# Efficiency of managing the production capacity of service enterprises, taking into account customer motivation

Olexander Subochev [1], Olexander Sichko [2], Michael Pogorelov [3], Igor Kovalenko [4], Nadiia Havron[5]

[1] Dnipro State Agrarian and Economic University, Serhii Efremov str., 25, 49600, Dnipro, Ukraine; subochev.alex@gmail.com

[2] National Transport University, Omelianovycha-Pavlenka str. 1, Kyiv, 01010, Ukraine; sae@ua.fm

[3] Donbass State Pedagogical University, Generala Batyuka str. 19; Slavyanks, Donetsk region, 84116; Ukraine; texfak@gmail.com

[4] Dnipro State Agrarian and Economic University, Serhii Efremov str., 25, 49600, Dnipro, Ukraine

[5] Ternopil Ivan Puluj National Technical University, 56 Ruska str., 46001, Ternopil, Ukraine

**Abstract**: A methodology has been developed for analyzing the production activities of posts, which allows identifying customers by their categories and territorial "affections", the emergence of which should be activated by a specific service enterprise. An algorithm has been developed for finding solutions for improving the quality of services and customer service conditions for a car service center. The practical implementation of the methodology was carried out on the basis of existing service enterprises for servicing trucks. Were found measures to increase the capacity of the production capacity of service enterprises, allows a particular enterprise to maintain its economic stability in a competitive environment. The criteria reflecting the production activities of the auto service enterprise are selected and justified. It is established that regular customers who apply for services more than three times, bring more revenue.

**Keywords:** service enterprise, production activity, customer, quality of services.

## 1. Introduction

Modern stage of countries' economic upturn characterized by growing of automobile park and rapid development of technical services. Competitive struggle, which appears in these circumstances, it took a problem of economic survival of service enterprises (SE) into the front view, cause to technical positions it is rely upon rational management of potential for production assets [1].

In the literature, the questions of the indicators of the efficiency of service enterprises, because they are not relevant in the condition of the development of the company as a business without any analysis of its impact on the efficiency of the economy or social status of society, are poorly covered. The only question of evaluation of efficient activity of SE was sufficiently developed and covered. The plenty number of works are devoted to competitiveness of business, customer acquisition and estimation of level of their satisfaction, expenditures on auto-care service activity and guarantee of its profitability. It concerns to estimation of auto-care service as social-economic system and provision of their efficiency from the point of living standards, this issue do not have appropriate attention [2, 3].

## 2. Literature review

Wide range of production processes on the enterprise for automobile transport drives technical service of SE to conduct a number of planning functions, organization and regulation of motor vehicle flow (MV) for maintenance and repair (M and R). The complex of such problems arises in connection with the fact, which a decrease in the total number, for example, of municipal buses and the equipment of posts and stations are complicated and correspondingly increase their value is recorded. Expensive equipment is not economically expedient to have on each SE, so it is advisable to create specialized production or create SE with full load of its capacities [4, 5].

However, in traditional methods of planning and managing the production of M and R of buses, production areas are used irrationally through the spontaneous, unregulated formation of "queues" by posts and individual performers [6].

Exploring the experience of the formation and development of industrial structures of motor transport, which provide the appropriate activities, we can conclude that the combination of the latter is not the only acceptable. A large part of production structures of automobile transport engage only in one type of activity, transferring others to the execution of outside entities. At the same time, a number of organizations combine these types of activities in certain combinations based on basic or auxiliary [7,8].

In Ukraine, in spite of the economic crisis, there is a gradual increase in passenger transportation, forwarding services and services in the field of M and R MV, provided by organizations specializing exclusively in these types of activities. This situation can be to some extent considered an objective process, which also corresponds to the general tendency that in the world economy it has observed in recent decades - economic organizations of various sectors of the economy tend to increase their competitiveness, concentrating on the main activity [9].

Functions that the SE had to provide decisive option for possible strategic directions for its further development in the transition to market relations. The MV's structural units, which were engaged in main and auxiliary activities, in many cases they transformed into strategic business units or independent specialized enterprises [10].

In modern conditions, with a decrease in the average number of MVs in carriers' parks, significant reduction of volumes of transportation by large carriers, an increase in the number of MV models, including foreign production, etc., can be expected to gradually increase maintenance and repair work, which can be passed on «to a third party». At the same time, car service companies themselves can act as logistic providers of economic organizations that provide transportation services. In fact, average annual output of post maintenance and repair was in 30% lower then it's planned. In order to ensure the economic stability of car-care service support or increase the demand for their services [11].

Along with this we noticed that issues were considerably less examined, especially those which related to influence of service quality, that're provided, on clients' decisions to repeat their requests to use services of particular enterprise [12].

Satisfaction of consumers with high-quality service will bring substantial contribution info economic growth of enterprise. In the companies, that had highest rates of quality of performed works, growth rate in annual volume of realization of services was in 9% higher, and profitability of sales was in 11% higher, then in those companies, which were worse according to these indicators [13].

Existing structure of service enterprises' (SE) assets is not workable in case of qualitative development. Absence of evidence-based methods for management of their development was not create real preconditions for establishment of promising sphere of auto-care in the face of competition. In a view of above a problem of appropriate development of auto service system has gained special importance for our country [14].

