This study's object is those business processes in the financial management system of business entities that are related to making substantiated management decisions based on aggregated financial data. The problem addressed is the lack of a comprehensive and formalized approach to the organization of decision-making support processes in the financial management system.

A procedure that organizes financial decision-making has been devised by using digital technologies based on Business Intelligence (BI), which holistically combines business process modeling, the construction of reasoned conclusions, as well as the processing of structured data. The feasibility of using the BPM+ approach was clarified and a procedure for its implementation was devised. Based on the latter, the course of analytical business processes in the financial management system was modeled, based on the results of which reasoned conclusions are made and appropriate management decisions and measures could be developed.

Modeling financial management tasks at the analysis stage in BPMN determines the order of implementation of business processes and the areas of responsibility for responsible persons involved in their implementation. Using an example of the process of analyzing the financial stability of the model built, the logic behind obtaining analytical conclusions using the Decision Model and Notation (DMN), which contains the Decision Requirements Diagram (DRD) and the decision table, has been formalized.

Input data for forming a decision is proposed to be prepared in the environment of digital products. Given the relevance of using BI software in analytics, the example of applying MS PowerBI was applied to demonstrate the features of building and transforming an information model of financial data, which is the basis for designing interactive dashboards. The financial indicator monitoring panels constructed provide operational support for decision-making by financial managers

Keywords: financial decisions, financial management, business process modeling, BPMN, DMN, Business Intelligence

DEVISING A PROCEDURE FOR ORGANIZING SUPPORT TO FINANCIAL DECISION-MAKING USING DIGITAL TECHNOLOGIES BASED ON BUSINESS INTELLIGENCE

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1. Introduction

Turbulent changes in the environment provoke conditions of uncertainty in the political, economic, technological, and social domains, in which business entities must operate. Prompt response to the dynamic changes taking place is an urgent aspect in business operations. It can be considered not only as a factor in ensuring the successful functioning of the enterprise but also as a prerequisite for preventing the development of crisis phenomena in its activities in general and in the financial condition in particular.

The process of making management decisions requires the processing of financial and non-financial data. It is on the basis of financial information that it is possible to assess and verify the quality of business operations [1]. For a business entity, solving the issues of ensuring solvency and profitability under conditions of instability occurring in the system of financial management always remains relevant.

Financial management is associated with the effective acquisition and distribution of both short-term and long-term financial resources to enable the achievement of the enterprise's goals [2]. Financial management according to [3] includes many types of activities that create or preserve the economic value of the assets of an individual, small business, or corporation. The task of financial managers is to make and help others make sound financial decisions.

The financial decisions devised and implemented concern the distribution of the company's available assets, bud-

geting its activities and individual projects, monitoring cash flows, risk management, formulating measures to achieve operational and strategic goals, etc.

To implement the above steps, financial analysis procedures are executed; their results are further processed using data mining methods. This makes it possible to determine the actual financial condition of the business entity, as well as the patterns and relationships among the processes that affected it. Therefore, financial decisions are an important element of management activity.

Analysis of the technology for finding financial solutions requires a thorough study of the operational and tactical tasks that financial managers face. Designing a subject area in the financial sector can be done by modeling its business processes.

A subject area model, built by using graphical notation, makes it possible to formalize business processes and document the execution of current operations in the event of unforeseen cases. Taking into account these needs, caused by modern challenges, the Object Management Group (OMG) association has formed a comprehensive standard Business Process Management Plus (BPM+) [4]. It combines formal modeling languages to obtain accurate decision-making algorithms that are easier to implement, test, and automate. The elements of BPM+ are Business Process Modeling Notation (BPMN), Case Management Model and Notation (CMMN), and Decision Model and Notation (DMN), designed to complement each other.

In a dynamic environment, a business entity can combine the above-mentioned approaches to business process modeling to document the implementation of current tasks, individual cases, and further devise solutions based on defined business rules. The advantage of using several modeling standards is the choice of the most appropriate one at each stage of organizing business processes in the financial sector.

The use of modern digital technologies allows businesses not only to keep up with the times but also to gain certain competitive advantages compared to business entities that are less active in the informatization of their own business processes. Global spending on corporate software by 2024 reached USD 1 trillion, which is 12% higher than over the previous period [5]. Digital solutions of this type are the fastest growing segment of the global IT industry. The Business Intelligence (BI) industry is a subsegment of the enterprise software market. The relevance of the use of this technology is confirmed by statistical data from the Statista portal [5, 6].

According to IBM terminology [7], Business Intelligence (BI) is a set of technological processes for collecting, managing, and analyzing organizational data in order to obtain information necessary for the formation of business strategies and operations. It is a tool for creating a description that makes it possible to make better decisions based on current business data.

Therefore, when studying the subject area and designing solutions, one should not ignore approaches to the implementation of business processes based on the use of the latest digital tools in general and Business Intelligence in particular. It is the capabilities of BI that create prerequisites for the development of quick and effective measures in the financial sector by businesses.

In practice, BPM+ models can provide a comprehensive representation of the subject area, the features of changes in its business processes and their results under the influence of various factors of the external and internal environment.

The link to the implementation of current digital tools, such as BI, reflects the possibility of improving or optimizing the implementation of procedures in the financial sector.

Therefore, it is a relevant task to carry out studies on modeling the organization of support for financial decision-making using digital technologies based on Business Intelligence.

