CONCEPT OF MANAGING QUALITY IN BAKING INDUSTRY, IN VECTOR REPRESENTATION

Radosław DROZD

Gdansk University of Technology, Department of Industrial Management; rdrozd@zie.pg.gda.pl,
ORCID: 0000-0003-1797-4488

Purpose: The goal of the article is to present an innovative process of managing quality in baking industry, in vector representation.

Design/methodology/approach: To achieve the planned goal, the author presents an innovative metrisable method of describing a manufacturing process. The article formulates vector representations of a manufacturing process, based on systems engineering models, as well as presents constitutive relations, as three vectors that combine: effects of quality as the product feature vector, loss vector, and input stream vector. The quality management process in baking industry is a purposeful process of an operator, acting on streams that represent an ordered set of relations between their elements, leading to the emergence of a product and inevitable losses. Each of the said streams will contain quantities of activities in time, relevant to its character. The types of activities within each stream will determine the goal of the operator's activity. The complete set of the input streams is represented by the operator's vector, formed from the sum of the individual input vectors. The activity of the manufacturing process operator results in the emergence of a product, described by six vectors that describe quality of a bakery product: nutritional value, taste, healthiness, attractiveness, durability, freshness. The losses are represented by four vectors: ecological, human resources, energy losses, and safety.

Findings: The author introduced an innovative metrisable method of describing a manufacturing process. The idea of vector structure of a manufacturing process allows to formulate quantitative relations between the activity of input streams, elements of product quality, and measurable effects of losses. The structure was basis for the formulation of the concept of the process of managing product quality in the baking industry in a vector representation. The application of systems engineering allows for a measurable answer to the fundamental questions of the goal of the manufacturing process, its efficiency in the context of combining all the elements, including product quality, as well as other improving activities.

Originality/value: The article may be a recommendation for manufacturing companies. The new idea for a metrisable vector structure of a manufacturing process has been designed with the baking industry in mind, but the whole system's construction makes it applicable to analyse other processes, in e.g. information production, didactics, strategy, etc., as it imposes no limitations on the character of the process, which may also be of immaterial production character.

Keywords: managing quality, vector representation, baking industry.

Category of the paper: Research paper.

1. Introduction

A modern company requires metrisable technical, market, economic, social, and ecologic evaluation, one that takes into account varied aspects experienced by the customers. The necessity for a complex evaluation calls for the search for methods of globally describing of the flow of manufacturing processes, based on advanced system engineering models (Gomółka, 1999; Luhmann, 2012; Powierża, 1997; Sienkiewicz, 1997; 1998). The application of systems engineering allows to "measurably" answer the fundamental questions related to the goal of the manufacturing process, its efficiency as a combination of all elements, product quality included, and varied improving activities (Dwiliński, 2020; Kijowski, 2004; Lisiecka, 2001; Sadowska, 2000; Wiśniewska, and Malinowski, 2011). At the same time, mathematical models of systems engineering allow to construct multi-criterion indicators and the use thereof in optimising the subsequent technological, organizational, and other steps (Drozd, and Piwnik, 2019, Drozd, 2020).

The placement of the issue of quality is in strong connection with combining all the elements of the manufacturing process.

This article presents a concept of a quality management process in the baking industry, in a vector representation.

In order to make the remaining material more accessible, the author follow the definition of quality in the understanding proposed by systems engineering. Thus, quality will mean a collective general characteristics of the manufacturing process which expresses the degree to which the expectations towards the process have been met.

In case of bakery products, quality is determined by nutritional value, taste, healthiness, attractiveness, durability, and freshness (Balon, Dziadkowiec, Sikora, 2016; Gambuś, Litwinek, 2011; Gawęcki, Jędryka, 2001; Gawęcki, Baryłko-Pikielna, 2007; Madej-Lachowska, Szwedziak, Polańczyk, Piechaczek, 2015; Skolik, 2011; Taniewski, Malinowski, 2009).

These will make the new metrisable method of describing the manufacturing process.

Vector representations of the manufacturing process will be set up, based on systems engineering. Also, constitutive relations will be introduced, as three vectors of a contemporary manufacturing system, combining the effects of the product quality vector $\vec{P}$, loss vector $\vec{S}$, and input streams vector $\vec{\phi}$. Scalar, mixed, and vector products of these vectors may form constitutive formulas of the processes. Interrelations of the three state vectors, $\vec{\phi}$, $\vec{P}$, $\vec{S}$, provide a possibility for metrisable complex analysis and assessment of the manufacturing process.

The article also provides practical formulas for providing vector values of the process.

