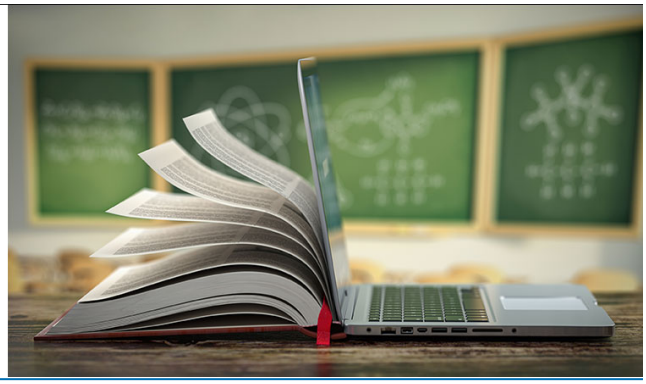
# Improvement of the workers labour rationing and motivation methodology for the manufacturing shop







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# Improvement of the workers labour rationing and motivation methodology for the manufacturing shop

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**Abstract**. The hypothesis considered in the work is that it is possible to normalize all works carried out at the production site and to use these norms to build a successful system of remuneration and motivation of personnel. To prove this hypothesis, the most complex and responsible in margin terms load section of the production plant was chosen. The work analyzed the causes of downtime and their impact on the productivity of workers and on the level of remuneration. The method of determining the worker 's earnings depending on the unit of indicators and parameters is proposed.

## 1. Introduction

The labour rationing in modern conditions is becoming an increasingly important parameter of the enterprise efficiency. For any ownership forms enterprises, the issue of productivity growth is relevant, this issue is particularly acute for the defense-industrial complex enterprises. [1,2,3] The modern approach to labor rationing and motivation involves the development and implementation of programs aimed at maximizing the use of labor resources by expanding the areas of labor rationing, ensuring the quality of the developed norms, the rationing process automating and ensuring the copied result. [1].

The modern approach to rationing and motivation is based on extensive foreign and domestic experience, application of rationing methods and mechanisms developed more than 50 years ago [4,5,6]. There is no doubt that the basic approaches and mechanisms (such as activity sampling, timing, norm calculation methods) are unchanged. On the other hand, the technology development level, peculiarities of production and labor modern organization, modern equipment specificity, operating rate, etc., require change and updating of approaches to labor regulation, as the existing norms are outdated, which do not reflect the real level of labor costs. For example, it is the microelement rationing system, which in modern conditions becomes relevant, on the one hand, because it allows to solve the problems facing the modern enterprise, and on the other - modern automation systems allow to reduce labor costs for the implementation of the microelement rationing system itself. [7] Another important factor is the use of information technologies in the process of the labour rationing, the solution of this task will not only increase the efficiency of specialists' work, but also improve the quality of norms and standards [8,9,10]. Thus, the problem of improving the production workers work standardization methodology seems relevant, as it will increase the production efficiency by increasing the productivity, ensure the accounting of working time, as well as the possibility of planning the production activity of the unit and the number of personnel.

The new wages calculation system of the pipe-electric welding unit workers, introduced in February 2015 on the enterprise, showed its high efficiency, this results were presented in publications of authors. At the same time, subsequent data collected between February and March 2015 revealed the need to solve the auxiliary works issue, namely the order of their rationing and accounting in cost.

## 2. Materials and methods

The established norms together with the agreement on payment of service and repair works at the rate of locksmiths-mechanics allowed to modify the wages calculation procedure for employees of the production line. The formula has the form:

$$W = A*X+B*Y+C \quad (1)$$

where W - salary for the past month (here and hereinafter one working unit is considered),
A - the cost of the production hour calculated from the maximum possible wage of the employee;
X - the number of production hours;
B – the cost of non-production hour;
Y - the number of non-production hours;
C - stimulating or depositing additive/deduction taken at the end of the month at the discretion of the direct or senior manager; Is entered as an additional variable, the default is zero.

