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INFORMATION AND ANALYTICAL SUPPORT FOR BUSINESS PROCESS MANAGEMENT: CONCEPTUAL, METHODOLOGICAL AND APPLIED ASPECTS

This study examines the issue of information and analytical support for management as a multi-level system integrating technological, organizational, and strategic aspects. The role of artificial intelligence, big data, and algorithmic models in decision-making is highlighted, along with an analysis of the balance between centralization and decentralization of information systems. The impact of digital technologies on management processes is explored, particularly the transition from linear structures to adaptive and self-learning systems. Strategic development directions are outlined, including the integration of ERP and CRM systems, analytical platforms, and cloud technologies. A classification of information support models is conducted, emphasizing the advantages of cognitive approaches. Free software for managerial skill development is reviewed. The study concludes that information systems are evolving from static to flexible digital ecosystems, providing a strategic competitive advantage.

Keywords: information and analytical support, information support for management, digital systems, software, management.

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ІНФОРМАЦІЙНО-АНАЛІТИЧНЕ ЗАБЕЗПЕЧЕННЯ МЕНЕДЖМЕНТУ БІЗНЕС-ПРОЦЕСІВ: КОНЦЕПТУАЛЬНО-МЕТОДОЛОГІЧНІ ТА ПРИКЛАДНІ АСПЕКТИ

У даній роботі було ґрунтовно проаналізовано інформаційно-аналітичне забезпечення менеджменту як багаторівневу систему, що інтегрує технологічні, організаційні та стратегічні аспекти управління. Було представлено сучасні підходи до управління інформаційними потоками, виокремлено роль штучного інтелекту, великих даних та алгоритмічних моделей у процесах ухвалення рішень. Розширено концептуальне розуміння балансування централізації та децентралізації управлінських інформаційних систем, наголошено на стратегічному значенні наскрізного інформаційного середовища для підвищення конкурентоспроможності організацій. Було проаналізовано трансформаційний вплив цифрових технологій на управлінські практики, зокрема зміщення акценту з лінійних структур на адаптивні, інтегровані та самонавчальні системи. Виділено стратегічні напрями розвитку інформаційного забезпечення менеджменту, які передбачають синергетичне поєднання ERP- та CRM-систем, аналітичних платформ і хмарних технологій для забезпечення операційної ефективності та стратегічної стійкості підприємств. Було здійснено критичний аналіз іс-

нуючих методів інформаційного забезпечення, серед яких визначено концептуальні, інструментальні, технологічні та когнітивно-адаптивні підходи, що демонструють еволюцію від традиційних систематизованих моделей до самонавчальних алгоритмічних механізмів. Обґрунтовано необхідність інтеграції міжрівневих інформаційних процесів, оскільки безпосереднє з'єднання операційних, тактичних, стратегічних і когнітивних рівнів є критично важливим для забезпечення цілісності управлінських рішень. Було здійснено класифікацію основних моделей інформаційного забезпечення менеджменту, розглянуто їхні переваги та обмеження, виокремлено перспективність когнітивних моделей, що забезпечують можливості адаптивного управління у середовищі високої невизначеності. Також розглянуто безкоштовне інформаційно-аналітичне програмне забезпечення з відкритим доступом для розвитку навичок менеджерів. Зроблено висновок, що інформаційне забезпечення управління еволюціонує від статичних ієрархічних рішень до динамічних та інтелектуальних цифрових екосистем, у яких інтеграція технологічних інструментів із когнітивними аналітичними підходами забезпечує стратегічну перевагу в умовах цифрової трансформації.

Ключові слова: інформаційно-аналітичне забезпечення, інформаційне забезпечення менеджменту, цифрові системи, програмне забезпечення, менеджмент

Formulation of the problem. In the current conditions of digital transformation, information-analytical support for management is becoming a key factor in effective governance. Traditional approaches to organizing information systems, based on centralized hierarchical models, are being replaced by adaptive, integrated, and self-learning systems that utilize artificial intelligence, big data, and algorithmic models. However, the processes of balancing centralization and decentralization of management information systems, integrating technological solutions into a seamless information environment, and ensuring transparency of information flows remain unresolved challenges. Additionally, the effectiveness of various methods of information-analytical support, which include conceptual, instrumental, technological, and cognitively adaptive approaches, has not been sufficiently studied. In conditions of high uncertainty, the need for cognitive management models capable of adapting to a dynamic environment and ensuring the strategic resilience of organizations is increasing. This requires a comprehensive analysis of existing approaches to management information support, identifying their advantages and disadvantages, and developing recommendations for optimizing the use of digital technologies in the field of management.

