AUTOMATION OF CONSTRUCTION PRODUCTION USING THE DSP METHOD

Vladimir Križaić

1 Politechnic of Međimurje, Čakovec, Croatia

Abstract

Mechanical engineering and industrial production are developing at an unimaginable speed with digital renaissance technology. Construction technology lags behind it, but software has been introduced into operating systems. However, the effect of digital and information technology is not very effective. The key problem is the obsolescence of the standardization and standardization of construction processes. Therefore, the dynamic structural programming (DSP) method for construction products is proposed. It is the trend of today's cyber system technology of any technological production. By combining the DSP method with Modified Gaussian S Curves (MGSC), a probabilistic mathematical iteration management of the operating system of construction products is created. This is how construction productive production fits into today's trend of modeling and simulating construction processes.

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1. Introduction to automation

Today, all scientific branches, including organizational ones, want to be functionally connected or modeled through design information systems. This is how machine programming first developed, where each command has a machine language code. Then the lower Assembler symbolic language, which for each machine code has a symbolic code of four characters, and is converted into a machine byte code (picture X), while the instruction is defined with 64 bits. Today, however, Internet XML code has swept the world and ushered it into a digital information communication (ITC) renaissance. Thus, it becomes a system of modeling and simulation in the sphere of design, organization, and management of systems [1]. Construction uses functional modeling, which finds strength in trigonometry. Organization or system management uses various software solutions on today's large relational databases. But the organization lags in simulation and modeling behind construction and technological technology. This especially applies to construction management. Therefore, the motivation of the research is to catch up with management and design. First, in the creation of management software at the technological level and to connect them in Digital Twins [2] systems, that is, in the creation of Artificial Intelligence (AI) systems. The original problem of Leibniz and Boolean was the automation of speech, which today is experiencing a digital boom. But all the softwareization of the construction system over thirty years of management did not bring the desired profit effect in addition to the image effect. Thus, the influence of the information technology (IT) system in business has too little contribution, and it is recognized that the root of the problem lies in the low-quality definition of the construction product. That is the definition of bill of quantities documentation with outdated normative technological processes. Therefore, there is great inaccuracy in the organizational and technological processes, as well as the calculations and planning of the bid construction, that is, the process of designing the construction production. Thus, the realization cannot enter into the automation of the process. The contribution of the work is to increase the impact of IT and ITC systems on increasing the profit of the construction business system with a new model of standardization for defining the construction product. Through the new standardization of the bill of quantities and bid construction with the DSP Bill of Quantities CODE, then by modeling the norms with vector norms also defined by the DSP code, the goal is to achieve greater profit in construction systems with IT and AI systems by automation and simulations of defining the construction product by model standardization with costing and the DSP CODE as a cyber system [3] in AI technology.
2. The state of automation in construction

Automation in construction is at a low level. Especially in the sphere of production. While in the conception and design phase, she helped a lot in defining the project's task. However, in technology today, there is modeling and simulation with digital twins and BIM tool systems [4], which also enter management systems through the definition of base relational systems.

2.1. Technological software

Technical software, except in the phases of conception and project definition, also entered the sphere of production. First, software was created in the realm of the main structural systems, and then in the realm of auxiliary technological constructions. This is how designer software was developed from Stress to Abacus, then architectural software from Cad to BIM tools from various manufacturers for designing products [5].

2.2. Management software

Management software is gaining weight with the development of relational databases, especially Oracle tools (Fig. 1). Large databases are suitable for data business models with entity relationship attributes (ERA) in graphic design today using the Unified Modeling Language (UML) diagram.

![Fig. 1. Structural data model of the PUPSG application (Maris)](image)

They enable the connection of all functions of the company in terms of accounting and production. It is production that leads to the idea of creating daily monitoring for project management. Continuing the given idea, a model standardization [6] of construction production is created, which is mostly developed to meet the needs of more precise standardization of bidding. The trend in contemporary research and within the dissertation is to achieve integrated informational project total quality management (TQM) and ranking of project success and risk criteria with daily monitoring [7] using the project management method using the modified Gaussian S-curve (MGSC) [8], which is favorable for simulations and optimization of projects. And this achieves more precise daily planning and control of the project, i.e., the introduction of "just in time" management. Of course, this enables the replacement of static POG with dynamic POG and PMD by integrating the mutual influence of norming, calculating, and planning in making an offer and implementing construction.

2.3. Cyber systems

The optimization and automation of business systems and multi-criteria decision-making create the management of expert business systems. By using the modern sciences of operational research and setting up a model in the function of the goal as a sum of states or vectors, and by systematizing them, a formula and a logical structure for creating experiential intelligence are created. However, a machine cannot be educated and cannot think abstractly like a human; the aspiration is to develop probabilities through statistical research and use combinatorics to create simulations in an analytical and visual system as an introduction to the AI system [9, 10]. Fig. 2.
The basis of automation theory is the extension of Boolean algebra to logical operators and operators for assigning a sign to a predicate that participate in the equation with sgn, i.e., heuristic graphic theories in the program implementation of the resolution-induction method and differential equations that simplify Laplace transformations or vector functionals in linear Letov problems. But simple models are based on mathematical induction and operational research as soon as the DSP method is reached.

3. DSP method of construction production

The DSP method paves the way for model standardization [11] by creating bills of quantities [12], bid constructions, and norms [13].

3.1. Model's standardization of the construction bid

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. Fig. 3. A record of the elements given by the project 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 of production (MSP) (1, 2).

![Fig. 3. Standardization of Activities: Elements of the Description of the Bid Construction Items [11]](image)

\[ MSP = \sum \text{Activities} = \sum \text{Process} = \sum \text{Operation} = \sum \text{Procedure} = \sum \text{Movement} \]

\[ MSP = \sum \text{projects} = \sum \text{construction} = \sum \text{resources} = \sum \text{dimension} \]

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.

