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Advanced Automation Solutions

Industry 4.0
Connected production
Digital enterprise
Industrial Internet of things

Automated process control systems
Automated enterprise management systems

Industrial automation today

• Increasing the volume of information. Information overload. The problem of providing the required information at the right time to specific professionals.

• To meet modern requirements and the use of more complex technical solutions and increase the number of equipment.

• More measurements and control. Increase and separation of systems and subsystems. Increase input and output channels.

• Increasing the requirements for automation functionality to achieve high performance in product quality.

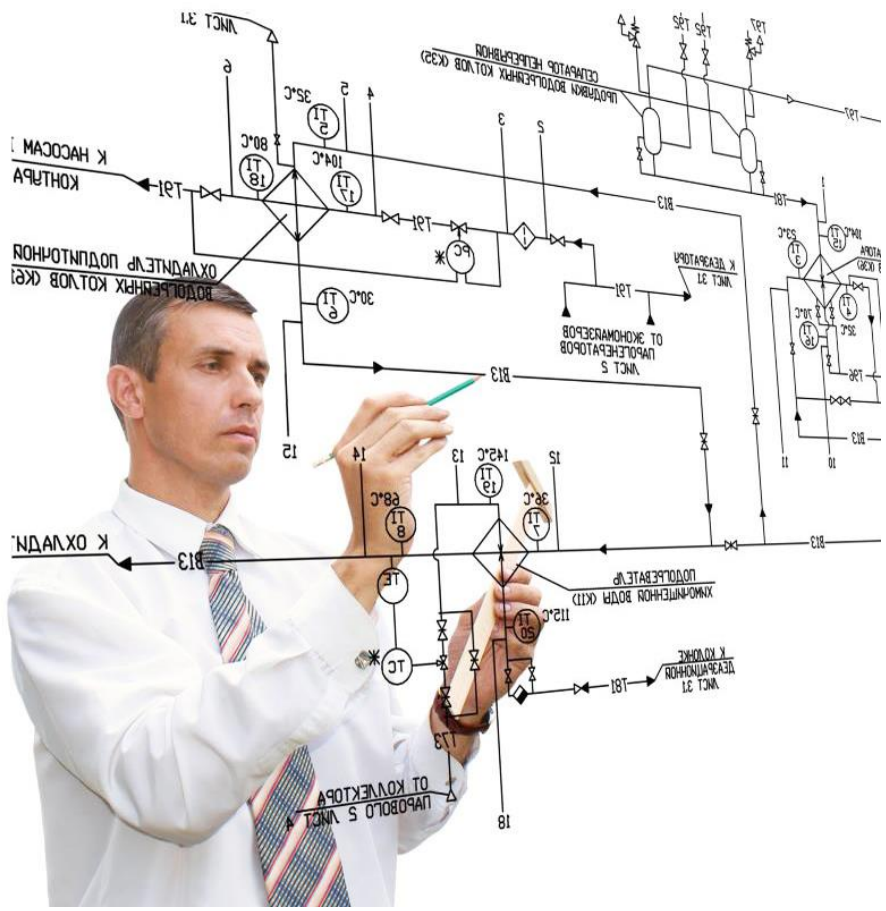
• Tools for management by economic criteria and key performance indicators.

• Tools for interaction in order to move from the management of an individual object to management, taking into account the current state of production and reduce decision-making levels.

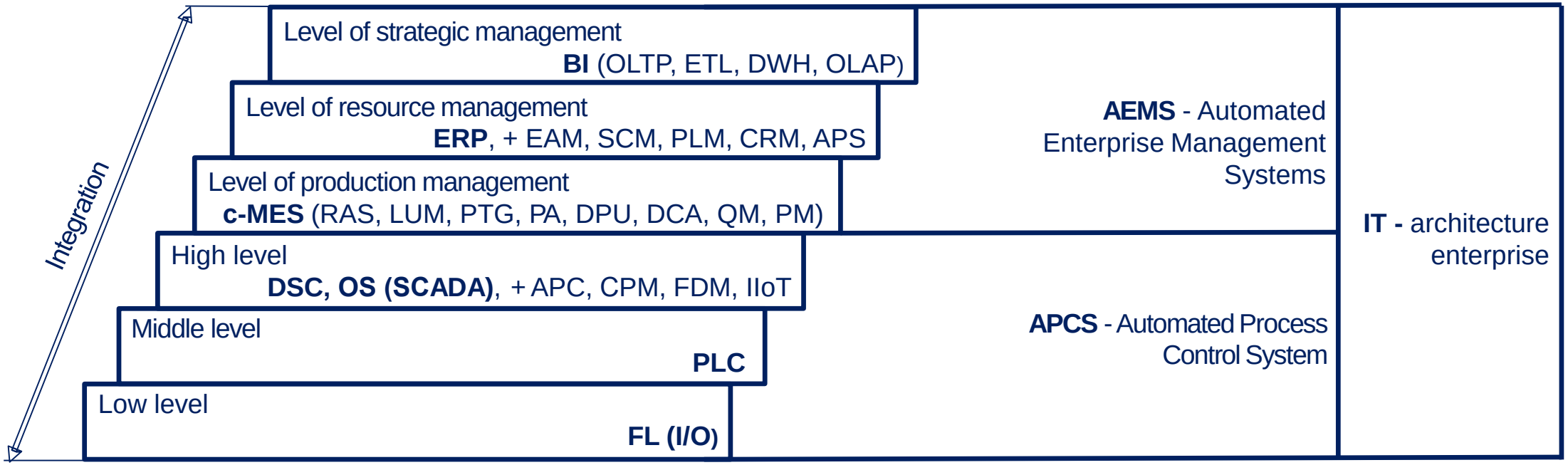
• Elimination of intermediate links. Need tools to manage proactively instead of responding to actual changes in object state.

• Close integration and interaction with a large number of adjacent and higher subsystems. The problem of information security.

• Accelerate the pace of hardware and software updates. The need for modern solutions based on virtualization and cloud technologies.



IT – HIERARCHY ENTERPRISE



BI - Business Intelligence
OLAP – On Line Analytical Processing
BW - Business Warehouse
BO - Business Object
ERP - Enterprise Resource Planning
CRM - Customer Relationship Management
PLM - Product Lifecycle Management
EAM - Enterprise Asset Management
APS - Advanced Planning & Scheduling

c-MES - Collaborative Manufacturing Execution System
RAS - Resource Allocation and Status
LUM - Labor/User Management
PTG - Product Tracking & Genealogy
PA - Performance Analysis
DPU - Dispatching Production Units
DCA - Data Collection/Acquisition
QM - Quality Management
PM - Process Management

DCS - Distributed Control System
SCADA - Supervisory Control and Data Acquisition
OS - Operating System
APC - Advance Process Control
CPM - Control Performance Monitor
IIoT - Industrial Internet of Things
PLC - Programmable Logic Controller
FL - Field level
I/O – Input / Output

c-MES - Manufacturing Execution System - Level of production management

1. **RAS** (Resource Allocationand Status)
2. **LUM** (Labor/User Management)
3. **PTG** (Product Tracking & Genealogy)
4. **PA** (Performance Analysis)
5. **DPU** (Dispatching Production Units)
6. **DCA** (Data Collection/Acquisition)
7. **QM** (Quality Management)
8. **PM** (Process Management)

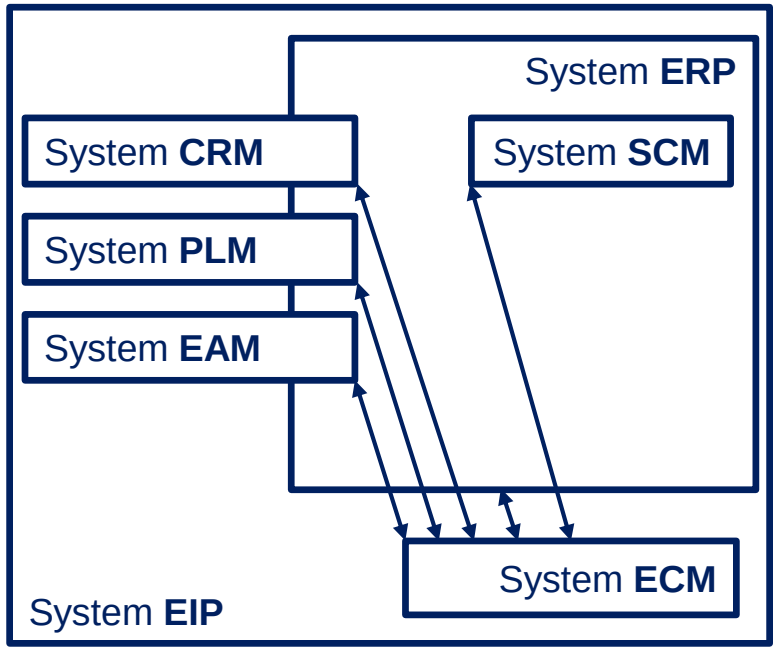
Subsystems: **ODS** (Operations / Detail Scheduling), **DOC** (Document Control), **MM** (Maintenance Management) – was eliminated in 2004 from the basic model MESA-11 (international association MESA, 11-subsystems) – but now there are proposals and implementations both separately and in the complex of these subsystems (what leads to duplication with the system ERP).

c-MES – development model Collaborative Manufacturing Execution System (8-subsystems) since 2004.

