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Strategic Decisions and Risk Management

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   - Rational and behavioural practices and techniques for developing and making managerial decisions;
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- Innovation, entrepreneurship and corporate entrepreneurship as strategic development factors;
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   - Strategies for the digital transformation of business and application of technologies of the Fourth industrial revolution;

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   - Methods and techniques of risk identification and consideration in the development and adoption of management decisions;
   - Methodology of strategic risk management;
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Fundamental knowledge and flexibility of thinking as priorities of management education for technological breakthrough

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Abstract

The article substantiates the need for a radical review of approaches to the training of managers in high technological industries, whose professional activity context is defined by continuous crises, growing uncertainty, dynamic trends, the massive emergence of the newest technical, organizational, and IT solutions, and a profound transformation of markets. Building upon their own research, analysis of expert opinions from top managers, university professors and the best practices of the world's leading universities, the authors identify trends indicating the growing role of the fundamental knowledge possessed by managers, who are capable of raising up to the challenges of an unstable environment. Links are determined between fundamental training and the flexibility of managerial thinking. A conceptual vision is presented of the peculiarities of managerial thinking and of conditions for developing its flexibility in the educational process.

The scientific novelty of the article includes arguments substantiating the need for stepping up fundamental training in line with objective demand for changes in the content of managerial functions. Such training is based on three components: methodology of anticipatory management; scientific and technological foundations of production and technologies of the future; a vision of professional activity and changes that will be brought about by the introduction of new technologies. On the applied side, the authors have designed a concrete structure of fundamental training and a mix of training methods that promote flexibility of thinking and have proved effective as part of Masters in Management programs.

Keywords: managerial training, industry-specific technology, technological breakthrough, fundamental knowledge, flexible managerial thinking, systemic approach, systems engineering, fundamental training, methods and technology of management education

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Introduction

The complex and unpredictable problems of an ever-changing world create significant challenges for organisations and their leaders. To remain competitive, it is necessary to respond to unforeseen changes in a timely manner, carrying out organisational changes dictated by the development of technologies, changing business models, building logistics and interaction with partners and customers on new principles. Foresight and anticipation become imperatives and prerequisites for survival itself. Under these conditions, management needs new intellectual, meaingful methods and tools. At the same time, the dynamics of change is such that classical training is increasingly lagging behind the practical tasks of improving the skills of managers. On the one hand, there comes an understanding that success accompanies not those who have mastered more advanced training courses, but those who have mastered the competencies of self-learning and are well aware of the need for continuous professional development. On the other hand, service support for the process of self-learning, both for individual managers and organisations as a whole ("self-learning organizations"), is becoming urgent.

It is generally recognised that the basis of a specialist's ability to solve new problems independently as well as to self-study, is high-quality fundamental training [Eliseev, 2007; Kosolapova and Kalinovskaya, 2013; Gladyshev, Gladysheva, 2020; Professionals in competition.., 2021]. At the same time, the changes taking place in the context of the tasks solved by management require a revision of the content of fundamental training in management education. The task is very difficult, and only this can explain that many experts, sin terms of the importance and relevance of fundamental education, reduce it to an extended list of classical training courses that are found in programs of various educational areas. Meanwhile, the question of specific proposals for the development of fundamental education remains open. Its constructive solution requires a special analysis and generalisation of best practices, a comprehensive discussion in the expert community.

This study continues the series of articles by the authors on the issues of management education [Gitelman, Kozhevnikov, 2018; Gitelman et al., 2019; Gitelman et al., 2020a; Gitelman et al., 2020b; Professionals in competition.., 2021] in the paradigm of proactive management and the advanced training of managers necessary for its implementation. This article reveals the relationship between fundamental education and other important aspects of managerial activity, which are especially in demand during a period of significant change: the use of new technologies, the transformation of economic systems, and the neutralisation of crisis phenomena.

1. Management has become an extremely knowledge-intensive profession

It should be recognised that modern managers operate in such a rapidly becoming more complex context that science does not have time to comprehend the new, radically different realities that require a new management paradigm.

1. Increasing frequency of various shocks (pandemic, geopolitical cataclysms, cyberattacks, significant structural shifts in the commodity and currency markets) multiply the uncertainty in all areas of economic activity and lead to crisis situations. It can be argued that the business community is undergoing a global transformation, the scale, costs, deadlines the results of which cannot be predicted [Medne et al., 2022]. In this regard, there is a sharp increase in the need for new tools for practice: multi-scenario programming based on big data analysis, modern risk assessment methods, mechanisms for ensuring flexibility and adaptability of business configuration.

2. Despite the growing crisis, the industry of the future (industry 4.0) continues to unfold with cyber-physical production systems that connect the virtual space of the Internet with production equipment through a set of network technologies and radically change the industrial architecture. Often at the same time, inherently inertial life supporting infrastructures turn out to be unprepared
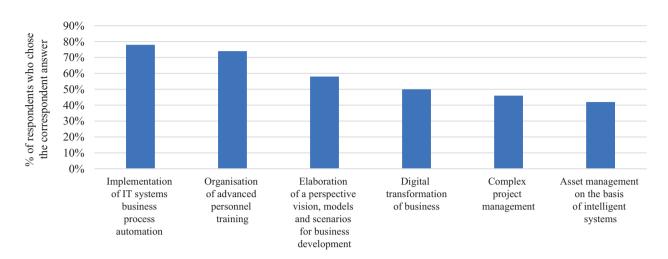
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Table 1
New knowledge that managers need to implement IT innovations

Area of implementation	Forecasted IT trends	New knowledge necessary for managers
Digital transformation of business	Territorially distributed enterprises Composite Applications Multimodal perception	Remote business management technologies Knowledge in the field of big data analytics for communication with Data Scientists Ability to build the logics of digital applications and basic knowledge of algorithmisation
Cloud technologies	Cloud Platforms Distributed Cloud Services	Opportunities and principles of cloud technology operation, problems associated with their use (including the availability of infrastructure and services) Service delivery models, estimating costs and benefits of using cloud solutions for business
Artificial intelligence	Formative AI Generative AI AI engineering Small volume AI	Principles of operation, possibilities and limitations of the use of AI, factors affecting the effectiveness of AI Modern directions of research in the field of AI, prospects for their application
Process automation	Hyperautomation Expanding the use of IT peripherals Autonomous systems	Understanding the components of hyperautomation, the capabilities of edge computing and autonomous systems, their impact on the business including risk assessment In-depth knowledge of business process design based on the use of AI
Cyber security	Mesh-type networks Differential Privacy AI-security	Fundamentals of business information security Knowledge of major cybersecurity trends
New technologies for working with data	(Data Fabric Decision intelligence Internet behavior Democratisation of knowledge	Principles, capabilities, limitations of advanced analytical tools Mastering data-driven business management Involving employees in the processes of summarising experience, accumulating knowledge and disseminating it within the company
Strategy and structure of business	Total experience Intelligent Composite Business	Building composite business architectures to respond flexibly to rapidly changing business conditions and needs Interdisciplinary knowledge at the intersection of IT, marketing, design, psychology, ensuring the use of generalised experience

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Fig. 1. Professional areas of managers experiencing a high need for new knowledge

Source: Compiled by the authors based on the results of a questionnaire survey.
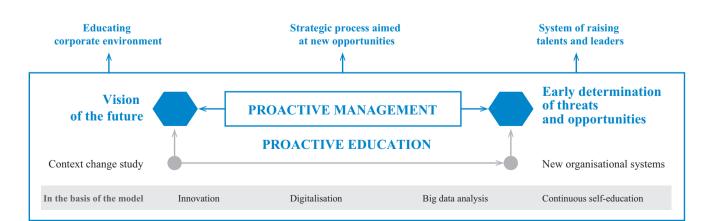
for the development of integrated solutions; for example, the electric power industry – to the electrification of new intellectual production facilities for this industry – consumers who put forward special requirements for the reliability and quality of power supply. Completely unprepared for the powerful innovation flow that accompanies industrial changes, the system of vocational education turned out to be also incapable of transitioning to the advanced learning paradigm. As a result, the competencies of managerial personnel do not meet the challenge, primarily in the field of organising innovation and technological breakthrough based on the introduction of the latest scientific and technological achievements and technologies of the future.

There is an urgent need for a broader vision, a holistic view of the context – promising innovations, emerging technological trends, which is fundamentally important

in their connection with IT, as well as the associated changes in vocational education.

3. Specialised IT technologies are rapidly developing, which allows to transfer control processes to a highly sensitive mode that takes into account both weak and strong signals [Gitelman, 2020]. Generalisation of changes significant for business in the IT field in recent years, noted in Gartner forecasts [Costello, Rimol, 2019; Karen, 2019; Maddox, 2020; Panetta, 2021; Shein, 2021], IDC [Bayern, 2019; High, 2020; Top ten.., 2021], as well as other reputable researchers [10 breakthrough technologies, 2020; Morris-Reade, 2021], allowed us to identify technological trends that will have the strongest impact on business in the short term and form requirements for a wide range of new knowledge necessary for managers of various functionalities, positions, and market specialisations (Table 1).

Fig. 2. Model of management focused on proactive management and anticipatory training

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The statement that among the various areas of professional activity it is in the field of implementing IT systems that new knowledge is especially actively emerging is confirmed not only by theoretical generalisations but also by empirical data. So, in the course of our survey of more than 50 practicing managers and university professors, almost 80% of respondents noted that solving the problems of building an IT infrastructure for companies and automating business processes is accompanied by a high knowledge deficit. The second critical area in this aspect is advanced training (Fig. 1).

4. A fundamental revolution is taking place in the business models of companies: the process of creating added value becomes spatial, and the very concept of "value" is now determined not so much by the set of a particular product useful properties but by the quality of organising consumer access to digital platforms and ecosystems that integrate offers and technological solutions of different market players and involve all interested participants in the process of joint product creation [Trachuk, Linder, 2015; Parker and Van Alstyne 2018].

Technology is the dominant source of business model change. They are the driver that transforms industries and markets beyond recognition, consumer preferences, methods of production, purchase and delivery of products to the end user [Trachuk, Linder, 2015; Kochetkov, 2019].

As a result, the taxonomy of organisational systems is becoming increasingly complex, and the systems themselves are becoming fluid and changeable. The most important function of management now is to ensure their balanced and, what is extremely important,

advanced development. Management, therefore, must act proactively. The role of the locomotive in solving this problem is given to interdisciplinary teams which include specialists from different subject areas (managers, engineers, business analysts, economists, IT specialists, lawyers) as well as external consultants and mentors [Sailer et al., 2019]. These teams are led by managers with a broad vision of the context, able to control the development of conceptual models that integrate the results of scientific research, engineering solutions, design and art [Francis et al., 2015; Kazemahvazi et al., 2015].

Thus, it can be argued that the challenge for management is that it must become proactive.

Proactive management as a response to the high dynamics of the external environment is a completely different content and scope of activities (tasks) compared to what managers had to do before [Gitelman, 2020]. By proactive management the authors understand a set of technical, organisational, resource and economic measures implemented at all levels of the industry, a specific business, aimed at preventing the negative impact of internal and external factors that threaten sustainability, functionality, competitiveness, economic and environmental efficiency.

Proactive management aims to proactively counter challenges and threats generated by external instability, as well as identifying emerging opportunities as a result of monitoring technology trends, observing weak signals, and structuring complex priorities [Gitelman et al., 2017]. The target function of proactive management is the early preparation of management for unexpected changes and
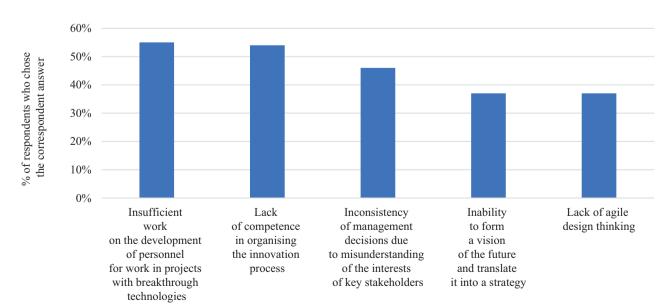
Fig. 3. Key disadvantages of high-tech business leaders

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planned innovations (forward 5–10–15 years), including R&D, human capital development, the introduction of flexible organisational structures, and making a creative corporate environment.

The predictive control model is illustrated by the diagram shown in Fig. 2.

Today Proactive management solution algorithms mean an intellectual revolution in management, radical changes in its paradigm, methodology, organisational systems and processes that cannot be implemented without deep transformations in infrastructure institutions: research and service centers, consulting organisations and, in particular, universities, which more often complex, non-linear problems, are undergoing significant changes and require distributed leadership combined with reliance on continuously updated analytics of both retrospectives and future trends. The subject and content of the work of managers is changing: it increasingly contains human-machine procedures, system analytics, complex algorithms and huge amounts of data. Managers have to interact with many specialists, including external consultants: knowledge bases, forecasting, information security, artificial intelligence. Thus, the modern work of a manager in terms of its information saturation, the variety of tools used, the operational composition of analytics, the dynamism of factors taken into account and the nature of decisions made has become much more difficult than it was a few years ago. It is important to realise that in the foreseeable future, significant changes will continue to occur in the managerial profession and it will become even more intellectually intensive.

In this regard, the following is indicative: in the survey of managers mentioned above, the respondents themselves note insufficient work on the development of personnel, first of all, in those projects that reflect global changes in business architecture: focus on breakthrough technologies and the lack of competencies in organising the innovation process as their main shortcomings (Fig. 3).

2. Background knowledge in anticipatory learning – the imperative of an uncertain context

Proactive management is impossible without proactive learning, which is an organised process of building knowledge and competencies to solve future problems that are in line with global trends and national development programs. The purpose of advanced training is to provide specialists with knowledge to work in the conditions of engineering, organisational, economic and socio-humanitarian systems that are being created in the foreseeable future, capable of quickly adapting and rebuilding to a changing industry context, based on new principles and functioning in an external environment with increased turbulence and uncertainty [Gitelman et al., 2019]. It should be noted that advanced training can be implemented at various levels of education (bachelor's, master's, MBA, PhD, DBA programs), but in different volumes: it is obvious that the higher the qualification level of the program, the more issues of advanced training are considered in it.
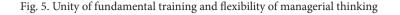
Fig. 4. Approximate structure of fundamental training in management master's programs

TOPICS OF FUNDAMENTAL TRAINING
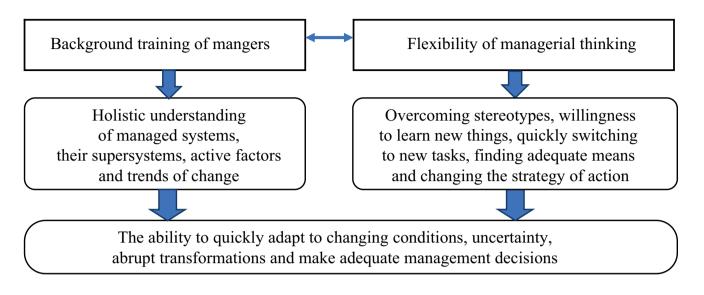
KNOWLEDGE AREA	PROACTIVE MANAGEMENT METHODOLOGY	SCIENTIFIC AND TECHNICAL FOUNDATIONS OF PRODUCTION AND TECHNOLOGIES OF THE FUTURE	VISION OF PROFESSIONAL ACTIVITY AND ITS CHANGES
Development of complex systems	Intelligent systems for predicting changes	Self-design business development	Management professionalism basics
Technological and socio-economic trends	Strategic analytics	Monitoring and analysis of weak signals	Future research methods
Future design	Organisation of applied research and development	Platform markets and ecosystems	Conceptual design

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Fig. 5. Unity of fundamental training and flexibility of managerial thinking

Proactive management and proactive learning focused on anticipating the future are inextricably linked and critical to the successful implementation of a technological breakthrough. At the same time, the characteristics of advanced learning objects, which are super-complex non-linear problems, determine fundamental differences in the content and methods of training managers, which form competencies and knowledge, primarily of a fundamental nature, corresponding to current and future tasks.

However, the question immediately arises: what fundamental knowledge, its content and depth of study are we talking about? Leading foreign universities are actively developing research and training of managers in such issues as systems engineering, future technologies, stability and adaptability of complex systems, network technologies and distributed architectures, data science, conceptual design, chaos management, self-organisation. Unfortunately, in this regard, our country is still in a catch-up mode.

Our analysis of English scientific publications [Wu et al., 2004; Nine major paradigm shifts.., 2018; Management skills.., 2019] shows that the focus is on fundamental training in the following areas of managers.

1. Interaction of managers with technologists, designers, product designers, economists, environmentalists when deciding on the choice of the most efficient production and information and telecommunication technologies for the implementation of specific projects. It is noted that this group of competencies is especially significant for industries with a high potential for danger, in which the risks of using incorrect design and technological solutions can cause catastrophic consequences [Bell, Wechsler, 2015]. That is why the services of technology consultants

are extremely expensive, and therefore, managers need to be trained in the basics of technology from the very beginning of their professional activities.

2. Ability to adapt acquired knowledge to solve non-standard, complex problems; formation on this basis of a personal arsenal of methods for solving complex, uncertain problems; possession of a culture of self-learning with a rapid build-up of missing knowledge from non-core areas.

3. Conceptualisation: the ability to apply creative thinking to generate new ideas and translate them into various conceptual and visual forms. Conceptualisation also includes the ability to diagnose and systematise problems, form a holistic vision of the situation, predict the threats that management will face in the foreseeable future, and those unique opportunities that need to be used, create a system for managing unpredictable risks and organise early readiness to solve new problems [Pettinger, 2016].

4. Communications: the ability to work productively in professional communities and establish interactions between stakeholders aimed at achieving a common result. This category also includes the skills of organising the work of experts from different professional fields, primarily the establishment of a single communication-conceptual apparatus [Nine major paradigm shifts.., 2018].

The third and fourth areas of activity in a number of publications devoted to issues of leadership and managerial power [Valk et al., 2011; Bell, Wechsler, 2015], are combined into one large group, which can be conditionally called ideological, or "the ability to read the world and predict its development." Arguing its

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importance, C. Bell and G. Wexler emphasise that the meaning of this skill is to help other employees realise that the well-known classical paradigms of resource management, marketing, logistics or organisational design no longer work in the modern world and that these paradigms must be reconfigured in according to the context – global, industry and market [Bell, Wechsler, 2015].

It is very interesting to look at the composition of managerial competencies by A. Amini [Amini, 2016], who distinguishes 28 types of them, grouped into several blocks: (1) setting priorities, clear goals and making effective managerial decisions; (2) management of people and teams (delegation of authority, motivation, mentoring, work discipline); (3) the art of "behaving in public"; (4) continuous self-development and learning; (5) intelligence - a block that can be defined as the level of "internal power" of the leader, allowing him to simultaneously manage various resources and subsystems of organisations.

One of the main tasks of fundamental training is to build a systematic vision of one's professional activity at the level of knowledge for theoretical understanding of changes in its content and practical solution to the problems of its improvement. [Professionals in competition.., 2021]. In the educational process, it is necessary to provide an understanding of the interdisciplinary relationships between the objects of management and the systems in which they operate. In our opinion, the current areas of fundamental training of managers are: (1) the methodology of proactive management; (2) scientific and technological foundations of production and technologies of the future; (3) a vision of professional activity and the changes that will occur in it as a result of the introduction of new technologies, both technical and organisational, economic and social. These three criteria determine the topics of the relevant academic disciplines and their general structure in the educational program (Fig. 4).

Within these areas, the content of the fundamental training of managers changes significantly at different levels of education: from specific scientific areas (economics, engineering, computer science, etc. [Professionals in competition.., 2021]), studied at the first level of higher education, to the content of complex objects and processes in which fundamental sciences are integrated with applied sciences (development of complex systems, strategic analytics, designing the future), which should be studied in a management master's program. As a result, fundamental training becomes as interdisciplinary as possible, which, on the one hand, allows expanding the range of relationships and the scope of students' vision, and on the other hand, makes it necessary and even forced to develop their flexibility of thinking.

A holistic understanding of production, organisational, economic systems, including markets, their relationships, trends of change and management decision-making tools is

formed in the process of fundamental training of managers in the study of disciplines that contain the main patterns of knowledge area of the profession. Understanding these patterns, which do not change quickly and under the full influence of even abrupt transformations in the conditions of the activities of organisations, allows managers to correctly navigate in unexpectedly difficult situations, form their understanding and a common vision for the further development of the business. The flexibility of managerial thinking at the same time allows you to quickly overcome the stereotypes of behavior that have developed in the previous period of activity, see new problems, rebuild the understanding of the changed environment, set new tasks in a timely manner, change your paradigm and find adequate management solutions that ensure the preservation and development of business. In the modern world, these factors of training managers who are able to overcome problems, solve complex task and see the prospects that shape the future are becoming more significant and highly demanded (Fig. 5).

Of course, for the rapid adaptation of a university graduate to practical activities, special training is also necessary. In contrast to the fundamental one, this is the formation of readiness for effective work to solve known problems. According to our estimates, it should be from 20 to 30% of the volume of educational programs and must be present, since the manager must be able to solve typical organisational problems and use the existing methods and tools for this. He must be ready not only for changes, but also for current activities, in which typical tasks remain relevant for one time or another.

The fundamental part of education is not characterised by the permanent content of education. It changes, but much more slowly and dosed compared to the specialised one. At the same time, monitoring the overdue necessary changes in the content of fundamental training and making appropriate corrections to it becomes an important task for the organisers of management education.

Thus, on the one hand, a holistic understanding of engineering, organisational, economic systems and trends in their changes, formed in fundamental training, and on the other hand, the flexibility of thinking, formed in a properly designed training content and methods for organising its assimilation, provide the ability of managers quickly adapt to turbulent phenomena in the external environment and adequately respond even to sudden changes in business management conditions.

An analysis of the development processes of a business environment of various scales, educational programs of leading domestic and foreign universities, as well as the latest tools that determine the effectiveness of the activities of modern business leaders, allows us to identify popular topics for strengthening fundamental training in management master's programs. These include courses or individual topics that can be represented as the main components of the content of interdisciplinary courses

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that correspond to our conceptual approach [Gitelman et al., 2020a; Professionals in competition.., 2021]. For example, as such, you can specify the following.

1. *Conceptual foundations for the non-linear development of the managerial profession:*
   - internal mechanisms and external factors of professional development;
   - a strategy for anticipating the need for new competencies;
   - management of advancing creation of new value.
2. *Scientific and technical foundations for the development of sectoral and intersectoral production complexes:*
   - promising technologies;
   - security of organisations and cyber systems;
   - big data analytics;
   - innovative business ecosystems.
3. *System engineering methodologies for business development management:*
   - scaling in sociotechnical systems and systems-of-systems;
   - overcoming the increasing complexity of systems and contexts;
   - ensuring adaptability and flexibility of systems and processes for their creation and maintenance.

The conceptual foundations of the non-linear development of the managerial profession form the student's potential for self-development, readiness to master new skills in connection with ongoing changes in the external environment that transform the content of the profession. A deep understanding of the specifics of one's profession and the multifactorial mechanisms of its change forms the methodological culture of a practical specialist, creating the possibility of successfully mastering the interdisciplinary and special disciplines of the training program, as well as the willingness to independently deal with new problems and master new types of knowledge. In addition, its practical significance lies in the fact that it lays the scientific basis for most professional competencies, the formation of which is completed in the disciplines of specialisation and continues to develop in experience. A conceptual understanding of one's activities also allows one to competently build the trajectory of one's career movement, in the implementation of which ambitions correspond to the abilities and potential of professional development. The conceptual vision of professional activity is an important factor for the full realisation of the potential of a specialist.

Understanding the scientific and technical foundations for the development of sectoral and intersectoral production complexes is aimed at obtaining knowledge about the features and patterns of functioning of specific production operations, markets, and industries. Without this knowledge, it is impossible to form a holistic vision of the objects and tasks of one's activity, and especially an understanding of their development trends, and,

accordingly, the formation of readiness for at least the near future.

The increasing complexity of the systems that the manager deals with requires special attention to fundamental knowledge in system engineering methodologies. The inclusion of this discipline in the curricula of bachelor's and master's programs in management implemented at the world's leading universities (MIT, Stanford University, Harvard University, Technical University of Aachen, Insead Business School and many others) is due to the growing complexity of systems, the intensity of their interaction with the environment and, consequently, the need to increase systemic literacy. It is system engineering, on the one hand, that makes it possible to carry out a theoretical understanding of the patterns of system development forming a system approach that is so significant today for a modern manager, and on the other hand, it offers specific practical tools for solving complex problems embodied in standards, sets of management principles, methodologies for creating elastic (resilient) and flexible (agile) systems.

The current field of system engineering includes solving the problems of creating sociotechnical systems and megasystems, ensuring the scaling and development of systems of any level, including systems-of-systems and the methodology of soft systems [Gavrilova et al., 2017; Systems engineering vision., 2021]. Thus, research and development in the direction of designing human activity systems (Human Activity Systems, HAS) makes it possible to highlight the general patterns of HAS and the specifics determined by the level of system complexity being designed [Calvo-Amodio, Rousseau, 2019]. The use of these patterns and proven methodologies significantly increases the competence of managers in the field of conceptualisation and communication.

