

## Problems in modernization of automation systems at coal preparation plants

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**Abstract.** The factors influencing the process of modernization (reconstruction) of the automation systems at coal preparation plants are described. Problems such as heterogeneity of existing and developed systems, planning of reconstruction of a technological complex without taking into account modernization of automated systems, commissioning without stopping the existing technological complex, as well as problems of conducting procurement procedures are discussed. The option of stage-by-stage start-up and adjustment works in the conditions of modernization of systems without long stops of the process equipment is offered.

### 1. Introduction

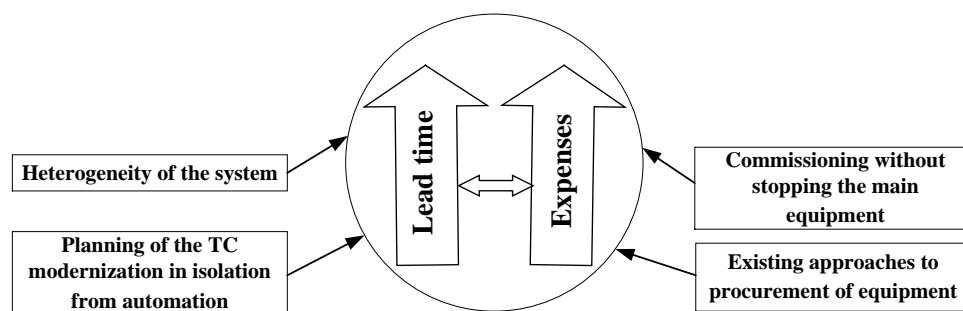
Currently, only in Kemerovo region operates more than 40 preparation plants of different production capacity. Some of them have a long history – they were launched more than half a century ago. The requirement of owners to constantly increase the production capacity, as well as the rapid development of modern enrichment technologies, lead to the need for reconstruction of technological complexes of preparation plants (PP). Usually the issue of reconstruction or renovation and automated control systems is solved during the reconstruction of technological complexes (TC).

### 2. The main problems of modernization

When modernization of automation systems for coal preparation plants is carried out, it is necessary to take into account a number of important factors that are encountered in practice. Ignoring these factors leads to an increase in costs and timing of modernization (figure 1).

**Heterogeneous systems.** During design of a new PP and, in the future, development of modernization projects, often, when ordering large technological equipment (filter presses, jigging machines, flotation machines, etc.), no requirements for equipment suppliers in the part of local automation systems are specified (usually questionnaires of manufacturers and suppliers do not contain relevant information at all). In this connection, deliveries are made without taking into account the unified projected information structure of the enterprise. “Binding” of various types of local automation systems into a single structure leads to an increase in the start-up period of the complex and an increase in the costs for training the maintenance personnel and for maintenance of spare parts, tools and accessories in the working state.





**Figure 1.** Factors arising during the PP modernization.

**Planning TC modernization in isolation from automation.** In the current practice, the planning of modernization (reconstruction) of the TC production facility is carried out without taking into account the terms of development of design solutions for technological complex automation. Moreover, the requirements for technological processes and equipment are developed separately and for the means of automation separately as well. This systemic drawback is inherent in the creation of new PP. This is due to the lack of scientific and methodological developments in the joint synthesis of control object and control subsystem.

Of course, the works on design of automation systems should be started as early as possible and, ideally, should be conducted in parallel (together) with the control object [1]. However, in practice, the sequence of designing industrial complexes consists, firstly, in design of technological schemes (objects), and then the control subsystem. From this it follows that the control subsystem is assigned the achievement of the required properties of the entire control system. This can lead either to a significant complication of the control subsystem or even to the impossibility of obtaining the required property of the entire system. In addition, the deadlines for commissioning the entire industrial site are also missed.

In addition, the technical task for the PP modernization (reconstruction, re-equipment) with the introduction of a part of the “new” technological units and sections is done separately from the existing TC (or affects it minimally, taking into account the “link-up” of material flows). The technical task for automated control systems is also done for newly introduced units and sections. However, it is necessary to modernize both control automation systems in terms of newly introduced equipment and the existing automation system, which, as a rule, is not taken into account at the stage of development of the Terms of Reference, and, accordingly, time and financial resources are not allocated.

Also, when choosing new technological equipment, it is necessary to take into account the linkage of electrical equipment, instrumentation, software and the hardware of an existing complex. The choice of software and hardware for new technological areas should be carried out taking into account the already existing similar means or ensuring their integration.

Relevant resources should also be included into development of hardware and software of integration blocks of the existing and new elements of the system.

**Start without stopping the main equipment.** Often the automation system, newly commissioned within the framework of modernization, is directly connected with the existing technological complex and its control system, for example, an automated dispatch control system. Integration of the newly introduced system with the existing system must be performed on the stopped technological equipment. However, in practice, the approved production plans for the processing of minerals allow the production equipment to be shut down only for the performance of scheduled preventive maintenance (SPM), which is often not enough to perform integration and debugging procedures. Thus, the commissioning of the updated automation systems is done piece by piece, during performance of SPM, competing in time with the work carried out by the maintenance personnel of the production facility. This significantly delays the commissioning period.

Thus, it is more rational to begin modernization of the system from the formation and installation of cabinets with new equipment, taking into account the close integration of the installed equipment with the existing one. Then, step by step (either by units or by technological subsystems), transfer the functions of the old system to the new one with the possibility of parallel operation of both systems. Dismantling of obsolete equipment is done at the end, only after the new system is put into operation.

When the control cabinets are ready and the signal lines are laid from the control panels of the units to the PLC cabinets, the following is performed:

- alternate switching on of temporary control schemes of technological units that can be stopped for commissioning; and it is necessary to provide for the possibility of functioning of a part of the units under the control of the old one, and part of the new system;
- in the time scheme the control of the upgraded units is transferred to the controller, however, for the purposes of monitoring and controlling the units the signal lines of the old system are used; the overall control of the technological complex and other units remains unchanged, the control also remains on the mimic diagram; at this stage the software debugging of the system being put into operation is conducted;
- after software debugging of all units controllers, a transfer to the final control scheme of the units is carried out; all unnecessary signal connections are removed;
- on the readiness of the upper level control (SCADA-system), the dispatching control is transferred from the mnemonic scheme to the workstation;
- after debugging the local control system of each unit, the control of the whole technological complex is transferred with the help of controllers of the updated automated control system.

The use of this kind of phased modernization, on the one hand, requires a lot of time to put the updated system into operation, on the other hand, it allows all routine maintenance of the system modernization to be done without long stops of the process equipment, which positively affects the output of the final product.

**Purchase of equipment.** In the existing procedures for procuring technological equipment (especially when forming requirements for equipment manufacturers) automation specialists from both the operator and the project organization are often not involved. This leads to the order of different types of local automation systems. When ordering hardware and software automation tools, the cost of the equipment is crucial, which is not always justified. It is necessary to consider other factors: the delivery time, the manufacturer and supplier's warranty, the number of suppliers and so on.

### 3. Conclusion

Thus, the small involvement of automation specialists, especially at the early stages of development of system-wide design solutions, during the technological complexes modernization of coal-preparation plants and their automation systems may cause a significant rise in the cost of the project and (or) an increase in the timing of its implementation. It is necessary as early as possible, even at the stage of forming the Terms of Reference and the time plan for the modernization of the production facility, to attract automation specialists, which directly relates to the approach of joint synthesis of the control object and the control subsystem [1, 2].

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### References

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