Analysis of recent research and publications. The issues of the essence of information-analytical support for enterprise management, including the role and impact of information systems, business analytics, digital transformation, regional management, decision-making, as well as the classification and application of information-analytical technologies in corporate and business management, have been examined by the following domestic experts: Bradul O., Antonov S. [1], Tyurina N., Nazarchuk T., Shkabara N. [2], Voronkova V., Belousov V., Kolyukh V. [3], Klepikova O. A. [4], Klepikova O. A. [5], Dzyamulich M. I., Shmatkovska T. O. [6], Kononenko Zh., Hrybovska Yu., Karnaukhova H. [7], Shaposhnikov K. S. [8]. However, the issue related to the analysis of free information-analytical software with open data, which can help managers develop skills in integrating digital platforms, adapting them to business tasks, and analytically utilizing data for managerial decisions, has not yet been addressed.

Formulation of the purpose of the article. The main objective of this work is a thorough analysis of information-analytical support for management as a complex multi-level system that integrates technological, organizational, and strategic aspects. Special attention is given to balancing the centralization and decentralization of information flows, integrating modern analytical tools, ensuring the continuity of the information environment,

and developing a methodology for the effective use of data in managerial decision-making. The study covers key methods of information-analytical support, including conceptual, instrumental, technological, and cognitive-adaptive approaches. It examines the role of artificial intelligence, big data, algorithmic forecasting models, and decision support systems in shaping the modern management paradigm. Factors influencing the effectiveness of digitalization in management processes are identified, and strategic directions for the development of information technologies in management are outlined.

Presentation of the main material. Modern management operates in an environment of high information density, increasing business process complexity, and the need to make well-founded decisions based on large-scale analytical data. In this context, information-analytical support for managerial activities becomes critically important, serving not only as a tool for operational response but also as a strategic factor for an organization's long-term development. In the era of digital transformation, information becomes a key resource, and technological solutions for its processing form the foundation of competitiveness. Traditional management approaches based on linear structures and hierarchical decision-making models are giving way to adaptive, integrated, and self-learning systems. The use of analytical platforms, ERP and CRM systems, cloud technologies, and artificial intelligence creates prerequisites for a qualitative evolution of management activities while simultaneously introducing new challenges related to security, transparency, and the efficiency of information flows. Thus, there is a need to explore the main objectives, tasks, methodologies, and models of information support in management.

The key objectives and tasks of information support for management are illustrated in Figure 1.

As shown in Figure 1, information support for management is not just a tool but a key factor in effective management, determining an organization's adaptability, competitiveness, and resilience. Its strategic significance lies in creating a seamless information environment that covers all levels of management from operational processes to strategic planning. At the same time, the development of information systems maintains a balance between the centralization and decentralization of data flows: centralized ERP and CRM solutions ensure transparency and control, while modular cloud systems enhance flexibility and scalability. Digital transformation is reshaping the managerial paradigm by emphasizing process automation and an analytical approach to decision-making. However, automation without a coordinated

strategy can lead to the isolation of individual departments, contradicting the concept of a unified information space [6, 7, 8]. The optimal approach involves integrating centralized systems with flexible cloud solutions, allowing for both control and rapid adaptation to changes.

The use of AI, Big Data, and analytical tools enhances decision-making accuracy, whereas data accumulation without effective processing methods can lead to information overload [3, 4].

Ensuring transparency through digital document management and automated access control systems is critical not only for internal management but also for regulatory compliance. The decentralization of information processes requires efficient communication tools that accelerate data transfer while improving coordination between departments. Successful companies integrate corporate platforms with project management systems, synchronizing operational activities with strategic goals. Meanwhile, the level of digital competence among personnel is a determining factor even the most advanced IT solutions will not yield the expected results without proper training [5, 6].

The next step is to examine the key methods of information support for management, as detailed in Figure 2.

As shown in Figure 2, an analysis of information support methods for management reveals the evolution of approaches from classical conceptual models to intelligent adaptive systems that shape a new managerial paradigm.

Conceptual methods lay the theoretical foundation: the systems approach views information support as an integrated set of elements interacting within the overall organizational architecture, while the process approach focuses on the sequence of operations that transform data into decisions. The network approach redefines traditional management by introducing the concept of distributed information flows and cloud platforms, ensuring accessibility and flexibility. The cybernetic approach, in turn, emphasizes the role of information as a feedback mechanism that enables real-time adjustments to management processes.

