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RATING ASSESSMENT OF THE PRIORITY OF CONSTRUCTION AT THE AUTOMATED PACKING EQUIPMENT BASIS

Abstract: *A generalized model of automated packing equipment was developed. The functional classification of equipment for the used technological units and devices is carried out. The analysis of the means for carrying out the rating estimation for determining the priority of the construction from the alternatively developed variants is carried out*

Keywords**:** *Packing equipment, technological schemes, classification marks, devices used, weighting criteria (factors) of evaluation, matrix of priorities, decision matrix*

INTRODUCTION, PROBLEM STATEMENT

One of the priority scientific directions in the process of creation of any automated technological equipment is the analysis and synthesis of existing technological schemes, nodes and devices classification on the basis of which the designer creates new alternative models of equipment and elaboration of a methodology by conducting a rating estimation to determine the priority of a particular construction among all possible options at the design stage.

LITERARY ANALYSIS

Depending on the way the technological system [3] is modeled, among the available trends of existing technologies [5], which principles of CAD [2] and what methodology for evaluation and decision making [4,6,7,8,9] are used, designer or the researcher have to obtain, for the used equipment, a rating valuation of the particular type (model) priority of the equipment among alternatively comparable variants.

Formulating the goals of the article. To develop new theoretical principles and practical methods for determining the priority of one of a number of proposed technological variants of the developed automated equipment at the design stage.

MAIN ARTICLE

It is well known that one of the most effective tools for researching the problem of the further establishment of any technical system is the perfect classification [1]. The designer's particularly valuable adviser is the existence of such a classification by certain features in relation to a certain class of not only the necessary

equipment, but also in general, any automated equipment, especially at the stage of development of its technological and structural schemes, since it is still possible at the design stage to evaluate and determine the best option.

The authors, on the example of automated packaging equipment, carried out the classification of this type of equipment by the functional appurtenance of nodes and devices, and a flowchart (generalized model) of this type of equipment (picture.1). In addition, Table 1 is constructed, in the graphs of which classified devices are described and their corresponding weight criteria are displayed, which may include parameters of cost, reliability, automation degree and others that the designer will take as a priority, or developed intuitively on the basis of his own qualification specially for this type of equipment, such as work [6].

Table 1

Functional nodes and mechanisms of automated packing equipment

№b/o	The name of the composing nodes, mechanisms and devices	Indication of the object's weight (price)
1	Main drive: a) - servo drive, including combined; b) - electric; c) - pneumatic; d) - hydraulic	 τ_0 τ_1 τ_2 τ_3
2	Special unwinding and drawling devices for (continuous) laminate and separate (individual) packing materials incl. finished tare: a) - individually installed motor-reducers for unwinding rolls or bobbin (hinged or coaxial); b) - roller (traction) drawling mechanisms; c) - mechanical capturing devices; d) - vacuum capturing devices; e) - pneumatic manipulators; f) - anchor mechanisms and other shut-off or sinkers (separators-inverters) of flows for single-loading of working positions;	 τ_4 τ_5 τ_6 τ_7 τ_8 τ_9
3	Drawling mechanisms, loop holders (for tape, filament and laminate materials)	τ_{10}
4	Shape-forming devices and mechanisms for packing of laminate materials: a) – device for laminate materials of type "collar"; b) - device for forming of packs with 3 seams; c) - device for forming of packs with 4 seams; d) - device for forming of packs of type "flowpack"; e) - device for forming of packs “tetrapack”,”purepack” etc. f) - devices for the forming of small product packs for multi-threaded automated TP	 τ_{11} τ_{12} τ_{13} τ_{14} τ_{15} τ_{16}
5	Devices and mechanisms for forming of packs of “korreks” type *	τ_{17}
6	Forming devices and mechanisms for producing the packs from hard paper or cardboard; *	τ_{18}
7	Shape-forming lines, devices and mechanisms for the formation of paper packing; a) – devices for producing of paper packs of 1.0 to 3.0 kg capacity; * b) – devices and mechanisms for forming of parallelepiped wrappers in the TP butter packing, minced meat, margarine, cookies and others ;	 τ_{19} τ_{20}

