INNOVINNPROM

ASSET PERFOMANCE MANAGEMENT SYSTEM

SAKURA-APM

IMPLEMENTATION PLAN

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Abstract

This document describes the stages and their scope for developing the SAKURA-ARM system for a complex of agro-industrial enterprises.

This document is a copy of the real business proposal with the emphasis on confidential information about the cost and terms of work.

In my line of proposition, let's describe the work of how the SAKURA-ARM works without being in the middle of the throat and about the forward modernization of the existing automated process control systems.

SAKURA-APM **is an Asset Performance Management system designed to manage the efficiency of production assets based on the technologies of the Internet of Things of the fourth industrial revolution (Industry 4.0).**

The term "assets" means any production equipment - both equipment that ensures the vital activity of enterprises (power grids, substations, boilers, compressors, ...) and that which carries out processing and production of products (furnaces, machines, dispensers, bottling or packaging lines, etc.).

SAKURA-APM contains two main components:

1. **Production management system aimed at operational efficiency (Operational Excellence).**
2. **Maintenance and Repair (MRO)**

Reduction of operating costs is achieved due to better reliability of assets, extension of their service life (life cycle), reduction of the cost of implementation and operation.

SAKURA-APM ensures the vertical integration of production systems of enterprises (enterprises) into a single information system and is responsible for control of technological processes, control and analysis of energy consumption, control and analysis of the efficiency of equipment use and control of the productivity of production processes and performs the following functions:

- Comprehensive control of technological processes in production in real time.
- Based on the analysis of large volumes of data, optimization of technological settings and delays, formation of recommendations for increasing production productivity.
- Calculation and analysis of energy efficiency of equipment, technological operations and production as a whole, formation of summary and comparative graphs and tables of energy efficiency for selected periods of time and in different operating modes.
- Control of personnel work, blocking and prevention of errors and emergency situations.
- Control and analysis of the work productivity of personnel individually, in shifts; planning of production changes and control of the placement of personnel in accordance with the level of training.
- Planning and control of maintenance and repairs of equipment.
- Accounting for equipment performance and consumption of energy resources, accounting and planning for the use of spare parts and materials during maintenance and repairs.

SAKURA-APM guarantees a decrease in the energy consumption of the company's equipment, an increase in the energy efficiency of technological processes, a decrease in associated production costs, and an increase in the service life of the equipment.

SAKURA-APM modules

HOLDING module

Visualization of aggregated, comparative, detailed and analytical information coming from the holding's enterprises, formation and analysis of information about the quantity and quality of products, energy intensity and energy efficiency of technological processes of the holding's enterprises.

ENTERPRISE module

Visualization of consolidated, comparative, detailed and analytical information of the enterprise, formation and analysis of information about the quantity and quality of products, energy intensity and energy efficiency of technological processes of the enterprise.

TOIR module

Planning and control of maintenance and repairs at the holding's enterprises. The main types of information are information about the operation of the equipment, energy consumption, the use of spare parts and materials during maintenance and repair.

ENERGY EFFICIENCY module

Measurement and analysis of the consumption of the main types of energy by each unit of equipment, technological group and the enterprise as a whole.

Based on the received data, the energy efficiency of equipment and technological operations is calculated.

Stages of SAKURA-APM implementation

Stage 1:

Unification of production and deployment of basic SAKURA-APM services

- Combination of separate areas of production into a single software project
- Installation of power consumption control devices of energy-intensive equipment
- Deployment of basic SAKURA-ARM services

- The only engineering center for production control and management on a single software basis

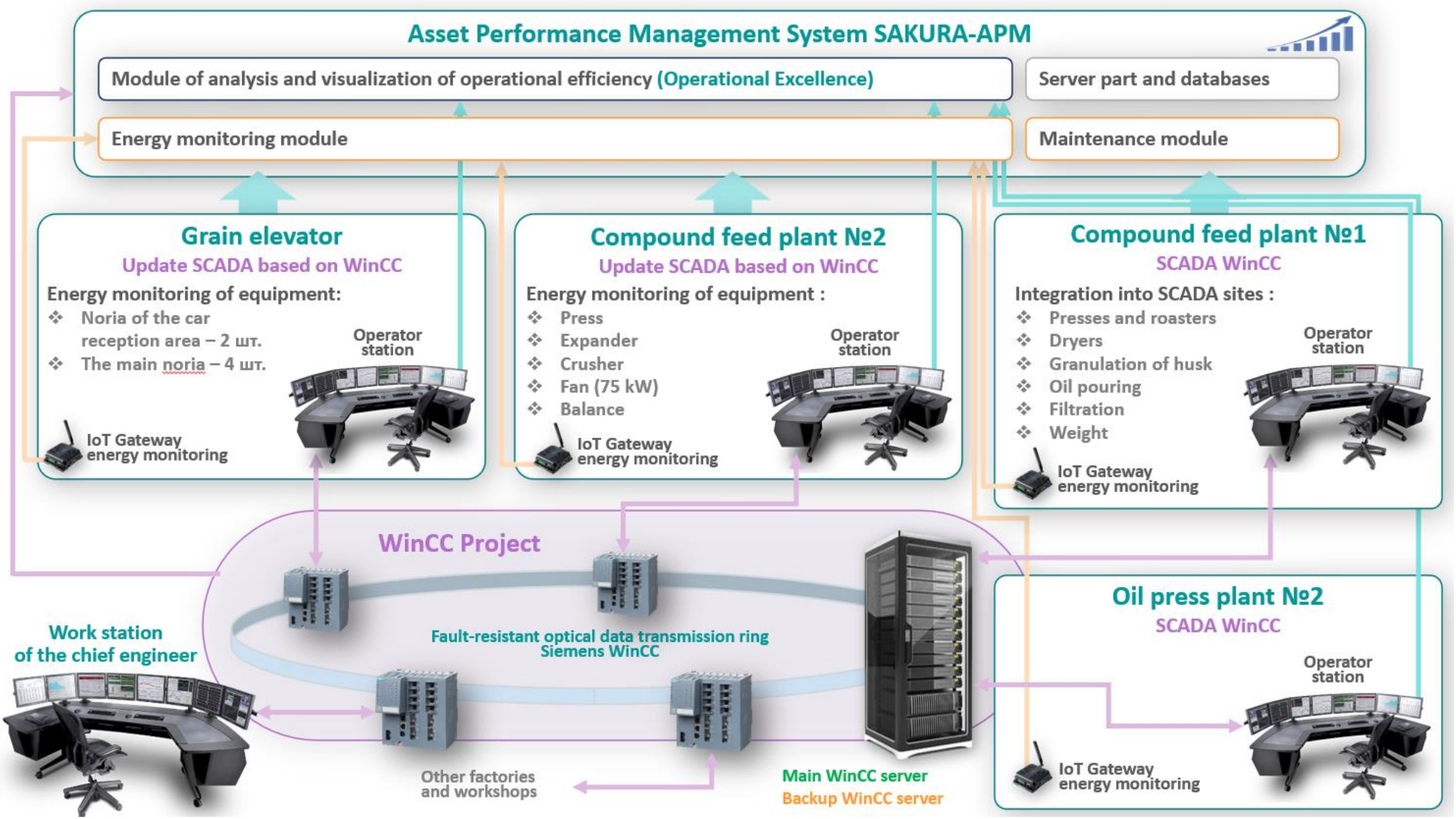
Stage 2:

