Modeling of the business process of workers' remuneration as an integral part of a balanced scorecard

Helen Matveeva, *Svetlana* Simagina, *Daria* Yuskaeva, and *Violetta* Evstafieva*

Povolzhskiy State University of Telecommunications and Informatics, Lva Tolstogo str. 23, Samara, 443010 Russian Federation

Abstract. The article is devoted to issues, related to the development of a system of remuneration for workers of a manufacturing enterprise. The enterprise is considered from the point of view of modeling business processes in accordance with the concept of a balanced scorecard (BSC). The importance of modeling the business process of workers remuneration in the context of digital transformation of the enterprise is shown. The efficiency of the entire production process largely depends on the business process of remuneration, which has a significant impact on the efficiency of the enterprise as a whole. The use of computer equipment and information technologies allows not only to form reasonable shift tasks on a daily basis and objectively take into account their implementation, but also to build a fundamentally new remuneration system. In the developed management systems in the conditions of digital transformation, it becomes possible to quickly, differentially and reliably assess the labor results of each employee and the workshop or site as a whole, ensuring economic interest in strictly performing planned shift tasks. The implementation of this method leads to increased motivation and productive, high-quality work, to economical use of material, energy and other resources.

1 Introduction

The efficiency of the entire enterprise as a whole depends on the processes of organizing and managing the main and auxiliary production at all stages and levels, from receiving an order to selling products, in relation to resource, material, financial and personnel support. Planning of production activities includes the development and adoption of decisions based on the set strategic and operational goals (collection and processing of information, monitoring the progress of basic production processes), as well as the organization and coordination of the activities of employees of the enterprise [7-9]. A very important issue that affects the overall efficiency improvement is the motivation and incentive of workers who directly perform production tasks. Motivation and incentive issues are an important component of the organization and management system and are included in the production process model that affects the sustainable functioning of the enterprise [1-4].

* Corresponding author: Violetta.9845@yandex.ru

Improving the management processes of a manufacturing enterprise requires an individual approach to each business process. It is necessary to take into account a significant number of parameters: the specifics of the products produced the type of production, the technical equipment, the level of production organization.

Solving the problems of effective enterprise management is currently possible only on the basis of digital transformation of the main directions of the enterprise's production activities-marketing, production processes, finance, human resources, and the labor remuneration system.

When developing the concept of planning and managing production enterprises, one of the important tasks is to coordinate strategic and operational activity plans. Strategic plans are developed on the basis of long-term strategic goals and determine the overall direction of action to achieve the global goal. Operational plans are the implementation of strategies, for which it is necessary to clearly coordinate the strategies of enterprises with specific actions. A modern systematic approach to linking strategies with operational management is the concept of a balanced scorecard, developed by D. Norton and R. Kaplan and widely used to improve the principles of managing the functioning of enterprises [6]. It is based on the identification of four basic aspects of activity – financial, production, consumer and innovation (Figure 1) [6,1,0,10]. These aspects are the main ones for the development of strategic goals of the enterprise and are determined by aggregated key indicators, such as competitiveness, innovation, employee motivation, including fair remuneration, as well as attractiveness to customers.