To provide with high quality of prevention and repair growing quantity of vehicles are to formulate service enterprises' production activity on scientific bases [6].

Methods of determination of rational part of enterprises with different capacities in auto service system are absent. That's defined the priority of solving the tasks made with theoretical foundation and mathematical formulation of an optimal balance between quantity of big, medium-sized and small enterprises in auto service systems of city, districts, regions and sub-regions.

A purpose of this work is increasing efficiency of service enterprises' work by rational choice of directions concern to improving the quality of services.

In the article [17, 18] describe that despite the importance of trust and commitment in relationship marketing, the scholarly inquiry on the issue is rather impeded in several ways. Also was describe that when it comes to the marketing of services and specifically for business-to-business (B2B) markets, the empirical documentation is even slimmer despite the fact that services are increasingly becoming a vital component of the product that the customers buy even when it comes to tangible goods such as computers or cars.

A tasks of this work:

To analyze research works in the area of maintenance and select the criterias, that will reflect production activity in service enterprises.

To develop methods of analysis of posts' production activity and make survey among customers of service enterprises.

To develop solving algorithm due to improve quality of services and service conditions.

To implement methods based on existing service enterprises foe servicing trucks in practice.

## 3. Research methods

Methodology of investigation based on statistical inference mathematical modelling with applying sociological methods.

Methodology of analysis of production activity on maintenance and repair and questionnaire of clients let us to receive mentioned indicators of service quality.

Repeatability of clients' services demand increases production program, confirms hypothesis and quantitative assessment of economical benefit for enterprise, which provides services through improving quality of service provisioning.

The algorithm of finding the solutions with aim to improve a quality of services and condition of relation customer care it forms analytic expression for improving a potential of production capacity of enterprises, as follows they are increasing quality and effectiveness of service provisioning.

In regime of current time it founds out the information for making the decisions on improving work of service enterprise according to indicators, which are characterize its work.

## 4. Research results

At the revising and valuation of quality system and separate components it was checked an ability to ensure compliance with the requirements throughout analysis of design, technology and normative and other documents analysis in respond to status of technical equipment, controlling means for measuring the parameters of the processes, appropriate staff. Quality system is determined by relative standard if there are no significant discrepancies or there are not more then 10 significant discrepancies.

Standards of ISO 9000 are establishing requirements to quality management system for internal use by enterprise. They were focused on application "process approach" at the design, the results were implemented and improved with aim to satisfy consumers through meeting their requirements (Fig. 1).

It is to analyze direct and cross-cutting connections between intentions and wills of customers to purchase an auto of that supplier, including re-purchase, and intentions to use services of dealer service enterprise (Figure 2). The basis of study was database about 5206 owners of cars (service customers). In a capacity of the most important factors, that have an impact on satisfaction and behavior intentions for automobile, that's became auto capacity, brake system and transmission, additional equipment. Analogous to service enterprise – wait for appointment to TS and R, the period of execution of works and quality of work, politeness of staff.

The result of work became estimation of the impact on level of customers' satisfaction with auto and their intentions to use dealer service enterprise and, in contrast, estimation of impact level of customers' satisfaction using service of SE on intentions to re-purchase them particular automobile model.
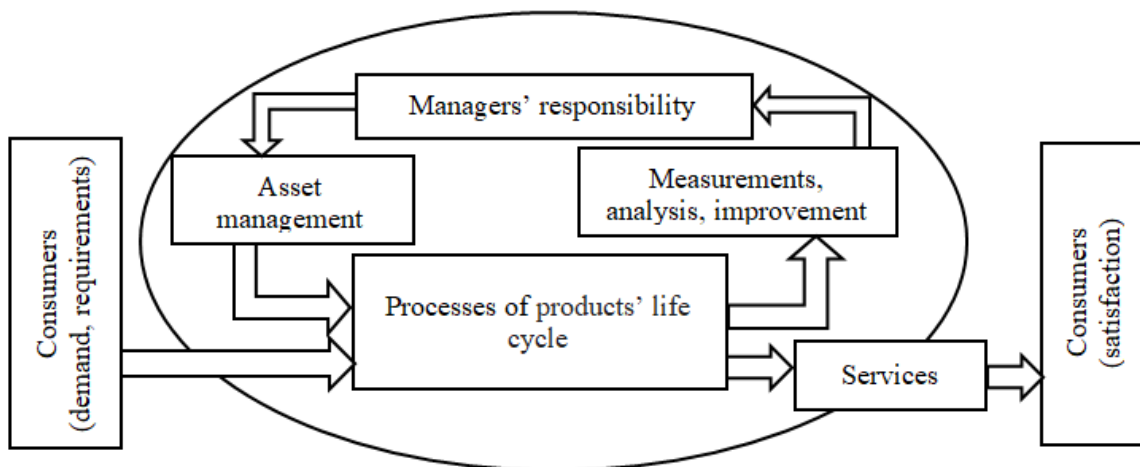
**Figure 1.** Quality product and service management, that's grounded base on process approach.



