

VECTOR MODEL STANDARDIZATION OF STANDARDS WITH KRIŽAIĆ DSP COD

The digital revolution extends not only to technology, but also to organization and management. Complex processes that are essential for the with will developementes of projects to improve economic principles as part of the business system. However, it has been found that there is not much progress in business development. Therefore, the recommendation is to change the model of the organizational structure to a vector organization, which has been upgraded to a process system as a by-product of the computerization of the economy and the production of projects. However, the method of copying or transferring the old standardization, calculation on build construction and tendering system to ICT technology proves to be insufficient for the operation of the system. Despite digitization, the problem of cumbersomeness and inaccuracy in linking standards and processes and the inaccurate definition of calculations and plans for process and construction production due to the obsolescence and static nature of standards and cost lists remains. Therefore, the vector model standardization of standards (MSN) is initially proposed for the model standardization of the offer or project with the dual code of dynamic structure programming (DSP) or the dual DSP code. The Križaić DSP method is a logical induction equation that, in cooperation with vector standards and the MGSC equation, establishes the infinity and uniqueness of the process product and creates an AI system for project management with BIM and digital twin tools.

Keywords: Model standardization bill of quantities, vector standard and organization, MSN, DSP dual cod, BIM digital twins standard

1. Introduction

The standardization or standardization system of various German (DIN), British (BS), American (ASTM) and Croatian (HRN EN) countries [1] consists of a tabular structure that defines a set of elements with a normative value for the need for certain resources to perform the operations of a particular process. These resources are labor, material and machinery, which are defined by the normal use of labor and the normal consumption of material components for the execution of a unit of quantity of the product in a time interval. Labor norms are the human potential of different occupations defined by the time required to perform a unit of a certain amount of the described work. Thus, mechanical engineering norms are defined by time, while material norms are defined by various units of measurement required for 1 unit of measurement of a particular activity or process. The static problem of the old normative tabular discrete data is the individual definition of the tables for each discrete description of the work of the deliverable with a particular dimension of design and production resources. In addition to the static nature of the tables, the problem is also the lack of a flow or sequence of procedures for the operation of the work described. Simply by changing the dimension of the resource or design, the standard becomes obsolete and a new one must be defined. This is a Sisyphean task, and there is no reference to the infinity and at the same time to the indeterminacy of all the differences in the data to which the standard applies in practice, and especially in the labor and time resources. Therefore, in order to accelerate the technological processes of planning and standardization as the engine of enterprises leading to the logistical regulation of the business system, it is necessary to replace the discrete elements of work, i.e. time norms, with dynamic, i.e. parametric [2] or vectorial [3] modeling. Norm modeling makes this possible and can be represented by a formula in a vector system.

It is proposed to create new functional vector norms (VN) from discrete tabular data through statistical processing and process synthesis of norms in process carpentry technology, which precedes discovery technologies. New work with new technologies also requires a new MSN that can be applied to the hydrodemolition of concrete structures with robots using high-pressure water jets. In the absence of a flow or sequence of operations of the work described, it is proposed to create tables using the DSP method, i.e. a digital system with double code similar to the XML code that logically links the process systems of standards and bill of quantities.

The contribution of the work is the modeling of VN with DSP double code ∞ record. The team digitizes, i.e. models the standardization or the effect of resources in an activity, which is also a precursor to modeling the standardization of construction production (MSGP), i.e. the offer as a product. A by-product is also the intensity of the development of standard technology, i.e. production technology.

The aim of the work is the model standardization of production (MSP), i.e. the operation or management of the business system to improve the productivity and profitability of projects and thus of business systems. While European and international organizations (ETSI) for the standardization of standards, in addition to those mentioned above, tend to focus on the sustainability of process technologies with circular technologies.

2. Status of the standard

The Croatian standards mainly deal with legal, resource-related and technological procedures for defining product conformity. They thus cover almost all areas of human activities, both Croatian (HZN) [4] and European (CEN, ETSI) and international (ISO). However, as far as the technical standards for determining material and labor consumption in the technological process are concerned, they all lag too far behind. Thus, productivity, i.e. the time spent per unit of product, is managed according to outdated standards, which hinders the development of society. There is also no global interest, instead companies fight for the market individually and offer their normative effects, i.e. resource specifications for a particular technology supported by data monogrammed by designers. Classic studies on time measurement [5] and processing time consumption are Taylor's study on time and motion, then Tippet's study on sample with the amount of downtime and probability distribution. The methods for measuring time consumption are time measurement, photo review, actual observations, and technical records with various daily reports. In this way, practical records become the strongest evidence of the time consumption that goes into the system of standards and organizational potentials. Today, new digital drone technology [6,7] is used for these records, monitoring production and defining the standard, but again in classic, static, tabular form. The problem of classics is a large deviation in the working time resource, which is usually the average of some approximate and obsolete effects on certain construction and resource dimensions. By changing the dimension of an element or component, a new standard must be created, resulting in ∞ many standards. Therefore, monograms are defined in construction and engineering technology (Figure 1), which open the way to the functional or parametric specification of resource requirements for a particular process..

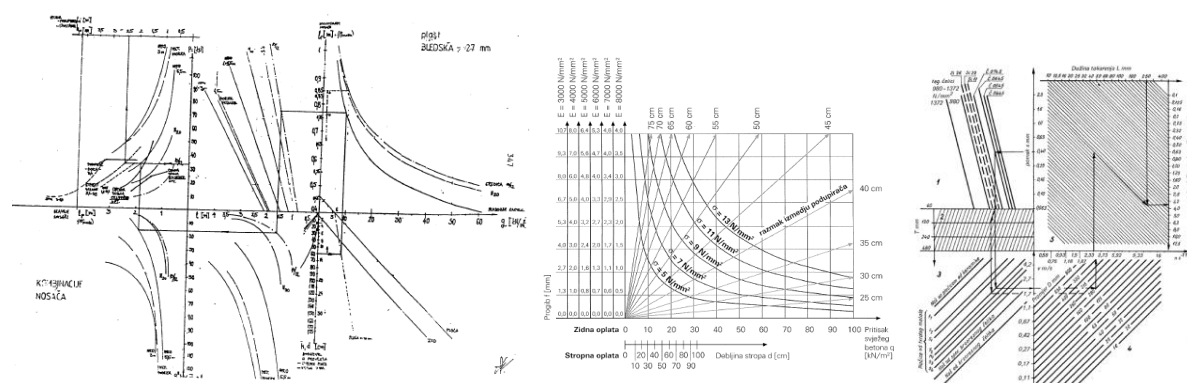


Figure 1. Monograms of carpentry (Križaić GK Međimurje [8], Doka) and mechanical engineering [9]

When optimizing with operations research methods, the working time of an activity can be improved by functionally linking variables that influence the course of the process [10]. In this way, static standards are converted into dynamic standards, which in process production transforms static work preparation into a dynamic logistical PMLD. This in turn is the path to MSGP, i.e. process technology (Figure 2).

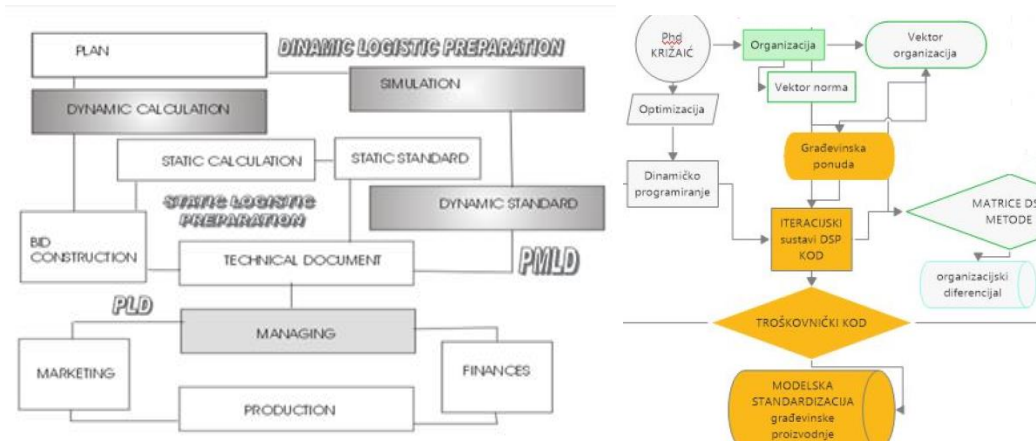


Figure 2. Static and dynamic work preparation and MSGP Phd

3. Norm vector and effec

The parametric or functional linking of standards is also the tendency of the image of companies in the development of new technologies (DOKA, PERI, ABM), which advertise the technology extensively in brochures in order to make it as useful as possible for the user in of specifications and technological possibilities. This leads to vector technology and organization [11] with carpentry formwork models in GK Međimurje and the company Carin Zagreb via the Conjet robotic system of bridge hydrodemolition technology.