2. Literature review and problem statement

Modern digital products in combination with approaches to the implementation of financial management create conditions for optimizing business processes of financial decision-making. In work [8], the features of decision-making in the financial management system of enterprises based on data from various financial statements and indicators are revealed. However, methodological approaches and digital tools that can ensure the organization of their development are ignored. The authors emphasize the aspects of the financial condition that should be studied, the stages of obtaining a financial decision; however, under the current conditions of digitalization of analytical processes for business, it is advisable to specify the tools that make it possible to implement these procedures.

The features of deploying a support system for financial decision-making based on big data processing are revealed in work [9]. The author's main attention is paid to the difficulties in implementing management, direct effects, and indirect benefits of solving problems of finance specialists through a big data platform from the position of mathematical support. The results of designing a decision-making system for big data in terms of personnel organization, procurement, and production quality management, capital expenditure planning and investment decisions are generally studied. Given the objectives of the study, the issues of information and analytical support for the implementation of financial management tasks remain unsolved.

The features of modeling a subject area using BPMN are disclosed in [10]. The authors note that the process of constructing business process models is subjective, and this subsequently leads to errors due to an insufficiently detailed description of the subject area. Therefore, before using the model in the Business Process Management (BPM) system environment to represent organizational knowledge, it should be analyzed from the standpoint of the presence of shortcomings. The main emphasis of the cited study is on the implementation of a digital product that involves loading and defining business processes unloaded from the BPM system in XPDL format. At the same time, the structural correspondence coefficient, errors in building models in BPMN notation, and the creation of recommendations for their elimination are calculated. Control calculations are given on the example of business process models of purchasing and sales of products. However, under conditions of dynamic changes in the environment and the need for urgent restructuring of the business model of activity under the influence of external factors (reorganization of the AS-IS model to TO-BE), a number of urgent tasks are formed. In particular, there is a need to use digital tools that would make it possible to quickly transform the visual description of procedures and, along with the analysis of compliance with the syntax of the notation, to conduct their diagnostics. The latter is done in order to analyze the terms of execution, cost, the possibility of achieving the final result and the sufficiency of the knowl-

edge base for making decisions in the financial realm that affect the profitability of the business.

Study [11] demonstrates that the approach used to modeling the subject area in the financial sector (UML) does not reflect the peculiarities of the emergence of information flows (data origin), the sequence of procedures for making investment decisions. The sequence diagrams used demonstrate the technology of data processing during the interaction of a financial manager with a digital product. However, the construction of an activity diagram remains out of focus, which can reflect the peculiarities of coordinating the work of the designed information and analytical support and data transmission. Because of this, the cited work lacks focus on the business processes of the subject area, interaction between its participants and points of making investment decisions. In general, the authors consider individual procedures in the financial sector related to the investment activities of the enterprise. Further development is required for a comprehensive approach to solving the tasks of financial management or due diligence.

The classification of known business models for business analysis of enterprise architecture is carried out in [12]. The reference business model proposed by the author is considered as a conceptual representation of the connections between business models that have their own characteristics. The study determined that modeling solutions focused on achieving business goals can be carried out in the DMN notation. Modeling processes and individual cases should be carried out in the BPMN, CMMN and SysML notations. The author notes that BPMN is suitable for procedural modeling focused on creating a specific result (product or service). The mapping conducted in the study comprehensively characterizes possible approaches to building business models focused on meeting various information needs of the business. However, the results are not tied to a specific area of activity of the enterprise, which uses various digital technologies to solve the tasks set. In particular, the features of forming the information basis and describing the decision-making procedures, including for the financial realm, which is one of the strategic areas of enterprise management and requires processing large data sets using up-to-date software, are ignored.

It is this approach that adapts to individual prerequisites and aspects of combining BPMN and DMN models that is considered in [13–17]. In work [13], the combination of BPMN 2.0 and DMN for information modeling of various variants of logistics processes (planning and movement) is demonstrated. In [14], attention is paid to modeling processes and decisions during the acceptance of clients in a Belgian accounting firm. However, the reported concepts cannot be adapted to solve problems in the financial domain. The results of work [15] demonstrate a general proposal for constructing BPMN models based on data obtained from DMN models. However, the study does not contain specific recommendations on the possibility of applying this approach to individual areas of business activity, in particular financial management. In [16], the work plan of teams for the production of software for the development of digital products for decision analysis is simulated; the complexity of combining business process management (BPMN) and business rules (DMN) approaches is emphasized. Given the differences in the content of technological business processes and the specificity of financial task implementations, it is not possible to adapt the models described in the work to perform financial management functions. Study [17] considers DMN modeling to represent

the business logic of methods that implement BPMN diagram elements and to automatically transform DMN models into smart contract methods in trade operations. The possibility of applying the used approach to modeling the operational activities of trade organizations using digital contracts in management business processes, which include financial management functions, is not disclosed.

Work [18] investigated the appropriateness of combining the proposed models to achieve the desired automation of the process of checking the compliance of coding with railway engineering rules. Business processes for analyzing organizational, technical and safety standards that regulate the design, construction, and operation of railway transport differ in content from the tasks of analyzing, planning, and controlling the results of financial activities. Therefore, the application of the above models to the field of financial management is not possible.

Work [19] highlights the use of BPMN and DMN to describe a large and complex medical manual on the standardization of the clinical path of contraception, as well as identifying problems that can lead to a potential expansion of standards. However, the reported business processes of medical protocols cannot be adapted to the management tasks in the field of financial management. Thus, in [13–19] a combination of BPMN and DMN approaches is implemented using the example of specific industries but the features of modeling tasks in the financial realm are not considered.

