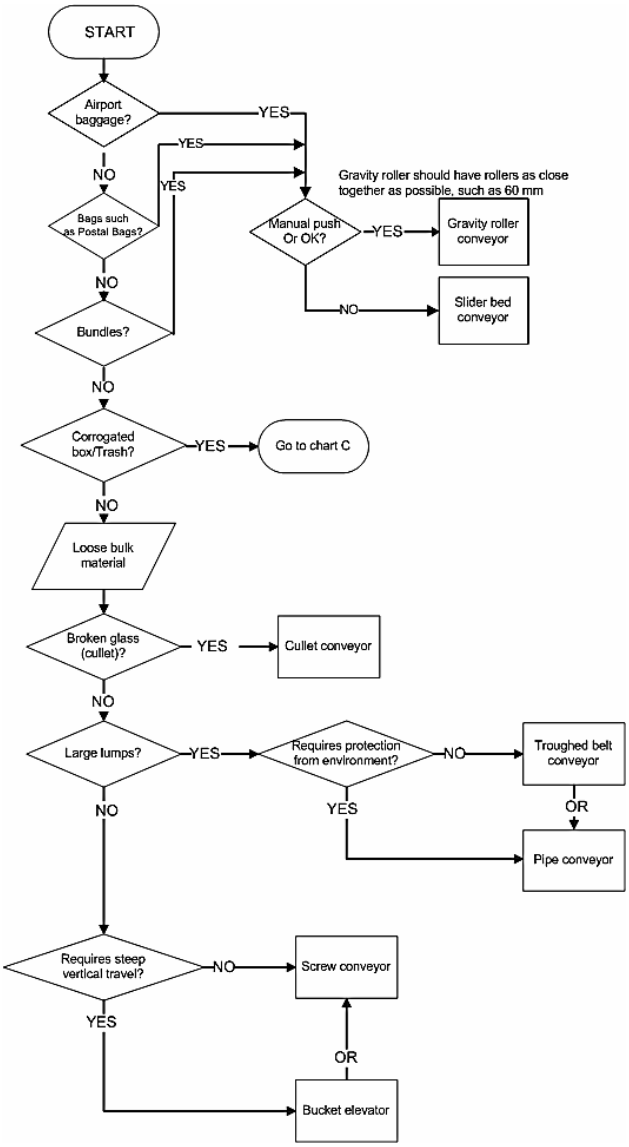

Figure 3. Conveyor selection for loose, bulk material [5]

Selection software includes 7 such diagrams that will allow the user to select the appropriate conveyor, based only on a few input data. Thus, even a less expert user will be able to obtain the desired result.

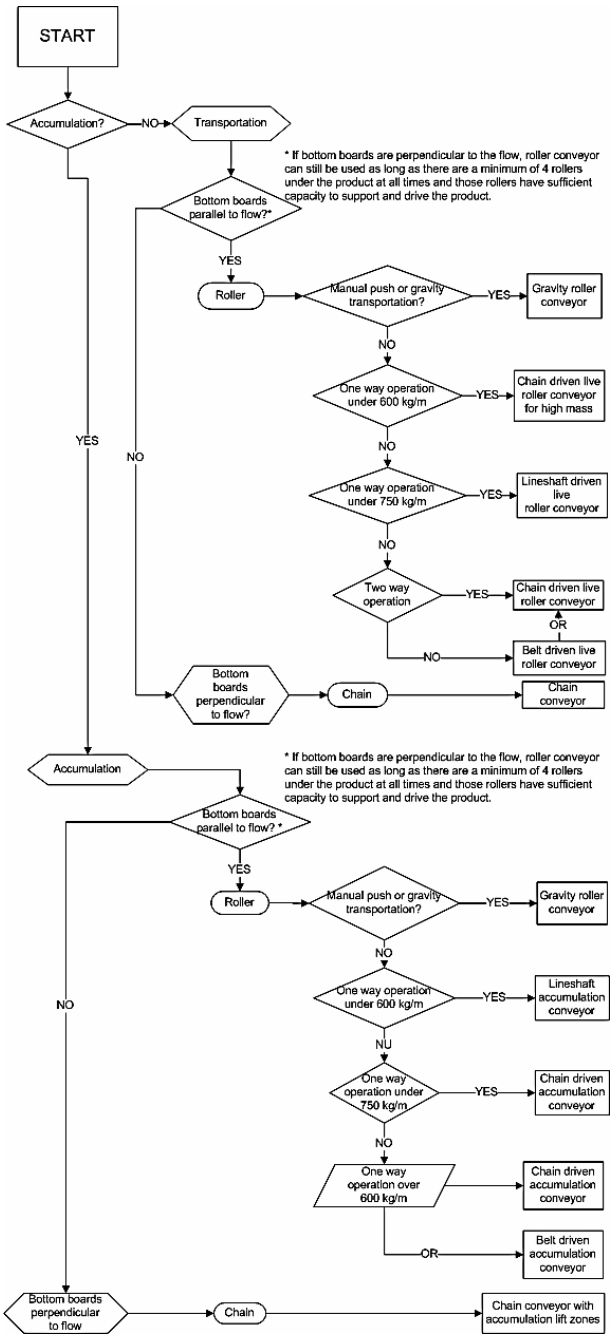

Figure 4.Conveyor selection for wooden pallet [5]