The dynamism of the external environment, the increasing speed of change require the created systems to be elastic (resilience) – the ability to cope with adverse conditions and events through preliminary preparation and planning, countering destruction, recovering from failure and successfully adapting to changes and destructive influences. Systems that are required to provide a given functionality for a long time must be able to anticipate, synchronise, proactively learn and respond [Hollnagel et al., 2006]. Studying the practice of creating and using such systems made it possible to identify characteristic features in system engineering and formulate the principles and methodologies of flexible design [Hollnagel et al., 2006; Jackson, 2010; Jackson, Ferris, 2013]. Mastering this area significantly increases the innovative potential of managers, allowing them to confidently act in the face of unforeseen changes in the situation, create, manage and directly participate in interdisciplinary teams. Thus, in order to understand the prospects and succeed in a dynamic environment, managers need to master the accumulated experience and follow the results of new developments in

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the field of agile system engineering [Dove, 2005]. The principles and methods applied in it require a creative approach, the ability to assess uncertainties, choose ways to respond to changes based on the goals and abilities of the organisation. Agile methodologies require from all participants an innovative approach to solving problems, the ability to take calculated risks, and respond in a timely manner to emerging threats and opportunities, in connection with which the flexibility of thinking becomes a necessary condition for the activities of managers.

3. On the agenda – increasing the flexibility of managerial thinking

Flexibility of thinking is one of the foundations of modern managerial professionalism. A manager who does not have flexible thinking is not capable of innovative activity and cannot be effective in dynamically changing conditions, and even more so in situations characterised by uncertainty.

The flexibility of managerial thinking is the ability to quickly switch to new tasks and correctly select effective methods and tools for solving them. To do this, it is necessary to have the ability to overcome the prevailing stereotypes and patterns, assimilate new ideas, hypotheses, identify and establish hidden connections and change the strategy of action depending on the specific situation [Professionals in competition.., 2021]. In general, the flexibility of thinking is closely related to the ability to adapt to the new and creative abilities.

Another approach to analyse the flexibility of managerial thinking is to determine the variety of mental models that are necessary to successfully solve complex problems. In this context, the flexibility of managerial thinking lies in the manager's ability to use different types of thinking: critical, systemic, conceptual, analytical, design, strategic, cost and emotional intelligence. Flexibility is primarily determined by the extent to which the manager owns all these types of thinking and is able to consistently or in a certain combination use their intellectual abilities in relation to different or the same objects, tasks, situations. The greater the number of types of thinking and the higher the level of their possession in the manager's arsenal, the higher the level of flexibility of his professional intelligence.

Thus, managerial activity is a multidimensional intellectual activity in which a wide range of different types of thinking is implemented in consistent and integrated forms.

In the process of improving the management magistracy and orienting it to specific industries, the task of selecting students with a certain basic training becomes relevant. If this task is solved according to the criteria of successful formation of managerial thinking flexibility, then, in our opinion, a choice should be made in relation to students with basic engineering, economics and natural science education.

For example, engineering activity in general, in all its many specialisations and varieties, as well as managerial activity, is characterised by a wide variety of mental models. Some authors believe that engineering activity includes technical, constructive, research and economic types of thinking [Mustafina et al., 2010]. Others include logical, figurative-intuitive, practical, scientific, aesthetic, economic, ecological, ergonomic, communicative, creative thinking [Stolyarenko, Stolyarenko, 2001; Nagornyak, 2012]. Also, engineering thinking is considered in a generalised form as "a complex systemic formation, including the synthesis of figurative and logical thinking and the synthesis of scientific and practical thinking" [Sazonova, Chechetkina, 2007]. Most authors single out logical, creative, visual-figurative, practical, theoretical, technical, spatial thinking in engineering thought. Consequently, a highly qualified engineer, and to some extent a well-trained graduate of an engineering bachelor's and specialist's degree, has many types of thinking, thanks to which he develops a "multi-screen" vision of professional tasks and gains the ability to identify and overcome technical contradictions and physical contradictions hidden in them.

When comparing managerial and engineering thinking, a conclusion arises about their similarity in terms of diversity ("multi-screen"), consistency, as well as their creative basis. However, the difference lies not only in separate individual varieties of thinking (technical for engineers or emotional for managers), but also in the features of the content of mental models that are common to them by name. The main differences in their thinking lie in the context of its application. Management and engineering activities are undoubtedly interdisciplinary, but the content and range of interdisciplinarity are significantly different. In engineering tasks (perhaps excluding the largest intersectoral scale) interdisciplinarity is characterised by closer areas of knowledge than in organisational and managerial ones. Therefore, the use of different types of thinking and their composite combinations in solving the professional tasks of a manager and an engineer always differs significantly. If we take into account the content of these tasks, then we can talk about the existence of even fundamental differences in their professional thinking.

Due to the variety of mental models required in engineering, it, of course, has a certain, and for some specialists, high flexibility. Nevertheless, as the analysis shows, when mastering the managerial profession, specialists of any profile need to form a new type of professional thinking and develop its managerial flexibility. The flexibility of thinking in one profession does not automatically transfer to the content of another, if it is not purposefully developed during its development, primarily because the interdisciplinary content of activity and the composition of mental models change.

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In management education, when recruiting students with any engineering specialisation, the task of forming strategic, conceptual, cost and development of critical, systemic and project thinking, as well as emotional intelligence arises. When solving this problem, especially in terms of the formation of managerial thinking, the methods and technologies of teaching, methods of working with educational content are of high priority. The content of disciplines, of course, also significantly affects the development of professional thinking, but still to a lesser extent than the methods and technologies of working with it.

The authors in the process of preparing managers pay considerable attention to the formation of managerial thinking in them. Therefore, in addition to common teaching methods and technologies (case studies, problem-based learning, role-playing games, team and individual project work, webinars), specially developed methods, technologies, organisational and methodological tools are also used, which, in particular, include: conceptual design, intellectual and business games "GO to the heights of mastery", advanced training based on research work, innovative tours and excursions, communication platforms, a joint innovation arena of the university and business, self-design of professional development, project-based learning together with business, etc. [Professionals in competition .., 2021]. The complex application of these methods in the educational process of master students provides a significant effect in the formation of managerial thinking and the development of its flexibility (Table 2).

These methods influence not only the formation and development of the flexibility of professional thinking among students of the master program in management, but also their motivation for learning and the readiness of future managers to work with a wide variety of new tasks and situations that the near future creates for them.

Conclusion

In the context of constant changes in the content and context of managerial tasks objectively causing a systemic complication of managers' activities, the role of their fundamental training and flexibility of thinking is increasing. Despite the high stability of fundamental knowledge, their content for the dynamically developing managerial profession, although slowly, is still changing. Determining the composition of fundamental education

that ensures successful adaptation of managers to problems with new content and uncertainty in high-tech industries is a special research task that is becoming one of the most relevant in management education. The results of the authors' research made it possible to identify a number of topics that should strengthen fundamental training in management education programs. They are presented in three interdisciplinary blocks: the conceptual foundations of the non-linear development of the managerial profession; scientific and technical foundations for the development of sectoral and intersectoral production complexes; system engineering methodology in business development.

An analysis of the data available in the literature and our own research show a close relationship between fundamental education and managerial thinking. Possession of fundamental knowledge develops systemic and conceptual thinking, contributes to the growth of the flexibility of managerial thinking, the role of which increases dramatically in the professional activities of a manager. In this regard, the flexibility of managerial thinking should become one of the independent goals of training managers. The difficulty of realising this goal, which is difficult to formulate in terms of competence, lies in the fact that it cannot be achieved by creating a separate training course, because this key soft skill is formed in the process of integrating all types of cognitive, educational and practical activities with contents of various disciplines. Therefore, the main factor in the development of the flexibility of managerial thinking is the variety of methodological tools in the educational work of students and its compliance with the best management practices. The presented methods and tools for the implementation of the educational process have the universality of application both in individual training courses (fundamental and applied), and in the integrated interdisciplinary content developed by the authors, providing the acquisition of experience with new knowledge in solving practical business problems.

Renewal of fundamental training adequate to objective changes in the content of the activities among managers of high-tech organisations and the targeted development of the flexibility of managerial thinking in the context of the entire educational process are key areas for the development and implementation of the advanced training concept for leaders of a new generation.

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Table 2
Teaching methods that develop the flexibility of managerial thinking

Name of the method	Key characteristics	Student learning activities	Application result	Author's experience
Problem-based learning combined with innovative activities	Problematisation of educational content and creation of a problem situation for educational work	Analysis and identification of contradictions in a real situation. Search and concretisation of their causes. Development of ways to resolve contradictions, the formation of of new knowledge system	Development of critical, analytical and system thinking	"Preparation of breakthrough teams" technology has been introduced. More than 100 specialists from Ural Federal University, PJSC "T Plus", "Bashkirenergo" were trained under technology
Conceptual design	Project task based on the current situation in an organisation or industry that requires a holistic radical solution	Active use of theoretical concepts and categories to search for guidelines and new opportunities in solving complex uncertain situations. Formulating and substantiating new ideas, creating a vision of the final solution that ensures the development of the organisation	Active use of theoretical concepts and categories to search for guidelines and new opportunities in solving complex uncertain situations. Formulating and substantiating new ideas, creating a vision of the final solution that ensures the development of the organisation	A conceptual design workshop has been created. The courses "Proactive Management", "Designing Digital Platforms and Ecosystems", "Visual Analytics and Design Thinking" are being implemented
Organisational and activity games	Organisation of team and consulting work on solving complex problems by teams in a short time	Analysis of tasks and problem situations with the formulation of questions for intermediate solutions and a common vision. Consideration of technical, legal, economic, personnel, environmental, and other aspects in interconnection and their integration into a complete picture to generate system solutions. Development of a conceptual design for solving a complex problem	The development of collective thinking skills, in which all types of managerial thinking are formed, its flexibility is actively developed. Expanding the range of opportunities for applying intellectual skills and acquired knowledge	More than 70 games were held, including games at Russian nuclear power plants. The total number of participants in the games over the past 10 years has exceeded 1000 people. (students and young business professionals).
Innovative tours and excursions (real and virtual)	Overview lectures, discussion panels, round tables, introduction to practical experience in companies and at real production facilities	Understanding new experience, comparing it with previously known, identifying its advantages and disadvantages, searching for opportunities to use it in other conditions and situations	The development of critical, analytical and systemic thinking when getting acquainted with new practical experience, as well as other types of managerial thinking, according to the object of innovative practice	Excursions are regularly held to the advanced facilities of Rosatom, Rosseti, T Plus, IDO Ural. The practice of virtual excursions (Ridero) has been initiated. Foreign internships are organised at leading universities

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Table 2 (*continuation*)

Name of the method	Key characteristics	Student learning activities	Application result	Author's experience
Communication platforms	Exchange of opinions, assessments and judgments on topical issues and tasks of management practice	Involvement in new issues and tasks through the analysis and modeling of their content, the formation of relationships between new experience and existing knowledge	Development of systemic and communicative thinking, as well as emotional intelligence	More than 10 network communication platforms have been created with business partners, domestic and foreign universities. Interdisciplinary scientific and methodological seminars are held on topical issues of management
Project-based learning in the format of smart partnership with business	Actualisation of interdisciplinary issues. Discussion of project development stages and criteria for their evaluation	Generating ideas for choosing the subject of design work. Coordination of organisational and managerial projects by partner companies. Development, system analysis and correction of design solutions. Assessment of resources for their implementation. Public presentation and protection of projects in a partner format	Development of critical, systemic, cost and project thinking. Mastering teamwork skills	Participation of students in corporate projects. Presentation of projects on different training modules for discussion at corporate seminars of business partners

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The influence of intercompany relations on the innovation performance: An empirical study of Russian industrial companies   Trachuk A.V., Linder N.V.

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The influence of intercompany relations on the innovation performance: An empirical study of Russian industrial companies

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Abstract

The interaction of companies in the innovation process is the basis for successful innovative development, as it allows industrial companies to reduce the time to market new products, cut production costs, increase operating profit. At the same time, an optimal choice of key partners is necessary to succeed in achieving the overall goals of innovative development. Currently, there are no studies that would answer the questions: is the interaction of companies implementing different models of innovative behavior effective? Will innovative companies earn a positive return from interaction with imitation companies? What models of interaction can be optimal between innovative companies and imitation companies?
The purpose of this study is to determine how the structure of the partnership, membership and characteristics influence the innovative performance of industrial companies. The study was conducted on a sample of 270 large Russian industrial companies. An econometric model based on the Cobb - Douglas production function was used for the analysis.
Keywords: innovation, innovation partnership, innovation networks, industry, innovation performance.

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Introduction

Many modern studies confirm the importance of building relationships with partners in the process of innovation, in particular, it is shown that partnerships allow companies to ensure an effective transfer of knowledge and technologies, share scarce resources and obtain a synergetic effect by supplementing their own resources, knowledge and skills with the resources of partner companies. [Linder, 2021]. The interaction of companies in the innovation process allows them to reduce the time to market for new products by 15-25% [Jiang et al., 2016], reduce production costs by up to 15% [Berger et al., 2015], increase profits from the sale of new products by 60% [Zakrzewska-Bielawska, 2018]. Such effects are achieved through

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easier transfer of knowledge and technology through partnerships [Palmatier et al., 2006], resource sharing [Holmlund, 2008], greater opportunities to interact with customers and create more value for them [Park, Trần, 2020]. [Hilbolling et al., 2020] shows how the type of partnership and the engagement of partners in the innovation process affects the achievement of innovation development goals.

However, there are no studies on how partnership structure and characteristics can affect innovation performance. The novelty of this study lies in the analysis of the impact of the partnership structure, the composition of its participants and characteristics on the effectiveness of innovative activities of industrial companies.

1. Literature review

To date, the research literature has accumulated a wealth of evidence for the key role of partnerships in enhancing the effectiveness of innovation. Existing research examines the role of partnerships in the innovation process in several ways. One of them is the selection of the most effective stages of the innovation process for the involvement of partners [Dhanarag, Parkhe, 2006]. In [O'Sullivan, Dooley, 2009] it is shown that the first stage of the innovation process, the generation of ideas, is the most important for the involvement of partners. According to the authors of these studies, it is the interaction at the first stage that leads to the emergence of completely new ideas - disruptive innovations. Other researchers, on the contrary, believe that the involvement of partners only at the first stage is possible only for incremental innovations, and the success depends on the introduction of innovations and, accordingly, the commercialisation of innovations, so it is necessary to attract partners at this stage. [Gök, Peker, 2017]. [Taherparvar et al., 2014; Yavarzadeh et al., 2015] states that the effectiveness of innovation depends not only on the development and commercialisation of innovations, but also on the introduction of new production methods, technologies, productivity improvements and can only be achieved by involving partners at all stages of the innovation process.

Another line of research looks at what types of partnerships are most effective in innovating. Some authors consider strategic alliances to be the most effective [Elis, 2011], others consider innovation networks [Soltani et al., 2013], while evidence has been obtained of the effectiveness of both business networks in the innovation process [Slotte-Kock, Coviello, 2010] and social networks. It is shown that sooner or later social contacts turn into business ones, for example, in [Havila, Wilkinson, 2002; Story et al., 2008; Elis, 2011]. At the same time, researchers note that business partnerships that have grown out of friendly relationships are stronger and characterised by greater commitment and trust between partners. This, in turn, affects the effectiveness of innovation activity [Von Krogh et al., 2003]. Some studies analyse links between the duration of relations in the innovation process and the novelty of the innovations being created (whether they will be incremental, radical or disruptive) [David, Shapiro, 2008].

Another area of research considers the involvement of partners in relationships and the effectiveness of innovative activities. At the same time, the level of involvement is measured by the intensity of interaction [Ozman, 2009]. The more intense the interaction of partners is, the more trusting relationships become and the more effective they achieve common goals [Gunday et al., 2011]. There are also studies that determine the optimal ratio of the number of stakeholders involved in innovation activity and its effectiveness. Stakeholders are divided into external and internal. For example, in a study [Rebyazina, Smirnova, 2011], conducted on the data of 160 Russian companies, it was revealed that the main criterion for choosing partners is their financial condition, and companies use a selective approach to building relationships and planning interaction.

At the same time, companies can implement various innovative strategies and models of innovative behavior [Linder, 2020]. There are no studies in the literature that answer the following questions: is the interaction of companies implementing different models of innovative behavior effectively? Will innovating companies benefit from interaction with imitating companies? What models of interaction between innovators and imitators can be optimal?

The object of this study is the structure of partnerships and its impact on the effectiveness of innovation.

2. Study sample

Empirical data for this work were collected in 2022 during the study "Scenario modeling of the socio-economic effect of stimulating the acceleration of industrial technological development and increasing labor productivity, and specifically based on digitalisation". The sample included 270 Russian industrial enterprises. To conduct the study, a stratified sample was used, formed on the basis of a certain type of innovative behavior implementation: innovator companies and imitator companies.

The cluster of innovative companies included industrial companies implementing an innovative strategy aimed at creating and developing new products, improving operating activities and, accordingly, introducing process and technological innovations.

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Innovation spending mainly consists of investment in research and development, new technologies, equipment and infrastructure improvements.

The cluster of imitation companies includes companies that do not independently create and distribute new knowledge and products on the market. The basis of the strategy of such companies - borrowings. At the same time, the companies included in the sample implemented three types of imitation strategies: copying entire products - a small proportion of the surveyed companies (18%); copying certain technical parameters, design and brand elements, borrowing innovative solutions (technologies, patents, knowledge, business processes, management principles and business models) - 44% of the surveyed companies. The rest of the companies used the strategy of creative imitation, which consists in making changes to the original innovation or finding a new application, as a result of which a new product, process or technology is created - 38% of the surveyed companies.

The data were collected through both personal interviews and questionnaires. The ratio of innovators and imitators was 42% and 58%, respectively. All selected companies were large industrial enterprises with more than 500 employees. The age of the companies ranges from 7 to 204 years, with an average of 32 years.

3. Modeling Data Analysis

To conduct a quantitative study, we used the methodology proposed by [Linder, 2021]. To model the efficiency of an industrial enterprise, non-linear Cobb-Douglas production functions are used, which are more flexible than linear functions. The Cobb-Douglas model allows the construction of hierarchical equations to exchange R&D results for production, in which the production functions for each partnership enterprise are Cobb-Douglas production functions. Based on this model, various schemes for building a partnership management model and options for sharing R&D results have been developed, depending on whether the partnership enterprises are built into the production model or practically independent organisations. Based on the scheme of total factor productivity reflecting the results of long-term technological changes in partners, we can consider an optimisation model that maximises the efficiency of all enterprises of the partnership at the same time. As a result, it becomes possible to study the dynamics of the system.

To this end, an econometric model has been constructed that reflects the influence of factors on the efficiency and innovative activity of industrial enterprises. R&D expenditures are taken as an indicator of innovation activity, and it is shown that the direction of transfer of research and development (R&D) is most effective in the direction from partner-innovators to partner-simulators. This can be explained by the fact that innovators can offer new products based on the results of R&D, while imitators are mainly focused on adapting products created by innovators to the requirements of the local market.

In general, the Cobb-Douglas function is expressed by the dependence:

$$Y = \gamma_T \, L^\alpha \, K^\beta, \tag{1}$$

where γ_T is a coefficient that takes into account the technological development of the industry in time T, L^α is labor costs, α is the elasticity coefficient for labor costs, K^β is capital costs, β is the coefficient of elasticity for capital costs.

Since the purpose of this article is to analyse the economic impact of the transfer of innovations from innovator companies to imitator companies, the Cobb-Douglas function will be the production function of the i-th company not investing into R&D in the time period T. In addition, we will introduce two more variables, C_A and C_P, which reflect investments in R&D by innovators. By A we will mean companies that do not invest in R&D, P – companies that invest in R&D, ε reflects the so-called Solow residual, which is responsible for those changes in production volumes that are not caused by labor, capital and innovation cost factors, α, β, φ are the elasticity coefficients of the corresponding input factors.

Thus, the Cobb-Douglas function will take the form expressed by the formula:

$$Y_i = \gamma_T \, L^\alpha \, K^\beta \, C_A^\varphi \, C_P^\varphi \, \varepsilon. \tag{2}$$

Let us test the following hypotheses:

Hypothesis 1. An increase in investment in R&D at enterprises ploughing into R&D has a positive effect on the productivity not only of themselves, but also of enterprises that do not invest in R&D. Therefore, in order to increase the effectiveness of the entire partnership, it is necessary to stimulate the innovative activity of enterprises and create effective mechanisms knowledge and technology transfer to partner enterprises not engaged in R&D.

Hypothesis 2. Knowledge and technologies developed by imitator enterprises and transferred to partnership innovators have a significant impact on the performance of innovative activities of both innovators and the entire partnership.

Hypothesis 3. The greatest effect, expressed in the growth rate of profit from sales of innovative products, will be observed in vertically integrated partnerships (as a result, having the greatest integration into the production system of the partnership).

To prove the first hypothesis, based on equation (2), we linearise the Cobb-Douglas production function and obtain the productivity gain of the i-th imitator company and the innovator company in partnership, represented by the equation:

$$\Delta \gamma_{iT} = \alpha \Delta L_{iT} + \beta \Delta K_{iT} + \gamma_A \Delta (C_A)_{iT} + \gamma A(C_P)_{iT} + \Delta \epsilon. \tag{3}$$

At the same time, the influence of the R&D investment factor can be expressed by the equation:

$$\Delta (CS_i)_{iT} - (C_S)_{iT-1} = \log \frac{C_{S_{iT}}}{(C_S)_{iT-1}}. \tag{4}$$

This formula is applicable both for innovator companies P and imitators A, i.e. S = A, P.

Due to the fact that the estimation of the production function is significantly complicated by many factors that affect it. By introducing a stable time invariant, we can mitigate this problem. The equation will take the form:

$$\gamma_S \Delta C_S = \left(\frac{\partial Q}{\partial C_S} \frac{C_S}{Q} \right) \Delta C_S \approx \left(\frac{\partial Q}{\partial C_S} \frac{\Delta C_S}{C_S} \right), S = A, P, \tag{5}$$

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Where $\dfrac{C_S}{\gamma}$ – annual investment in R&D, Q is the marginal rate of return of partnership enterprises from sales of innovative products. Transforming equation (3), we obtain:

$$\Delta\gamma_{cT} = \alpha\Delta K_{cT} + \beta\Delta l_{cT} + Q_A\left(\frac{C_A}{Q}\right)\iota_{T-1} + Q_P\left(\frac{C_P}{Q}\right)_{cT-1} + \eta_{cT}, \quad (6)$$

Where Q_A and Q_P are profit rates from sales of the innovative product of partnership enterprises, respectively, η_{iT} – a new value of random error.

Using the concept of total factor productivity, including the accumulated knowledge and technologies used, DTFP $= \Delta\gamma - \alpha\Delta c - \beta\Delta l$, introducing the assumption that $(\alpha + \beta = 1)$, we transform equation (4) and obtain:

$$DTFP_{cT} = Q_A\left(\frac{C_A}{Q}\right)_{cT-1} + Q_P\left(\frac{C_P}{Q}\right)_{cT-1} + \eta_{cT}. \quad (7)$$

To assess the quality of the model and the reliability of the obtained coefficients for the main indicators of the model, we used the least squares method with a confidence level of 95%.

4. Measurement and variables

270 industrial enterprises under survey comprised 78 partnerships. The calculations were performed using the Matlab application program, the model variables are described in Table 1.

5. Research results

The results of the study are presented in Table 2 and 3.

The empirical model is valid as $R^2 = 95.1\%$. The factors of investment in R&D by innovating enterprises turned out to be more significant than labor factors. The cost factors of physical capital were not included in the empirical model and turned out to be insignificant. The main significant factor of investments in R&D was the factor of investments of innovating enterprises (2.971), that is, there is a direct relationship between the isolated investments of innovating enterprises in R&D and the growth in the total productivity of production factors at imitating enterprises in partnerships.

Table 1
Variables of the econometric model

Variable	Description
$\Delta\gamma_{iT}$	Average annual growth rate of sales proceeds (according to Form No. 2)
ΔL_{iT}	Average annual growth rate of labor costs (according to reports). Labor costs are defined as the size of the payroll fund, the average headcount and investments in staff training during the year under review
$\Delta\kappa_{iT}$	Average annual growth rate of physical capital, calculated as an increase in the book value of equipment and non-current assets
$\Delta c_{P_{iT}}$	Growth of investments in R&D of innovative companies
$\Delta c_{A_{iT}}$	Growth of investment in R&D of imitator companies
DTFP	Average annual growth rate over 5 years (2017-2021) at full factor productivity for imitator companies, calculated as DTFP $= \Delta\gamma - \alpha\Delta c - \beta\Delta l$, where $\Delta\gamma$, Δc and Δl are the average annual capital (book value of equipment and non-current assets) and labor costs (wage fund, average headcount and training costs). β – estimated labor coefficient (the share of wages in sales proceeds), the coefficient for physical capital is calculated as $\alpha = 1 - \beta$
$\dfrac{C_A}{Q}$	Rate of return on investments in R&D of imitator companies relative to investments of an innovator company, calculated as the ratio of investments of imitator companies to investments of innovator companies
$\dfrac{C_P}{Q}$	Rate of return on investments in R&D of innovating companies, calculated as an increase in investments relative to the previous period
$\dfrac{C_A}{Q} \times \dfrac{C_P}{Q}$	The interaction between the R&D department of the innovator company and the R&D of imitator companies, calculated as the cost of transferring technologies and innovative products from innovator companies to imitator companies.