Instrumental methods demonstrate the transition from conceptual models to practical mechanisms for data processing. The use of statistical analysis and forecasting not only assesses the organization's current state but also models future development scenarios.

Simulation modeling methods and digital twins enable the testing of strategies without the risks associated with real-world implementation. At the same time, visualization and semantic analysis methods enhance the understanding of complex data, which is crucial in multifactor decision-making scenarios.

Technological methods highlight the growing role of automated systems in modern management. ERP, CRM, and BI systems provide centralized business process management, while big data technologies facilitate the processing of vast information arrays, uncovering hidden patterns. Artificial intelligence and machine learning extend

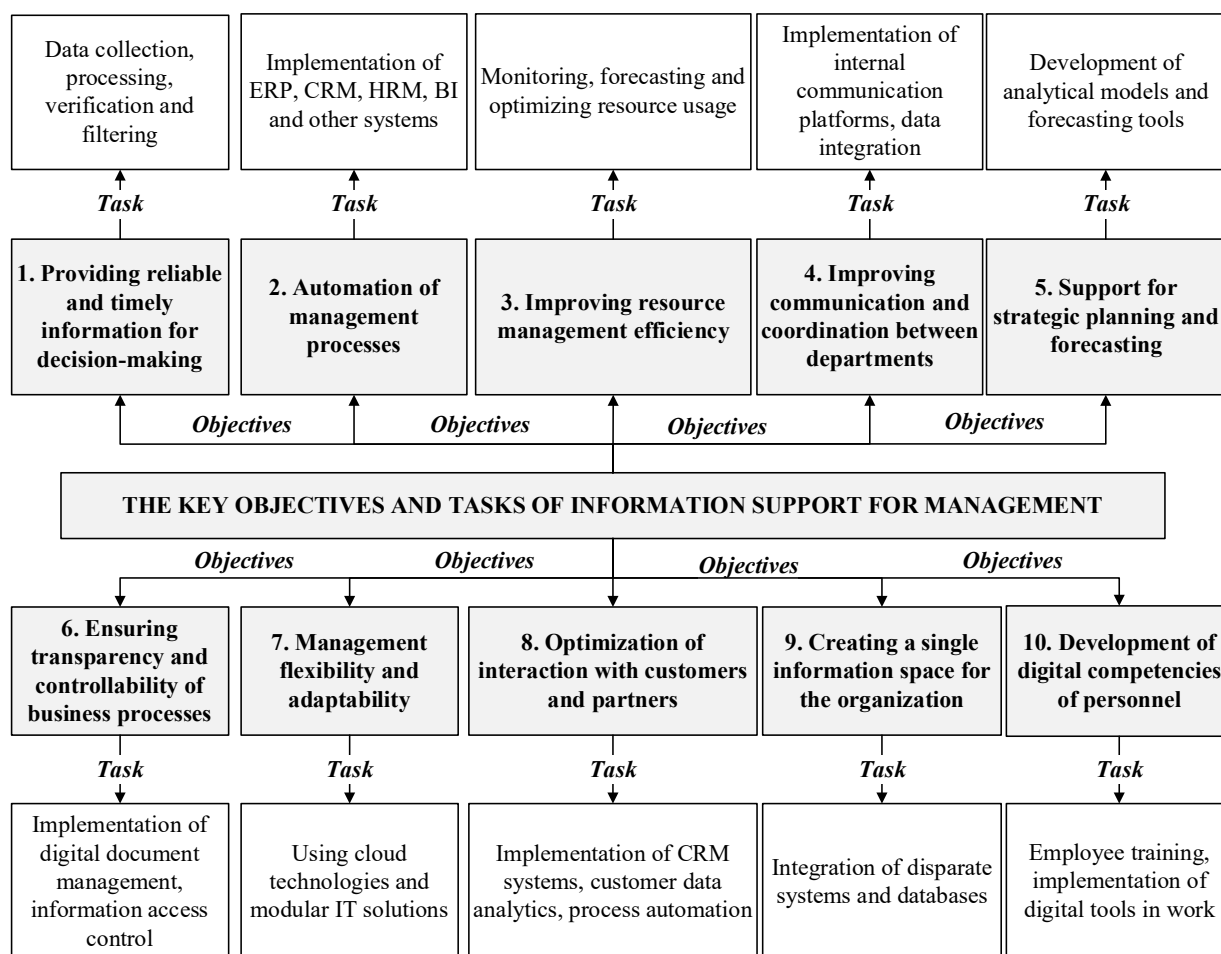


Figure. 1 The key objectives and tasks of information support for management

Source: formed by the authors based on sources [5, 6, 7, 8]