Deployment of the main SAKURA-APM services

- Services for monitoring the operation of each unit of equipment
- Services of analysis and control of the operation of technological lines and
- Energy efficiency assessment services of technological processes
- Production efficiency analysis and assessment services
- Maintenance and repair control software

- A complete information picture of production
- Optimizing the efficiency of technological processes and reducing production costs
- Reduction of energy consumption
- Reducing the role of the human factor
- Growth of production productivity

Plan of modernization and unification of production



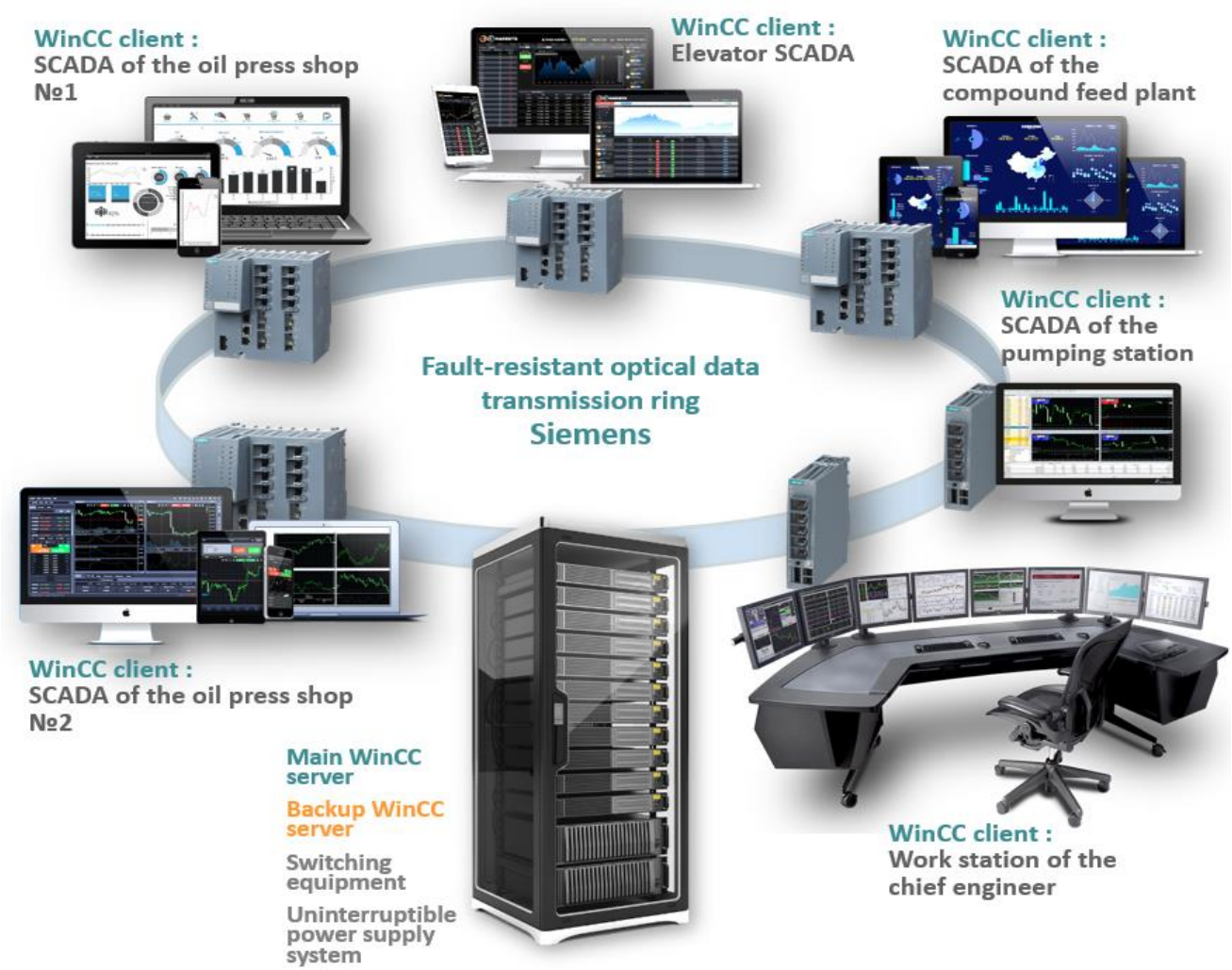
Technology implementation roadmap

Stage 1: Unification of production and deployment of basic SAKURA-APM services

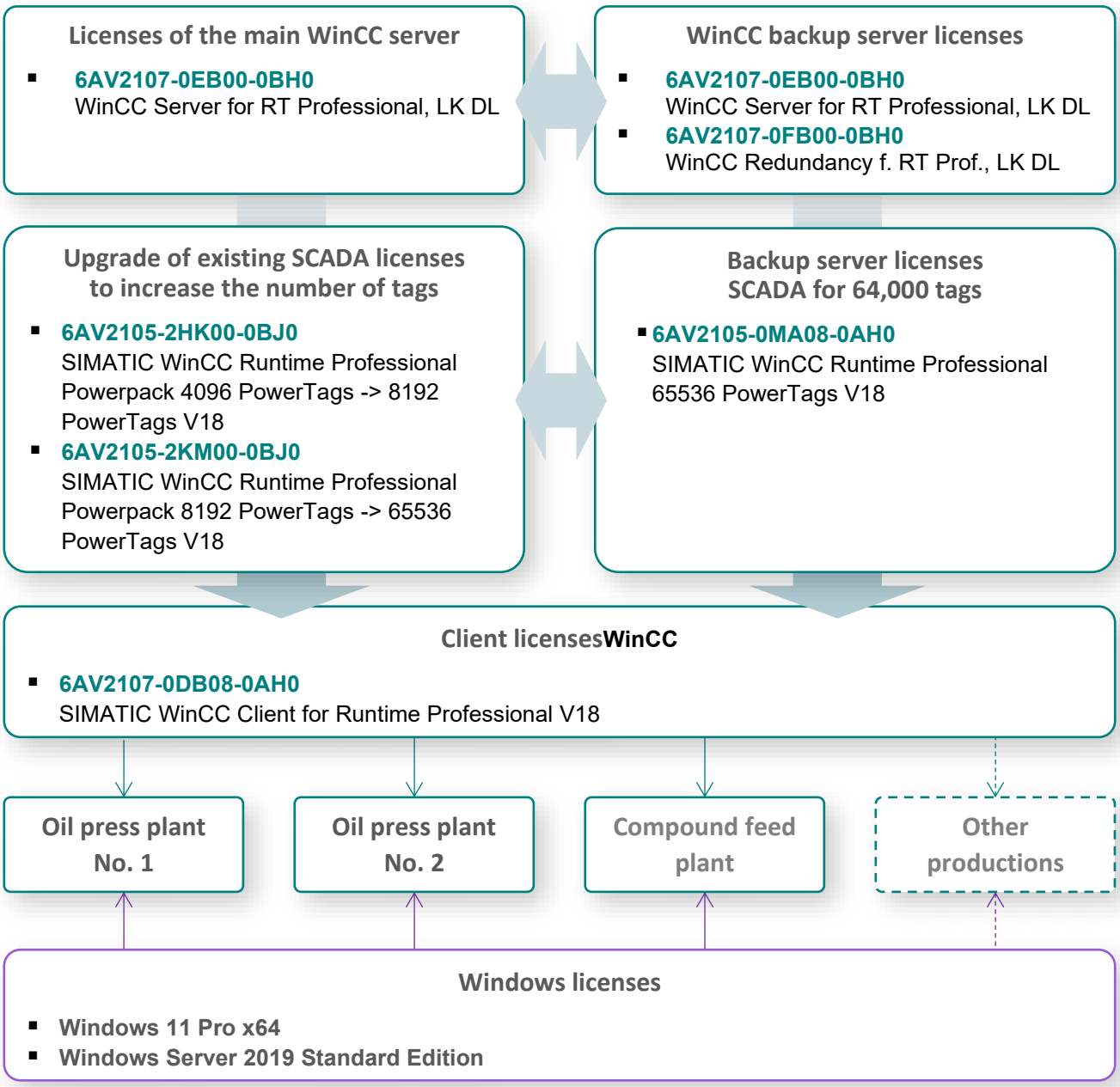
1. Unification of production based on Siemens SIMATIC WinCC solutions

During the stage, work is being carried out on the installation of a server rack with a redundant Simatic WinCC server, which is a global norm for the management of technological equipment and has the following advantages:

- Significant increase in reliability and fault tolerance of production;
- Unification of SCADA systems of distributed production on a single WinCC platform;
- Control and diagnosis of production and technological processes from a single workstation of the chief engineer;
- In case of failures or breakdowns, the possibility of backup control of any technological process from any workplace in accordance with the granted access rights;
- Concentration of technological data in single databases common to all productions;
- Concentration, formation and analysis of technological data of any process in any area of production;
- There is no need to interact with many contractors, it is enough to have a full-time programmer or a partner company to solve most current problems from the workplace of a single engineering station.



Structure of required Siemens SIMATIC WinCC licenses



The described version of the application of technologies and licenses will allow to build a basis for the unification of production on a single hardware and software platform, to maximize the reliability of production management and control, to unite and improve the efficiency of interaction of various productions and factories of the production complex, to create and use unified databases. This is a one-time capital investment that will lead to a significant reduction in production costs associated with production management and control. Further connection and modernization of new productions (plants) to a single platform will only require the purchase of inexpensive client licenses and switching network equipment.

The created single database of production and technological data will ensure the minimization of financial and time costs for connecting external systems and services such as M&R, accounting and economic services. In addition, this approach significantly simplifies and reduces the cost of installing the maintenance and repair system, since a significant part of maintenance and repair operations is implemented directly in the SCADA of production management and uses a single database of equipment operation.