Source: compiled by the authors.

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Table 2
Results of multiple regression estimates of total factor productivity for partner companies

Parameters	Assessment		Standard deviations		t-statistics	Significance level (F-criterion)
	Innovating companies	Imitating companies	Innovating companies	Imitating companies		
Constant	0.0106	-0.119	0.024	0.022	0.032	1.88
$\Delta \gamma_{tT}$	0.034	0.23	0.088	0.123	0.024	1.92
ΔL_{tT}	0.653	0.16	0.079	0.39	0.065	1.56
$\Delta \kappa_{tT}$	0.031	0.09	0.049	0.074	0.0029	0.97
$\Delta c_{P_{tT}}$	4.057	—	0.561	—	0.013	1.99
$\Delta c_{A_{tT}}$	—	0.904	—	0.159	0.088	1.73
DTFP	1.88E-2	2.16E-3	4.52E-4	4.83E-4	0.101	1.78
$\dfrac{C_A}{Q}$	0.28	0.15	0.088	0.53	0.049	1.93
$\dfrac{C_P}{Q}$	0.035	0.048	0.37	0.072	0.037	2.05
$\dfrac{C_A}{Q} \times \dfrac{C_P}{Q}$	7.5E-4	6.55E-43	5.43E-4	2.33E-4	0.051	1.66

Note. $R^2 = 0.951$ (95.1% confidence - significant).
Source: compiled by the authors.

Table 3
Transfer effect of innovative products and technologies

Partnership companies	Change of DTFP	Share of DTFP change through the transfer of innovative products	Share of DTFP change due to technology transfer
Partnership	4.08	0.50	0.21
Innovating companies	4.31	0.23	0.15
Imitating companies	2.53	0.68	1.36

Source: compiled by the authors.

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All labor indicators (0.653) turned out to be significant for innovation activity, including the number of employees. The indicator of investments in personnel training has the greatest significance.

However, according to the results in Table 3, isolated investments of imitator enterprises in R&D have an insignificant impact on the growth of profits of innovatory enterprises (0.875). Thus, 81% of the profit from innovation activities was provided by investments in R&D by innovating enterprises and 19% by imitating enterprises.

In Table. 3 to analyse the features we divided the indicators of the transfer of innovative products and technologies by enterprises-innovators and enterprises-imitators. At the same time, the share in percentage points of the change in DTFP due to the transfer of innovative products and technologies was calculated using the formula:

$$Q_\rho \left(\frac{R\rho_i}{Q} \right)_{T-1} \times 100. \tag{8}$$

According to the obtained results, innovative enterprises are more willing to transfer innovative products (0.29 percentage points of DTFP growth) to imitator enterprises than technologies (0.13 percentage points of DTFP growth). If we consider the relations between indicators, then the correlation analysis of variables showed that there is a relationship between the level of wages at imitator enterprises and technology transfer: technology transfer occurs to a greater extent at imitator enterprises with higher labor costs. This, in turn, may indicate that the introduction of new technologies and processes at imitating enterprises requires a higher level of competence and this is a more difficult task than "enriching" imitating enterprises with a new product.

However, according to our calculations, the transfer of new technologies for imitator enterprises has a larger effect (1.42 p.p.) in terms of DTFP growth than the transfer of new products (0.72 p.p.).

If we analyse imitator enterprises that have the highest profit from the transfer of innovative products and technologies, then vertically integrated enterprises have the highest growth rate; this confirms the first hypothesis that technology transfer will be of particular importance if the imitator is highly integrated into the partnership production system. In this case a mechanism is needed to facilitate effective parent-subsidiary interfirm relations.

Conclusion

Thus, the studies confirmed our hypothesis that an increase in investments in R&D at partnership innovators has a positive effect on the productivity not only of themselves, but also of partnership imitators.

However, the second hypothesis - about the impact of innovations and technologies developed at imitating enterprises on the effectiveness of innovative activities of both innovating enterprises and the entire partnership - at a 5% significance level was not confirmed and can only be accepted at a 10% significance level.

The third hypothesis that the greatest effect, expressed in the growth rate of profit from sales of innovative products, will be observed in imitating enterprises that have the greatest integration into the partnership production system, has been fully confirmed.

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Heuristic model of "effective interpreter" in portfolio investment in high-tech companies   Ilkevich S.V.

Heuristic model of "effective interpreter" in portfolio investment in high-tech companies

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Abstract

The last fifteen years are characterized by a sharp increase in the share of high-tech companies in terms of attracting investment resources in the world's leading stock markets. High-tech companies over this period significantly outpaced value stocks in terms of return on investment. On the one hand, what is happening is a natural process, since in the face of accelerating industry changes, both in traditional sectors and in sub-sectors of the new economy, there are more opportunities for the emergence of companies with disruptive innovations. High market capitalizations of such companies are a natural metric of fundamental shifts in the economy. On the other hand, the very nature of investment decision-making is changing, since an objective assessment of the intrinsic value of the business of high-tech companies is becoming vaguer, more controversial, dependent on future scenarios, and subject to interpretations. And these interpretations, according to the theory of reflexivity, are increasingly having a feedback effect on fundamentals, especially in high-tech companies.

The purpose of this article is to conceptualize a new heuristic model of the "effective interpreter", which, in the conditions of high reflexivity and narrative contexts of the stock market, has significantly diverged across a number of key attributes from the traditional model of the "rational investor". The author compares the two models. The process of divergence of the two models occurs under the influence of a number of behavioral heuristics and cognitive biases. At the same time, the author emphasizes that a high narrative component in the value of companies does not always and necessarily mean the predominance of irrationality. Here it is more correct to assume some correlation between the rise of narrative decision contexts and the cognitive challenges of investment decision makers.

As one of the possible directions for further research, the author notes the systematization of the main factors of cognitive biases, which seem to make switching to the "effective interpreter" model in portfolio investments in high-tech companies irreversible in the current conditions.

Keywords: cognitive biases, behavioral heuristics, narrative economics, reflexivity, market capitalization, portfolio investment, innovation, irrational optimism, irrational exuberance, growth companies, value companies, behavioral finance, high-tech companies.

Introduction

In the last decade and a half, despite the previous collapse of the dot-com bubble in 2000-2003, there has been a steady trend towards high market expectations of stock market participants towards high-tech companies, the so-called growth companies. This is a generally understandable phenomenon in terms of the fundamental principles of company valuation in the context of both the emergence and development of new sectors of the economy (for example, marketplaces, biotechnology, the commercial space launch industry), and the general innovative restructuring and digital transformation of many traditional sectors of the economy.

The emergence of companies with disruptive business models allows us to hope for a snowball effect in terms of their future market capitalisation. In addition, if we take the statistics of the American stock market, the last 14 years, starting from 2008, turned out to be the first significant period in terms of duration when the average investment in growth companies significantly outpaced the so-called value investment, which refers to investment in undervalued companies predominantly in traditional industries [Lev, Srivastava, 2019]. Such positive statistics further fueled interest in high-tech companies, among which there are many more the so-called disruptors, by definition, than among companies in traditional industries.

Moreover, in a study by A. Sorescu and colleagues, it was found out that over the past 200 years, radical innovations were accompanied by large bubbles in the capitalisation of those companies that were leaders in these innovations; this happened in 73% of cases. It was also found out that the size of bubbles increased with the radicalness of innovation, the magnitude of indirect network effects, and also responded positively to the public visibility of companies during periods of commercialisation of radical innovations. Companies also actively raised new equity capital during bubble periods, but due to increased productivity in the economy, long-term investors, on average, did not suffer losses from investments, despite the formation of their portfolios at local extremes [Sorescu et al., 2018].

As P. Lynch emphasised in the golden era of investing (1980-1990s) in the context of companies from predominantly traditional industries, the amazing nature of the stock market is that an investor does not need to be right at all even for outstanding results (at least in some sense) in more than 50% of cases. Even if a long-term investor turns out to be right only in two or three cases out of ten, but the selected companies turn out to be so-called multibaggers (at least so-called tenbaggers, that is, they increase their capitalisation 10 times from the moment of purchase within a decade), this will be enough for a market participant in order to outperform the average market rates of return, taking into account dividends for long periods of investment. In this sense, according to Lynch, it is actually not so difficult for a thoughtful retail investor to be better than professional fund managers on Wall Street [Lynch, Rothchild, 2012].

The last three decades have been a new spiral in the evolution of the search for multibaggers, as the natural progression of business development in high-tech companies is even more conducive to the perception of them as tenbaggers and even hundredbaggers. It is one thing for companies such as Walmart and Coca-Cola to build business value over decades gradually, although even in such cases, from time to time, the reflection of the increase in business value in market quotations can occur somewhat abruptly. It is a completely different matter when high-tech companies, especially on the effect of low initial capitalisation, can have a really explosive increase in value within just a few years by dozens of times. This fundamental prerequisite largely determines that many investors are in constant search of the next big thing (the next big story). It also means that because of their fascination with narratives about future success, they suffer with some inevitability from the "survivor bias", since projecting already established, highly successful so-called big techs onto startups is too tempting.

The last two years (spring 2020 - 2022) have been a period of unprecedented outstripping growth in the value of companies in new sectors of the economy. This recent growth was largely induced by the acute phase of the

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coronavirus epidemic, as a result of which demand for information technology has skyrocketed and forecasted revenue, margins, and cash flows of companies have increased. However, it is important to emphasise that the capitalisation of many companies has grown many times more and more significantly than the increase in the above indicators. According to many experts, international stock markets (especially US markets) have moved increasingly into a stage of irrational optimism, exuberance [Shiller, 2000] and investor overconfidence.

These phenomena, of course, did not arise for the first time. Stock markets are, by their very nature, a phenomenon of mass psychology with alternating phases of greed and fear, and most of the time in the market investors spend in one of these extreme moods. In order to feel this, it is enough to look, for example, at P / E charts or even Schiller's ten-year smoothed P / E, PACE - for decades they resemble a cardiogram. Apparently, the economic and psychological nature of the market pulse is the case. However, the overbetting of many investors on high-tech companies now seems more than ever to be inextricably linked to the issue of cognitive biases. The "cognitive landscape" itself in interpreting business models of companies and portfolio investment in them has become much more complex and multidimensional, therefore, in order to interpret reality and make predictions about the future, investors must use cognitive shortcuts. Cognitive shortcuts are automatic thought patterns that are used to somewhat improve decision making under high stress, time constraints, and complex decision contexts. However, cognitive labels have a significant drawback: by simplifying and speeding up decision-making, they make it less informed and more irrational, their use carries the risk for the investor to suffer from unproductive "mind games" and lose essential threads of contact with the reality [Munger, 1995].

The conflict between rationality and behavioral biases (cognitive biases) in investors essentially means that no investor is completely rational or completely irrational (subjective-behavioral) at all times. The investor is faced with a certain continuum between completely irrational and completely rational behavioral positions. Moving towards rationality is a choice, but being completely rational is costly, it requires serious cognitive abilities, mental calculations, as well as self-reflection about one's cognitive distortions, prejudices [Mukherjee, De, 2019]. Satisfied decision-making when investing in the context of the need to interpret the business potential of high-tech companies is becoming less and less homogeneous. There are more and more interpretations of business models in various sectors, and it is less and less clear at what point in the accumulation of information and analysis of interpretations one can speak that the investor makes a fairly balanced decision close to a relatively rational one.

The noted problems intersect with a conglomerate of cognitive and behavioral factors, among which aspects of irrationality can be noted: short-term thinking (short termism, although this is a debatable factor, in a recent study by M. Roh demonstrated that the capital expenditures of European and Japanese companies that do not face any

American-style quarterly stock markets or aggressive investor-activists shrink faster than in American companies) [Roe, 2021], rely on irrational cognition and intuition [Kudryavtsev et al., 2013], investor neuroticism [Niszczota, 2014], gambling [Chen et al., 2021].

This, in turn, creates a new level of threats and risks, which can give rise to systemic and long-term problems with the sustainability of the development of high-tech companies and even broader socio-economic consequences.

First of all, it is necessary to dwell in detail on what exactly has changed in the behavioral heuristics of equity capital market participants and why - at least in part of high-tech companies - it can be argued that a model of an "efficient interpreter" different from the "reasonable investor" model has formed.

1. Shift of behavioral heuristics to the "efficient interpreter" model

Financial theories such as modern portfolio theory [Markowitz, 1952], the arbitrage principle [Modigliani and Miller, 1958], and the efficient market hypothesis [Malkiel and Fama, 1970] assume that capital markets are perfectly efficient, since all investors are rational in their actions. However, prospect theory [Kahneman, Tversky, 1979] argues that investors' decisions and choices are based on their perception of their own utility, and they do not use all available information [Wang, 2017] – and this leads to irrational decision making.

As complexity and volatility increase, the behavioral effects and heuristics of equity market participants in valuing the business of high-tech companies make it less and less realistic to apply approaches based on the efficient market hypothesis. Research results show that market sentiment, overconfidence, overreaction, and herding behavior influence investment decisions [Nareswari et al., 2021]. Even a weak version of the efficient market hypothesis seems to lose its explanatory power in the new realities. Many are familiar with the apt statement of J.M. Keynes as a general warning to speculators: "Markets can remain irrational much longer than you can remain solvent" [Keynes, 1936]. A feature of the markets of the last three decades is that the phases of irrational exuberance and investor overconfidence can and do last for a long time - up to a decade.

However, in case of sharp swings in market sentiment (from prolonged euphoria to prolonged depression and despair, when investors completely lose faith in the possible growth of companies) in the context of traditional industries, investors can at least hope for a long-term planning horizon and the so-called margin of safety, according to B. Graham). The latter refers to the purchase of shares at the lower bound of their intrinsic value, well below the long-term growth path of the business. Margin of safety is a measure of the extent to which an asset is sold at a discount compared to its intrinsic value. According to Graham, permanent or long-term capital losses periodically arise due to the purchase

of low-quality securities, far exceeding their tangible value [Graham, 2003]. Therefore, investment risk can be largely avoided by buying quality securities at low prices, that is, by adopting the safety margin principle. Research over many decades confirms that investors with a margin of safety were able to combine low investment risk with high inflation-adjusted returns [Klerck, 2020]. Careful analysis allows the investor to get an estimate of the intrinsic value of the asset, and buying a company with a significant margin of safety ultimately increases the average future return. At the level of the broad market, this is statistically confirmed by the values of the Shiller-CAPE index over many decades. Since intrinsic value is difficult to accurately calculate, a margin of safety provides protection against poor investment decisions [Otuteye, Siddiquee, 2015].

In Graham's definition, "a reasonable investor is a realist who sells stocks to optimists and buys from pessimists", which, even with significant short-term dips in the value of the portfolio due to a collapse in the market, eventually over a long distance (15-20 years) allows you to even out the position and increase portfolio value. In addition, with regular value investment, including in the conditions of long-term downward phases of markets (in the so-called bear market), the positions of long-term investors are regularly averaged at the price of acquiring positions. With a really long investment horizon, this approach in some sense often ends up working on the principle of "it would not be good luck, but misfortune helped," since even a bear market can be perceived as an opportunity to gradually create a low average cost of acquiring assets. Unlike a situation where the market is full of optimism and quality stocks are especially expensive. According to many well-known practitioner investors, the main money and fortunes are made not from the growth of the market as such, but from the opportunity to buy good companies at a cheap price. Conversely, the likelihood of future abnormally low returns over long-term investment horizons is disproportionately high when stock markets are trading at extremely high valuation levels.

This is why it is so important for investors to "manually" or algorithmically detect irrational exuberance in financial markets, as they are most often followed by abnormally low returns [Viebig, 2020].

However, even in this seemingly very encouraging position of a conservative, long-term investor it is important to note that today's more dynamic business environment, the current and even more so the future landscape in many industries undermines to a certain extent this classical philosophy (in a sense, the "gold standard") of smart investment. Even 50 years ago, the average lifespan of a Fortune 500 company was 70 years, so a well-founded initial market participant's investment thesis had a good chance of remaining relevant even after years of temporary business difficulties. Today, the survival time has decreased to 15 years, which makes the prospects of waiting for the situation to improve even in fundamentally promising companies less obvious and probable. So-called disruptive innovations can rapidly change the industry landscape and simply immediately "cancel" the leading company, which until then experienced, it would seem, only temporary,

opportunistic difficulties and only because of this was cheap and very attractive for long-term value investors on financial ratios, for reasons of "margin of safety".

Practical application of the investment philosophy of B. Graham, W. Buffett, C. Munger in terms of the statement that the best company is the one whose shares will never have to be sold (since it was bought with a good "margin of safety", and the further business growth trajectory only multiplies the initial success of the purchase), in the face of more dynamic shifts and restructuring in industries, it becomes increasingly difficult. Historically, value stocks have outperformed growth stocks; however, since 2008, value stocks have performed relatively poorly, creating an investment "value trap". The term "value trap" refers to a situation that, on the face of it, offers an investor the opportunity to acquire significant assets and/or profits relative to the market price, promising a chance of above-average returns in the future, but such expectations turn out to be illusory due to many factors. Value traps can appear for a variety of reasons, including a change in the ability of a firm or even an entire industry to generate cash flows, alternating peak earnings in cyclical industries with rapid declines, and cash flow problems despite a good situation with income.

To evaluate the business of high-tech companies, the reflexivity theory of George Soros is more relevant, according to which, from the point of view of the stakeholder and investment perception of building a business, it is important for companies to get into a favorable development spiral. A positive perception of a company leads to better fundamentals (through better funding opportunities, profitable partnerships, and a more motivated and skilled workforce), which then reinforces the initial narrative of the company's success and business model. The result is a self-fulfilling prophecy effect. In modern conditions, in many respects, it is the narrative and perception of stakeholders that shape not only the fate of the company's product, but also its investment assessment. It is amazing, but true: Soros' book The Alchemy of Finance [Soros, 2015], first published back in 1987, not only debunks the efficient market hypothesis, but surprisingly accurately describes the main investment mechanism of business models of the modern economy, especially high-tech.

Companies such as Amazon, Netflix, Uber are vivid examples of the phenomenon when investors, despite not only losses, but also high and even extremely high burn-out rates during a sharp scaling (blitz scaling) of the business, for many years (almost decades) were ready to wait for companies to reach profitability.

And at least one study [Carpentier et al., 2018] demonstrates that high market valuations of unprofitable IPO companies are not investor irrationality. The high valuation of unprofitable firms is not always explained by behavioral factors. Using a sample of small Canadian listed firms, this study showed that both individual investors and underwriters value losing firms more than winning firms, all other things being equal. However, it turned out that, as a result, the backlog in development, business scaling within

3 years after the IPO does not statistically differ between unprofitable and profitable companies. This means that investors behave irrationally for all firms, but their higher degree of irrationality regarding the perception of loss-making firms is not at all obvious.

It is important to understand that narratives, by their nature and economic role in the modern economy, are not part of some black and white picture in terms of rational and irrational stock market pricing and investment. It would be a reductionist approach to say that narratives are some 100% irrational component that only makes it difficult to evaluate businesses at their objective and fair value. The investment attractiveness of a high-tech company, by definition, lies to a lesser extent in current financial ratios and market position, and to a much greater extent in a bright future story, storytelling, and narrative. However, no one can know the future for sure, so the main criterion for evaluating narratives is their plausibility. In a sense, this is double-edged sword.

However, the worst that can happen is if the narrative component takes on a life of its own, and mass psychology and cognitive distortions lead to a large gap between expectations and the fundamental value of companies - value in terms of their productivity, technology, products, innovative performance. In addition, narratives are the plane in which it is easier to build various kinds of market manipulations, including the so-called pump and dump cycle, which is a fraudulent activity that is difficult to prove, when a positive narrative about a company is immediately "stuffed", the share price rises sharply - and the initiators of the "stuffing" sell their shares to interested investors and speculators. Later it turns out that the scale of positive news and assumptions was not true [Loa et al., 2020].

It is wrong to forget a certain function of narratives as a productive economic coordinating mechanism: through it, the stakeholders of a progressive company build their future and really embody a certain common vision of all stakeholders, which led and constantly leads to the construction of great companies that revolutionised entire industries. In the beginning there was the Word. Or rather, narrative.

Consider, for example, Tesla, which has been a particularly heated and even quasi-religious controversy. Many exchange practitioners and some academic researchers, speaking about the extremely high capitalisation of the company, make conclusions and statements about irrational pricing, a bubble and similar categories. It is difficult to fully agree with such a degree of categoricalness, since, it seems, an inappropriate terminological apparatus is used. In the case of Tesla, we reliably have one of the brightest and at the same time large-scale cases of storytelling, narrative and high reflexivity. What is the future scenario for Tesla by 2025 or 2030 is a really big question. The risks that this will be undershooting are great, but there are even the likelihood of overshooting scenarios - we are dealing with a company that is a powerful technological disruptor.

It is more neutral and correct to say that companies like Tesla are largely driven by narrative. And the narrative, in principle, can be either predominantly irrational and

manipulative, or realistic and relatively rational, despite the high level of ambition. We can say that Tesla pricing is irrational only if we establish that investors are in the grip of cognitive biases. In other words, a high narrative component in the value of a share does not equal irrationality. It is necessary to avoid situations where we would confuse soft and warm. To some extent, we can generally say that most highly narrative business projects are high-risk and often end sadly for investors in the later stages of the company acquisition, since the high, "overclocked" share price was not worth it. One might even advise risk-intolerant investors to generally avoid such companies if there is evidence of high overheating (this paper joins this kind of call for caution).
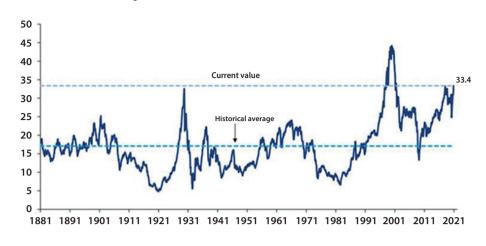
Storytelling, combined with the complexity of the modern financial system, especially in the context of high-tech companies, influences the economic behavior of investors. N. Taleb argues that people are "fooled by randomness", making a narrative error in which they invent narrative explanations for random phenomena [Taleb, 2001; 2007]. All this does not allow us to say with accuracy that a certain company N is a bubble based on irrational perception. Its narrative can either be plausible or have a distribution of scenarios, some of which can be over-successful in terms of future capitalisation estimates.

However, speaking about future scenarios for the development of a promising company, it is important to note that the connection between narrative and irrationality can occur within the framework of the following cognitive distortion. Scenario thinking not only provides new opportunities for investors to assess the situation, but, according to a number of studies, leads to bias. Investors often make forecasts that take into account only the most likely scenario, rather than taking into account the full range of scenarios and possibilities [Johnson et al., 2020].

2. Is it possible to measure or evaluate the narrative (reflexive) component of business value in an ordinal way?

A regular question arises: what metrics can be used to assess the reflexive (or, as another terminological option, narrative) component in the business value of a certain company, especially a high-tech one? A somewhat simplified, but already quite indicative marker, a measure of positive reflexivity level of a company is the ratio of the company's capitalisation to its annual revenue, or P/S. Of course, none of the metrics alone is sufficient to determine the fair value of a business (and, accordingly, isolate its reflexive, narrative component), it is necessary to compare at least several basic financial ratios. For example, S. Penman and F. Reggiani recommend using profit-to-price and book price ratio multipliers together. If profit and book value express value in an accounting sense, then the ratio of profit to price and to book value signal the risk and the expected return from this risk. Higher growth in the context of a high book value is risky, as stocks with a high book value are subject to stronger shocks [Penman, Reggiani,

Fig. 1. Shiller CAPE value for the S&P500 index
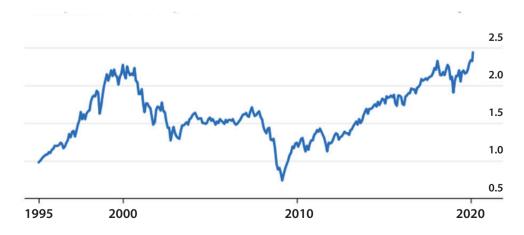
Source: https://www.thinkadvisor.com/2020/12/01/stocks-prices-not-as-absurd-as-some-think-shiller/.

2018]. It is also worth noting that many practitioners and analysts prefer to use the ten-year Shiller P/E ratio - Shiller CAPE (Fig. 1) to assess the potential for future stock returns (Fig. 1), especially since in 2021 it almost caught up with the record 1999, which predicts a lower stock returns over the next decade [Lechner, 2021].

However, the ratio of a company's capitalisation to its annual income (P/S) seems to be especially important to understand as a general, preliminary estimate of the expression. Over the course of decades, for the US stock market, the normal value (for example, according to the SP500 index) for this indicator was the range from 1 to 2, including for the last 30 years, as shown in Fig. 2. This industry average is both "healthy", clear and user-friendly even at household level. In simpler terms, we can say that if there is some average business in terms of operational and financial parameters that has already passed the

filters of industry competition to one degree or another, then the investor can "outbid" in value in his favor from previous owners of the generated flow of profit according to the average historical calculation 1, 5 dollars of his so far passive money for 1 dollar of profit generated by an already sold and growing business. The investor's money thus moves, figuratively speaking, into a kind of "business-active" state.