According to statistics, c-MES provides:
- reduced production cycle time by an average of 45%;
- reduction in data entry time 75%;
- reducing the number of work in progress by 24%;
- decrease in paper reporting between shifts by an average of 61%;
- reduction of the production cycle time by an average of 27%;
- reduction in the volume of marriage by an average of 18%;
- reduction of unnecessary paper documentation by 56%.

Leaders in MES solutions in 2018 (Gartner. Magic Quadrant for Manufacturing Execution Systems):
- Honeywell Connected Plant (HCP)
- Siemens PLM Software
- SAP
- Dassault Systems
- Rockwell Automation

ERP (Enterprise Resource Planning) + systems: EAM, SCM, PLM, CRM, APS - Level of production management



Decision leaders ERP:

- SAP: SAP Business All-in-One и SAP Business One (SAP HANA).
- Microsoft: Microsoft Dynamics AX.
- 1C.
- Oracle.

ERP - organizational and information system that integrates production and operations, human resources management, financial management and asset management, focused on the optimal use of enterprise resources.

EAM (Enterprise Asset Management) - information system aimed at optimal management of physical assets and their modes (operation, risks and costs throughout the life cycle to achieve and implement the strategic plans of the organization.

SCM (Supply Chain Management) - information system designed for automation and management of all stages of supply of the enterprise and for control of all goods. It covers the entire product cycle: the purchase of raw materials, production, distribution of finished products.

PLM (Product Lifecycle Management) - a system, including application software, for product lifecycle management.

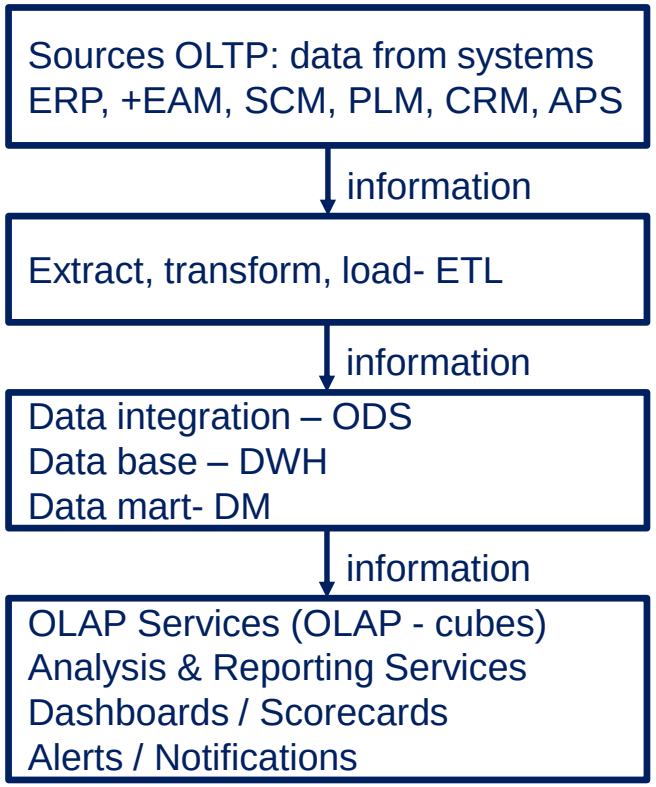
CRM (Customer Relationship Management) - application software for organizations intended for automation of strategies of interaction with customers (clients), in particular for increase of level of sales, optimization of marketing and improvement of customer service by saving information on clients and history of relationship with them, establishment and improvement of business processes and the subsequent analysis of results.

APS (Advanced Planning & Scheduling) - advanced planning, software for production planning, the main feature of which is the ability to build a schedule of equipment throughout the enterprise.

ECM (Enterprise Content Management) - enterprise information resources management system or corporate information management.

EIP (Enterprise Information Portal) - corporate portal, information automated system that provides employees with the necessary services in a single order.

BI – Business Intelligence - Level of strategic management



BI (Business Intelligence) - identification of computer methods and tools for organizations that provide translation of transactional business information into human-readable form suitable for business analysis, as well as media for working with such processed information. The purpose of BI is to interpret a large amount of data, focusing only on key performance factors, modeling the outcome of various options, tracking the results of decision-making. BI supports a variety of business solutions — from operational to strategic.

OLAP (On Line Analytical Processing) - interactive analytical processing, technology of complex multidimensional data analysis. The reason for using OLAP to process requests is speed. OLAP-cubes-technology that allows you to do in real time (1-5 seconds) any reports and conduct a full analysis of the data.

OLTP (Online Transaction Processing), transactional system-real-time transaction processing. A way to organize a database in which the system works with small transactions, but with a large flow, and the client requires minimal response time from the system.

ETL (Extract, Transform, Load) - tools: programs that allow you to load data into DWH from different accounting systems.

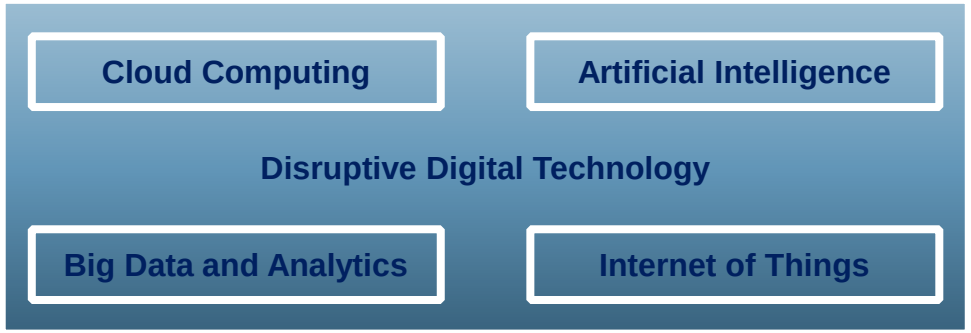
DWH (Data Warehouse) - storage: a complete SQL database for preparing and storing data for Analytics.

ODS (Operational Data Store) - a database designed to integrate data from heterogeneous sources and then use that data by applications.

DM (Data Mart) – a subset of a data warehouse organized to solve analytical problems.

The largest provider of BI solutions: GlowByte Consulting, Softline, Техносерв, Крок.
Popular BI platforms: QlikView, Klipfolio, Tableau, Power BI.

Disruptive Digital Technology



Disruptive Technologies (breakthrough technologies) - have the greatest transformational potential among other Digital Technologies:

1. **Cloud Computing** (технологии облачных вычислений) - the use of these technologies significantly increases the efficiency and efficiency of doing business by leasing to the customer on demand scalable computing resources: infrastructures, platforms and applications. Main service models: IaaS (Infrastructure-as-a-service); PaaS (Platform-as-a-service); SaaS (Software-as-a-service).
2. **Artificial Intelligence** - based on the use of computer algorithms that simulate various aspects of human thinking, based on flexible methods of machine learning, i.e. the use of algorithms that allow to derive their own rules of decision-making from the analysis of large amounts of training data (there is self-learning computer programs). Classes and types of AI-systems: “smart assistants” (agents, intelligent agents); AI robotic systems; self-learning AI-systems; game self-learning AI-systems.
3. **Big Data and Analytics** - the technology of machine learning and big data analysis for the global economy and society as a whole, as well as to improve the efficiency of doing business by various companies, will only increase.
4. **Internet of Things** - it is customary to designate a rapidly growing and extremely heterogeneous class of industrial and household appliances, devices and other devices that combine with each other the possibility of their joint operation and interaction via wireless communication (via the Internet or via telephone lines; an alternative is also the use of radio frequency identification technologies).