3.1. Norm vector model

By analyzing and systematizing the description of the process of old norms, the variables of construction, technology and organization can be identified for the definition of the vector norm hypothesis. The normative time can be represented as a resource effect in a three-dimensional formula. The variables are elements of project construction (X_c) and technology (Y_r), which are defined by the categorized variable of organization (Z_o) (Figure 3).

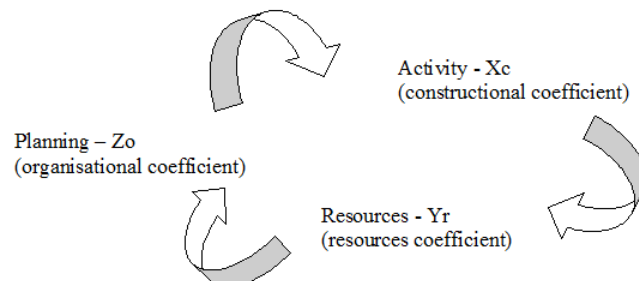


Figure 3. Idea for the creation of a norm vector in the building industry

Thus, in the example of formwork technology, there are tables in the function of resources (r), i.e. technology of execution and construction of execution (k) and dimensions of construction (k_{di}), which affect not only the time resource but also the material part of the standard. By using these variables and

defining the basic construction (frame), all discrete tabular representations of formwork systems can be reduced to a graphical vector image and the structural equation (1). Excluding the basic or initial construction, which is the simplest and most frequently executed, the beginning of the VN is defined, and depending on this, the other constructions are written with the specified coefficients.

$$VN = f(kd, ko, k, r) = kd_i ko_i f(k, r) \quad (1)$$

Material consumption is defined by connecting the designer's equations with the effects of resources reduced to the dimensions of the design documentation of GK Međimurje formwork technology defined by the equations in the monogram with units of measurement in cm, m, kN. Labour costs By creating standards according to workers' occupations, the discrete data of labour standards are shortened and the model is obtained by defining the functional relationship of resource and time standards in relation to the dimension of construction or labour. By analysing and systematising the old standards, the three-dimensional variables of construction, technology and organisation can be used to define the vector standard hypothesis.

3.2. VN formwork technology

Bywork technology synthesizing the tabular processes of the old standards, that is, the descriptions and normative data of the resources, the basic constructive element with the basic needs of the resource values is defined in digital form (Figure 4)..

OPLATA RAVNIH TEMELJA, MAŠINSKIH FUNDAMENATA, RAVNIH BETONSKIH ZIDOVA										GN-601-201 1604 XX																																
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Figure 4. Extract from strict standards [12] and digital data set - double wall cladding - foundations

By extending or adding new tables or monograms to the data of Peri, Doka [13,14], a functionally dependent structure defined by four coordinate axes, called VN, is formed (Figure 5).

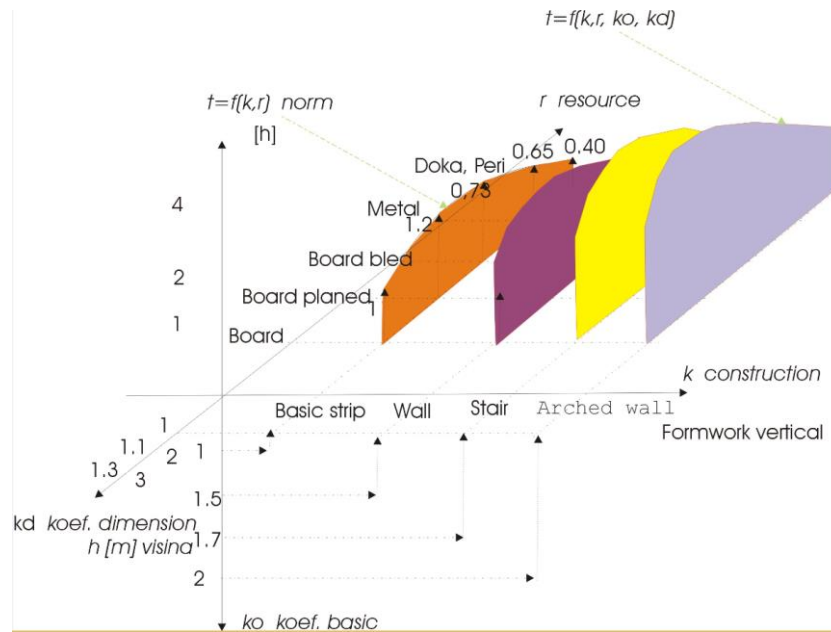


Figure 5. Functional dependency of the double-sided HV wall cladding

3.2.1. Standard of time

The initial basic structure of the HV foundation as a function of production resources is defined by the statistically probabilistic Gaussian least squares method [15,16]. The MSN approximation for the basic formwork system (2,3,4) results from this method. For a linear or nonlinear system of equations in which x is the resource variable (r) of the input in the production process with the value of the effect or duration norm (t) in the activity of manufacturing a certain constructive element (k).

$$MSN_k = f(x) = a + bx + cx^2 \quad (2)$$

$$K_k = T D^{-1} \quad (3)$$

K - koeficijenti, T - norm, D –dimenzije(red resursa)

$$\begin{bmatrix} n & \sum_{x=1}^n x & \sum_{x=1}^n x^2 \\ \sum_{x=1}^n x & \sum_{x=1}^n x^2 & \sum_{x=1}^n x^3 \\ \sum_{x=1}^n x^2 & \sum_{x=1}^n x^3 & \sum_{x=1}^n x^4 \end{bmatrix} x \begin{bmatrix} T_1 \\ T_2 \\ T_3 \end{bmatrix} = \begin{bmatrix} a \\ b \\ c \end{bmatrix} \quad (4)$$

For a two-handed wall formwork, the resource value (5) ($r = x$) is therefore for 1 board, 2 planed boards, 3 battens, 4 metal and 5 doc formwork jackets. The effect (t) for the unit of measurement 1 h is given in a matrix order in m³/h (Figure 6).

$$x = \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{bmatrix}, t = \begin{bmatrix} 1.07 \\ 1.20 \\ 0.73 \\ 0.65 \\ 0.40 \end{bmatrix} \quad (5)$$

The Gaussian least squares method defines a functional continuous quadratic curve (6,7,8,9).

$$b = \begin{bmatrix} b1 \\ b2 \\ b3 \end{bmatrix} b1 = \sum_{x=1}^n x, b2 = \sum_{x=1}^n xt, b3 = \sum_{x=1}^n x^2 t \quad (6)$$

$$\begin{bmatrix} n & \sum_{x=1}^n x & \sum_{x=1}^n x^2 \\ \sum_{x=1}^n x & \sum_{x=1}^n x^2 & \sum_{x=1}^n x^3 \\ \sum_{x=1}^n x^2 & \sum_{x=1}^n x^3 & \sum_{x=1}^n x^4 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix} \quad (7)$$

$$X = bA^{-1} \quad X = \begin{bmatrix} 1.192 \\ -0.03 \\ -0.026 \end{bmatrix} \quad (8)$$