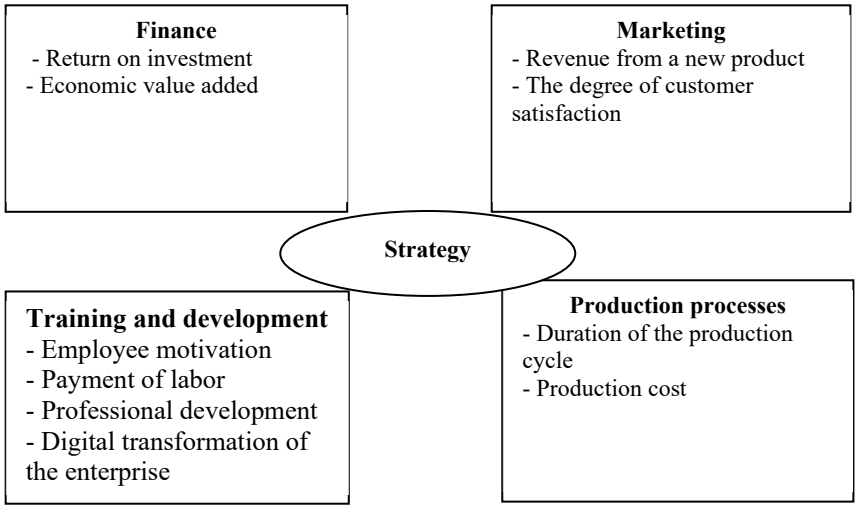

Fig. 1. SSP system modules.

MTSP is actually a system planning and management methodology. It's main provisions are:

- Transition from strategic to operational plans;
- Identify ways to achieve the business unit plans.
- Sharing information and communicating strategic plans to lower levels of the hierarchy.
- Establishing feedback;
- Initiating staff training processes;
- Motivation of employees (including labor remuneration) and others. [6,10].

The task of the MTSP is to translate the strategy into specific business plans and measurable performance indicators of enterprises. These indicators determine the internal characteristics of business processes that have the greatest impact on production performance, innovation and development processes, as well as marketing data for shareholders, partners and customers. The main purpose of the MTSP is to link all aspects of activity into a single system of organization and management and motivate all employees to achieve the strategic goals of the enterprise.

Operational planning is built on the basis of a systematic approach due to the centralized development of a set of multi-level interconnected plans for production divisions of the enterprise, drawing up a calendar schedule for the production of products, specialization of workplaces, etc. [1,4, 7,9]

Operational planning is the delivery of production tasks to direct performers. Its objectives are to influence and develop incentives to improve the use of equipment, reduce the cost of production, accelerate the turnover of working capital, increase profitability, and increase labor productivity.

The incentive function is expressed in encouraging workers to perform shift tasks in full volume across the entire nomenclature, which leads to an increase in qualitative and quantitative indicators that affect labor productivity and wages. Stimulating workers has a direct impact on the growth of production and improving the efficiency of using all types of enterprise resourcesя. The salary is calculated depending on the results of the worker's work. In order to receive higher wages, a worker needs to improve their skills, intensify their labor activity, and achieve higher quality labor indicators.

Analyzing the main provisions of the MTSP concept, it can be seen that one of the most importantих components is the labor remuneration system, which has a significant impact on the regulation of the production process. To create a system of remunerationы for labor, it is necessary to form an appropriate methodology that allows you to quickly and impartially calculate wages and bonuses for work performed.

2 Results of applying the unprocessed methodology

The creation of a wage system that encourages individual shift tasks to be performed by workers and the production plan as a whole is an important condition for ensuring the effective functioning of a production enterprise in a given mode with minimal deviations of the actual course of production from the planned calendar schedule [4-5].

In the existing production enterprise management systems, the formation and recording of shift tasks performed by craftsmen is subjective, often formal, or not conducted at all. An individual bonus is awarded to workers once a month for the amount of work performed, according to the completed closed orders and the established percentage of the bonus for the structural division for certain types of work.

The tasks of daily forming and recording the performance of shift tasks, remuneration depending on daily results require a large amount of labor and time for craftsmen, employees of labor and salary bureaus, economists, accountants, and at the same time efficiency in their solution, which can only be realized in the context of digital transformation.

The use of computer technology, information technologies, and the solution of optimization problems make it possible not only to form reasonable shift tasks on a daily basis and objectively take into account their implementation, but also to build a fundamentally new remuneration system.

In the developed системах управленияproduction enterprise management systems, it becomes possible to quickly (daily), differentially and reliably assess the labor results of each employee and division (shop or site), ensuring economic interest in the strict implementation of shift tasks and the division's plan as a whole, increasing motivation for productive, high-

quality work, for the economical use of material, energy and other resources used in the in the production activity of resources [4, 7, 10]. The formation of labor remuneration is shown in Figure 2.