Quality has been defined with three modules of orthogonal Cartesian space vectors. This means the weight of the role of the modules is identical and equals 1. The resultant vector represents global quality assessment.

2. Vector structure of the manufacturing process in the baking industry

The vector structure of a manufacturing process founded on systems engineering allows to formulate quantitative relations between the action of input streams, features of the product, and effects of losses, and the relation between the distribution of stream processes in time, product, and losses as vector functions. This is a new innovative approach found in subject literature. Lack of such analyses so far is noticed not only in Poland but also in more developed economies, making this a valid research gap identified by the author.

The starting point is the new description concept – vector fields of the action of the system streams, features of the product, and character of losses.

The presented vector description of the functioning of a manufacturing process does not impose limitations on the character of the process, as non-material production can also be described.

Vector relations between the distribution of streams, features of the product, and types of losses are scalar, vector, and mixed products of the vectors representing the activity of the streams $\vec{\phi}$, product $\vec{P}$, and losses $\vec{S}$.

The relations between the vectors $\vec{\phi}$, $\vec{P}$, $\vec{S}$ reflect the synchronism and the unambiguity of the manufacturing process, symbolically representing the relations as:

$$\widehat{O}_p(\phi_{E_a}, \phi_{M_b}, \phi_{F_c}, \phi_{I_d}, \phi_{Z_e}, \phi_{W_f}, \phi_{T_c}, \phi_{K_h}) \longrightarrow \widehat{P} + \widehat{S} \tag{1}$$

These relations as well as an overview for further analysis of bakery product manufacturing process are presented in Figure 1.

The starting point for the definition of the manufacturing process in the baking industry was the establishment of the set of relations between the elements of the following streams:

- energy stream, ϕ_{E_a},
- material element stream, ϕ_{M_b},
- manufacturing financial stream, ϕ_{F_c},
- ordered information stream, ϕ_{I_d},
- manufacturing process management stream, ϕ_{Z_e},
- controlled process output stream, ϕ_{W_f},
- timed activity stream, ϕ_{T_g},
- process dynamics change (correction) stream, ϕ_{K_h}.
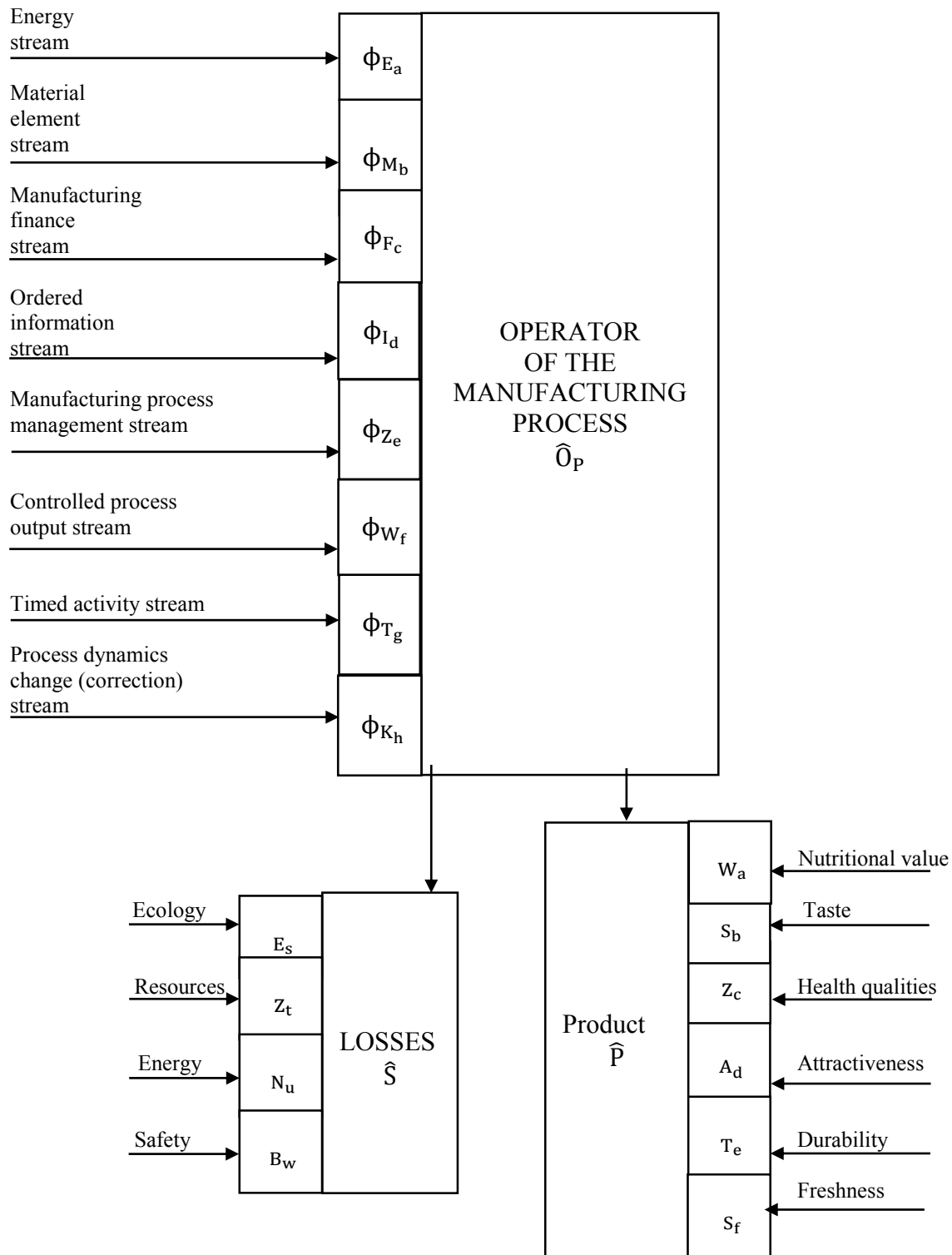
Energy stream → ϕ_{E_a}

