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# Development of a control system for the technological complex of "Mine No. 12" processing plant based on the Wonderware System Platform 2017

V V Grachev<sup>1,2</sup>, L P Myshlyaev<sup>1,2</sup>, M V Lyakhovets<sup>1</sup>, K A Ivushkin<sup>3</sup> and G V Makarov<sup>1</sup>

<sup>1</sup>Siberian State Industrial University, 42 Kirov str., Novokuznetsk, 654007, Russia <sup>2</sup>LLC "Research Center of Control Systems", 55A Stroiteley str., Novokuznetsk, 654005, Russia

<sup>3</sup>LLC "CC "Sibshakhtostroy", 9 Kuznetskoye shosse, Novokuznetsk, 654015, Russia

E-mail: mail@nicsu.ru

**Abstract**. The article is devoted to the peculiarities of creating an automation system for the technological complex control of "Mine No. 12" processing plant based on the Wonderware System Platform 2017. The hardware and software of the system are described, the key points and features of the use of the Wonderware System Platform 2017 are given, which made it possible to reduce labor costs during development and to increase efficiency during system operation.

## 1. Introduction

The processing plant (PP) "Mine No. 12" was commissioned in the mid-60's of the XX century. In 2013, a decision was made to carry out its deep modernization. The plant's capacity for the new project is 4 million tonnes per year. The design solutions provide for the replacement of the processing technology from gravity to heavy medium. Replacement allows processing efficiency to be increased as well as the concentrate yield by 15 - 20%. The modernization of the processing plant required the design and implementation of a modern automation control system of a technological complex (ACS TC), including technical, software and information support.

## 2. Enlarged technical structure

The ACS TC hardware of the PP "Mine No. 12" is implemented on the basis of Omron programmable logic controllers (PLCs), personal computers, virtualization servers and a disk array of Hewlett-Packard Corporation (figure 1).

The main virtualization server is the data provider for automated workstations (WKSs) of the PP dispatcher, specialists and the operator of the drying-furnace department. In the event of its failure, automatic switching of WKSs occurs to the backup virtualization server, which is in the "hot" standby. This redundancy option provides increased system fault tolerance and data safety, eliminating the loss of production information [1, 2].

When creating the ACS TC of the PP "Mine No. 12", the vSphere hypervisor from VMware (USA) and the Wonderware System Platform 2017 [3, 4] by Wonderware, a structural division of Schneider Electric (France), were chosen.

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Figure 1. The technical structure of the ACS TC of PP "Mine No. 12".

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Wonderware software is built on a modular principle and is as open as possible – it has the ability to interface with various products of other companies, has a powerful and universal scripting language, the ability to embed ready-made components, including ActiveX components.

## 3. Basic software

The basic software of the upper level of the ACS TC of PP "Mine No. 12" includes the following software products:

- data input-output means (Device Integration Server);
- system platform (Wonderware System Platform 2017);
- virtualization system (VMware vSphere);
- means of history storage (Wonderware Historian Server);
- software for the organization of remote access to production information (Wonderware Information Server);
- software for collection and processing of production data (Wonderware Industrial Application Server);
- data visualization tools (Wonderware InTouch View);
- software development and system maintenance (Wonderware Development Studio).

The Wonderware System Platform 2017 (WSP 2017) provides a single and scalable software platform. It acts as an "industrial operating system" by providing standard services including visualization, configuration, deployment, connectivity, security, data connectivity, data storage and management, staff interaction, etc.

The Wonderware System Platform 2017 outperforms other similar solutions in design simplicity, operational flexibility, and information processing capabilities. It ensures that customers are guaranteed the results they need, the operational integrity of their businesses is protected, the analytical skills of staff are improved and their adaptation to changes is painless.

ACS TC of the PP "Mine No. 12" is designed and implemented as a system with a distributed architecture based on the WSP 2017 package, which includes:

- IAS1: primary object server Wonderware Application Server, primary server of I / O Device Integration Server, Kepware OPC Server.
- IAS2: standby server object server Wonderware Application Server, standby server of I / O Device Integration Server, Kepware OPC Server;
- IDE: development server Wonderware Development Studio, reporting software Dream Report;
- History: history server Historian Server;
- GR: licensing server, project repository Galaxy Repository;
- two WKSs of the PP dispatcher (main and backup) client stations with InTouch View and Historian Client;
- WKS of the DFD operator: client station with InTouch View and Historian Client;
- five WKSs of specialists client stations with InTouch View and Historian Client.