Here, of course, it is necessary to make a reservation that the range noted above is applicable to developed financial markets with successful implementation of corporate governance principles, protection of minority shareholders, stable dividend policies, strict prosecution of insider transactions and other institutions. It is easy to see that, for example, the Russian market is characterised by a situation where in many sectors (for example, in oil and gas, electric power, retail, telecommunications, banks), profitable

Fig. 2. P/S value for the S&P500 index

Source: https://seekingalpha.com/article/4327204-enormous-stock-market-bubble-and-future-financial-and-economic-consequences.

Table 1
Top 10 companies with the highest P/S ratio with market caps over $ 10 billion

Large cap company	Industry, sector	Market capitalisation as of 07/01/2022 (billion dollars)	Capitalisation ratio / annual revenue
Lucid Group	Automotive, electric cars	28	337
Rivian Automotive	Automotive, electric cars	23	154
Argenx SE	Biotechnologies	20	55
The Liberty Braves Group	Telecommunications and entertainment	28	48
Aspen Technology	Software	25	36
Snowflake	Software	43	31
Datadog	Software	30	25
Crowdstrike Holdings	Information security	39	24
Texas Pacific Land Corporation	Power economy	12	22
Bill.Com Holdings	Software	11	22

Source: Compiled by the author based on finviz.com data.

Table 2
Top 10 companies with the highest P/S ratio with market caps from $ 2 billion to $ 10 billion

Mid cap company	Industry, sector	Market capitalisation as of 07/01/2022 (billion dollars)	Capitalisation ratio / annual revenue
Turning Point Therapeutics	Biotechnologies	3.8	613
Nuscale Power Corporation	Renewable energy	2.2	479
MSP Recovery	Information services in healthcare	6.8	349
Ascendis Pharma A/S	Biotechnologies	4.8	331
Eaton Vance Senior Floating Rate Trust	Investment company	2.4	322
Intellia Therapeutics	Biotechnologies	3.9	104
Karuna Therapeutics	Software	3.8	102
Nutex Health	Information services in healthcare	2.1	91
Legend Biotech Corporation	Biotechnologies	8.5	73
Appelis Pharmaceuticals	Biotechnologies	4.8	60

Source: Compiled by the author based on finviz.com data.

companies often stand at P/S 0.5 or even lower. This ratio might have pleased Graham at first: one of the parameters of his method was to target companies that cost around 0.3 P/S. However, as unique domestic practice shows (in this case, unique - in a sad sense), companies can be greatly undervalued for decades, primarily due to the impact of adverse institutional factors.

At the same time, it is necessary to understand that P / S at the level of 1-2 on the SP500 index is just a kind of average historical value. Over the past decades, as you know, there have been periods of crises of various origins (including acute liquidity crises) - and then quality companies cost less than 1 and even less than 0.7 in terms of P / S ratio. At the same time, in the case of high levels of marginality and/or rapid business growth and/or product uniqueness, coefficients for individual industries and sectors can traditionally be significantly higher than industry and historical averages. For example, the P / S ratio of stock exchanges (as a type of business) and companies - leaders in the development of computer and mobile games for the last 10 years has been in the range of 3-7, since stock exchanges have very high margins and often a monopoly position in many market instruments, while companies are famous for high business growth rates and a relatively protected oligopolistic market structure as the main characteristics of their investment attractiveness.

3. A selection of companies with the highest level of narrative value (maximum reflexivity)

As can be assumed from the data in Tables 1 and 2, the "stratospheric" levels of capitalisation of the most "narrative", "reflexive" companies are served to investors and a wider range of stakeholders (in particular, partners, suppliers, consumers, current and future employees) as confirmation of the exclusivity of companies.

Against the background of these companies, Tesla, with a current P / S ratio of about 18, no longer looks so "irrationally" overvalued. I would like to emphasise once again that "irrationality" is an unfortunate term for even the most overheated companies. If Palantir Technologies is worth 18 annual revenues in June 2022, that's a lot, but it's not irrational. Investors believe that this developer of information analysis software and solutions for supporting many types of data (including unstructured, relational, geospatial) is on the verge of receiving major contracts from commercial and government customers, including the US CIA. It is possible that investors are mistaken in the probability of the most optimistic scenario or, as mentioned earlier, they do not sufficiently consider the probability of alternative scenarios, but this is very difficult to prove ex ante in a particular case. Theoretically, it would be possible to use the expert method ex ante to some extent as some kind of relative evidence, but this is not practically feasible.

Of particular interest is the question of how narratives are constructed in the modern investment ecosystem, what,

in a sense, is the methodology for giving the narrative characteristics of plausibility. However, this issue is still poorly and fragmentarily addressed in the literature.

With this in mind, regarding the valuation of the business of high-tech companies, we can say that the stock markets live with expectations to a special extent. In such circumstances, investors are particularly dependent on narratives. And this, by definition, is a breeding ground for "mind games". As a result, portfolio investors in high-tech companies experience routinisation of decision-making under the influence of many behavioral factors.

4. The main distinguishing features of the "effective interpreter" model at the present stage

Undoubtedly, investors need to strive to become aware of cognitive distortions and reflect on them, because of this, by reducing risks and instability, both the participants themselves and the entire financial system would benefit from the point of view of long-term sustainability and real provision of high-tech companies with investment resources. At the same time, it must be admitted that the very model of making decisions about buying or selling shares has fundamentally changed. There has been a certain shift in the significance of investors' competencies from long-term financial orientations (the "reasonable investor" model) towards understanding the mass narrative, mass psychology, and one's own response to the behavior of other investors. Such a model can be called the "efficient interpreter" model. Narrative, perception and context have become a new plane in which participants in the equity capital market compete with each other. We are talking about a new qualitative state of the investment system.

This is consistent with the more general paradigm of the so-called narrative economy introduced as a conceptualisation by R. Schiller in 2017 [Shiller, 2017; Mackintosh and Schiller 2021]. According to Schiller, when shared among the public in the form of popular stories, ideas can go viral and move markets, be it the belief that technology stocks can only go up, that house prices never fall, or that some firms are too big to go bankrupt. Whether that be truth or a lie, stories like these, shared by word of mouth, the media and increasingly through social media, drive the economy, shaping our decisions about how and where to invest, how much to spend and save, and more. Narrative economics as a new conceptual field seeks to lay the groundwork for understanding how so-called storytelling and narratives help move forward economic processes.

Researchers have already begun to apply the principles of narrative economics to conceptualise and classify behavioral strategies in the investment community. The approach of S. Johnson and D. Tuckett seems to be innovative and productive. They propose to distinguish between three types of behavior in terms of making forecasts about the future value of shares: rational expectations from neoclassical economic theory (investors predict in accordance

with neoclassical financial theory) and two types of psychological approaches to the formation of expectations: (1) behavioral expectation approach (investors understand empirical market anomalies and expect these anomalies to occur) and (2) narrative expectation approach (investors use narrative thinking to predict future prices) [Johnson, Tuckett, 2022]. It seems that the British colleagues raised an extremely interesting question regarding the possibility and expediency of distinguishing between behavioral and narrative expectations.

As part of Johnson and Tackett's literature review and experiments on investor decision-making under uncertainty, the authors focus on the usefulness of distinguishing between two psychological approaches. In particular, in the case of an unexpectedly high performance of the company being valued, investors with prevailing behavioral expectations are prone to a short-term increase in their perceptions the business value, but two weeks after, expectations normalise based on benchmarking and comparison with other companies. At the same time, investors who are guided by narrative expectations prefer images of the company's future, project both positive and negative trends into the future, and considerations of past reporting, benchmarking and comparisons do not affect the period of a positive or negative trend projection into the future. In other words, the narrative is decisive.

Importantly, the empirical findings of the study support the idea that people rely on narratives to predict the price paths of financial assets. Whereas participants with neoclassical rational expectations would predict asset prices to rise at a market rate of return, participants in the experiments clearly distinguish positive and negative surprises in the results, predicting sharply outperforming growth in the light of positive rather than negative news. This happened despite the fact that the predicted price changes were made relative to the price after the announcement of the news [Johnson, Tuckett, 2022].

Although this paper will further propose a unified (both behavioral and narrative) model of the "effective interpreter" based on the notions of strong mutual interweaving and influence of behavioral and narrative aspects and motives in investment decision making, this year's article by Johnson and Tuckett, will deservedly become fundamental in terms of laying the foundations of the research direction. Nevertheless, despite all the academic validity of the separation between two psychological types - behavioral and narrative, with regard to the scientific and practical applicability of such a categorical distinction, many difficulties can be expected. Since, analysing behavioral and narrative factors in the pricing of specific companies, it will be difficult to say where in its pure form a behavioral component is, and where - a narrative one.

As S. Mackintosh and R. Shiller point out, narratives about stock market bubbles are fueled by psychology, since stock prices are associated with general confidence [Mackintosh, Shiller, 2021]. At the same time, general trust is based on behavioral dynamics, including herd behavior. The circle "narrative - trust - behavior" is closed. One can envision a spiral where primarily herd behavior and other

behavioral dynamics and cognitive biases (e.g. retrospective survivorship fallacy) are facilitators of narrative growth. The "survivor fallacy," for example, is often used to draw analogies to already successful tech giants, reinforcing the narrative.

Another argument that can be raised against the practicality of separating behavioral and narrative aspects into two different decision-making models is the common practice of so-called momentum strategies. It would be incorrect to say that these strategies are based only on the narrative motives of investors. Momentum strategies have historically evolved as a behavioral phenomenon [Chan et al., 1996], although narrative is now of particular importance. As part of experiments on the formation of expectations and asset valuation, S. Homes and his colleagues in 2008 found that in most experiments, prices deviate from the foundation and bubbles occur endogenously. Research has shown that these bubbles are inconsistent with rational expectations and are caused by participants' behavior in chasing a trend or "expecting positive feedback." The participants in the experimental group, as a rule, coordinate their actions in relation to the overall forecasting strategy [Hommes et al, 2008].

The exchange, speculative principle "buy on rumors - sell on facts" is a classic, it was popularised (both on the stock exchange and even in popular culture) back in the "roaring 1920s". Even D. Ricardo, one of the founders of economic theory, as you know, made a fortune on active stock speculation. There has always been strategic behavior and interdependence among equity capital market participants. Now the narrative and behavioral components of value in the context of modern economics have become much more significant. This is confirmed by the research, which found out that investors from the same country consciously and unconsciously follow each other. For example, a recent study used high-frequency intraday data to study the herding behavior of investors in the global market at the country level and found strong evidence of significant herding behavior at the country level. Country-level herding behavior is a combination of conscious and unconscious subtypes, with the effect of unconscious herding behavior being about five times greater. Notably, unaware herding behavior at the country level is affected by momentum trading, investment style, and market pressures [Chen, 2021].

Assessing the present and focusing on the unknown future, financial market participants create financial opportunities. At the heart of this process is the work of experts who claim to conduct "thorough analysis" of economic trends and market movements. There was even such a thing as narrative authority [Leins, 2022; Stolowy et al., 2022] due to the need to refine and broaden the understanding of building narrative authority in capital markets, as powerful media intermediaries increasingly influence markets. The lack of one's own reasonable idea of the fair value of high-tech businesses leads to exaggerated expertise of analysts.

Management rhetoric is also a very important component of narratives. Members of the investor community compete to understand better and interpret more realistically the messages of managers. A recent study found that the

management narrative (in corporate reports on technology and innovation disclosures) is used as a critical investor communication channel through which managers convey information to the investment community, and is positively associated with risk fall in stock prices for the year ahead. Moreover, the positive association between managerial narrative and the risk of a stock price collapse is more pronounced for firms with powerful, more capable, younger CEOs. The negative impact of managerial narrative on future stock prices is predominant among firms that face high competition [Andreou et al., 2021].

Another study used computational linguistics tools to analyse the qualitative part of the annual reports of UK listed companies. The frequency of words associated with various language indicators was measured and used further to predict future stock returns. Several indicators, primarily reflecting the headings "activity" and "realism", predict subsequent price increases even after accounting for a wide range of factors. At the same time, the increase in these two linguistic variables was not accompanied by additional risks [Wisniewski, Yekini, 2014]. As a result of the mentioned works, the descriptive part of the annual/quarterly report and the presentations of managers contain valuable information that has not yet been included in prices.

One study also found that the positive tone of sentiment on Twitter is more pronounced for small and emerging

Table 3
Comparison of the "rational investor" model and the "effective interpreter" model

Attribute	"Rational investor" model	"Effective interpreter" model
Company valuation emphasis	Profit, revenue, free cash flow, debt	Opportunities for rapid scaling of revenue, building an ecosystem
Narrative context in business perception	Low (estimated to a greater extent by fundamental indicators). In conditions of nervousness - average. Market Sentiment Influences Decision Making	High (positive narrative and perception about the company become decisive and may outweigh bad fundamentals even in the medium term)
Business Development Forecasting Methodology	Predominantly extrapolation	Mostly scenarios and images of the future
Codependency of investors (strategic behavior of players)	Average (crowd psychology is applicable, but the last line of self-assessment of the market situation is the fundamental indicators of the business)	High (most players have a complete focus on consensus opinion, the precariousness of their own perception due to the lack of their own formed position regarding the fundamental value of the business)
Significance of analyst forecasts (share price per year)	Average (indicators can be calculated by yourself, including forward ones)	High (indicators depend on interpretations, the "fork" of estimates of forward indicators is wider)
Willingness to endure business losses	Low (1-2 years)	High (unlimited subject to high revenue growth rates)
Focus of speculative strategy	"Buy on hearsay, sell on facts"	Maximum emphasis on interpreting participants' behavior
The degree of applicability of "the last fool" concept	Low (booming – medium)	High (even in the conditions of a strong "overbought" of the company, the players still have the expectation that the price will be even higher at the moment)
Degree of applicability of momentum strategies	Average (there is an expectation, supported by long-term statistics, that the market moves mainly by trends)	High (based not only on long-term statistical observations, but also on the expectation of continued blitz-scaling of the business)
The level of cognitive distortions among market participants	Usual	Advanced (cognitive biases are more varied due to greater complexity and uncertainty)

Source: compiled by the author.

market firms, consistent with the literature that says small firms are difficult to value and firms in emerging markets are characterised by high information asymmetries. Tan and Tas, 2021]. Therefore, as it follows from a number of studies, for investors it is beneficial to be inattentive to most news topics and their mood, if guided by a rational decision-making model [Uhl, Novacek, 2021]. Another thing is that such a conclusion may be somewhat incomplete, based on the fact that investors can be in a good way cynical about narratives realising their manipulative nature. Then the narratives become a separate behavioral dimension, where investors and speculators also compete with each other, as they do in connection to any financial and market information related to the activities of the issuer.

With regard to the narrative component of modern investing, the literature has also established that retail investors are "net buyers" of attention-grabbing stocks. One study found that factors such as financial experience, wealth, advice, and other individual characteristics that indicate investor sophistication explain differences in net buying decisions. Greater trading experience comes from net selling during months when stocks get a lot of attention and net buying during months when they get less attention. Investors who trade during the months of the least attention are more experienced, more involved in complex trading, richer and have a higher income than those who trade during the months that attract the most attention [Gavish et al., 2021]. This is a very intuitive result, but again, it seems necessary in modern realities to distinguish between traditional sector companies and high-tech businesses. For high-tech companies, attention and so-called hype is the necessary "fuel" for the growth of not only quotes, but also fundamental operating indicators, as it follows from the theory of reflexivity.

All of the above, therefore, means that investors, especially in high-tech companies, are shifting from the plane of the traditional "smart investor" model to the plane of the "efficient interpreter" model.

With regard to the characteristics in Table 3 ten comparative attributes for two heuristic models can be assumed as debatable. For example, for the "smart investor" model, it can be argued that during the boom and euphoria, many players have a strong tendency to believe that at any purchase price a little later, there will still be a "last fool". After all, the famous "tulip mania" of 1636-1637 took place outside any context of advanced technologies and, accordingly, the complex narratives tied to them. In addition, Keynes, back in 1936, very accurately noted that the market is like a beauty contest, the purpose of which is not to evaluate the beauty of the participants, but to predict accurately the assessments of other judges [Keynes, 1936]. However, the degree of such a "fool" still differs in fundamental and qualitative characteristics in the two models.

In the traditional configuration (the "smart investor" model), someone can actually buy a company for two, three, and many times more than its fundamentals, still believing that this is not the last extreme on the stock price chart and can be resold after some time for a little more. In the case of

the "efficient interpreter" model, however, the symptoms seem to be even more pronounced: until the bubbles burst, there are massive cohorts of investors, especially in relation to high-tech companies that overpay many times over for a business, having an extremely limited understanding of its processes and fundamental indicators. They bought a share of the company on a "black box" model on the basis of the formed narrative sentiment – and they are betting that the positive narrative, the so-called hype, will continue for some time.

Conclusion

The democratisation of investing in financial markets (desktop and mobile brokerage applications), strengthened by new technical and technological solutions, was superimposed on a cultural transformation: investing and speculation have become part of mass culture. The orientation of businesses in many sectors towards rapid growth, scaling and breakthrough innovations has led to a decrease in the subjective significance of financial and economic indicators of efficiency and effectiveness in assessing the value of a business. As a result, everyone can feel like an interpreter of the future business development trajectory. For an individual "efficient interpreter", such activity may end in different ways, but for a large social system of co-dependent interpreters, this may sooner or later end not just in a stock market panic, but also in wider socio-economic consequences.

The current period of irrational optimism in the stock markets may also be a factor in further widening socio-economic inequality, as retail investors from the middle and lower strata of society form their portfolios from the weakest possible positions not only from the point of view of the "rational investor" model, where their analytical capabilities are behind institutional investors on average. Only few retail investors follow Lynch's advice on how to bridge the analytics gap with institutional investors and professionals.

Within the framework of the "effective interpreter" model, retail investors are most dependent on behavioral effects and cognitive distortions. Of course, in the context of individual factors, this is not yet a fully explored area, although there are already many studies. However, there is the following general consideration: the role of retail investors in the chain of forming narratives of high-tech companies is more passive and they approach the narratives not critically enough and in a sense not cynical enough, in contrast to institutional investors, who, with their market "weight", can induce or support "hypes" at earlier stages. As a result, retail investors enter the already "overclocked" stocks (the so-called rockets in exchange jargon, and even with the battle cry "To the Moon!") of high-tech companies on average later, already at higher price levels of issuers - and are especially vulnerable to permanent or long-term loss of value. This is even if they do not try to speculate, which usually multiplies the losses even more. It should also be taken into account that high-tech companies in the market are characterised by deep corrections (sometimes called super-compensatory) after a sharp and unreasonable growth. The phenomenon of supercompensation seems to be

of particular interest for empirical research: the collapse of the current narrative often causes such a strong correction, collapse, and the value of companies then turns out to be lower than it was before the appearance of the narrative.

Of particular interest may also be the systematisation of the whole variety of factors that, in current realities and developing trends, lead to an increase in behavioral effects and cognitive distortions within the framework of a new

qualitative state of investor behavioral heuristics, which is formed in the "effective interpreter" model. Probably not all of them are completely new, but even some of the traditional factors are given a meaningful new momentum by the context of investing in high-tech companies.

In the next work on the cognitive aspects of the "effective interpreter" model, the author plans to continue study in this direction, assuming that we can talk about a dozen of factors.

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Causality dynamics of corruption and economic growth in an emerging economy

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Abstract

Leveraging on the Ibrahim Index of African Governance (IIAG) and economic growth rate data from the World Bank (WB), this study employs a robust VAR time series methodology in delineating the relationship between corruption and economic growth in Zimbabwe. Noting the worsening corruption levels coupled with a grim economic performance, this study informs policy for the new political administration keen to fight corruption. The study affirms a unidirectional causality flowing from corruption to economic growth and a negative impulse response. To increase the fortunes of the economy in the future, current action to 'stop' corruption is obligatory.

Kewords: Ibrahim Index of African Governance (IIAG), corruption, economic growth, robust VAR, Zimbabwe.

For citation:

Introduction

The Ibrahim Index of African Governance (IIAG)[1] of 2017 shows that though governance slightly improved in Zimbabwe, it remains in the lower echelons of the African governance rankings (40 out of 54 at an overall score of 45.4)[2]. Zimbabwe's 2017 IIAG overall score is below the African average of 50.8 as well as the average for Southern Africa of 58.6 (IIAG 2018)[3]. The Corruption Perception Index (CPI) for Zimbabwe also worsened amongst a number of Southern African countries. Zimbabwe's CPI in 2000 was at 30 and in 2017 it was at 22. For the period 2015–2016, Zimbabwe slipped on its CPI rankings from 150 to 154 The (Open Society Initiative for Southern Africa (OSISA), 2017) showing the grossness of the corruption scourge in the country. But how has corruption manifested in Zimbabwe?

As if in confirmation of the worsening corruption measures, recently the local[4] and foreign[5] media has been awash with re-

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[1] The index gauges the extent and trend of governance in Africa making use of four key components: safety and rule of law; participation and human rights; sustainable economic opportunity and human development. Corruption undermines good governance [Measuring corruption in Africa.., 2016], thus the IIAG reflects on the level of corruption through monitoring governance trends.

[2] The higher the IIAG index, the lower the incidence of corruption. The same interpretation applies to the CPI.

[3] http://iiag.online/.

[4] Newsday, 9 May, 2018; The Chronicle, 28th April, 2018; The Herald 20 April, 2018.

[5] BBC 20 April, 2018; eNCA 7 May, 2018; Aljazeera 20 April, 2018.

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ports of the former president being invited to answer to a parliamentary portfolio committee on the missing $ 15 billion diamond revenue (The Chronicle, 28th April 2018)[6]. Massive bribe soliciting has been linked to Zimbabwe Republic Police (ZRP) and the Vehicle Inspection Department (VID); bogus tenders in the power utility - Zimbabwe Electricity Supply Authority (ZESA); import duty-related corruption involving Zimbabwe Revenue Authority (ZIMRA) employees and officials; shadowy deals around the acquisition of new planes by Air Zimbabwe and the Ministry of Transport; abuse of toll-gate revenues by high-ranked politicians at Zimbabwe National Roads Administration (ZINARA) are amongst a plethora of widespread cases of corruption. Writing about Zimbabwe, [Tizor, 2009] notes that, "corruption has become an accepted and almost expected way of doing business especially in the public sector."

Against this background, the economy since 2000 has gone through a rutted transition and continues to be in the abyss. Despite the sound recovery of the economy from the negative growth rate experienced during the hyper-inflationary period, the exceptional growth registered during the Government of National Unity (GNU)[7] slumped after the 2013 elections. From a growth rate of 13.6% in 2012, growth fell to 5.3% in 2013 and even slipped further to 1.4% in 2015 [Economic partnership agreement.., 2016]. In a country whose national budget falls below $ 4.5 billion and manages to lose $ 15 billion diamond revenue, as well as towering unemployment and grim poverty levels, questioning the link between corruption and economic growth is an obligation. Growth remains relevant in the fight against poverty and inequality. Growth is a cog relevant in reversing the poverty dent on societies as backed by a multiplicity of empirical work [Dollar, Kray 2002; Fosu 2011; 2014; Abdelaziz, Helmi, 2017]. This explains the perennial desire to grow economies by various governments. Despite these known benefits of economic growth, Zimbabwe's economy continues to miss the Regional Indicative Strategic Development Plan (RISDP) benchmark of 7% per annum.

Taking a wealth maximization cue from corporate finance, governments exists to serve the people and as such, just like a company, should seek to maximise the welfare of the shareholders who are the electorate. The welfare of a nation is measured by the gross domestic product (GDP) per capita and therefore increasing output of a nation and fully maximising a country's resources is a key government's responsibility. In recognition of the same and acknowledging the worsening corruption in Zimbabwe, it is government's role to remove obstacles (corruption) to economic growth. Aggravated corruption is worrying especially for Zimbabwe which recently came out of nearly four decades of autocracy. In the new dispensation since November 2017, the Government of Zimbabwe was presented with a mammoth task of correcting the previous and current inefficiencies which derail economic growth. It is against this status quo that we seek to establish scientifically (through unit root tests, Granger causality tests, vector autoregressive (VAR) model and impulse response function) the relationship between corruption and economic growth in Zimbabwe and provide recommendations to the new administration. Our methodol-

ogy accommodates the possibility of economic growth generating more resources to fight corruption thereby allowing for quizzing whether weak growth cultivate corruption too. With the government selling the 'Zimbabwe is open for business' mantra – laying bare the 'greasing' or 'sanding' effect of corruption is plausible as the Government of Zimbabwe has set institutions and laws to fight corruption.

1. Literature review

Whereas a burgeoning expanse of empirical work debated whether corruption 'greases' or 'sands' economic growth [Wei, 2001; Pierre-Guillaume, Khalid, 2005; Mayo, 2013; Linhartova, Zidova, 2016], the subject remains relevant for a number of developing countries facing erratic growth in the face of worsening corruption. By engaging in corruption, economic agents can circumvent trade-stifling regulations – unlocking colossal business deals unavailable under restrictive regulations thereby 'greasing' economic growth [Méon, Weill, 2010]. The 'sanding' hypothesis concedes the 'cost of corruption' in relation to "reduced domestic and foreign investment, increased cost of production, misallocation of national resources, higher inequality and poverty, uncertainty in decision making" [Wright, Craigwell, 2012].