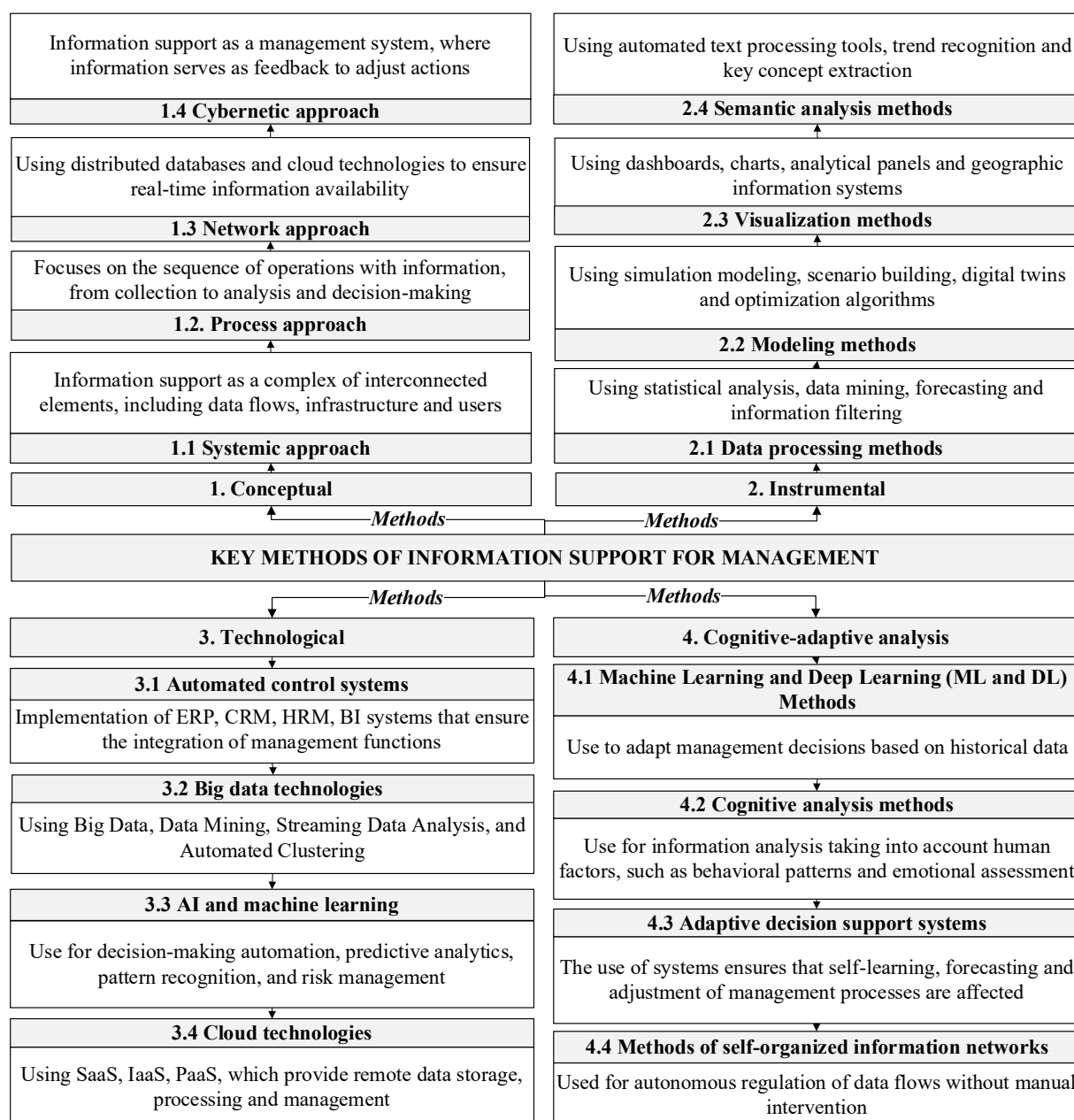


Figure. 2 Key methods of information support for management

Source: formed by the authors based on sources [1, 2, 3, 4, 5, 6, 7, 8]

beyond traditional analysis, laying the groundwork for automated decision-making and personalized management strategies. The adoption of cloud technologies enhances scalability and mobility, eliminating geographical and infrastructural limitations. Cognitive-adaptive methods represent the highest level of evolution in information support, as they combine technological advancements with a deep understanding of human cognitive processes. Machine learning in adaptive decision support systems creates a self-learning effect, allowing automated systems to improve their efficiency without external intervention. Cognitive analysis transcends formal algorithms by incorporating behavioral and emotional aspects of decision-making, which is critical in highly uncertain environments. The integration of self-organizing information networks paves the way for decentralized management and increased autonomy of digital systems.

