The value creation chain: diagnostic restrictions and challenges

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Abstract. The article presents an approach to diagnosing constraints in the operating value chain. The presented approach is based on the requirements and recommendations of quality standards for the application of the process approach. Based on the definition of the value stream, an optimization problem is formulated: increasing the stream value of products and services through improving the properties of the main processes, taking into account the resource limitations of the organization. The method of constraint analysis is applied to the formulated optimization problem, three types of constraints of the operating value chain are considered - in terms of effectiveness, efficiency and resource intensity. Diagnostics of the restriction of the flow of value was carried out using the methodology for assessing customer satisfaction. This made it possible to formulate an integral satisfaction rating for the value chain based on the estimates of its constituent operations according to the criteria of “Importance” and “Satisfaction”, as well as the “critical” parameter of the operation-restriction through the description of the process model and the formation of score scales for certain process parameters. The results of expert evaluations will help to form clusters of stakeholder’s opinions, which will help in initiating and managing improvement projects. The proposed approach to the diagnosis of restrictions on the flow of value of products and services can be applied to various industries and services: construction, energy, medicine, transport logistics, etc.

1. Introduction
The main advantages of creating and developing a Quality Management System (QMS) are [1]:

- the ability of the organization to consistently provide products and services that meet the requirements of consumers and current regulatory requirements;
- creating opportunities to increase customer satisfaction.

The QMS policies and goals aimed at increasing customer satisfaction are determined by the selected positioning strategy for the “price-quality” of products and services for the consumer segment. At the same time, from the standpoint of the process approach, products and services are the value result of the implementation of the value chain (VC), which includes processes from the development of the concept to launch into production and from the acceptance of the order to delivery to the consumer [2].

The operational vector of the development of the value chain determines the priorities (objective function) of improving activities in the following areas (process properties) [3]:

...
• quality of processes, products and services (performance);
• cost of processes, products and services (resource intensity);
• lead time of processes and delivery (efficiency).

In accordance with the definition of the value stream [2], improvement of activity is achieved in the properties of the main processes that create value (products and services) and other necessary processes, including resource support of the main activity. Thus, an optimization problem can be formulated to increase the value of the flow of products and services (value of the objective function) taking into account the resource limitations of the organization.

2. Methods
To solve the optimization problem, the following methods were used:

1. The method of analysis of restrictions in accordance with State standard GOST R ISO 10014-2008 [4]. Successful integration of management principles (customer orientation, process, systemic approaches, continuous improvement, factual decision making, etc.) is based on the application of the process approach and the Plan-Do-Check-Act (PDCA) methodology. This approach allows senior management to assess requirements, draw up action plans, allocate required resources, and take actions to continuously improve and measure the effectiveness of the results. This will allow senior management to make informed decisions whether they are determining commercial strategies, developing new products or fulfilling financial agreements.

2. Methodology for assessing customer satisfaction [5]. Standard promotes the adoption of a process approach when developing, implementing and improving the effectiveness of a quality management system, to enhance customer satisfaction by meeting customer requirements.

3. The method model analysis method described in accordance with State standard GOST R ISO / IEC 12207-2010 [6]. This method is intended to represent a specific set of processes that facilitate communication between acquiring parties, suppliers and other copyright holders during the life cycle of software products and services.

3. Results. An approach to increasing the value of the flow of products and services, taking into account the resource constraints of the organization

3.1. Formation of an integral satisfaction rating for a value chain
Application of the method of constraint analysis [4] to the formulated optimization problem involves the consideration of a constraint system that includes 3 parameters (type of constraint) of the operational data center - in terms of effectiveness, efficiency and resource intensity.

To diagnose the limitation of the flow of value, a methodology for assessing customer satisfaction can be used [5], while the integral satisfaction score for the value chain is calculated based on the estimates of its constituent operations according to the criteria of “Importance” and “Satisfaction”.