Business rules, which are determined by the DMN model and taken into account when forming reasoned conclusions, are applied to key indicators in accordance with the set goals of financial management. Input data in the form of critical indicators for decision-making can be formed using modern software. Taking into account modern trends in the development of IT for analytics and flexible functionality of BI tools, their integration into the organization of financial decision-making support is an unexplored issue.

3. The aim and objectives of the study

The purpose of our work is to devise a procedure for organizing support for financial decision-making. This will make it possible to optimize the expenditure of time and resources on the formation and implementation of measures in the financial domain based on operationally aggregated information and modeling of informed choices using modern digital environments.

To achieve the goal, the following tasks were set:
– to model the organization of financial management (BPMN) and support for the development of a financial decision (DMN);
– to build a data model to support management decisions in the Business Intelligence tool.

4. The study materials and methods

The object of our study is defined as business processes in the financial management system of business entities, focused on making informed management decisions based on aggregated financial data. The hypothesis is put forward that the integration of methodological, technological, information, and digital tools, available for practical use and with the ability to adapt to the needs of financial management, into a

single system enables increased efficiency of the organization of financial decisions.

The study implies simplification of the industry-specific features of the functioning of business entities that carry out financial management.

The results of analysis of existing approaches to modeling financial management business processes are systematized on the basis of building a mental map. The BPM+ approach was used to model the organization of financial decision-making support, which allows for a comprehensive study of the subject area based on the creation of BPMN and DMN diagrams. Modeling the technology of implementing financial management procedures using BPMN, supported by a number of digital products, will contribute to the development of a business process system that will make it possible to determine the specificity of their implementation sequence, analyzing performance and progress.

The DMN model describes the logic of decision-making during the implementation of financial management business processes. The financial data model for ensuring management decision-making in the environment of digital Business Intelligence tools is an element of information support for individual options for scenarios of events in the financial domain.

The construction of BPM+ models and financial data was carried out using a graphical method in the environment of specialized digital products listed below. The MS Visio environment was used to design the business process model. The construction of a DMN diagram, which describes the content of analytical searches, the prerequisites for obtaining and possible results of business processes on the development of financial measures or identification of the type of financial characteristics of the enterprise, was carried out using the capabilities of the bpmn.io platform.

The construction of the structure of financial information processed by the financial manager in the course of analytical research and further conclusions developed on their basis was carried out using the MS Power BI software. The latter, in addition to constructing a data model, allows for the aggregate visualization of financial information necessary for the formation of substantiated conclusions and decision-making on its basis.

At the same time, a high-quality organization of information flow processing requires the identification of the features of the organization of financial management in an unstable business environment.

Increasing the efficiency of a business entity is implemented through constant improvement of its business processes by optimizing individual procedures and reducing the number of incorrect decisions. The organization of the development and implementation of management decisions in the financial management system occurs during the execution of its business processes. To describe the latter, one can use a text, tabular, or graphical approach. Visualization of business processes in the subject industry is the result of modeling using generally accepted standards for building graphic models. Among them, the most common are Value Added Chain Diagram (VAD), Integration Definition for Function Modeling (IDEF), Unified Modeling Languages (UML), Event-driven Process Chain (EPC), Business Process Model and Notation (BPMN), etc.

Based on the results of our research, the approaches used to model strategic and operational tasks in the financial sector were systematized (Fig. 1), among which EPC, UML, BPMN, and other diagrams are common. Considering the modern challenges faced by enterprises, there is a need to use a wide range of reliable sources of financial data that will allow for the formation of substantiated conclusions regarding the situations that arise in the financial and economic activities of business entities. The accumulation, systematization, and study of information to be processed occurs at each stage of financial management (Table 1).
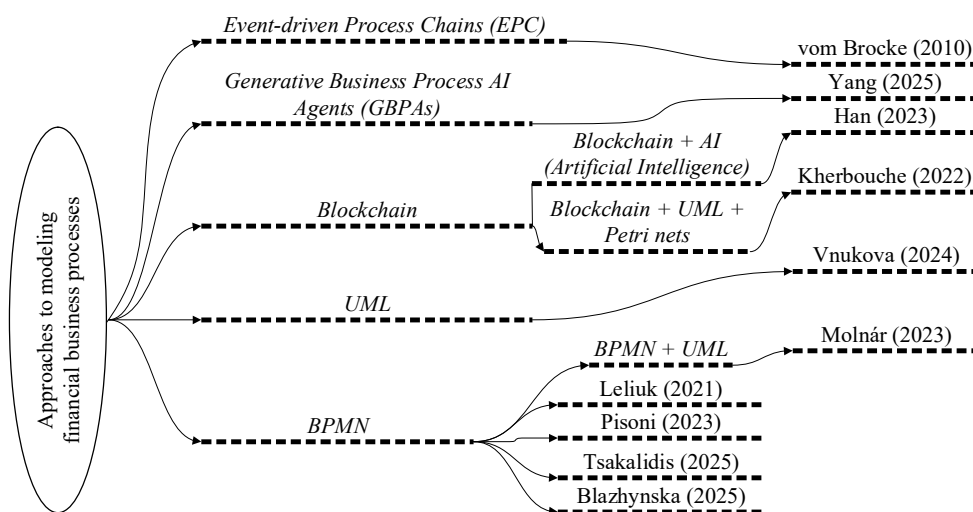

Fig. 1. Systematization of approaches to modeling financial business processes based on [11, 20–28]

5. Results of devising a procedure for organizing support to financial decision-making

5. 1. Modeling the organization of financial management and support for making a financial decision

In the management system, the need for timely decision-making requires the processing of large amounts of financial and economic data coming from various sources.