The key levels of information support for management are outlined in Table 1.

As seen from Table 1, management information support is a multi-level system where each level performs a specific function, forming an interconnected structure of managerial analytics. The operational level ensures the seamless execution of current tasks, serving as the informational foundation for further analysis. Its tools (CRM, WMS, SCM) optimize operations, but without integration with higher levels, their potential in strategic planning remains limited.

The tactical level does not merely aggregate data but analyzes it in the medium term, utilizing ERP systems, HRM platforms and BI tools. It balances resources and facilitates horizontal coordination between departments, which becomes more complex in decentralized or low-digitalization environments. In contrast, the strategic level shapes long-

term management directions, forecasting resource dynamics through business modeling, machine learning, and scenario planning. This level enables the transition from reactive to proactive management but requires high-quality input data and sophisticated analytical algorithms.

A critically important role is played by the integration level, which synchronizes all levels, eliminating informational gaps and ensuring a unified decision-making logic. Without it, strategic planning risks becoming disconnected from real processes, while operational management may become inefficient. The most dynamic is the cognitive level, which goes beyond classical approaches by using neural network algorithms for automatic pattern detection and adaptive management. While the strategic level builds forecasts based on past data, the cognitive level ensures flexible responses to new challenges, identifying hidden trends in real-time.

Next, we will examine the main models of management information support, as shown in Figure 3.

According to Figure 3, the development of management information support models reflects not only the evolution of technological approaches to data storage and processing but also the transformation of management itself as a process.

The centralized model ensures a strict hierarchy of information access and high procedural standardization, making it optimal for stable environments with well-regulated business processes. However, its main drawback is excessive dependence on the central node, which remains vulnerable to technical failures and data processing speed limitations, potentially affecting the responsiveness of management decisions. In contrast, the decentralized model grants greater autonomy to individual units, enhancing management responsiveness at the local level.

However, it also introduces challenges such as data inconsistency, fragmentation of information flows, and complexity in integrating cross-level solutions. It is particularly effective in large multinational corporations, where the need for rapid adaptation to local markets outweighs the demand for standardized management. The networked model overcomes the limitations of both centralization and decentralization by ensuring data mobility, real-time accessibility, and flexible management through cloud technologies. However, it is vulnerable to cyber threats, as its dependence on internet connectivity and the potential risk of unauthorized access pose new challenges in information security.

Therefore, the hybrid model serves as a compromise between the stability of centralization and the flexibility of

decentralization, allowing critical data to be stored in secure centralized systems while secondary processes operate within distributed structures. However, such an architecture requires complex integration across different access levels, making its implementation challenging for companies with underdeveloped digital tools. The transition to self-governing information systems marks a new stage in management technology development, as these models do not merely process data but autonomously make decisions based on artificial intelligence algorithms. Their main advantage lies in their ability to independently identify patterns, detect anomalies, and optimize processes without direct human intervention. However, a key limitation of such systems is their lack of transparency in decision-making, raising ethical and managerial concerns regarding the delegation of critical functions to machine algorithms.

The most complex and promising approach is the cognitive model, which goes beyond traditional algorithmic solutions by incorporating deep analysis, self-learning, and behavioral analytics. It not only reacts to environmental changes but also predicts them, making it indispensable in highly volatile business environments. At the same time, such a system requires significant computational resources, limiting its application in small and medium-sized enterprises. Additionally, it creates the risk of excessive reliance on technological systems, which, despite their adaptability, may generate nonlinear and difficult-to-predict scenarios.

The next step is the classification of information-analytical management software (see Table 2).

The analysis of software categories presented in Table 2 allows us to conclude that digital platforms are highly differentiated in terms of functionality, driven by both industry specifics and the level of management tasks they address. The most comprehensive solutions are ERP systems, which provide centralized management of all enterprise resources and serve as the core for integrating financial, production, logistics, and HR processes. In comparison, CRM systems focus on customer-oriented strategies, emphasizing sales automation, marketing, and customer interactions, making them essential tools for service-oriented companies.

