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CRITERIA FOR FACILITIES LAYOUTS DECISION MAKING

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ABSTRACT
Paper discuss optimal selection of criteria for facilities layout decision making by application of the logistics holistic approach in multicriteria decision making. The decision criteria are selected according to the logistic objectives and grouped into groups corresponding to the groups of logistic objectives, respectively to the levels of making logistics decision (strategic, tactical and operational level). Selected criteria (quantitative and qualitative) are applicable to the problems of facilities layout decision making in various problem areas (industry, energy production, crafts, services, ….). Analytic Hierarchy Process is applied for evaluation and selection of alternative from Pareto set of alternatives of "workspaces" (facilities layouts) in the department for design.
Keywords: facilities layout, logistics objectives, criteria, analytic hierarchy process.

1. INTRODUCTION
The complexity of the logistics systems imposes the need for multi-criteria optimization and decision-making in order to achieve the basic goal of logistics: a smooth flow of goods and information through the system. To achieve this goal it is necessary that the facilities layout is optimal. The facilities include physical entities such as machines, work centers, production cells, workshops, departments, storage and everything else that makes it easier to achieve expected work performance . Importance of the facilities layout problem is stressed by the fact that the material handling and other costs depending on the facilities layout contribute 20-50% to the total operating costs [1].
Generating facilities layouts requires defining one or more objectives, which can be expressed in the form of the objective function or the criteria for evaluating layout alternatives. The different facilities layout models use just a few of the large number of objectives where the most commonly used are optimizing the flow (of materials, information and personnel), minimizing the cost of material handling, optimizing the use of equipment and optimizing capital investment [2]. These are mainly the operational level objectives. Shahin and Poormostafa used qualitative and quantitative criteria for evaluation of the generated layouts (flexibility, accessibility, maintenance, ease of implementation, number of key personnel, cost of implementation, cycle time, waiting time, total cost), therefore, the criteria inherent to the operational level [3].
For evaluation of layout alternatives 35 criteria (qualitative and quantitative) are suggested [4] and only some of them are used in the recent works [5,6,7,8]. List of objectives that induce various authors is presented in [2]. Within the list, objectives are classified into three groups: the objectives of

the strategic, tactical and operational level. Since the real problems of determining the facilities layout require simultaneous analysis of several criteria, including both qualitative and quantitative, relevant to the different levels of logistics decision making, there is a need to develop a model that would satisfy these requirements. The selection of criteria from logistics point of wiew follows.

2. DECISION MAKING CRITERIA

Decision criteria are selected according to the logistic objectives. Criteria are grouped (Table 1 to 3) corresponding to the logistic objectives groups, respectively to the levels of logistics decision making (strategic, tactical and operational level). They are given with the measurement units to be used, and are defined as criteria to be either maximized or minimized.

Table 1. Strategic level criteria

Criteria	Designation	Unit of Measure	Max/Min
Share of unrealized (unfulfilled) purchase orders (ordered quantity), caused by lack of capacity, in total ordered quantities per year	SC1	%	Min
Modularity (plan for future expansion)	SC2	Linguistic value	Max
Consitency with company image, promotional value, public or comunity relations	SC3	Linguistic value	Max
Net present value	SC4	BAM	Max
Internal rate of return	SC5	%	Max
Payback period	SC6	Number of years	Min
Installation period	SC7	H	Min
Noise emission level	SC8	dB	Min
Quantity of pollutants' emission to the air	SC9	t/year	Min
Quantity of energy used for conditioning, heating and cooling	SC10	J/year	Min
Distance of output / input from the place of loading / unloading	SC11	M	Min
Total distance of exit from the entrance to other facilities	SC12	M	Min

Table 2. Tactical level criteria

Criteria	Designation	Unit of Measure	Max/min
Fits into the organizational structure	TC1	Linguistic value	Max
Facilitating the monitoring, control and communications	TC2	Linguistic value	Max
Optimizing the use of space	TC3	Linguistic value	Max
Number of requests for non-standard elements (equipment, tools, work surfaces, ...)	TC4	#	Min
Maintain flexibility in scheduling and operations	TC5	Linguistic value	Max
Average time from service request to service implementation	TC6	H	Min
Number of departments in which the intensity of daylight is not sufficient	TC7	#	Min
Facilitating the maintenance and household	TC8	Linguistic value	Max
Distance of departments staffed by employees with disabilities to the departments with which they are in close cooperation, or restaurant, toilets	TC9	M	Min

