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# **BASICS OF DESIGNING AN ENTERPRISE OPERATING SYSTEM AS AN ELEMENT OF OPERATIONS MANAGEMENT**

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The current state of the global economic environment is characterized by a critical level of uncertainty caused by the interweaving of technological revolutions, geopolitical shifts and the need for a fundamental restructuring of value chains. In the context of operational management, the design of the operating system (OS) of the enterprise ceases to be a purely technical task of organizing the production cycle and turns into a strategic process of forming an adaptive business architecture. Traditional models of operational management, focused on static optimization of resources, have exhausted their potential in the crisis.

The urgency of rethinking the conceptual foundations of OS design for Ukrainian enterprises is reinforced by the unprecedented challenges caused by full-scale military aggression. This requires management not just to maintain current functionality, but to create systems with high resilience properties – the ability not only to withstand shocks, but also to quickly recover and evolve in conditions of infrastructure destruction and logistical gaps [10]. OS design today integrates issues of financial security, cyber protection of information fields and the implementation of Industry 4.0 tools, which makes this process multidisciplinary [4].

Digitalization of the economy has brought radical changes to the understanding of the boundaries of the operating system. If earlier the OS was considered as an internal mechanism of transformation of "inputs" into "outputs", then modern research focuses on the creation of digital ecosystems, where the integration of information technologies (IT) and operational technologies (OT) allows creating smart manufacturing. Military instability leads to the destruction of supply chains, shortage of energy resources. The consequence is a shift to strategies

## ABSCHNITT 5.

### MANAGEMENT, ÖFFENTLICHE VERWALTUNG UND ADMINISTRATION

of OS mobility and decentralization. Financial security requires liquidity monitoring within the operating cycle. The result is the integration of operational and project management. Compliance with standards and international quality standards (ISO/GMP) requires strict regulation of processes through standard operating procedures. Scientific substantiation of the conceptual foundations of OS design allows enterprises to form an architecture that is both stable in compliance with standards and flexible in implementing innovative changes [1].

The purpose of the research is the theoretical generalization and practical substantiation of the conceptual foundations of the design of the company's operational system as an integrated element of operational management, which ensures sustainable competitiveness in the digital era. OS design is aimed at achieving the emergency of the system – a situation when the total potential of the organization exceeds the sum of the potentials of its individual units.

OS design aims to create a "consumer value chain", where each stage – from the purchase of raw materials to after-sales service – is logically justified and resource-efficient. Within the framework of modern management, the goal is also to integrate the principles of lean production, which allows you to eliminate losses and maximize value for the client [6].

The formation of OS is based on the synergy of several methodological approaches, each of which adds a specific toolkit for the analysis and design of organizational structures. Studies have revealed a transition to transformed and integrated approaches that take into account the conditions of conflict and uncertainty [2].

The system approach considers the enterprise as a complex open system consisting of interdependent subsystems: technical, social and managerial. OS design within this approach requires taking into account such properties as integrability (the presence of specific qualities inherent only to the system as a whole) and self-preservation (the ability to maintain the structure in the event of external disturbances).

The cybernetic aspect of the system approach focuses on management processes as a purposeful influence of the subject on the object. This involves the use of the principle of feedback, where information about the initial results of the system (product quality, costs) is used to correct input parameters. The complexity of the control system should correspond to the complexity of the controlled process, which is especially relevant when designing multi-disciplinary productions.

The process approach transforms the perception of the enterprise from a set of departments into a network of interconnected business processes. Each operation is considered as a process of transforming resources into a result that has

value for an internal or external consumer. This approach is the basis for the implementation of international quality standards (ISO 9001) and industry requirements (GMP).

OS design based on processes allows: to reduce the number of decision-making levels (decentralization); to form a "value creation chain" covering consumer involvement, production preparation and product implementation; use modelling methodologies to visualize and optimize workflows [6].

The situational approach is based on denying the existence of universal management methods. The choice of OS architecture depends on specific factors of the external environment, strategic goals and available technologies. In conditions of high turbulence, this approach evolves into the concept of adaptive management of business processes, which uses the principles of reflection and self-organization. For modern Ukrainian enterprises, the situational approach means the ability of the operating system to quickly reconfigure when conditions change (for example, switching to autonomous power sources or changing sales markets) [2, 9].

Borrowed from software engineering, the object-oriented approach suggests modelling an enterprise as a set of autonomous objects that interact through well-defined interfaces. Objects can be work centres, teams, orders or individual technological modules [8].

Object-oriented modelling allows you to create "modular" operating systems, where replacing one element does not require redesigning the entire structure, which is critical for innovative development.

Modern research considers OS as a socio-technical system, where productivity depends not only on technical excellence, but also on the interaction of people with technologies and organizational structures [1]. The concept of System of Systems (SoS) considers a large enterprise as a set of semi-independent subsystems that evolve and must act harmoniously in a single operational context.

