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INAUGURAL LECTURE FOR OPENNING THE ACADEMIC YEAR 1994/1995

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COMPUTER REPRESENTATION OF THE INFORMATION SYSTEM FOR THE HOUSING SECTOR

The building industry has many specific qualities that could positively benefit the whole national economy. It is especially important in today's economic transformation, carrying serious material and social costs.

The main subject of this article is in referring to one of the most important bearings of system transformation, which is a natural necessity of improving management systems, systems concerning a housing sector in this case. Taking full advantage of computerization whichis developing rapidly in recent years, might play a very significant role in this process. The enormous possibilities arising for the building industry in this domain have not yet been put to good account.

The analysis presented here comprises, in a model manner, of links connecting a building company with other partners on the market. Such an approach is completely unknown in the specialist literature so far issued, concerning organization and management in the housing branch. It allows however for a distinct separation of the information and material units in the disscused area. This in turn, enables the study of relations between the elements with full particulars, which finally results in a binary record of functions reflecting decisions controlling the whole system. Bringing the decision functions to the Boole's notation is a natural premise for computerizing the system. Works of this type, undertaken on the WAN (Wide Area Network) level, would constitute an absolute novertty in the housing sector.

1. INTRODUCTION

One of the key elements of Poland's system changes, started in 1989, is the transformation of the economy. Its essential target is to perform transition in ownership structure and rearrange all industry according to market rules, based on demand-supply principles. This process is sure to create an avalanche of information growth and a visible increase in information demand. The

ability to store and transform information has a particular meaning in management. One of the ways to overcome a cognitive barrier put up as a result of this is applying computer technology.

Pointing outthe enormous possibilities of applying computerization in managing a housing sector is the main subject of this article. According to the opinion of many experts it is housing sector growth that can really stimulate the national industry and accelerate it's transformation.

In the hitherto existing manner of running a building interest, computers did not play any significant role. They began to use them in the late eighties, especially in cost calculation.

The nineties brought the necessity to adjust accountancy rules to European standards. It was the second sphere of activity where computer aid was applied. No doubt it is only the beginning in this line. More and more subjects taking up housing introduce local area networks – LAN (e.g. NOVELL), coordinating information flow among all divisions of a company.

2. MODEL

It is supposed that the next stage will be connected with introducing wide area networks – WAN, comprising all participants of the building process: investors, designers, contractors, banks, real estate agents etc. So it is necessary to form a model which would identify all the basic subjects participating in a housing sector and the mutual relations among them. A model will allow for the hiding of detail and for the concentration on general characteristics of what is being modelled (Hall, Mosevich 1988).

The basic structure of a housing sector model is shown in Fig. 1.

The model is presented as a relatively isolated system (U) – it is a housing sector working in the environment of the whole industry (G) (Nowicki, Unold 1994).

There are two basic units in the system:

– information (D) and

– material (W).

The task of the information unit is to control the flow of material flows in the material unit along the line of feedback through the set of information fluxes connecting both units. So, the fundamental idea in the presented model is a distinct separation of the information area from the material area of the analyzed sector.

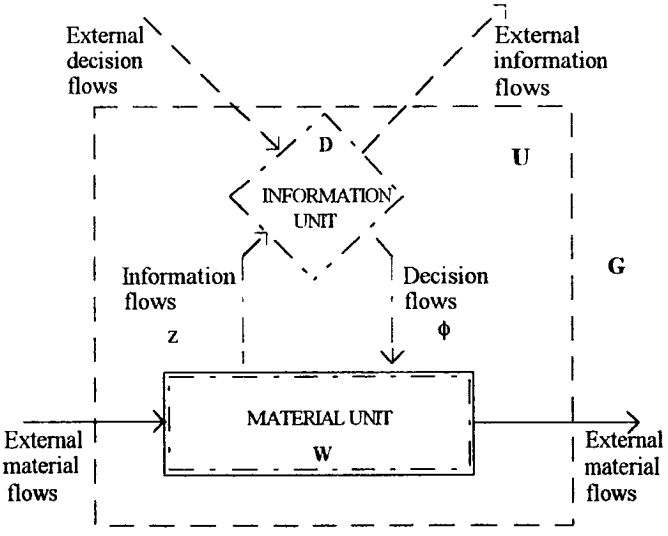

Fig. 1. The identification model of the housing sector

Source: developed on the basis of Wesołowski 1987

More detailed description of this model allows us to define particular blocks composing both basic units and all the oriented edges connecting them.

