Methodological Approach to Assessing the Efficiency and Resilience of Integrated Automotive Service Enterprises

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Abstract

This article proposes a methodological approach to assessing the efficiency and resilience of integrated automotive service enterprises. Based on the previously developed model of three-loop integration, a system of indicators is introduced to analyze the interaction between technical, procurement, and customer-related components. Particular attention is given to measuring the operational coherence of processes and identifying factors that influence business resilience. The proposed approach enables a transition from descriptive analysis to a structured evaluation of small enterprise performance under conditions of institutional instability.

Keywords

methodological approach, integrated automotive service enterprises, business efficiency, enterprise resilience, operational model, systems analysis, small business, process management, performance evaluation, institutional environment, entrepreneurial risks, three-loop integration model

1. Introduction

Analysis of small automotive service enterprises in previous studies has shown that their efficiency is determined not by individual indicators, but by the interaction of multiple functional components.

However, in practice, there is no universal tool that allows:

- assessment of process coherence;

- identification of weak elements within the system;

- forecasting of enterprise resilience.

The objective of this study is to develop a methodological approach that enables both quantitative and qualitative assessment of the efficiency of an integrated automotive service center model.

2. Methodological Foundations for Assessing Integrated Automotive Service Enterprises

Previous studies have formulated the concept of the integrated automotive service center as a system combining technical, procurement, and customer-related components. However, for practical application of this concept, a transition is required from a descriptive level to a level of formalized analysis.

Existing approaches to evaluating small business performance are generally based on financial indicators. While these approaches allow assessment of the current state of the enterprise, they do not reflect the internal structure of processes or the degree of their coordination. In the context of an integrated model, this becomes a significant limitation.

The objective of this section is to develop a methodological approach that enables the assessment of enterprise efficiency and resilience, taking into account its internal structure.

2.1. Limitations of Traditional Performance Indicators

Classical indicators such as revenue, profit, and profitability are important, but they do not provide a complete picture of the state of an integrated system.

First, they capture outcomes but do not explain their underlying causes. High revenue may coexist with unstable processes that could later lead to a decline in efficiency.

Second, these indicators do not reflect the quality of interaction between different elements of the enterprise. For example, profit may remain stable even in the presence of hidden problems in procurement or repair organization.

Third, financial indicators do not allow for the identification of potential risks before they materialize.

Thus, there is a need for an approach that makes it possible to analyze not only outcomes but also the internal structure of processes.

2.2. Principle of Structural Assessment

The proposed approach is based on the principle of structural assessment, according to which the enterprise is viewed as a system of interconnected elements.

The key components are:

- the technical component;

- the procurement component;

- the customer component.

Each of these components performs its own function, but their overall effectiveness is determined by the degree of interaction among them.

Therefore, the assessment must consider not only the condition of each component but also their level of coordination.

2.3. Parameters for Assessing Components

To analyze each component, it is proposed to use three parameters:

- efficiency;

- stability;

- coordination.

Efficiency reflects the ability of a component to perform its primary function.

Stability indicates the consistency of results over time.

Coordination characterizes the degree of interaction with other components.

This approach enables a transition from static to dynamic analysis.

2.4. Technical Component

The technical component forms the core of the enterprise, as it is responsible for delivering the primary service.

The following indicators may be used for its assessment:

- average time required to complete work;

- utilization rate of production capacity;

- share of repeat repairs;

- frequency of identifying additional faults.

These indicators make it possible to assess both productivity and quality of service delivery.

2.5. Procurement Component

The procurement component provides the resource base of the enterprise.

Key indicators include:

- availability of required parts;

- delivery speed;

- inventory turnover rate;

- share of urgent purchases.

Analysis of these parameters makes it possible to assess the effectiveness of inventory management and the degree of dependence on external suppliers.

2.6. Customer Component

The customer component reflects the enterprise's interaction with the market.

Key indicators include:

- frequency of repeat visits;

- average transaction value;

- customer waiting time;

- level of customer satisfaction.

This component plays a crucial role in ensuring enterprise resilience, as it generates the flow of orders.

2.7. Integrated System Assessment

For a comprehensive evaluation, it is proposed to consider the combined performance of all three components.

System efficiency is determined not by the sum of individual indicators, but by their coordination.

Even with high values of individual parameters, an enterprise may remain unstable if the interaction between components is disrupted.