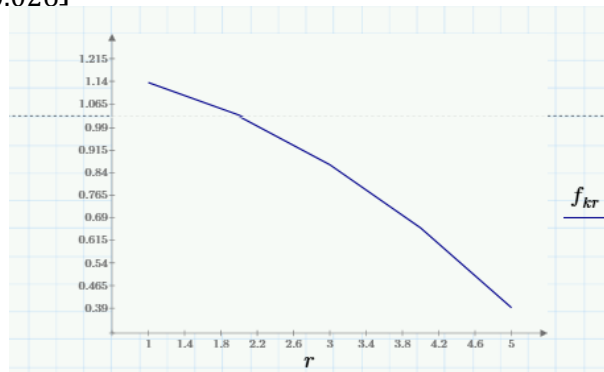


Figure 6. The standard curve of the foundation formwork technique

$$t = f(kr) = 1.192 - 0.03r - 0.026r^2 \quad (9)$$

3.2.2. Standard of material and basic business resources

The specification of materials by vectorial or functional connection and logical structural connection in algorithms creates a software component that adopts BIM and AI technology today. Carpentry formwork technology is full of research and development time with constant progress. First of all, the desire to minimize the use of resources is related to the statics of structural technologies, which depends on the hydrostatics of fresh concrete, which is a function of the height of the structure. The auxiliary construction of the scaffolding, which complements the work at height, also depends on the height. The algorithms for the formwork and the software solution for the specification of the tubular scaffolding (Figure 7) are the first step in optimizing the specification of material resources. Then the Doka BIM tools and Peri Software technology tools obtain precise resource specifications.

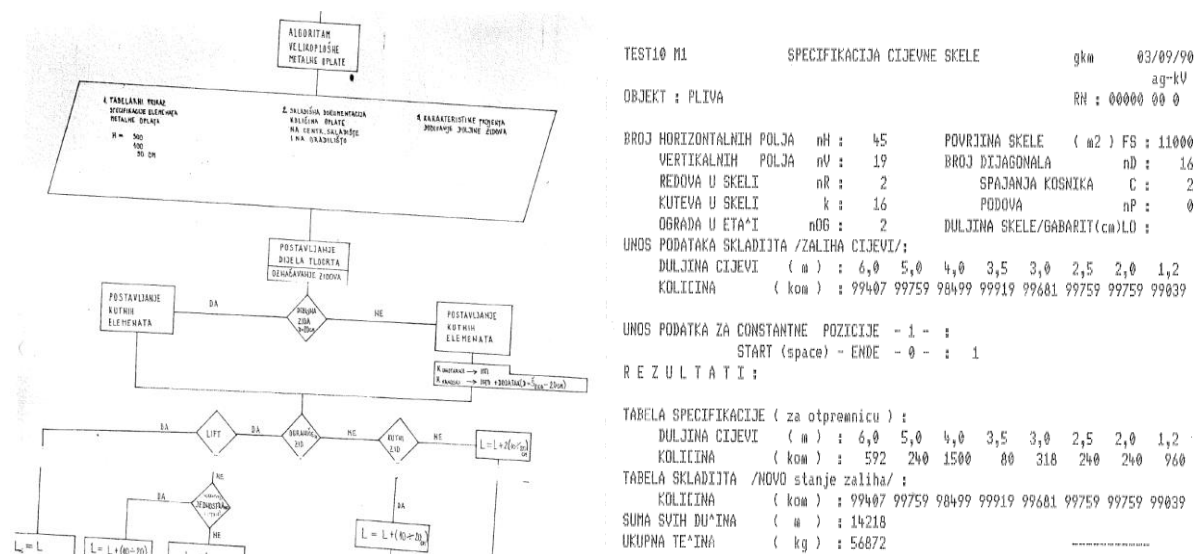


Figure 7. Algorithms for formwork and software solution for the specification of tubular frameworks

The machines are associated with work and machine parameters such as length, speed, quantity, which depend on the consumption of the machine and the calculation of the work. It turns out for that

mechanical work is mostly a problem of precision, since the specified variables are not written in units of m, but of km. Therefore, the standard effect or the norm of the machine (10) with general and special coefficients and the theoretical effect is defined variably parametrically by the tree system (Figure 8).

$$Up = ko \cdot kp \cdot Ut \quad (10)$$

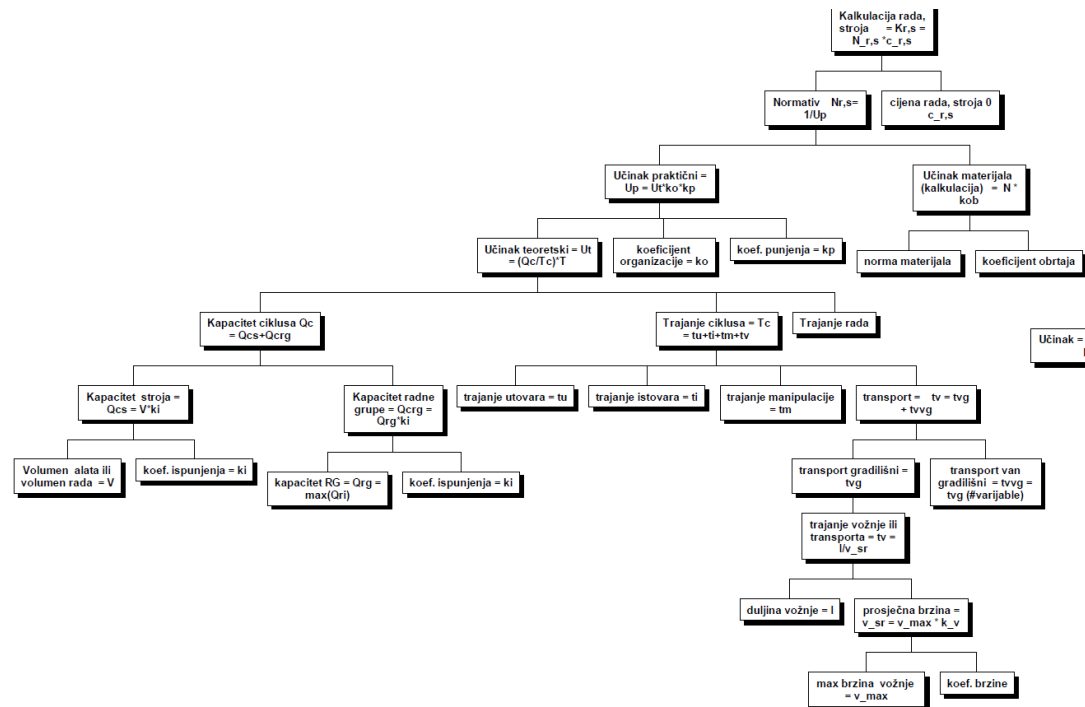


Figure 8. Tables of activities differentiated in smaller JM.

The Bim architecture and construction technology also determines the material resources with great precision, and the material standards for installation in the building are automatically determined for each project.