OS architecture consists of a number of interconnected elements, each of which performs a specific role in the process of transforming resources into value. The design decision regarding each element must be integrated into the overall strategy of operational management [5]. The operational strategy is the foundation of OS, determining the long-term priorities for the development of production facilities. It is based on the concept of "distinctive competence" – what the company does better than its competitors. Elements of strategic planning include:

1. Selection of the process type. Process-focused (flexibility), product-focused (efficiency), or repetitive process.

2. Life cycle of the product. The influence of the cycle phase on the choice of technologies and output volumes.

## ABSCHNITT 5.

### MANAGEMENT, ÖFFENTLICHE VERWALTUNG UND ADMINISTRATION

3. Model. A tool for matching market requirements with production capabilities.

The information infrastructure of the modern operating system is based on enterprise resource planning (ERP) systems. The ERP system is a cross-functional platform that integrates finance, marketing, logistics and production into a single information space [3]. Features of technical resources include flexibility, complexity, and openness. These resources enable the OS to adapt to specific business needs. The next group of resources is organizational. Features of organizational resources include support of best practices and integration of processes. They provide an opportunity to standardize operations throughout the organization. The third key group of resources is information. The feature is a single data structure, the impact on operational activity is to ensure the accuracy and speed of decision-making.

Human capital is the most flexible, but also the most complex element of OS. The design of this level includes the formation of the organizational structure, motivation and training systems. Modern OS require a transition to a "competence-functional approach", where the emphasis is on the universal use of knowledge and management competencies to support innovation. It is important to integrate the principles of lean production, which requires a change in personnel culture towards continuous improvement (Kaizen) [2].

In modern conditions, the information security subsystem is included in the OS structure. It considers security objects as assets, including hardware, software, and business processes. ISMS design is based on a system-process approach, where security is an integral part of every step of value creation. In addition to cyber security, this level is responsible for the physical security of resources and financial sustainability, integrating financial security criteria into operational decisions [6, 10]. Project management is considered as a tool for OS transformation. If the operational activity is permanent, then the projects ensure the development of the system (introduction of new lines, IT systems, change of structure). Effective design of the OS requires the availability of mechanisms for the rapid launch of development projects without disturbing the current operational stability.

The pharmaceutical industry of Ukraine demonstrates a unique example of a combination of strict international regulation and high adaptability to wartime conditions. OS design in this area has a number of specific dominants. For a pharmaceutical enterprise, Good Manufacturing Practice (GMP) standards are not just recommendations, but fundamental frameworks for OS design. GMP is harmonized with European standards, which requires Ukrainian manufacturers to constantly confirm compliance [9].

Impact of GMP on OS elements:

1. Process design. Each operation must be validated and documented in Standard Operating Procedures (SOP).

2. Infrastructure design. The requirements for "clean rooms", ventilation systems and water preparation determine the architecture of production sites.

3. Quality management. The quality system is integrated into the production process at all stages – from development to distribution.

For large Ukrainian manufacturers, the logistics of foreign economic activity is a critical sub-process of OS. Studies emphasize the role of SOP in ensuring the quality of products when entering foreign markets. SOPs in logistics perform six key functions: informative, communicative, control, organizational, optimization and integration. This makes it possible to fulfil the rules of logistics (the right product in the right quantity of the right quality) with minimal costs even in difficult geopolitical conditions. The destruction of pharmacy networks (more than 500 damaged facilities), the blocking of humanitarian aid by the occupiers, and the disruption of logistics chains required an immediate redesign of the OS. The shortage of imported raw materials in OS design requires the search for alternative suppliers and the diversification of raw material sources. The destruction of warehouses requires the decentralization of stocks and the use of mobile warehouse units. The need for quick help in OS design prioritizes the production of critical groups of drugs. The logistics blockade requires integration into the Single Market Program of the EU, the use of land corridors.

The stability of the pharmaceutical OS today is measured by the ability to support therapy for chronic patients (diabetes, oncology) even in conditions of active hostilities. This requires the implementation of innovative communication strategies and contactless delivery methods [4].

Ukrainian pharmaceutical enterprises are actively implementing digital technologies to increase the efficiency of OS. This includes systems for electronic dossiers of the drug series, automated control of environmental parameters and Track & Trace systems for tracking each package. OS design in the Pharma 4.0 format allows not only to guarantee quality, but also to significantly reduce operational risks associated with the human factor.

The results of the study confirm that the conceptual foundations of designing the operating system of the enterprise have evolved from mechanistic models to complex adaptive architectures. An operating system today is the intelligent framework of a business that combines physical assets, digital data and human competencies. OS design should be based on the principles of Enterprise Architecture, where strategy, processes and IT infrastructure form a single entity. The use of an object-oriented approach allows to ensure the necessary modularity and flexibility of the system. Implementation of Industry 4.0 tools is a prerequisite for competitiveness. This requires operational management to acquire new competencies in the field of big data analysis and cyber security. For Ukrainian



## ABSCHNITT 5.

### MANAGEMENT, ÖFFENTLICHE VERWALTUNG UND ADMINISTRATION

enterprises, the main criterion for OS design quality is its resilience. The system's ability to self-organize and rapidly reconfigure in war is a critical factor in survival. In the pharmaceutical industry, OS is derived from GMP standards. Effective design of SOP and integration of the quality system into all business processes allows to ensure high product value while minimizing costs. The development of the concept of System of Systems and "intelligent ecosystems" indicates that the boundaries of OS will continue to expand to include interactions with suppliers, customers and even government regulators in real time. OS design as an element of operational management remains a dynamic field of scientific and practical research, where success depends on the ability to harmoniously combine technological excellence with social responsibility and strategic flexibility.

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