P.1 – vehicle class;
P.2 – transmission mechanism;
P.3 – brake;
P.4 – additional equipment;

P.5 – wait for appointment to TS and R;
P.6 – quality of work;
P.7 – the period of execution of works;
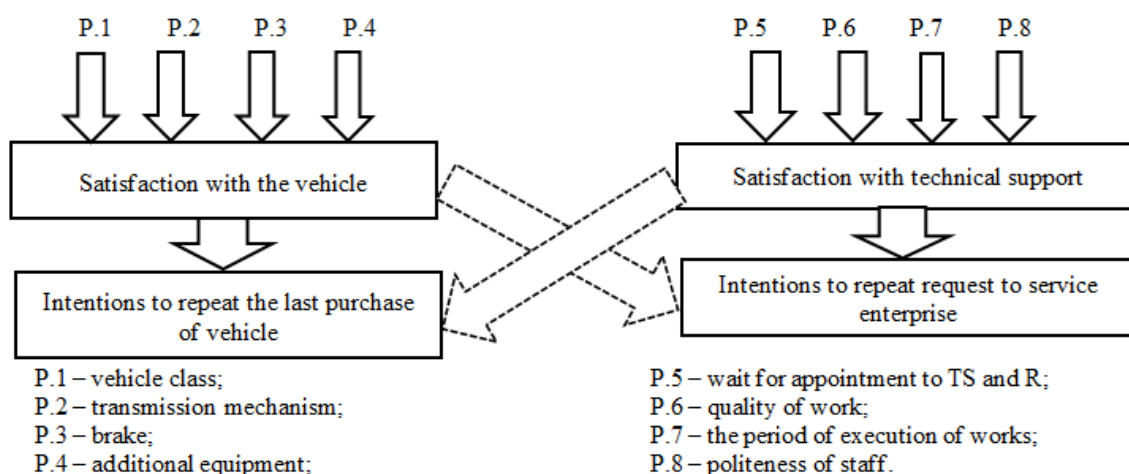P.8 – politeness of staff.

**Figure 2.** A model of interaction between intentions under power of considerable factors.

One of key feasible indicators of work performance on service enterprise and realization of potential is coefficient of using production capacities:

$$K_{PC} = \frac{T_{RPC}}{T_{MPC}} ,$$

(1)

where $T_{RPC}$ - real production capacity of enterprise; $T_{MPC}$ - maximum production capacity of enterprise.

In clients' structure, what was using for auto-care center services, presented clients, which relevant to loyal category, or to new added category, entering flow of request on services and production programs are described by further calculations:

$$\begin{cases} T_{NEW_{1i}} \cdot C_{NEW_{1i}} \cdot K_{NEW_{1i}} + T_{LOYAL_{1i}} \cdot C_{LOYAL_{1i}} \cdot K_{LOYAL_{1i}} = T_{RPC_{1i}} \\ T_{NEW_{2i}} \cdot C_{NEW_{2i}} \cdot K_{NEW_{2i}} + T_{LOYAL_{2i}} \cdot C_{LOYAL_{2i}} \cdot K_{LOYAL_{2i}} = T_{RPC_{2i}} \end{cases} ,$$

(2)

where $i$ – is an index of workshop (area) auto service; $1,2$ – the indexes of real and planned indicators respectively; $T_{NEW}, T_{LOYAL}$ - labor input of new and loyal customers' satisfaction respectively;

$C_{NEW}, C_{LOYAL}$ - quantity of new and loyal clients; $K_{NEW}$, $K_{LOYAL}$ - frequency of requests on services from new and loyal clients.

Reserve of increasing a capacity utilization rate for enterprise caused improving level of service quality on $i$ workshop:

$$\Delta K_{PC}(i) = P_i \cdot K_{PC_i} \cdot \left[ \frac{K_{ADDIT_i} \cdot K_{CLIENT_i} \cdot \left[ 1 + D_{LOYALi}{}^n \cdot \left( K_{ORDER_i} \cdot K_{FREQ_i} - 1 \right) \right]}{\left[ 1 + D_{ADDITi}{}^r \cdot \left( K_{ORDER_i} \cdot K_{FREQ_i} - 1 \right) \right]} - 1 \right]$$

(3)

Taking into account the fact, that at the same time service has technical and consumer features, the calculations of indicators with applying multiplicative method:

$$\Pi_j^{TECH} = K_j^{TECH} \cdot K_{lj}^{TECH},$$

(4)

$$\Pi_j^{EQUIP} = K_j^{EQUIP} \cdot K_{lj}^{EQUIP},$$

(5)

$$\Pi_j^{PERF} = K_j^{PERF} \cdot K_{lj}^{PERF}$$

(6)

where $\Pi_j^{TECH}, \Pi_j^{EQUIP}, \Pi_j^{PERF}$ - corresponding to average quality indicators, that are characterized technology, equipment and performers concerning $j$-type of works (services).