Thus, integrated assessment should take into account:

- the balance between system elements;

- the presence of bottlenecks;

–   the stability of processes over time.

2.8. Application of the Methodology

The proposed approach can be used to address practical tasks.

First, it enables the identification of weak elements within the system. For example, high utilization of the technical component combined with low procurement efficiency may indicate the need to revise purchasing policies.

Second, the methodology can be applied to enterprise development planning. Structural analysis helps determine which components require strengthening.

Third, the approach is applicable to risk assessment. Misalignment between components may serve as an indicator of potential problems.

2.9. Limitations of the Proposed Approach

Despite its advantages, the methodology has several limitations.

It requires the availability of reliable process data.

Some indicators are qualitative in nature and depend on subjective evaluation.

The approach does not replace financial analysis but complements it.

In addition, its application requires a certain level of managerial competence.

2.10. Chapter Conclusions

The developed methodological approach enables a transition from descriptive analysis of the integrated model to its structural evaluation.

Key conclusions:

–   enterprise efficiency is determined by the interaction of its components;

–   traditional indicators do not reflect the internal structure of processes;

–   assessment must consider efficiency, stability, and coordination of components;

–   the proposed methodology allows identification of weaknesses and supports enterprise development management.

Thus, the integrated automotive service center can be considered as a system whose efficiency is determined not by individual indicators, but by the quality of internal coordination.

3. Model Formalization and Integrated Assessment of Resilience in an Integrated Automotive Service Enterprise

In the previous section, a structural approach to analyzing the integrated automotive service enterprise was proposed, based on the identification of three key components: technical, procurement, and customer-related. However, structural decomposition alone does not provide a tool for comparing different states of the enterprise over time, nor does it allow for a more rigorous analytical assessment.

To address this, the next step is model formalization. Within the framework of this study, formalization is understood as the transition from a qualitative description of interrelated processes to a system of analytical parameters that enable evaluation of the internal state of the enterprise as a unified system. In other words, while the previous section addressed the question of what elements constitute an integrated automotive service center, the present section addresses how to assess its level of resilience, coordination, and efficiency.

This transition is particularly important for analyzing small businesses in transitional economies, where many processes are not standardized and a significant share of decisions is based on practical experience. In this context, formalization should not replicate rigid corporate models typical of large enterprises. Instead, it must reflect the specific characteristics of small businesses, including limited resources, the central role of the owner, the combination of formal and informal practices, and dependence on the external institutional environment.

3.1. The Need to Transition from Description to Assessment

The limitation of descriptive models of small business lies in the fact that they effectively capture the logic of a phenomenon but are of limited use for managerial application. It is possible to describe that an enterprise depends on supply chains, customer loyalty, and repair quality, but without a formalized framework it is difficult to determine:

- which component is the most vulnerable;

- the extent of imbalance between system elements;

- whether the current state of the enterprise is sustainable;

- which changes require immediate managerial intervention.

In practice, the owner of a small enterprise often intuitively senses when the system begins to operate unstably. For example, even with acceptable revenue levels, the number of urgent purchases may increase, customer waiting times may grow, and overloads may appear in the

repair area. These signals indicate internal imbalance that may not yet be reflected in financial results but already creates conditions for future decline.

Therefore, a formalized model is necessary not only for academic analysis but also for identifying hidden points of tension within the business.

3.2. The Enterprise as a System of Interconnected States

For the construction of an analytical model, it is useful to consider that an integrated automotive service center does not exist in a single fixed state. Instead, it continuously moves between different configurations of internal balance.

In simplified terms, three possible system states can be distinguished:

- a coordinated state;
- a strained state;
- a unbalanced state.

A coordinated state arises when customer flow, procurement, and production capacity are in acceptable equilibrium. The enterprise fulfills orders within reasonable timeframes, inventory does not experience critical shortages, and workload corresponds to available capacity.

A strained state is characterized by the system maintaining functionality but already showing signs of overload or misalignment. For example, the number of urgent purchases increases, repair duration grows, and some orders are completed under resource pressure.

An unbalanced state occurs when misalignment between components leads to systemic disruptions. In this case, the enterprise does not merely operate with difficulty but begins to lose customers, miss deadlines, and face cascading problems.

Thus, the analytical task is not only to evaluate current indicators but also to determine which type of state the system is approaching.

3.3. Core Analytical Dimensions of the Model

To assess the state of an integrated automotive service enterprise, it is proposed to use three fundamental dimensions applied to each component.