Expert evaluations of operations are carried out taking into account the adopted operational strategy for the development of the value chain, which is expressed by the priorities for improving its parameters of effectiveness (quality), efficiency (time) and resource intensity (cost):

\[ P_{\text{quality}} + P_{\text{time}} + P_{\text{cost}} = 100\% \] (1)

For each value chain operation, based on expert assessments, the average score of “Satisfaction” and the weight of “Importance” are calculated:

\[ W_i = \frac{M_i}{\sum_{i=1}^{n} M_i} \] (2)

where:
\[ W_i \] - importance weight (i);
\[ M_i \] - importance mark (i);
\[ \sum_{i=1}^{n} M_i \] - Sum of the importance mark of all operations (from 1 to n)/

By analogy with the approach of [4] self-assessment of the maturity level of the organization to assess “Satisfaction” it is proposed to use ordinal (mark) scales (tables 1, 2, 3).

**Table 1.** Scale of "Performance" value chain operations.

| No. | Operation | Mark | The “Performance” Criterion |
|-----|-----------|------|-----------------------------|
| 1   | Operation 1 | 0    | I can not appreciate |
| 1   | Operation 1 | 1    | Results are rarely (less than 25% of cases) achieved in a given volume and quality, often there are significant deviations (inconsistencies) |
| 2   | Operation 1 | 2    | Partially results (more than 50% of cases) are achieved in a given volume and quality, sometimes there are significant deviations (inconsistencies) |
| 3   | Operation 1 | 3    | The results are mainly (more than 75% of cases) achieved in a given volume and quality, rarely there are minor deviations (inconsistencies) |
| 4   | Operation 1 | 4    | The results are almost always (100% of cases) achieved in full and of the required quality. |
| 5   | Operation 1 | 5    | The results are always achieved in full and of the required quality, there is still a power reserve (reserve for quality and quantity) |

**Table 2.** "Efficiency" scale of value chain operations.

| No. | Operation | Mark | The “Efficiency” criterion |
|-----|-----------|------|-----------------------------|
| 1   | Operation 1 | 0    | I can not appreciate |
| 1   | Operation 1 | 1    | Results are rarely (less than 25% of cases) achieved within a given time frame and of the required quality, often there are significant deviations |
| 2   | Operation 1 | 2    | Partially results (more than 50% of cases) are achieved in a given time and of the required quality, sometimes there are significant deviations |
| 3   | Operation 1 | 3    | The results are mainly (more than 75% of cases) achieved in a given period and of the required quality, rarely there are minor deviations |
| 4   | Operation 1 | 4    | Results are almost always (100% of cases) achieved in a given time and of the required quality. |
| 5   | Operation 1 | 5    | Results are always achieved no later than the specified period and the required quality, there is still a margin of time (performance reserve) |

**Table 3.** “Resource intensity” scale of value chain operations.

| No. | Operation | Mark | The “Resource Intensity” Criterion |
|-----|-----------|------|-----------------------------------|
| 1   | Operation 1 | 0    | I can not appreciate |
| 1   | Operation 1 | 1    | Results are rarely (less than 25% of cases) achieved within a given time frame and of the required quality, often there are significant deviations |
| 2   | Operation 1 | 2    | Partially results (more than 50% of cases) are achieved in a given time and of the required quality, sometimes there are significant deviations |
| 3   | Operation 1 | 3    | The results are mainly (more than 75% of cases) achieved in
a given period and of the required quality, rarely there are minor deviations

4 Results are almost always (100% of cases) achieved in a given time and of the required quality.

5 Results are always achieved no later than the specified period and the required quality, there is still a margin of time (performance reserve).

Operations that have the maximum value of the ratio of the weight of “Importance” to the average score of “Satisfaction” are recognized as “limitations” of the flow of the Centers in terms of effectiveness, efficiency and resource intensity.

3.2. Definition of the “critical” parameter of the operation-constraint

The next step in diagnosing a constraint is to determine the “critical” parameter of the constraint operation. For this it is necessary to determine a process model that, in accordance with State standard GOST R ISO / IEC 12207-2010 [6], can be described by the following attributes:

- name - conveys the scope of the process as a whole;
- goal - describes the ultimate goals of the process;
- outputs - represent the observed results expected with the successful completion of the process;
- activity - is a list of actions used to achieve exits;
- tasks - are requirements, recommendations and acceptable actions designed to support the achievement of process outcomes;

And also in accordance with standard P 50.1.028-2001 [7] the parameters of the IDEF0 model of the process representation:

- function - determines the purpose of the process conversion;
- input - data or material objects that are converted by the function into output;
- output - data or material objects produced by a function;
- management - the conditions under which the exit will be correct;
- mechanism - means used to perform a function.