At the same time, resource management requires a differentiated approach, necessitating the use of specialized tools such as HRM systems for personnel management, BI systems for business analytics and forecasting, as well as BPM and MRP solutions for business process modeling and production management.

Table 1

The key levels of information support for management

№	Level name	Definition
1	Operational	Includes current information for performing daily tasks, covering data on sales, inventory, orders and interaction with customers, using CRM, WMS, SCM and Task Management systems.
2	Tactical	Covers medium-term resource management, including financial analysis, personnel data and production plans, using ERP systems, HRM platforms and analytical BI tools.
3	Strategic	Includes predictive analytics, business modeling and scenario planning, using BI systems, machine learning and simulation models.
4	Coordination	Provides a single information space through comprehensive corporate platforms and inter-system API integrations, unifying all other layers.
5	Cognitive	Provides the use of neural network algorithms and cognitive analysis for automatic trend recognition, optimization of decisions and adaptive management under uncertainty.

Source: developed by the authors themselves

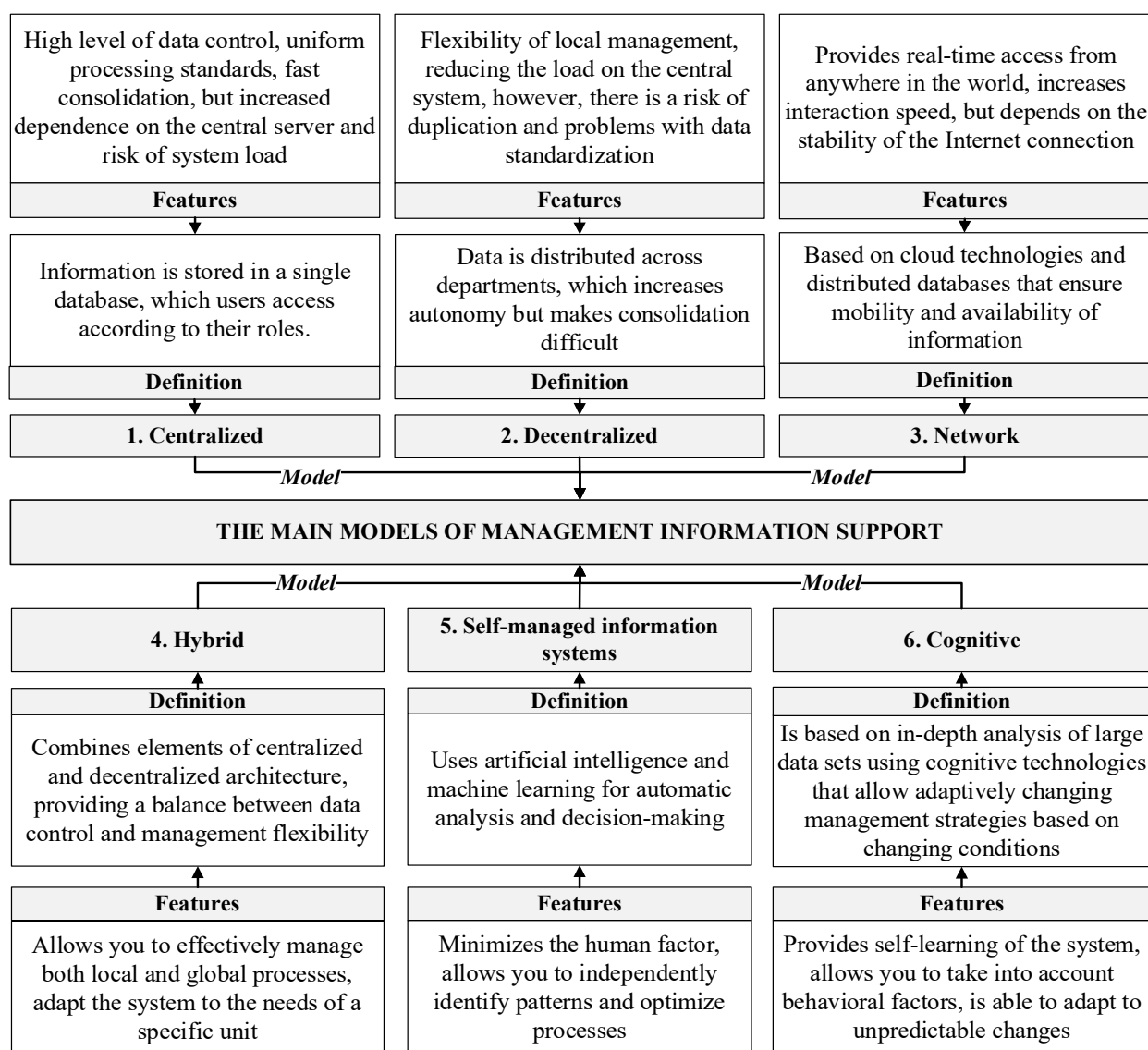


Figure. 3 The main models of management information support

Source: developed by the authors themselves

This multi-layered structure reflects a shift in management paradigms—from rigid centralization to adaptive approaches, where enterprises operate flexible platforms that synchronize with other systems through API integration. Notably, specialized solutions such as PLM systems for product lifecycle management and PIM systems for centralized product information storage play a crucial role in dynamic markets with increasing demands for high-quality product catalog data.

It is also important to highlight that beyond traditional accounting and management systems, internal communication tools such as corporate messengers and video conferencing platforms play a significant role in ensuring efficient team interactions, particularly in decentralized and remote work models. This indicates a gradual integration of information management and communication platforms into unified digital ecosystems, enabling greater decision-making flexibility and enhancing corporate synchronization.

However, while automated systems significantly improve management efficiency, their effectiveness

largely depends on the level of integration, depth of data analysis, and adaptability to new challenges. Companies capable of ensuring seamless interaction between ERP, BI, BPM, SCM, and other solutions gain a strategic advantage, as their information infrastructure becomes not only a business support tool but also a key driver of growth. This highlights a shift from simple automation to the development of intelligent digital ecosystems that can adapt to dynamic business environments and serve as a foundation for strategic decision-making.

Next, we will highlight information-analytical software with free licensing and open source (see Table 3).

