CHARACTERISTIC SOLUTIONS OF MATERIAL FLOW SYSTEMS

Péter Telek

University of Miskolc, Hungary

Abstract: There are many possibilities to create a material flow system depend on the specifications of the given process. Because of the differences they can not be designed by the same devices. To simplify the design, operate and control processes we have to use given, similar methods which can be determined for certain material flow structures. If we can define typical groups among the possible varieties the required methods can be described for these groups in a limited number. In this paper we try to define the above mentioned groups for material flow systems and to determine the characterizations and solutions belongs to them.

Keywords: Material flow system, structures, solutions, grouping

There are many possibilities to create a material flow system depend on the application field and conditions. Number of the theoretical varieties is very high, but the real possibilities in practical applications can be much less.
Because of the above mentioned situation, at the design process of material flow systems there is an important possibility which is the grouping of the varieties. During the grouping process typical varieties have to be defined which can be suit for more of the practical situations (with some modification).

1. Grouping of material flow systems

Material flow is a simple physical process in which products, materials or living objects are flowing between two or more objects using a transport channel. If there are direct relations between the process elements we can define material flow process, but if the relations are complex and we can not describe the process by direct flows, we have to use a material flow system to determine the objects and their relations. In generally material flow systems use more than one material handling equipment to solve the handling tasks (in homogenous or inhomogeneous structure).
If a material handling system contains not only handling elements but also other objects (production, service, etc.) we can design and operate it as an integrated system. In this case we can speak about an integrated material handling system.
Material handling systems can be grouped into three categories depend on the volume of the material handling tasks:

- extern material handling systems (for example: supplier systems, city transport systems, etc.),
- intern material handling systems (for example: industrial material handling systems, material handling systems for hospitals, etc.),

- handling systems of technology equipment.

At design and operation of material handling systems an important aspect is that in the different categories, the applicable equipment, techniques and processes are different. Because of it selection process of the applied system and their elements are different in the different cases.
Material handling systems in all of the three categories contain four different object types:

- material handling equipment,
- functional objects,
- stores and warehouses,
- intern and extern transfer points.

In the aspect of the objects the difference between the categories is the type of the functional object, which can be

- production or service object in extern material handling systems,
- technology equipment in intern material handling systems,
- a given technology equipment in handling systems.

In the next chapter we describe some characteristic solutions for intern materials handling systems.

2. Characteristic solutions for intern materials handling systems

During the design process of a materials handling system all of the four object types have significant effects to the structure of the system.
Role of technology equipment is primary during the design process, but in the aspect of the material flow it can be defined by some characteristic parameter:

- space requirement (required area for the machine and for its service, etc.),
- connection method into the materials handling processes (continuous, discontinuous, etc.),
- scheduling specifications (intensity, time intervals, etc.).

If the above mentioned parameters are defined, technology equipment can be grouped so the task can be simpler.
The other three object types are basic elements of the materials handling processes so they have to be treated together in an integrated form. Roles and characterizations of these objects can be defined by the applied materials handling machines.
Materials handling systems combine the characterizations of the applied individual materials handling machines, but because of the integration process effects of certain parameters can be reduced or increased during the operation of the systems. Of course as another result of the integration new characterizations can be appeared, for example:

- loading, transportation and storing tasks have to be realized for goods in different size, weight and shape in one given system,
- several transportation line can be used for a given task,
- common transport line for different materials handling equipment,
- the applied equipment can modify
    - the scheduling of the transportation,
    - the volume of the material flow,

- systems in generally use automated, computer controlled machines and elements, etc.

In the aspect of materials handling machines materials handling systems can be (figure 1.)

- systems using a given machine type (for example: roller conveyor, belt conveyor systems, etc.),
- systems using more than one machine types (for example: roller conveyor-truck, crane-truck systems, etc.).

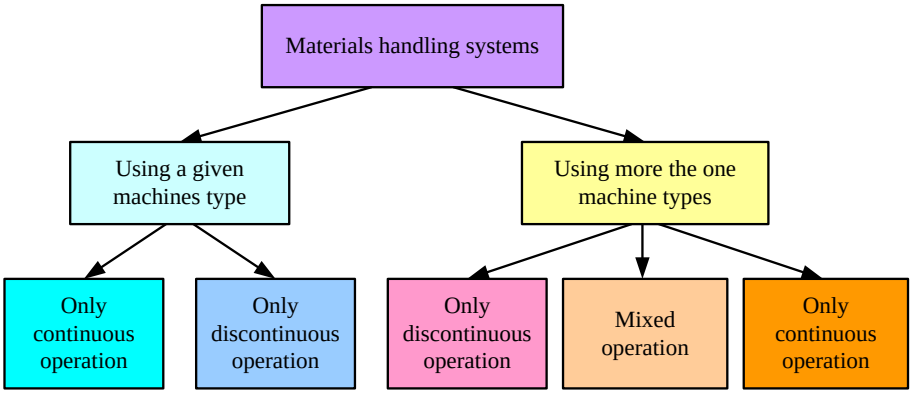

Figure 1. Grouping of materials handling systems

Among the materials handling machines there are some types which can be used only in systems (for example: overhead trolley, etc.), but all of the types can be integrated in a system.
If we use only one machine type for materials handling in the system, additional design and operation tasks are simple, contain mainly the synchronization and continuity of the system elements, because of the same characterizations.