The first dimension is functional efficiency. It reflects the ability of a component to perform its primary function. For the technical component, this refers to the quality and speed of repair. For the procurement component, it refers to ensuring the availability of necessary resources. For the customer component, it refers to the ability to retain and serve the flow of requests.

The second dimension is operational stability. It indicates how consistent the results of a component are over time. Even high efficiency at a given moment does not guarantee stability if it is achieved through overload or unstable practices.

The third dimension is inter-component coordination. This is the central element of the proposed model. It reflects the degree of alignment between components. For example, even an efficient technical unit does not ensure overall stability if procurement is consistently delayed and customer demand overloads production capacity.

Thus, a three-dimensional logic of assessment is formed, evaluating not only how well each element performs, but also how stable it is and how well it is aligned with other elements of the system.

3.4. Formalization of the Technical Component

The technical component represents the core of the integrated enterprise, as it produces the primary outcome for which customers seek service. However, in analytical assessment it is important to recognize that the technical component is not limited to the mere execution of repairs. It should be evaluated as a production-service system.

Among the most significant characteristics of the technical component are:

- average duration of work execution;
- share of orders completed within agreed timeframes;
- rate of repeat visits for the same issue;
- utilization of repair stations;
- variability of production workload.

These indicators are important because they reflect not only productivity but also internal stability. For example, high utilization may appear positive, but beyond a certain level it begins to reduce quality and increase service time. Therefore, the efficiency of the technical component cannot be reduced to simply increasing the number of completed jobs.

For small enterprises, it is particularly important to account for dependence on specific employees. If a key specialist performs a significant share of work, the technical component may appear efficient but remain structurally vulnerable. Therefore, within a formalized assessment, it is necessary to distinguish between current productivity and sustainable production capacity.

3.5. Formalization of the Procurement Component

The procurement component provides the material foundation for the functioning of the entire system. In the integrated model, it plays not a supporting but a structural role. Without

coordinated procurement, the technical component loses its ability to operate in a predictable manner, and the customer component loses its ability to sustain trust.

The main characteristics of the procurement component may include:

- the share of orders fulfilled without additional waiting for parts;

- average time required to meet parts demand;

- inventory turnover rate;

- proportion of urgent purchases;

- dependence on a limited number of suppliers;

- share of incorrectly ordered or unused items.

For a small enterprise, the key factor is not the absolute size of inventory, but its structural adequacy. In other words, what matters is not the volume of stock itself, but the degree to which inventory corresponds to the actual needs of the repair process.

From an analytical perspective, the procurement component is one of the most sensitive to hidden imbalances. An enterprise may maintain apparent stability for some time even as procurement performance deteriorates, compensating for shortages through urgent purchases and manual intervention. However, such compensation is typically associated with increased costs and reduced overall resilience.

3.6. Formalization of the Customer Component

The customer component reflects the market dimension of the integrated model. Unlike the technical and procurement components, which are largely formed within the enterprise, the customer component connects internal processes with the external economic environment.

The following groups of characteristics may be used for its assessment:

- share of repeat visits;

- average order value per customer;

- average waiting time before service begins;

- frequency of service refusals after initial diagnostics;

- frequency of conflicts or disputes;

- stability of customer flow over time.

The indicator of repeat visits is of particular importance, as it reflects not only customer loyalty but also the enterprise's systemic ability to maintain long-term relationships with the market. For small businesses, repeat customers are more valuable than occasional ones, as they reduce uncertainty in future workload and lower the cost of acquiring new demand.

It is important to emphasize that the customer component should not be evaluated solely by the volume of incoming requests. A high customer flow combined with weak technical or procurement performance may not strengthen the enterprise but instead accelerate internal imbalance.

3.7. Inter-Component Coordination as the Central Analytical Indicator

The most significant contribution of the proposed model is the recognition that the primary object of assessment is not individual components, but their coordination. For small integrated enterprises, this is particularly important, as their viability depends not on the presence of strong individual elements, but on the ability of all components to function as a unified system.

Inter-component coordination may be defined as the degree of alignment between production, procurement, and customer-related parameters.

If customer demand exceeds procurement capacity, the system begins to compensate for resource shortages through urgent purchases, delays, and increased organizational strain.

If the procurement component is expanded beyond what is required by current production and customer activity, the enterprise faces excess inventory and capital immobilization.