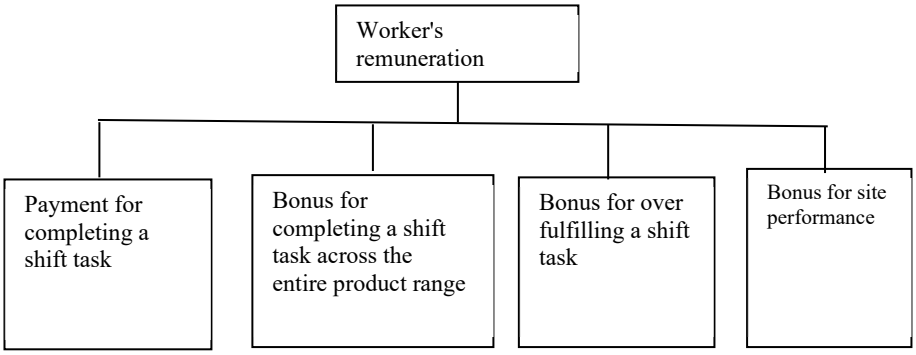

Fig. 2. Forming a worker's salary.

The bonus is awarded to each employee depending on their individual indicators (daily and monthly) and on the performance of the division for the month.

A daily bonus is awarded to each worker for the amount of work performed per shift only if they complete the shift task for all planned positions. Over fulfilling a shift task is allowed only by processing parts scheduled for the next shift.

A replacement task is considered unfulfilled if at least one item from the task is not completed in full or a smaller batch is completed, even if the batches for other items are exceeded. No bonus is awarded for unfulfilled shift tasks. The bonus is also not awarded for completed shift tasks, but those completed late or untimely [4, 10].

The daily accrual of an individual bonus to each worker for performing a shift task P_{cm} of PCM with piecework is carried out according to the formula (1):

$$P_{cm} = K_{cm} \times \sum_{i=1}^{m} C_i \times n_i, \quad (1)$$

Where K_{cm} is the bonus coefficient awarded for completed shift tasks.

- m - Number of detail operations performed per shift (1,2,3..).
- C_i - the price of the i-th detail operation.
- n_i - processed batch of parts for *the* i-th operation.

The daily accrual of an individual bonus to each worker for performing a shift task *of* P_{cm} the PCM with time-based remuneration is carried out according to the formula (2):

$$P_{cm} = K_{cm} \times z_j \times \sum_{i=1}^{m} t_i \times n_i \quad (2)$$

Where z_j is the hourly rate *of the* j–th employee.

- t_i ti - operational time for the i-th detail-operation.

The individual bonus of the worker for the completed monthly volume P_{mo} work in n / h is calculated at the end of the month, provided that the worker in the billing month *has* $K_{vn} > 1$, where K_{vn} is the coefficient of compliance with standards.

If a worker *has* $K_{vn} < 1$, then this month's volume bonus is not credited to them.

$$K_{vn} = \frac{\sum_{i=1}^{k} t_i \times n_i}{T_f} \quad (3)$$

The coefficient of compliance with the norms K_{vn} is calculated for each worker for a month using (3):

Where k is the number of detail operations performed in a month.

- T_f - time limit for the month.

The bonus for the amount of work performed per month is calculated according to the formula (4):

$$P_{mo} = K_{mo} \times \sum_{i=1}^{k} t_i \times n_i \quad (4)$$

Where K_{mo} is the bonus coefficient for the amount of work performed.

The value of individual bonus coefficients for performing shift tasks K_{cm} and based on the results of work for the month K_{mo} is determined depending on:

- Depending on the types of standards (calculated and experimental statistics).
- Depending on the type of work (automatic machines, machine tools, locksmithing, etc.);
- from the labor remuneration system (piecework and time-based);
- Depending on the degree of intensity of shift tasks (when planning shift tasks with a K_{vn} exceeding the average K_{vncz} set for this type of work).
- Depends on the degree of intensity of the monthly task (when planning the total monthly volume of shift tasks with K_{vn} higher than the average K_{vncz} this type of work) [4.10,10].