2. Combination of separate areas of production into a single Siemens SIMATIC WinCC software project

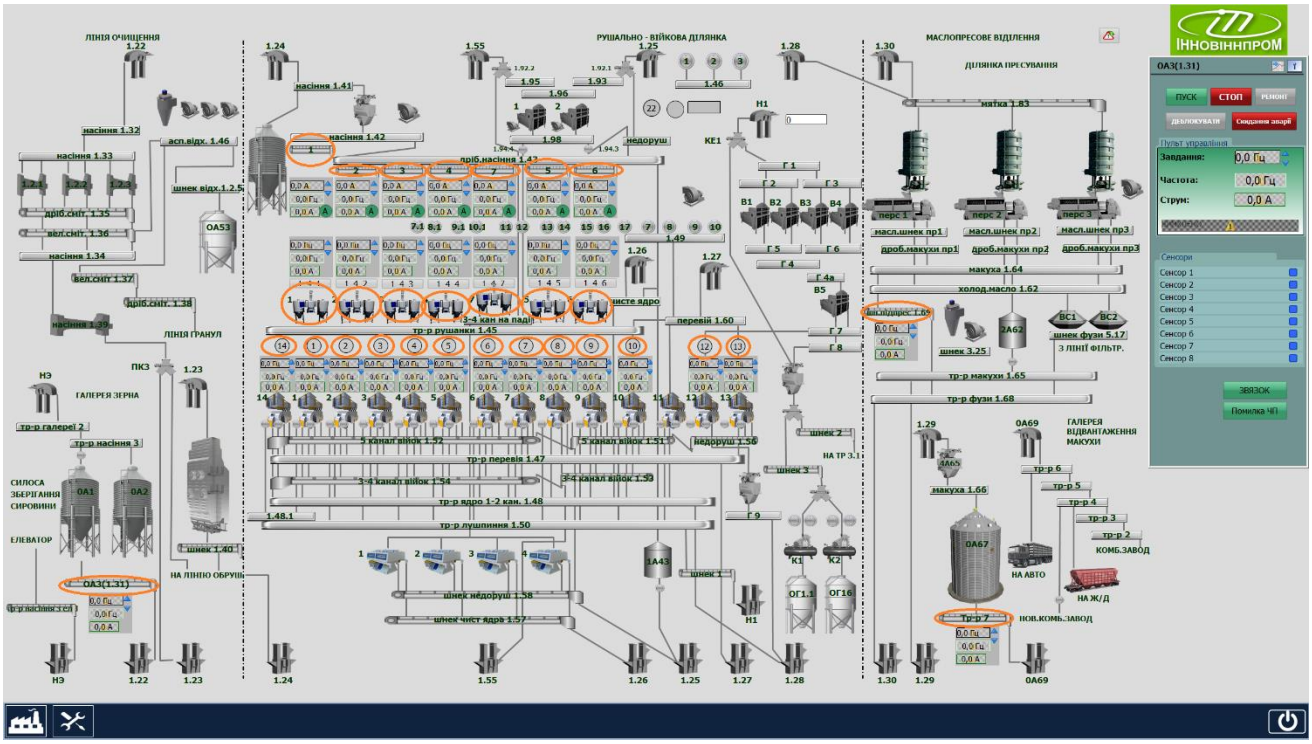
In the course of the stage, work is being carried out on the unification of fragmented technological equipment management programs into a single Siemens Simatic WinCC project of oil press plant No. 1. At the same time, the use of existing equipment and the integration of the software code into a single project with minimal changes are assumed. This will make it possible to abandon a large number of non-reserved PCs and heterogeneous data transmission network equipment, significantly increase the reliability of the system and reduce the cost of its operation and maintenance.

During the stage, the SCADA software of presses and roasters, dryers is integrated into a single project.

List of works:

1. Integration into a single SCADA Siemens Simatic WinCC project of the oil press plant No. 1 software of the following individual sections:
   - Software **SCADA** presses and roasters;
   - Software **SCADA** dryer.

2. Integration into a single SCADA Siemens Simatic WinCC project of an oil press plant or software development in standardized software programming languages of the following areas:
   - weight;
   - Filtration;
   - Oil-filled.

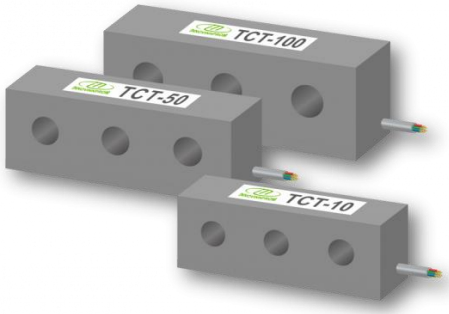


3. Installation of power consumption control devices of energy-intensive equipment

During the stage, work continues on the unification of fragmented technological equipment management programs into a single Siemens Simatic WinCC project of oil press plant No. 1. At the same time, the use of existing equipment and the integration of the software code into a single project with minimal changes are assumed. This will allow you to get rid of a large number of non-reserved PCs and disparate data transmission network equipment, significantly increase system reliability and simplify its operation and maintenance.

Devices for monitoring energy consumption parameters are also being installed, which provide for the measurement of active, reactive and total, current, power and energy with data transmission discreteness of no more than one second to ensure the control of powerful mechanisms at the grain elevator, oil press plant No. 1 and the compound feed plant. At the same time, the connection to the equipment system of the grain elevator and feed plant No. 2 is carried out using wireless technologies, and at the oil press plant through Siemens Simatic WinCC PLC and SCADA.

The PKPM-3F4K electrical network parameter indication device is designed to monitor electrical parameters in four sources of a three-phase 380V 50Hz electrical network.
The device monitors active/reactive/total energy, current values of voltage and current in the phases of each of the four channels of a three-phase electrical network.