3. INFORMATION UNIT

The structure of the information unit (D) and the flow of the information flows are shown in Fig. 2.

Block D_1 – is the Management of a building firm (contractor).

Block D_2 – is the Investor of a building process; a individual or a legal person (e.g. a housing co-operative).

Information flows d_{12} – denotes current information supplied to the Investor by the Contractor, e.g. details describing contractor in a tender, scope of work defined in the agreement, successive reports on progression of works etc.

Decision flows d_{21} – denotes decisions and instructions of the Investor supervision for the Contractor. They refer to running works in accordance with a project, technology and the Building Law on the strength of the agreement.

Information flows z_{ki} and decision flows ϕ_{ik} are characterized in the description of the material unit.

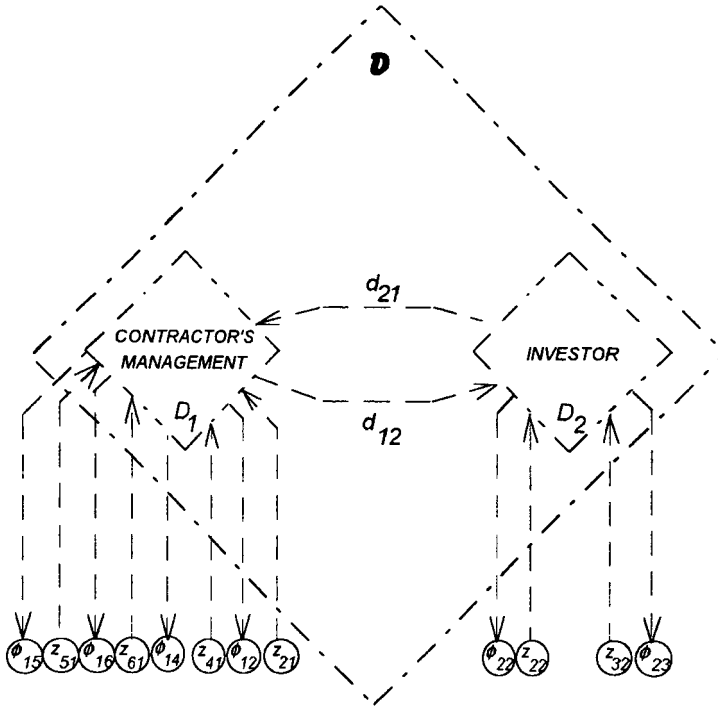

Fig. 2. The flows in the information unit

Source: own research

4. MATERIAL UNIT

The task of the material unit is to enable the flows material and energy flows in the analyzed sector.

The structure of the material unit (W) and the flows material and energy flows is shown in Fig. 3.

The material blocks:

Block W_1 – Contractor. According to the assumption of the model this block represents a productive level of a building company, opposite to the information-decision level expressed in block D_1.

Block W_2 – Bank. It provides money for a housing investment by granting a credit.

Block W_3 – Consumer (user), a prospective tenant of the house.

Block W_4 – Manpower Market.

Block W_5 – Building Materials Market.

Block W_6 – Subcontractors. Various branch firms realizing installation works in the building: wiring, central heating, sewerage, water supply etc.

