Automated tracking-time system for academic staff of Russian university

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Abstract. The article discusses an automated time-tracking system (ATTS) for the academic staff of a Russian university, which is integrated into its enterprise information system (EIS). The ATTS implements a mechanism controlling teaching load on the territory of the university as part of the academic staff performance management system based on the analysis of the loss work time rates of teachers caused by violations of their labour discipline. The ATTS is implemented based on the physical access control system (PACS), which provides automated control of safety and regulates the attendance at the university. Introducing the proposed ATTS in the university will allow the managers of the educational and methodical department to put in place effective measures of material incentives for teachers, which will increase their labour discipline and responsibility for the quality of the educational process.

1. Introduction
The key goal of a modern Russian university is to increase the effectiveness of educational activities, which will lead to an overall improvement in the quality of graduates’ training and, as a result, will ensure their employability in the federal and regional labour markets.

To solve this problem, the university utilizes a personnel management system providing academic staff performance management [1].

In practice, one of the effective mechanisms for managing the activities of the enterprise personnel is to control the working hours of employees [2]. When conducting the educational process on the territory of the university, control can be carried out by checking the teacher’s presence in a classroom.

However, the solution to this problem for academic staff is complicated due to the specifics of the organization of its labour activity [3].

So, to standardize the teaching load in universities, the practice of teachers’ classes scheduling is used [4].

A class schedule is a table containing information about the upcoming (planned) classes of a particular teacher.

In each university, the class schedule is compiled in accordance with the adopted “Regulation on the Schedule” document.

Monitoring the compliance with the teachers’ schedule is carried out, as a rule, by the educational and methodical department of a university.
Thus, to ensure control of the academic staff’s working time, it is necessary to develop and implement an automated time-tracking system (ATTS) focused on the current class schedule of teachers.

2. Problem formulation

The analysis of known approaches to increasing academic staff performance showed that the best results are achieved using the mechanisms of controlling its motivation and stimulation [5].

So, to control motivation of the academic staff in Russian universities, normative ranking mechanisms of material incentives are used, in which the amount of additional remuneration to the monthly salary of a teacher depends on the values of KPIs used in a particular university.

As one of these KPIs, we propose using the loss work time rate of a university teacher $K_L$ is calculated by the following formula:

$$ K_L = \frac{H_L}{H_W} $$

where:

- $H_L$ – total working time in academic hours lost during the reporting period (a week or a month);
- $H_W$ – teaching workload in academic hours for the reporting period (a week or a month).

It should be noted that the duration of an academic hour in Russia is 45 minutes.

Thus, the problem of controlling a teacher’s working time can be formalized as an optimization problem of the form:

$$ K_L \rightarrow \min $$

subject to restrictions on the duration of working hours for academic staff in accordance with the Russian labour legislation [6].

The use of this rate in the KPI system can be different, and it depends on the degree of importance of this indicator in a specific period of time.

So, for example, if a significant number of passes or delays to start classes is recorded for a teacher, then it is advisable to make $K_L$ blocking.

That is, the achievement for this indicator will depend on the amount of premium for other KPIs:

$$ P_i = (1-K_L) \times (S_1+S_2+...+S_n), $$

where:

- $P_i$ – the remuneration amount for the $i$-th group of KPIs (for example, for educational activities);
- $S_j$ – the remuneration amount for the $j$-th ($j=1, 2, ..., n$) indicator of the $i$-th ($i=1, 2, ..., I$) group of KPIs.

To solve this problem, we propose to utilize an automated system that implements a work time control mechanism for teachers within the academic staff performance management system.

Figure 1 shows a loop of the academic staff performance management system based on the work time control mechanism for teachers.
Figure 1. A loop of the academic staff performance management system based on the work time control mechanism for teachers.

Thus, a high value of $K_L$ can negatively affect the amount of the teacher incentive payment. This measure will ensure the improvement of the teacher’s work discipline and responsibility for the quality of the educational process.

3. System description

The ATTS block diagram is shown in Figure 2.

Figure 2. The ATTS block diagram.

ATTS is integrated into the enterprise information system (EIS) of the university. The key component of ATTS is a physical access control system (PACS). PACS is a combination of hardware and software providing automated control of safety and the regulation of attendance in an organization [7].
Modern Russian universities use PACS not only to improve the safety of students and employees but also to solve common management problems, such as control of the academic staff’s working time. Nowadays, various access control systems and devices are available, the combined advantages of which constitute an effective PACS [8].

Practice shows that in large organizations of the social and economic sphere in Russia, such as universities, PACS using plastic bank cards to control access of the personnel have become widespread.

When teachers pass through the turnstile, the PACS generates the following data:

- $\tau_{in}$ – the time of entry into the university building;
- $\tau_{out}$ – the time of exit from the university building.

This data is used as the input to the management information system (MIS).

The task of the MIS is to provide data on violations of labour discipline to managers of the educational and methodical department of the university in a form convenient for decision-making on the measures of material incentives for the academic staff.

It should be noted that only $\tau_{in}$ and $\tau_{out}$ belonging to the interval $(t_b, t_e)$ are taken into account in the MIS.

Here, $t_b$ and $t_e$ are the times of the beginning and the end of the $i$-th ($i = 1, 2, ..., I$) lesson in the class schedule of a particular teacher, respectively.

We use these data according to the formula (1), the loss work time rate of a particular teacher is calculated:

$$K_{L}^{(n)} = \frac{\sum_{i} (B_{in_{i}}^{(n)} - t_{hi}^{(n)}) + \sum_{j} (t_{ci_{j}}^{(n)} - T_{out_{j}}^{(n)})}{H_{w}^{(n)}},$$

where:
- $n$ – a teacher identification number (IT credential) in the database of the university personnel accounting subsystem, which is a component of the EIS;
- $B_{in}, T_{out}$ – the minimum and maximum values of $\tau_{in}$ and $\tau_{out}$, respectively.

Based on the obtained value of $K_{L}$, in accordance with the technique used in the university, the incentive payment for a specific teacher is calculated.

For the implementation of the PACS, the innovative solution APACS 3000 was used [9].

Easy MIS software integration is ensured by its implementation on the EIS platform on the basis of the object-structural approach to the design management accounting information systems [10].

4. Conclusion

The article describes an automated time-tracking system (ATTS) for academic staff of a university, which is integrated into its EIS.

This system implements a control mechanism of the academic staff working time at a university within a performance management system based on the analysis of the loss work time rate of a teacher.

Utilizing the proposed ATTS in the university will allow managers to put in place effective measures of material incentives for teachers, which will increase their labour discipline and responsibility for the quality of the educational process.
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