By analogy with the assessment of the maturity level of an organization’s management system according to state standard GOST ISO 9004-2019 [8], appropriate scales for assessing “Importance” and “Satisfaction” can be developed for process parameters (an example of scales for the “Management” parameter of a process model is presented in tables 4 and 5).

Table 4. “Importance” parameter's scale.

| No. | Parameter | Mark | The “Importance” criterion |
|-----|-----------|------|----------------------------|
| 1   | Parameter 1 | 0    | I can not appreciate      |
| 1   | Parameter 1 | 1    | The parameter is not related to process control and improvement. |
| 2   |            | 2    | Increased attention to the parameter improves the description and regulation of the process (improves the accuracy of planning goals, results and necessary resources) |
| 3   |            | 3    | Increased attention to the parameter improves the execution of the process (increases the effectiveness of the sequence and content of actions) |
| 4   |            | 4    | Increased attention to the parameter improves process control (increases the efficiency and productivity of actions) |
| 5   |            | 5    | Increasing attention to the parameter improves the process |
Table 5. “Satisfaction” parameter's scale.

| No. | Parameter | Mark | The “Satisfaction” Criterion |
|-----|-----------|------|------------------------------|
| 1   | Parameter | 0    | I can not appreciate        |
| 1   |           | 1    | Policies and approaches to process management not defined |
| 2   |           | 2    | Process criteria, policies and management approaches are documented, a process passport is documented, information is kept up to date |
| 3   |           | 3    | The owner and participants of the process know the criteria of the process and the PDCA process management cycle, are guided by the relevant documents, the conformity of knowledge is confirmed by the results of audits |
| 4   |           | 4    | Process criteria, policies and approaches to process management are in line with corporate culture and strategic goals, risk and loss are analyzed, key performance indicators are applied based on the PDCA process management cycle, managed conditions are supported |
| 5   |           | 5    | Results are always achieved no later than the specified period and the required quality, there is still a margin of time (performance reserve) |

“Critical” is a parameter that has the maximum value of the ratio of average scores of “Importance” to “Satisfaction”.

Based on the results of expert assessments, based on correlations, clusters of opinions of interested parties can be formed, which will make it possible to assess the opportunities and risks of projects to improve the value chain.

4. Conclusion

Thus, to increase the value of the value chain flow using the described approach, it is necessary:

- form a model of the operating value chain;
- determine the operational vector of improving the value chain (priorities for effectiveness, efficiency and resource intensity);
- determine the “limitations” of the value chain based on expert assessments of “Importance” and “Satisfaction” for the constituent operations;
- define “critical” parameters for value chain restriction operations;
- initiate and manage improvement projects.

5. Discussion

In continuation of this study, it is planned to consider the impact of value chains on an enterprise development strategy. As a result of the reorganization of value chains and processes in accordance with the needs of existing and prospective customers, the company will be able to strengthen its competitive position in the market and lay the foundation for long-term business development. As experience shows, the method of constructing and analyzing value chains can be effectively used to structure the business of a company. This problem is especially relevant in the era of digital transformation of enterprises, when the ecosystem of enterprise development, factors of the external and internal business environment, and the business model of the enterprise are changing qualitatively [9], [10].

As a rule, heads of organizations need a clear idea of the state of their business in order to carry out further development. You can understand how a business is organized by receiving and analyzing
information about its functional structure, what processes are carried out inside it, who is responsible for them. It is necessary to structure the company’s activities in the form of processes and consider the existing functional and organizational structure in terms of the distribution of responsibility of managers for the processes and the participation of units in them. The method of constructing and analyzing value chains is one of the possible tools for solving this problem in the era of digital transformation.

The proposed approach to the diagnosis of restrictions on the flow of value of products and services can be applied to various industries and services: construction, energy, medicine, transport logistics, etc.

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