Considering last formulas a quality consensus representative of $j$-service investigated $i$-workshop (area) will be determined next way:

$$\Pi_j = \Pi_j^{TECH} + \Pi_j^{EQUIP} + \Pi_j^{PERF}.$$

(7)

Algorithm of solution search concerns with quality and terms of service for customers of service enterprise are including five phases, the results shown up on Figure 3.
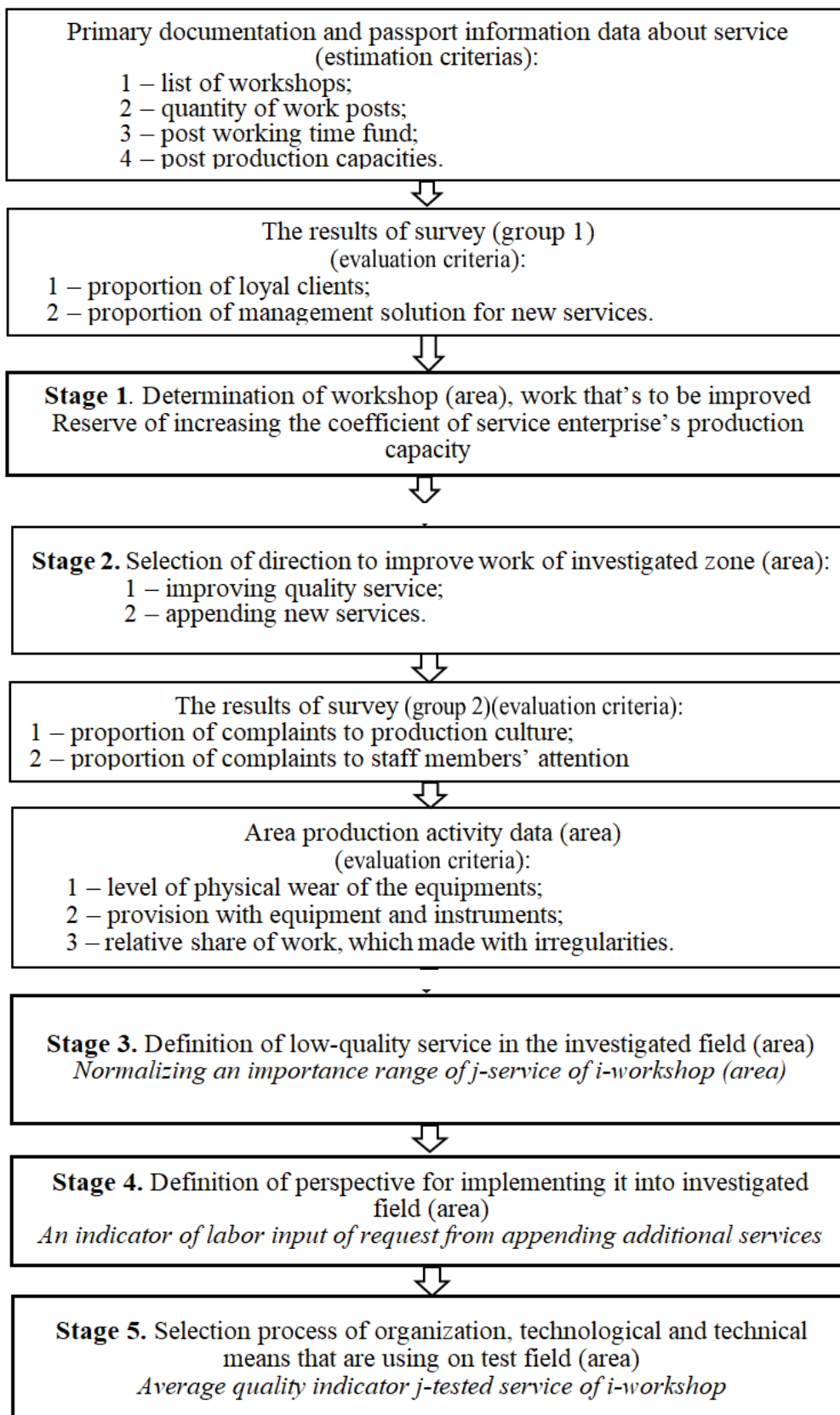
Primary documentation and passport information data about service
(estimation criterias):
1 – list of workshops;
2 – quantity of work posts;
3 – post working time fund;
4 – post production capacities.

The results of survey (group 1)
(evaluation criteria):
1 – proportion of loyal clients;
2 – proportion of management solution for new services.

**Stage 1**. Determination of workshop (area), work that's to be improved
Reserve of increasing the coefficient of service enterprise's production
capacity

**Stage 2.** Selection of direction to improve work of investigated zone (area):
1 – improving quality service;
2 – appending new services.

The results of survey (group 2)(evaluation criteria):
1 – proportion of complaints to production culture;
2 – proportion of complaints to staff members' attention

Area production activity data (area)
(evaluation criteria):
1 – level of physical wear of the equipments;
2 – provision with equipment and instruments;
3 – relative share of work, which made with irregularities.

**Stage 3.** Definition of low-quality service in the investigated field (area)
*Normalizing an importance range of j-service of i-workshop (area)*

**Stage 4.** Definition of perspective for implementing it into investigated
field (area)
*An indicator of labor input of request from appending additional services*

**Stage 5.** Selection process of organization, technological and technical
means that are using on test field (area)
*Average quality indicator j-tested service of i-workshop*

**Figure 3.** Searching means algorithm with aim to improve quality of service and their terms for service enterprise' consumers.

*Phase 1.* Determination of production field (area) of auto service, work that's should developed, it's made in respond to amount of reserve of increasing capacity utilization rate for service enterprise from improving quality services in *i*-workshop $\Delta K_{PC}(i)$.