At systems contain more than one type of machines, next differences have to be eliminated caused by the operation characteristics:

- differences between continuous and discrete operations,
- differences between free moving and moving on fixed lines,
- differences between manual and automatic operations, etc.

To sort the materials handling systems it is important to define relations and hierarchy of the elements which can be:

- system contains one material flow process,
- system contains one main and some additional material flow processes,
- system contains several parallel material flow processes,
- system contains several parallel main and some or more additional material flow processes.

In systems contain one material flow process, all of the objects and process elements are located along a linear transport line. In this case every moving objects use the same transport channel. Material flow can be actualized by one or more machine types.

In systems contain one main and some additional material flow process, the task of the additional process elements is to serve the main material flow (figure 2.). Additional material flow process elements can be:

- transportation of raw materials and parts into the objects,
- transportation of finished and partially finished products from the objects,
- transportation of units between the main line and the objects,
- transportation of units into and from the stores,
- transportation of empty loading unit building devices, etc.

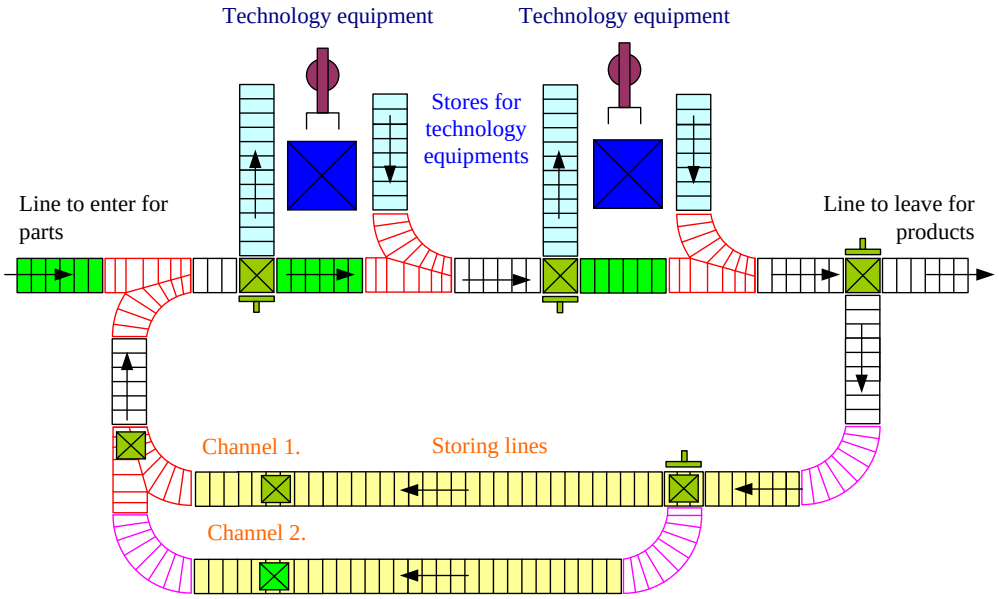

Figure 2. Example for a main and some additional material flow processes in a roller conveyor system

In this cases, in generally the main transport channel is a given materials handling equipment, the devices of the additional material flow processes in generally suited to the solvable tasks, and can be one or more types.
In systems contain several parallel material flow processes there are more than one main transport line in which the objects can be different suited to the different products or product types (figure 3.).
Of course some part of the parallel lines can use the same materials handling devices, so the relations of the individual lines can be:

- divergent lines,
- convergent lines,
- independent lines,
- complex systems contain different combinations of the parallel lines.

Material flow can be actualized in generally by one machine types but mixed systems can be also realized in the practice.
In systems contain several parallel main and some or more additional material flow processes, the task of the additional process elements is also to serve the main material flows (figure 4.).