3.3. Vector effect/standard of robotic conjet technology of water destruction of concrete components

3.3.1. Model of basic construction and resources for production

The basic structure for water extraction is the bridge deck. Beams and walls or supports are compared from it. The methods for technical standardization and for measuring time consumption are the method of time measurement, photo inspection, recording, ongoing observations and technical records. The statistical distribution curve of the effect of the Conjet 362 robot was determined using the logbook method or technical recordings by observing and recording the process of water demolition on the bridge in Zagreb on the Sava River using the analytical data "Table 1".

datum	robot	smjena	strojar 1	strojar 2	dubina	širina	duljina	m3	efektivni radni s	učinak
25.3.2008	362	2 Brko	Kovačić.Z		0,2	3,2	6	3,84	5	0,77
25.3.2008	362	2 Brko	Kovačić.Z		0,2	0,4	8,5	0,68	1	0,68
25.3.2008	362	2 Brko	Kovačić.Z		0,2	1,6	19	6,08	6	1,01
26.3.2008	362	1 Brko	Kovačić.Z		0,2	1,6	36	11,52	10	1,15
26.3.2008	362	2 Palijan	Ciprić		0,2	1,6	39	12,48	11	1,13
27.3.2008	362	1 Vedrina	Mlinarić		0,2	3,2	22	14,08	8	1,76
27.3.2008	362	1 Vedrina	Mlinarić		0,2	1,6	25	8,00	4	2,00
27.3.2008	362	2 Palijan	Ciprić		0,2	3,2	30	19,20	11	1,75
28.3.2008	362	1 Vedrina	Mlinarić		0,2	1,6	4	1,28	11	0,12
28.3.2008	362	2 Palijan	Ciprić		0,2	3,2	10	6,40	5	1,28
28.3.2008	362	2 Palijan	Ciprić		0,2	1,6	23	7,36	6	1,23
29.3.2008	362	1 Vedrina	Mlinarić		0,2	1,6	24	7,68	5	1,54
29.3.2008	362	1 Vedrina	Mlinarić		0,2	3,2	4	2,56	2	1,28
31.3.2008	362	1 Vedrina	Januš		0,2	1,6	48	15,36	10	1,54
31.3.2008	362	2 Ptičar E	Ivančić		0,2	1,6	47	15,04	11	1,37
1.4.2008	362	1 Vedrina	Podhraški		0,2	1,6	48	15,36	11	1,40
1.4.2008	362	2 Ptičar E	Ivančić		0,2	1,6	26	8,32	7	1,19
1.4.2008	362	2 Ptičar E	Ivančić		0,25	4,2	5	5,25	5	1,05
2.4.2008	362	2 Ptičar E	Ivančić		0,2	1,6	11	3,52	4	0,88
2.4.2008	362	2 Ptičar E	Ivančić		0,25	1,6	14	5,60	7	0,80

Table 1. Operator's work plan for robot 362 and pumps for water demolition

These measurements were transformed into a discrete function, which is approximately replaced by the exponential Weibull distribution derived from the Erlang distribution [17], which is typical for labor and service activities. The given discrete recorded example was transformed into a function of the event frequency density of the effect of the robot work, which determined the effect and the norm, i.e. the expected duration of the process [18]. Extreme data were discarded and an interval favorable for the Erlang distribution was determined (Figure 9).

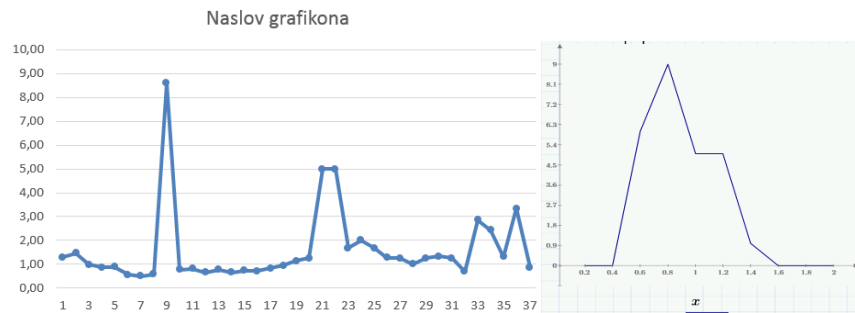


Figure 9. Discrete frequency of impact partially and cumulatively by the impact from monitoring the variables of operation Conject robots 362 at level 5/7

The data "Table 2" defines $P(x)$, i.e. the probability of occurrence of the frequency of the effect of the robot to determine the expectation of the statistical variable of the effect for a given activity of the robot 364. It follows that $E(x)$ (11) is 0.89, i.e. 0.9 m3/h for a robot and a pump operated by 1 operator each, so that the standard "Table 1" is duplicated.

$$E(x) = \sum_X x P(x) \quad (11)$$

suma	26	1,00	0,89
t	n		E(x)=0,90
x	ni	$Px=ni/\sum ni$	x Px
0,2	0	0,00	0,00
0,4	0	0,00	0,00
0,6	6	0,23	0,14
0,8	9	0,35	0,28
1	5	0,19	0,19
1,2	5	0,19	0,23
1,4	1	0,04	0,05
1,6	0	0,00	0,00
1,8	0	0,00	0,00
2	0	0,00	0,00

Table 2. Effect frequencies of E(x) robot 362 on the Zagreb-Zaprešić bridge

Drugom metodom funkcijskog povezivanja učinka pomoću modificirane Erlangove krivulje dobiva se približan rezultat (12).

$$y(x) = \lambda(\lambda x)^k e^{-\lambda x} / k! \quad (12)$$

The second method of functional correlation of the effect using the modified Erlang curve gives an approximate result (12).

$$E(y_x) = \int_{-\infty}^{\infty} x(y_x) dx \quad (13)$$

$$E(x) = \frac{k+1}{\lambda} \quad (14)$$

The parameters k and λ are discrete values of a sample for whose values the Erlang function approximates the distribution of observations of the effects of a particular robot. By using the Matcad tool and assigning specific parameter values, we define and observe whether the curve corresponds to our selective distribution. Modified Erlang has an exponent for the variable x $k-1$ instead of k (15). The variable x is from the interval $[0, 2-2]$, $k = 5$, $\lambda = 0.96$, $kf = 13$, and the Erlang curve (Figure 10) is defined as $E(x) = 0.64 \text{ m}^3/\text{h}$, i.e. the expected effect of the observed hydrodemolition robot.

$$f(x) = \frac{1}{k!(\lambda^{k+1} x^{k-1} e^{-kx})} * kf \quad (15)$$

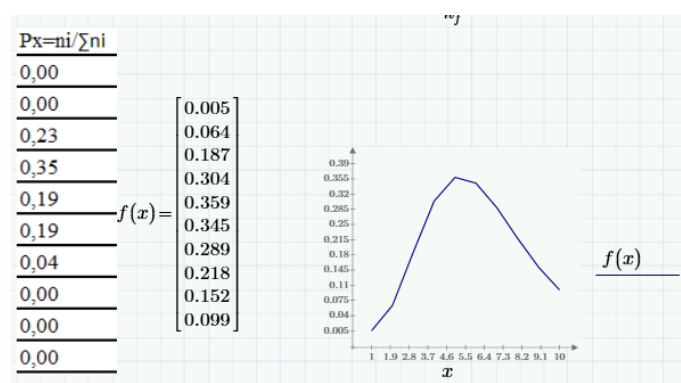


Figure 10. Modified Erlang distribution of the work of machine operators on robots and hydrodemolition pumps

It can be seen that the expected value of the norm is higher for the continuous event definition than for the discrete event definition, since the continuous line fills the gaps in the discrete distribution (16).

$$E(y_x) = \int_{-\infty}^{\infty} x(y_x) dx > \sum_i (x_i y_i / \sum_i y_i) \quad (16)$$

The given curve is parabolic and resembles the Gaussian distribution density function (Eqs. (17,18,19,20,21,22)) for the effect of the robot. The matrix variables for the given Gaussian system are the matrix t with the frequency of the effect and the matrix x with the numerator value of the machine effect, which is replaced by a vector with the unit numbers of the effect multiplied by 10. The number of measurements is $n=10$, and the result is (Figure 11).