Solving analysis tasks in the financial management system, during which analytical work takes place, creates a basis for further decision-making (Fig. 2). Modeling the organization of decision-making support can occur at the level of business processes, during which they are generated, and in terms of the logic of obtaining the data necessary for this.

The database is filled on the basis of information flows that are created based on the results of financial management business processes or are used to implement them. Decision-making can concern various aspects of business activities. In each individual case, taking into account the goals set for the financial manager, an analytical data model

is formed using digital technologies, including BI tools. The latter is a structured information array that makes it possible to build dashboards (monitoring panels) to identify existing patterns in the financial realm and the relationships between them, which contributes to the further adoption of informed decisions.

Table 1

Financial management procedures and features of their implementation (systematized based on [9, 29—31])

| Stage	Main tasks	Approaches	Implementation tools
Planning	Identification of financial goals; formation of target indicators (preparation of plans, budgets); ensuring financial balance of income and expenses	Strategic financial planning methods; budgeting	Financial models; budget matrix; balanced scorecard (BSC)
Organization	Organization of effective management of financial flows (internal and external), working capital, receivables, and payables	Cash flow management; organizational design	ERP systems; cash plan; CRM systems (for financial analytics)
Coordination	Coordination of activities of structural units; interaction with counterparties	Portfolio approach; integration of financial flows	Digital internal control tools; communication platforms
Control	Monitoring of implementation of developed plans; assessment of financial discipline	Internal audit; ratio method	Digital audit tools; financial data dashboards
Analysis	Analysis of reporting; assessment of financial risks; forecasting of financial results	Express analysis of financial statements (horizontal / vertical); SWOT analysis of financial condition; forecasting methods	ERP systems (analytical modules)
Decision-making	Choosing optimal sources of financing; development of investment policy	Scenario analysis; discounted cash flow (DCF); cash flow sensitivity modeling	Investment analysis tools; financial calculator
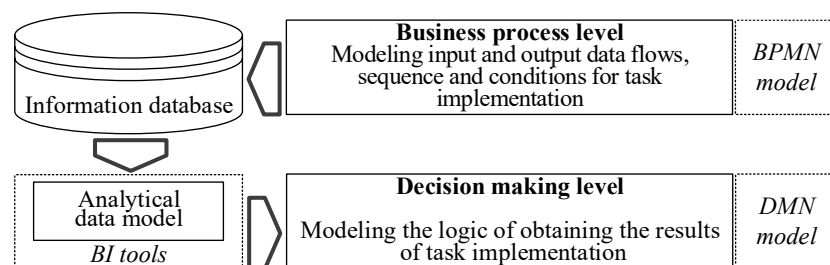
Fig. 2. Diagram of the decision-making process in the financial management system

Business Process Management Notation (BPMN) [32], which is a modern approach to solving the issue of constructing a model, was used as an intermediate link on the way from formalization to implementation of financial management business processes. A set of BPMN elements allowed us to identify tasks that lead to decision-making, their order of execution in the financial management system, responsible persons, areas of authority, features and types of procedures they carry out. The notation contributed to the description of possible changes in business processes through the onset of crisis events or the emergence of threatening phenomena, involved information sources and repositories for accumulating data.

The result of building a BPMN model for business process analysis in the financial management system is shown in Fig. 3. The diagram consists of one pool involving analytical procedures for studying the financial condition of the enterprise. The paths represented in the model reflect the areas of responsibility of the involved executors of financial business processes, including operator, financial analyst, C-level manager for financial issues.

The operator is tasked with administering and monitoring the operational filling of the information base with up-to-date data from external and internal sources. Internal information that must be taken into account is contained in financial documents of regulated and management reporting prepared by structural divisions on financial and economic issues. Depending on the specificity of business entity's work, the formation of a data warehouse can be implemented both in a corporate digital environment in an automated manner and using universal digital products for business. It is the updating of the information base that creates the prerequisites for the activities of a financial analyst.

Financial analyst is a specialist responsible for analytical procedures for express analysis of financial statements, assessment of coefficients regarding the state of solvency, business activity, profitability and financial stability, etc. His/her powers also include conducting factor analysis, assessing financial risks (including the probability of bankruptcy), predicting the future level of financial condition using forecasting methods, summarizing results and formulating conclusions on the analytical tasks being solved. The task "Assessment of the financial condition of the enterprise" is represented in the form of a detailed subprocess and reflects the logic of implementing business processes regarding coefficient analysis of the financial condition of a business entity and calculating its integral level. Taxonomic analysis or expert methods can be used to calculate the latter.

Fig. 4 shows a diagram of subprocesses for the "Analysis of influence factors" module. The visualization of the model reveals the implementation of parallel procedures that makes it possible to clarify the factors influencing the integral indicator of the financial condition and financial results of the business entity, the opportunities and threats of its activities.