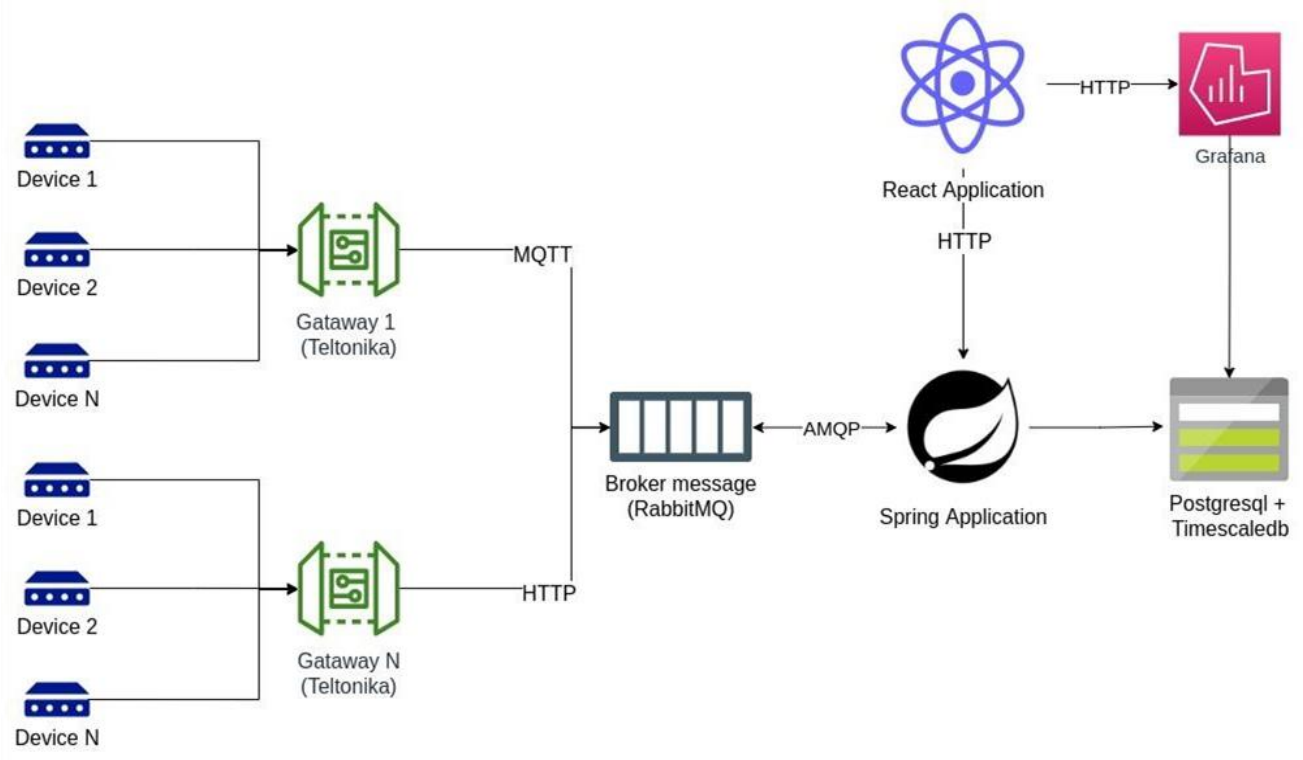


Measuring three-phase transformers of the TST series are intended for simultaneous use with a device for indicating electrical network parametersPKPM-3F4Kas a part of systems of technological electricity accounting, systems of control and analysis of energy parameters,

4. Deployment of basic SAKURA-APM services

During the stage, work on the deployment of the platform (PaaS) is carried out **SAKURA-IIoT**:

- Deployment of the RabbitMQ message broker to interact with the Gateway;
- PostgreSQL database deployment;
- Deployment of a server application based on the Spring framework;
- Deployment of a client application based on the React framework;
- Deployment of the Grafana data visualization tool;
- Jenkins deployment providing CI/CD for future automated deployment of server and client applications.



Services are deployed on the resources of the customer or the IaaS service provider chosen by the customer.

Technology implementation roadmap

Stage 2: Deployment of the main SAKURA-APM services

1. Services for monitoring the operation of each unit of equipment
Energy monitoring module

The module provides a display of all available information about the operation of each unit of equipment. The module provides an opportunity to analyze the operation of equipment and the efficiency of its use in production processes.

Parameters displayed when using the control equipment manufactured by INNOVINNPROM:

- list of equipment;
- equipment on/off time;
- duration of work;
- total consumed active, reactive and total energy for the selected time period;
- equipment load factor;
- active, reactive and full power;
- active, reactive and total current in each phase;
- power factor (cos ϕ) in each phase;
- voltage in each phase;
- active, reactive, full energy;
- gas consumption (for drying equipment).

The user has the ability to change the size and number of screen windows, apply display filters of certain parameters, choose the date and display period.

Discreteness of data measurement - no more than 20 ms (when using equipment manufactured by INNOVINNPROM).

The discreteness of the transmission of processed data to the database is no more than 1 s (it can be reduced by increasing the number of data transmission gateways).