$$x = \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \\ 8 \\ 9 \\ 10 \end{bmatrix} \quad t = \begin{bmatrix} 0 \\ 0 \\ 6 \\ 9 \\ 5 \\ 5 \\ 1 \\ 0 \\ 0 \\ 0 \end{bmatrix} \quad b = \begin{bmatrix} b1 \\ b2 \\ b3 \end{bmatrix} \quad b1 = \sum_{x=1}^n x, \quad b2 = \sum_{x=1}^n xt, \quad b3 = \sum_{x=1}^n x^2 t \quad (17)$$

$$\begin{bmatrix} n & \sum_{x=1}^n x & \sum_{x=1}^n x^2 \\ \sum_{x=1}^n x & \sum_{x=1}^n x^2 & \sum_{x=1}^n x^3 \\ \sum_{x=1}^n x^2 & \sum_{x=1}^n x^3 & \sum_{x=1}^n x^4 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} = \begin{bmatrix} b1 \\ b2 \\ b3 \end{bmatrix} \quad (18)$$

$$X = bA^{-1} \quad X = \begin{bmatrix} -1.937 \\ 2.839 \\ -0.288 \end{bmatrix} \quad (19)$$

$$f(r) = (a + br + cr^2) \quad (20)$$

Kf is the reduction factor for the approximation of the data to normative times.

$$fr1(r) = f(r)kf \quad (21)$$

$$fr1(r) = (-1.933 + 2.839r - 0.288 r^2)1/14.4 \quad (22)$$

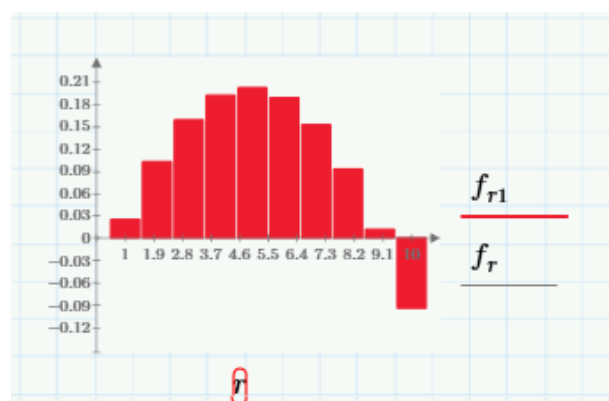


Figure 11. Modified parabolic distribution of the work of operators on robots and pumps for hydrodemolition

The variable r replaces x , and by correcting the equation obtained, we approximate the quadratic equation with the product $1/14.4$ and obtain the distribution "Table 2". From this approximation it follows that $E(x)$ is 1.1 h, which is assumed for the Conject 362 robot.

	sum	26	1,97	0,98
	t	n		E(x)=0,90
r	x	ni	$Px=ni/\sum ni$	x (Px/K1)
1	0,2	0	0,05	0,01
2	0,4	0	0,18	0,04
3	0,6	6	0,28	0,09
4	0,8	9	0,33	0,13
5	1	5	0,35	0,18
6	1,2	5	0,33	0,20
7	1,4	1	0,27	0,19
8	1,6	0	0,16	0,13
9	1,8	0	0,02	0,02
10	2	0	0,00	0,00

Table 2. frequencies of the effect with $E(x)$ of robot 364 on the Zagreb-Zaprešić bridge when returning from a quadratic function

It can be seen that the expectation of approximation functions increases. Thus, for the given example, the output m3/h per machinist increases from 0.9 to 1.1. The total effect will therefore be twice as down because one mechanic operates the robot and one operates the pump.

3.3.2. Dimension coefficients

When sorting the given database with different queries of the given variables influencing the effect, the most common one is the depth of hydrodemolition, which depends on the brand of concrete. Before hydrodemolition, the bridge was divided into fields and the strength of the fields was determined using a sclerometer. If the smaller and larger performance data and the concrete mark are disregarded, the proportionality of the dependence of these data becomes visible (Figure 12). In this way, the equation is defined that is used to determine the dimensional coefficient kd, i.e. for the concrete strength kdc. The base unit is taken for C 30/35. The solution of the curve as a function of the effect variable (x) and the concrete strength variable (t,y, σ) is defined by linear Gaussian regression (23,24,25,26).

$$x = \begin{bmatrix} 0,59 \\ 0,69 \end{bmatrix}, t = \begin{bmatrix} 37,4 \\ 32,17 \end{bmatrix}, b = \begin{bmatrix} b1 \\ b2 \end{bmatrix}, b1 = \sum_{x=1}^n t, b2 = \sum_{x=1}^n xt \quad (23)$$

$$\begin{bmatrix} n & \sum_{x=1}^n x \\ \sum_{x=1}^n x & \sum_{x=1}^n x^2 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} = \begin{bmatrix} b1 \\ b2 \end{bmatrix} \quad (24)$$

$$X = bA^{-1} \quad X = \begin{bmatrix} 68.25 \\ -52.3 \end{bmatrix} \quad (25)$$

$$\sigma = y = 68.25 - 52.3 x \quad (26)$$

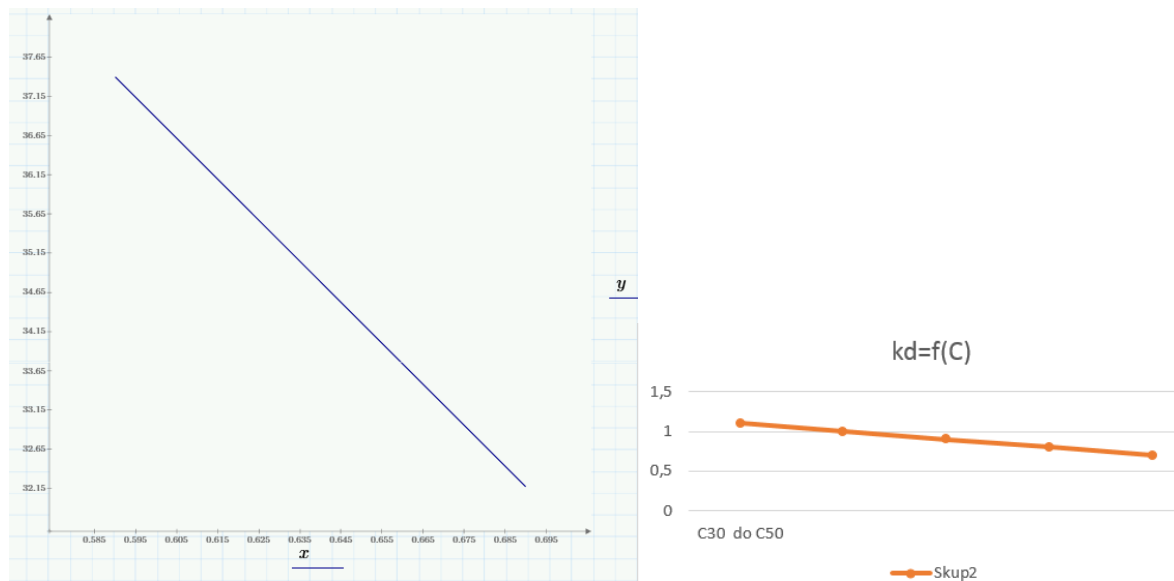


Figure 12. Dependence of the bridge plate between the thickness of the plate and the performance of effect the robot

This results in the functional dependence of the dimensional coefficient, i.e. the concrete strength kdc, which is represented by the assumed linear function (27). With the given coefficients, kdc is reduced decimally by the numerator n, which follows the concrete strength series of +C 5.

$$k_{dc} = -0,1n + 1,2 \quad (27)$$

Thus, the numerator n has the interval [1-5] and C [30,35-50]. In the previous one-year study of the robot's work on over 1700 m³ of concrete and over 3200 effective hours, it was found that the shift work does not have too much influence on the effect, while the width of the work is identified with the depth. The observations at depth show that they are dependent on the brand of concrete. Thus, it can be seen that for $d > 20$ the effect is approximately constant and it is beams of stable concrete brand C 40/50, while for lower thicknesses. For slabs where the concrete has failed (effect of the salt on the connection between the reinforcement and the concrete), the scatter of the effects corresponds approximately to the scatter of the strength of the concrete. By defining the mathematical expectation, i.e. the arithmetic mean or, technically speaking, the center of gravity of the Erlang distribution, it is satisfactory to use this point as the average performance of the robot for calculation and design procedures. If you test the given Erlang distributions with the chi-square test for $\alpha = 0.05$ and 2 degrees of freedom $\chi^2 < \chi_{\alpha}^2$, the given curves are valid for a sample, as the deviations of the empirical distribution from the Erlang distribution are not significant.

