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# The Concept of Engineering Accounting and Management of Intellectual Capital University

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**Annotation.** The article discusses the concept of engineering systems of accounting and management of intellectual capital of the university.

The concept put metamodel accounting engineering focus that integrates a system of accounting and management of the brand as part of the university structure, behaviorist and educational capital. The engineering model - a complex system created by the formation of relationships in the form of a pattern, algorithms, formulas, computer programs.

The concept of engineering management of university formulated four patterns:

- Modern accounting and management systems;

- Objects of accounting and management: of funding, structural, behavioristic, educational equity, the brand of the university;

- Engineering and management accounting methods: engineering, transaction, behaviorist, reengineering, synchronous model;

- Accounting and brand management of the university: Financial and intellectual capital, a synergistic effect, the margin of safety.

Considered accounting and management system of University management: traditional, engineering, behavioral.

Proposed a model Reserve University and the risk management process.

**Keywords:** engineering and management accounting; behavioristic account; metamodel accounting; brand of the university; structural capital; behavioristic capital; educational capital; synergistic effect.

The concept of an engineering management system developed by universities in the scientific school of Professor V. I. Tkach, "System engineering and management accounting in microeconomics", which in Russia and abroad trained 10 proffessors, 17 doctors and 73 candidates of economic Sciences, proceeding from the following positions:

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First, management as a science is based on the concept of extensive use of mathematics, engineering mechanisms, statistical and other qualitative methods.

After the Second world war from 10 main areas of management, is Finance and Accounting moved to the first place that led to the formation of efficient managerial, strategic, transactional, behavioral accounting, control, analysis and management of universities.

Secondly, the main methodological aspects have been transformed from the system of national accounts, developed by the Nobel prize winner in Economics R. Stone (information base engineering type, aggregated accounting entries, mega-account, etc.) [40].

The system of national accounts 1993 formed a complex of more than 500 accounts:

1st class: description of the economy as a whole;

2nd class: analytical accounting of production, consumption and accumulation in national income;

3rd class: analytical accounting of revenues, expenditure and financing of capital in sectors of the economy.

Thirdly, Nobel laureate in Economics Fritz Machlup, considering marginalist, behavioral and managerial theories of the firm, stressed that the unification of the marginalist and management approaches allows to obtain and use in the management of an objective function linking profits with other management functions in a single formula – "maximizing behavior" [22].

In higher education "maximizing behavior" is reduced to accounting and management of intellectual capital and is expressed in structural, behavioral and educational equity, combine to form the brand of the University. Search engines in English on request "brand university" accumulate links for 10-15mn. sources. Search in Russian language "the brand of the University" gives a few thousand links (southern Federal University, Tomsk Polytechnic University, ITMO).

Fourthly, the subject and the elements of the subject of accounting, which provides system management of economic processes and brand of the University, presents the complex, forming a meta-model of accounting based on a single formal language (pic.1):

- financial accounting;
- strategic accounting;
– management accounting of funding and expenditure;
- engineering accounting and management;
– behavioral-based tracking and management of PPPs;
– management accounting of funding and expenses.

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Fifth, University financial engineering – development of the pattern system of accounting and control brands on the basis of an engineering chart of accounts and complex megashadow for the management of financial, structural, behavioral and educational capital in the context of assessing the implementation of knowledge and implementation of effective contract.

Accounting engineering and management online is formed by the following mechanisms:

1. Initial statement: system engineering mega-account in the chart of accounts of the University.

2. System iteration to ensure the property management and the structural, behavioral and educational capital.

3. Accounting, monitoring and control functions in the online mode on the basis of aggregated accounting entries, developed on the basis of adjacency graphs and deterministic graphs.

Engineering deterministic graph of double entry is based on the uniqueness of the numerous connections of economic phenomena with the basic balance sheet equation:

- state capital = assets – liabilities;
- non-state capital = assets – liabilities;
- intellectual capital = intellectual assets – liabilities;
- behavioral-based capital = behavioral assets – liabilities;
- educational fund = educational assets – liabilities.