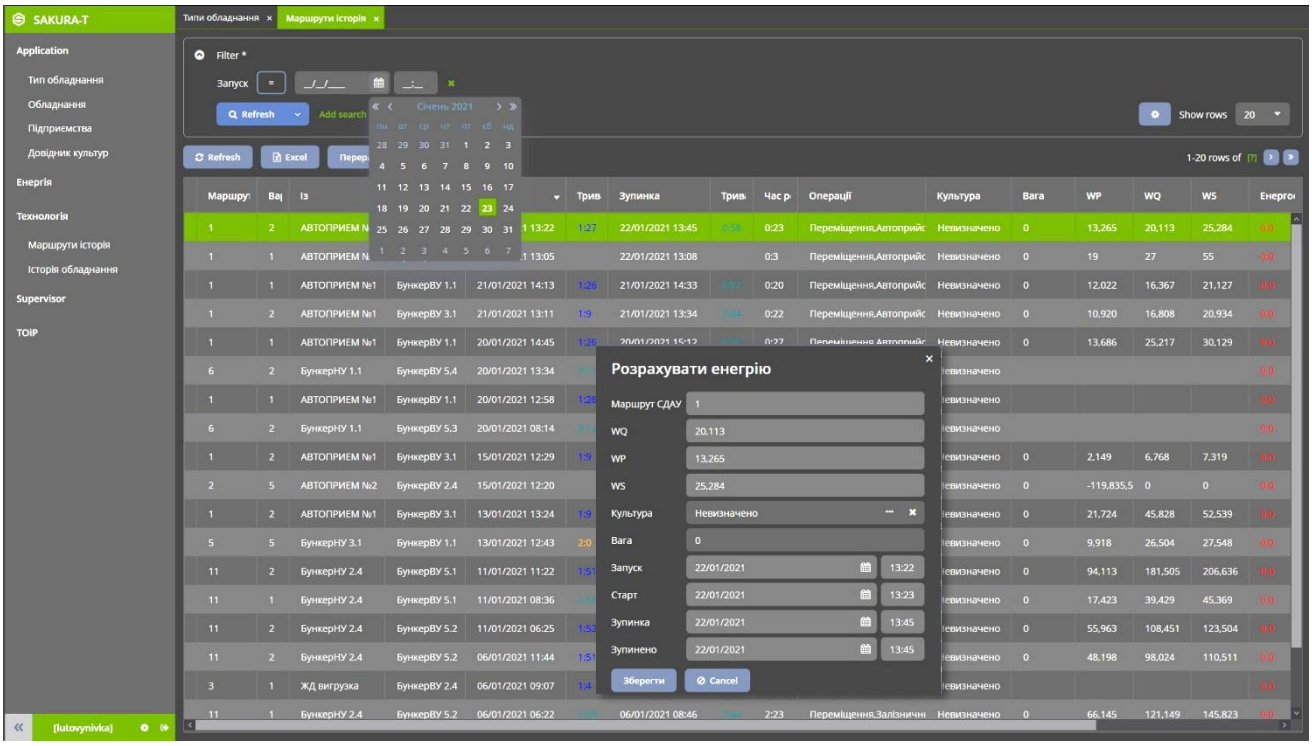
During the stage, the following works are carried out:

- ❖ Correcting and entering into the system a list of equipment equipped with means of monitoring electrical parameters;

- Entering equipment parameters into the system, whose energy consumption data will be calculated mathematically;
- Building a multi-level hierarchical interactive equipment table;
- Entering into the system data on equipment belonging to technological routes and lines, as well as data on equipment operation algorithms in routes;
- Setting display modes of equipment parameters;
- Implementation of digital duplicates of the equipment, which will be used as standards for analyzing the operation of the equipment;
- Development of work control and analysis algorithms for typical groups of equipment, as well as each unit of equipment separately.

2. Services of analysis and control of the operation of technological lines and productions Energy efficiency module

Analytical module Energy efficiency provides processing and generalization of information on efficiency, including energy efficiency of the use of both individual equipment units and technological sections (routes).



The module receives data as from **SAKURA-IIOT** about the consumption of the main energy carriers, as well as data from the production quantity and quality accounting systems available at the enterprise (for example, SAKURA-Production, 1C-Elevator, etc.) about the quantity (weight) of products, as well as data from the ACS TP about the operation of technological lines (routes movement of grain products on elevators) and equipment operation.

Based on data on the quantity and quality of products and the consumption of the main energy carriers, the module calculates the energy efficiency of technological operations in real time, and generates reports for a specified period (shift, day, month, quarter, year, etc.).

If it is not possible to obtain data on the amount of grain moved along a certain technological route, the module will calculate the amount of product based on the load factor of the key equipment of the route (nories and conveyors). The possibility of manual data entry is also provided (access to manual data entry is negotiated at the stage of forming the technical task).

Data are provided in the form of interactive tables and graphs. The user has the ability to change the size and number of on-screen tables, the size and location of columns, hide columns, sort data by selected characteristics, apply display filters of certain parameters, choose the date and display period.

The principle of evaluating the energy efficiency of technological operations at the enterprise consists in measuring the amount of energy resources spent on the implementation of technological operations of moving, drying, shipping a known amount of grain products and, based on the obtained data, calculating the energy efficiency coefficient.

The amount of consumed energy is measured by obtaining data from standard drive equipment (frequency drives and soft starters) and energy meters (electricity, gas, heat) and additionally installed on each mechanism for measuring electrical parameters.

The measurement of the number of moved grain products is carried out by obtaining data from the System of quantitative and qualitative accounting of grain, for example, "SAKURA-Production" of INNOVINNPROM or another standard system of the enterprise and data from the scales available at the enterprise and by installing flow meters at the entrance of each vertical conveyor (noria).

It is also possible to make an approximate calculation (with an accuracy of 5%) based on the calculation data of the power factor (cos ϕ) of the nori load.