The formula (1) was converted to the following formula (2):

$$AP = A*X+B*Y+D*Z+C \quad (2)$$

where D - the cost of an hour of additional work,
Z - the number of hours of additional work.

The number of additional works hours (Z) is the number of hours that corresponds the standards for repair, line maintenance, parts replacement, etc. This number is established on the basis of reports received for production and according to the standards for performance of the corresponding works. In rare individual cases, the decision on the required number of hours is made individually.

The cost of the additional works hour (D) is assumed to be equal to 70% of the production hour cost (A). In this case, the cost of such an hour is equal to the work hour cost of the locksmith and mechanic. The introduction of such payment spurred the working areas to carry out almost all repairs, except the most difficult ones, by their own forces.

In such case, the number of non-production hours (Y) is defined as the difference between the hours specified in the team timesheet (Ttsh)and the number of production and additional hours:

$$Y = Ttsh - X - Z \quad (3)$$

And then the general formula will be the following:

$$W = W_{max} * T_m^{-1} * \left(\sum_{i=1}^{n} N_i * No_i^{-1} * +8m + 0.7Z\right) + W_o * T_m^{-1} * \left(T_{tsh} - \left(\sum_{i-1}^{n} N_i * No_i^{-1} + 8m + 0.7Z\right)\right) + C \quad (4)$$

Where
Wmax - the maximum wage per month for a particular brigade employee;
Tm - the number of hours in the past month according to the working schedule.
Ni - the number of pipes released over the past month;
No - the rated number of pipes per hour that can be released at the maximum possible actual speed without stops for a particular pipe size
Wo – the base part of the wage

The introduced pay system, based on the rationalization of all works - basic and auxiliary - also plays the role of motivation system on the site. Of course, the motivation system in the classical presentation takes into account not only wages and their level, but also all kinds of additional incentives, bonuses and fines. Including the social position of a skilled worker, encouragement through certificates and award tickets for various events, etc. However, here we consider the system of motivation based on monetary encouragement in the form of the received salary.

## 3. Results and discussion

The analysis of production reports carried out in parallel with the previously described system of rationing and remuneration formation process, allowed to highlight some common groups and types of works, both repeated and performed sporadically. Among all such works, the following are highlighted:

- Preparation of materials for production: import of strips from the external warehouse and subsequent layout by grade in the internal warehouse. In winter it is additionally necessary to keep such rolls and strips in the shop for heating to a temperature above 10 ° C;
- Current replacement of the saw disk;
- Current ferrites replacement;
- Current inductor replacement, clipping or replacement of plastic tubes of inductor cooling system;
- Current replacement of the grating cutter (nip) and finishing cutter;
- Emergency replacement of bearings in rolling and intermediate stands;
- Emergency replacement of drive shafts and elements of rolling mill mechanical units;
- other causes.

Summation of data on downtime for the period of 8 months showed that downtime on average per day shift is up to 35% of the duration of the whole shift, per night - up to 50%. The allocation for reasons of downtime is presented on Figure 1.