The set of computer programs operating on these principles provides accounting and management of online financial, structural, behavioral and educational capital of the University and its structural subdivisions.

Representatives of the scientific school "System engineering and management accounting in microeconomics" has registered more than 100 patents and computer programs in the Rospatent of the Russian Federation [26-30].

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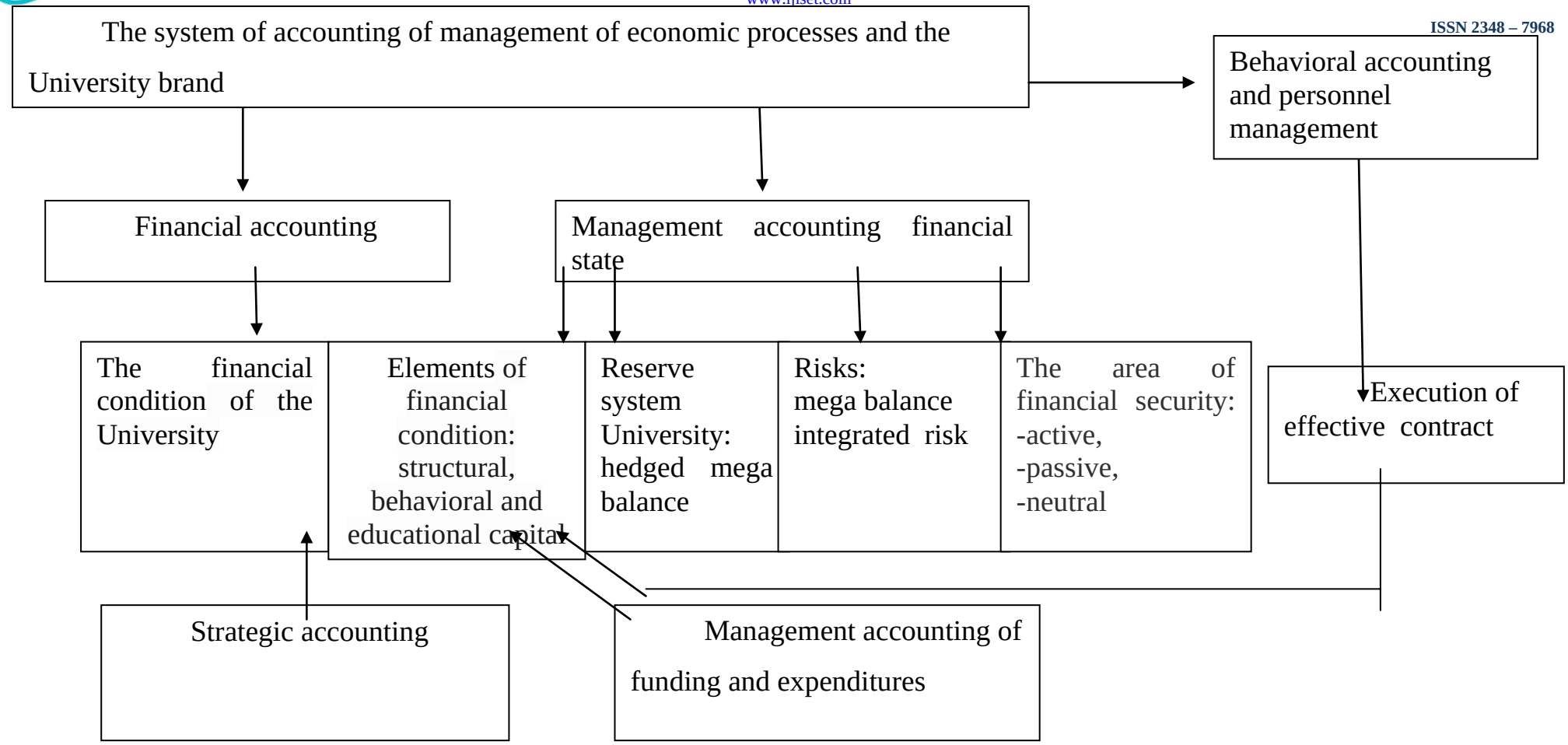


