SECTION 5. Innovative technologies in science.

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BUILDING A MANAGING SYSTEM OF COMPLEX PRODUCTION PROCESSE

Annotation. *The paper presents an approach to building a managing system of complex production processes, based on the investigation of combining various technology factors, forming tables to analyze the impact of technology on the output properties and studies of combinations of transitions between the stages of processing.*

Key words: *Building a managing system, complex production processe.*

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Production characterizes the set of technology factors $x=(x_1,...,x_n)$ and a set of output properties (quality indicators) $y=(y_1,...,y_m)$.

There is a set of N experiments, where every experiment corresponds to the quality of product y. Each technological factor is enclosed within certain limits: $x_i^{'} \le x_i \le x_i^{''}$, where $x_i^{'}$ - minimum observed value, a $x_i^{''}$ - maximum observed value.

The range of values of each factor can be divided into k sections. To simplify, we can divide the bands into equal segments. After this process the value of the factor x_i. Each experiment occurs in one of the sections x_{ij}, where i - index factor ($i=1,...,n$), a j – index sections ($j=1,...,k$).

Next specify required values of quality indicators, i.e. specify sections of quality indicators. For example when checking for compliance with STANDARD number of sections may be equal to 3, where 1 - is the section corresponds to values below the STANDARD, 3- the section of the value above the STANDARD.

After a given partitions, the value of each output properties in each experiment falls into one of the sections. In every line of our set of experiments, the number of output properties, that corresponds to standards differently.

We denote this number w_m, that varies $0 \le w_m \le m$, so if $w_m = 0$, we can say that neither one output property fall into the area specified by the standard; if $w_m = m$, we can say

that all output properties were in areas specified by the standard, in other words, the products fully comply with standards. This information can be represented in a table 1.

Table 1

Data about the combinations of production factors and output properties (for n = 5, k = 3, m = 5).

Combinations of technological factors $x_{1j}x_{2j}x_{3j}x_{4j}x_{5j}$	The number of experiments that fall into the area in this combination n	w_m					
		0	1	2	3	4	5
11111	n_1						
11112	n_2						
…	…						
33333	n_L						

You can continue to study the impact of technology on the output property that has its own set of segments. For each output properties you can conduct a working out in detail of the caught number in each segment of experiment.

Table 2

Analysis of the impact of technology on the output properties (number of plots for the output property is 3).

$x_{1j}x_{2j}x_{3j}x_{4j}x_{5j}$	n	w_m						y_1			y_2			y_3			y_4			y_5		
		0	1	2	3	4	5	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
11111	n_1																					
…	…																					
33333	n_L																					

Part of the resulting table is shown in Table 3 (due to the large volume table contains incomplete amount of data).

Table 3

Part of the table displays data about the combinations of production factors and output properties (for n = 8, k = 3, m = 3).

x1x2x3x4x5x6x7x8	n	y_1			y_2			y_3			w_m			
		1	2	3	1	2	3	1	2	3	0	1	2	3
01001000	21	0	19	2	0	18	3	0	15	6	0	0	11	10
01001001	83	0	72	11	0	71	12	0	69	14	1	6	22	54
01001002	29	0	26	3	0	26	3	0	23	6	0	1	10	18
01001010	23	0	20	3	0	18	5	0	20	3	0	2	7	14
01001011	111	0	95	16	0	94	17	0	85	26	1	6	44	60
01001012	39	0	32	7	0	32	7	0	32	7	0	4	13	22
01001021	5	0	5	0	0	4	1	0	4	1	0	0	2	3
01001100	39	0	36	3	0	28	11	0	25	14	1	5	15	18
01001101	141	0	118	23	0	123	18	0	109	32	0	11	51	79

To investigate the multistep processing we can apply the following scheme of analysis of the impact of technology on output properties. At each stage of the processing unit there will be a

certain set of process parameters $\bar{x}_i = (x_{i1}, \ldots, x_{in_j})$ where i- the index of the unit or stage of processing, j- the index of technological parameter typical for the i- unit or processing steps, n_j - a number of technological factors at this stage. And as in the previous case, there is a set of output properties (quality indicators) $y = (y_1, \ldots, y_m)$. Then, this succession can be represented as a chain of processing stages or units as in Figure 1.

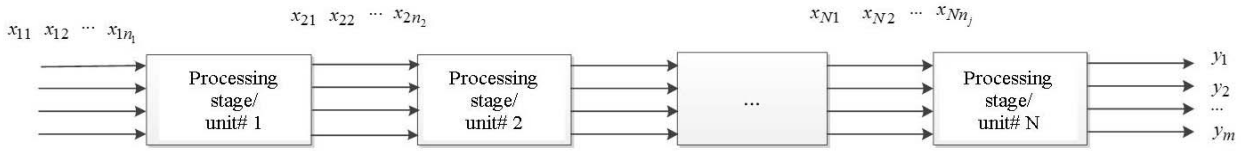

Figure 1 - Representation of a multi-stage processing.

As it can be seen at each stage of processing there is a different set of process parameters. After the last processing stage, we get a product with a set of output properties (quality indicators).

We can describe the transitions between stages 1 and 2 in table 4.

Table 4

Matrix of transitions between stages 1 and 2

x_1x_2 \ x_3x_4	11	12	…	33
11			…	
12			…	
…	…	…	…	…
33			…	

The table cell gets the number of experiments that contains a combination of factors x_3x_4 in the set of factors on the first stage with a value x_1x_2. This way we can describe the transitions between all the stages of processing at the last stage of working. All the possible combinations for output properties can be found in the header of the table. The result for the 1st and 2nd stages are presented in Table 5.

Table 5

The resulting matrix of transitions between stages 1 and 2.

	11	12	13	21	22	23	31	32	33
11	225	379	33	1900	3362	381	1648	2926	337
12	154	284	26	1337	2286	266	1233	2107	211
13	8	12	1	57	100	8	44	83	8
21	364	697	71	3276	5769	639	2914	4957	580
22	274	501	64	2294	4190	444	2061	3578	418
23	9	24	2	85	150	13	81	128	22
31	68	156	12	688	1240	158	602	991	125
32	64	95	12	471	852	102	398	757	74
33	2	5	1	21	32	2	15	31	5

Now let's examine the technological modes of processing, those paths that were observed in production. The first five modes are most probable and received according to the original table of records of monitored process parameters, are given in Table 6.

Table 6

The most probable routes

Rout	Number of repeats	Probability
22[1]->21[2]->22[3]->22[4]->222[5]	620	0,010
22[1]->21[2]->22[3]->12[4]->222[5]	539	0,009
22[1]->21[2]->32[3]->22[4]->222[5]	514	0,009
22[1]->21[2]->32[3]->12[4]->222[5]	462	0,008
22[1]->22[2]->22[3]->22[4]->222[5]	426	0,007

As can be seen from the previous tables there are transitions and ways to weight, that is small if compared to other transitions. For example, we can take the transition 31 [1], 13 [2] from Table 15, with the weight 1 which is substantially loses if compared with the transition from 22 [1] 21 [21] with a weight of 5936.

We introduce a boundary to show the ways in which the number of repeats / weight are greater than 100, and show the resulting graph and the transition matrix.

In this case, the number of links decreases sharply by combining paths going through the same vertex, and by introducing a boundary. This method of analysis of technological regimes is more acceptable, as it displays only those paths which occurred most often.

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