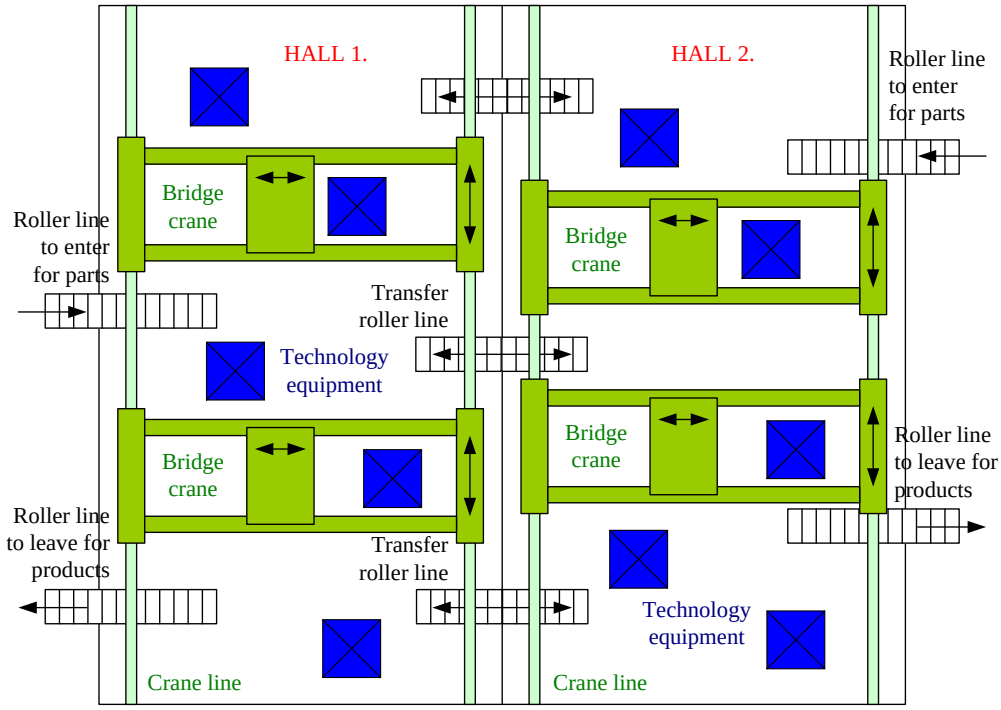

Figure 3. Example for a parallel material flow process in a crane-truck system

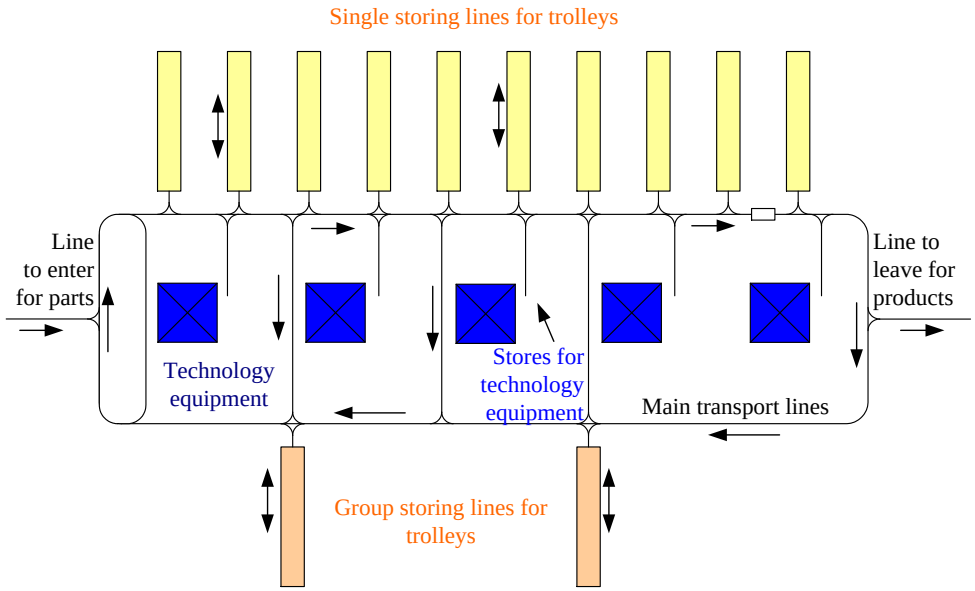

Figure 4. Example for several parallel main and more additional material flow processes in an overhead trolley system

3. Summary

Design of a complex materials handling system is generally not an easy task, because of the large number of the applicable system varieties uniform design method can not be described. The main possibility is the grouping of materials handling systems which can help us to create typical design methods applicable for certain system varieties. In these cases using the similarities of the systems makes the design process easier (in the most situations).
We tried to summarize the grouping possibilities and their characterizations in our paper and shown some typical example for them.
After the grouping the next step is to create sub-varieties for the typical systems and make a database about them to reduce the time and steps of the design process.

Acknowledgements
This research was carried out as part of the TAMOP-4.2.1.B-10/2/KONV-2010-0001 project with support by the European Union, co-financed by the European Social Fund.

References

[1.] CSELÉNYI J., ILLÉS B. (edit.): **Logisztikai rendszerek I**. Miskolci Egyetemi Kiadó, 2004.
[2.] CSELÉNYI J., ILLÉS B. (edit.): **Anyagmozgatás-logisztika. Tudomány a gyakorlatban**. Horizont Média Kft., Kiskunhalas, 2006. ISBN 963 06 0848 0
[3.] CSELÉNYI J., ILLÉS B. (edit.): **Anyagáramlási rendszerek tervezése és irányítása I.** Miskolci Egyetemi Kiadó 2006. ISBN 963 661 672 8
[4.] CSELÉNYI J., ILLÉS B. (edit.): **Logisztika alapjai** BAY-LOGI, Miskolc 2006. ISBN 963 87052 6 4