Table 3. Operational level criteria

Criteria	Designation	Unit of Measure	Max/ min
„Work in progress“ turnover	OC1	#	Max
Cost of material flow	OC2	BAM	Min
Cost of the flow of information and personnel	OC3	MAMi	Min
Handling optimization	OC4	Linguistic value	Max
Number of injuries of employees per year	OC5	#	Min
Number of thefts of materials and equipment per year	OC6	#	Min
To provide convenience for workers and improve job satisfaction	OC7	Linguistic value	Max
Percentage of equipment that performs the function in the observed period	OC8	%	Max
Daily effective engagement of employees	OC9	h/day	Max

3. CASE STUDY - FACILITIES LAYOUT DECISION MAKING

The problem of 3 “workspaces” layout decision making is structured into the hierarchy presented with the Figure 1. Analytic Hierarchy Process (AHP) is used as decision making support tool which, by its essence, well corresponds to the problem and the context of the problem (qualitative and quantitative criteria, grouped into criteria groups).

3.1. Decision Making Hierarchy, Alternatives and Result

Decision making hierarchy comprises four levels: the goal (selection of the best alternative), criteria groups, critera and alternatives. The facilities are "workplaces" (desk and chair within the area for placing and movement of chair during the work). Layouts of " workplaces ", desk and chair on needed floor space take the form of a rectangle whose dimensions and areas are given in Table 4. Layout of the room is rectangle with dimensions 6m x 5m. Layout variants (alternatives) from the Pareto set are presented in Figure 2 a-c.

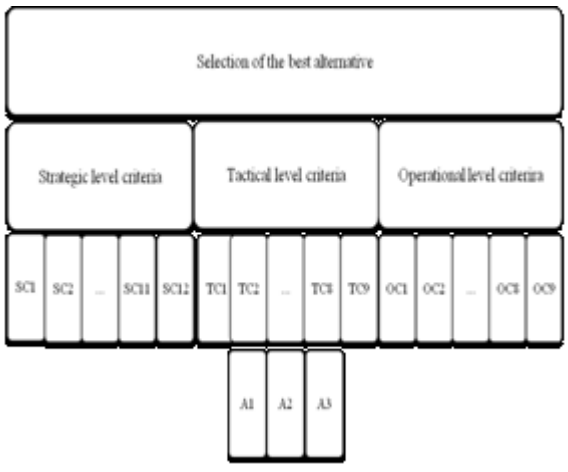

Figure 2. Decision Hierarchy

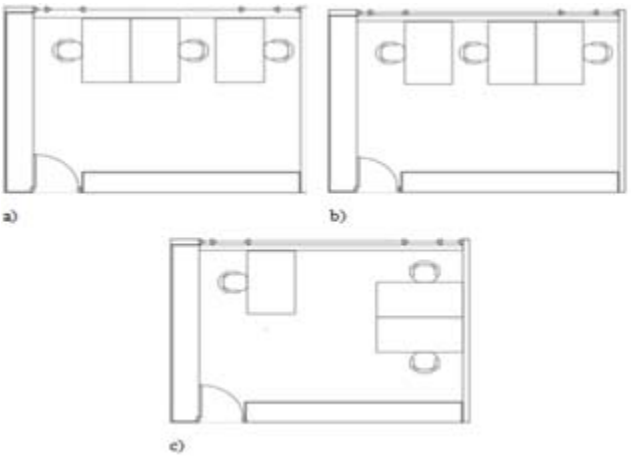

Figure 2. a) A1, b) A2, c)A3

The decision maker is a tactical level manager and directly manages the work of employees who will be assigned to the "workplaces". Result of AHP application is presented in the Table 5.

Table 4. Dimension of facilities

	Length (m)	Width (m)	Area (m^2)
"Workplace"	2	1,3	2,6
Desk	1,3	1	1,3
Area for placing and movement of chair	1,3	1	1,3

Table 5. Result

Alternative	Alternative Priority Value
A1	0,387
A2	0,396
A3	0,217

Without the application of AHP, employees have chosen alternative A3 (unlike of AHP result-A2). They have made the choice by consensus, but based on only one criteria to be minimized: the visibility of the content on the monitor by others (measure of work privacy).

4. CONCLUSION

In this paper criteria for facilities layout decision making are selected and grouped into 3 criteria groups: criteria of strategic, tactical and operational level. The selection is done in accordance with logistics objectives levels. The selected criteria were applied in choosing the best "workplaces" layout in the design department using the AHP method. The result is compared to the choice made by employees who will be assigned to these positions and found to be quite different. Such differences could be explained as consequences of the tendency of people to make decisions guided by self-interest in terms of work. Building a model which will take into acount the preferences of employees of all three levels of decision-making at the same time, and which would result in a kind of compromise between expressed preferences, may be the direction of future research.

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