An amount of reserve of increasing capacity utilization rate in service enterprise was defined $\Delta K_{PC}(i)$ with aid of improving quality of esistng and appending additional service on each enterprises' production areas.

In fact a maximum figure of indicator $\Delta K_{PC}(i)$ have got priority № 1 rang, and *i*-production zone is finding as the problem respectively. In case of equality distribution of indexes $\Delta K_{PC}(i)$ on two production areas (districts) selection is established on the account of another area, in such reserve coefficient rising $\Delta K_{PC}(i)$ cause to improving higher quality of services.

Following analysis will be done only for particular *i*-workshop (area) of auto service.

*Phase 2.* Selection process of the direction aimed to improve the workshop (area) includes: increasing the quality of existing areas or organization of additional services, it's determined when there is maximum reserve of increasing a capacity utilization rate for service enterprise from improving quality of services in *i*-production area:

$$\Delta K_{PC}(i) \to MAX$$ (8)

In case of equality of indicators $\Delta K_{PC}(i)$, which were obtained separately from the quality improvement and implementation of additional services, an advantage was taken to quality growth, as this direction of improvement of this activities, as follows references have shown, that it's the most relevant to modern auto-care service in competitive conditions.

*Phase 3.* Identification of low-quality service under investigated workshop (on the field) of quto service was done in condition of maximum normative range indicator of importance:

$$\Pi_{i\ j}^{N} \to MAX$$ (9)

*Phase 4.* Determination of future area for application in investigated auto service workshop conducted in condition of maximum indicator of labor-intense from introduction additional services:

$$K_{ADDIT_i}(j) \to MAX$$ (10)

It is determined an indicator of labor-intense of order $K_{ADDIT_i}(j)$ from taking additional service in the investigated workshop (on the field) of auto service. Meanwhile, a maximum value of indicator $K_{ADDIT_i}(j)$ has gotten № 1 rang of priority, and responding *j*-service was found perspective as well.

*Phase 5.* Selection of organizational, technological and technical measures on improving types of services, which were provided on this area, it's complied in the occasion of minimum average indicator of quality of *j*-services investigated *i*-workshop (area):

$$\Pi_j \to MIN$$ (11)

Selection of «weak link» in algorithm resulting from high importance of holding the clients by service staff member, that's why a necessity appears in looking for and erasing trivial defects in service process, they may lead to loss of clients and incomes. Furthermore to cut «weak link» is not reasonable way.

Service enterprise provides customers with complex services and cutting some type of works, it will cause to dissatisfaction with their needs in complex servicing for auto mobiles. This, as follows, will bring to loss of clients and incomes.

The main obstacles in applying proposed methodology lies in:

- methodology is focused on small and middle-sized service enterprises;

- reserve of increasing a capacity utilization rate for enterprise calculated only based on improving the quality and service range;

- organization of new types of works (services) in the workshops (on the fields) of auto service relavant to aspect of rebuilding (reconstruction) PTB auto service enterprise.

Found data set is a subject to statistical processing, the results are performed. The composition of clients in groups starting from 1 to 6th applications were heterogeneous. At the determination of the average weighted workload, as a mileage has taken a mileage between the customer's call to the service company.

The analysis of data of the primary documentation of truck service enterprises.

Repeat application from clients (more than 3 times) on services in the investigated truck service centers come along with double growing in labour-intense order (Figure 4).

There are not no noticeable changes in the frequency of customer referrals to a service facility and inter-repair mileage – most of clients using services with monthly periodicity.

The histogramme of general mileage on car starting from exploitation and age of the car at the moment of 1st -6th clients' appeal to service facility was designed (Figure 5, 6).
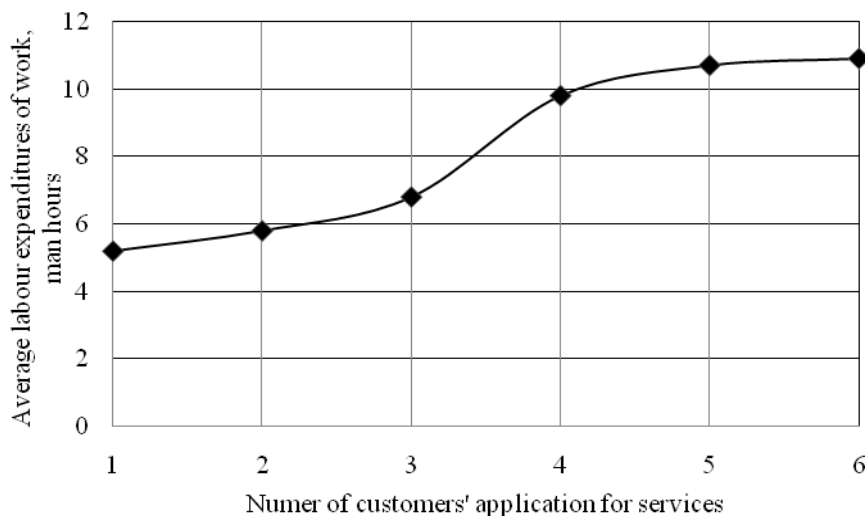