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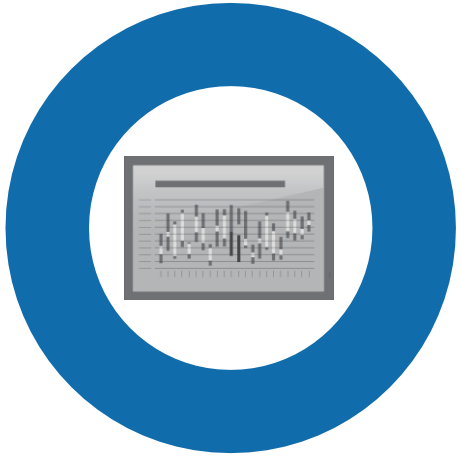
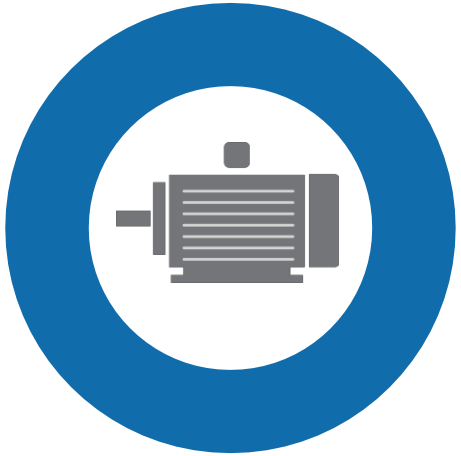
Connected production

Seamless integration of processes, assets and people in the enterprise

ACCURATE DATA ABOUT THE COMPANY



INFORMATION ABOUTPROCESSES



DATA ABOUT THE PERFORMANCE OF ASSETS

DATA SKILLSAND SECURITY

Optimal production performance every day, expert skills for all employees of the organization

Cybersecurity

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Connected production

Examples of the application of technologies connected to production

- Complex installation
- MES-production management systems
- KPI-key performance indicators
- Digital double
- APC-process autopilot system
- RTO-real-time monitoring system

Increase throughput and yield

- Compressors
- Heaters, heaters
- Heat exchangers, coolers
- Pumps, engines, electrical equipment

Increase of operational readiness of production

- Digital procedures
- Attached device
- Connected smart helmet
- Training and education through virtual and augmented reality technologies

Increased safety and efficiency

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Connected production

The connection of processes, assets and people for the continuous maintenance of the efficiency of production

- In-depth substantive examination.
- Optimization and Analytics through digital doubles.

- A broad ecosystem of expertise and capabilities.
- Predictive control. Increase working time.
- Reduced downtime.

- Improving the quality of solutions through data analysis.
- The safety and satisfaction of the employees.

- Unique industrial solution.
- Integrated solutions for the entire enterprise.

Increase in production and output 7%	The increase of the coefficient of readiness 2%	Capitalization of the knowledge of retiring workers	Increase in annual profit

Based on advanced software solutions

Vocational training system. Support of maintenance and repair of production personnel on the basis of augmented and virtual reality.

Advantages:

- Faster and more efficient training of new staff. Interactive on-the-job learning environment.
- Allows you to simulate different scenarios of operation and failure. Maintenance of the process and sequence of maintenance or repair.
- Operational access to technical and permits during the work. Access to experts.
- Combination of training and verification of acquired skills. Allows you to directly link the skills of staff with the performance of the enterprise by measuring the effectiveness of training based on real results.
- For the learning process of employees can be observed in the formal system of management training.

Industrial Internet of Things (IIoT) for the entire enterprise

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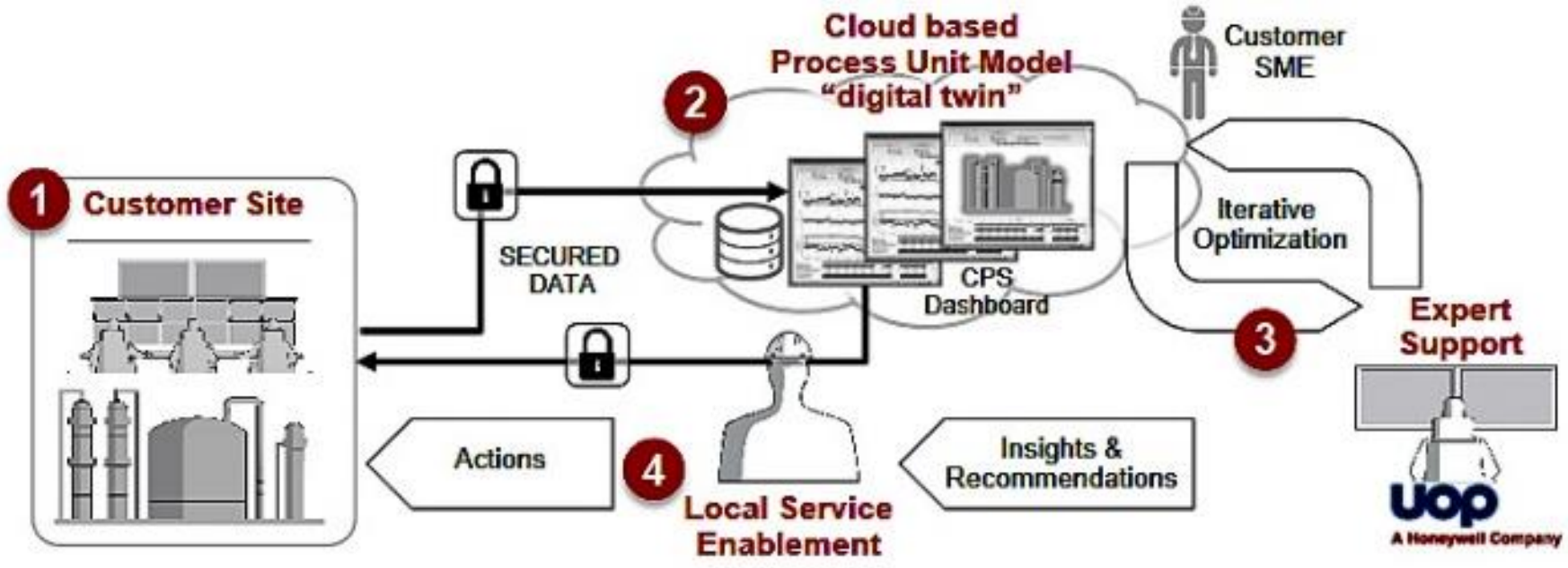
Use of key breakthrough technologies:

- High-speed communication and low-cost mass storage in the clouds.
- All-pervasive and inexpensive sensor technology.
- Advanced Analytics (Big Data) and machine learning.
- Remote interaction. Access to competence Centers.
- Routine monitoring goes to the machines.