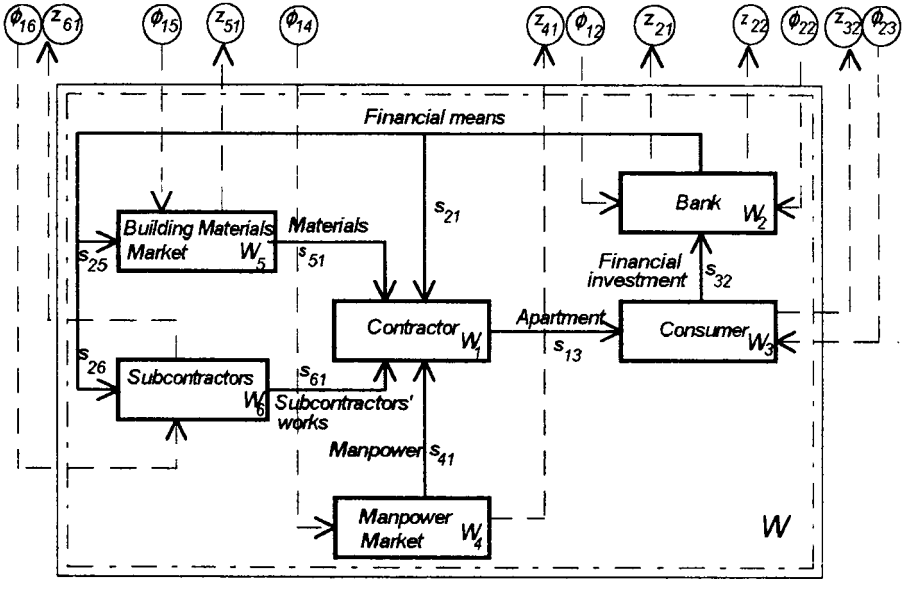

Fig. 3. The arrangement of the material block and flows

Source: own research

The material flows:

s_{21} – financial means assigned for salaries in the housing firm,

s_{25} – financial means assigned for purchase of building materials,

s_{26} – financial means assigned for subcontractor charges,

s_{61} – elements of branch works,

s_{41} – manpower,

s_{32} – financial investment of the prospective tenant,

s_{13} – an apartment, the final effect of the investment process

The information flows from the material unit (W) to the information-decision unit (D):

z_{32} – information of a housing area demand – it initiates the whole process,

z_{22} – Bank's information of the current state of account of the Investor – it subordinates the decision of starting and continuing the investment process,

z_{21} – Bank's information of the current state of account of the Contractor – it determines carrying out work,

z_{41} – information of the current situation on the Manpower Market – it determines the time and scope of works,

z_{51} – information of the current supply of the Building Materials Market – it determines carrying out work,

z_{61} – Subcontractors' information of the course of branch works – it determines coordination of works on the building site.

The decision flows controlling the material unit (W):

ϕ_{22} – the Investor's order to pay the Contractor for the accomplished stage of works,

ϕ_{12} – the Contractor's order to transfer financial means for: salaries, purchase of building materials, paying the Subcontractors or paying taxes,

ϕ_{14} – the Contractor's decision concerning staff policy; engagement and disengagement of personnel,

ϕ_{15} – the Contractor's decision concerning purchase of building materials,

ϕ_{16} – the Contractor's decision connected with the coordination of the process,

ϕ_{23} – the Investor's decision on the allocation of ready apartments.

5. MATRIX REPRESANTATION

The blocks and flows described above and the oriented relations among them can be presented, besides a block diagram, in a concise and transparent matrix form. Such a formalized image of the discussed structure should enable to adapt computer aid for a detailed analysis. There will be used a specific property of a matrix notation, which allows for reading off all connections of each block. To identify particular relations one ought to read off, in a column and in a row, values situated on two perpendicular lines passing through a given block.

The matrix representation of the management structure of the housing sector is shown in Fig. 4.

	W_1	W_2	W_3	W_4	W_5	W_6	D_1	D_2
D_1	0	ϕ_{12}	0	ϕ_{14}	ϕ_{15}	ϕ_{16}	0	d_{12}
D_2	0	ϕ_{22}	ϕ_{23}	0	0	0	d_{21}	0
W_1	0	0	s_{13}	0	0	0	0	0
W_2	s_{21}	0	0	0	s_{25}	s_{26}	z_{21}	z_{22}
W_3	0	s_{32}	0	0	0	0	0	z_{32}
W_4	s_{41}	0	0	0	0	0	z_{41}	0
W_5	s_{51}	0	0	0	0	0	z_{51}	0
W_6	s_{61}	0	0	0	0	0	z_{61}	0