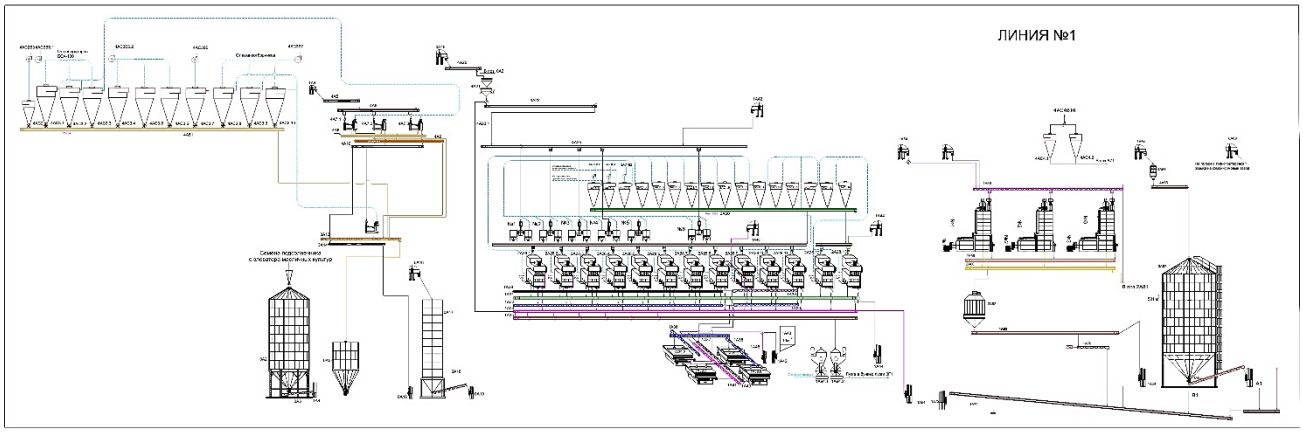
During the stage, work is carried out on the analysis of the optimality of the work of technological lines and productions and their interaction, determining nodes that critically affect the productivity of production:

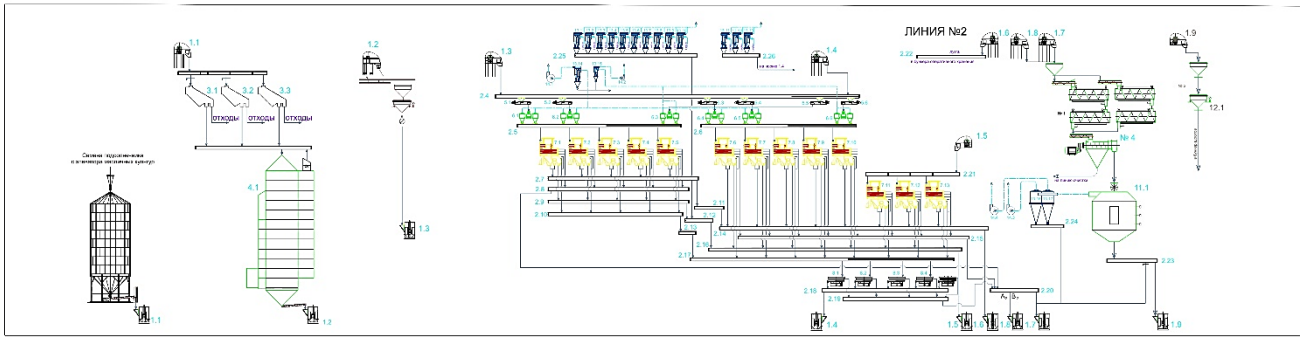
- Organization of receiving into a single database from previously unrelated software technological routes, sections, lines, productions;
- If necessary, installation of additional gateways, etc. data collection devices, network equipment for data exchange between controllers of technological lines and production automation systems;
- Selection of key performance indicators of routes;
- Development of digital duplicates of technological routes;
- Construction and coordination of tables and graphs;

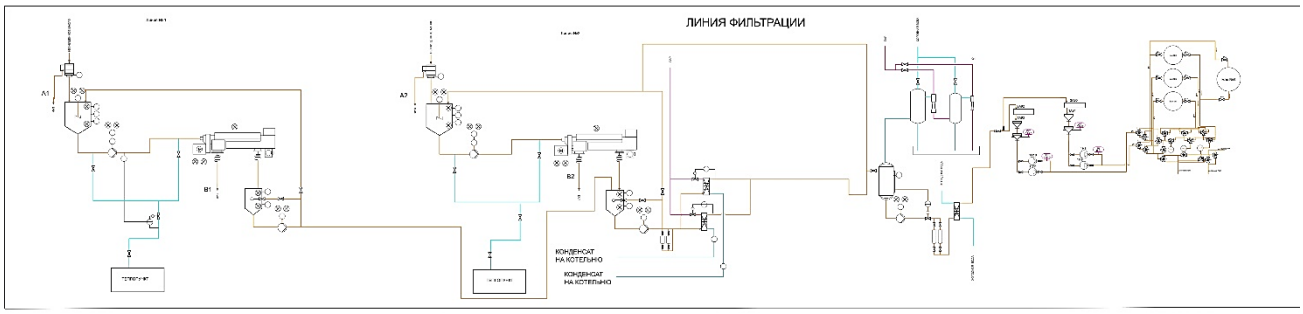
3. Energy efficiency assessment services of technological processes

The main task of this stage is the development and implementation of algorithms for the analysis of the energy efficiency of production as a whole, as well as the energy efficiency of the operation of each unit of equipment in the composition of technological routes, sections, lines, productions separately.

At the initial stage, those available in the basic version are deployed **SAKURA-APM** algorithms, dependencies and means of their analysis and visualization. Further, together with the customer, the algorithmic and visual parts are clarified.