If the technical component lags behind customer demand and procurement capacity, unfinished work accumulates, leading to overload and declining service quality.

Thus, coordination can be considered an integrated measure of the system's structural adequacy in relation to itself.

3.8. Logic of Constructing an Integrated Resilience Index

For practical application of the model, it is proposed to introduce an integrated resilience index for the automotive service enterprise. This index should not be understood as a rigid universal mathematical formula applicable to any business regardless of context. Within this study, it is treated as an analytical tool that integrates data on functional efficiency, stability, and coordination of components.

In general terms, the resilience index can be represented as a function of four groups of parameters:

– indicators of the technical component;

- indicators of the procurement component;

- indicators of the customer component;

- a coefficient of inter-component coordination.

The logic of the index is as follows. Even if each component demonstrates satisfactory performance individually, the overall level of resilience declines if there is no balance between them. Therefore, inter-component coordination is not a secondary element of the index but performs a corrective function.

In other words, the resilience index should reflect not simply the sum of strengths, but the degree of systemic coherence of the enterprise's internal structure.

3.9. Qualitative Scale for Interpreting the Index

For applied analysis, it is advisable to use not only a quantitative but also a qualitative interpretation of the resilience index. This is particularly important for small businesses, where many managerial decisions are based on practical assessment rather than complex mathematical calculations.

Three qualitative levels can be distinguished:

- high resilience;

- conditional resilience;

- reduced resilience.

High resilience indicates that the enterprise maintains balance between components, is capable of fulfilling orders in a predictable manner, and possesses a certain degree of adaptive capacity.

Conditional resilience indicates that the system remains functional but depends on continuous compensatory efforts by the owner or staff. Such enterprises may appear stable externally but accumulate hidden risks.

Reduced resilience indicates that internal imbalances have become systemic and are already affecting timelines, quality, customer loyalty, or financial performance.

This scale allows the index to be used not only as an academic tool but also as a basis for practical diagnostics.

3.10. Example of Analytical Application of the Model

Assume that an enterprise demonstrates a stable customer flow and acceptable revenue. At first glance, its condition may be considered satisfactory. However, a deeper analysis reveals that the share of urgent purchases is increasing, repair times are growing, and repeat customer visits are beginning to decline.

Within a traditional framework, such changes might be detected too late, after financial performance has already deteriorated. Within the proposed model, this situation is interpreted as a decline in inter-component coordination. The customer component continues to generate demand, but the procurement and technical components are no longer able to sustain this demand without internal strain.

Accordingly, the resilience index should decrease in such a situation even before the enterprise faces a visible crisis. This illustrates the practical value of formalization, as it enables early detection of structural imbalances.

3.11. Methodological Limitations of Formalization

Despite the analytical usefulness of the proposed model, its limitations must be acknowledged.

First, some parameters in small businesses are difficult to measure with high precision due to limited data systems.

Second, the assessment of certain characteristics, especially inter-component coordination, inevitably includes an expert judgment component.

Third, the model is primarily designed for integrated enterprises and should not be mechanically applied to other business types without adaptation.

Fourth, the resilience index does not replace financial analysis but complements it by revealing the internal structure of processes.

However, these limitations do not diminish the value of the model. On the contrary, they highlight the need for careful and context-sensitive application.

3.12. Conclusions

The formalization of the integrated automotive service enterprise model makes it possible to move from structural description to analytical evaluation of system performance. Within this section, the following key propositions have been formulated.

First, enterprise resilience should be assessed not only through financial outcomes but also through the condition of its internal components.

Second, for each component it is advisable to consider functional efficiency, operational stability, and the degree of coordination with other elements of the system.

Third, inter-component coordination serves as the central analytical indicator, as it determines whether the strengths of individual elements translate into overall system resilience.

Fourth, the integrated resilience index can be used as a tool for early diagnosis of internal imbalances and as a basis for managerial decision-making.

Thus, the proposed model allows the integrated automotive service center to be viewed as a system whose resilience is determined not by a simple set of parameters, but by the quality of internal coordination and the ability to maintain structural balance in a changing environment.

3.13. Formal Model for Assessing the Resilience of an Integrated Automotive Service Enterprise

To enhance the analytical applicability of the proposed approach, it is advisable to introduce a formal model for assessing the resilience of an integrated automotive service enterprise. This model does not claim universality in a strict econometric sense, but it enables the translation of qualitative observations into a system of comparable indicators.