3.2. DSP KOD

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 (3).

\[
F(X_j) = \sum_{j=1}^{n} g_j(x_j), S = \sum_{j=1}^{n} x_j 0 \leq x_j \geq S
\]  

(3)

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 \( f_{(n-1)}(S_n-x_n) \) with all possible changes in the value of the variables in the given functions or processes (4).

\[
f_n(S_n) = \max_{0 \leq x_n \leq S} (g_n(x_n) + f_{n-1}(S-x_n))
\]  

(4)

For multidimensional vector dynamic programming, the equations are identical, only with more variables \((x,y)\). The organizational differential is marked as follows: Fig. 4.

\[F_n(S_{i,j,k}) = \text{technology (T)}\]
\[F_{n+1}(S_{i+1,j+1,k+1}) = \text{technology (T)}\]

Fig. 4. 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. 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 and the element of the item are defined as \( \text{MSP} = \sum F_n(S) = J(T,O) \) as a function of the record of technology (construction) and execution organization, and \( T \approx O = J(A,R,D) \), 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 (5,6).

\[
f_n(T_n, O_n) = f_{n+1}(T_{n+1}, O_{n+1})
\]  

(5)

respectively

\[
\begin{align*}
A_{m} & | R_{m} | D_{m} | A_{m+1} | R_{m+1} | D_{m+1} = [A_{m+1} | R_{m+1} | D_{m+1} | A_{m+1} | R_{m+1} | D_{m+1}]
\end{align*}
\]

(6)

The statistical MGSC method and the method of least squares and the method of structural modeling and combining are used to optimize the creation of a bid construction.
3.3. MGSC u DSP projects

In recent times, probabilistic forecasting of project performance and the use of stochastic S-curves with a program package for generating stochastic S-curves and a simulation approach have defined the dispersion deviation of the MGSC project’s finances and time as a function of the density distribution of costs and time. Diagrams of expected monetary value (EMV) or S diagrams are popular today and supplemented with functional 3D-MGSK [14] (7), Fig. 5.

\[
A_A(x, T) = \lambda A_A \cdot \int_0^\infty \frac{1}{(aT+b)^{\frac{1}{2}}\pi} \cdot e^{\frac{-(x-\mu)^2}{2(aT+b)}} dx
\]  

(7)

The leveling and matching of the curves, i.e., the modification of the Gaussian curve, refers to the introduction of a constant kv parameter in the value of 10,000 units.

Fig. 5. Simulation project management using MGSC (Mathcad and Solidworks) tools

By further supplementing the DSP method by planning a three-iteration record of permutations and variations, the form of the equations shows the software code of loops over the variables within the matrix structure, which does not have standard mathematical characteristics but software mathematics.

3.4. Combinatorics in the DSP bid construction

Creating a record of all Croatian lottery combinations opens the way to defining permutations, variations, and combinations in a few minutes given by equation (8). Such combinatorial iterative equations are suitable for computers. Permutations can also be shown graphically by adding the next number to all intermediate columns and the first and last columns of the previous record. A software iterative equation defines a series of records of all combinations or variations using a matrix representation [15].

\[
K = U \left[ \begin{array}{c}
\eta_1 \rightarrow k_{max} - 1, \eta_1 \rightarrow 1, \eta_1 \rightarrow \eta_1 + 1, \eta_1 \rightarrow \eta_1 - 1, \eta_1 \rightarrow n_{max} - 1, \eta_1 \rightarrow \eta_1 + 1 \\
\eta_1 \rightarrow k_{max} - 1, \eta_1 \rightarrow - k_{max} - 1, \eta_1 \rightarrow \eta_1 - 1, \eta_1 \rightarrow \eta_1 + 1, \eta_1 \rightarrow n_{max} - 1, \eta_1 \rightarrow \eta_1 + 1 \\
\end{array} \right]
\]  

(8)

Today, Mathcad has also greatly developed, and it can also graphically write matrices using software mathematics, so that such matrices or determinants can be called software matrices.

4. Conclusion

The new model standardization for defining the construction product of the bid construction with the DSP costing code in mind is slow, but it provides more precise normative data for defining the planning and calculation of the project. This requires a new model for standardization of norms with the vector form of VN-KOD norms [16] defined by the DSP code. This gives more precise specifications for resources in production. DSP in terms of norms and bills of quantities replaces the component of the norm and bill of quantities in a classic way and enables the automation of construction products from project documentation to production, which enables chipping of the construction bid, i.e., the design bill of quantities. By systematizing and synthesizing, such waste VN-CODE can be returned to the normative base, thus creating a model standardization base of norms. At the same time, this norm becomes the basis for unit calculations and the basis for the new definition of product certificates directly from the normative structure. Finding and modeling the functional dependencies of a certain type of work opens a continuous process of modernization and standardization of standardization. Further filling
of the database of construction site data and their processing leads to optimal results. As for the time component of the work resource, it can be modeled in function with designer equations, mechanical and other scientific achievements, or equations for the material or machine normative values of the resource. In connection with structural programming as a great support for modeling, we turn the classic static normalization into a dynamic one. With this DSP modeling, we can make an organizational leap in technological development by defining the organizational differential. It is a path to AI systems and a great contribution of digitization to daily management, i.e., the creation of profit within software-mathematical organizational problems. Which leads to system automation [17] at the system level of physical processes and controls and the establishment of smart project management [18] with the aspiration to define AI [19] with simultaneous management. Thus, Android technologies communicatively unify the concept of the fourth industrial revolution through the cloud of the Internet and virtual technology [20].

References