**Figure 4.** Variation of labour-intense of services in relation to number of customer's application to service enterprise.
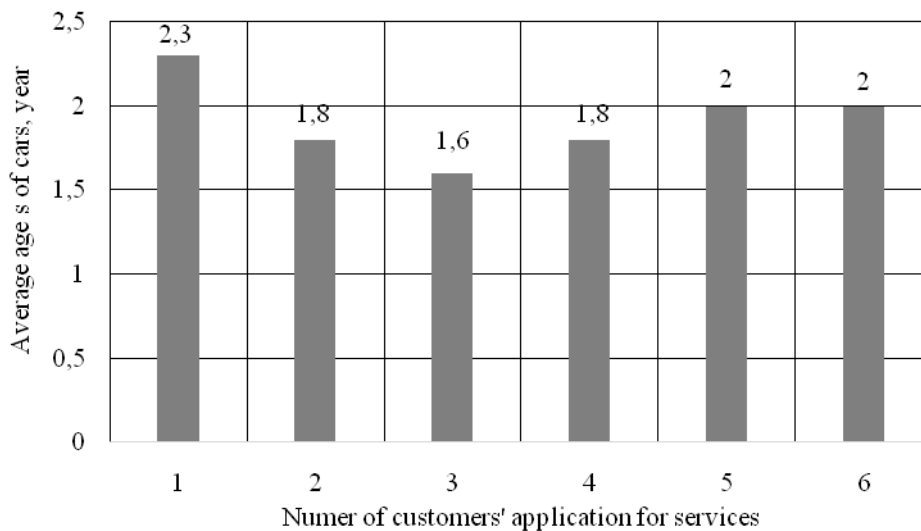


**Figure 5.** Age structure of clients' auto park divided into groups.
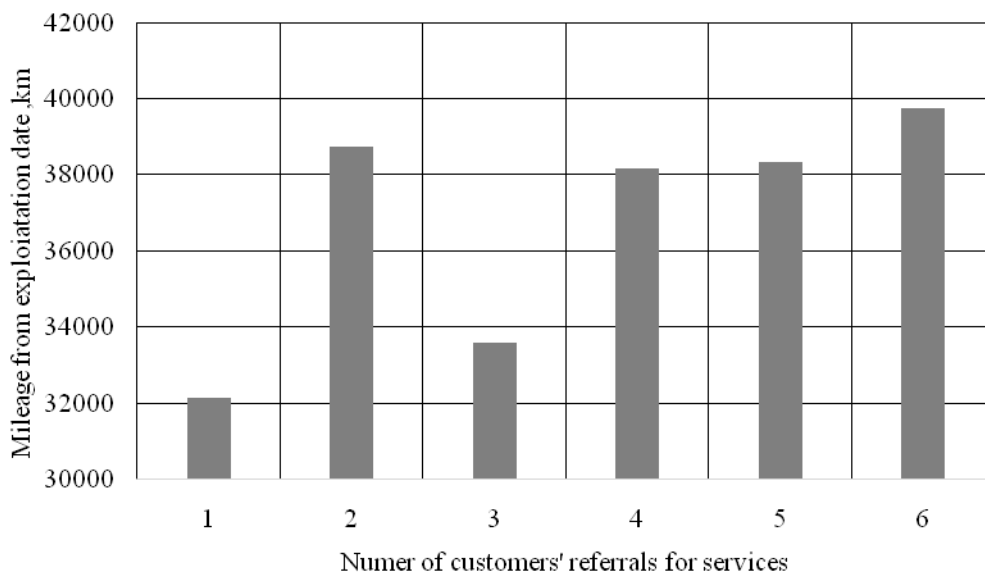
**Figure 6.** Allocation of mileages on cars from the beginning of exploitations divided into groups.

Income (hrn/km of mileage) or average weighted labour-intense of complied world on auto mobiles' work (man hours /1000 km) it's increasing along with growing clients' referrals to service enterprise (Figure 7). Average weighted labour-intense of services, that required by loyal clients, in average in 2 times higher, than in primery clinets and concludes approximately 3-3.3 man hours / 1000 km. For this reason holding and loyal customers are more profitable for service enterprise.
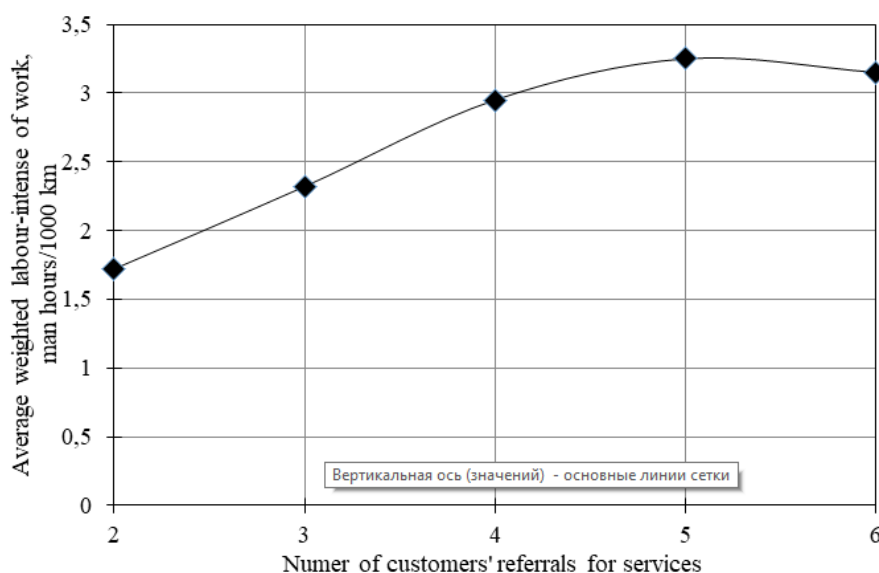


**Figure 7.** Change of average weighted labour-intense of services in dependence of number of customers' referrals to service enterprise.