Material element stream → ϕ_{M_b}

Manufacturing finance stream → ϕ_{F_c}

Ordered information stream → ϕ_{I_d}

Manufacturing process management stream → ϕ_{Z_e}

Controlled process output stream → ϕ_{W_f}

Timed activity stream → ϕ_{T_g}

Process dynamics change (correction) stream → ϕ_{K_h}

OPERATOR OF THE MANUFACTURING PROCESS $\widehat{O}_P$

Ecology → E_s

Resources → Z_t

Energy → N_u

Safety → B_w

LOSSES $\widehat{S}$

Product $\widehat{P}$

W_a ← Nutritional value

S_b ← Taste

Z_c ← Health qualities

A_d ← Attractiveness

T_e ← Durability

S_f ← Freshness

Figure 1. Structure of bakery product manufacturing process. Source: own study.

The area of the activity of the manufacturing process operator $\widehat{O}_P$ is supplied with eight input streams. The type and amount of streams, as well as their weights, constitute the character of this process, whose goal is the quality management process. Individual streams, powering the manufacturing process operator are presented in figure 2.

Figure 2. Vector structure of bakery products manufacturing process. Source: own study.
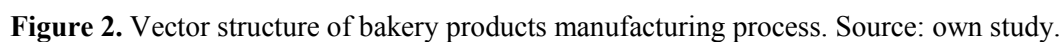
1. The energy stream ϕ_{E_a} is the necessary set of a-elements converting different kinds of Energy (mechanical, electrical, heat, pneumatic, etc.) Baking industry is heavy on energy and consumes 12.5% of energy needed for all the food industry. The energy stream ϕ_{E_a} will be represented by the vector $\vec{r}_e$.

2. The material energy stream ϕ_{M_b} is a necessary set of b-elements securing the materials needed for the manufacturing process. These are: raw materials, buildings, machines, installations, media, and other objects. The stream ϕ_{M_b} is measured in a number of elements in time, and its vector representation is $\vec{r}_m$.

3. The finance stream ϕ_{F_c} is a set of c-elements that define costs of activity of defined stream relations, trends, and other outlays for the activity on the process on the product

requirements. The stream ϕ_{F_c} is measured in outlays of resources in time. The vector of the ϕ_{F_c} is designated as $\vec{r}_f$.

4. The ordered information stream ϕ_{I_d} is a set of d-elements of strict theoretical and empirical knowledge. These are instructions, guidelines, management, orders, algorithms, patents, and other segments of contemporary knowledge that translate to the highest efficiency of the process. The stream ϕ_{I_d} is measured in amount of information in time and its vector representation is $\vec{r}_i$.

5. The manufacturing process management stream ϕ_{Z_e} is a set of the activities of e-elements that satisfy optimal selection of technological parameters and maintaining their stability in order to achieve the desired quality of the final product. The stream ϕ_{Z_e} is measured in number of activities in time w and vector representation in the form of $\vec{r}_z$.

6. The stream of controlled process output ϕ_{W_f} is a set of f-elements of control of individual phases of the manufacturing process and interoperational control of semi-finished product quality. The stream ϕ_{W_f} is measured in number of control elements and its vector representation is $\vec{r}_w$.