The model is based on representing the enterprise as a system of three interconnected components:

- the technical component;

- the procurement component;

- the customer component.

For each component, a partial state index is calculated to reflect its current level of performance. Based on these partial indices and a coordination coefficient, an integrated resilience index of the enterprise is then determined.

3.13.1. Partial Component Indices

Let:

- T denote the index of the technical component;

- S denote the index of the procurement component;

- C denote the index of the customer component.

Each of these indices takes a value in the range from 0 to 1, where:

- 0 indicates a critically weak state;

- 1 indicates a maximally stable and efficient state.

Each partial index is defined as a weighted average of several normalized indicators.

For the technical component, the following formula is proposed:

$$T = w1t \times t1 + w2t \times t2 + w3t \times t3 + w4t \times t4$$

where:

- $t1$ is the normalized indicator of adherence to repair deadlines;
- $t2$ is the normalized indicator of service quality;
- $t3$ is the normalized indicator of capacity utilization;
- $t4$ is the normalized indicator of repeat visits for the same issue;
- $w1t, w2t, w3t, w4t$ are the weights of the indicators, with their sum equal to 1.

For the procurement component:

$$S = w1s \times s1 + w2s \times s2 + w3s \times s3 + w4s \times s4$$

where:

- $s1$ is the normalized indicator of parts availability;
- $s2$ is the normalized indicator of inventory turnover;
- $s3$ is the normalized indicator of dependence on urgent purchases;
- $s4$ is the normalized indicator of supply stability;
- $w1s, w2s, w3s, w4s$ are the weights of the indicators, with their sum equal to 1.

For the customer component:

$$C = w1c \times c1 + w2c \times c2 + w3c \times c3 + w4c \times c4$$

where:

- $c1$ is the normalized indicator of repeat visits;
- $c2$ is the normalized indicator of average customer waiting time;
- $c3$ is the normalized indicator of customer satisfaction;
- $c4$ is the normalized indicator of customer flow stability;
- $w1c, w2c, w3c, w4c$ are the weights of the indicators, with their sum equal to 1.

Thus, each partial index reflects the aggregated state of the corresponding component.

3.13.2. Normalization of Indicators

To combine indicators of different nature into a single index, it is necessary to bring them to a unified scale.

If an increase in the indicator improves the state of the system, direct normalization is applied:

$$x' = (x - x_{min}) / (x_{max} - x_{min})$$

where:

- x' is the normalized value of the indicator;

- x is the actual value of the indicator;

- x_{min} is the minimum acceptable value;

- x_{max} is the maximum desirable value.

If an increase in the indicator worsens the state of the system, inverse normalization is applied:

$$x' = (x_{max} - x) / (x_{max} - x_{min})$$

This allows proper consideration of the fact that an increase in waiting time or the share of urgent purchases reduces resilience, while an increase in repeat customer visits enhances it.

3.13.3. Inter-Component Coordination Coefficient

A distinctive feature of the proposed model is that enterprise resilience depends not only on the quality of each component, but also on the degree of their mutual coordination.

For this purpose, a coordination coefficient K is introduced, which also takes values from 0 to 1.

In its simplest form, the coordination coefficient may be defined through the dispersion of partial indices:

$$K = 1 - [max(T, S, C) - min(T, S, C)]$$

Since all indices lie within the interval from 0 to 1, the coefficient K also remains within this range.

If the values of T, S, and C are close to each other, K approaches 1, indicating a high level of coordination.

If one component significantly lags behind the others, K decreases, reflecting structural imbalance within the system.

This approach is methodologically important because an enterprise may demonstrate relatively high values for individual indices while remaining unstable due to a lack of coordination among them.

3.13.4. Integrated Resilience Index

After calculating the partial indices and the coordination coefficient, the integrated resilience index of the enterprise, U, is determined.

The following formula is proposed:

$$U = (aT + bS + cC) \times K$$

where:

- U is the integrated resilience index;
- T is the technical component index;
- S is the procurement component index;
- C is the customer component index;
- a, b, c are the weights of the components, with their sum equal to 1;
- K is the inter-component coordination coefficient.

If no sector-specific or empirically justified prioritization is required, equal weights may be used:

$a = 0.33, b = 0.33, c = 0.34$

In this case, the integrated resilience index takes a simple and transparent form:

$$U = (0.33T + 0.33S + 0.34C) \times K$$

This formula simultaneously accounts for two aspects:

- the overall quality of enterprise performance;
- the degree of structural balance between components.