Assuming the findings from analysis of age structure of auto park and mileages starting from exploitation of the clients' automobiles from various groups of referrals, they weren't disclose strong pattern of index changing at the re-referrals. We can come to conclusion that: single-use and average weighted labour-intensity of services, which are required by clients, that's caused by building trust to firm, it occurs in case of repeat application for services.

Increasing confidence in work quality for those investigated truck service enterprises (from 3-rd, 4-th appliances) goes with growing a volume of order due to inclusion of some ancillary, that client accepts, and appearance of a large-volume work order, which client did himself before or in another auto service. As a result single-use and average weighted labour work have risen.

The empirical values of the criterias $K_{3AK_i}, K_{ЧАСТ_i}$ for the management potential of the production capacity of freight service enterprises have such figures, as $K_{3AK_i}$ = 2, $K_{ЧАСТ_i}$ = 1.

Experimental studies carried out on freight service enterprises, they show that: loyal clients of auto service, who applied more that 3 times, they took bigger profit; for service enterprise it's reasonable holding customers on service in connection with higher economical upturn from loyal clients.

The empirical values of the criterias $K_{3AK_i}, K_{ЧАСТ_i}$ are management functions of production capacity potential of service enterprise using the solving algorithm for improving client servicing.

The main customer of car-care service is private companies, which have got up to 14 automobiles (Figure 8). Relative weight for those customers is - 78%. The majority of them have got auto park of up to 4 items.

Adjustment factor takes into account seasonality of receipt of applications for repairs. In the frames of TS and TR have taken place dispatch center for co-operation with customers. Reception and registration of order for repair is complied with dispatcher in agreement with foreman of production area or master of the reception. Dispatcher is making a description of a car, an external inspection, receipt paperwork, calculations on the cost of services.

Service receptionist agrees with customer a volume of work, spare parts, time for accomplishment and release of order date, and he provides consultations on the question of maintenance and repair of car.

After placing the respective values:
- in conditions of increasing of work quality, provided
1. Area for diagnostic of engine: = 5%;
2. Areas TS and TR: = 2%;
3. Area for repair of aggregates: = 1%;
- in condition of new type of services organization:
1. Area for diagnostic of engine: = 1%;
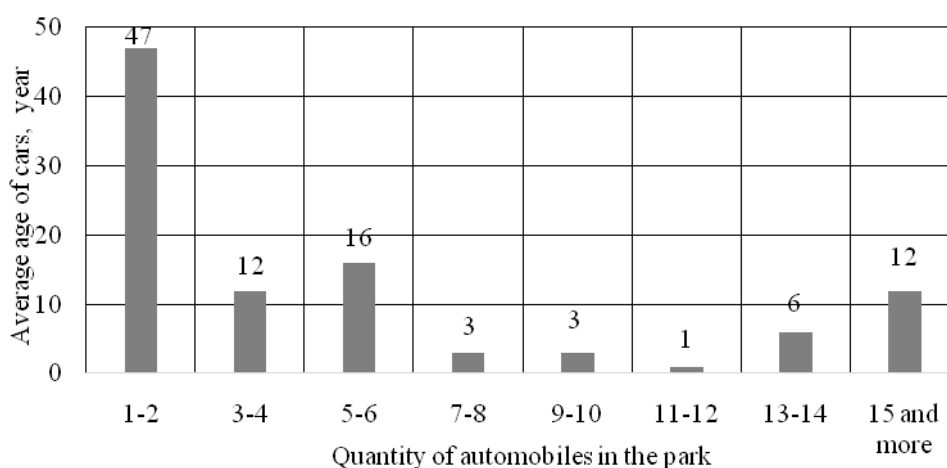2. Areas TS and TR: = 1%;
3. Area for repair of aggregates: = 1%.