Industrial Internet of Things (IIoT) - connected enterprise architecture

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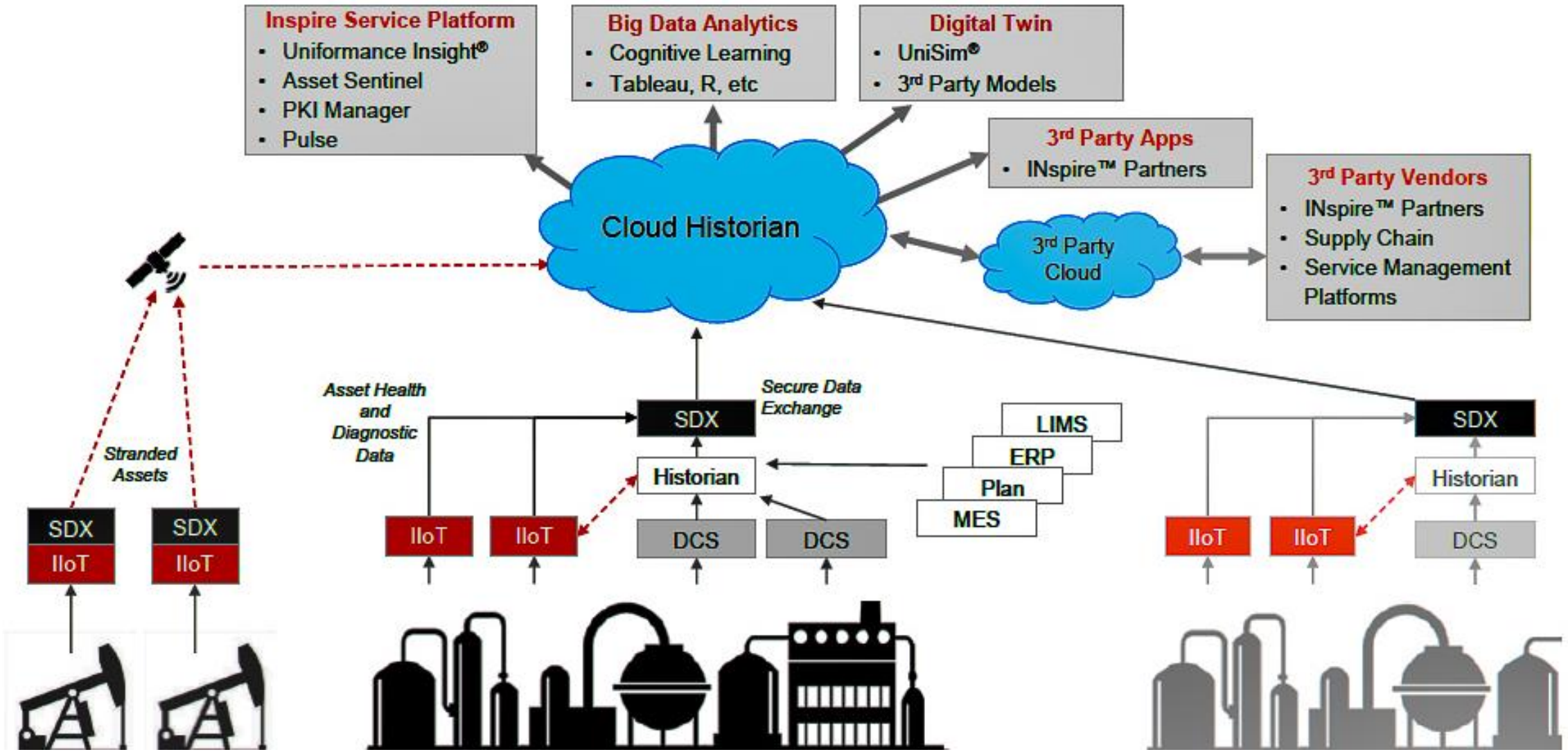
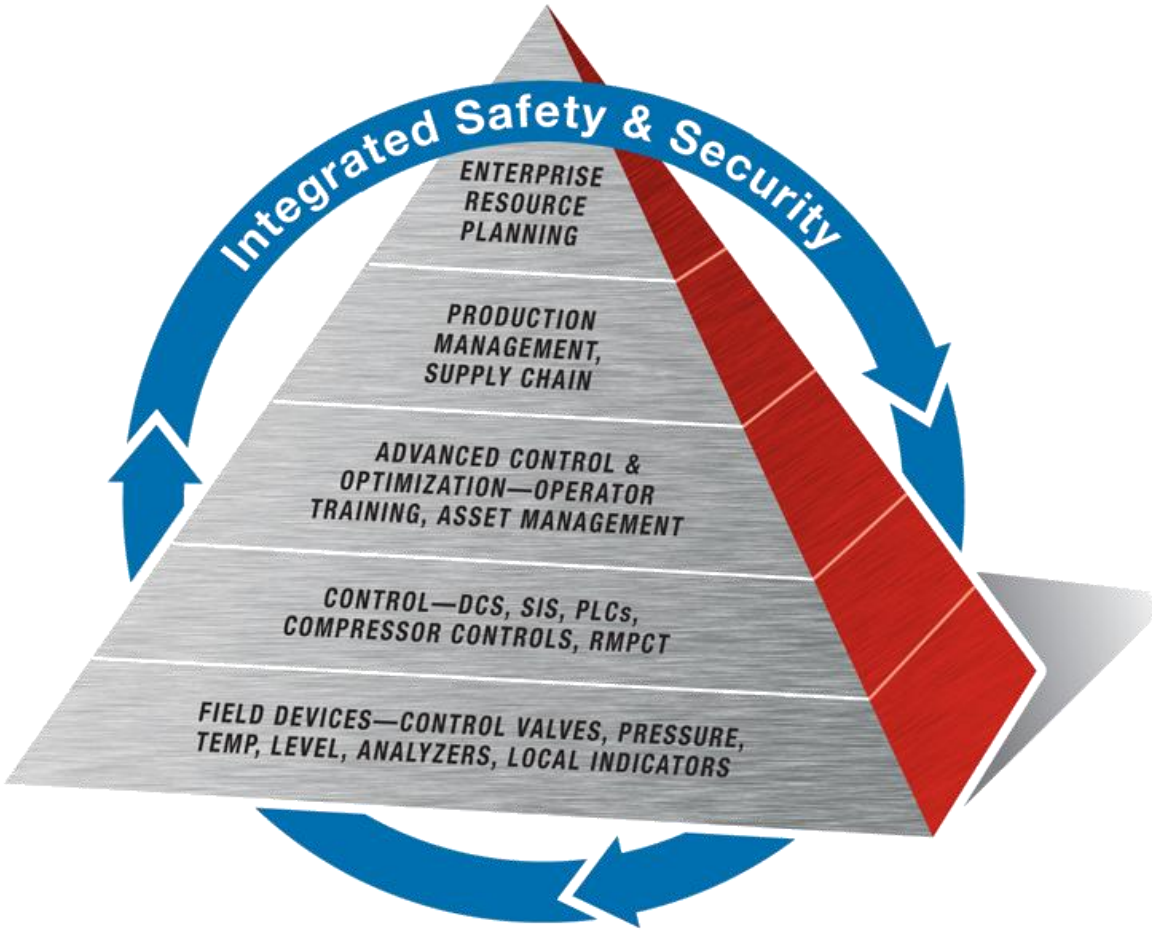


The main tasks of advanced automation

- Creation of a unified management system for the entire production chain-from the receipt of raw materials to the shipment of commercial products. Ensuring optimal modes of all production and coordination of joint work of all plants and shops.
- Construction of a unified system of emergency protection, fire and gas, alarm and fire extinguishing systems. Ensuring a high level of production safety and control over the condition of all technical means.
- Construction of a unified diagnostic system for dynamic equipment and instrumentation. Providing the possibility of maintenance in order to increase the overhaul cycle.
- Creation of a universal operator workstation that provides quick access to the necessary data and tools for advanced, group and advanced management.
- Implementation of high-tech solutions that contribute to increase output and reduce raw material and energy costs:
  - systems of control and management of material flows and energy resources.
  - systems of production scheduling and monitoring of key performance indicators.
  - real-time pumping and mixing control systems.



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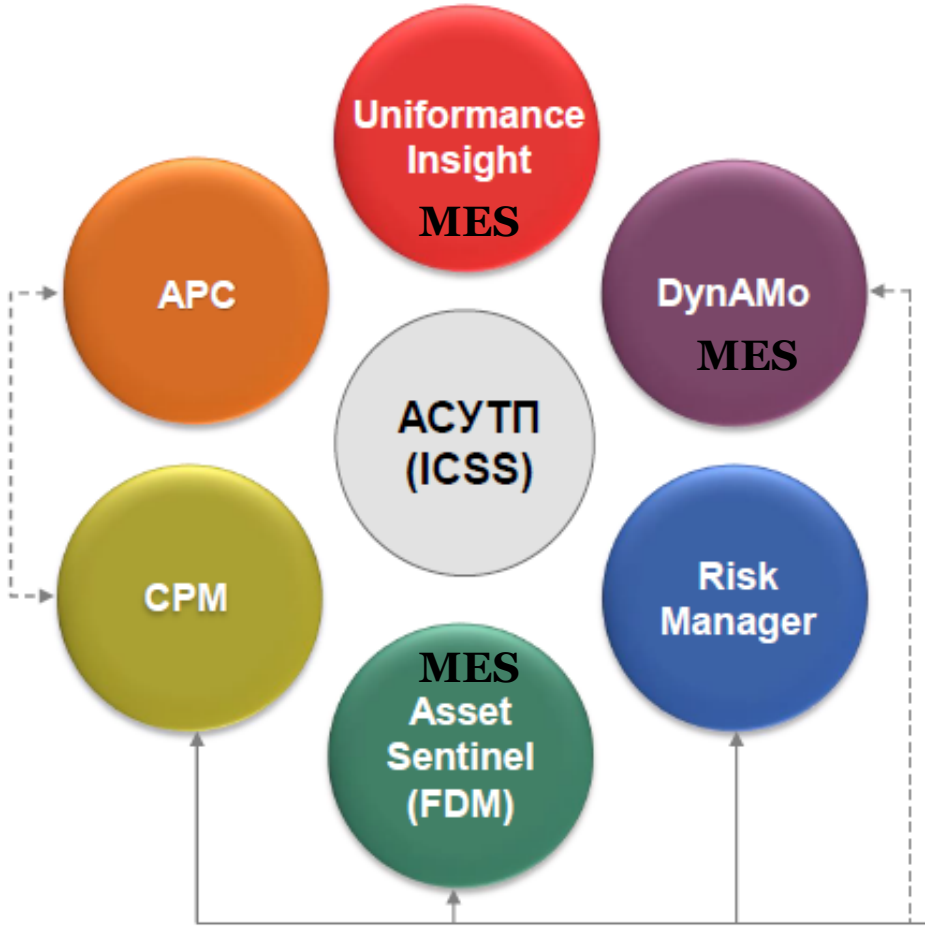
Intelligent automation (main components)