3.13.5. Interpretation Scale of the Resilience Index

For practical application, it is advisable to use a qualitative interpretation scale for the values of U.

The following scale is proposed:

- U from 0.80 to 1.00 indicates a stable state;

- U from 0.60 to 0.79 indicates a conditionally stable state;

- U from 0.40 to 0.59 indicates an elevated risk zone;

- U below 0.40 indicates an unstable state.

This scale is not absolute and may be adjusted depending on industry conditions, but it provides a convenient tool for analytical diagnostics.

3.13.6. Example of Calculation

Assume that the enterprise has the following values:

$T = 0.78$, $S = 0.62$, $C = 0.81$

Then the coordination coefficient is:

$K = 1 - (0.81 - 0.62) = 0.81$

The integrated resilience index is:

$U = (0.33 \times 0.78 + 0.33 \times 0.62 + 0.34 \times 0.81) \times 0.81$
$U = (0.2574 + 0.2046 + 0.2754) \times 0.81$
$U = 0.7374 \times 0.81 = 0.5973$

Thus, the value of the index is approximately 0.60, which indicates a transitional state between the elevated risk zone and conditional stability.

Interpretation of this result shows that the enterprise is generally functioning, but the procurement component lags behind the technical and customer components, reducing the overall level of system resilience.

3.13.7. Analytical Significance of the Model

The proposed formal model offers several advantages.

First, it enables a transition from a general description of the enterprise to a system of comparable evaluations.

Second, it makes it possible to diagnose not only strong but also weak elements of the system.

Third, it introduces the category of coordination into the analysis, which is typically absent in traditional financial approaches.

Fourth, it is suitable for dynamic application, allowing the tracking of enterprise changes over time.

Thus, the formal model makes it possible to use the integrated resilience index not only as a research construct, but also as a practical management tool.

4. Application of the Methodological Model to the Analysis of External and Institutional Factors

The methodological model developed in the previous section enables a transition from internal analysis of the enterprise to the examination of its interaction with the external environment. In transitional economies, external factors often play a decisive role in the resilience of small businesses. At the same time, their impact is not direct, but is manifested through changes in the state of individual components and disruption of their coordination.

The purpose of this section is to demonstrate how institutional and external influences can be interpreted within the proposed model and how they are transformed into internal imbalances within the enterprise.

4.1. The External Environment as a Factor of Change in Internal System Parameters

In classical economic models, the external environment is viewed as a set of conditions in which the enterprise operates. Within the proposed approach, the external environment is understood more actively, as a factor capable of altering the parameters of each component and influencing their interrelations.

The impact of the external environment is not limited to changes in demand or prices. It may affect:

- resource availability;

- cost structure;

- planning capabilities;

- stability of customer flow;

- speed and predictability of operations.

Thus, external factors do not merely form the background of enterprise activity, but become elements that shape its internal configuration.

4.2. Typology of External Influences

For analytical purposes, it is useful to distinguish several types of external influences, which affect the structure of the integrated automotive service enterprise in different ways.

The first group consists of market influences. These include changes in demand, increased competition, price fluctuations, and shifts in the structure of the vehicle fleet. These factors primarily affect the customer component and, to a lesser extent, the procurement component.

The second group consists of resource-related influences. These are associated with the availability of spare parts, logistics, supply costs, and procurement capabilities. These factors influence the procurement component and, through it, the technical component.

The third group consists of institutional influences. These include changes in regulatory requirements, administrative procedures, inspection activities, and other forms of interaction with external authorities. These factors may simultaneously affect all components of the enterprise.

A distinctive feature of institutional influences is their high level of uncertainty and their independence from market logic.

4.3. Mechanism of Transmission of External Influences into Internal Imbalances

An important aspect of the analysis is understanding how external influences are transformed into internal changes.

For example, changes in supply conditions may lead to longer delivery times. This directly affects the procurement component. As a result, the share of urgent purchases increases, operational costs rise, and the predictability of service execution declines.

This impact is then transmitted to the technical component. Repair processes begin to experience delays, workload pressure increases, and the likelihood of errors rises.

In turn, this affects the customer component. Waiting times increase, customer satisfaction declines, and the proportion of repeat visits decreases.

Thus, a single external influence propagates through all elements of the system and produces a systemic effect.