3. Selection software

Based on the above three criteria it was started the development of selection software *MHE_selection* (*Material Handling Equipment selection*) that has as logical diagram that presented in Figure 5. The software is intended to be an integrated one, to include in the future the main design elements for each equipment and to connect to an oriented search engine as that included in *globalspec.com* web site.

In Figure 6 and Figure 7 are presented two of the *MHE_selection* software [6].

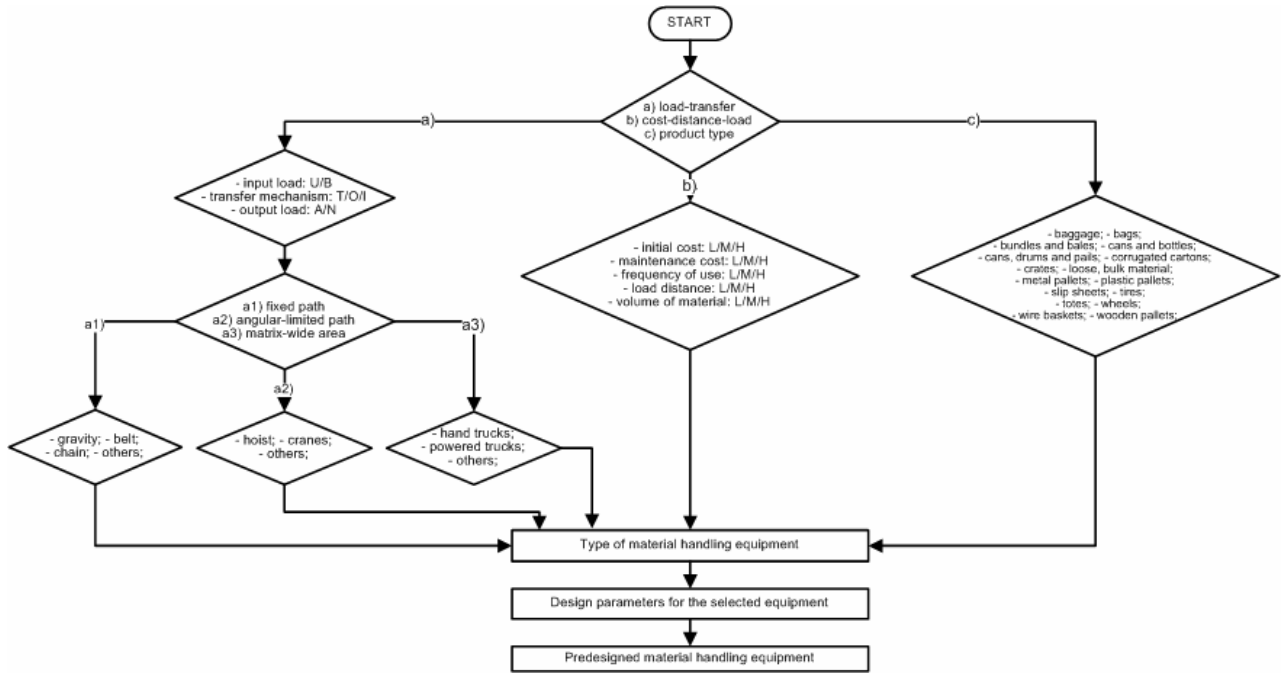

Figure 5. Software structure

Figure 6. *MHE_selection*software window (selection based on load and position)

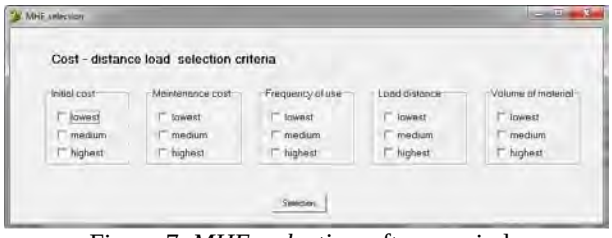

Figure 7. *MHE_selection*software window (selection based on costs)

4. Conclusions

The main aim of selection software is to minimize the time between defining the need and obtaining the product. It is very difficult to develop such software because of the many approaching ways to get the product. The *MHE_selection* wants to be integrated software that contains three methods of choosing a material handling equipment, based on different type of input data and further, for the selected equipment, to offer the possibility of predesigned it, thus the selection will be more correlated to the requirements.

The software is a continuously developing one and it is intended to be on capable to connect to firms web sites and thus, integrate the offer with request.

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