**Pic.1. A meta-model with engineering and behavioral positions**

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Sixthly, the financial engineering of the University is the creative development of accounting and control and management of engineering tools, providing management of the two defining tasks:

- the operation of the financial condition of the University (solvency, reserve, risk, financial results, targeted programs, etc.);

- the management of intellectual capital and endowment Fund: structural, behavioral, and educational capital in the whole University and in the context of institutions, faculties, departments, laboratories.

Seventh, the sustainable development indicators is the system of indicators of economic, environmental and social development of countries, regions and the world, which it is advisable to include in the system of national accounts of the country. At the global level developed complex S. D. I.[1], this includes 134 indicators, most of which are economic (UN Commission on sustainable development).

At the University level, sustainable development is defined by structural, behavioral and educational capital and the strategy adopted for the formation of the brand [8, 11, 31, 33, 34, 37, 40].

Eighth, accounting-managerial engineering provides quantification evaluation of phenomena such as the formation of the intellectual capital of the University and its kinds (structural, behavioral, educational, reserve system), risks on radically new engineering-economic methods:

- engineering chart of accounts, based on mega - account;

- graph theory and matrix calculus;

- economic units and aggregated accounting transactions;

- the system of algorithms, matrices;

- nets "Petri".

Ninth, the development of engineering systems of accounting and management of higher education institutions is formed by the use of such mainstream papers in the field of theoretical

[1] S. D. I. - Sustainable Development Index

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and practical financial, economic, legal and social engineering, which dealt with the following issues:

– three elements of accountancy: legal, economic, mathematical [8,13,18,31,32,34];

– mega-account and mega-becquerel [43,48,49];

– interpretation of capital in the financial account as a ratio of assets and liabilities, in management as advanced faction, in engineering in relation to the area of financial risk and margin of safety [1,7,8,11,19,23,33,38];

– the use of Petri nets in the flow of information: a roadmap, backup system, etc. [20,24,25,31,35,39,40];

– engineering-behavior-based modeling [2,3,12,22,37,41,42,44,45,46,47];

– transformation procedures engineering [4,5,31,33,34,36,37,38,49];

– microeconomic stability [2,6,10,14,25,35,40];

– optimization processes the use of human capital [3,8,11,16,33,37,42,44,45,46,47];

– instrumental support economic sphere solutions [15,17,21,26-30,31,34,38];

– integration into the accounting procedure of the predictive blocks and situations [4,31,33,35,39,41].

Based on these defining positions, the concept engineering system can be paternalistic in the form of four blocks (Pic.2).

I. Current accounting and management systems from the point of view of positioning two functions:

– accounting and analytical support of management;

– management of accounting and economic processes and intellectual capital of the University.

II. The objects of accounting and management with a view to ensuring the management of intellectual capital and its components in the optimization control.

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III. The engineering and behavioral-based methods of accounting and management from the standpoint of modeling.

IV. Accounting and brand management of the University.

In this case engineering model is a performance of complex systems that are created by forming key linkages (pattern, algorithm, formula, computer program).

XXI century is characterized by a dominant feature of the University in the Information Society as a system-generating factors: the priority of knowledge, intelligent technologies, priority intellectualization, displacement semantics to create structural, behavioral and educational capital in comparison with the financial, i.e. the result is the formation or destruction of the brand of the University.

In General, the concept of engineering systems of the higher education institution can be represented by the data of Pic.2.

Block No.1 of the concept of "Modern accounting and management systems of University management" presents the data of Pic.3.