Although prior studies acknowledge the schism and lack of equi-finality on the 'greasing' and 'sanding' debate [Mironov, 2005; Chiam, 2015; Nyoni, 2017; Ondo, 2017], a leading strand of recent evidence from developing countries buttresses the growing need to arrest corruption if economic fortunes are to be unleashed [Mikaelsson, Sall, 2015; Teymurov, 2016; Wang, 2016; Boussalham, 2018]. Startling empirics by [Lambsdorff, w.y] show that "an increase in corruption by one point on a scale from 10 (highly clean) to 0 (highly corrupt) lowers productivity by 4 per cent of GDP and decreases net annual capital inflows by 0.5 per cent of GDP." The compromised rule of law and governance evident of corrupt-ridden economies explain the contraction of capital inflows (foreign direct investment) – scattering investment, capital formation and growth. On the contrary, [Wright, Craigwell, 2012] noted that, "an improvement with regard to corruption by 6 points of the Transparency International Corruption Perceptions Index – for example, Tanzania improving to the level of the United Kingdom – increases GDP by more than 20 per cent and increases net annual capital inflows by 3 per cent of GDP." Notably, reducing corruption edifies growth but, how does corruption afflict growth?

Gross haemorrhage of investment funds through illicit financial flows (IFFs)[8], diversion and misappropriation of ear-marked development funds explains deficient investment and growth in corrupt countries [Measuring corruption in Africa.., 2016][9]. Whereas Africa received ODA totalling $ 1 trillion over the past 50 years, Africa also lost nearly the same amount in IFFs. It is on record that $ 50 billion is lost from Africa annually through IFFs though this estimate might be an understatement given the shadowy nature of IFFs[10]. Accounting for its share of IFFs, Zimbabwe lost $ 12 billion through IFFs and smuggling from 1980–2000 [Global financial integrity, 2017]. Also, between 2005 and

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[6] http://www.chronicle.co.zw/robert-mugabe-called-to-testify-in-15-billion-diamonds-probe/.
[7] 2009–2013.
[8] Most IFFs are underhand and corruption-induced movement of funds meant to conceal the source of such funds.
[9] Corruption coupled with poor growth has taken a toll on the welfare of citizens given the grim effect of corruption on the poor, aggravated inequalities, worsening social services and pitiable governance culture.
[10] Impliedly, without the loss of resources through IFFs Africa could fund her investment and growth.

2015 a staggering $ 15 billion diamond revenue was lost – an amount nearly matching four times the annual national budget of slightly above $ 4 billion. In this realm, un-capitalized infrastructure investments as well as Zimbabwe Agenda for Sustainable Socio-Economic Transformation (ZIMASSET[11]) could have been financed effortlessly. Acknowledging the various facets of corruption and the effect of the same on governance, investment, politics, service delivery and public finance management, the toll of corruption on economic growth is imminent. But, what has research shown on the relationship between corruption and economic growth, especially for developing countries and Zimbabwe alike?

Though tainted by an estimation technique with a feeble explanatory power[12], [Teymurov, 2016] quizzed the relationship between corruption, FDI and economic growth and concluded that corruption repels FDI and since economic growth is dependent on capital (FDI), it is in turn undercut by corruption[13]. Without assuming a quantitative approach, [Bonga et al., 2015] focused on the economic and social impact of corruption in Zimbabwe and suggested the "return to the teaching of moral education to empower children with the spirit of stewardship, while adults live exemplary lives, reflecting truth, kindness, dignity of labour, and integrity" as a way of suppressing corruption. A decade ago, [Ngulube, 2007] explored the impact of corruption on economic growth in SADC and recommended a "holistic approach" in redefining governance if corruption afflicted countries are to experience growth. Noting the effort to describe the roles of different stakeholders in fighting corruption in Zimbabwe [Moyo, 2014], this study making use of a robust time series methodology capitalizing on both CPI and IIAG delineates the nexus between corruption and economic growth in Zimbabwe. The current effort seeks to chlorinate a non-quantitative study[14] which hailed the incidence of corruption in Zimbabwe describing it as "a blessing in disguise" [Nyoni, Bonga, 2017].

Theory and practise presumes that corruption 'causes' economic growth given the damaging effect of corruption on key variables (governance, rule of law, business confidence and investment) shaping economic growth. [Wright, Craigwell, 2012] provide an alternative facet of this relationship observing that the level of economic growth might explain the extent of corruption (reverse causality). Economic growth may provide extra financial resources instrumental in fighting corruption whereas erratic and poor economic growth might deprive the state of the necessary resources to curb corruption. By allowing for the testing of the direction of causality, this study presents a mature introspection into this relationship. In pursuit of the same, the next section details the data sources as well as the methodology assumed.

2. Data and methodology

We model economic growth (EG) using the Gross Domestic Product (GDP) at local currency. Corruption (COR) is measured using the IIAG. The corruption index for IIAG is denoted COR. The series for IIAG covers the period 2000 to 2016. The GDP series consistently covers similar period as the IIAG series and

was obtained from World Bank. To accentuate the causality and impact of EG and COR we specify their respective adapted definitions from [Barro, 2003] as follows:

$$EG_t = \ln\left(\frac{GDP_t}{GDP_{t-1}}\right)$$

$$COR_t = \ln\left(\frac{IIAG_t}{IIAG_{t-1}}\right),$$

where t and t-1 is the time denoting current and previous year respectively, In – is the natural logarithm.

We adopt econometric methods namely The Augmented-Dickey-Fuller (ADF) test for unit root, lag selection test, Granger causality, unrestricted vector autoregressive (VAR) model, and impulse-response tests to determine the short run association between EG_t and COR_t. EViews 10 software was used for the data analysis.

3. Empirical results

The Augmented Dickey Fuller test was used to test for unit root of the logarithm series of IIAG and GDP. The null hypothesis is that the series under consideration is non-stationary or has unit root. A stationary series implies a constant probability distribution over time making statistical inference easy to be conducted.

Table 1
Augmented Dickey Fuller test

Logarithm series	p-value	Order	Comment
IIAG	0.0032*	I(1)	Stationary
GDP	0.0311*	I(1)	Stationary

* Significant at 5% level of significance.

Findings from Augmented Dickey Fuller test in table 1 highlights that the logarithm series of IIAG and GDP has no unit root after the first differencing. Probability values of the series are both less than 5% level of significance and therefore the null hypothesis of unit root is rejected.

Our interest in this study is the short run dynamics of economic growth and corruption. We use Granger causality test to investigate whether a directional relationship exists between economic growth and corruption.

Table 2
Granger causality test

Null hypothesis	F-statistic	p-value
COR does not Granger cause EG	5.52330	0.0170*
EG does not Granger cause COR	1.87283	0.2089

* Significant at 5% level of significance.

We find that corruption does Granger cause economic growth since the p-value is 0.0170, which is less than the 5% level of significance. However, we fail to reject the null hypothesis that economic growth does not Granger cause corruption. Our results

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[11] An Zimbabwean economic transformation blueprint which suffered a still birth owing to the lack of the requisite $ 27 billion funding.

[12] The R^2 and the Adjusted R2 was a paltry 30%.

[13] The study was based on a panel of 40 countries (Zimbabwe included) drawn from across the world.

[14] This is against Wright and Craigwel (2012) who proclaimed that "the causal pattern between corruption and economic growth cannot be determined theoretically and one must undertake an empirical analysis to resolve this issue."

reveal that there is only one directional relationship from corruption to economic growth debunking the possibility of reverse causality inked by [Wright, Craigwell, 2012]. We therefore proceed to select the lag order of a vector autoregressive (VAR) model using the Akaike information criteria (AIC). The lag order is crucial because few lags will result in our statistical inferences failing to capture all the information whereas large lags result in unbiased estimated coefficients [Stock, Watson, 2015]. The lag chosen is one which corresponds to a low AIC value. A lag of order one was chosen for the VAR model and the associated AIC value is -1.582372 as presented in Table 3.

Table 3
VAR test results with economic growth as the dependent variable

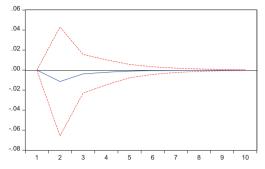|	EG
EG (-1)	0.585182
COR (-1)	-0.413558*
AIC	-1.582372
R^2	0.247967

* Significant at 5% level of significance.

Statistical inference results in table 3 with economic growth as the dependent variable indicates that past corruption significantly and negatively affects economic growth because of a negative significant beta coefficient value of -0.413558. Corruption contributes nearly 25% of variation in economic growth as reported by the R-square, further amplifying the corruption-growth relationship identified earlier. Our findings are consistent with policy-oriented theory of corruption which suggest that corruption "bruises" an economy and hampers its growth [Odi, 2014]. The responsiveness of the economy on account of the incidence of corruption is captured by the impulse response (fig. 1).

The impulse response function in fig. 1 shows that economic growth responds negatively to a shock in corruption. Findings in fig. 1 buttress the point illustrated by the VAR results that past corruption negatively affect economic growth. The corruption shock fades away after approximately 5 years implying that past corruption incidences continue to afflict the economy in the short run (5 years). The empirical results are in line with [United Nations.., 2001] which assert that misallocation of resources in the

Fig. 1. Impulse response function

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past (which stifle investment and scare away investors) reduces economic fortunes of a country [Mo, 2001] highlights the drivers of corruption shocks as bureaucratic inefficiencies in institutions and lack of a strong legislation and judicial systems. With regards Zimbabwe, past corruption-induced inefficiencies has negative effects on economic growth into the future (short run).

4. Conclusions and recommendations

We purposely sought to empirically establish the relationship between corruption and economic growth. The study employed time series econometric methods based on IIAG and GDP data for the period 2000-2016. A robust VAR model shows that corruption negatively affects economic growth in Zimbabwe and it runs from corruption to economic growth. The study also cements that past corruption incidences got a negative effect on economic growth in the short run. This implies that for the economy to recover in the future, current action to nip corruption is an obligation. The economy today therefore is suffering from corruption committed in the past thus the government of the day must take sweeping measures to arrest corruption to enhance economic fortunes in the future. In that realm, alleged political interference in government institutions must be investigated same as the gross embezzlement of state resources by public office bearers. Furthermore, adhering to international best practises in governance and non-politicization of the anti-graft institution go a long way in cleansing the economy of the widespread corruption – setting the stage for the rebound of the economy.

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Comparison of Russian national standard "Risk Management. Principles and Guidelines" releases (GOST R ISO 31000:2019 and GOST R ISO 31000:2010), taking into account primary sources

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Abstract

Publication of new releases of professional standards in different areas is always a challenge for experts since usually after such events organizations, which declare following principles formulated in those standards formally or informally, start implementing new processes. That is why it is necessary to understand the difference between the new release of a standard and a previous one. That circumstance is extremely important since risk management standards from the ISO family declare that the risk management has to become an intrinsic essential part of all business processes in an organization. In case of Russian national standards GOST R ISO 31000:2019 and GOST R ISO 31000:2010 Russian professional community didn't perform the work mentioned above. The reason was the COVID-19 pandemic which influenced the economics in general and activity of all professional communities in particular. The aim of the article under consideration is to fill in that gap.
Keywords: risk management, risk-oriented management of an organization, national standard GOST R ISO 31000:2019, national standard GOST R ISO 31000:2010.

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Introduction

Risk management as an independent direction of managerial and scientific thought was finally formed in 1955-1956: in 1955, the term "risk management" was proposed at Temple University in the USA by insurance professor W. Snyder. In 1956, R. Gallagher first described the profession of a risk manager in the Harward Business Review. In 1963 I. Mayor and B.A. Hedges published the first textbook on risk management in a commercial enterprise [Lyubuhin, 2021].

At the moment, having spread far beyond the field of finance and ensuring industrial safety, risk management covers, to one degree or another, almost all branches of enterprise activity, having turned from a narrow specific tool into one of the key components of a modern organisation management system [Oparin, 2017].

In order to systematise knowledge and ideas about risks, in 1995 the risk management standard AS / NZS 4360: 1995 was issued (the first national standard that applies to the territory of Australia and New Zealand). The standard contains general recommendations on risk management to ensure appropriate activities in terms of senior management of both state, private and public organisations, groups of individuals [Lyubuhin, 2021].

After the release of a number of national standards in the field of risk management, in particular in Canada and Japan, in 2009 the International Organisation for Standardisation released the first edition of the international standard ISO 31000:2009. Risk management - Principles and guidelines[1] (hereinafter referred to as the ISO 31000:2009 standard), which was translated and put into effect in the Russian Federation in 2010[2] GOST R ISO 31000-2010 was the key regulatory document in the field of risk management in Russia until the end of 2019 [Sekletsova, Ermolaeva, 2020].

Anticipating the presentation of the main material in the article, it should be noted that the previous and current versions of the standard are very close to each other not only in letter, but also in spirit. From our point of view, the key idea of both versions of the standard is expressed in the fact that risk management cannot be considered as a separate functional activity in an organisation, but is a specific set of tools and methods that allow company managers to make better management decisions, taking into account risk and uncertainty. At the same time, updating the standard can serve as both a reason and justification for the need to introduce risk management in an organisation, which, in our opinion, is still very relevant for most organisations in the country. Thus, it is possible to evaluate the changed wording of the standard from a political standpoint, in particular from the point of view of their perception by the decision maker. Without belittling the importance of the work carried out by the authors of the GOST R ISO 31000:2019[3], standard, we would like to note that a number of formulations used in the GOST R ISO 31000:2010 standard are more successful from the noted perspective.

The text structure of the GOST R ISO 31000:2019 standard consists of four large semantic blocks: basic terms, principles, structure and processes.

Terms. The section "Terms and Definitions" has changed dramatically - in the first version of 2010, 29 concepts were deciphered, in the new version of 2019 there were only 9. Moreover, in the English version of 2018, five terms directly migrated from the old version, and in the Russian version all 9 terms were adjusted . Of the 20 terms not included in the glossary, only 2 are not used in the new standard, the rest are deciphered and disclosed directly in the text.

The definition of the term "risk" is supplemented with a note that a risk can be associated with both negative and positive consequences at the same time.

The introduction of the term "participant" is an innovation of the new Russian standard GOST R ISO 31000-2019 and requires additional semantic terminological analysis and comparison with the term "interested party" to establish or refute the synonymy of concepts.

As part of the definition of an "event", the GOST R ISO 31000-2019 standard omits a note that an event, in addition

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to several causes of occurrence, can have not one, but several consequences of its completion (which is also an innovation of the ISO 31000: 2018[4] standard).

Also, regarding the definition of the term "consequences" of the Russian version of the standard, two significant aspects in the notes to the term in the ISO 31000:2018 standard are missing, in particular, that the consequences can affect the goals directly or indirectly, as well as the possibility of a cumulative effect along with cascading in relation to the result of the consequences.

There is no definition of the term "risk level" in the new standard, while it is used in the text without disclosing its essence, which may lead to ambiguous interpretations of the term.

In the new version, the concept of "residual risk" has disappeared, which may introduce some uncertainty into the idea of risk management at the level of a general understanding of risk management in an organisation.

Principles. The scheme of principles is significantly simplified compared to the previous version of the standard and emphasises the equal importance of each principle by presenting them in the form of sectors of the same size, shortening their names. The central place (not equivalent, as before) was taken by the principle: "Risk management serves to create and protect value." In fact, this - the creation and protection of value - is declared the goal of risk management. Two principles are excluded: consideration of risk management exclusively by uncertainty and the inclusion of risk management in the decision-making process.

At the same time, the authors would like to note that the abbreviated wording o the principles of risk management principles in the new edition of the standard, despite the given interpretations compared to the wording in the previous version, may give rise to misunderstanding e of the principle essence, primarily among top management, which will be discussed in the relevant part of the article.

Structure. The translation of the term "risk management framework" has changed - previously it was translated as "risk management infrastructure". The scheme has changed: "leadership and commitment" have become the central element of the structure, the other elements are equivalent to each other. A new element of the structure - "adaptation" was added. The block "Monitoring and analysis of infrastructure" was replaced by the block "Performance assessment". The cyclical nature of work process on the risk management structure has been preserved. Block names have been shortened and simplified.

Process. The block has undergone minimal changes. The first group of processes in the previous version of the standard was called "situation (context) definition", in the new edition it is called "scope, environment and criteria". According to the authors, the goal-setting stage should be singled out from this group due to its critical importance.

The new version of the standard continues to emphasise the iterative and cyclical nature of risk management processes, as well as the fact that risk management processes should exist in three environments: monitoring and reviewing risk management processes, ongoing consultation with the organisation's stakeholders, and documentation and reporting (this element was not present in the previous version of the standard).

1. Introduction of the new standard and detailed analysis of changes

The authors of the article see the purpose of this work in analysing changes not only in the terminological apparatus of the GOST R 31000-2019 standard compared to the GOST R ISO 31000-2010 standard, but also in a number of fundamental provisions, including reference to the original source - the original versions of the "parent" standards ISO 31000:2018 and ISO 31000:2009, that is, the transformation of the principles and methodology of risk management, which is of unconditional value in practice.

At present, instead of GOST R ISO 31000-2010 "National Standard of the Russian Federation. Risk management. Principles and guidance" (hereinafter referred to as the GOST R ISO 31000-2010 standard), which is a translation of the ISO 31000:2009 standard, the new standard GOST R ISO 31000-2019 "National standard of the Russian Federation. Risk management. Principles and guidance" (hereinafter referred to as the GOST R ISO 31000-2019 standard) comes. The standard is also a translation of the international standard ISO 31000:2018. Risk management - Guidelines (hereinafter referred to as the ISO 31000:2018 standard), developed by Technical Committee ISO / TC 262.

It should be noted that at the time of preparation of this article, such standards as GOST R 58771-2019 "National Standard of the Russian Federation. Risk management. Risk Assessment Technologies" (approved and put into effect by the order of Rosstandart dated December 17, 2019 No. 1405-st), GOST R 51897-2011 / ISO Guide 73:2009 "National Standard of the Russian Federation. Risk management. Terms and definitions" (approved and put into effect by the order of Rosstandart dated November 16, 2011 No. 548-st), which are translations of the ISO standards of the same name, however, it should be recognised that it is the GOST R ISO 31000-2019 standard that is the methodological core of building a risk management system within the national regulation.

2. Concepts and terms

Careful attention should be paid to the transformation of the conceptual and terminological apparatus in the standards.

The disclosure of the terms used in the standard is carried out in section 3 "Terms and definitions" of the version of the GOST R ISO 31000-2019 standard. The section contains 9 definitions of terms instead of 29, reflected in the GOST R ISO 31000-2010 standard. The authors analysed these terms, including comparing them with the definitions in the original ISO 31000:2018 and ISO 31000:2009 standards.

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[4] *ISO 31000:2018. Risk management – Guidelines.* https://www.iso.org/ru/standard/65694.html.

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Nine definitions in ISO 31000:2018 are provided for the following terms (clauses 3.1.-3.8.1):
- risk;
- risk management;
- risk source;
- involved (interested) party (stakeholder);
- event;
- consequence;
- plausibility (occurrence of the event) (likelihood);
- management (risk) (control);
- comparative risk evaluation.

All 9 definitions were amended in GOST R ISO 31000-2019 compared to GOST R ISO 31000-2010. However, for 5 terms no changes were made in the international standard ISO 31000:2018 compared to ISO 31000:2009 (excluding Notes), in particular, they include: risk, risk management, stakeholder, consequence, likelihood, which, apparently, is associated with a change in the approach to translating the text into Russian by developers. Also, in the GOST R ISO 31000-2019 standard, in relation to the ISO 31000:2018 standard, an additional definition is given to the term "uncertainty".

According to the authors, the key methodological features of the changes in the applied concepts are the following.

Changing the basic term "risk management" to "managing risk". If in the first case, based on the wording, subjectively, in the opinion of the authors, it is possible to allow the interpretation of risk management as the implementation of management activities under risk conditions, then the second wording somewhat limits this possibility, clearly outlining the object of management.

The definition itself in the version of the GOST R ISO 31000-2019 standard refers to the impact of uncertainty on the achievement of the set goals, however, in the text of the ISO 31000:2018 standard, the phrase "achievement of the set ones" is not used. Thus, we can conclude that the translation version of the term presented in the GOST R ISO 31000-2010 standard is closer to the ISO 31000:2018 standard. It should be noted that risks can affect not only the achievement of goals, but also the very formulation of the goal (especially when it comes to interpreting risk in a positive way - as an opportunity), but at the same time, the extremely high importance of the goal setting for risk management should be taken into account, which is emphasised by the translation of the current version of the standard.

The introduction of the term "stakeholder" is an innovation of the new Russian standard GOST R ISO 31000-2019 and requires additional semantic terminological analysis and comparison with the term "interested party" to establish or refute the synonymy of concepts. Important, in our opinion, here is the concept of "interest", which can be revealed as a positively colored emotional process associated with the need to learn something new about the object of interest, increased attention to it. Therefore, "interest" in one way or another is more active in nature, and "involvement" can also be expressed in passive forms of its manifestation, but it should not be confused with "passive indifference".

Participation can also be expressed in the conscious inaction of the subject.

Regarding the definition of the risk source presented in the GOST R ISO 31000-2019 standard, in comparison with the ISO 31000:2018 standard, there is no significant note in its translation into Russian that an event can also be a risk source.

As part of the definition of an event, the GOST R ISO 31000-2019 standard omits a note that an event, in addition to several causes of occurrence, may have several consequences of its completion (which is also an innovation of the ISO 31000:2018 standard).

As part of the term "risk control", the ISO 31000:2018 standard adds the ability to keep the risk up to date as one of the components of the risk control process. This aspect is not taken into account in GOST R ISO 31000-2019.

With regard to the definition of the term "consequences" of the GOST R ISO 31000-2019 version, two significant aspects are missing that are present in the notes to the term in ISO 31000:2018, in particular, that consequences can affect goals directly or indirectly, as well as the possibility of having a cumulative effect along with a cascading effect in relation to the result of the consequences.

Of the remaining 20 terms previously present in the "Terms and definitions" section of the ISO 31000:2009 version of the standard, most (17) are contextually disclosed in the following sections, while 2 previously used terms are not present in the text:
- attitude to risk (risk attitude);
- risk profile.

Separately, we should consider the term "risk level", previously present in the GOST R ISO 31000-2010 standard. It is absent in the GOST R ISO 31000-2019 standard and, at the same time, it is used in the standard without disclosing its essence, which, in our opinion, is a drawback of the new edition of the Russian standard. Nevertheless, it should be noted that the concept is present in the National Standard of the Russian Federation "Risk Management. Terms and definitions GOST R 51897-2011 / Guide ISO 73:2009, approved by the order of Rosstandart dated November 16, 2011 No. 548-st, in accordance with clause 3.6.1.8 of which the level of risk is a measure of risk or combination of several types of risk, characterised by consequences and their plausibility/probability.

The 17 terms not included in the Terms and Definitions section of GOST R ISO 31000-2019 include: risk assessment, risk evaluation, risk management framework, risk identification, risk analysis, risk treatment, monitoring, review, residual risk, risk criteria, external context, establishing the context, risk owner, risk management process, risk management plan, communication and consultation, risk management policy.

The key features of the changes in the applied concepts are the following.

The term "risk management plan" in the text of the GOST R ISO 31000-2019 standard is also not used, however, the use of "plans that determine the necessary time and resources" is supposed to be used as a tool for implementing risk management. Thus, the restriction on the

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inclusion of measures for the implementation of the risk management infrastructure exclusively in the document named as the "risk management plan" has been removed. Meanwhile, in accordance with the requirements of the GOST R ISO 31000-2010 standard, it is stipulated that an alternative document should also include a description of the risk management approach, components and resources. This change is broadly in line with the change in approach to risk management plans in ISO 31000:2018.

An understanding of its characteristics has been added to the goal of risk analysis, and an understanding of the level of risk has been made as an optional element.

The GOST R ISO 31000-2019 standard does not use the terms "monitoring" and "review" separately. The disclosure of terms in the text of the standard is simplified through the description of their elements, including planning, collecting and analysing information, documenting results and providing feedback.

"Risk criteria" - in the GOST R ISO 31000-2019 standard risk criteria should allow to highlight not only the significance of the risk, but also its type and scale (value, size), in addition, the set of factors that must be taken into account when defining risk criteria. Also, in relation to this term, the following, in our opinion, shortcoming in the translation of the original standard should be highlighted. With regard to the factor "the method of determining and assessing the consequences (both positive and negative) and their likelihood", which must be taken into account when determining the risk, a technical error is likely made, in particular, closer in meaning to the ISO 31000:2018 standard would be the wording "a way of determining and evaluating the consequences (both positive and negative) and their plausibility" (taking into account the translation of the term likelihood in section 3 of the standard).

The term "environment" (context) was previously translated as "context" or "situation" within the framework of the GOST R ISO 31000-2010 standard. In connection with the change presented, related terms have also changed, such as "external environment" (external context) and "internal environment" (internal context), as well as "defining the environment" (formerly "establishing the context"). Similarly, the translation of the term "risk evaluation" to "comparative risk assessment", "risk treatment" , "risk management framework" in the version of the GOST standard R ISO 31000-2018 have been renamed.

The risk documentation and reporting element have been added to the definition of the risk management process.

It should be noted that hereinafter, in the text of the ISO 31000:2018 standard, the term reporting is used, the meaning of which in some cases implies not only the preparation, but also the provision of prepared reports (including for subsequent analysis). According to the text of the GOST R ISO 31000-2019 standard, the phrase "reporting preparation" is used with the exception of clause 6.7 in terms of mentioning the forms of preparation and the method of reporting. In our opinion, in all cases of using the phrase "reporting preparation" it should also be supplemented with the words "and its provision".