7. The stream of timed activity ϕ_{T_g} is a set of g-elements of order of the activity of relations between streams in time. These also define duration times for individual operations and tasks that secure the completion of the streams' concept and design assumptions. Therefore, the timed activity stream is one of the crucial success indicators for changes within the business. The stream ϕ_{T_g} is measured in number of ordered operations in time and its vector representation is $\vec{r}_t$.

8. Process dynamics change (correction) stream ϕ_{K_h} is a set of activities of h-elements marking forced and unpredictable changes to the defined concept of the manufacturing process. The stream is characterised by high sensitivity to proper flows of all the other streams. The stream ϕ_{K_h} is measured by the number of relations and order corrections in time and its vector representation is $\vec{r}_k$.

The combined streams that supply the manufacturing process is represented by the vector $\vec{\phi}$. It is a sum of all the component stream vector, as shown in Figure 2.

The method for constructing vector streams is described in section 1.3.2.

The activity of the manufacturing process operator $\widehat{O}_P$ results with the product $\widehat{P}$ and losses $\widehat{S}$.

The product $\widehat{P}$ is described by six vectors:

–   nutritional value vector $\vec{w}_a$,

–   taste vector $\vec{s}_b$,

–   healthiness vector $\vec{z}_c$,

–   attractiveness vector $\vec{a}_d$,

- durability vector $\vec{t}_e$,
- freshness vector $\vec{s}_f$.

The method for constructing the $\vec{P}$ product vector is described in section 1.3.3.

The loss stream $\widehat{S}$ is described by four vectors:

- ecological vector $\vec{e}_s$,
- resource vector $\vec{z}_t$,
- energy loss vector $\vec{n}_u$,
- safety vector $\vec{b}_w$.

The resultant loss vector $\vec{S}$ is a sum of the four component vectors, as shown in Figure 2.

The method of defining loss vectors is described in section 1.3.4.

According to the presented concept of the process of managing quality in a bakery, the manufacturing process is a purposeful activity of the manufacturing operator $\widehat{O}_P$ on the streams representing an ordered set of relations between stream elements, resulting in the emergence of the product $\widehat{P}$ and inevitable losses $\widehat{S}$.

The manufacturing operator space is supplied by eight streams, i.e.:

- three material resource streams: energy, material element, and finances;
- one information stream – the ordered information stream;
- four steering streams – the manufacturing process steering stream, controlled output stream, timed activity stream, process dynamics change stream.

Each of the mentioned streams contains amounts of activities in time, adequate to its character. Types of activity within each of the streams determine the goal of the operator. The streams supplying the manufacturing process are represented by the operator vector – a vector comprised of the vector sum of all the input streams.

The activity of the operator of the manufacturing process results in a product, characterised by six vectors, representing features of the quality of bakery product, enumerated above.

Losses are represented by four vectors: ecological (agro-climatic conditions), human resource (raw material selection, process output), energy loss (no energy, power outages), and safety vector (health-related, machine failures).

In the presented concept of managing manufacturing quality in the baking industry, all relations are active. i.e. each has their tasks to perform.

Therefore, the description of the system needs to take into account momentary and unambiguous relation between the manufacturing process operator, product, and losses. A strict description of such a relations is immensely difficult. Some possibilities are provided by vectors, though.

For this reason, the further part contains ways of assigning the sets of vectors (stream $\vec{\phi}$, product $\vec{P}$, and losses $\vec{S}$) to the activity of the manufacturing system.

3. Defining the vectors of the manufacturing process

3.1. Introduction

All the vectors of the manufacturing process are set in rectangular grids, see Figures 3-5.

The *y* axes mark module values of the individual vectors of the system.

The values of vector modules and weights are of non-dimensional type.

The *x* axes contain weights, where the $\vec{e}_x$ unit versor is assigned, while the *y* axes are assigned with the $\vec{e}_y$ unit versor.