3.3.3. Basic coefficient

The roadway deck slab is the basic and most common element of the hydrodestruction process in bridge maintenance. By comparing it with other structural elements, the value of the parameter for the slab is created and multiplied by the value for the beam and the wall. With several observations of the mathematical expected value $E(x)$, the average value for the beam is 0.65 and for the wall 0.5 "Table 3". order n less effective than the slab.

slect-beam						beam			
robot	operation	deep	width	length	efect	sum	9	1,00	0,31
364	beam	0,2	0,4	49	0,44	t	n		E(x)=0,90
364	beam	0,3	0,4	28	0,37	x	ni	Px=ni/Σni	x*Px
362	Beam	0,2	1	12	0,24	0,1	0	0,00	0,00
364	Beam	0,2	0,4	30	0,3	0,2	3	0,33	0,07
364	Beam	0,3	0,4	30	0,4	0,3	2	0,22	0,07
364	Beam	0,2	0,35	38	0,27	0,4	4	0,44	0,18
364	Beam	0,2	0,4	33	0,24	0,5	0	0,00	0,00

Table 3. Ko for the beam

By observing further projects, Who is defined with this data. Of course, the table can be corrected by further observations.

3.3.4. Vektor effect/norm-robot-conjet technology

The design dimension coefficient kdc is derived from the characteristic strength C , i.e. the brand of the concrete. The base coefficient is a function of the constructive element and the effect equation Ukr , which is a function of the resource r and the constructive element k . For the base effect, the listed coefficients are unity, so the equation takes the form of a function of the hydrodestructive effect of the C35 slab (Figure 13).

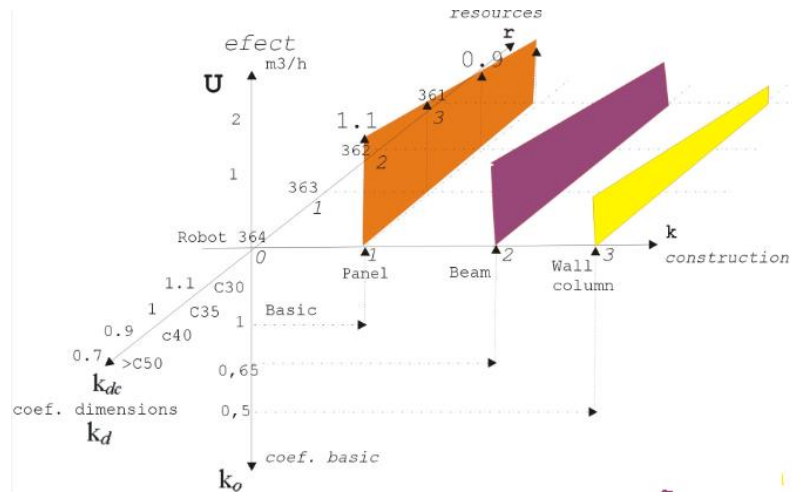


Figure 13. Vectorial effect of water destruction by Conjet robots

The reciprocal of the effect [m3/h] gives the norm [h/m3] (28), (Figure 14).

$$N = \frac{1}{U_{k,r,k_0,k_d}} = 1/k_{dc}k_oU_{k,r} \quad (28)$$

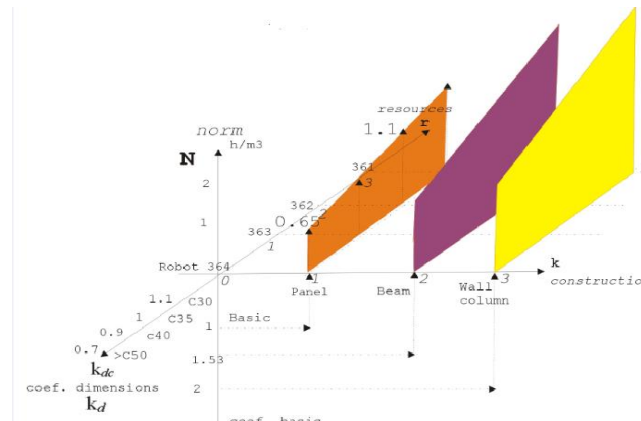


Figure 14. Vector norm of water destruction by Conjet robot

It can be seen that the slab is easier to hydrodemolish than the beam and especially the wall, as the forces act most strongly in the direction of gravity.

4. Development of standards and technologies using the MGSC curve

Assuming that natural processes related to duration, i.e. standards and action, occur according to the Erlang or approximately Gaussian distribution, the MGSC curve is used to predict the development of technologies and the time required for a new technology.

4.1. MGSC curve

A modified Gaussian method for the definition of the S-curve (MGSC) (Eq. 1) was developed for the development of project plans [19,20]. The integral S-curve or summary curve was created based on past projects and risk coefficients were also applied to demonstrate the future of the plans. Based on a series of projects and linking the main variables of the Gaussian equation to field data or situations in construction, a new general definition of MGSK as a function of production time and project cost or equation (29) for the project situation was established.

$$MGSC(x, T) = \lambda kv \cdot \int_0^x \frac{1}{(a \cdot T + b) \cdot \sqrt{2 \cdot \pi}} \cdot e^{\frac{-(x-\mu)^2}{kv \cdot (a \cdot T + b)}} dx \quad (29)$$

The equation is merely a prototype of real S-curve in function T (sum-norm), x or t (time) and constant kv with a value of 10,000. Parameters λkv , a and b for a specific project are fixed (29) (Figure 15).

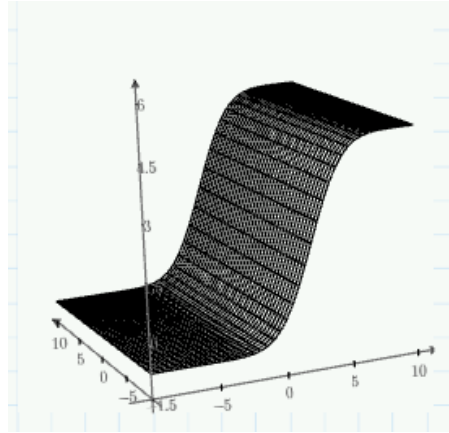


Figure 15. Modified Gauss S-curve

The service life of the technology is therefore compared using the derivative of the given curve.

4.2. Development of formwork technology

arpentry formwork technology is an excellent example of the development of technologies. For example, formwork technology is constantly changing its characteristics with an increase in the impact, i.e. productivity and efficiency of the business process. By looking at formwork and robots from the 1980s, 40 years ahead with 5 formwork technologies and 4 robots using the MGSC curve, the future of technology is defined (Figure 16). The equation is simply a prototype of the real S-curve in the function T (sum norm), x or t (time) and the constant kv with a value of 10,000. Thus, by modifying the σ -Gaussian distribution density function, first via the constant and then via the linear equation (30) into the functional relationship of σ and T , a more precise distribution curve is obtained, which is almost identical to the given discrete one.

$$\sigma = -3.81 \cdot 10^{-8} \cdot T + 7.57 \cdot 10^{-4} \quad (30)$$

T is the sum norm of 15 e.g. is 4.05 h. The parameters λkv are differences and the parameters (a) and (b) for a specific project are fixed. The parameters λkv and solutions are 0.002.