If a worker fails to perform shift tasks during the month, the bonus coefficient for the monthly volume completed decreases depending on the number of cases of non-fulfillment. For work with a personal brand, the bonus coefficient for the completed monthly volume increases.

The bonus for the results of the work of the site is determined by the total indicator of the work of the site for the month K_{uo}, which reflects the formula (5):

- execution of the plan by the site by volume in n / h (K_{uo});
- execution of the plan by the site according K_{un});
- Implementation of the plan by the precinct to create an interoperable reserve for the next month (K_{uz}).

$$K_u = K_{uo} \times K_{\text{un}} \times K_{\text{uz}} \quad (5)$$

The coefficient of implementation of the plan by the site by volume in n / h $to_{the\ uo}$ is calculated using the formula (6):

$$K_{uo} = \frac{\sum_{j=1}^{p} Q_j}{\sum_{j=1}^{p} T_{fj}}, \quad (6)$$

Where p is the number of workers on the site.

- Q_j - monthly amount of work actually performed in n / h by the j-th worker.
- T_{fj} - time limit of the j-th employee for the month.

The monthly volume of work actually performed Q_j in n / h by the j-th worker is calculated by the formula (7):

$$Q_j = \sum_{i=1}^{k} t_i \times n_i, \quad (7)$$

Where k is the number of detail operations performed by the j-th worker in a month.

- t_j - operational time of the i-th part-operation, batch size nj of the i-th part-operation.

The coefficient of implementation of the production site plan for the K_{un} nomenclature is calculated using the formula (8):

$$K_{un} = \frac{H_f}{H_{pl}}, \quad (8)$$

Where N_{plz} is the number of items of work-in-progress parts (WIPHZP) in the calendar schedule for the planned month.

- N_{pl} – the number of positions of parts in the plan.

The coefficient of implementation of the production site plan for creating an interoperable reserve for the next month K_{un} is calculated using the formula (9):

$$K_{uz} = \frac{H_z}{N_{plz}}, \quad (9)$$

Where N_{plz} is the number of items of work-in-progress parts (WIPHЗП) in the calendar schedule for the planned month.

- H_{nf} – the number of actually completed items of WIP parts for the month.

If $K_u > 1$, then the worker's bonus accrued for completing the inventory P_n and the premium for the volume P_o increases by the coefficient K_u and will amount to $(P_n + P_o)$ x K_u.

If $K_u < 1$, then the worker's bonus will be $P_n + П_o$.

The company develops a scale and level of individual bonuses for workers in accordance with the rules and objectives of the company (Table 1).

Table 1. Employee bonus scale.

Level of non of-fulfillment of assigned tasks	**Unacceptable**	**Planned**	**High**
	< 100%	**100%**	**>100%**
Premium in %	0	30	40-60

- If you complete less than 100% of a shift task, no bonus is awarded.
- When performing a shift assignment of 100%, the bonus is 30% of the salary.
- If overfulfillment the plan is exceeded, the bonus is 4-60% of the salary.

In addition, the bonus is calculated based on the results of the work of the site. An additional bonus of 20% may be awarded for the implementation of the plan for all indicators.

The application of the developed methodology has led to a change in the composition of workers ' wages. The main part of the salary depends on the personal indicators of the worker. There is an incentive for workers to improve the qualitative and quantitative indicators of labor activity. As a result, improving the remuneration of workers leads to an increase in the efficiency and productivity of workers.

The results of calculating wages in accordance with the developed methodology (in thousands of rubles) are shown in figure 3 on the example of turners of 3-5 categories.

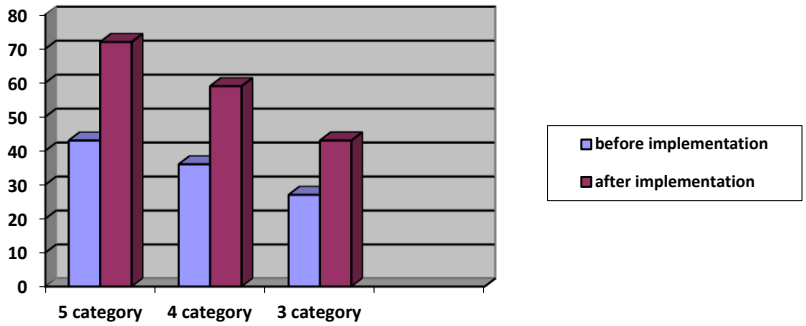

Fig. 3. Results of implementation of the payroll methodology.