The C-level financial manager is involved in the stages of developing measures to improve financial management results. It is within the framework of the specified business processes that management decisions in the strategic plane should be made. At the level of the financial analyst, tactical tasks are considered. For example, during the procedure for assessing financial condition ratios, it is provided to determine the type of financial stability of the business entity. This task involves formulating a conclusion on the state of financial independence of the business based on the processing of a pre-formed set of financial data on the volume of working capital (WC), long-term liabilities (LLs), short-term loans (SLs) and inventories (Is). Modeling the logic of deci-

sion-making related to the tasks of the business process identified in the BPMN diagram can be represented using DMN.
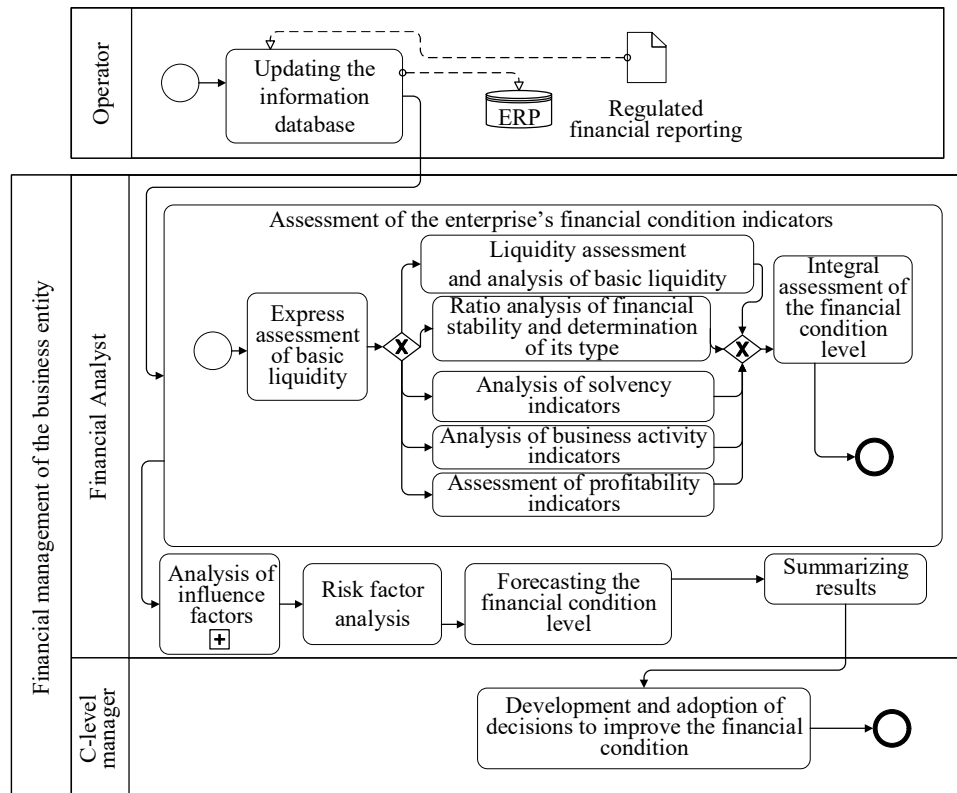

Fig. 3. BPMN diagram for analytical business processes in a financial management system
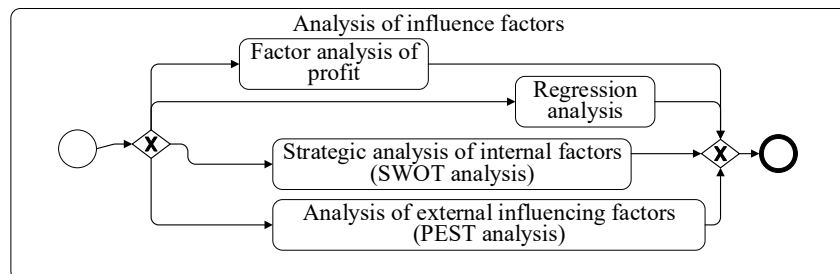

Fig. 4. Subprocesses in the "Analysis of Influence Factors" module

This notation involves construction of a DRD diagram (Decision Requirements Diagram) and a decision table [33]. The visualization in Fig. 5 reflects the functionality of making conclusions about the type of financial stability as a network of decisions with supporting business knowledge models.

The decision table of the constructed DRD diagram models the logic of making a decision about determining the type of financial stability (Fig. 6).

The methodology for determining financial stability involves building a table with the results of comparing the calculated values based on the volumes of working capital, long-term and short-term liabilities, and inventories.

The table parameter "Hit policy" is set to "Unique", which indicates the formulation of a unique decision about the type of financial stability, taking into account the values of the input variables ("WC – Is", "WC + LLs – Is", "WC + LLs + SLs – Is"), previously indicated in the DRD diagram. Rules are four sets of input and output data that are displayed in the rows of the table, which has a horizontally oriented structure.

Based on the results of processing combinations of input information according to the DMN model decision table, the type of financial stability (variable "TypFS") will be determined, which can take the values "Absolute", "Normal", "Unstable" financial condition, or "Crisis".

A similar approach to the formation of justified financial decisions using the DMN model can be implemented for business processes of assessing liquidity, business activity, or profitability indicators. For the coefficients of the above groups of financial indicators, there are established normative values that should be taken into account as criteria when building decision tables. The justification of financial decisions for such business processes is determined by the deviation of the actual level of the indicator from its normative value. In particular, if partial profitability indicators do not reach level 1, it is possible to form decisions on the urgent need to increase the profitability of the enterprise.