The proposed model allows these chains to be identified and analyzed at the structural level rather than as isolated events.

4.4. Institutional Factors as a Source of Systemic Instability

Particular attention should be given to institutional factors, as they have the greatest potential to disrupt system balance.

Unlike market influences, which may be partially predictable, institutional changes often occur independently of the enterprise's economic logic. They may be associated with changes in regulations, their interpretation, or their enforcement.

Within the integrated model, such influences may manifest as follows:

– in the procurement component, through changes in requirements related to purchasing, documentation, or logistics;

– in the technical component, through new requirements for equipment, facilities, or working conditions;

– in the customer component, through indirect effects on reputation or service accessibility.

The key characteristic of institutional factors is their ability to simultaneously affect multiple components, thereby amplifying their overall impact.

4.5. Analysis of Resilience under Changing External Conditions

The proposed model makes it possible to assess enterprise resilience under different scenarios of external influence.

Under moderate changes, the system may maintain balance through internal adaptive mechanisms. For example, when delivery times increase, the enterprise may temporarily expand inventory levels or adjust priorities in order execution.

However, once external influence exceeds a certain threshold, the system enters a strained state. In this state, the enterprise continues to operate but becomes dependent on continuous compensatory efforts.

If external pressure continues to intensify, an unbalanced state emerges, in which internal adaptation mechanisms are no longer sufficient to offset external changes.

Thus, resilience should be understood as the system's ability to maintain coordination among components under changing external conditions.

4.6. The Role of Managerial Decisions under External Pressure

In a small integrated enterprise, the managerial center plays a key role in adapting to the external environment.

Unlike large organizations, where decision-making is distributed across multiple levels, in small businesses most decisions are made by the owner or a narrow group of individuals.

This leads to two important consequences.

On the one hand, the speed of response to external changes increases. The enterprise can quickly adjust procurement strategies, reallocate resources, or modify work schedules.

On the other hand, the burden on the managerial center increases. The need to simultaneously account for multiple factors raises the likelihood of errors and reduces resilience under prolonged pressure.

Thus, the enterprise's ability to adapt to external conditions is directly linked to its managerial capacity.

4.7. Practical Application of the Model for External Environment Analysis

The proposed methodology can be used for practical analysis of external influences.

First, it enables identification of which components are most sensitive to specific types of external influences. For example, supply disruptions may be critical for enterprises with limited inventory.

Second, the model allows for assessment of systemic risk. If an external influence affects multiple components simultaneously, its consequences will be significantly more severe.

Third, it can be used to develop adaptation strategies. Understanding the structure of external impact makes it possible to determine in advance which measures may reduce risk.

4.8. Limitations of External Factor Analysis

Despite the analytical capabilities of the model, several limitations must be considered.

First, the external environment is characterized by a high degree of uncertainty, and not all influences can be anticipated.

Second, the assessment of external factors is often probabilistic in nature.

Third, the model cannot eliminate risks entirely, but only improves their understanding.

Nevertheless, even partial formalization of external influences significantly enhances the quality of managerial decision-making.

4.9. Conclusions

The analysis shows that the external and institutional environment exerts a systemic influence on integrated automotive service enterprises.

Key conclusions:

- external influences are transformed into internal changes through the system of components;

- institutional factors have the greatest potential to disrupt system balance;

- enterprise resilience is determined by the ability to maintain process coordination under changing external conditions;

- the managerial center plays a decisive role in adaptation;

- the proposed model enables analysis not only of internal processes but also of their relationship with the external environment.

Thus, the integrated automotive service center should be viewed as an open system whose resilience depends on its ability to adapt to a complex and evolving institutional environment.

5. Practical Implementation of the Methodological Approach and Managerial Decision-Making

The developed methodological model acquires practical value only if it can be applied to managerial decision-making. This is particularly important in the context of small integrated automotive service enterprises, where most decisions are made rapidly and based on limited information.

The purpose of this section is to demonstrate how the proposed evaluation system can be applied in practice and how analytical results are translated into managerial actions.

5.1. Diagnosis of the Current State of the Enterprise

The first stage of applying the methodology is diagnosing the current state of the enterprise. Within the proposed model, this diagnosis is carried out through analysis of the three components and their interrelations.

In practice, this involves a sequential assessment of:

- the state of the technical component;

- the state of the procurement component;

- the state of the customer component;

- the degree of their coordination.