Therefore, each of the process vectors is a section on the *x-y* plane and is described as:

$$\vec{a} = a_x\vec{e_x} + a_y\vec{e_y} \tag{2}$$

The a_x values reflect the weights, while a_y mark numeric values of the modules of the state vectors. The a_x and a_y take values between zero and one.

$$a_x \in [0,1] \, , \, a_y \in [0,1] \tag{3}$$

Each of the vectors of the manufacturing process reflects the modules and weights into a numerical set [0,1]. The method of showing individual parts of the system is described further.
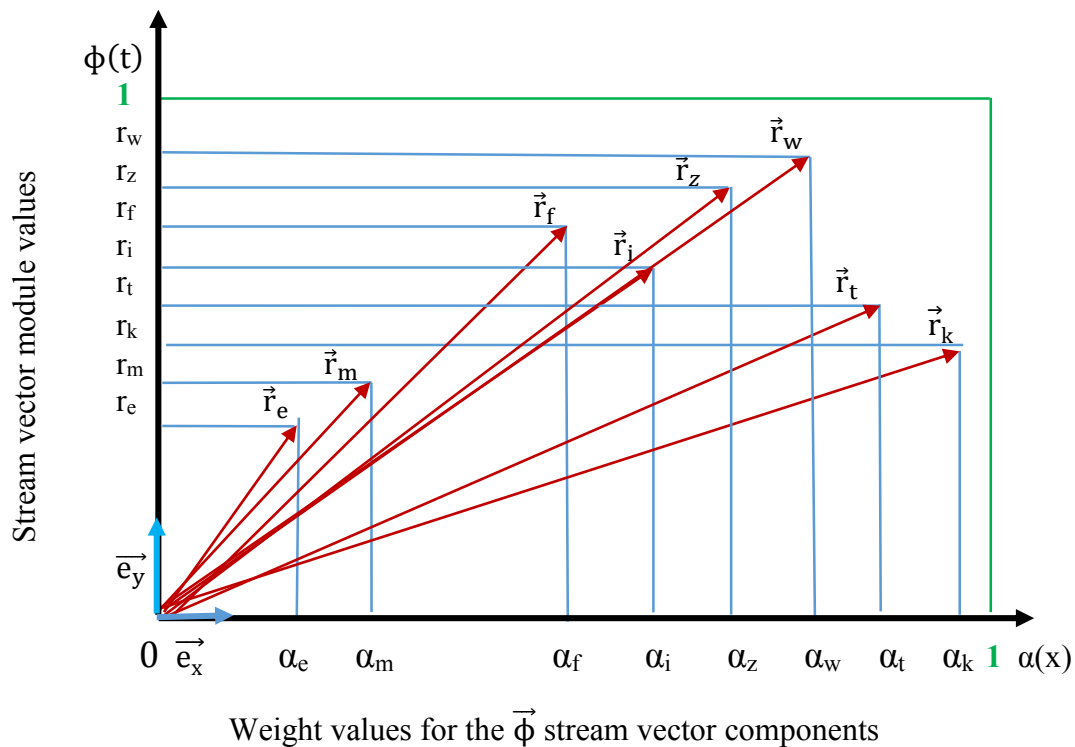

Figure 3. Components of the stream vector $\vec{\phi}$ in the grid of their values and weights. Source: own study.
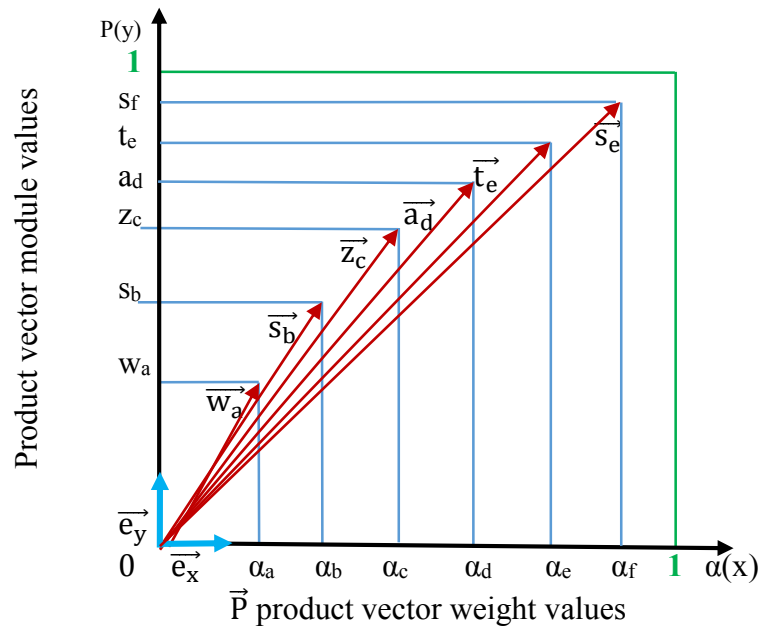
Figure 4. $\vec{P}$ product vector components in the grid of their modules and weights. Source: own study.
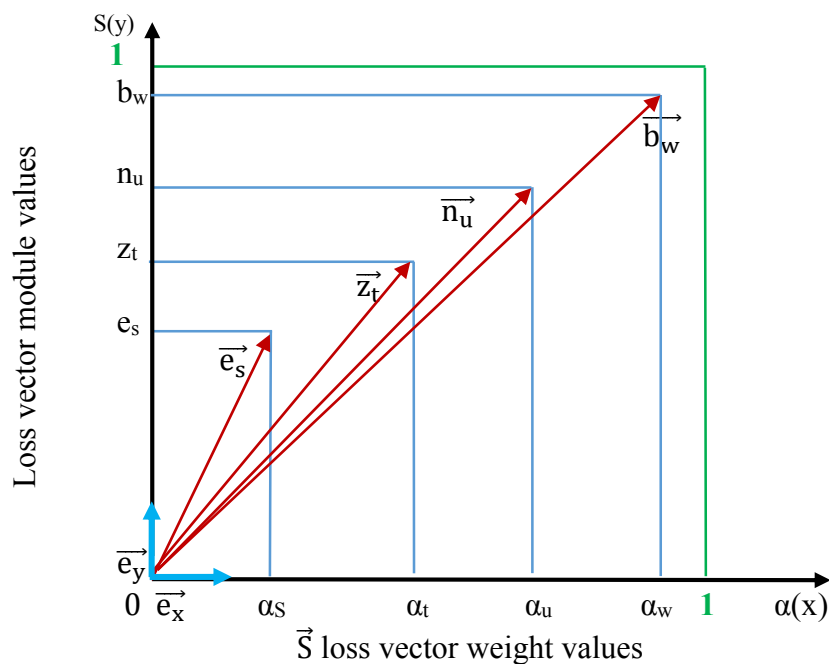