The DMN model operates on a knowledge base formed on the basis of normative values of calculated values and coefficients of financial condition. In case of negative trends in indicators, the rules embedded in the model will argue for the feasibility of anti-crisis measures. In the case of positive trends in indicator levels, strategies to maintain the current state will be justified, according to the knowledge base.

The objectives of BPMN modeling are to visualize the sequence and features of financial management procedures. The diagram can be used to find "bottlenecks" in the organization of financial management. Only after redesigning the current (AS-IS) business process model, it is advisable to quantitatively evaluate BPMN diagrams for the relevance of the optimization performed. A quantitative assessment of the effectiveness of the constructed BPMN models can be carried out based on the results of their further simulation in terms of duration and cost only in the context of reengineering of business activities. After all, only a comparison of AS-IS and TO-BE models will make it possible to compare changes in the time frames of decision-making and the costs of implementing financial management procedures. A quantitative assessment of the effectiveness of DMN models will be affected by a decrease in the % probability of incorrect interpretation of the levels of financial indicators by persons making financial decisions.
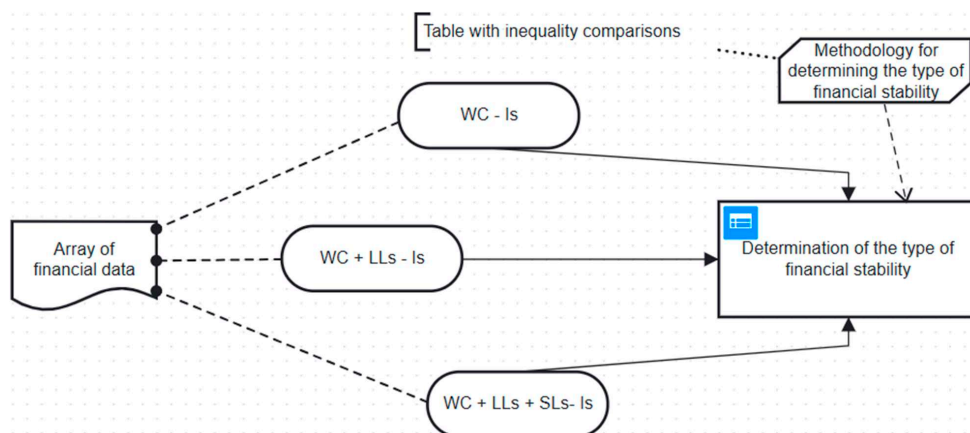
Fig. 5. DRD diagram of the DMN model for organizing decision-making regarding the type of financial stability of the enterprise, developed in the bpmn.io environment

Fig. 6. Decision table for the node "Determination of the type of financial stability"

5. 2. Construction of a data model to support management decisions in the Business Intelligence tool

The financial data array shown in Fig. 5 is the basis for monitoring partial indicators necessary for studying the type of financial stability and further comparing their levels with descriptions of target states.

More and more business representatives are using the capabilities of Business Intelligence tools to process and monitor corporate data and further make management decisions. According to the forecasts from Statista resource [3, 4], over the next few years, the size of the Business Intelligence market will grow from 15.3 billion US dollars in 2021 to over 18 billion in 2026. It is also assumed that global revenue in this segment during 2024–2029 will constantly increase by 8.6 billion US dollars (+30.95 %) and will peak at 36.35 billion US dollars at the end of the period. The use of BI tools facilitates access to a variety of financial data (operational, retrospective, from internal or external sources, structured and unstructured).

Input financial information for formulating conclusions about the financial independence of the business can be represented in the form of an interactive panel in the BI product environment. Devising visualizations for further data monitoring involves a number of preparatory steps.

The internal corporate system of the business entity is a source of primary information. The financial analyst can process the latter using built-in analytical functions in the ERP system or can upload it in the form of data files for further manipulation in the environment of specialized software products.

The information base formed from corporate storage data can be tabular or relational. To import the accumulated financial information into the environment of BI tools (for the purpose of further analysis of financial stability indicators), its structure must correspond to that given in Table 2 (tabular) or shown in Fig. 7 (relational model).

The model shown in Fig. 7 is formed by a reference table "Indicators", which contains a list of indicators of the organization's financial reporting, and a subordinate fact table "Data". The elements of the relational data model are interconnected by a "one-to-many" relationship. The model was implemented in the MS Power BI environment. Alternative BI tools for processing financial data and supporting management decision-making are Strategy One, ThoughtSpot Analytics, Qlik Sense, Looker, Domo Data Experience Platform, Tableau, etc. Each BI product has its specific tools for isolating critical data (SQL, Python, R, accessing data sources via chatbots with artificial intelligence, etc.), creating visualizations and organizing a monitoring panel for individual business needs.

