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A METHOD FOR FACILITIES LOCATION AND WEARHOUSE LAYOUT DESIGN

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ABSTRACT: *Organizations and enterprises around the world differ greatly in terms of mission, scale, and scope. Yet all of them aim to deploy the best possible network of facilities worldwide for developing, producing, distributing, selling and servicing their products and offers to their targeted markets and clients. Underlying this continuous quest for optimal network deployment is the facility location and layout design engineering.*

KEY WARDS: *warehouses, location decision, storage area.*

I. Introduction

Organizations and enterprises around the world differ greatly in terms of mission, scale, and scope. Yet all of them aim to deploy the best possible network of facilities worldwide for developing, producing, distributing, selling and servicing their products and offers to their targeted markets and clients.

II. Exposition

The intensity and pace of this flux is growing in response to fast and important market, industry and infrastructure transformations. Location and layout design is being transformed, from mostly being a cost-minimization sporadic project to being a business-enabling continuous process; a process embedded in a wider encompassing demand and supply chain design process, itself embedded in a business design [5].

Figure 1 exhibits levels of layout representation used for design purposes. The least aggregate first level, here termed processor layout, shows the location and shape of the building, each center, each aisle and each signifi cant processor within each center.

At the second level of aggregation lies the net layout which does not show the processors within each center. The assumption when focusing the design process on the net layout is that prior to developing the entire layout for the facility, space estimates have been made for each center, leading to area and shape specifications, and that as long as these spatial specifications are satisfied, then the net layout embeds most of the critical design issues. The space estimation may involve designing a priori potential alternative processor layouts for each center. The transposition of the net layout to a processor layout for the overall facility is left as a detailed exercise where the layout of each center is developed given the shape and location decided through the net layout.

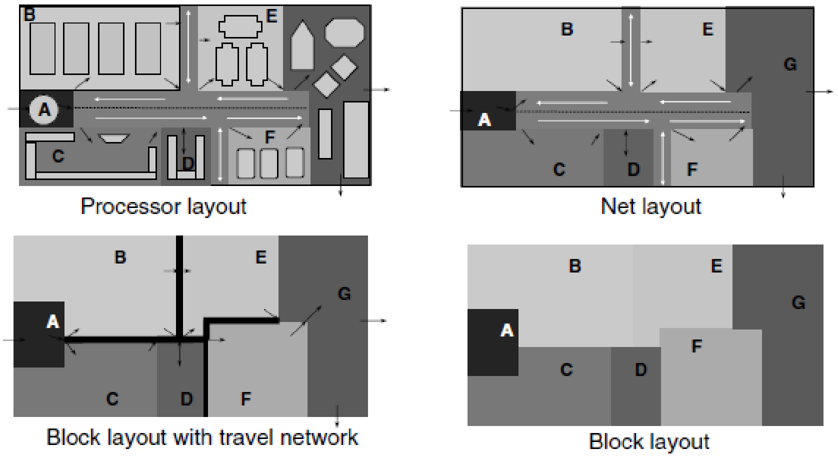

Fig. 1. Degrees of aggregation in layout representation for design purposes.

At this third level, instead of including the aisle set explicitly, the design depicts the logical travel network [3]. This network, or combination of networks, connects the I/O stations of the centers as well as the facility entry and exit locations. There may be a network representing aisle travel, or even more specifi cally people travel or vehicle travel. Other networks may represent travel along an overhead conveyor or a monorail. The network is superimposed on the block layout, allowing the easy alteration of one or the other without having to always maintain integrity between them during the design process, which eases the editing process. Links of the network can be drawn proportional to their expected traffic.

At the fourth level of aggregation, the travel network is not depicted, leaving only the block layout and I/O stations [2, 4]. Editing such a block layout with only input/output stations depicted is easy with most current drawing packages. These stations clearly depict where flow is to enter and exit each center in the layout. Even though the I/O stations of each center can be located anywhere within the center, in practice most of the times they are located either at center periphery or at its centroid. The former is usually in concordance with prior space specifications. It is commonly used when it is known that the center is to be an assembly line, a U-shape cell, a major piece of equipment with clear input and output locations, a walled zone with access doors, etc.

The absence of travel network representation assumes that the design of the network and the aisle set can be straightforwardly realized afterward without distorting the essence of the network, and that flow travel can be easily approximated without explicit specification of the travel network. Normally, one of the two following assumptions justifies flow approximation. The first is that a free flow movement is representative, computed either through the rectilinear or Euclidean distance between the I/O stations between which a flow is expected to occur. Figure 2 illustrates these two types of free flow.