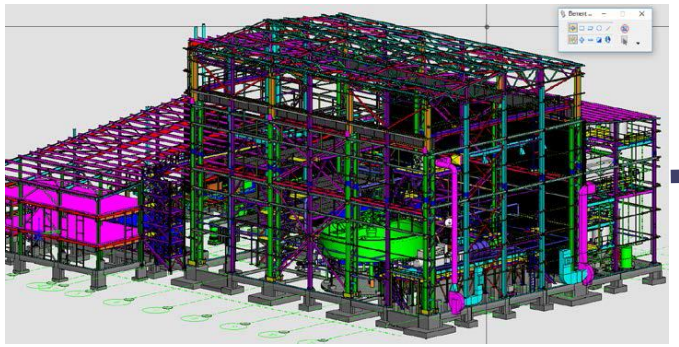
- **Uniformance Asset Sentinel** – complex system of monitoring and diagnostics of equipment operation
- **Field Device Manager (FDM)** – advanced diagnostic system for instrumentation
- **Industrial Cyber Security Risk Manager** – system to control the level of information security
- **Dynamo** – alarm monitoring, analysis and rationalization system
- **Control Performance Monitor (CPM)** – system to monitor performance of control loops
- **APC** – advanced process control system
- **Uniformance Insight** – single production web portal for personnel interaction

Diagnosis, assessment and protection of automation

Digital double for efficient design, construction and operation of industrial facilities

Bentley Advancing Infrastructure

Design



Construction

Operation

The optimal system of implementation of digital double

Digital double for efficient design, construction and operation of industrial facilities

Bentley Advancing Infrastructure

Digital organization

1. High resolution shooting and geolocation
Fast digital mapping and evaluation

2. 5D information modeling
Project platform

3. Digital collaboration and mobility
Transition to paperless projects in the office and among the working staff

4. Internet of things and in-depth Analytics
Intelligent decision-making and asset management

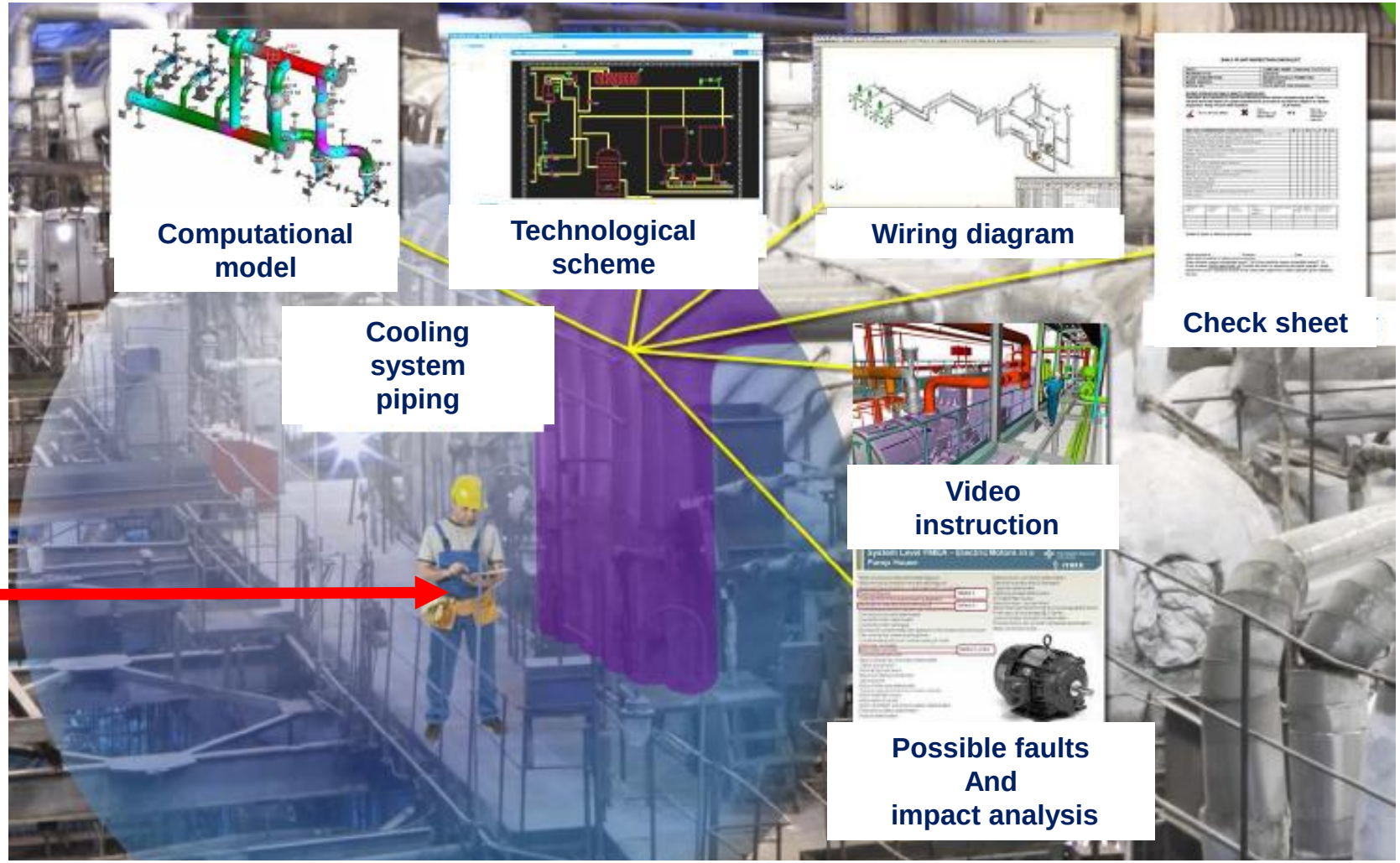
5. Modern design and construction
Design with the use of advanced solutions and methods

Digital double for efficient design, construction and operation of industrial facilities

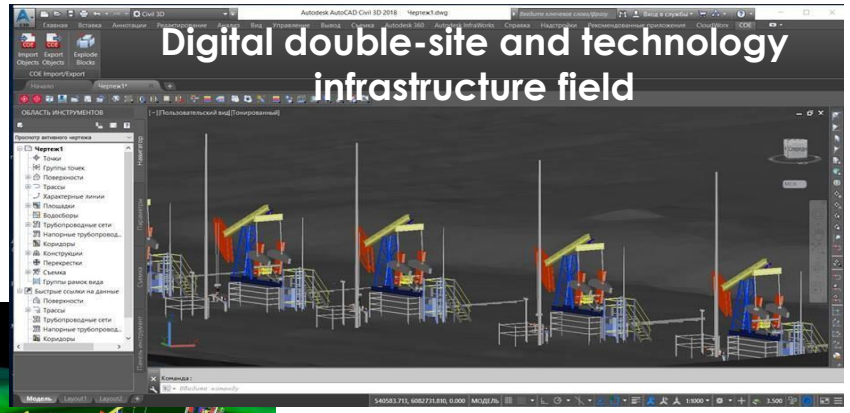
Modeling the reality of existing objects

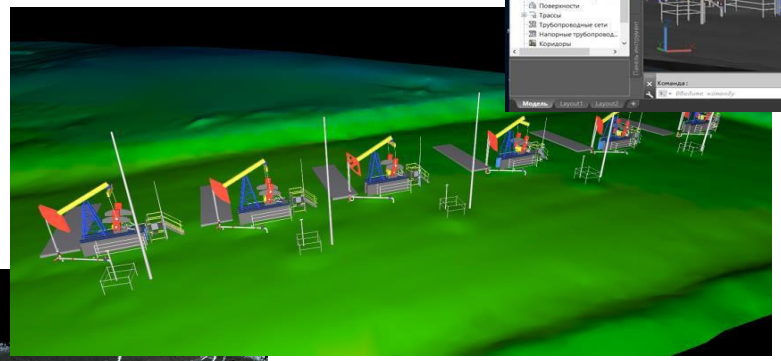
- Advanced surveying technology
- Laser scanning
- Photography with drones and " hands”
- Source data
- Executive survey
- Mapping “as designed” and “as built " in 2D and 3D
- Comparison of the volume of work performed and the volume of materials

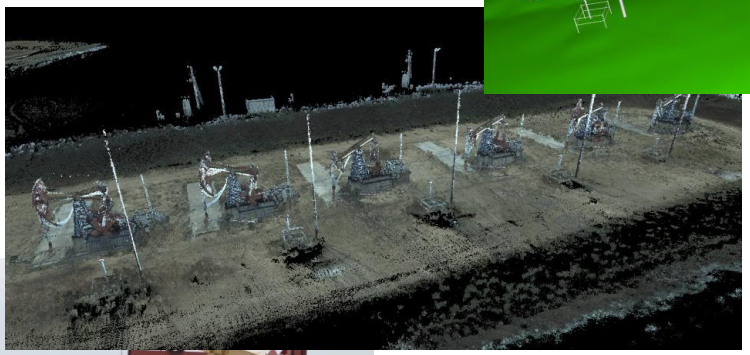
Digital double in the process of operation of industrial facilities



Digital field-digital double







3D digital double of the field area and engineering infrastructure based on digital aerial photography and laser scanning

Intellectual oil and gas field

Today, digital technologies cease to carry only a service function, becoming a full participant in business processes, turning data into a valuable resource for companies.