Fig. 4. The matrix representation of the blocks and fluxes

Source: own research

6. DECISIONS AS FUNCTIONS OF INFORMATION

Exercising this representation one can display decisions ϕ_{ik} controlling the flows material as *functions* of the received pieces of information z_{ik}, d_{12} and d_{21}:

$$\phi_{22} = f_1(d_{21}, d_{12}, z_{22}, z_{32}),$$
$$\phi_{23} = f_2(d_{21}, d_{12}, z_{22}, z_{32}),$$
$$\phi_{12} = f_3(d_{12}, d_{21}, z_{21}, z_{41}, z_{51}, z_{61}),$$
$$\phi_{14} = f_4(d_{12}, d_{21}, z_{21}, z_{41}, z_{51}, z_{61}),$$
$$\phi_{15} = f_5(d_{12}, d_{21}, z_{21}, z_{41}, z_{51}, z_{61}),$$
$$\phi_{16} = f_6(d_{12}, d_{21}, z_{21}, z_{41}, z_{51}, z_{61}).$$

If, in the next step, one eliminates as inessential for a given decision, pieces of information (d) flowing out from a given decision block and the rest of

quantities in the parenthesies arranges in the hierarchy of importance, one obtains a modified notation of the functions:

$$\phi_{22} = f_1(z_{22}, d_{21}, z_{32}),$$
$$\phi_{23} = f_2(d_{21}, z_{32}, z_{22}),$$
$$\phi_{12} = f_3(z_{21}, d_{21}, z_{51}, z_{61}, z_{41}),$$
$$\phi_{14} = f_4(d_{21}, z_{61}, z_{41}, z_{51}, z_{21}),$$
$$\phi_{15} = f_5(z_{21}, z_{51}, d_{21}, z_{41}, z_{61}),$$
$$\phi_{16} = f_5(z_{61}, d_{21}, z_{21}, z_{51}, z_{41}).$$

The pieces of information of direct influence on a given decision are distinguished with bold letters to fully illustrate the algorithm. The rest of the information in a given relation is less essential.

7. APPLICATIONS

One of the relations above will be analyzed thoroughly to present the huge possibilities in applying computer aid in the discussed area.

The ϕ_{22} decision, which stands for the Investor's order to pay the Contractor for the accomplished stage of works, depends directly on:

z_{22} – Bank's information of the current state of account of the Investor,

d_{21} – on the Investor's approving of the finished stage of works.

The last factor, z_{32} – demand for apartments, has no direct influence on ϕ_{22} decision.

To further analyze this relation let us introduce two auxiliary denotations:

w_w – value of the Contractor's current invoice,

w_i – current state of the Investor's banking account.

Then, the inequalities:

$$w_i \geq w_w$$

constitutes the basic condition starting the decision flow ϕ_{22}.

But, simultaneously, more conditions must be fulfilled. The d_{21} flow is a factor of a dual character:

– quantitative – for the condition of a proper advancement of works has to be fulfilled,

– qualitative – for the accomplished element of a building one has to fulfill some specific standards of quality, according to the project, technology, aesthetics, art of building etc.

Let us introduce now the following auxiliary denotations:

z_b – current, real advancement of works,

z_u – contractual advancement resulting from the co-ordinated schedule,

q_r – quantity of the completed works,

q_u – quantity expected by the Investor.

Then, the inequalities:

$$z_b \geq z_u$$

$$q_r \geq q_u$$

are the next conditions obligatory to start the decision flow ϕ_{22}.

In this formulation one meets two cases:

1) $w_i \geq w_w \ \wedge \ z_b \geq z_u \ \wedge \ q_r \geq q_u \Rightarrow f_1 = 1$

which means that the decision flow ϕ_{22} has started. The Investor has ordered the Bank to transfer financial means to the Contractor's account.

2) $w_i < w_w \vee z_b < z_u \vee \ q_r < q_u \Rightarrow f_1 = 0$

which means that the Investor has deferred transferring money.

So, the decision flow ϕ_{22} can be started when all the conditions described above occur simultaneously. Even if one of them is not fulfilled, the decision path ϕ_{22}, acting as the function f_1, cannot be used.

The function $\phi_{22} = f_1(z_{22}, d_{21})$ has therefore a *binary* character.

On the basis of the analysis relations presented in this article one can find that the rest of the functions: ϕ_{23}, ϕ_{12}, ϕ_{14}, ϕ_{15} i ϕ_{16} are also of the binary.

Taking all these features into account, there appears a natural premise for applying computer aid to run the housing sector. In practice computer-aided management will considerably rationalize the decision process and will eliminate useless links in the discussed area.

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