Table 2

Structure of input tabular data required to determine the type of financial stability of a business entity

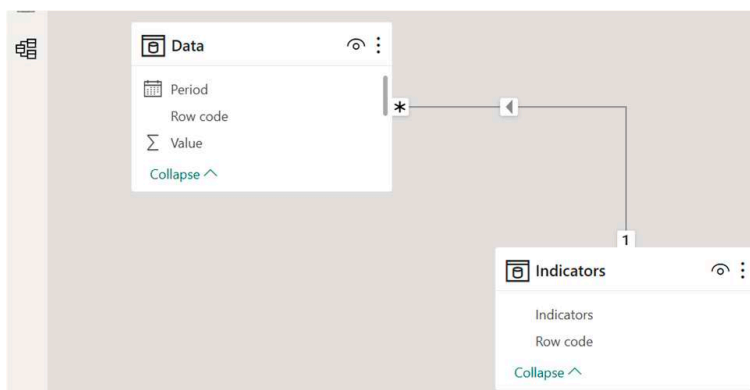| Field	Data type
Code (primary key)	Integer
Period	Date
Measurement name	Text
Measurement value	Decimal

Fig. 7. Financial data model to enable management decision-making regarding the type of financial stability in the BI tool environment (using MS Power BI as an example)

The specified structure of incoming financial information will facilitate its quick and efficient processing in the BI product environment. The configuration of the financial data model to display absolute financial indicators of liabilities (short-term and long-term), working capital, and inventories necessary for the study of financial stability, is shown in Fig. 8.

Given that the volume of WC required to assess financial stability is a computational value defined as the difference between the amount of equity (line No. 1495) and non-current assets of the business entity (line No. 1095), a new measure was devised in the BI environment using the capabilities of the DAX (Data Analysis Expressions) query language.

```
WC =
CALCULATE(
      SUM('Data'[Value]),
      'Data'[Row code] = 1495
)
–
CALCULATE(
      SUM('Data'[Value]),
      'Data'[Row code] = 1095
)
```

Similarly, new variables were devised – measures to calculate three criteria that should be taken into account when studying the type of financial stability:

1) the difference between the volumes of working capital and inventories;

2) the difference between the amount of working capital with long-term liabilities and inventories;

3) the difference between the amount of working capital with liabilities (short-term and long-term) and inventories.

Visualization of critical financial reporting indicators and their correlations, necessary for determining the type of financial stability, among the set of input data available in the arrays, allows us to focus the attention of the financial analyst on them and help in developing conclusions (Fig. 9). The results of constructing a dashboard are represented according to the financial reporting data from the Ukrainian enterprise LLC "MERKS INTERIOR", the main activity of which is the production of furniture for offices and trade.

The constructed visualizations based on financial data models allow for operational monitoring of critical indicators and form the information basis for the implementation of the DMN model.

Fig. 8. Data configuration at the stage of importing it into the BI tool environment (using MS Power BI as an example)
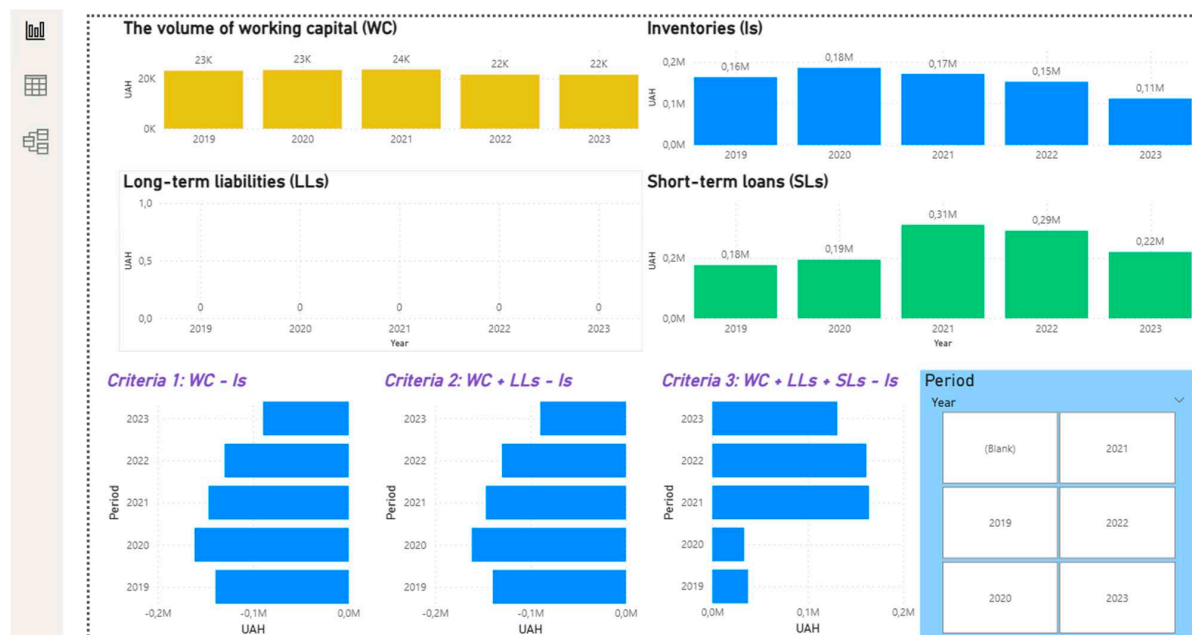

Fig. 9. Fragment of the dashboard for assessing partial indicators of the financial stability of the business entity LLC "MERKS INTERIOR", constructed with BI tools (using MS Power BI as an example)

6. Discussion of results based on modeling the organization of financial decision support

The systematization of approaches (Fig. 1) contributed to the determination of the need for a comprehensive solution to the problem of modeling financial business processes. Taking into account the peculiarities of the implementation of financial management procedures (Table 1), the BPM+ approach [2] was chosen, which makes it possible to avoid ambiguity in the representation of the subject area of our study. Unlike the studied options for building models, systematized and shown in Fig. 1, BPM+ aims to build diagrams for further automation of business processes related to the formation of financial decisions. Taking this into account, the developed algorithm for organizing decision support in the financial management system (Fig. 2) involves the design of BPMN and DMN models in combination with the use of BI tools [5]. The latter are relevant tools for building an information model of financial data necessary for qualitative analytical research and constructing monitoring panels of critical metrics for making management decisions.