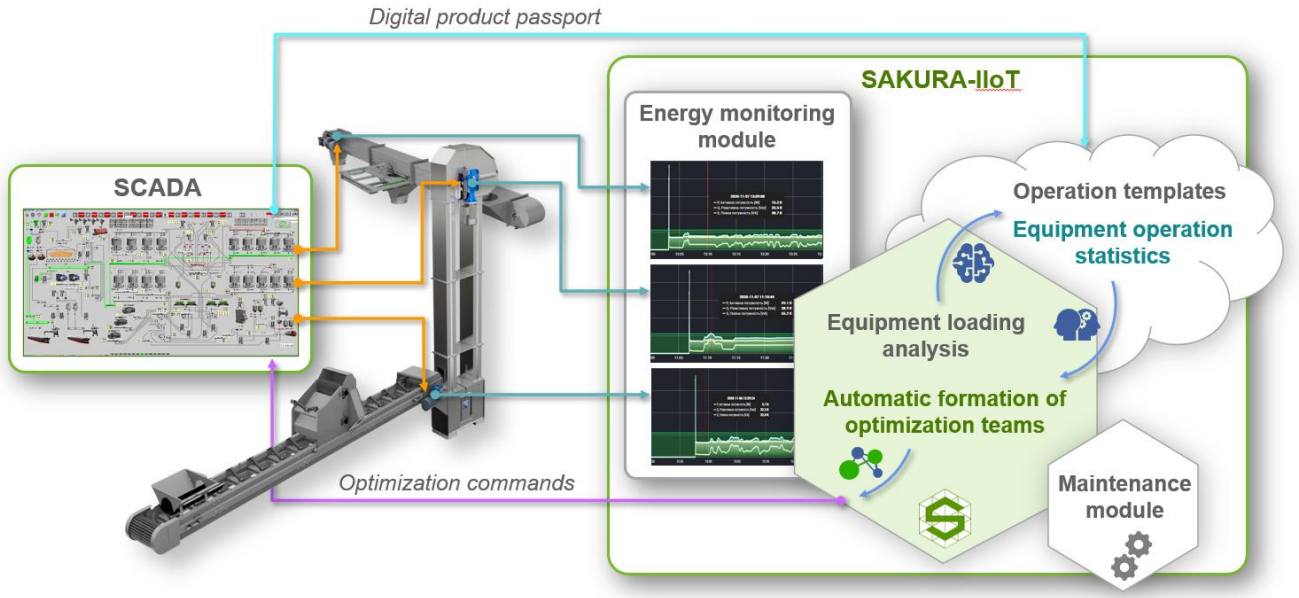


* More detailed information is confidential

4. Production efficiency assessment services

The main task of this stage is to achieve the maximum efficiency of production as a whole and reduce production losses. To **SAKURA-APM** data from logistics, financial, transport and other systems are integrated.

Thanks to the integrated components artificial intelligence and machine learning according to the data of the Energy efficiency module and based on arrays of statistical data **SAKURA-APM** automatically forms teams to optimize technological processes and operations in order to ensure maximum energy efficiency and overall production productivity.



The greater the volume and completeness of the data it receives **SAKURA-APM**, the better the calculation of productivity and energy efficiency of processes. **SAKURA-APM** reads data from the equipment and software available at the facility, without interfering with the technological process. **SAKURA-APM** supports most industrial protocols and interfaces.

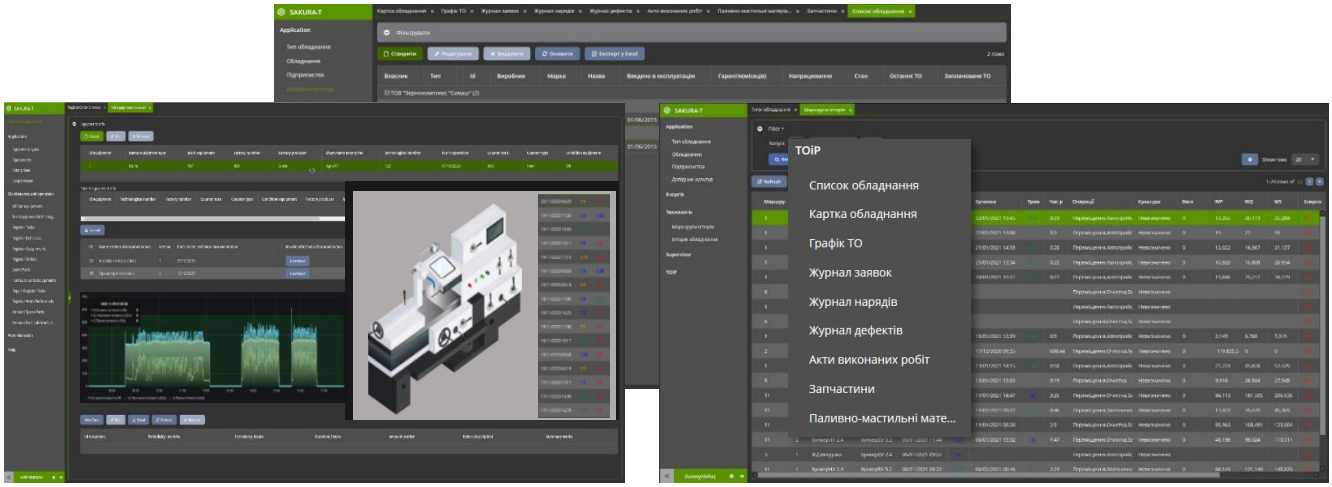
As a rule, the self-sufficiency of production modernization costs and the return to net profit are planned **in 2-3 years**. The maximum period of self-sufficiency **is 5 years**. More precisely, the indicator can be calculated after determining the depth of modernization and the volume of deployment of the necessary components of production control and analysis. In any case, the customer immediately receives full control of production, control of productivity and efficiency of production, including energy efficiency, and tools for analysis and optimization of production costs.

5. MAINTENANCE

Maintenance and repair module

The Maintenance and Repair module provides planning and control of equipment maintenance and repairs. The main types of information are information about the operation of the equipment, its consumption of energy resources, the use of spare parts and materials during maintenance and repairs. The maintenance module receives information about the operation of the equipment and its modes of operation from the Energy efficiency module or directly from the automatic control system.

The basis of the module is the schedule of maintenance and repairs, which displays the planned activities and the results of their implementation.



The module operates with equipment cards, which carry information about the completeness and condition of the equipment, its operation, periodicity and types of maintenance.