**Figure 8.** Customers' distribution by quantity of automobiles in the park.

On Figure 9, 10 have shown graphic interpretation of service quality on diagnostic of engine. The resulting quality feature obtained by general data of the questionnaire of clients and the data on the production activities in the areas.
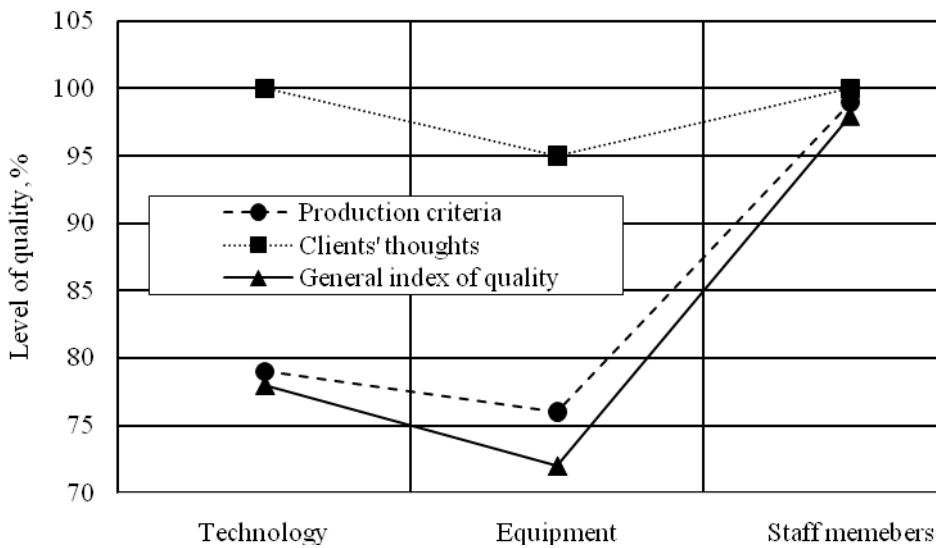


**Figure 9.** Tests of low level quality of diagnostic and inspection works.
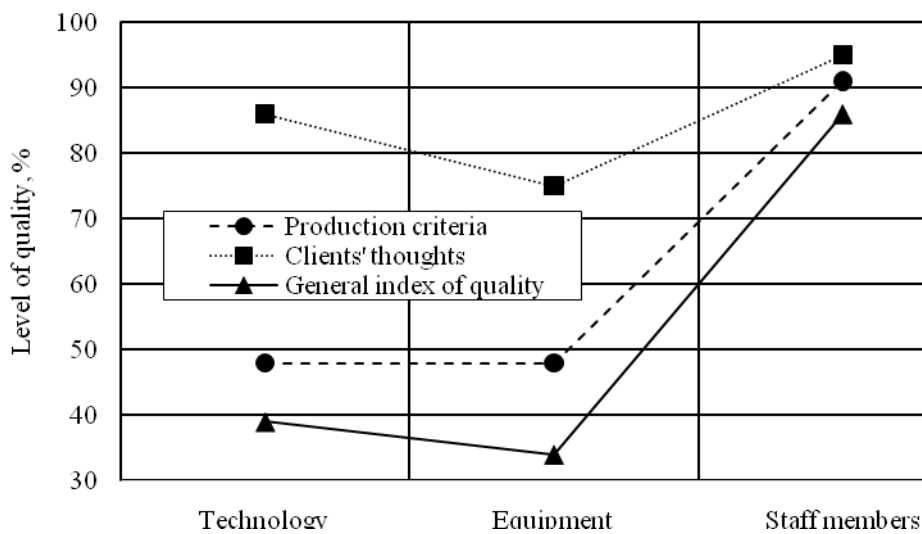


**Figure 10.** Investigation of low level of work quality with servicing the fuel equipment.

In order to increase a quality of work of fuel systems (Figure 4, 5, critarias «Technology», «Equipment») is technological equipment for working place in respond to typical requirements and insertion of main technical equipment on needed technical conditions.

Realization of methodology of managing a potential of production activity on particular facility allows to increase a coefficient of $K_{B\Pi}$ to 5%.

## 5. Discussion of the results

Today is given attention to principles of design and building of service enterprises, optimization of location, valuation methods and indicators of production-technical base (PTB), feasibility studies on volume and capacities of SE, but also on design issues [16].

The key factor of market successes of the companies are bringing in and holding of clients, taking into account effective measures done to satisfy their needs. The main directors of increasing power on the market are developing of cooperation service centers with dealers in proving services for clients' automobiles, «information service», «off-premise service», «exchange of appliances service», «service in terms of contract with enterprise» [13].

Apart from this, it's assumed, that enterprise conducted maintenance services according to technologies and SE standards, the results of work was handled by responsible representative from auto center. Oral complaints, that were raised from clients to staff members, it's not paid particular attention, meanwhile they quantity is increasing quantity of written complains in 10 times [1].

## 6. Conclusions

Analysis method for posts' production activity and questionnaire of service enterprises' customers was done. A survey of revised enterprises let to discover clients according to their categories and territorial affiliation, appearance of those should be activated in particular service enterprise. For instance, on checked service facility is to activate customer appearance, who are in radius of 7 km from SE.

The algorithm of solution seeking on improving quality and terms of services was designed. Modeling allows to intentify main solutions aimed to develop working process in the enterprise with high profitability in amount of 90% and relative mistake in amount of 5%.

Practical realization of methods based on existing service enterprises for managing trucks was done.

The measures to increase a potential of production capacities of service enterprises were found, and the conclusion of this it allows a separate enterprise keeping its economic strength in competitive conditions.

The factors, which describing production activity of auto service enterprise were selected and grounded.. In fact, a key factor is share of loyal auto service customers. In order to maintain stable work of enterprise this factor must be no lower than 60%.

It was found, that loyal consumers, which have applied for the services more than 3 times, they brought higher income. Average weighted labour-intense of services (man hours /1000 km), required by loyal customers approximately in 2 times higher, that the same indicators fist clients have. It brings into the front view the measures for holding existing clients.

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