The results of the modeling in the form of BPMN diagrams (Fig. 3, 4), DRD (Fig. 5) and decision tables (Fig. 6) clearly demonstrate the features of the organization of financial management of a business entity from receiving input data to formulating substantiated conclusions. In particular, the model in Fig. 3 provides tracking of the implementation of analytical business processes in the financial management system, determines the boundaries of responsibility of staff units, information flows necessary for them for managerial influences and the basis for possible optimization of activities.

The minimum required data set for analytical procedures in the financial management system is given in Table 2. The proposed structure of the information model in the MS Power BI environment (Fig. 7) is exhaustive for forming an interactive monitoring panel of financial indicators (absolute or relative) based on the data of the financial reporting of the business entity. If it is necessary to attract additional sources of external or internal information, the relational model built can be modified by adding new tables and normalizing relationships.

Limitations in the practical application of our results may be caused by the impossibility of using (including collective) modern digital environments to construct BPMN, DMN models, or Business Intelligence products because of the lack of financial capacity of the business or the unpreparedness of management to implement current software products. The reliability of the adopted conclusions based on the results of analytical studies using DRD diagrams and decision tables depends on the qualifications of the personnel and the correctness of the formation of the knowledge base for the DMN model. The data settings are shown in Fig. 8 and a fragment of the monitoring panel in Fig. 9 can be used to determine the type of financial stability of a business entity.

In the case of conducting other analytical searches or making decisions in the business management system, the list of indicators and the structure of the monitoring panel should be adapted to the needs of the person implementing these procedures. The features of the used digital Business Intelligence product determine the language for building queries to obtain the necessary data or the programming language for working with them. Also, the choice of BI software determines the set of tools for building visualizations on the monitoring panel.

The disadvantage of our research is associated with the implementation of the devised approach only on analytical business processes of studying the level of financial stability of the enterprise.

Our procedure for modeling the organization of financial decisions in Fig. 2 is a basic template. It can be adapted to support decision-making not only in the course of analytical procedures. In particular, its implementation is also advisable at the stages of planning, organization, control, coordination, search for sources of financing or development of investment policy and development strategies in the financial management system.

Further research in this area may aim at simulating the formed algorithm for organizing decision-making support on the example of analytical business processes in the environment of specialized digital products. That would make it possible to investigate the features of its implementation in terms of duration, cost of procedures, and resources involved.

7. Conclusions

1. We have systemized approaches to modeling financial business processes that showed the lack of a comprehensive vision of the organization of decision-making support in the financial management system. Analysis of its procedures and features of their implementation led to the need to apply a process approach (to identify aspects of solving procedures in the financial realm) and a situational approach (for the purpose of substantiated adoption of management decisions and formulation of analytical conclusions). To address this issue, a scheme of the decision-making process in the financial management system was developed based on the capabilities of BPM+ and modern digital Business Intelligence tools. Our conceptual scheme provides for building a BPMN model for a graphic description of business processes; forming a data model for analytical searches in the BI environment; constructing a DMN model for formulating substantiated conclusions regarding the current situation. Based on the results of the modeling, a BPMN diagram was built that visualizes the system of financial management business processes, the sequence of their implementation and distribution among responsible specialists, and details analytical procedures for studying influence factors. The logic behind making a management decision using the example of determining the type of financial stability, as well as the knowledge base structure necessary for its argumentation, is represented as a result of constructing the DRD model and the corresponding decision table.

The devised BPMN and DMN models form a comprehensive representation of the organization and implementation of individual business processes in the financial management system with different levels of detail – performing financial analysis, analyzing influencing factors, and making decisions on the type of financial stability.

2. The structure of input information was designed in the form of a data model necessary for identifying the type of financial stability of a business entity, which includes a list of information fields and their corresponding types. The data model built forms information support for making management decisions regarding the type of financial stability in the environment of the BI product – MS Power BI. The information array loaded on the basis of the constructed data model was configured with the tools of

the aforementioned software product, which made it possible to identify the critical financial indicators of stability for the study – the volumes of working capital, liabilities, and inventories. To obtain calculated indicators, new objects (measures) were devised in MS Power BI. The values of the latter were calculated using the DAX query language based on critical indicators and reflect the criteria for compliance with the types of financial condition. In order to provide information support for determining the type of financial stability, a monitoring panel of key indicators was formed. Unlike existing ones, the designed panel visualizes critical metrics for a visual analysis of the state of financial stability of the enterprise in the course of financial management. The structure of the dashboard and the content of its elements correspond to the solution of the analytical questions posed and could be adapted to the needs of the person who implements business processes and makes decisions in the financial management system. Shifting the manager's focus to the analysis of other financial condition metrics would involve flexible rearrangement of our visualizations and measures by changing the data sources – the fields in the "Indicators" table.

Conflicts of interest

The authors declare that they have no conflicts of interest in relation to the current study, including financial, personal, authorship, or any other, that could affect the study, as well as the results reported in this paper.

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Data availability

The manuscript has associated data in the data warehouse.

Use of artificial intelligence

The authors confirm that they did not use artificial intelligence technologies when creating the current work.

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