Accounting and management systems from the point of view of objects, mechanisms and results management are divided into three types:

1. Traditional (manual).

2. Engineering (computer, aimed at the management of economic processes in an optimum mode).

3. Behavioral-based (computer, focusing the management on the optimal use of human capital).

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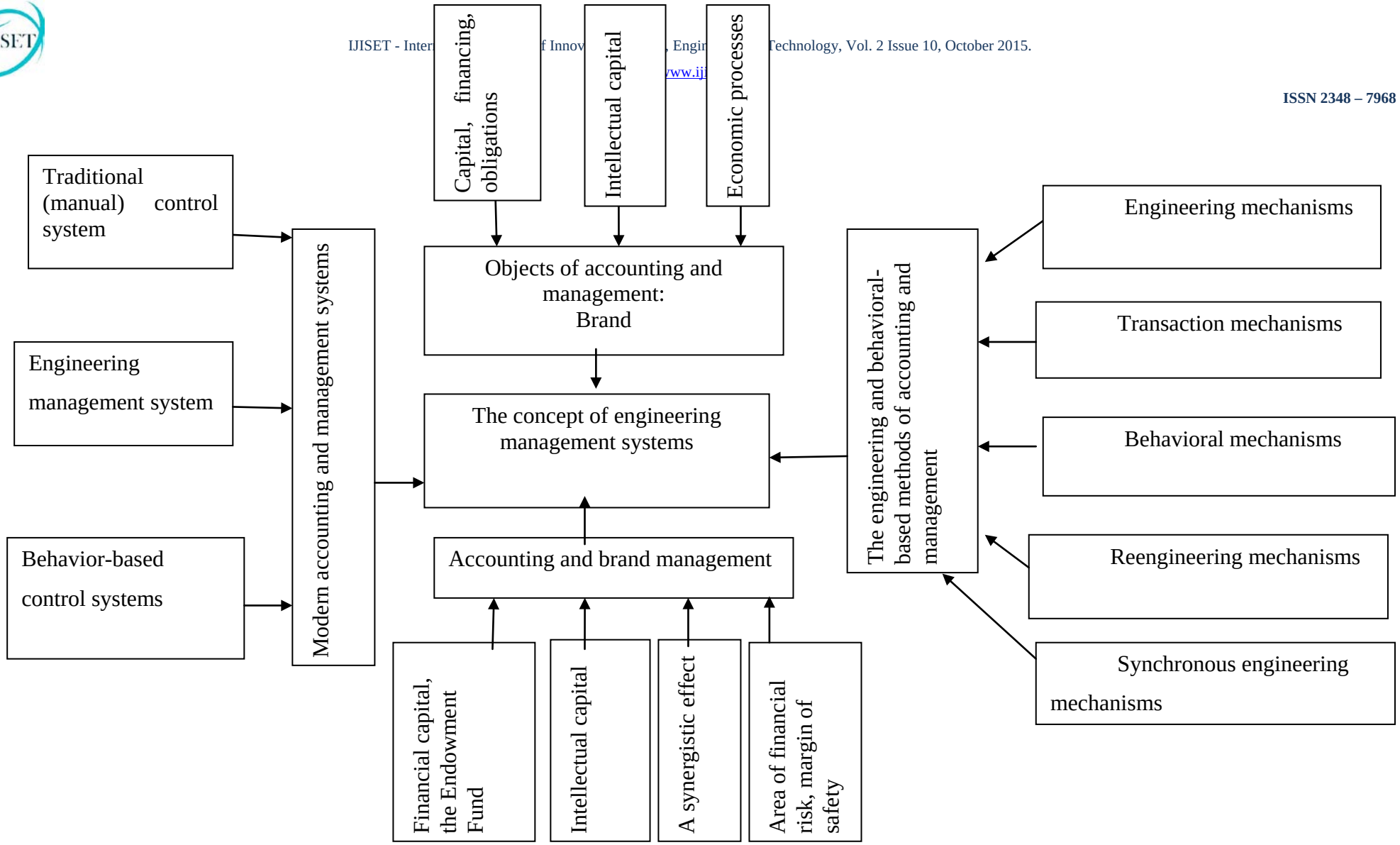