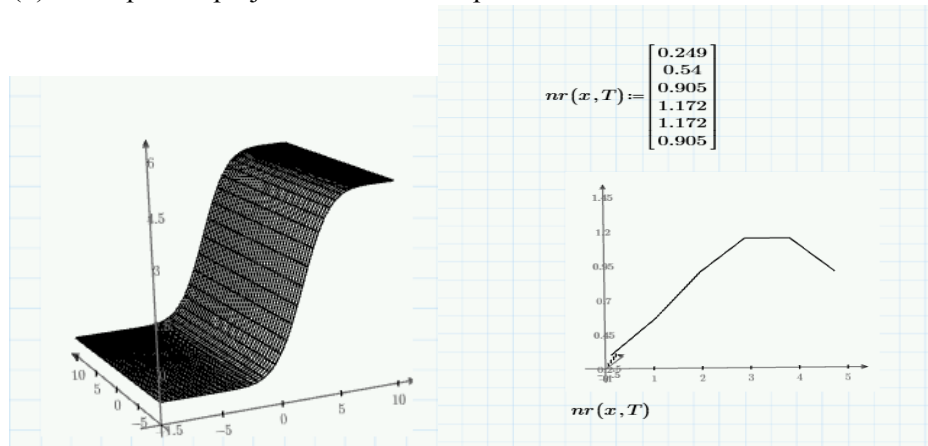


Figure 16. MGSC formwork technologies

For the above 5 technologies, MGSC is 4.03 and for 6 new technologies it is 4.94. Delta t-n = 0.9. The derivation of the future MGSC rtechnological curve of foundation formwork defines y' for 6 technologies with values (Figure 17). The derivation of the MGSC curves defines y', i.e. the speed or intensity of technological change over time. Assuming that a certain technology trajectory (TT) of 8 years lifetime is followed for 40 years. From 1985 to 2015. then the derivation of the MGSC curve defines the evolution from board to planer in 3 years and to blažujek in 5 years. While for the large-format metal pa doka and peri, 10 years each are assumed (e.g. 2).

$$40 = \Delta T_{teh} = \sum_i^n y' TT \quad (31)$$

The future technology can be extracted according to the given MGSC curve in 8 years. The decline of the standard can be predicted according to the basic equation.

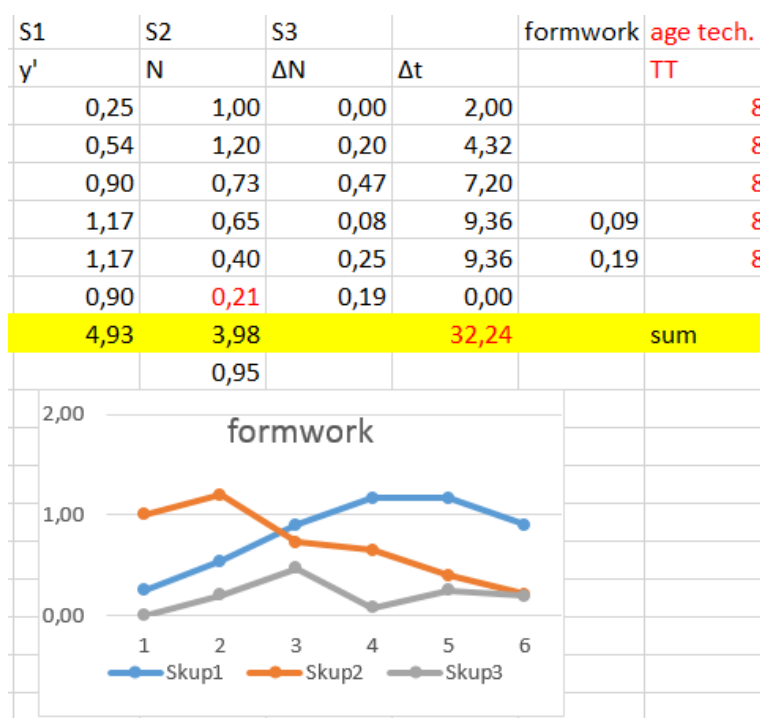


Figure 17. Technological development of vertical formwork technology

Development of the Conjet robot

4.3. Development of the Conjet robot

Conjet technology is an excellent example of the development of robotics. The equation is simply a prototype of a real S-curve in the function T (sum norm), x or t (time) and the constant kv with a value of 10,000. Thus, by modifying the σ -Gaussian distribution density function, first via the constant and then via the linear equation (32,32,33) into the functional relationship of σ and T, a more precise distribution curve is obtained, which is almost identical to the discrete Dana (Figure 18).

$$\sigma = -3.81 \cdot 10^{-8} \cdot T + 7.57 \cdot 10^{-4} \quad (32)$$

(T) is the sum norm of 15 e.g. is 3.8 h.

The parameters λkv are differences and the parameters (a) and (b) for a specific project are fixed. The parameters λkv and solutions are 0.002.

Thus, for the robot effect, the resource value (r=x) for 1 Conjet is 361 (Co361), 2 Co362, 3 Co363 and 4 Co364 [21]. The effect (t) for the unit of quantity, i.e. m3, is given in a matrix.

$$x = \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \end{bmatrix}, t = \begin{bmatrix} 0.9 \\ 1.0 \\ 1.11 \\ 1.25 \end{bmatrix} \quad (33)$$

MGSC for the given parameters $x = 4$ is 3.78 h and for $x = 5$ 4.28. The difference in performance for the new technology is 0.05 m³/h.

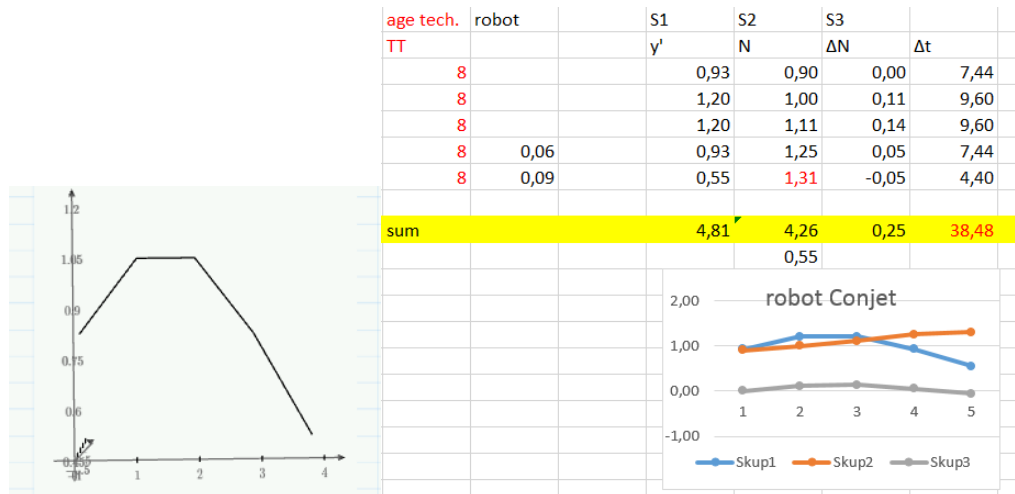


Figure 18. Technological development of vertical formwork technology

The picture shows that the new robot technology increases the output by 0.06 m³/h, and the development in 4.5 years. Where is the end of these curves, of course in the exponential curve of increasing performance or decreasing standards.

5. Model standardization VN Križaić DSP COD

5.1. MSVN on dual DSP Cod

By jointly harmonizing the description of the item in the offer, that is, the text of the bill of quantities, that is, the norm, a unique code is created for defining the construction product. A record of products is formed by levels and distribution from complex process to procedure, and the construction production record is modeled using the combinatorics and linking of these records by model standardization. (Figure 19). A record of the elements given by the project MSP (34,35)) definition of the structure with a certain resource and a description of the operational elements, from activities, processes, and operations for construction production and other more advanced production to the movement of the robotization of production, the equation of the model standardization standard [22].



Figure 19. Standardization of Activities: Elements of the Description of the Items Norms

$$MSP = \sum A = \sum Pe = \sum O = \sum Pd = \sum M \quad (34)$$

$$MSP = \sum p = \sum c = \sum r = \sum d \quad (35)$$

Norm N making left side with variable process Pe, operation O, procedure Pd i movement M, dok je A activity, c construction, r resources, d dimension. Modular and variant components can simulate all practical processes and operations up to the procedure through CPS, MindJet graphic technology, or the software DSP method.