The application software developed using the WSP 2017 package is presented in the form of mnemonic diagrams on the monitors of the WKSs of the factory dispatcher, WSKs of operators and WKSs of specialists. For example, figure 2 shows the mnemonic schemes of the automated workplace of the factory dispatcher.

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**Figure 2.** Mnemonic diagrams of the dispatcher's workstation at the PP of "Mine No. 12": a) mnemonic diagram of the first (left) monitor of the dispatcher's workstation, b) mnemonic diagram of the second (right) monitor of the dispatcher's workstation.

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## 4. Features of Wonderware System Platform 2017

According to the results of the development of the applied software of the ACS TC of the PP of "Mine No. 12" and the work with WSP 2017, the following key points and features should be noted.

1. Possibility of quick and easy deployment of a distributed system consisting of servers, disk array and dispatching stations. Storing data on a disk array provides the possibility of virtual machines migration to a backup server.

2. Availability of multi-user access when developing and changing a project. All developers can connect to a project located on a remote server using terminal access to the server. This allows for collaboration without the need to track changes made by other developers.

3. Automatic replication of the project to all stations. Changes made to the project are automatically transferred to all nodes without the need to reboot. This is possible thanks to the dynamic network application development engine used in WSP 2017. The essence of this technology lies in the fact that the project is stored and modified on the central node (repository of the GR project) and, if necessary, changes are transferred and deployed on the corresponding servers and workstations.

4. Organization of "hot" server backup. Switching from the main to the backup server is carried out almost instantly, without creating inconveniences for the operational dispatching personnel.

5. The presence of a built-in library of symbols and ActiveX-elements. The development of a mnemonic diagram of the PP technological process is significantly accelerated and simplified by using the elements available in the library. There is no need to develop the necessary functionality from scratch, the library elements just need to be adapted to the existing conditions.

6. A rich set of input / output drivers allows information with the equipment of almost all global manufacturers of controllers to be exchanged, which is very convenient when interfacing with automation tools supplied complete with equipment.

7. The possibility to use an object-oriented approach when developing a system.

## 5. Implementation of an object-oriented approach in system development

During the development process, a hierarchy of object templates was created, which made it possible to implement the inheritance of scripts, attributes, graphic objects, configuration of alarms and trends from a parent object to a child object [5].

A parent template "\$ AGR" has been created for all aggregates. It contained the basic attributes and scripts. For example, scripts of the commands "Start" and "Stop", which are used in all objects of the project. Then a template was created for each specific type of unit: for conveyors – "\$ K", for feeders – "\$ P", etc.

A template created from the parent template "\$ AGR" inherits all of its attributes and scripts. Instances of specific objects were created from typical templates. For example, from the template "\$ K", instances of the conveyor object were created – "K201", "K202", etc., which inherit the attributes and scripts from the parent templates "\$ K" and "\$ AGR".

Wonderware System Platform 2017 has the ability to split the models of any technological object into two parts. The first part of the model is the graphical representation of the object along with animation. The second component is a logical view, which stores object attributes, scripts, alarm and trend configurations.

For each type of aggregates, common diagnostic pop-up windows were created, thanks to the use of the "Me" indirection variable. The link between the graphic and logical representation of the object model is formed when creating video frames in the Development Studio development environment. When you click on the graphical image of the unit on the video frame, the script for calling the diagnostic window generates the value of the indirect variable "Me" in accordance with the name of the called object and opens an instance of the diagnostic window of a specific unit – "Screener pos. 210" (figure 3).

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Figure 3. Template (a) and instance (b) of the unit diagnostic pop-up window.

#### 6. Conclusion

The use of Wonderware System Platform 2017 software for the creation of the ACS TC of the PP of "Mine No. 12" made it possible to reduce labor costs during system development, simplify the process of making changes, and increase the convenience and efficiency of work during system operation. Many software and hardware solutions with minor adjustments can be used to create automation systems for the management of mining enterprises.

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