**Pic.2. The concept of engineering systems of University management**

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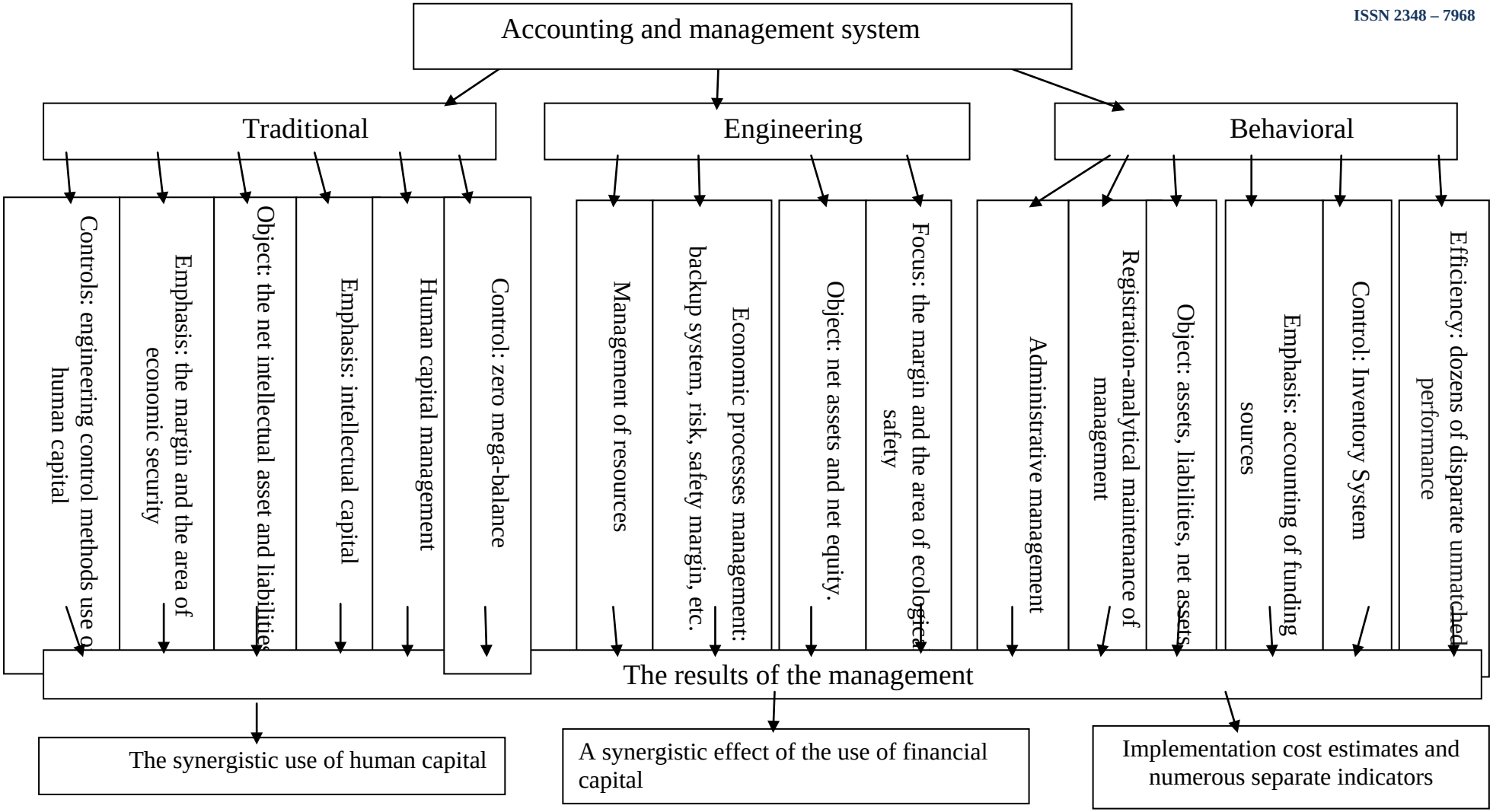


**Pic.3. Modern accounting and management systems in education**

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Traditional management systems are functioning at the following examples:

– administrative nature management;

– accounting provides management with analytical information related to assets, liabilities and results of performance of estimates, plans with a focus on the indicators of financial results: profit and loss and dozens of quantified values;

– information presented and used in the management after the expiry of the reporting period (month, quarter, year).