In the oil industry, the trend of digitalization has affected all areas - from production to sales. The modern field, and especially the field of the future, is unthinkable without constant monitoring of the state of wells and downhole equipment, pipelines and ground infrastructure.

The data obtained allow to monitor production performance in real time, to respond to changes in processes in a timely manner, to prevent breakdowns and accidents, to save energy and other resources.

Further processing and analysis of information make it suitable for use in planning and making quality management and strategic decisions. The result of the introduction of "smart" automation in the fields-optimization of drilling and increase oil recovery, savings on operating costs.

Other terms of the Digital intellectual field:" control over the field"," integrated operations"," smart production " — many terms describe the same processes that have long been used by the leaders of the oil industry and are now actively developing in Russia.

At the same time, the approach is not limited to the introduction of technologies that make production easier and more efficient. It also includes significant organizational changes and affects all areas - from drilling to work with staff.

Intellectual oil and gas field

Intelligent oil and gas field — an automatic control system for oil and gas operations, providing continuous optimization of the integrated field model and production management model.

The main part of the integrated model is the geological model, which is a complex and fuzzy system. In this regard, it is impossible to build a fully automatic control of oil production, it is possible to significantly reduce the influence of the human factor in the process of managing the life cycle of deposits.

To ensure the integrity of field management, an integrated asset information model must model: geological, geographic, technological, supply chain, economic, financial and strategic.

The intellectual field includes control circuits:

- the operating circuit provides control over the efficiency of operations management processes for the field (production, control and management of operating modes and condition of equipment, auxiliary processes, etc.);

- modeling contour-provides dynamic development of the control model under changing external (context) and internal (content) conditions. The necessary conditions for the existence of an intellectual field is:

- the formalization of the information model fields;

- management personnel;

- the most accurate feedback interfaces (sensors, communication);

- interfaces to optimize processes, models and criteria.

The implementation of the intelligent field is based on the open standards ISO 15926 (industrial automation Systems and integration - integration of life cycle data for process plants, including oil and gas production facilities), ISA-95 (international standard for the development of the interface between enterprises and control systems), ISA-88 (standard for the management of the batch addressing process), etc.

Intellectual oil and gas field

One of the significant competitive advantages of a company that does not produce a unique product is internal efficiency. We are talking about both the technological efficiency of production and the optimality of business processes.

Mine assets are implemented the program "Digital oilfield", whose main task is not just to saturate the production of automated solutions, but to find the optimal point of their application, to apply advanced technologies where they respond to key challenges of the business.

The creation of the" digital field " means the widespread use of advanced information technologies in order to increase the profitability of production and improve field exploration technologies.

Thus, the field should collect all data-geological, technical, statistical, which are then transferred to the center, processed, analyzed and stored in an accessible form, which is fully consistent with the concept of the industrial Internet of things IIoT.

Modern digital solutions in oil exploration and production will reduce the cost of development of hydrocarbon reserves and increase its supply.

Options for digitization:

1. Remote management of the Fund;
2. Predictive failure analysis of deep-well pumping equipment;
3. Occupational and industrial safety (staff);
4. Occupational and industrial safety (equipment);
5. New visualization technologies;
6. Management of reservoir pressure maintenance systems;
7. Well testing in real time;
8. Oil and gas treatment;
9. Integrated planning;
10. Integrated modeling;
11. Augmented and virtual reality technology;
12. Decision support system.

Digital technologies in automation

Necessary digital solutions for production

Production data management.
Maintain and analyze a secure archive of your production data to improve the quality of subsequent decisions.

Technological monitoring.
Know the status and efficiency of your wells and make better decisions.

Production efficiency.
Provide your team with the tools to plan, execute, and improve production.

Production safety.
Provide field operators with the technical means to ensure safe operation and reliability of production.

The efficiency of the equipment.
React in real time to minimize costs and maximize asset efficiency.

Operational efficiency. Identify risks and opportunities of your production, react to them harmoniously by all company.

Digital solutions include

Production data management.
Real-time databases and Analytics

Production safety.
Alarm control.
Analysis of emergency stops.
Analysis of the state of emergency protection systems.
Safety valve analysis.
Testing of downhole barriers.

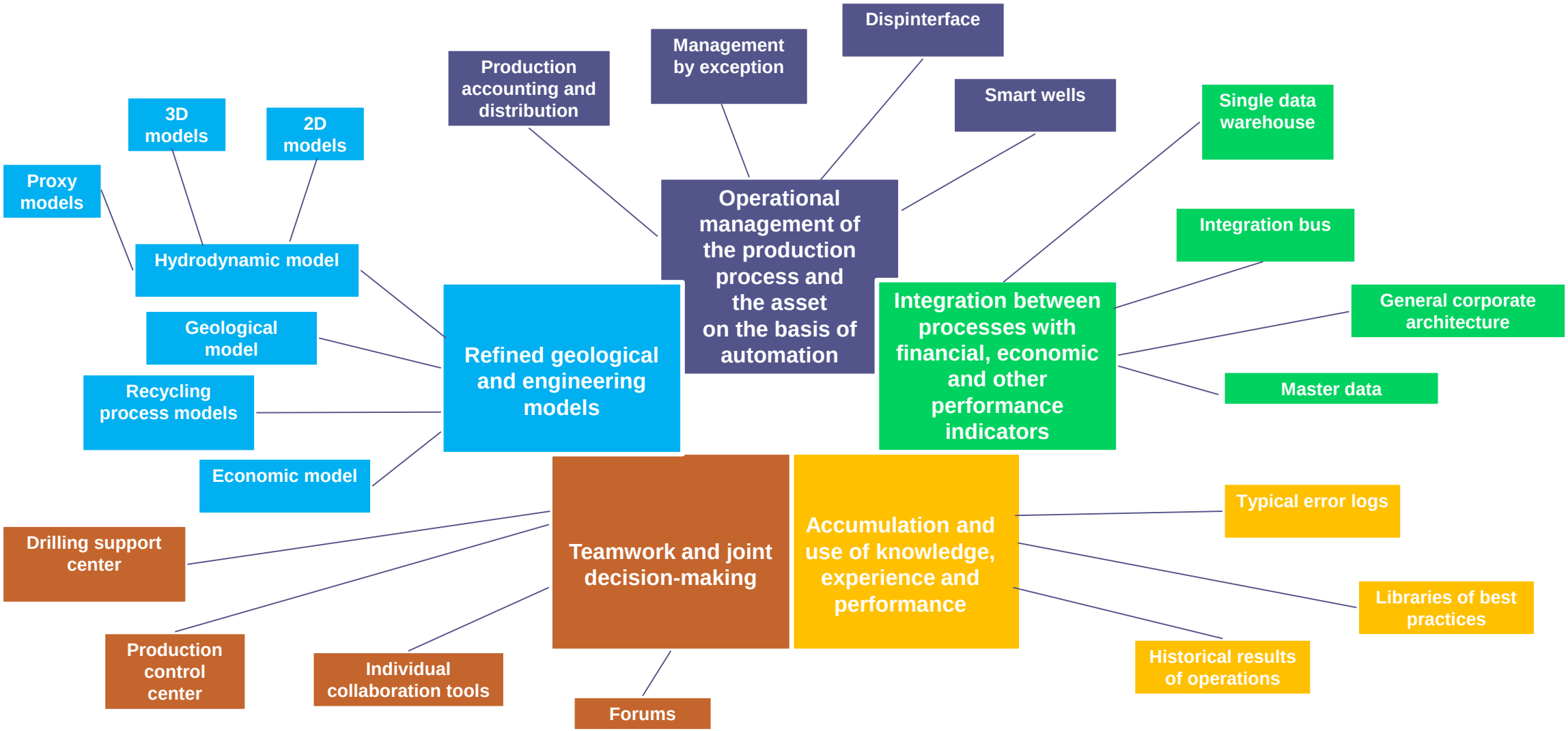
Technological monitoring.
Monitoring of wells, production.
Well testing verification.
Well testing management.

Operational efficiency.
Corporate interactions.
Efficiency management.
Integrated operations center.
Situation analysis.