3 Results and discussions

The created system of labor remuneration objectively reflects the daily personal contribution of the worker to the implementation of the division plan by nomenclature and volume in n / h, it becomes possible to objectively reflect the daily personal contribution of the worker to the implementation of the plan by nomenclature and volume, excluding subjectivity in calculating bonuses, which has a significant impact on the quality and productivity of labor.

The inclusion in the bonus system of performance indicators of the K_u site K_y creates an incentive for workers to perform individual shift tasks, plan the entire site in accordance with the monthly production plan and calendar schedule, while observing the nomenclature, deadlines for delivery of finished parts, and WIP.

In addition to the main indicators that reflect production productivity, on which the premium system is based, it is now possible to calculate indicators based on actual material consumption.

Based on the comparison of the actual consumption of materials M_f with the standard consumption *of* M_n, the coefficients of material consumption are calculated individually for each worker K_{rmi} and in general for the site K_{rmu}. Having formed a position on labor remuneration at the enterprise, it is possible to provide conditions for bonuses for material consumption depending on the value of the coefficients K_{rmi} and K_{rm} with the accrual ofadditional and P_{rm} for savings at $K_{rm} < 1$ (or depremirovaniem for overspending at $K_{rm} > 1$).

The implementation of these measures provides for the responsibility of all employees of the enterprise involved in the production process, which favorably affects the work of the entire enterprise as a whole.

4 Conclusion

The developed method of remuneration is an element of a balanced system of indicators and allows you to motivate workers to perform shift tasks in full on time and high-quality volume. Thus, one of the most important tasks is fulfilled - motivating all employees to achieve the strategic goals of the enterprise.

References

1. V.N. Volkova, A.A. Denisov, *Fundamentals of Systems theory and System Analysis* (St. Petersburg, SPbGPU Publishing, 2003), p. 520
2. N.V. Diligenskiy, E.A. Matveeva, *Enterprise Management System Research Based on Decomposition Methods* (Samara, Infocommunication technologies, 2011), **2**, pp. 59-63
3. N.V. Diligenskiy, E.A. Matveeva, *Conceptual Model of Small-Scale Machine-Building Production Management in Modern Conditions* (Samara, *Proc.of the International Scientific and Technical Conf. "Information, Measurement and Control Systems* (IIUS-2010)" SSTU), 286-290 (2010)
4. A.S. Ivanova, V.V. Pirogov, S.N. Polotovsky, E.A. Matveeva, *Integrated Production Management Systems of Machine – Building Enterprises* (Samara, OOO Publishing House "AS Gard", 2011), p. 312
5. V.V. Trofimov, *Information Systems and Technologies in Economics and Management* (Moscow, Vysshee obrazovanie Publ., 2006), p. 480
6. R. Kaplan, D. Norton, *Balanced System of Indicators. From Strategy to Action* (Boston: Harvard Business School Press, 2004), **l2**
7. E.A. Matveeva, S.G. Simagina, *Manufacturing Process Optimization at Enterprises,* Conf. Series: Key Engineering Materials. Cep. «Advanced Materials and Processes of Metalworking **684**, 409-413 (2016)

   https://www.doi.org/10.4028/www.scientific.net/KEM.684.409
8. K. Negoice, *Application of Systems Theory to Control Problems* (Moscow, MirPubl, 2020), p. 180
9. O.I. Volkov, O.V. Devyatkin, *Organization of production at an enterprise* (firm) (Moscow, INFRA-M, 2010), p 448
10. E.A. Matveeva, S.G. Simagina, *Functional Management of the Economic Activitie of Industrial Systems,* In the collection: MATEC Web of Conf. **129** (2017)