As seen from Table 3, the analysis of open-source software for business process management reveals a complex balance between functionality, flexibility, and the technical resources required for adaptation. ERP systems such as Odoo and Dolibarr centralize resource management, which is critical for integrating business units. However, their modularity can be constrained by configuration complexity. CRM solutions like SuiteCRM simplify customer interaction but lag behind commercial

Table 2

Classification of information-analytical management software

№	Software Type	Software Type	Purpose
1	ERP (Enterprise Resource Planning) Systems	Integrated Resource Management Systems	Centralized management of finances, warehouse, procurement, personnel, production
2	CRM (Customer Relationship Management) Systems	Customer and Sales Management	Sales automation, customer service, marketing
3	BI (Business Intelligence) Systems	Data Analytics and Visualization	Data analysis, business analytics, forecasting
4	HRM (Human Resource Management) Systems	Human Resources Management	Human resources, recruiting, personnel assessment
5	Project Management Systems	Classic and Agile Tools	Project planning, control and coordination
6	Task Management Systems	Kanban Boards and Task Trackers	Operational task distribution and tracking
7	Financial Accounting and Bookkeeping	Finance and Reporting Automation	Accounting for income/expenses, tax reporting, budgeting
8	Document Management Systems (DMS)	Document Archiving and Collaboration	Electronic documents, collaboration, version control
9	Internal Communication Systems	Corporate Chats and Messengers	Message exchange, team chat organization
10	Videoconferencing Systems	Online Meetings and Webinars	Video communication, remote meetings, webinars
11	Remote Access Systems	Connection to Work PCs	Technical support, remote work, administration
12	SCM (Supply Chain Management) Systems	Supply Chain Management	Logistics, inventory management, supplier control
13	BPM (Business Process Management) Systems	Business Process Management	Business process modeling, automation and optimization
14	MRP (Material Requirements Planning) Systems	Product Resource Management	Material requirements planning, production management
15	PIM (Product Information Management) Systems	Product Data Management	Centralized storage and management of product catalogs
16	LMS (Learning Management System) Systems	Personnel Training and Development Systems	Corporate training, testing, advanced training
17	Monitoring and Reporting Systems	Business Process Control	Visualization, performance control and monitoring
18	PLM (Product Lifecycle Management) Systems	Product Lifecycle Management	Product development, production and support
19	Time and Schedule Management Systems	Planning and Time Management	Organization scheduling, meeting management, time planning
20	E-Commerce Systems	Online Store Management	Online sales, product management, trade automation
21	EDM (Electronic Document Management) Systems	Exchange of Legally Significant Documents	Electronic archives, accounting integration, digital signatures