Figure 5. $\vec{S}$ loss vector components in the grid of their modules and weights. Source: own study.

The *x* axes of the grids marks the weights of the individual vectors. In each case, the sum of all vectors for a singular part of the manufacturing process equals 100 per cent

3.2. Stream vectors

As the fundamental functions describing controlled outlays of streams in time, let us introduce non-dimensional relations that take into account the ratios of the actually spent amounts of stream elements to the same values set by the concept of the product norm.

These will be non-dimensional values defining the activity of streams in time $t_0 \leq t < t_{fin}$. Their values are a_y in the formula (3). The representation is as follows:

1. Non-dimensional momentary output of the energy stream

$$r_e(t) = \frac{\int_{t_0}^{t} \phi_{E_a}^{rz}(t) \cdot dt}{\int_{t_0}^{t} \phi_{E_a}^{n}(t) \cdot dt} \qquad (4)$$

2. Non-dimensional momentary output of the material stream

$$r_m(t) = \frac{\int_{t_0}^{t} \phi_{M_b}^{rz}(t) \cdot dt}{\int_{t_0}^{t} \phi_{M_b}^{n}(t) \cdot dt} \qquad (5)$$

3. Non-dimensional momentary output of the financial stream

$$r_f(t) = \frac{\int_{t_0}^{t} \phi_{F_c}^{rz}(t) \cdot dt}{\int_{t_0}^{t} \phi_{F_c}^{n}(t) \cdot dt} \qquad (6)$$

4. Non-dimensional momentary output of the ordered information stream

$$r_i(t) = \frac{\int_{t_0}^{t} \phi_{I_d}^{rz}(t) \cdot dt}{\int_{t_0}^{t} \phi_{I_d}^{n}(t) \cdot dt} \qquad (7)$$

5. Non-dimensional momentary output of the manufacturing process management stream

$$r_z(t) = \frac{\int_{t_0}^{t} \phi_{Z_e}^{rz}(t) \cdot dt}{\int_{t_0}^{t} \phi_{Z_e}^{n}(t) \cdot dt} \qquad (8)$$

6. Non-dimensional momentary output of the controlled process output stream

$$r_w(t) = \frac{\int_{t_0}^{t} \phi_{W_f}^{rz}(t) \cdot dt}{\int_{t_0}^{t} \phi_{W_f}^{n}(t) \cdot dt} \qquad (9)$$

7. Non-dimensional momentary output of the timed activity stream

$$r_t(t) = \frac{\int_{t_0}^{t} \phi_{T_g}^{rz}(t) \cdot dt}{\int_{t_0}^{t} \phi_{T_g}^{n}(t) \cdot dt} \qquad (10)$$

8. Non-dimensional momentary output of the correction stream

$$r_k(t) = \frac{\int_{t_0}^{t} \phi_{K_h}^{rz}(t) \cdot dt}{\int_{t_0}^{t} \phi_{K_h}^{n}(t) \cdot dt} \qquad (11)$$

The defined non-dimensional momentary stream outlays in time can be defined empirically in the course of the manufacturing process.