With regard to the term "risk management policy", the restriction on the form was removed to reflect the general intentions, directions of the organisation's activities in relation to risk management, precisely in terms of their placement in the risk management policy.

The concept of "residual risk" has disappeared in the new version. The removal of this term from the list completely overturns the existing risk management processes in many companies, changing the established approach. Previously, the philosophy of working with risks, so to speak, was

Table 1
Information about the results of comparison of terms and definitions

	ГОСТ Р ИСО 31000-2010	**ISO 31000:2018**
1	Terms given in section 3 "Terms and definitions" of the GOST R ISO 31000-2010 standard	29
2	The terms given in section 3 "Terms and definitions" of the GOST R ISO 31000-2019 standard, including:	9
2.1	terms that differ in definition compared to GOST R ISO 31000-2010	9
2.2	Terms in which definitions have not been changed in ISO 31000:2018 from ISO 31000:2009	5
3	Terms that are not in section 3 "Terms and definitions" of the GOST R ISO 31000-2019 standard, but are present in the GOST R ISO 31000-2010 section of the same name, including:	20
3.1	terms that are not used in the text of the GOST R ISO 31000-2019 standard	2
3.2	terms that are used but not disclosed in the relevant sections of the GOST R ISO 31000-2019 standard	1
3.3	terms that are contextually disclosed in the relevant sections of the GOST R ISO 31000-2019 standard	17

Source: compiled by the authors based on the standards GOST R ISO 31000-2019, GOST R ISO 31000-2010, ISO 31000:2018, ISO 31000:2009.

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based on the fact that uncertainty cannot be completely eliminated, but it can and should be constantly reduced. Accordingly, work with uncertainty consisted in the cyclic identification of its (uncertainty) manifestations through risks, more precisely, risk events ("risk is the impact of uncertainty on goals"), and attempts to reduce possible risks by controlling "residual risks" [Sidorenko et al. , 2016]. Such an idea, such a philosophy of working with risks were one of the drivers that ensured the cyclical and continuous operation of the risk management system in the organisation. The absence of the term and its definition in the new standard to some extent shifts the emphasis, and there is a danger in the perception of risk by the company's management as a relatively static phenomenon, completely removable at the moment (which is categorically wrong).

Applying the GOST R ISO 31000-2019 standard, an organisation is able to build an effective and continuous risk management process. A visual representation of the process elements and the relationship between the blocks
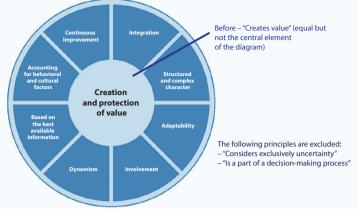
Fig. 1. Key changes in the "Principles" block

Source: compiled by the authors based on the standards GOST R ISO 31000-2019, GOST R ISO 31000-2010.

are shown in the diagram shown in Fig. 1 of the standard "Principles, structure and process". Further Fig. 2-4 show the details of the mentioned blocks. Let us consider each block of the specified scheme separately, and then turn to the relationship between them.

Table 2
The ratio of the names of the elements of the block "Principles" presented in the diagram
(taking into account the names given in the original standards in English)

GOST R ISO 31000-2019	GOST R ISO 31000-2010	ISO 31000:2018	ISO 31000:2009
Value creation and protection	Creates value	Value creation and protection	Creates value
Integration	Integral part of organisational processes	Integrated	Integral part of organizational processes
Structured and comprehensive character	Systematic, structured and timely	Structured and comprehensive	Systematic, structured and timely
Customisation	Tailored	Customized	Tailored
Involvement	Transparent and inclusive	Inclusive	Transparent and inclusive
Dynamics	Dynamic, iterative and responsive to change	Dynamic	Dynamic, iterative and responsive to change
Best available information	Based on the best available information	Best available information	Based on the best available information
Human and cultural factors	Takes human and cultural factors into account	Human and cultural factors	Takes human and cultural factors into account
Continuous improvement	Facilitates continual improvement and enhancement of the organization	Continual improvement	Facilitates continual improvement and enhancement of the organization
—	Explicitly addresses uncertainty	—	Explicitly addresses uncertainty
—	Part of a decision making process	—	Part of decision making

Source: compiled by the authors based on the standards GOST R ISO 31000-2019, GOST R ISO 31000-2010, ISO 31000:2018, ISO 31000:2009.

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3. Principles

The first block of elements includes principles that establish the characteristics of effective and efficient risk management, reflect its values and explain its role and purpose. The key changes in the composition of the block are shown in Fig. 1.

Table 2 shows the ratio of the block elements in the versions of the standards in Russian and English. The table made it possible to compare the elements of the block and highlight their changes.

The scheme given in the GOST R ISO 31000-2019 standard is significantly simplified compared to the previous version of the standard and emphasises the equal importance of each principle by presenting it in the form of sectors of a single size, abbreviating their names.

The fact that in the updated version the block "Creating and protecting value" (previously - "Creates value") has become a central, and not an equivalent element, is quite remarkable: in fact, the creation and protection of value in the new edition of the standard is declared the goal of risk management. The idea of the activities of a commercial organisation has been greatly transformed over the past decades and has gone quite far from the primitive idea of a company as a means of extracting profit from the outside world. The modern view of business defines a company as a structure for the supply (or production, but still further supply) of value to customers. The situation in management is such that if there is a supply of value, there will be both its monetisation (profit) and the benefit for shareholders (increase in value). And the ISO 31000:2018 standard proposes to consider risk management as an essential part of the overall process of creating and delivering value by a company, marking it as the center of management disciplines. With regard to the functioning of public authorities, the issue of finding and determining value is complicated by the fact that we are talking about large and super-large systems where it is necessary to establish rules and maintain public goods for the widest possible strata of the population and business. And here, of course, embedding risk management into overall management processes is a non-trivial task, which at the same time carries huge potential benefits.

We see the need to evaluate changes in the content of the principles and their composition.

Integration. In the previous version of the standard, instead of a very vague wording: "Integrated risk management is a main part of all organisational activities" - it was said that: "Risk management is an integral part of all organisational processes", which, in fact, meant that those or other business processes themselves become risk factors, which gave the risk manager a clear clue in identifying risks.

Structure and complex character. In the opinion of the authors, the translation of the English term comprehensive as complex is not entirely successful. Here, comprehensive means, rather, integrated, which implies that without risk management, the effective and efficient operation of the organisation is not possible.

It should be noted that from the description of the fourth principle - involvement - the requirement of transparency has justifiably disappeared. On the one hand, all stakeholders of the organisation should be involved in risk management processes in one way or another (the translation of this term as "participants", in the opinion of the authors, is also not entirely successful), on the other hand, as a result of the implementation of risk management measures, information may arise , which is a trade secret. Moreover, certain information on risk management must be kept inside the organisation as well, otherwise, for example, such a risk identification tool as cross-interviews becomes ineffective.

Dynamism. It should be noted that when deciphering this principle, the mention of iterative risk management processes disappeared. This is most likely due to the fact that the new version of the standard does not contain the concept of residual risk. The authors of this article still consider it necessary to conduct an analysis and comparative assessment of risks that turned out to be impossible to eliminate after the hypothetical execution of all planned "risk treatment" activities. Moreover, it is known that "risk treatment" activities can lead to the emergence of new risks, the strengthening of other risks that have not been "treated", therefore, it seems that a direct reference to the iteration of risk management processes would be useful in the new version of the standard.

Based on the best information. In this case, taking into account the practical side of the implementation of the principle, it is necessary to keep in mind the possibility of competing interests between the person responsible for risk management and other stakeholders and the existence of barriers to obtaining the necessary information due to this fact.
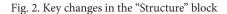
Accounting for behavioral and cultural factors. The wording and definition of the principle in the text of the GOST R ISO 31000-2019 standard fully coincide with those presented in the version of the GOST R ISO 31000-2010 standard and are understandable and sufficiently complete.
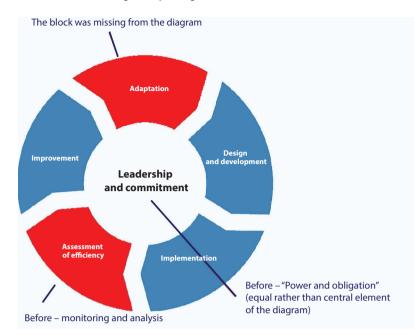
With the similarity of the formulation of continuous improvement principle with that presented in the previous version, in the opinion of the authors, in the version of GOST R ISO 31000-2010 this principle of kaizen was revealed more deeply and had a more applied character. "Risk management contributes to the continuous improvement of the organisation" - this is the old formulation of this principle. That is, if risk management does not contribute to the continuous improvement of the effectiveness and efficiency of the organisation, then this is not risk management. The new wording proclaims risk management as a kind of "thing in itself", which must be constantly improved.

The new standard excludes such principles (compared to the GOST R ISO 31000-2010 standard) as the consideration of risk management exclusively by uncertainty (or the presence of a clear connection between risk management and uncertainty) and the inclusion of risk management in the decision-making process. The exclusion of the last two principles from the modern version of the standard, in the opinion of the authors, is inexpedient, first of all, from a practical point of view.

Risk management deals exclusively with uncertainty. When working with the risk register, responsible people

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Fig. 2. Key changes in the "Structure" block

Source: compiled by the authors based on the standards GOST R ISO 31000-2019, GOST R ISO 31000-2010.

quite often make mistakes of incorrectly identifying risks, which is quite understandable due to purely psychological reasons: a person refers to risks not an event or condition that falls under the standard, but what he is most afraid of. Therefore, restrictions quite often fall into the risk register, that is, negative conditions that already exist, or negative events, the probability of which is extremely high and which is almost impossible to influence. They are reflected in the registry using, for

example, the wording "insufficient funding" or "lack of qualified personnel". Maintaining the principle could, to some extent, reduce the likelihood of committing these methodological errors.

And finally, risk management is part of the decision-making process. It seems to us that if this principle remained in the updated version of the standard, then it would be an excellent reminder to all top managers of organisations that they must take into account risks when making key management decisions.

4. Structure

На рис. 2 приведены ключевые изменения блока «Структура».

The ratio of the "Structure" block elements presented in the diagram (taking into account the names given in the original standards in English) is shown in Table. 3.

With regard to the risk management structure, attention should be paid to the change in the translation of the term "risk management framework" in comparison with the GOST R ISO 31000-2010 standard: previously it was translated as "risk management infrastructure".

In this diagram, "leadership and commitment" is the central element of the structure, the other elements are also presented as equivalent to each other due to the equal size of the display. All the more, a new element of the structure

Table 3
The ratio of the names of the elements of the "Structure" block presented in the diagram
(taking into account the names given in the original standards in English)

GOST R ISO 31000-2019	GOST R ISO 31000-2010	ISO 31000:2018	ISO 31000:2009
Leadership and commitment	Mandate and commitment	Leadership and commitment	Mandate and commitment
Adaptation	—	Integration	—
Design	Design of framework for managing risk	Design	Design of framework for managing risk
Implementation	Implementing risk management	Implementation	Implementing risk management
Evaluation	Monitoring and review of the framework	Evaluation	Monitoring and review of the framework
Improvement	Continuos improvement of the framework	Improvement	Continual improvement of the framework

Source: compiled by the authors based on the standards GOST R ISO 31000-2019, GOST R ISO 31000-2010, ISO 31000:2018, ISO 31000:2009.

has been added - "adaptation". The block "Monitoring and analysis of infrastructure" was replaced by the block "Performance assessment". The cyclical nature of the process of work on the risk management structure has been preserved. Block names have been shortened and simplified. The description of the blocks is given in section 5 of the GOST R ISO 31000-2019 standard.

According to the authors, the cycle of work on the management infrastructure is a special case of the implementation of the Deming-Shewhart cycle, which involves planning (Plan) in its structure (including goal setting and identifying resources to achieve them), doing what was planned (Do), monitoring and evaluation of the achievement of goals (Check), implementation of measures to improve performance (Act):

Plan - design and development;

Do - implementation;

Check - performance evaluation;

Act - improvement.

At the same time, the new element "adaptation", as the authors believe, ensures compliance and mutual integration of the management system and the organisation's processes in the risk management system.

Without diminishing in any way the importance of the information presented in this section of the GOST R ISO 31000-2019 standard, the authors would like to draw attention to some vagueness of the wording of very important provisions from a practical point of view, which were more clearly stated in the previous version of the standard. The essence of the meaning of the English term framework is the basis (regardless of translation), that is, it is a set of organisational components that helps to successfully integrate risk management into the organisation's activities.

The term "leadership" in the modern managerial vocabulary is vague and somewhat discredited. Thus, placing it in the center of the description of the knowledge area basis, related by and large to professional activity (hard management skills), in the opinion of the authors, is not entirely correct. Moreover, the decoding of this term includes:

- 5 points of explanations for understanding the terms "leadership" and "commitment";
- 6 competitive advantages that an organisation receives when implementing the principles of leadership and commitment in relation to risk management;
- 5 groups of expectations and requirements from the control and supervisory authorities in relation to the organisation in the field of risk management.

At the same time, the risk management infrastructure scheme itself, given in the text of the GOST R ISO 31000-2010 standard, despite a certain visual cumbersomeness, pointed to the "organisational components" that are in the basis of effective risk management:

1) without understanding the internal and external environment (context) in which the organisation operates, the implementation of risk management is impossible;

2) the risk management standard is universal, applicable to any organisation of any size and any form of ownership, therefore it is impossible not only to describe specific processes, but even to give an exhaustive list of required documents and reports. However, the standard considers one single document mandatory - the risk management policy - a kind of declaration of intent in this area;

3) the standard states that risk management information should be included in corporate reporting (organisation reporting), without focusing on how this should be done;

4) rightly focuses on the thesis about the need to integrate risk management into all organisational processes;

5) postulates the need to allocate resources of the required quality (primarily human) for the implementation of risk management in the organisation. In practice, personnel is often assigned to roles one way or another related to risk management on a residual basis;

6) the need to establish general rules and a mechanism for collecting and exchanging information within the organization is postulated (to ensure the implementation of the principle of basing on the best information);

7) the need to establish general rules and a mechanism for collecting and exchanging information with external stakeholders of the organisation (to ensure the implementation of the principle of basing on the best information) is postulated.

It was further stated that the starting position and the basis for the implementation of these components is the distribution of powers and responsibilities (in the text of the GOST R ISO 31000-2010 standard - obligations). The presence of this item in the scheme made it possible to immediately ensure the distribution of powers in the field of risk management between the CEO, risk manager, functional managers, owners and other parties (in relation to a commercial organisation).

It should also be noted that the term commitment in the previous version of the standard was translated as an obligation, and in the new one - as involvement. From the point of view of the authors, both interpretations are of extremely high significance. On the one hand, risk management should provide for a clear distribution of powers (obligations assumed), on the other hand, all levels of the hierarchical ladder should be involved in risk management in an organisation, starting from a low-level specialist and ending with the person responsible for making management decisions of high level himself [Tsakaev, Saidov, 2020].

5. Risk management process

The key changes in the "Process" block are shown in Fig. 3.

The specified block has visually undergone minimal changes. However, if the first group of processes in the previous version of the standard was called "Defining the situation (context)", then in the modern edition it is called "Scope, environment and criteria". At the same time, recalling

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the definition of risk given in the standard as a consequence of the influence of uncertainty on the achievement of goals, we must emphasise that without proper goal setting all risk management loses its meaning, therefore, according to the authors, the goal setting stage should be separated from the group "Scope, environment and criteria".

The new version of the standard emphasises the iterative and cyclical nature of risk management processes (which was also evident in the previous version), as well as the fact that risk management processes should exist in three environments: monitoring and reviewing risk management processes, constant consultation with stakeholders of the organisation and documentation and reporting. The last element within the risk management process was not present in the previous version of the standard. Its inclusion in the new edition seems reasonable to the authors.

Based on the analysis of changes in the risk management process diagram (Fig. 3), the authors believe it is possible to distinguish the following main stages of the risk management process:

1. Setting the goals of risk management based on the decomposition of the organisation goals and its divisions.
2. Definition of risk criteria (to establish what is considered a risk for the organisation).
3. Risk identification (find, recognse and describe the risk).
4. Risk analysis (understand the nature of the risk and its characteristics, the causes and consequences of its possible implementation). Try to determine the level of risk. At this stage, as a rule, there is a draft list of possible actions for "risk treatment".
5. Comparative risk assessment (compare the results of the risk analysis with the established risk criteria, determine where additional action is required). At this stage, the selection of measures for "risk treatment" from the previous list is carried out.
6. Preparation of a risk treatment plan (selection of the final "risk treatment" option and documentation of this option).
7. Implementation of the "risk treatment" plan (timely and adequately response to risks).
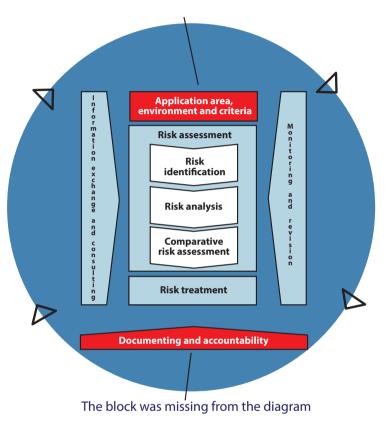
6. General scheme of risk management

The relationship between the blocks of the central scheme of the GOST R ISO 31000-2019 standard is shown in Fig. 4.

Changes in the relationships between the blocks of the scheme involve the spread of risk management principles both to its entire process and to the entire structure of risk management.

In the previous version of the standard, it was schematically assumed that the principles were extended to the structure exclusively through the "authority and obligation" structure element, there was no relationship of the principles with the process, and the relationship between the structure and the process was probably implied by the "application of risk management" element of the structure.

Fig. 3. Key changes in the "Process" block

Before – "Establishing the context"

The block was missing from the diagram

Source: compiled by the authors based on GOST R ISO 31000-2019, GOST R ISO 31000-2010.

7. Summary and conclusion
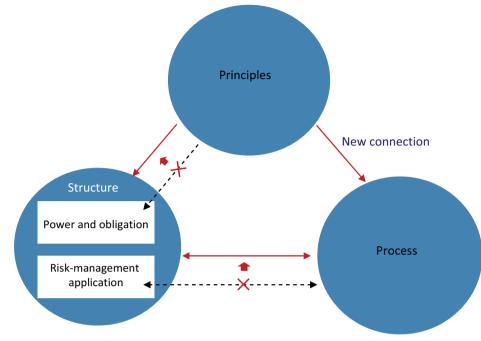
The analysis of the provisions of the analysed documents, taking into account, in particular, the international standards of the ISO 31000 family, made it possible to identify and evaluate the features of the new standard GOST R ISO 31000-2019 and its primary source.

According to the authors of the article, during the development of the ISO 31000:2018 standard, the following tasks were achieved, among other things:

• reducing the amount of textual content of the standard, in particular by excluding definitions of contextually understandable terms from the relevant section (for example, "risk management process", "monitoring and review", "risk analysis");
• ensuring increased flexibility in the organisation's

Fig. 4. Changing relationships between blocks

Source: compiled by the authors based on GOST R ISO 31000-2019, GOST R ISO 31000-2010.

actions when creating and maintaining a risk management system when using the standard [Tsakaev, Saidov, 2020];

• clarification and addition of certain terms of the standard in order to improve their understanding (for example, this refers to the concept of "risk" and notes to it; in terms of keeping the risk in a given state; emphasised consistency in demonstrating that the risk can be associated not only with negative , but also the positive impact of uncertainty on the goals of the organisation, as well as simultaneously with these two effects).

The new version of the standard has greater application flexibility, as well as a more accessible visual component (used in the text of flowcharts), however, it has a number of features compared to the previous version of the standard, which are ambiguously evaluated by the authors from a practical and political point of view, in particular, the exclusion of the term " residual risk" from the relevant section, the exclusion of the principles that are important from a practical point of view "Risk management deals exclusively with uncertainty" and "Risk management is part of the decision-making process".

It is also important to once again pay attention to the authors' proposal to single out goal-setting in the field of risk management in the risk management process diagram as an independent block along with the "Scope, environment and criteria" block.

An analysis of the transformation of the conceptual apparatus in the GOST R ISO 31000-2019 standard made it possible to conclude that a significant part of the terminological changes in the new edition of the standard compared to the GOST R ISO 31000-2010 standard is associated with a change in the translation of key terms into Russian in the new version of the standard. If it becomes necessary for an organisation that was previously guided by the requirements of GOST R ISO 31000-2010 to bring risk management activities in line with GOST R ISO 31000-2019, it is also advisable to use a comparison with its primary source - ISO 31000:2018 and (or) this article , which will avoid unnecessary creation of new risk management elements in the enterprise by transforming existing ones.

It should be noted that significant work has been done in terms of translating the English version of the standard into Russian with the elimination of a number of inaccuracies made during the translation of the ISO 31000:2010 standard. Nevertheless, according to the authors, the approved translation of the GOST R ISO 31000-2019 standard into Russian can be recommended for supplementing the previously unaccounted for individual notes of the original ISO 31000:2018 standard, for revising a number of notes to the terms and individual wordings used in the definitions in terms of ensuring a more complete and accurate compliance with the ISO 31000:2018 standard (Table 4).

It should be noted that in practice, risk management in an organisation is designed primarily to prevent threats to its functioning that arise or may arise in the future, and secondly, to probable opportunities that will improve the performance of the company, increase its efficiency as a whole or in parts of separate processes. In any case, for a commercial organisation, the implementation of risk management should lead to positive financial consequences, and for a budgetary organisation, to a more efficient and effective achievement of established performance indicators.

It should be remembered that risks can be associated both with the internal processes of the organisation

Table 4
Information on the results of comparison of terms and definitions

№	Text fragment	Place in standard	Translation Suggestions and Comments
1.	The above components may be partially or fully implemented in the organisation, however, they may require adaptation or improvement for more effective, efficient and consistent risk management.	"Introduction" section, paragraph 7	Suggested revision: "The above components may be partially or completely implemented in an organisation, but they may require adaptation or improvement to ensure the effectiveness, efficiency and consistency of risk management" (in accordance with the semantic content of the text in the ISO 31000:2018 standard).
2.	This International Standard establishes a set of principles that must be followed in order for risk management to be effective. This International Standard recommends that organisations develop, implement, and continually improve a risk management framework and process that will add value to organisations.	"Introduction" section, paragraph 9	Delete (not included in ISO 31000:2018).
3.	risk: A consequence of the influence of uncertainty on the achievement of goals	Clause 3.1	Suggested revisio: "risk: The impact of uncertainty on goals" (in accordance with the semantic content of the text in the ISO 31000:2018 standard). Uncertainty can affect not only the achievement of goals, but also directly on the formulation of goals, on the process of setting them as a definition of the desired state of the organisation. In particular, the identification of the risk of a positive event occurring during the implementation of risk management may lead to the need to establish a goal that involves maximising the likelihood of this event occurring.
4.	Risk is often characterised by describing a possible event (3.5) and its consequences (3.6), or their combination.	Clause 3.1, notes 3, 4	Suggested revision: "Risk is usually expressed (or characterised) as a source of risk, as potential events, as their sequence and as the probability of their occurrence." In the opinion of the authors, in this version of the presentation, the text more accurately conveys the content of the corresponding text fragment of the ISO 31000:2018 standard.
5.	Risk is often presented in terms of the consequences of a possible event (including changes in circumstances) and the corresponding probability.		
6.	Uncertainty is the state of complete or partial absence of information necessary to understand an event (3.5), its consequences (3.6) and their probabilities	Clause 3.1, note 5	It is proposed to be excluded. Is absent in ISO 31000:2018.
7.	After the influence of uncertainty, it is necessary to understand the deviation from the expected result or event (positive and / or negative)	Clause 3.1, note 1	Suggested revision: "Influenced by uncertainty refers to deviation from what is expected. It can be negative, positive, or a combination of both, and can eliminate, create, or lead to opportunities and threats." (in accordance with the semantic content of the text in the ISO 31000:2018 standard, the definition given in the translation does not contain a mention of opportunities and threats).
8.	risk management: coordinated activities to direct and manage an organization in the area of risk	Clause 3.2	Suggested revision: "risk management: coordinated action to direct and control an organisation in relation to risk".