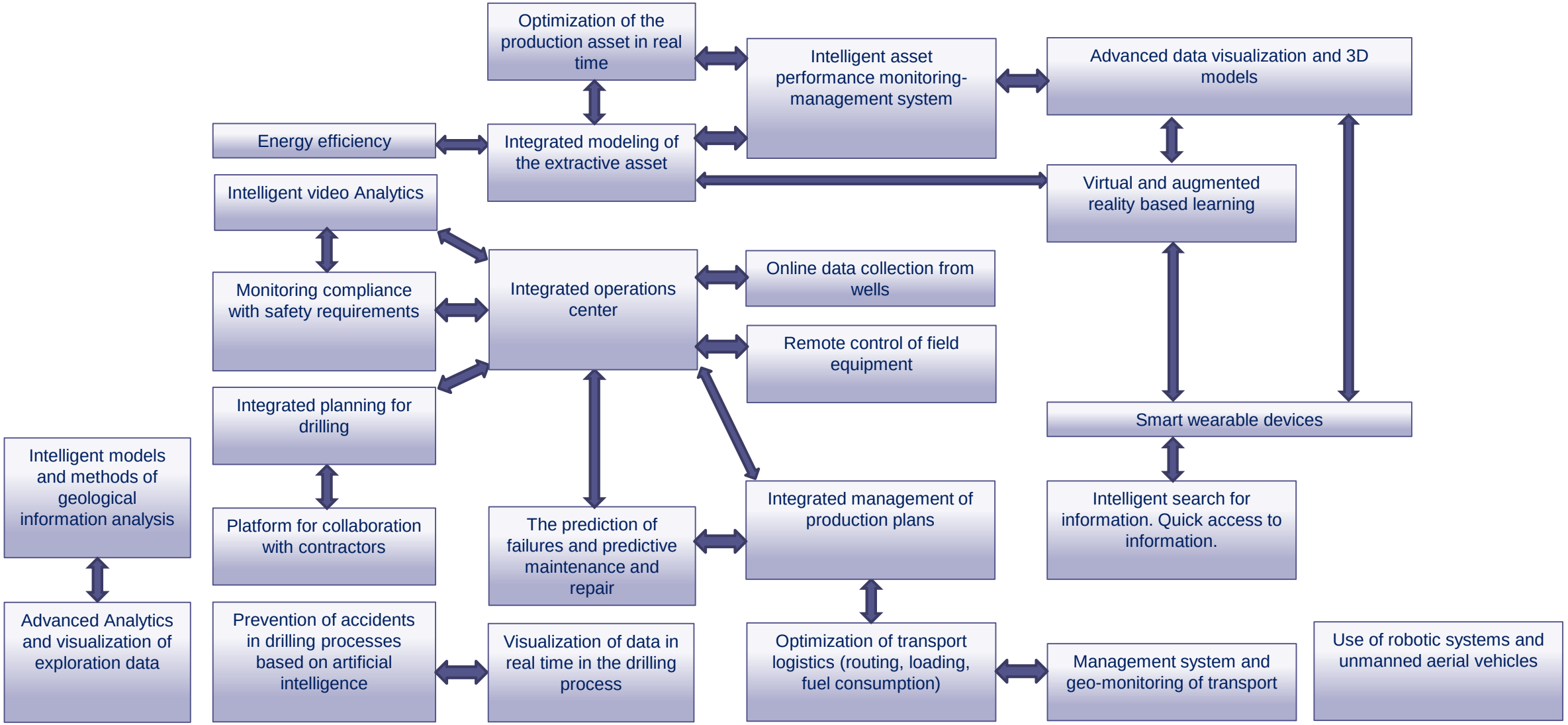
Эффективность оборудования
Учет простоев
Мониторинг состояния, целостности и эффективности оборудования
Мониторинг датчиков
Мониторинг контуров управления
Прогнозирование коррозии

Production efficiency.
Management of the operation.
Integrated planning.
Integrated modeling.
Production management.
The competence of the operators.
Process control and optimization.

Digital field concept as a set of complementary approaches



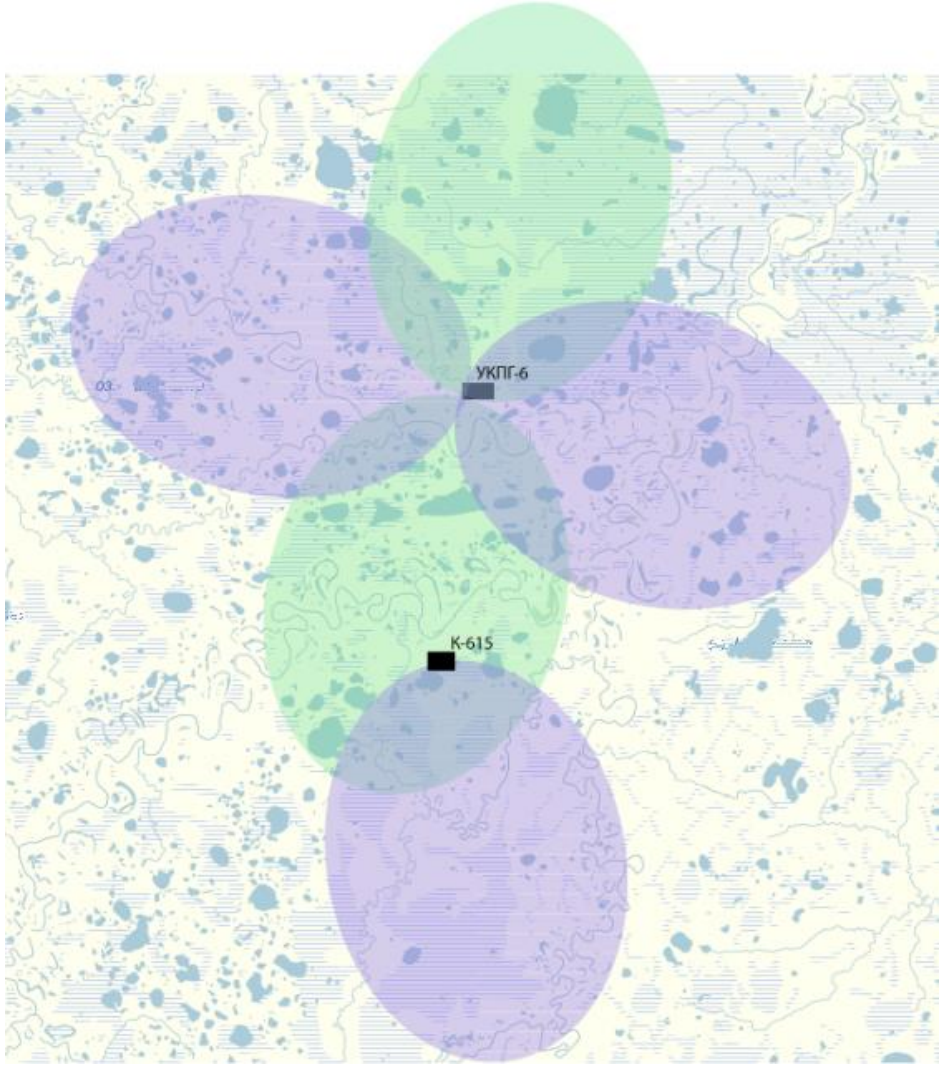
Digital intellectual field. Example of a network of digital models and solutions



Comprehensive solutions for remote control of remote oil production facilities with the use of WiMAX technology and WiFi

SIEMENS

- Telemechanization of single wells and nodes within a radius of up to 40 km from the control room in real time; Integration of various oil production facilities into a single network;
- Organization of new, previously impossible, services;
- Reliable software and hardware complex for data collection, processing and storage;
- Access to the Internet or the local network of the company in the entire WiMAX coverage area;
- Networking between remote controllers without the use of optical fiber at station facilities.