After the formulas (2), (4)-(11) have been accounted for, we receive the following formulas for the components of the stream vector:

$$\vec{r_e}(t) = \alpha_e \vec{e_x} + r_e(t)\vec{e_y} \tag{12}$$

$$\vec{r_m}(t) = \alpha_m \vec{e_x} + r_m(t)\vec{e_y} \tag{13}$$

$$\vec{r_f}(t) = \alpha_f \vec{e_x} + r_f(t)\vec{e_y} \tag{14}$$

$$\vec{r_i}(t) = \alpha_i \vec{e_x} + r_i(t)\vec{e_y} \tag{15}$$

$$\vec{r_z}(t) = \alpha_z \vec{e_x} + r_z(t)\vec{e_y} \tag{16}$$

$$\vec{r_w}(t) = \alpha_w \vec{e_x} + r_w(t)\vec{e_y} \tag{17}$$

$$\vec{r_t}(t) = \alpha_t \vec{e_x} + r_t(t)\vec{e_y} \tag{18}$$

$$\vec{r_k}(t) = \alpha_k \vec{e_x} + r_k(t)\vec{e_y} \tag{19}$$

The components are shown in Figure 6.3.

The resultant stream of the vector $\vec{\phi}$ is a vector sum of its components and is represented as:

$$\vec{\phi}(t) = \vec{r_e}(t) + \vec{r_m}(t) + \vec{r_f}(t) + \vec{r_i}(t) + \vec{r_z}(t) + \vec{r_w}(t) + \vec{r_t}(t) + \vec{r_k}(t) =$$
$$\vec{e_x}\,[\,\alpha_e + \alpha_m + \alpha_f + \alpha_l + \alpha_z + \alpha_w + \alpha_t + \alpha_k\,] +$$
$$\vec{e_y}\,[\,\vec{r_e}(t) + \vec{r_m}(t) + \vec{r_f}(t) + \vec{r_i}(t) + \vec{r_z}(t) + \vec{r_w}(t) + \vec{r_t}(t) + \vec{r_k}(t)]$$

3.3. Product vectors

The product may be represented by six vectors. They are as follows:

1. Nutritional value vector, $\vec{w_a}$

$$\vec{w_a} = \alpha_a \vec{e_x} + w_a \vec{e_y} \tag{20}$$

2. Taste vector, $\vec{s_b}$

$$\vec{s_b} = \alpha_b \vec{e_x} + s_b \vec{e_y} \tag{21}$$

3. Healthiness vector, $\vec{z_c}$

$$\vec{z_c} = \alpha_c \vec{e_x} + z_c \vec{e_y} \tag{22}$$

4. Atttractiveness vector, $\vec{a_d}$

$$\vec{a_d} = \alpha_d \vec{e_x} + a_d \vec{e_y} \tag{23}$$

5. Durability vector, $\vec{t_e}$

$$\vec{t_e} = \alpha_e \vec{e_x} + t_e \vec{e_y} \tag{24}$$

6. Freshness vector, $\vec{s_f}$

$$\vec{s_f} = \alpha_f \vec{e_x} + s_f \vec{e_y} \tag{25}$$

The values $\alpha_a, \alpha_b, \alpha_c, \alpha_d, \alpha_e, \alpha_f$, are weights, while $w_a, s_b, z_c, a_d, t_e, s_f$ are empirically defined through procedure designated specifically for the product.

3.4. Loss vectors

Losses within the system are described by the sum of the following four component vectors:
1. Ecological vector

$$\vec{e_s} = \alpha_s \vec{e_x} + e_s \vec{e_y} \tag{26}$$

2. Resource vector

$$\vec{z_t} = \alpha_t \vec{e_x} + z_t \vec{e_y} \tag{27}$$

3. Energy loss vector

$$\vec{n_u} = \alpha_u \vec{e_x} + n_u \vec{e_y} \tag{28}$$

4. Safety vector

$$\vec{b_w} = \alpha_w \vec{e_x} + b_w \vec{e_y} \tag{29}$$

The values $\alpha_s, \alpha_t, \alpha_u, \alpha_w$ are the weighs of the vectors. The values e_s, z_t, n_u, b_w are defined empirically according to the procedures designated specifically for the researched manufacturing process.

The resultant $\vec{s}$ loss vector is the sum of the abovementioned vectors:

$$\vec{s} = \vec{e_s} + \vec{z_t} + \vec{n_u} + \vec{b_w} \tag{30}$$

The value of the module of the vector $\vec{s}$ takes values of $[0,1]$. The components of the vector $\vec{s}$ are shown in Figure 5.