The emphasis of the management is focused on the use of sources of financing: budgetary, regional, commercial and financial results and individual quantitative indicators (man-hours; printed sheets, ratings data, etc.) and cost (cost, implementation funding). At the same time created the intellectual (structural, behavioral and educational) capital and obtained a synergistic effect or synergism is not used in management.

The control is manual in nature and is reduced to using reports, memos, reconciliations, inventories, etc., with numerous comparisons of quantitative and cost indicators of foreign values on the University, institutes, faculties, departments, laboratories, and faculty. Often this control is set to the score: a University Professor must perform a scope of work for the year in the amount of 146 points, many in man/hours by type of activity. Created intellectual capital in rubles is not defined: structural (equipment of the educational process and scientific research work), behavioral (the cost of the Professor), education (the cost of graduates in the labor market).

For example, the process of accreditation of universities established 17 indicators with actual data and threshold values, i.e. each of them can be answered:

– exceeded a threshold value;

– not met threshold.

State accreditation indicators are reflected in four ways:

1. In quantitative terms: the availability of textbooks and manuals.

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2. In monetary terms: the average annual volume of funding for scientific research.

3. As a percentage of: % of teaching staff with specialized education.

4. The presence of the indicator (+); absence (-); training.

These indicators are difficult to define intellectual capital of the University, term of structural, behavioral and educational (brain) capital.

Engineering accounting and economic management system aimed at efficient management of resources and operate on the following principles:

– extensive use of economic-mathematical methods and systems;

– manage online;

– management mainstream economic processes: the backup status of your system, institutional units, risk management, financial risk protection, the safety margin, the solvency, financial condition, fulfillment of Federal and other targeted programs by definition result in the form of changes in the fair value of net assets, etc.;

– the emphasis of management is aimed at monitoring the security margin and areas of financial risk.

The result based management engineering accounting management system is a synergistic effect of the use of financial capital, defined as the size between the net liabilities in fair value and net assets at market value.

Behavioral-based accounting system and management are widely used in the world economy in universities, audit firms, consulting organizations, venture firms, research organizations, etc., that is, the institutional organizations, the success of which depends on intellectual capital.

The essence of behavioral management is reduced to the following main provisions:

– management of human capital;

– the emphasis in management is on intellectual capital, including structural, behavioral and consumer (education);

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– object management: the net intellectual assets and liabilities;

– the emphasis of management: margins and zone of economic security (active, neutral, passive);

– controls: engineering control methods use of intellectual and human capital.

The result of behavioral management: the synergistic use of human capital.

Synergetics of university is based on the interaction of many subsystems (rector, institutes, faculties, departments, laboratories) in order to achieve a certain level of intellectual capital (structural, behavioral, educational).

Block No. 2 concepts of engineering management systems higher education institutions are represented by objects of management and accounting, subdivided into three categories (Pic.2):

1. Capital, financing, obligations (financial objects).

2. Intellectual capital (behavioral objects).

3. Economic processes transaction types: reserve, risk, safety margin, etc. (engineering objects).

Engineering tools in financial, managerial and strategic accounting can be presented in the data table. 1.