	c) devices and mechanisms for forming of packs for single-use of tea packs. *	τ_{21}
8	Devices and mechanisms for the formation of polymeric glasses;*	τ_{22}
9	Devices and mechanisms for organizing the process winding the rigid packs of cigarettes, parfumes, etc. with stretch film; *	τ_{23}
10	Devices and mechanisms for the mutual fixation of materials in the process of packing formation: a) - devices and mechanisms for glue applying; b) - devices and mechanisms for cold soldering; c) - devices and mechanisms of joining of packing elements by threads; d) - devices and mechanisms of joining of packing elements with metal elements like clamps and etc; e) - devices and mechanisms of joining of packing elements by a method of heat-sealing (linear and rotary heat-generators);	τ_{24} τ_{25} τ_{26} τ_{27} τ_{28}
11	Dispensers: a) - volume dispensers for bulk products; b) - volume dispensers for liquid products; c) - volume dispensers for viscous and paste-like products; d) - weight dispensers; e) - screw dispensers; f) - dispensers for single-digit products (counters).	τ_{29} τ_{30} τ_{31} τ_{32} τ_{33} τ_{34}
12	Mechanisms for the separation of uninterrupted (sleeve) packing of laminates from each other : a) - mechanisms for the mechanical separation (knife cut); b) - mechanisms for the thermal separation (spiral cutting); c) - perforation device.	τ_{35} τ_{36} τ_{37}
13	Mechanisms and devices for marking: a) - chip-flow markers; b) - tampon ink markers; c) - thermo-date film devices; d) – embedded dated symbols in the thermopads	τ_{38} τ_{39} τ_{40} τ_{41}
14	Devices for ventilation of product pipelines and dust absorption;	τ_{42}
15	Devices for foam formation reducing and swelling of liquid products, preventing splashing and dropping.	τ_{43}
16	Devices for calculation of pack quantity equipment operating time.	τ_{44}
17	Control and tracking devices (mark, accessories, packaging, product control devices, etc)	τ_{45}
18	Clogging and regulating equipment (faucets and valves which are capable to operate stand-alone and are not included in the above mentioned devices and mechanisms, the container position regulating mechanisms and devices before filling, clogging, etc.)	τ_{46}
19	Clamping devices (on the basis of adhesive, thermal, ultrasonic devices etc.), the devices for single-digit feeding and separation of clogging elements (for example, corks, covers), mechanical tightening and sealing devices for tubes, korreks and blisters.	τ_{47}
20	Devices for sticking etiquettes, labels, excise stamps etc	τ_{48}
21	Devices and mechanisms for preparation of materials or tare before (after) filling the product (bactericidal processing, washing, drying or other)	τ_{49}

22	Devices of interoperable transport (swivel tables, fork-lifts, satellites, multi-speed conveyors, devices for collecting and dividing product flows, interconnectors and more)	τ_{50}
23	Devices for vacuum environment creating in closed volumes, while forming vacuum packings;	τ_{51}
24	Devices for creation of temperature zones at packing of products	τ_{52}
25	Devices for operational movement(loading) of a product, material or container in the process of packing (hauling of the product by fork-lifts during movement in thermal tunnels, lifting-lowering of the support with film material in the group packing of products, located on euro pallets, moving rotors-conveyors in bottling machines of continuous action, and etc);	τ_{53}
26	Devices and mechanisms for controlling the unauthorized additions that can fall into the pack (sieve-separators, magnetic catchers, etc.)	τ_{54}
27	Console and control system (controls, power supplies, logic controllers, sensors, frequency converters, thermostats, etc.)	τ_{55}

* - only variants that can be set and used in packaging equipment as a separate module;

One of the tools that can be used in this process, after setting the weights of objects in the table, constructing variants of the technological schemes of equipment and obtaining numerical values for the best option, is the matrix of decision-making [6], which is also called the table of weighing (comparing) the technical tasks. In order to compile such a matrix, a number of tasks is being solved step by step: creating a list of alternatives; determining evaluation criteria and comparative schemes; composing the decision-making matrix; selecting and estimating the weight of the evaluation criteria; collecting information; evaluating the project variants; carrying out the calculation of weighted ratings; finding the final weighted ratings and the analyzing of the results [6].

Also it is known the method for evaluating the alternative variants in the form of the Pugh`s Matrix [7], which also allows to take the weighted decisions.

However, for the experienced user, a matrix of priorities has also shown ease of use [8], which immediately gives a summary (resulting assessment).

The rules and foresight for taking decisions in uncertainty also allows the work of the following authors of D. Kaneman, P. Slovik, A. Tverskoy [4].