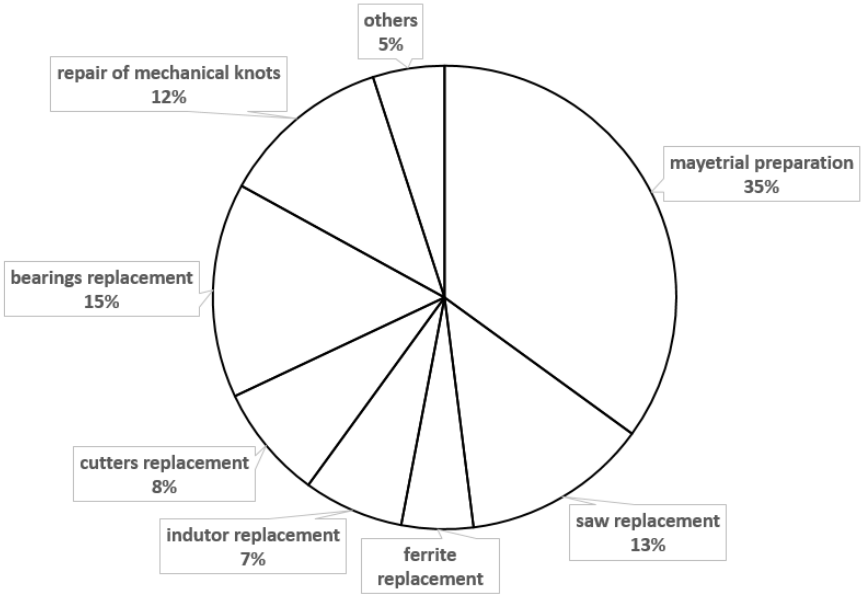


**Figure 1.** The allocation for reasons of downtime

The greatest concern at this stage of the investigation was the downtime associated with the material preparation: on average, 35% of the total downtime of the production line was spent on working with the workpiece (strip) - bringing into the workshop, sorting, laying out in-house warehouse, working with tags and labels, accounting for incoming raw materials. This practice developed during commissioning on the described production line and lasted for more than a year without change.

Taking into account the rather low average market wages of low-skilled workers involved in logistics operations at the enterprise during the described period, it was decided to exclude such operations from the daily duties of employees of the pipe-electric welding mill team. All the raw materials manipulations were assigned to a slings team, which for this purpose needed to be strengthened by two additional workers in each shift.

This approach made it possible to free up production time, but far from the size it was reflected in production reports. The reason for this paradox turned out to be simple: earlier at this time - in parallel with the import of raw materials into the workshop - some repair, service and adjustment works on the line were carried out and such breaks were "cheered" in logistics operations, without reflecting in reports. After the described changes, each line stop for the purpose of performing any of the service or repair operations became visible and recorded in the reports in an explicit form, indicating the duration in minutes or hours. As a result, the number of registered downtime for reasons other than logistics has increased.

On average, the number of downtime during the next two months averaged 40 hours per month. The distribution for downtime reasons is presented on Figure2.