Source: developed by the authors themselves

counterparts in terms of available modules, forcing businesses to either accept these limitations or invest in customization. The adaptation challenge is particularly evident in analytics and financial management. Orange provides powerful data analysis tools but requires deep knowledge of Data Science, whereas commercial BI systems like Tableau are easier to use. GnuCash is suitable for small businesses but lacks the functionality needed by large enterprises. Project management systems are divided into comprehensive (OpenProject, Redmine) and simplified (TaskBoard, Trello) solutions. OpenProject offers extensive functionality but requires significant effort to master, while Trello is intuitive but limited in customization. HRM solutions like Sentrifugo are useful for small businesses but are significantly inferior to SAP SuccessFactors and Workday. In corporate communications, Mattermost and Rocket.Chat ensure data control, which is crucial for security, but require administrative resources. Similarly, Jitsi Meet and BigBlueButton allow self-hosting but demand technical support. The choice between open-source and commercial software extends beyond financial savings to include long-term costs of implementation,

maintenance, and integration. Open-source software offers independence from vendors but requires resources for customization, while commercial solutions, though more expensive, provide stability and support. Therefore, using open-source software is justified only if a company is ready to invest in its maintenance. Applying these tools helps managers develop key digital competencies. ERP and CRM systems enhance analytical thinking, strategic planning, and customer relationship management skills. BI tools improve data-driven decision-making and forecasting capabilities. HRM systems support workforce planning and process optimization. Project and communication platforms such as OpenProject, Trello, Mattermost, and Jitsi Meet refine coordination, resource planning, and task management in dynamic environments. Remote access tools like RustDesk and UltraVNC enhance digital security awareness.

Conclusions. The research highlights that information-analytical support in management is not just an auxiliary tool but a key factor in strategic decision-making. It spans all levels from operational control to predictive analytics ensuring data integrity and improving managerial efficiency. The study identifies the main approaches

Table 3

Information-analytical software with free licensing and open source

№	Software name	Category	Qualifications	Advantages	Disadvantages
1	Odoo (Community Edition)	ERP, Resource Management	Logistics, Finance, HR, Operations Managers	Flexibility, modularity, scalability	Requires configuration, basic version is limited
2	Dolibarr	ERP, CRM	Sales Managers, Operations Managers	Simplicity, integration with other systems	Fewer features than commercial ERPs
3	SuiteCRM	CRM, Customer Management	Marketing, Sales, Service Managers	Alternative to paid CRM, extensibility	Limited selection of ready-made modules
4	Orange	Business Analytics, Data Science	Analysts, Strategic Managers	Data visualization, powerful analytical tools	Requires data skills
5	GnuCash	Financial Accounting	Financial Managers	Simplicity, support for different currencies	Limited functionality for large companies
6	OpenProject	Project Management	Project Managers, Team Leaders	Powerful set of tools	Complicated for beginners
7	TaskBoard	Task Management	Project Managers, Operations Managers	Simplicity, Kanban board	Minimal functionality compared to Trello
8	Trello	Task Management	Project Managers, Team Leaders	Intuitive interface, integrations, mobility	Limited capabilities for complex projects
9	Redmine	Task Management, Projects	Project Managers, IT Managers	Flexibility, many plugins	Requires technical configuration
10	Sentrifugo	Human Resources Management (HRM)	HR Managers	Full HR functionality: personnel accounting, evaluations, vacations	Not the most modern interface
11	Jitsi Meet	Video Conferencing	All Managers	Simplicity, video calls without installation	Requires stable internet
12	BigBlueButton	Video Conferencing, Webinars	Training, HR, Corporate Trainings	Interactive tools: whiteboard, surveys	Requires a server for installation
13	Mattermost	Team Communications	Operations Managers, IT Managers	Slack alternative with full control	Requires deployment on a server
14	Rocket.Chat	Corporate Chat	All Managers	Support for integrations, own servers	Requires configuration
15	RustDesk	Screen Mirroring, Remote Access	IT Managers, Technical Support	Completely free, P2P connection	Requires server deployment for corporate use
16	UltraVNC	Remote Access, Screen Mirroring	IT Managers, Administrators	Simplicity, works even on old PCs	Complexity of configuration for beginners

Source: developed by the authors themselves

to structuring information systems: centralized, decentralized, networked, hybrid, and cognitive models, each with its own advantages and limitations depending on the company's structure and level of digital maturity. Key methods of information support have been outlined, including conceptual, instrumental, technological, and cognitive-adaptive approaches, enabling management not

only to process data but also to forecast future scenarios. Additionally, the research highlights open-source information-analytical software, whose use helps managers not only master the functionality of these systems but also develop the ability to integrate digital platforms, adapt them to business tasks, and leverage data analytically for decision-making.

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