4. Vector constitutive relations of the manufacturing process

A complex metrisable assessment of a manufacturing process ought to take into account the relation between the distribution of the input streams, product quality, and measurable effects of losses.

The set of three vectors, $\vec{\phi}, \vec{P}, \vec{S}$, representing the state of the process, allows to formulate a constitutive equation of the manufacturing process.

There are a few possible associations between the three abovementioned vectors. However, we shall present those which lead to better understanding of the phenomena and optimisation towards product attractiveness, energy consumption, and cost efficiency.

The relations between the vectors $\vec{\phi}, \vec{P}, \vec{S}$ may be functions or vectors, the result of whose calculations are of scalar or vector nature.

Among the vector ones, we may enumerate the vector product $(\vec{\phi} \times \vec{P}) * (\vec{S})$. The formula is as follows:

$$\vec{V}= (\vec{\phi} \times \vec{P}) * (\vec{S}) = \begin{vmatrix} \vec{e}_x & \vec{e}_y & \vec{e}_z \\ P_x & P_y & P_z \\ S_x & S_y & S_z \end{vmatrix} * \sqrt{s_x^2 + s_y^2} \tag{31}$$

Vector representations of the manufacturing process may also be achieved by the sum of vectors $\vec{\phi}, \vec{P}, \vec{S}$ and their double vector product.

The formula is as follows:

$$\vec{\Sigma} = \vec{\phi} + \vec{P} + \vec{S} \tag{32}$$

$$\vec{D} = (\vec{\phi} \times \vec{P}) \times \vec{S} \tag{33}$$

Modules of the vectors $\vec{\Sigma}$ and $\vec{D}$ may be scalar functions of the manufacturing process.

5. Conclusion

The placement of the issues of quality is of strict importance to the combination of all the elements of a manufacturing process. This section presents a concept of quality process management in baking industry in vector representation. Quality, in the understanding proposed by systems engineering, will denote collective general characteristics of the manufacturing process expressing the degree to which requirements related to the subject process are met.

The author introduced an innovative metrisable method of describing a manufacturing process. Vector representations of a manufacturing system were presented, ones that are based on systems engineering models. Also, the article presents constitutive relations – three vectors that combine the quality effects, as a vector of the features of the product, loss vector, and input stream vector.

The idea of vector structure of a manufacturing process allows to formulate quantitative relations between the activity of input streams, elements of product quality, and measurable effects of losses. The structure was basis for the formulation of the concept of the process of managing product quality in the baking industry in a vector representation.

According to the presented concept of managing quality in baking industry, the manufacturing process is a purposeful activity of an operator on streams, expressing an ordered set of relations between their elements, leading to the emergence of a product and inevitable losses.

The manufacturing operator space is supplied by eight streams, i.e.:

a) three material resource streams: energy, material element, and finances;

b) one information stream – the ordered information stream;

c) four steering streams – the manufacturing process steering stream, controlled output stream, timed activity stream, process dynamics change stream.

Each of the mentioned streams contains amounts of activities in time, adequate to its character. Types of activity within each of the streams determine the goal of the operator. The streams supplying the manufacturing process are represented by the operator vector – a vector comprised of the vector sum of all the input streams.

The activity of the operator of the manufacturing process results in a product, characterised by six vectors, representing features of the quality of bakery product, enumerated above.

Losses are represented by four vectors: ecological (agro-climatic conditions), human resource (raw material selection, process output), energy loss (no energy, power outages), and safety vector (health-related, machine failures).

In the presented concept of managing manufacturing quality in the baking industry, all relations are active. i.e. each has their tasks to perform.

Therefore, the description of the system needs to take into account momentary and unambiguous relation between the manufacturing process operator, product, and losses. A strict description of such a relations is immensely difficult, and impossible to measure in some instances. Some possibilities are provided by vectors and scalars, though. The article presents practical methods for assigning vector values to the said processes.

The application of systems engineering allows for a measurable answer to the fundamental questions of the goal of the manufacturing process, its efficiency in the context of combining all the elements, including product quality, as well as other improving activities.

At the same time mathematical models of systems engineering allow to construct multi-criterion indicators and their application to optimize the subsequent organisational, technological, and other steps.

The new idea for a metrisable vector structure of a manufacturing process has been designed with the baking industry in mind, but the whole system's construction makes it applicable to analyse other processes, in e.g. information production, didactics, strategy, etc., as it imposes no limitations on the character of the process, which may also be of immaterial production character.

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