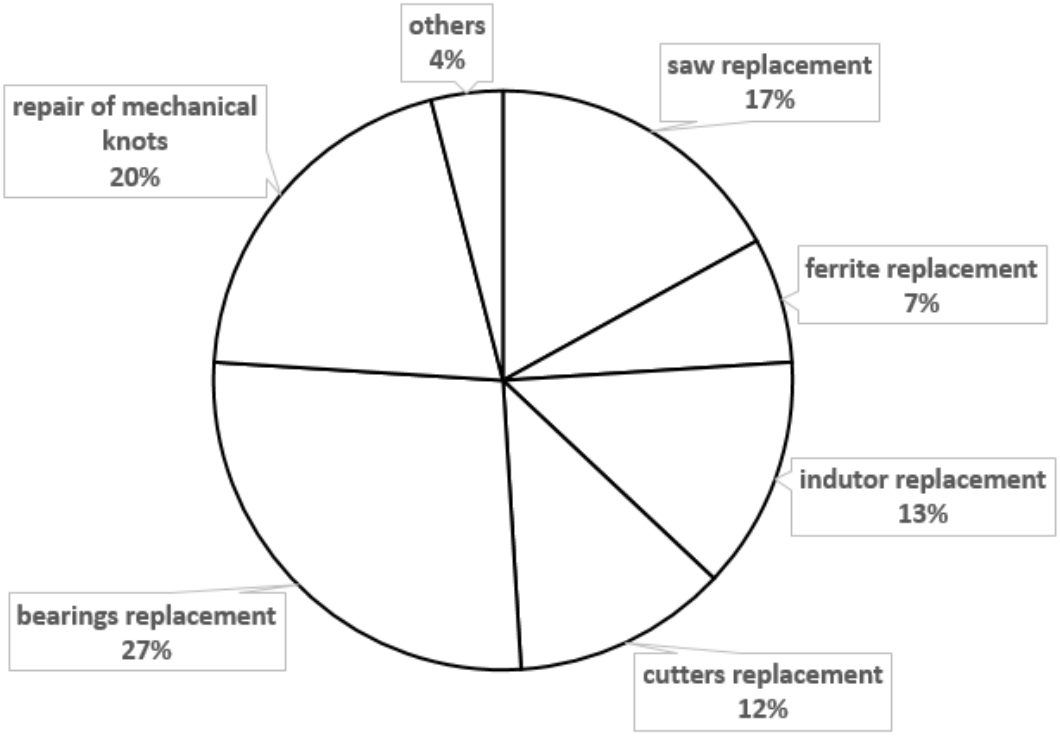


**Figure 2.** Distribution for downtime reasons

Based on the updated data obtained, as well as using statistics and reports on the production of the previous observation period, some facts have been revealed, on which a number of conclusions have been drawn:

1. The average stability of the saw disk was 1300 cuts, which corresponds to the saw operation time from 10 to 18 hours, depending on the number of downtime during the shift;
2. Two men from the team are involved in the replacement of the saw disk;
3. Average resistance of cutters and cutters of the grating device is from 20 to 25 hours of line operation;
4. Replacement of cutters and cutters by one person from the brigade;
5. The ferrites resistance was comparable to that of inductors, both of which were sufficient for the production of about 5000 pipes, after which ferrites had to be changed, the inductor changed or repaired;

6. Bearings were the first to fail in drive stands, as a rule before the first breakdown after re-adjustment bearings managed to work 7-8 shifts, in rare cases less than 6 shifts, by the 10th shift bearings began to fail already several pieces per shift;

7. Repair of drive shafts and other mechanical units, as a rule, was carried out not more than once a month, mainly parts of cardans and elements of gears failed;

8. When replacing bearings and repairing mechanical units, a team of locksmiths-mechanics was involved, which together with the employees of the production team additionally served this line, all these specialists were trained by the equipment supplier.

Observations showed that in the repairs on the line for any reason, together with the four most qualified workers of the production brigade, three mechanical locksmiths were involved. While simultaneously not more than two or three people carrying out the repair operations, the rest only observed and participated in the discussion of the problem.

Taking into account the fact that in the current period the production team employees wages were already calculated according to the new approved method, the team tried to minimize all service and repair operations. As a result - the quality of performance of such works significantly decreased, which in turn led to short-term (1-1.5 weeks after the introduction of the new method) increased average working productivity, after which there was a sharp increase in the number of repairs, increased wear of the tool to the not repairable condition.

One of the proposed ways to solve the problem of repairs was tested: to reward service specialists for trouble-free work. For the time while the production line was in operation, the link of locksmith mechanics serving this line received wages from the calculation of salary plus the maximum premium. If the line stopped, this link received only a guaranteed minimum salary on hours until the repairs were over. This was supposed to increase motivation for maintaining the line 's operability, maintaining it and preventing breakdowns.

This system was launched in test mode and showed its failure in the conditions of the described enterprise - the link of locksmiths refused to go to the site and perform the necessary works. Sabotage of such a system of motivation and remuneration led to the dissolution of the link, employees were transferred to other sites.

Discussion of the current situation with the most qualified employees of production teams gave impetus to the implementation of the previously planned idea - to assign responsibility for maintaining the efficiency of the line directly to the production team. Taking into account the fact that the number of employees in such a brigade is seven, it was possible to create the necessary base for carrying out the above-described service and repair works by the brigade after a small improvement of skills, and only in exceptional cases to resort to the help of specialists of the Department of Chief Mechanic of the plant.

The suggested payment system is to set the cost of the hour of performance for service and repair works at the level not lower than the cost of such hour at the locksmith-mechanic with3 the corresponding qualification.

Taking into account the already accumulated extensive statistics and fact-finding described above, often performed service and repair works were possible to normalize. In addition to the rationing for such works, maintenance standards for the pipe welding unit have been developed and implemented quite quickly.