Table 4 – *continuation*

№	Text fragment	Place in standard	Translation Suggestions and Comments
9.	Interested party - stakeholder Any individual, group, or organisation that can influence, be affected by, or feel affected by a risk	Clause 3.3	Requires additional semantic terminological analysis and comparison with the term "interested party" to establish or refute the synonymy of concepts (detailed in the text of this article). According to the note to the term given in clause 3.3 of ISO 31000:2018, it is allowed to use the original concept of stakeholder along with the concept of interested party as its alternative.
10.	The source of risk can be tangible or intangible.	Clause 3.4, note	It is proposed to be excluded (is absent in ISO 31000:2018 standard).
11.	An event can be single or repeated and can have multiple causes	Clause 3.5, note 1	Suggested revision: "An event can have multiple causes and multiple consequences" (based on ISO 31000:2018).
12.	The event can be defined or undefined	Clause 3.5, note 2	Suggested revision: "An event can be something that is expected but does not happen, and something that is not expected but happens" (based on ISO 31000:2018).
13.	An event without consequences (3.6) can also be called the threat of a hazardous event, the threat of an incident, the threat of injury, or the threat of an emergency.	Clause 3.5, notes 3, 4	Proposed to be excluded (is absent in ISO 31000:2018, limits the meaning of the concept by excluding events that have positive consequences).
14.	the event can be called by the terms "incident", "hazardous event" or "accident"		
15.	consequence - the effect of an event (3.5) on an object	Clause 3.6	Suggested revision: "The result of an event that affects goals" (including based on the definition of the term "risk", the text of ISO 31000:2018 standard).
16.	The impact of an event can result in one or more consequences.	Clause 3.6, note 1	Proposed to be excluded (is absent in ISO 31000:2018 in the specified clause, is present in note 1 to clause 3.5).
17.	Consequences may be definite or uncertain, and may range from positive to negative.	Clause 3.6, note 2	Suggested revision: "Consequences can be definite or uncertain, have a positive or negative direct or indirect effect on the objectives." In the approved edition of the GOST R 31000-2019 standard, the moment of direct or indirect influence of the consequences on the goals, reflected in ISO 31000:2018 standard, is omitted.
18.	Initial consequences can cause further consequences to escalate in a domino-like manner	Clause 3.6, note 4	Suggested revision: "Any consequence can be amplified by the impact of a cascading and cumulative effect" (to a greater extent corresponds to the text of the ISO 31000:2018 standard, in particular, there is no mention of a cumulative or synergistic effect in the translation).
19.	Risk management (Control) measures to change a risk (3.1)	Clause 3.7	Suggested revision: "risk management (control): Measures aimed at changing the risk (3.1) or keeping it up to date" (to a greater extent corresponds to the text of the ISO 31000:2018 standard, in particular, there is no indication in the translation of keeping the risk up to date (the word maintain is used).
20.	Risk management covers the processes, policies, devices, methods and other tools used to modify risk	Clause 3.7, note 1.	Suggested revision: "Risk management includes, but is not limited to, the processes, policies, devices, methods and other means used to change or keep risk up to date" (more in line with the text of ISO 31000:2018, in particular: - the word "covers" used in the translation does not contain an emphasis on the fact that risk management always includes more elements than are listed; - the translation does not contain an indication of keeping the risk up to date

Table 4 – *continuation*

№	Text fragment	Place in standard	Translation Suggestions and Comments
21.	comparative risk assessment: The process of comparing analysis results with risk criteria to determine risk acceptability	Clause 3.8.1	Proposed to be excluded (is absent in ISO 31000:2018 in section 3), is a contextually clear term, disclosed in clause 6.4.4 of the standard.
22.	Comparative risk assessment can be used when deciding on risk treatment	Clause 3.8.1, note	
23.	Structured and complex character A structured and integrated approach to risk management contributes to consistent and comparable results	Clause 4, item b	In the opinion of the authors, the translation of the English term comprehensive as "complex" is not entirely successful. Here, comprehensive means, rather, "all encompassing". Thus, it is proposed to state this principle of risk management as follows: Structured and comprehensive. A structured and comprehensive approach to risk management contributes to consistent and comparable results.
24.	Inclusion consists in the appropriate and timely participation of stakeholders, which allows to take into account their knowledge, views and opinions. This leads to increased awareness and informativeness within the framework of risk management.	Clause 4, item d, paragraph 2	It is proposed to consider the possibility of replacing the word "informativeness" with the phrase "validity of decision-making" (on the basis of paragraph 9 of clause 6.5.2. of the translation. In both cases, the word informed is used).
25.	Reporting preparation	clause 5.4.2, paraghraph 8; clause 6.1, paragraph 1; clause 6.7, paragraph 7	Suggested revision: "Preparation and submission of reports". With regard to the risk management process, the issue of preparing reports is also relevant (including on time and through established communication channels), the English word reporting in a number of contexts does not exclude, in addition to reporting, its provision.
26.	establish the level and type of risk that may or may not be used to develop risk criteria and ensure that these criteria are communicated to the organisation and its stakeholders	Clause 5.2., paragraph 9	It is proposed to consider the possibility of replacing the word "level", since in the initial text of the ISO 31000:2018 standard, the phrase level of risk is not used in the corresponding fragment. Moreover, this term is used in paragraph 8 of clause 6.3.4 of the specified standard.
27.	Commitments should include, but not be limited to	Clause 5.4.2, paragraph 1	The translation needs to be revised. The answer to the question of what obligations are taken into account is not obvious. The following edition is possible: "Commitments in the field of risk management".
28.	the purpose of the organisation in relation to risk management and links to overall objectives and other policies	Clause 5.4.2, paragraph 1	It is proposed to read as follows: "the purpose of the organisation in relation to risk management in connection with its overall objectives and other policies". The phrase does not appear to be entirely consistent with the original text. The ISO 31000:2018 standard directly indicates the relationship of the organisation's goal in relation to risk management with the overall goals of the organisation (and links to its objectives).
29.	– determine the list of people who have responsibility and authority for risk management (risk owners); – emphasise that managing riskt is one of the fundamental responsibilities	Clause 5.4.3, paragraphs 2, 3	Paragraph order must be aligned with the ISO 31000:2018 standard.

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Table 4 – *continuation*

№	Text fragment	Place in standard	Translation Suggestions and Comments
30.	The methods and nature of communication and consultation should reflect stakeholder expectations where appropriate.	Clause 5.4.5, Paragraph 1	In this case, in accordance with the context, it is proposed to consider the possibility of expressing the phrase as follows: "The manner in which information is exchanged and consulted, and the content of these processes, should reflect the expectations of the stakeholders, where appropriate."
31.	The close relationship between these processes should facilitate the actual, timely, relevant, accurate and understandable flow of information throughout the organisation, taking into account the confidentiality and integrity of information, as well as the privacy rights of individuals	П. 6.2, абзац 1	With regard to the phrase "as well as the rights to the privacy of individuals" in the context of the regulatory framework of the Russian Federation, it is probably advisable to use the phrase: "the right to privacy" (Article 23.1 of the current version of the Constitution of the Russian Federation), in particular, setting out the phrase as follows: "as well as the privacy rights of individuals".
32.	a way of identifying and evaluating consequences (both positive and negative) and their likelihood	Clause 6.3.4, Paragraph 5	According to ISO 31000:2018, when determining risk criteria, it is also necessary to take into account the method for determining the likelihood (plausibility) of consequences, and therefore it is proposed to revise the text of the translation of this phrase
33.	Probability of events and consequences	Clause. 6.4.3, Paragraph 4	Proposed revision: "Credibility (probability) of the realisation of events and consequences." Section 3 (clause 3.7) of the standard introduces the term "likelihood". The original text snippet also uses the term likelihood.
34.	Decisions must take into account the wide impact of the environment, the actual and potential consequences for external and internal stakeholders.	Clause 6.4.4, Paragraph 8	It is proposed to consider the possibility of correcting the translation of the phrase, taking into account the selected fragment. The original phrase of the ISO 31000:2018 standard is "take account of the wider context", which implies the use of a comparative degree in relation to the width of the contextual frames.
35.	The purpose of risk treatment is to select and implement risk treatment options	Clause 6.5.1, Paragraph 1	It is proposed to carry out a synonymous analysis of the phrase "risk treatment", it is already used as corresponding to the term risk treatment of the ISO 31000:2018 standard. At the same time, in the given text fragment, the source for the phrase "implementation of risk treatment options" is the fragment implement options for addressing risk ("implementation of risk elimination options").
36.	Monitoring and review should be an integral part of the implementation of risk treatment practices to ensure that various forms of risk treatment continue to be effective.	Clause 6.5.2, Paragraph 12	Suggested revision: "Monitoring and review should be an integral part of the implementation of risk treatment methods to ensure that various forms of risk treatment become and continue to be effective" (in the sense closer to the ISO 31000:2018 standard; transformation of inefficient tools into effective ones).

Source: Compiled by the authors based on GOST R ISO 31000-2019, ISO 31000:2018.

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(for example, with incorrect marketing organisation or employee errors), and with external conditions (for example, with inflation or the political situation), that is, with the internal and external environment or context [Brykalov and Trifonov, 2020].

Threats and opportunities, or rather, their assessment, taking into account the likelihood of implementation and consequences (clause 6.4 of the standard), should always be in the attention of competent employees (having the necessary skills, knowledge and authority); the list of threats and opportunities (usually referred to as the "risk register") should be reviewed regularly. These employees should maintain not only a list of risks, but also, if possible, on-line, based on up-to-date data, monitor the dynamics of the probability of their occurrence (for example, based on the information about the current financial condition of the organisation, information about the daily volume of products sold) [Oparin, 2016].

In order to prevent or respond to threats in a timely manner, as well as to realise opportunities for each risk, the algorithm of the standard for their processing (clause 6.5 of the standard) must be applied. In particular, it is necessary to choose a processing method (for example, eliminate the cause, reduce the likelihood, protect against the consequences , do nothing about the risk, refuse to take actions to increase the likelihood of risk), plan and execute (including if necessary) appropriate measures (for example, the purchase of new equipment, the formation of a financial or product reserve, reorganisation of production). It is imperative that "residual risks" must be taken into account, with which it is also necessary to carry out work similar to the one named, up to their elimination or responsible acceptance.

The results of risk assessment, planning and implementation of activities (or results associated with their absence) should be documented and regularly evaluated.

Relevant reports should be brought to the attention of authorised people, who, in turn, should make decisions based on the information provided and, if necessary, use additional information.

Since threats and opportunities can be realised at any of the levels of the organisation's functioning (in particular, at operational, process, managerial), as well as the reasons for their occurrence (for example, a stop in sales of products leading to a conflict with a counterparty that occurred as a result of equipment failure), the list of risks, the development of necessary measures, and the assessment of their implementation should cover all these levels - from corporate goals (their planning and achievement control) to the activities of each individual employee (a group of employees with similar job responsibilities) - and be based, among other things, on the results of the assessment external and internal environment (context). To work successfully with risks, it is necessary to establish processes for the exchange of relevant information (including in terms of consulting), establish access rights to it, ensuring the preservation of trade secrets and the protection of privacy.

Algorithms, rules, the amount of resources of the risk management process, the powers of the participants in the process, fixed in the documentation (all stages of the process are subject to regulation) and actually implemented, should be regularly assessed in terms of improving the efficiency and effectiveness of the process. As a result of the evaluation, activities to improve the process should be developed, planned and implemented; their results are subject to evaluation in the next cycle.

Also, according to the authors, it is important to note that the management, as well as the structural divisions of the organisation, whose activity is to audit or supervise organisational processes, should take an active part in the risk management process and fully support its development, including on the basis of documented assigned powers.

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Problems of digitalization of the Russian industry

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Abstract

The article is devoted to the substantiation of the model of the formation of an industrial development ecosystem based on modern digital technologies in industry.

The article deals with the problems of technological sovereignty of the Russian economy. It is shown that the solution of this problem is possible only on the basis of an industrial development ecosystem – a system of production chains of the most important types of industrial products, a technological development platform, interaction of subjects of industrial production with consumers of its products in the domestic and foreign markets. The necessity of concentration of industrial potential, resources of technological development, qualified personnel potential and direction to create conditions for providing the Russian economy with products corresponding to the world technological level is shown. The article analyzes the main existing and promising models of the functioning of an industrial enterprise. A detailed description of the barriers and difficulties on the way of digitalization of industrial enterprises in the Russian Federation is given.

In order to form the ecosystem of industrial development of the Russian Federation, the directions of identifying and assessing the state of production and technological personnel potential, its compliance with the needs of the domestic market are formulated. Recommendations are given on the creation of an ecosystem structure, mechanisms for the interaction of its various elements, a management and coordination system based on digital technologies for creating a system of individual elements that form information and analytical centers in various functional areas of the ecosystem.

A model of the ecosystem of industrial and technological development of the Russian economy based on digital technologies is proposed.

A set of mechanisms that contribute to reducing the level of uncertainty is proposed, and a design method of interaction within the framework of the digital industrial enterprise technology platform model is described.

The article formulates recommendations for the digitalization of an industrial enterprise in the new technological conditions of economic and social development, in the so-called new technological paradigm "Industry 4.0", the characteristic features of which are minimal use of manual and mechanized labor, as well as a low level of transaction costs.

A new approach is proposed, on the basis of which industrial enterprises will interact on the basis of shared access to information and digital resources and the ability to combine the development of innovative projects and value chains necessary to create competitive products in order to increase the operational efficiency of enterprises.

Keywords: digital technologies, Industry 4.0, global value chains, regional value chains, industrial policy, industrial revolution, digitalization levels, smart manufacturing, advanced technologies, ADP, industry ecosystem.

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Acknowledgment

Introduction

The key task of the Russian economy is to ensure its technological sovereignty. World practice shows that digital technologies (hereinafter - DT) are effective tools for solving this problem, since they are widely used in leading countries to implement the industrial revolution 4.0 with the transition to a new technological order. It should be noted that DT has been used in industrial production for more than 70 years. Currently, the classification of production systems by the level of use of digital technologies is as follows [Delera et al., 2022]:

- 1st level - inflexible production. For this type of production DT are aimed at organising the solution of a specific problem (production or development);
- 2nd level - lean manufacturing. For this type of production DT organise, regulate and control the quality of various production functions (automation of the production process, interaction between production and development);
- 3rd level - integrated production. For this type of production DT facilitate the integration of different activities and functions (e.g. production management system);
- 4th level - smart production. For this type of production DT provide a fully integrated production process. In this case, not only individual processes are regulated, but feedback is provided in real time. The quality management system for production processes is built on the basis of the application of the Internet of Things and artificial intelligence [Industrial Development Report.., 2020].

1. Description
of the research methodology

This study draws on a review of leading research on the application of digital technologies in today's industry. Also, based on the research tools of the United Nation Industrial Development Organiation (UNIDO) in the field of industrial development of countries, they analyse the level of the development of digital technologies in the industry of the Russian Federation by technological levels (from 1 to 4). The results of this study were prepared as part of a fundamental research paper on the topic "The concept of a single digital space for the effective functioning of the Russian industry."

At present all countries use DT at various levels of production development from the 1st to 4th. In the conditions of Russia the 1st and 2nd levels are widely used in production processes. In rare cases the 3rd level is applied (military-industrial complex enterprises). On the whole, Russian industry is characterised by a fragmented production process for complex products (consisting of a number of large units). In addition, to solve the key problem of technological sovereignty, it is necessary to integrate the scientific potential of the Russian Federation. The analysis shows that in all areas of the development of science and technology in the Russian Federation there are teams that work at the world level, but there is no system for organising the work. So, for example, the development of microelectronics is carried out separately in various departments. This reduces development efficiency and contributes to excess costs. Thus, the solution of the problem is possible only on the basis of the integration of scientific, technological, human, financial and other organisational resources with the widespread use of digital transformation of the 3rd-4th levels. It should be noted that in the world, even in the leading countries, a small number of companies operate in the 4.0 standard. This standard is met by technologies such as: electrical energy based on smart power plants, energy from renewable sources, software platforms, industrial Internet of Things, big data analysis, artificial intelligence, industrial and collaborative robots, additive manufacturing, smart manufacturing, the use of which leads to a fully integrated stand-alone manufacturing process. In fact, many of these technologies evolved and emerged based on the same engineering and organisational principles that operated during previous industrial revolutions, which suggests an "evolutionary transition" rather than a "revolutionary breakthrough" [Kupfer et al., 2020].

It should be noted that, despite the widespread introduction of modern technologies in the production process, 70% of companies in the world use "analogue production", in which the level of technology corresponds to the 1.0 standard: manual labor and mechanical devices (mechanisation) are used in most of the production processes. A characteristic feature of "analogue manufacturing" is the lack of use of digital technologies throughout the entire production process (for example, interacting with suppliers in person or by phone, using equipment that is not based on microelectronics) [Industrial Development Report.., 2020].

No more than 15-30% of companies in the world use the latest technological advances that form the next wave of progress (industry 4.0). The process of introducing level 4.0 DT is defined in the literature as the fourth industrial revolution. Within its framework, the convergence of new technological areas is carried out - digital production, nanotechnology, biotechnology and the development of new materials (NBIC convergence). NBIC convergence refers to the acceleration of scientific and technological progress due to the mutual influence of various fields of science - nanotechnologies, biotechnologies, information and cognitive technologies [Schummer, 2009].

2. Theoretical and calculated parts

Modern production requires a high degree of cooperation based on unified technologies and a strict system of control over the production process. Enterprises connected to the ecosystem through cooperation links within the smart industry system access and apply

these technologies in production and fall under the classification of advanced manufacturing enterprises, or enterprises with advanced manufacturing technologies (hereinafter referred to as ADP technologies) [Industrial Development Report.. , 2020].

Enterprises that use ADP technologies receive the status of smart factories / plants due to the presence of production systems of industry 4.0, or smart industry. The main features of smart manufacturing are the control over the production process using sensors and equipment connected to digital networks, as well as the use of artificial intelligence to support managerial decision-making. Another characteristic feature of smart manufacturing is manifested in the use of cyber-physical systems (CPS) [Albrieu et al., 2019]. In such a system, sensors, equipment and information systems are connected throughout the entire value chain that goes beyond a single enterprise or business. These systems communicate with each other using standard Internet protocols to predict, self-adjust and adapt to change. Cyber-physical systems cover entire industries and countries at different speeds and in different directions. Equipped with sensors, processors and actuators, these smart network systems are designed to recognise and interact with the physical world and support in real time [Industrial Development Report.., 2018; Readiness for the Future.., 2018].

Industries with a wide product line, such as automotive, food, benefit from the flexibility of cyber-physical systems and productivity growth. Industries that require high quality, such as electronics and pharmaceuticals, benefit from the use of big data and analytics, continuous improvement in product quality and functionality.

Developed countries with a high cost of skilled labor can take advantage of the growing demand for skilled workers. Developing countries with young people who have skills in IT and mechatronics can jump over several technological stages and create completely new production concepts [Challenges for industry.., 2018].

Mechatronics, first introduced into production based on electric drive technology, has become the core of robotics development and determined the level of production automation based on the use of three important components: hardware, software and communications. Thanks to new smart manufacturing technologies, the industrial landscape of the global industry will change significantly [Graetz, Michaels, 2018].

The introduction of digital heating into the production management system is aimed at solving several main tasks:

1. Development, implementation and management of production processes based on the use of digital heating in specific equipment.
2. Ensuring the control of the technical and economic characteristics obtained as a result of a specific production process, the requirements for the

characteristics of the entrance to the system (for example, based on the SIPOC principle) for the next production process.
3. Receiving feedback in the form of decision-making and its implementation based on the output of the system.

Researchers and developers of ADP technologies, managing modern manufacturing enterprises, investors of the new industrial landscape, predict quite significant socio-economic results from the introduction of new technologies [Industrial Development Report.., 2020] (Table 1).

It should be noted that when implementing advanced technologies, the main costs are associated with the use of equipment rather than resources, components and assemblies. Therefore, the economic feasibility of using technology is possible only if there is a large-scale production. In this regard, the global economy has formed several centers for the production of nanoelectronics - Taiwan, Japan, South Korea, China [China Manufacturing.., 2017]. These countries account for more than 70% of the industrial production of the global electronics industry. Currently, there is a drop in the production of automotive industry products in the world due to the lack of some microelectronic elements. Modern production, due to its concentration, is sensitive to various kinds of non-economic influences: sanctions, protectionist policies, pandemic measures, and everything else that disrupts global value chains. Therefore, attempts by a number of leading countries to carry out "reshoring" and the creation of appropriate production are facing economic problems associated with profitability: the demand for products at the national level does not cover the costs of production equipment. There is a problem of creating a model of industrial production that ensures the harmonisation of supply and demand under these conditions. Thus, high-tech development of production processes based on cyber-physical technologies is not enough - a fundamentally new systematic approach to organising modern production based on digital heating is needed. When developing such a model, the following should be taken into account:

1. According to UNIDO statistics, the share of ten national economies is about 90% in the segment of advanced industrial and new technologies (ADP) [Kupfer et al., 2019].
2. A high degree of technology concentration used in production is a characteristic feature of advanced digital production.
3. The leading countries - the USA, Japan, Germany, China, Taiwan, France, Switzerland, Great Britain, South Korea and the Netherlands account for most of the innovative activity in the industry. Moreover, even in these countries, only a few corporations have a full deployment of ADP technologies. In

Table 1
Results obtained from the application of advanced digital manufacturing (ADP)

Focus areas	Solutions	Rresults
Development of new competitive production	New solutions for low-income population	Medical devices at affordable prices
	New more adapted to the market business models	• Personalised products, mass customisation • New services and services based on data processing • New pricing models
	Release of goods that meet environmental standards of operation	• Products made from environmentally friendly materials • Improved product energy efficiency
Increasing the efficiency of production capacities	Reducing economic costs and improving energy efficiency	• Reduction of emissions and waste • Accelerating the transition to a circular economy
	Minimisation of operational expenses	• Flexible and decentralised production • Supply chain connectivity, delivery, efficiency and logistics • Flexible, adaptive organisation
	More efficient use of capital	• Diagnostic and automatic maintenance, reduced downtime • Reduced inventory quota, shortenedcash conversion cycle
	Attracting more qualified personnel from the labor market and strengthening cooperation with the service sector	• Improved working conditions, safety • Gender balance in the structure of personnel in production • New skills, task performance efficiency

Source: Compiled by the authors based on UNIDO data.

other countries, no more than 5% of companies have access to the technologies of the fourth industrial revolution.

A characteristic problem of involving the industry of developing countries in a new technological paradigm is an attempt to integrate the technologies of previous industrial revolutions into modern industrial management systems, while the level of mastering the technologies of the previous generation is low (low level of automation and ICT in industry) [Hathaway et al., 2016] (Fig. 1).

The main direction of solving the problems of ADP technology deployment in developing countries is the gradual integration of new technologies into the existing production systems of the previous generation, as well as the modernisation of existing production systems.

Global value chains (hereinafter referred to as GVCs) concentrate the best competencies of various types of production process. In this regard, they are the flagships of the technological development of the world economy.

Currently, there is a process of disintegration of GVCs and their reorganisation at the regional level within partner trade unions. However, it is necessary to solve a number of economic and technological problems and create profitable production [Digital Russia.., 2017].

As a result of the sanctions regime for the Russian economy, there is a need to meet domestic needs in the production of industrial products. The need

arose not only for the production of high-tech sector products, but also for the production of automobiles (components, metallurgy). In all these types of production, there are different types of technologies. In this regard, in order to organise a system for the use of digital technologies in Russian industrial production, it is necessary to determine their key areas, which should meet the strategic needs of the Russian economy. In this regard, it is necessary to create an ecosystem for the introduction of digital technologies in industry. One of its sectors should be an information system that can monitor the structure of the domestic market by type of product based on its existing classification. This determines the volume of products, their export-import structure and quality level, as well as the level of novelty (no more than 3, no more than 6 years).

As world experience shows, electronics and mechanical engineering are manufacturing industries that are most susceptible to the transition to advanced technologies. Indeed, these industries are already experiencing large-scale adoption of digital technologies based on cloud computing and 3D printing. And in the field of transport engineering, robotisation of production capacities is widely carried out. Thus, the variety of DT tools used in industrial production is due to the peculiarities of the production process. Therefore, in different countries with different production profiles, different digital technology tools will be used. For example, in Japan and Germany, where the automotive industry is developed, production robotisation processes are being intensively carried out.

With the help of the existing register of enterprises of the Ministry of Industry and Trade of the Russian Federation, enterprises that participate in the production chain for the creation of these types of products are determined. Further monitoring of production and technological levels, as well as human resources is carried out.

Technological level is the level of novelty of the technologies used (from 3 to 6 years). In each of these age periods the share of imported products is determined.

In this case, the production potential will be determined using the following indicators:
- share of production assets (industrial equipment) up to 3, up to 6 years;
- share of imported and domestic equipment;
- average age of equipment;
- share of export potential;
- labor productivity (GVA / number of employees);
- profitability of production;
- profitability of export products to domestic profitability;
- personnel potential;

Fig. 1. The main problems of ADP technology deployment in developing countries

- share of specialists with higher technical education (in general and up to 50 years old);
- average age of specialists with higher technical education;
- share of workers with secondary technical education (in general and up to 50 years old);
- average age of specialists with secondary technical education;
- share of qualified specialists with a working specialty;
- the proportion of specialists with skills in the use of digital technologies;
- share of technologies that use digital technologies and by types of levels;
- financial efficiency of production;
- financial effect of production capacities.

Based on the results of monitoring, a set of industrial enterprises is formed - participants in the technological chain that produces a certain type of end product.
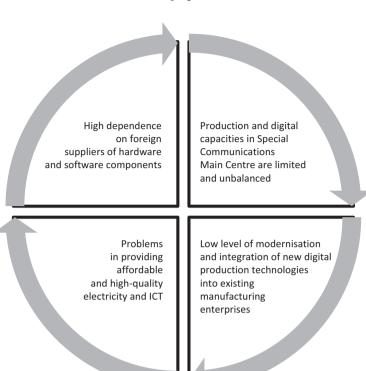
Based on the technological production potential, the engineering of the technological chain is carried out. According to the results of engineering, bottlenecks that require the purchase of a certain type of equipment and technologies are identified.