DSP code is created by connecting dynamic programming and object or structural programming. It is very interesting because the consumption of resources can be recorded simultaneously in several processes under the condition of using the given capacity. By noting a multi-process system, it is possible to define a series of vectors x. Optimization determines which process we have to give more resources to for greater profit. In order to get that solution, it is necessary to write down all possible distributions of resources by all processes, that is, to write down and calculate all possible paths. Records can be generated using cybernetic equations (36).

$$F(X_j) = \sum_{j=1}^n g_j(x_j), S = \sum_{j=1}^n x_j \quad 0 \leq x_j \leq S \quad (36)$$

That is, by the method of recurrent equations, whose characteristic is the iteration of the functional equations of the state of the system $f_n(S_n)$ in the sum of the observed function g_n and the function of the previous state $f_{n-1}(S-x_n)$ with all possible changes in the value of the variables in the given functions or processes (37).

$$f_n(S_n) = \max_{0 \leq x_n \leq S} (g_n(x_n) + f_{n-1}(S - x_n)) \quad (37)$$

For multidimensional vector dynamic programming, the equations are identical, only with more variables (x,y). The organizational differential is marked as follows (Figure 20).

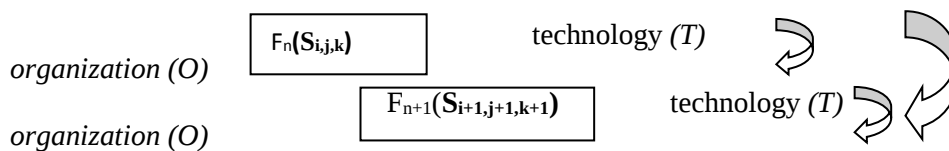


Figure 20. DSP vector iteration organizational differential

The mathematical methods of logic and inductive optimization and the programming methods define the dual DSP structure. TREE wood plus the equation of induction, i.e., dynamic programming with object programming, defines the idea of the DSP equation for modeling the production process, i.e., construction bid construction with DSP code (5) and TROSKO code and NORM COD on Standard. By interconnecting and upgrading the mentioned models with iteration software technology, a DSP model was developed, which contributed to solving the problem of defining production and products. Thus, the product of the bid construction or MSN. The element of the item are defined as $MSN = MSP = \sum F_n(S) = f(T, O)$ as a function of the record of technology (construction) and execution organization, and $T \approx O = f(A, R, D)$, i.e. as a function of the variables A-activities, R-resources, and D-dimensions of construction and resource performance. The greatest influence is on the standardization of the records of bid or cost-tender items as a recurrent form (38,39) (Figure 21).

$$BC = U [f_n(T_n, O_n) = f_{n+1}(T_{n+1}, O_{n+1})] \quad (38)$$

respectively

$$DSP COD = U [f_n([A|R|D|]) = f_{n+1}([A|R|D|])] \quad (39)$$

2.1.1. Izrada višestruke glatke oplote unutarnjih 8jezgrovskih zidova d=20 cm i stupova kvadratnog presjeka etaža objekta i ugradnja betona klase prema projektu

Kalk. norma ekvi - grupa postupci-aktivnost

Posuda za beton 750 l s istovarom 15'

Materijal

Dim satnica → H → 1 → 30 → 30

H/m3 → 0,04 → 1,5 → 0,01

KWh → 1,54 → 0,97 → 1,5

Kalk. norma → H/m3 → 0,04 → 1,28 → 0,05

Amortizacija

Dim satnica → H → 1 → 1,28 → 1,28

Amortizacija = NV/(10*2000)

Koef. amort. vremenski = 10 g

NV=25600

Efektivni sati god=2000 h

Kalk. norma → M3 → 1 → 20,02 → 20,02

Kalk. norma → M3 → 1 → 18,58 → 18,58

Betonirac RG

Kalk. norma → H/m3 → 0,04 → 428,61 → 17,14

Norma vektorski za t=1 istovar 15' VN = kd*ko*Uo(k,r)=0.04 m3/h

Koef. osnovni=ko =1

Koef. konstrukcije =kc =1

Vektorski Učinak VUT=f(r,k)=-0.018+0,048*r+0.006*

PA218-RG-ugradnja

Vibrator

Dim satnica → H → 1 → 428,61 → 428,61

U/m3 → 0,04 → 7,24 → 0,20

$$DSP_{MGSCUr}COD := [f_{n+1}([MGSCNr(x, R, Ur)_{ijk}]) = f_n([MGSCNr(x, R, Ur)_{ijk}])] + \Delta f_{n+1}([MGSCUr(x, R, Ur)_{ijk}]) \quad (48)$$

In the implementation, the main problem is to define the change in the actual and planned S-curve caused by various risks or changes in the intensity of work, i.e. resource utilization. This is solved by numerical iteration, i.e. by induction and iteration of the cost estimation equations Nrproc using the planned normative costs Nr_p and their derivation. The derivative of the MGSCNr valuation curve is therefore the value of the difference between EAC_Ur, BAC_Ur and the value of the valuation cost functions (Urproc) and the plan (Urplan), i.e. the normative costs T (49,50,51) of the standard MGSCNr curve plus the differential costs ΔNr.

$$Ur_{x+1} = Ur_x + \Delta Ur_{x+1} \quad (49)$$

$$U' = \frac{\Delta Ur}{\Delta x} = \frac{\Delta Ur}{\Delta t} = y' \quad (50)$$

$$T_{x+1} = MGSCNr(x, R, Ur) = \lambda kv \cdot \int_0^x \frac{1}{(a \cdot Ur + b) \cdot \sqrt{2 \cdot \pi}} \cdot e^{\frac{-(x-\mu)^2}{kv(a \cdot Nr + b)}} dx + Ur' \Delta x \quad (51)$$

How to assume the expansion or reduction of the norm can be achieved by the step of differentiating the function, i.e. by creating the intensity of resource utilization U' = f (degree of rotation intensity of resource utilization). On the other hand, if we assume that ΔNr is equal to the sum of the costs of all resource structures S_{ijk}, i.e. R_j (52), then Δt can also be calculated from this data.

$$S_{ijk} = R_j = \sum_{i=1}^{nr} a_r i_r Ur_i \quad (52)$$

6. Conklusion

The optimal actual state of the standards is achieved by digitally filling the standards database from the construction site data and processing it. The HV method functionally links activities and normative functions both for the time component of the work resource and for the material, i.e. machine and transportation requirements of the resource. They model the functions and contributions of the old basis of standards and design equations with engineering and other scientific achievements. Linking and modeling the functional dependencies of a particular type of work opens up a continuous process in the modernization and standardization of standardization, i.e. MSN technologies. PhD research proves the possibility of application, but since all innovations are met with resistance, this technology has already been developed for 20 years. Efficiency in the digital world is slow, especially when the database needs to be filled. The mathematical functions of MSN will certainly speed up the process in the future, as this is the way to digital twin systems. The limits lie in the state structures, which are rigid in these areas and tend to prolong the old system, which allows for many organizational errors in the operation of production companies. In the context of Križaić promotion research, i.e. with the DSP code method, the cost rate is automatically linked to the normative rate. The team transforms the classic static normalization into a dynamic one. In this way, organizations can use the dual DSP code or modeling to create a leap in technological development and at the same time reduce their backlog. The vector-functional correlation of certain phenomena is improved by the iterative DSP method. Thus, both organizational and technological models can be linked, so that planning is defined as an organizational component with movement, activity in time, which can be easily predicted with the MGSC curve. Since the future curve was created based on the past of the project, MGSC is also used in standard technology. Today, intelligent and other AI methods are being developed that are implemented in computer simulations with algorithms. The creation of vectorial or parametric standards provides an introduction to today's digital twin simulation tools. What is the future of standards and process technology with an introduction to systems.

The mathematical MSVN with DSP_MGSCUr COD [24] connection of all structures enables the connection of the effect with the energy or with the frequency in the example of hydrodemolition, which becomes quantum physics, i.e. a clear definition of the unit of evaluation of the effect or standard.

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