Euclidean distance assumes that one can travel almost directly from one station to another while rectilinear distance assumes orthogonal staircase travel along the X and Y axes, like through a typical aisle set when one does not have to backtrack along any of the axes. The second alternative assumption is that flow travel is to occur along the center boundaries.

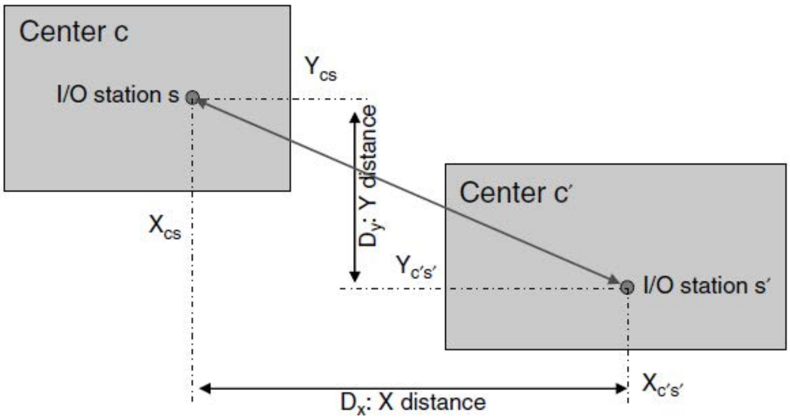

Figure 2 Free flow distance measured according to rectilinear or Euclidean distance.

$$D_R = D_x + D_y\,;$$
$$D_E = \sqrt{D_x^2 + D_y^2}\,, \qquad (1)$$

Where:
D_R - rectilinear distance;
D_E - euclidean distance.

Thus distances can be measured accordingly through the shortest path between the two I/O stations of each flow, along the contour network of the facility. This network is implicitly created by inserting a node at each corner of one center and the facility, and inserting a link along each center or facility boundary segment between the nodes. In Figure 1, a flow from the northern output station of center B to the input station of center G would be assumed to travel from the output station of B southward along the west boundary of center B, then turning eastbound and traveling along the southern boundaries of center E, and keeping straight forward to reach the input station of center G.

Location and layout is about locating and shaping centers in facilities or around the world. The design effort attempts to generate expected value for the organization through spatial configuration of the centers within a facility, or of facilities in wide geographical areas. Space is thus at the nexus of location and layout design. It is therefore not surprising that representation of space has long been recognized to be an important design issue. The essential struggle is between a discrete and a continuous representation of space.

Facilities location and layout are both inherently prone to hierarchical aggregation so as to best direct design attention and harness the complexity and scale of the design space. Depending on the scope of design decisions to be taken, the engineer selects the appropriate level of aggregation. Yet he must always take advantage of in-depth knowledge of higher and lower levels of aggregation to leverage potential options, taking advantage of installed assets and fostering synergies.

III. Conclusion

In most operational settings, the flow of materials and resources is a key for evaluating and optimizing a layout or location decision. It is sometimes sufficient to treat it through qualitative relationships. However, in most cases it is far more valuable to treat flow explicitly. Flow generally defines the amount of equivalent trips to be traveled from a source to a destination per planning period. There are two basic flow issues at stake here associated with implementing a design. First is the expected flow travel or flow intensity. Second is the flow traffic. The former is generically computed by summing over all pairs of entities having flow exchanges, the product of the flow value between them and their travel distance, time or cost, depending on the setting. Flow travel has long been used as the main flow-related criterion for evaluating alternative layout and location designs.

References:

[1]. Harrison T P, L.L. Traft L L Global supply chain management at Digital Equipment Corporation, Interfaces, v25, no1, 69–93. NY 2005

[2]. Bassan, Y., Roll, Y., and Rosenblatt, M. J. (1999). Internal Layout Design of a Warehouse. IIE Transactions.

[3]. Heizer, J. and Render, B., Operations Management, 7th ed., Prentice-Hall, London, 2003.

[4]. Heragu S., Irani M. Next generation factory layouts: research challenges and recent progress, Interfaces v32, no6, 58–76.Saaty, T.L., The Analytic Hierarchy Process, McGraw-Hill, New York, 2008.

[5]. Verter (2001). A continuous model for production-distribution system design, European Journal of Operational Research, v129, no2, 287–298. 2009