A distinctive feature of this approach is that it enables the identification not only of obvious problems but also of hidden imbalances that have not yet affected financial indicators but already create risks.

For example, an increase in service time while revenue remains stable may indicate the onset of system overload, which may later lead to deterioration in performance.

5.2. Identification of Bottlenecks

After completing the diagnostic stage, the key task becomes identifying bottlenecks within the system.

A bottleneck is defined as an element that limits the efficiency of the entire structure. In the integrated model, such an element may be any of the components or their interaction.

Typical situations include:

– shortage of spare parts under stable customer demand;

– overload of the repair area despite sufficient procurement capacity;

– decline in customer flow despite available production capacity.

It is important to note that eliminating a bottleneck often leads to significant improvement in overall system performance, as it restores balance among the components.

5.3. Principles of Managerial Decision-Making

Based on the analysis of system conditions, managerial decisions are formulated.

Within the proposed model, several key principles can be identified.

The first principle is the priority of coordination over maximization of individual indicators. Improving the performance of one component should not occur at the expense of others.

The second principle is gradual implementation of changes. Under conditions of limited resources, radical transformations may introduce additional risks, so preference is given to incremental adaptation.

The third principle is consideration of systemic consequences. Any managerial decision should be evaluated in terms of its impact on all components of the enterprise.

5.4. Management under Resource Constraints

Small enterprises operate under constraints in financial, human, and infrastructural resources. This imposes limitations on available managerial decisions.

Unlike large companies, which can develop multiple directions simultaneously, small enterprises must prioritize.

Within the integrated model, this implies:

– selecting key areas for development;

– limiting excessive investments;

– focusing on the most critical system elements.

Thus, management takes the form of optimization under resource constraints.

5.5. Adaptation Strategies

Under conditions of an unstable external environment, enterprises are compelled to develop adaptation strategies.

These include:

– modification of the service structure;

– adjustment of procurement policies;

– redistribution of production capacity;

– changes in the model of customer interaction.

The choice of strategy depends on the nature of external influences and the current state of the system.

For example, in the case of supply instability, inventory levels of high-demand parts may be increased. In the case of declining customer flow, efforts may be intensified toward retaining existing clients.

5.6. Monitoring and Adjustment

A single diagnostic assessment is not sufficient. Effective management requires continuous monitoring of the system's state.

Within the proposed approach, monitoring includes:

– tracking key parameters of the components;

– analyzing changes over time;

–   identifying deviations;

–   adjusting managerial decisions.

A distinctive feature of small businesses is that monitoring is often informal, yet its regularity plays a decisive role.

5.7. Limitations of Practical Application

Despite its applied nature, the use of the model is associated with several limitations.

First, some indicators are difficult to formalize without implementing accounting systems.

Second, the high dependence on the managerial center makes the system sensitive to subjective assessments.

Third, limited resources may prevent the implementation of optimal decisions.

Nevertheless, even partial application of the methodology improves the manageability of the enterprise.

5.8. Conclusions

The practical application of the methodological model makes it possible to consider the integrated automotive service enterprise as a manageable system.

Key conclusions:

–   system diagnosis enables identification of hidden problems;

–   identifying bottlenecks is a central element of analysis;

–   managerial decisions must account for the systemic nature of the enterprise;

–   resource constraints require prioritization of actions;

–   adaptation strategies ensure resilience;

–   regular monitoring enhances management effectiveness.

Thus, the proposed approach can be used as a tool for improving the resilience and efficiency of small businesses.

6. Conclusion

This study has proposed a methodological approach to analyzing integrated automotive service enterprises based on a structural model of interaction between technical, procurement, and customer components.

The research leads to the following conclusions.

The integrated automotive service center represents a complex system in which efficiency is determined by the interaction of its elements rather than by their isolated characteristics.

Traditional performance indicators do not fully capture the state of the enterprise, as they do not reflect the internal structure of processes.

The proposed model enables analysis of component coordination and identification of systemic imbalances.

An integrated approach to resilience assessment makes it possible to detect risks at early stages and support informed managerial decision-making.

Particular importance is given to the consideration of external and institutional factors, which exert a systemic influence on enterprise performance.

The practical application of the model improves the manageability of small businesses and supports their adaptation to unstable environments.

Thus, the proposed methodology can be regarded as a tool for analyzing and managing integrated automotive service enterprises, as well as a foundation for further research in the fields of small business and institutional economics.

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