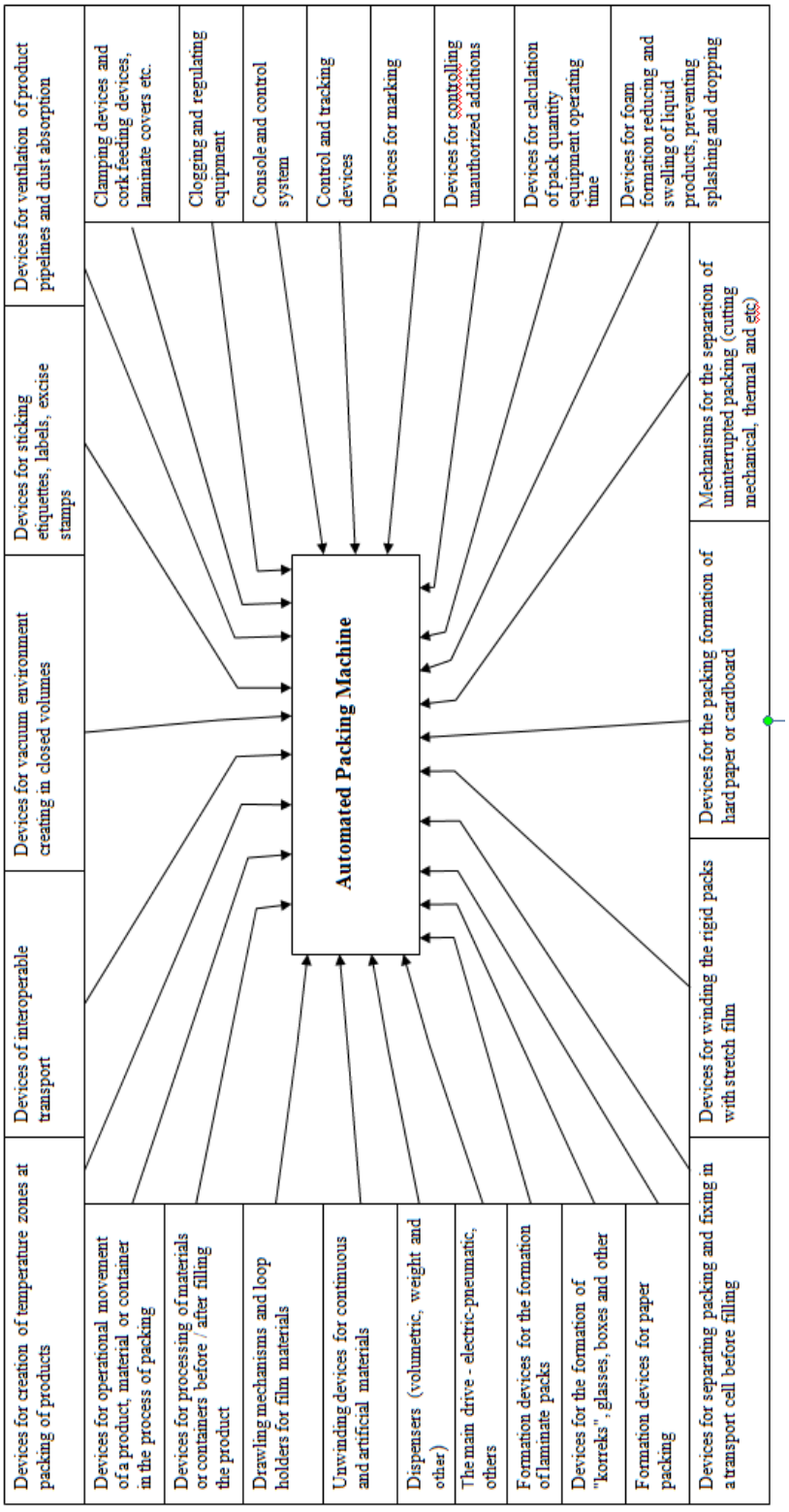

Fig.1. *Block - scheme of automated packing equipment, authors'*

CONCLUSIONS

A generalized model of automated packing equipment is developed on the basis of functional features of used nodes and devices. It was created the table with a detailed description of the functions performed and their corresponding weights. The matrix-type methods are proposed for estimation and determination of the priority variant of the technological scheme of the automated equipment.

REFERENCES

[1] Gava, O.M., Bespalko, A.P., Volchko, A.I., & Kokan O.O. (2010). *Packing equipment.* Textbook. "Package".

[2] Palchevsky, B.O., Krestyanpol, O.A., Valetsky, B.P., Bondaruk, D.V., & Rak, V.S. (2008). *Fundamentals of CAD Packaging Equipment*. Textbook. Lutsk. LNTU.

[3] Stotsko, Z.A. (2013). *Modeling of technological systems: teaching.* Manual. Lviv: Lviv Polytechnic Publishing House.

[4] Kannon, D., Slovik, P., & Tverskoy, A. (2018*). Making decisions in uncertainty. Rules and prejudices.*Humanitarian Center.

[5] Short course of packaging technologies. (2003). *Packing,* 357.

[6] A. A. (2014, September 24). Decision matrix [Web log post]. Retrieved November 23, 2018, from http://robotosha.ru/no-rubric/decision-matrix/html

[7] Official website (2018). Retrieved from http:// www.uspeh-succes.ru/matritsa-prinyatiya-reshenia/html.

[8] Official website (2018). Retrieved from http:// www.kpms/implement,QMS_Proritzation_Matrix.htm.

[9] Official website (2018). Retrieved from http:// https//4brain/ru/blog/матрица