So, for example:

- Replacement of saw disk and cutting tool of the grate-collecting mechanism must be performed simultaneously before changing within the limits of rigid established standards for these works. Side effect - less wear of structural elements of cutting tool and improvement of its operation quality (less skewing and emergency failures - scraps, chips, etc.);
- Mandatory maintenance of inductor and its cooling system is introduced at the moment of ferrite replacement;
- Standards for replacement of bearings are established (15 minutes in intermediate stands, 20 minutes in drive stands);

- Duration of the line operation before re-adjustment is limited to ten shifts, at the moment of re-adjustment mandatory replacement of all bearings in the stands was carried out;
- Rules and regulations for servicing the main nodes of the line have been established, as a result, the number of breakdowns and forced stops of the line has decreased.

The established maintenance time standards and the introduced regulations eventually reduced downtime by almost half - from an average of 40 hours per month to 22. At the same time, the distribution of reasons for downtime according to the results of observations as it shown on Figure 3.

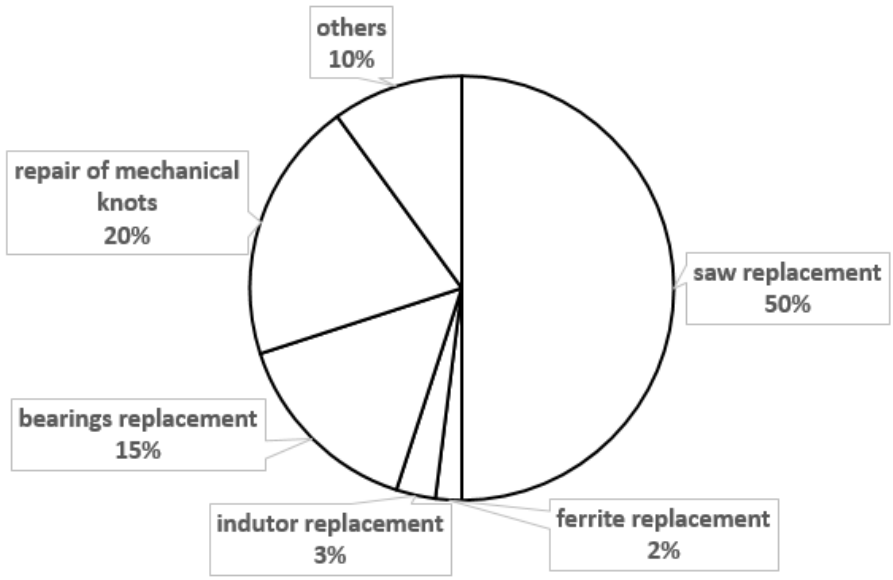


**Figure 3.** Distribution of reasons for downtime.

As can be seen from the diagram, unscheduled stops significantly decreased and averaged no more than 11 hours per month.

## 4. Conclusion

The results obtained under the conditions of the active site were even higher than expected. All employees increased their average monthly wages, the enterprise received an increase in productivity and absolute figures for produced products in tons with simultaneous reduction of the share of wages of the main employees in the cost price of the unit of production.

It is worth noting that the developed technique relies on the absence of auxiliary time in its classical sense. However, after certain modifications to the conditions of specific enterprises, this system can be used in mechanical processing workshops focused on serial or large-scale production.

For such adaptation, it is necessary to bring the current standards of basic time to the total norm per unit of production per hour or per unit of semi-finished product per hour. By using reports or by inviting highly qualified specialists, you can set the average productivity for the types of work in question. After making the stock one way or the other, summarize this data with the standard of hourly production. By extending this norm to all operations of the machine-section-line, it is possible to obtain data on the actual production capacity. Using this knowledge, it is possible to find a compromise between the employee and the employer on the issue of wages and to develop a suitable wage system.

Naturally, knowing precisely the given, hourly productivity, it is possible to develop such a system of remuneration of labor piece (for example, for small-scale production), or time (for mass production). In both cases, these systems will be somewhat hybrid and account for multiple factors.

In order to save staff, it is possible and necessary to retrain personnel to combine professions, then it will be possible to save some jobs, free human resources or reduce costs.

All the measures considered and the proposed methods passed the test at other sites of the subject of the study. Approximately similar performance results were obtained everywhere.

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