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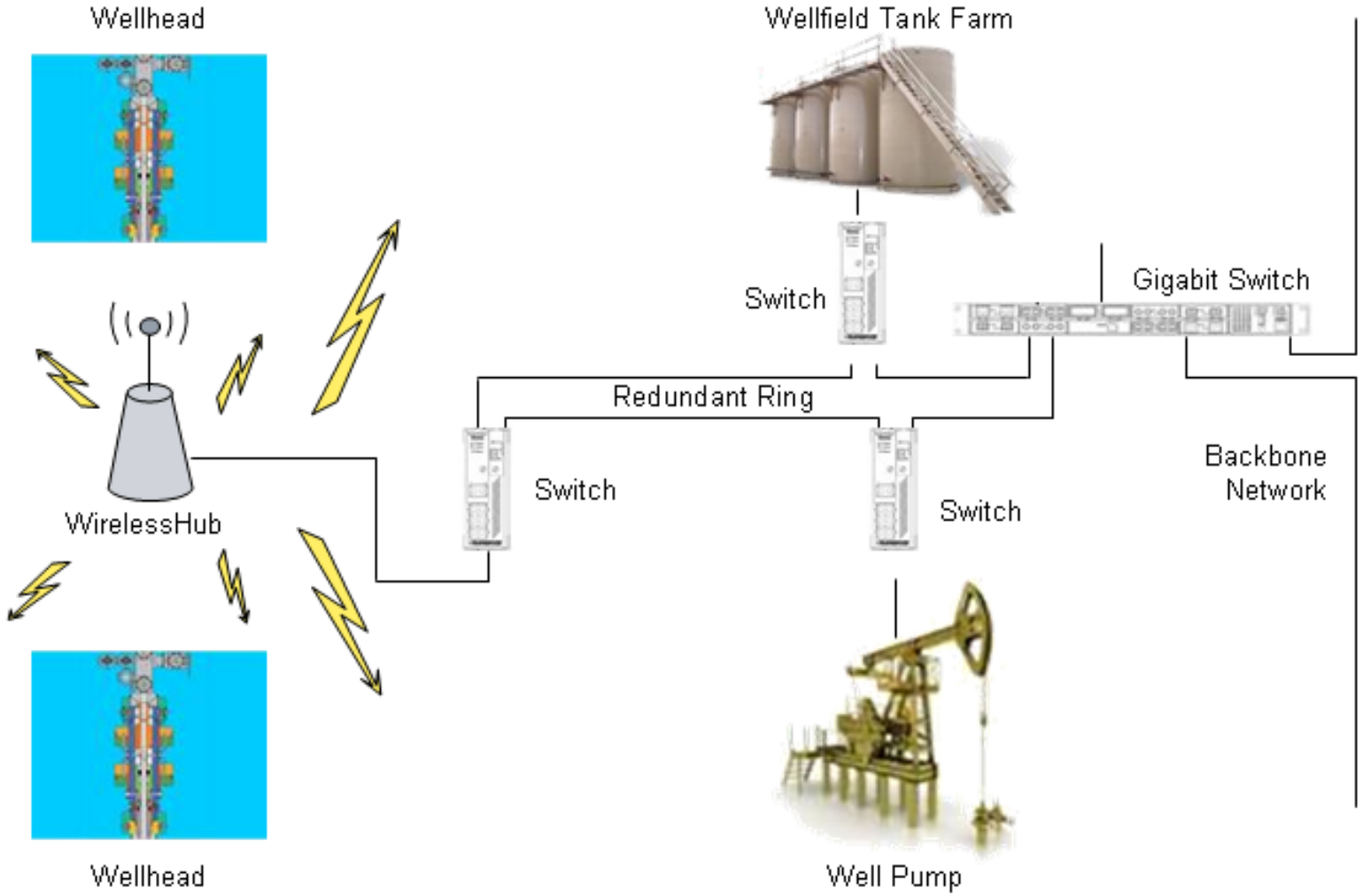


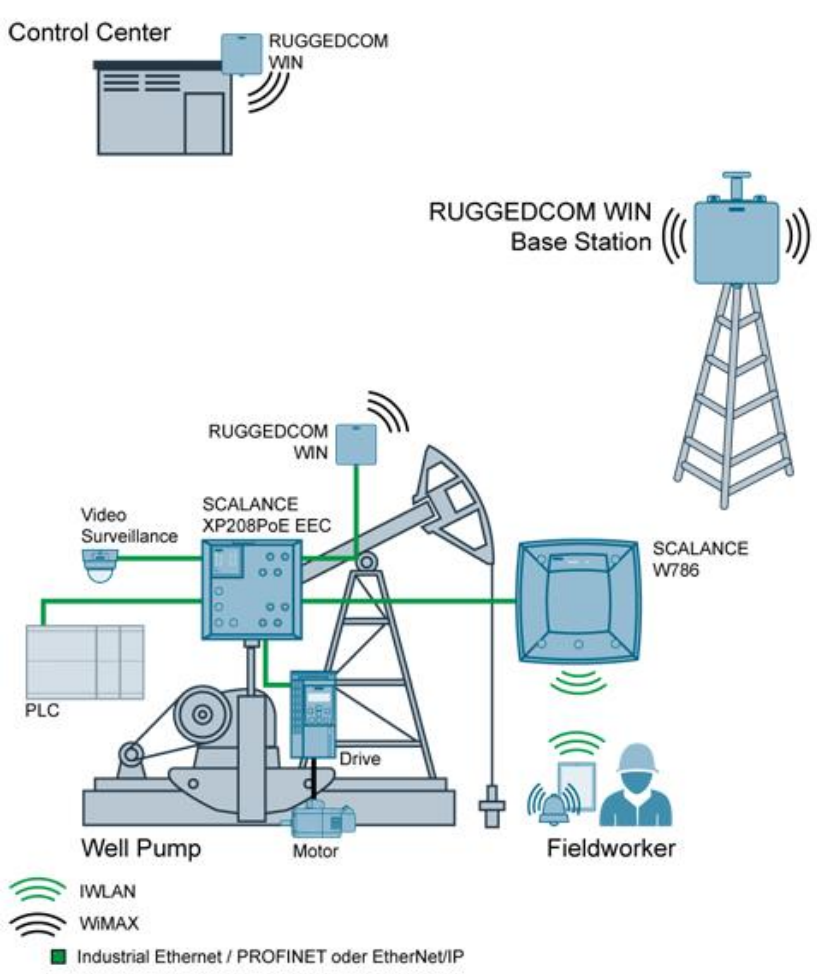
Organization of a single network of various oil production facilities

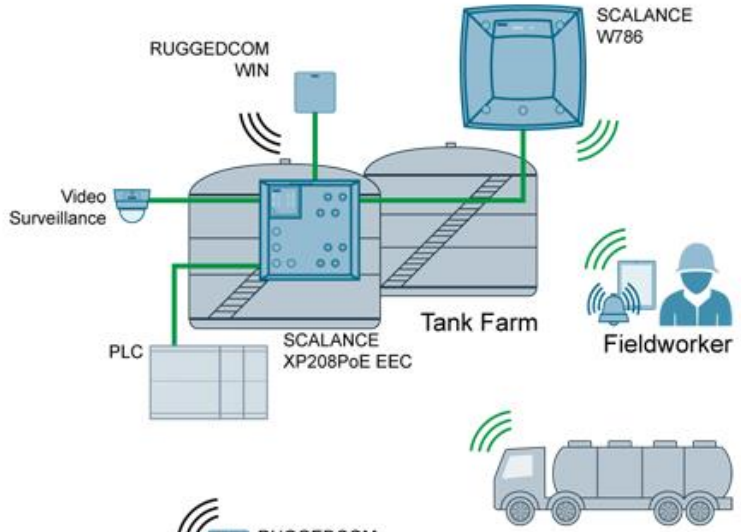
Comprehensive solutions for remote control of remote oil production facilities with the use of WiMAX technology and WiFi

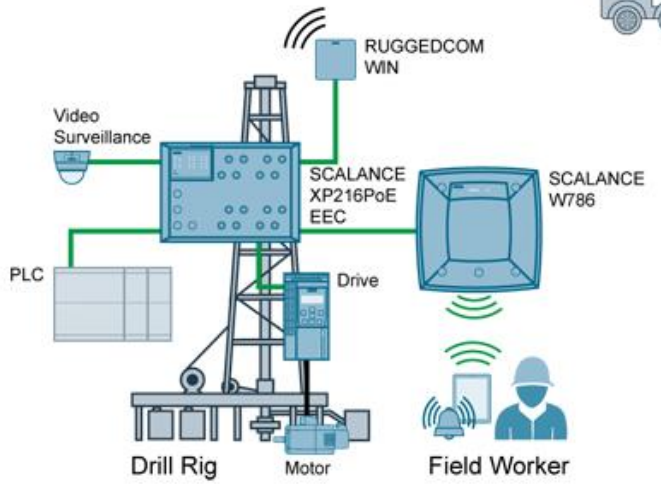
SIEMENS

New services-new opportunities:

- Implementation of technologies with requirements for instant response systems;
- Telephony;
- Access points not available for fiberglass;
- Technological and security video surveillance;
- Real-time monitoring and control of the process, including the use of mobile applications;
- Organization of access to the local network of the enterprise and the Internet at any point of WiMax coverage;
- Great speed of deployment.







Thank you!

Advanced Automation Solutions

Industry 4.0
Connected production
Digital enterprise
Industrial Internet of things

Automated process control systems
Automated enterprise management systems