**Table 1.**

**The use of accounting engineering tools in financial, managerial and strategic accounting**

| Computer information system | The authors |
|---|---|
| 1. Management of capital investments | Bocharov V. V. |
| 2. The management of borrowed capital according to the strategic and management accounting | Zatagina V. V. |
| 3. Financial management accounting of investment activity | Bondar D.V. |
| 4. Management accounting changes | Tkach I. M. |
| 5. Strategic management accounting | K. Drury |
| 6. Management accounting of insurance activities | Sidorina T. V. |

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| | |
|---|---|
| 7. The aggregated net assets and net liabilities | Teyvazhykova F. T. |
| 8. The strategy of innovative enterprise | Shchemelev A. N. |
| 9. Fractal manufacturing balance sheet | Krohicheva. G.E. |
| 10. Strategic management and accounting of entrusted management of property | Kurseev D.V. |
| 11. The organization of the network situation into account | Maksimenko A.N. |
| 12. Financial and managerial accounting obligations | Foroponova T.M. |
| 13. Hedge accounting | Anikeev M. J. |
| 14. Accounting and control of safeguards | Dolgopolova E.T. |

**The end of the table 1.**

| | |
|---|---|
| 15. Monitoring of financial condition | Rusina E.J. |
| 16. Semantic[2] derivative balance sheet | Maksimenko A.N. |

Doctor of economic Sciences, Professor M. V. Shumeiko has developed a qualitative characterization embedded derivatives carrying an engineering report with a description of the three categories qualimetry: an engineering, technological, productive, focused on the management of any economic, financial, reorganization, innovation and other processes in line with the regulation of the status and level of safety of functioning [38].

3rd block of the concept of engineering systems of University management (Pic.2) describes methods, subdivided into 5 mechanisms:

– engineering;

– transaction;

[2] Semantics (from gr. "semantikos" means). The principles of semantics by creating information retrieval system, search patterns. Reviewed by A. Tarski, the founder of logical semantics as deductive theory. A. Tarski (b. 1902), Polish logician and mathematician.

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– behavioral;

– reengineering;

– synchronous.

Professor A. I. Belousov, L. V. Close note that the essence of engineering is to integrate into the accounting procedures of computer units and situations [41], many of which are currently registered in the Rospatent of the Russian Federation (several hundred in engineering, transactional, behavioral, reengineering and simultaneous engineering mechanisms). Reengineering, engineering built on a radical overhaul of the business processes of the University:

– the use of qualitative characteristics of systems of accounting, control, management;

– operation of engineering the chart of accounts;

– structural, behavioral, and educational capital;

– extensive use of mathematical methods: graphs, matrices, algorithms, economic units, the network "Petri", etc.;

– qualitative characteristic of the brand of the University.

While deterministic immunization system of accounting for and control of the University was built on the assumption that the reserve system and the risk situation is determined by complex aggregates (up to 20), allowing to determine the area of financial risk and the safety margin in the deterministic mega balance.

4th unit concept (Pic.2) generated by the accounting system and brand management of the University and includes 4 sub-block:

– financial capital;

– intellectual capital;

– synergistic effect;

– area of financial risk, margin of safety.

Financial model reserve system of the University is based on the backup protection (insurance, reserving, hedging and complex protective equipment), which is characterized by economic blocks:

– backing system;

– the patent organization;

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– units reserve system;

– accounting engineering the mechanism of reflection;

– risks;

– risk areas;

– management.

The risk management process is the use of engineering mechanisms (risk, hedged mega balance) for the identification, analysis and structuring of the financial area of risk and margin of safety University.

Settings backup protection – qualitative characteristic parameters, essential for the functioning of enterprises (units reserve system).

The parameter values of the reserve system is determined by the area economic activity (active, neutral, passive) and margin of safety.

The situational model of risk-oriented management of complex situations (economic, segmental, fractal, backup, etc.), which are intended for the blocks:

- accounting criteria;
- engineering chart of accounts;
- engineering financial accounting;
- management, strategic accounting;
- control and management [2,25,27,29,34].

Based on the developed concept and engineering of the control system solved the following problems:

– methodology and organization of engineering system of accounting for and control of the University;

– engineering management of the University;

– engineering -behavioral-based analysis and control of functioning of the University.

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