Further, a program for the implementation of tasks is being developed, which provides for the introduction of DT at various levels.

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The personnel potential for such a system will be determined as follows: the formation of a register of jobs in the technological chain, which indicates the necessary competence and level of education and prescribes the level of competence and its relevance, working conditions and wages. Based on this, a register of all technological chains and jobs is created. Requirements for the competence of the workplaces of specialists graduating from higher schools and institutions of secondary technical education. The organiser must have a register of competencies. The most important requirement in the personnel management system will be the ability to use these competencies in practice and solve non-standard tasks.

The second sector of the new ecosystem will be the sector that forms the production site for the production line. A consortium of enterprises included in a certain production and technological chain is formed.

Stages of work to build this sector:

1. Formation of the production process - preparation of the production site and placement of production equipment, organisation of the system of production processes within the frames.
2. Creation of a system for the selection and development of qualifications of personnel with the necessary competencies to work with digital heating.
3. Establishing the work of production and technological chains of product management.
   The production and technological chain involves control over the technical characteristics of products manufactured at the previous stage, control over production at this stage, control over the result. Such a chain is a set of production sites. At present, the practice of introducing DT has shown that the most effective form of industrial organisation is the organisation of a system of technological chains based on enterprises that perform only production functions.
4. Implementation of a quality management system at all stages of the life cycle: from project management to service maintenance.

A good example of such work is the organisation of a quality management system in the enterprise system of the leading corporation in the global nanoindustry TSCMS (Taiwan). The need to implement this approach in a Taiwanese company arose due to the case of a large manufacturing defect (100,000 microcircuits), which led to economic losses and claims from customers [China Manufacturing.., 2017].

It should be noted that the development of the technological level of production requires certain costs. In this case, the cost of equipment and workplace exceeds the cost of material resources. Therefore, large orders are required and, as a result, such enterprises work around the clock (in several shifts).

For example, most industrial companies need to revise the standards of competitiveness and decentralisation of suppliers. Intel tried to expand the number of suppliers to obtain its nanoplates for electronics, but faced the problem of poor product quality. As a result, Intel was forced to return to the scheme of a single mono-supplier (from Taiwan).

3. Results and discussion

Indeed, in the global economy, the production of high-tech products is present in a limited number of countries - Taiwan, Japan, South Korea, China.

Since the cost of creating smart production is high, it is assumed that the competencies of the production process of certain types of products are concentrated. In this regard, it is necessary to form a federal program for the development of the technological level and structure of industrial production in the Russian Federation.

This program will make it possible to differentiate the focus areas of technological chain production, taking into account the needs of the state's economydevelopment. This approach will allow to concentrate the efforts of the development priorities of the state. For example, the Government of the Russian Federation has determined that pharmaceuticals and electronics are the priority areas for development. The main drawback of the leading Russian industrial development programs is the inefficient methodology for their implementation. It was supposed to support individual enterprises with export potential (metallurgy, production of semi-finished products and fertilisers, food).

As a result - a low technological level and labor productivity, which differs many times from the similar indicator in advanced countries; dependence of the domestic market on foreign supplies in a wide range of industrial products, especially in its high-tech sector. We propose the concept of a program for organising a technological chain, within which the final product is produced, which makes it possible to ensure the technological development of manufacturing industries (means of production, including equipment for the digitalisation of control systems). At the same time, the program is aimed at the formation of sustainable inter-industry relations and the core of industrial development based on the outstripping economic growth of high-tech industries that create complexes of modern equipment for various sectors of the economy.

Due to the fact that the technological level in the Russian Federation is insufficient, it is necessary to organise stable relations with friendly countries that are able to supplement the necessary competencies of domestic technological chains.

In the Russian Federation, there are examples of the effective use of scientific potential in a wide range of scientific problems of production development. For example, the development of the nuclear industry, solving the problems of the aviation industry for defense purposes,

the creation of a high-tech military-industrial complex, etc. In these industries, a system of technological chains for the production of a wide range of products has been created. The nuclear industry of the Russian Federation is the only one in the world that produces the entire range of products using nuclear technologies.

It is necessary to create a high-tech sector in the Russian economy, within which, on the basis of the existing technological potential, programs for the modernisation and breakthrough development of production potential are being developed. To do this, the developments of scientists over the past 5-10 years are monitored with their comparison and compliance with the requirements of world science and scientific and technical progress. According to his results:
- scientific teams are determined, the scientific potential of which corresponds to the world level
- a register is formed in which research teams are distributed according to state priorities.
- teams within each direction form development programs with technical specifications for the technical and economic characteristics of products.

To organise the management of the solution of tasks on the technological sovereignty of the Russian economy, a control and coordination center is formed, which consists of departments for each priority area. Each department defines a system of tasks for scientific and technological development. To coordinate their solution, a core is formed [Digital Russia., 2017]. Each core has the following structure:
- management committee, headed by the Deputy Prime Minister of the Government of the Russian Federation, who oversees the relevant direction of the technological development of the Russian economy, and heads of enterprises that determine the technological chain and aggregate product development plans.
- an advisory body under the committee, consisting of leading specialists, developers and technologists who create programs for industrial and technological development in priority areas.
- a group of economists who determine the mechanism and amount of financial support for the development of each priority area. This group is also developing systems of indicators that characterise the effectiveness of its implementation.

The Committee elaborates a development program based on the agreed proposals of the advisory body and a group of economists, and then submits the program for approval to the Federation Council and the State Duma.

Thus, the introduction of DT is a tool for solving the problems of technological sovereignty of the Russian economy. For the comprehensive systemic implementation of digital transformation in the industry of the Russian Federation, it is necessary to create an institute of digital technologies in industry, within which to form a target methodological center for each level of digital transformation. The functions of the methodological center are the development of software, methods for organising the use and training of personnel, a system for monitoring the effectiveness of digital heating use at the appropriate level.

The main directions of the development institute are:
- elaboration of a program-targeted set of directions for the development of the domestic industry;
- formation of the production process based on modern digital technologies;
- selection and advanced training of personnel with the competencies of digital transformation.

Conclusion

It should be noted that the current industrial revolution is the last element in the evolutionary and technological development of the world society, the goal of which, according to a number of experts, is an all-encompassing sustainable industrial development. Development is possible subject to the application of two groups of new technologies based on:
- bringing new products to the market (products that meet the standards of the modern environmental agenda, products of new industries, new jobs and income opportunities);
- growth of production efficiency due to the consumption of energy from renewable sources and raw materials from the latest materials, the development of industrial competitiveness, close ties with related activities (complementary approach).

For the effective functioning of the ecosystem of technological development of the industry of the Russian Federation, it is necessary to form fundamentally new competencies. These competencies can be divided into three groups:
- ability to analyse data and information in the system of production processes;
- professional skills in the use of a certain type of technology;
- engineering and mathematical skills to use relevant knowledge to solve non-standard problems of practical activity.

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Digital transformation of retail trade: Efficiency of automation and robotization of business processes   Katasonov I.A.

Digital transformation of retail trade: Efficiency of automation and robotization of business processes

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Currently, retail is one of the fastest growing segments of the Russian economy with a noticeable real practical implementation and application of digital solutions. The introduction of digital products covering the trading process confidently brings the industry closer to the leading pool of digitalization industries (banks, ICT, insurance, media, industry, etc.), becoming the main tool in attracting consumers and increasing profits.

The article describes the results of an experiment on the introduction of automation for the management of assortment matrices of goods. The positive effect and profit for retail companies are shown. In conclusion, recommendations are offered on the formation of a methodology for various participants in the assortment management process.

Keywords: digitalization of retail, category management, assortment management, automation of business processes, introduction of digital technologies, retail.

For citation:

Introduction

The end-to-end penetration of new technologies accompanied by profound changes in the structure and nature of the modern consumer market, increased requirements for the development of trade on a global scale makes inevitable the transformation of the "classical" retail model. The natural potential and flexibility to introduce digital products, combined with a high degree of socialisation of the trading industry, provide expanded opportunities for functioning in a new competitive digital environment and achieving the greatest dynamics of technological advancement relative to other types of economic activity [Digital transformation, 2021].

One tool that helps retailers compete is Efficient Consumer Response (ECR). This tool involves the formation and management of the assortment and individual categories based on the requests and needs of consumers [Winning in a Digital Era, 2021]. A separate assortment control element was created - the assortment matrix. A high-quality assortment matrix, which will bring the greatest income, profit or traffic (depending on the goals), is the main result of the work of a category manager. Its timely updating is the most important task on which the success of its work and the results of the company depend [How to carry out digital transformation.., 2020]. At the same time, assortment management is characterised by low marginality of the

Table 1
The share of online sales in the turnover of large retailers
in the Russian market (%)

Company	Industry	2019	2020
«M.Video – Eldorado»	Electronics	33	60
DNS	Electronics	13	26
«Detsky Mir»	Children's goods	11.7	24
«Vkus Vill»	Food retailing	6.8	11.5
X5 Retail group	Food retailing	0.25	1.01
«Magnit»	Food retailing	—	0.13*
«Lerua Merlen»	DIY	3	9

* Recovered sales for the year based on December 2020 data.

sphere and high labor costs [Zvereva, Deputatova, 2019]. These two factors create a fertile ground for automating these business processes, which allows you to save staff costs, increase the effectiveness of the work performed: volume, speed, quality, etc.

The purpose of this article is to show how automated process of forming assortment matrices allows retailers to achieve higher financial results compared to manual assortment management.

1. Digital transformation of Russian retail: key trends and features

The retail industry is constantly changing driven by rapid and unprecedented technological innovation. This change presents both a challenge and an opportunity for retailers to adapt to a trading environment that has been completely transformed by the $2.3 trillion global e-commerce marketplace, as well as an increasing number of qualified shoppers who are always connected and have permanent access to the world's largest virtual supermarkets [Ideal consultant.., 2018].

For retailers and brands, digital analytics and innovation, whether it's an AI-powered chatbot that fulfills customer queries or a hyper-local store that gets information from the Internet of Things, is critical to increasing sales and profits in today's on-demand economy.

Since the pandemic, the global retail market has undergone significant changes. First of all, this concerns the growth in the share of e-commerce [Research on the impact of the pandemic.., 2021]. According to Rosstat, the share of online sales was 4.3% and 3.9% in 2021 and

2020, respectively, against 2% in 2019. They grew twofold in 2020, and, as we see, the trend continues. At the same time, the share of online sales of individual Russian retail players has changed even more [Research on the impact of the pandemic.., 2021].

For example, Detsky Mir increased its share of online sales from 8.2% and 11.7% in 2018 and 2019, respectively, to 24% in 2020, online sales grew by 140% in one year (Table 1)[1]. Other retailers significantly increased this figure. As you can see, the share of online sales in grocery retail is quite low, but it also tends to grow rapidly [Paskova, 2020].

Another important trend that can be traced in Russian and global retail is the desire for omnichannel and general digitalisation, which consists in blurring the lines between the traditional offline consumer experience and digital [4 retail industry challenges.., 2020]. Companies are actively introducing digital tools into the customer journey. This, for example, is stated by the M.Video - Eldorado group, presenting its concept of "One Retail" [Consumer sector .., 2020]. The same can be observed at the grocery retailer VkusVill: their mobile application has a button "I'm in the store" which provides a discount on random products when buying in an offline store, this application also has a barcode scanning function that allows you to read detailed product information in the app, add it to your shopping list or order online.

Sports retail is not far behind: for example, the Sportmaster chain of stores provides an opportunity to scan a QR code on some products and continue your customer journey in the digital space of a mobile application. This network, like M.Video, has a self-pickup function through the application, which is convenient to use not only from

[1] Annual reports of PJSC Detsky Mir. https://ir.detmir.ru/blog/yearly-reports/..

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home, but also while in physical stores [Smotrova, Narolina, 2020].

Another example of digitalisation is self-service checkouts and so-called kiosks. The first allow you to independently break through and pay for the goods. They can be used, for example, in stores such as Perekrestok, Auchan, VkusVill, Decathlon, etc. The number of stores with such cash desks is constantly increasing. Kiosks make it possible to get acquainted with the assortment of the store on a large digital screen, place an order for self-delivery from the existing stock of the store or order goods from the warehouse to the store or with home delivery. You can use the kiosk in the stores such as M.Video, Sportmaster or Detsky Mir [Digital 2020.., 2020].

Digitalisation does not affect only the area of improving the customer journey. It extends to other components of modern retail companies: marketing, logistics, assortment management, hiring, communications within the company, etc. Retailers are ambitiously aiming to bring modern technologies into almost all their processes, often without analysing the effectiveness of digitalisation of certain business processes [E-commerce worldwide, w.y.].

Retailers face challenges of a very different nature. As a result of radical changes, such as the explosion of mobile and online commerce, retailers have become embroiled in a highly competitive and multi-channel battle for the consumer's wallet and attention.

Changing customer preferences and behaviors are major catalysts for transformation. New consumers accustomed to instant satisfaction of their needs cannot imagine their lives without a smartphone, the window to the world of communication, work and shopping. They use it to pay bills, book hotels, share vacation photos, and buy household appliances [Retail digital transformation.., 2019].

In this regard, the mechanisms for making decisions about purchases have also changed. Targeted marketing and advertising messages are becoming less effective as consumers rely more on social media friends and other influencers such as YouTube stars.

Another challenge for retailers is that shoppers spend more on restaurants and spa than on physical goods.

They are not tied to specific channels and expect the same convenience and support when buying online, in a mobile device, in a store, or using any combination of these three models.

As noted in the Accenture report, "Consumers expect stores to 'automagically' adjust to them in physical, digital and emotional interactions"[2].

The new reality in the retail sector is that any solution that customers find convenient for themselves immediately becomes the standard for the industry, and everyone has to implement it [Weber, Schütte, 2019].

Analysing new consumer expectations, market participants come to the conclusion that long-term strategies aimed at increasing profitability and customer loyalty no longer guarantee sustainable success. To remain competitive in a rapidly changing world, retailers must fundamentally rethink customer interaction models and related business processes and find new ways to apply technology.

Transforming customer acquisition processes requires anticipating the wants and needs of consumers, whether they are in the store, at home, or on the go. They should have access to personalised and relevant information and advertising, as well as convenient shopping mechanisms. Such solutions should be based on technologies for analysing data from various channels, collected by means of sensors and beacons.

In this regard, automated formation of assortment matrices for consumers becomes an important tool for maintaining the competitiveness of the retail business.

2. Methodology for automated formation of assortment matrices in retail stores using blockchain and other innovative technologies

Conventional assortment planning includes an analysis of revenue and the level of rotation of goods. However, the blockchain technology available in the modern world, big data tools and advanced analytics allow you to analyse a much larger number of metrics, while spending a minimum of effort, just by "clicking a button".

The development of advanced analytics and assortment management tools is especially important in the modern world due to the following factors [Smartphone ownership, 2018; Analytical assortment optimisation.., 2019]:

1. Increase in the number of articles

Big brands are constantly improving their products and increasing the number of presented articles. At the same time, local brands offer few articles, but the number of such brands is constantly growing. Do not forget about the growth of private labels, which add a significant number of items to the assortment.

2. Limited space for goods

The number of articles is growing, but the amount of shelf space is not. Possibilities to increase or redistribute shelf space are limited or non-existent. In addition, many retailers are now developing small store formats, where there is even less space on the shelf.

3. Increasing Supply Chain Complexity

Despite the increase in the number of articles, the supply chain is becoming more complex. This creates additional importance in the choice of products to be added to or removed from the listing.

4. The complexity of the choice and the infinity of the virtual shelf

While there is an endless shelf in e-commerce, retailers need to manage inventory in order to keep consumers' attention and control storage and logistics costs.

5. Dynamics depending on the location

Retailers have a variety of formats and locations in which they operate. Location-related factors, such as location traffic or area socio-demographic characteristics, affect

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[2] Channel shift: Prioritizing digital commerce (2020). https://www.accenture.com/us-en/about/company/coronavirus-digital-commerce-impact

Table 2
Expected contribution on various levers of value creation

Lever	Content	Effect
Systematic exclusion of goods from the assortment matrix (delisting)	Growing margin from an improved set of products	Margin growth up to 0.5 pct
Strategic addition of products to the assortment matrix (listing)	Coverage of previously ignored or underrepresented client needs	Revenue growth by 2-4%
Supply Chain Simplification	Lower operating costs in the supply chain, branch operations and product development	Margin growth up to 0.5 pct
Improved purchase conditions	Improved leverage in negotiations due to a better understanding of the importance of the supplier	Reducing the purchase cost by 1-3%

Источник: [Analytical assortment optimization.., 2019].

sales results [The key drivers.., 2020]. The same article in different stores can bring markedly different results. Therefore, the assortment should be optimised taking into account the characteristics of the location. This optimisation usually includes two levels. The first determines how much space on the shelf in a particular location a given category receives, the second determines which articles should be on the shelf in this location.

A study by Mckinsey [Analytical assortment optimisation.., 2019] showed that effective assortment management can bring significant financial results.

The expected contribution for various levers of value creation is presented in Table. 2.

Obtaining a financial result in the given planes requires not a superficial understanding of the assortment, but a deep analysis. For example, a strategic listing should not end with a simple search for trending products, and delisting is not just an exclusion from the matrix of slow-moving products.
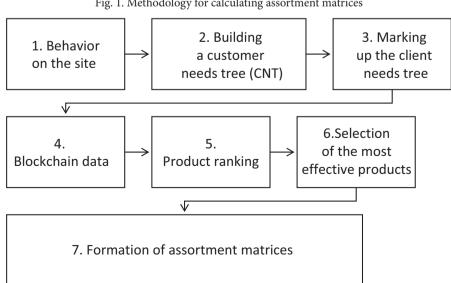
To manage the matrix, it is important to understand not only the turnover, but also the uniqueness of the product, as well as to conduct a deep analysis of customer needs [The key drivers.., 2020].

To make all these decisions, it is necessary to conduct complex analytics. This can be done most effectively using big data and advanced analytics.

What should be the methodology in order to achieve the results described above?

Methodology goals:
• To minimise the routine of category managers, automate their typical tasks to free up time for more intellectual and expert tasks (for example, searching for new needs and trends, reaching agreements with suppliers, planning activities, etc.).
• Help category managers make more cost-effective decisions, improve category performance (revenue, margins, receipts).
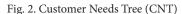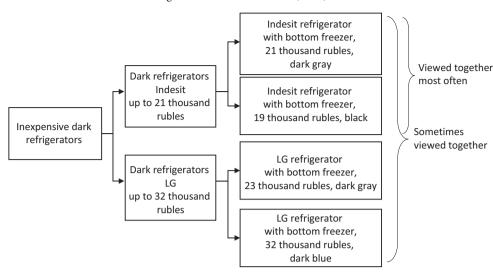
Fig. 1. Methodology for calculating assortment matrices

Source: compiled by the author.

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Fig. 2. Customer Needs Tree (CNT)

Source: compiled by the author.

3. Methodology for calculating matrices

The methodology consists of seven stages presented in Fig. 1.

1. Behavior on the site: customers browse products not only on the basis of categorisation on the site, but also in accordance with specific consumer requests. Some products from different categories / subcategories / groups may be indistinguishable for the client, while others may be in a group, but perceived differently by the client. The author's methodology proposes to analyse the behavior of customers on the site and take it into account when forming the assortment.

2. Building a tree of client needs: based on client behavior, the methodology creates a tree of client needs. It is built on the basis of jointly viewed product analysis within the same session (Fig. 2). For example, a site visitor views refrigerators within the session. At the same time, the majority of customers with such a request view refrigerators of the same brand together: some of them look at Indesit refrigerators together, the other look at LG refrigerators, and a small part of customers watch many refrigerators of different brands at the same time. Based on the methodology, a tree is formed showing that some customers have a request to purchase Indesit brand refrigerators, while others have a request to purchase LG refrigerators.

3. Next is the marking of the tree. It consists of determining the depth at which the grouping of goods occurs, and identifying the needs that this group satisfies. Depending on the category, you can build a tree of different depths: in the example, you can stop at grouping products at the brand level or go further and see that there are separate needs for refrigerators in the price categories of 19 thousand rubles and 21 thousand rubles. The depth of product grouping is determined by the category manager.

4. Blockchain data: Blockchain technology allows you to receive reliable data on goods supplied to the trading network. At this stage, the calculation takes into account the data obtained through blockchain technology about the supply chain of the goods. For example, if a product does not meet the set criteria, it is removed from the analysis or receives a reduction factor.

5. Ranking of goods. The purpose of this stage is to rank products according to a number of priority factors, find optimal products and reduce the time spent by the category manager on manual routine operations.

Tool logic. The optimiser ranks SKUs with working lifecycles within store premium tiers and within a group (a group is a classifier level that has a seat limit set).

The methodology helps to automatically take into account:
- how well the product was sold earlier in those outlets where it was in stock - the premium point and the balance are taken into account;
- different priorities of revenue, number of checks, front margin;
- how unique the product is within the framework of the need it covers.

To rank SKUs the tool uses the following formula: $CEI \times UI$.

It contains two coefficients:

CEI is a consolidated economic indicator, which is calculated in terms of premium based on 3 months of sales history, receipts and margin, taking into account the sales recovery operation. Sales recovery is an operation that allows you to calculate the possible sales of an article if it was available only in some stores or in part of the period under review. The operation of normalising the indicators necessary for calculating the CEI is also carried out: goods for each indicator receive values from 0 to 1, from worst to best. This is necessary in order to take into account different dimensions in the summary indicator (sales can be ten times more than the margin and thousands of times more than units). When calculating the CEI, the weights of various metrics can be changed in accordance with the goals.

UI (Uniqueness index) = (Product similarity to itself = 100%) / (Sum of similarities to all products within the same need identified in the previous step).

6. Selection of the most effective products. After calculating the CEI × UI, the goods within the group are ranked according to this indicator from the maximum and, in descending order, fall into the assortment matrix for the corresponding category.

7. Formation of the assortment matrix. After receiving the result, the category manager can review the recommended matrix, make corrections and changes according to his expert opinion and information not yet implemented in the tool as a factor in the matrix (for example, the lack of goods from the supplier). After making amendments by the category manager, we get the assortment matrix of the category.

The tool calculates metrics to rank products according to store grouping by premium. That is, the final matrix in more premium stores will differ from the matrices in lower premium stores. This allows you to increase the efficiency of the final matrix.

4. Additional ways to apply the methodology

Based on the constructed tree of client needs, it is possible to draw conclusions applicable in related processes: determining categorisation, filters on the site, merchandising, etc.

For example, we observe that a group of products has formed in the tree under the "teapots" category, where all products have a retro design:

- apparently, buyers open such cards from the catalog on the site, focusing on the photo, but the filter would make their search more convenient. We initiate the creation of a "retro design" filter on the site;
- Perhaps buyers will be interested in this type of teapots in retail as well. Consider the option of allocating space in the layout for retro models.

This tool allows you to reduce the amount of manual labor, expand the possible amount of assortment covered by one category manager, increase the quality of analysis by increasing the number of analysed indicators and calculations that a category manager can carry out. In the modern retail market, where marketplaces with their very large assortment are actively expanding, profile retailers need to expand their assortment in order to remain competitive. This tool allows you to manage this expanding range effectively.

Additional ways to use blockchain technology in assortment management:

1. The use of blockchain technology to get on the shelf in discount retail chains. In discounters, the main criterion for getting on the shelf is the price. Currently, category managers are forced to manually check each supplier and their products. Blockchain technology will automate this process. If the supplier passes at the best price and the production/delivery of the product meets the requirements of the retailer, the product ends up on the shelf.

2. Automated sale of shelf space to large retailers through smart contracts. Large retail chains often sell shelf space to product suppliers. The use of smart contracts based on blockchain technology will automate this process. Shelf space can be billed as a contract, and any supplier that meets the conditions will be able to enter into this contract.

5. Approach to evaluating the results of the work of the methodology

Pilots are conducted to evaluate the results of the methodology. Their goal is to obtain confirmation of the optimised matrix effectiveness in certain categories and to refine the values of the target product metrics depending on the calculated effect.

Pilot metrics - growth in sales, margins, checks in the stores of the pilot group (with pilot matrices) relative to the stores of the control group (matrices do not change). The stages of the pilot are shown in Fig. 3.
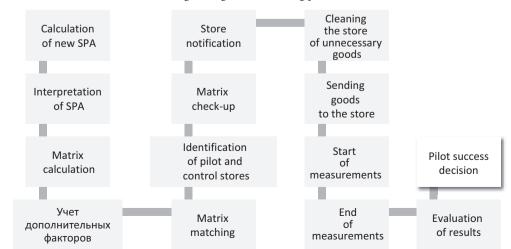
Fig. 3. Stages of conducting pilots

Source: compiled by the author.

The effect will be evaluated using A/B testing.

Description of the experiment

Using the data analysis methodology, an assortment matrix for stores is formed, that is, which goods should be sold in which stores. Then a subgroup of pilot stores is determined, where the goods are sent in accordance with the compiled matrix, as well as a subgroup of control stores, where the matrix remains unchanged. Next, the sales results of these two subgroups are compared in the context of the selected target metric, for example, sales in rubles. At the end, it is concluded how good the assortment matrix that was formed is.

Subtasks of A/B testing

Subtasks that need to be solved in order to conduct A/B testing correctly:

1. To estimate the observation period. To determine how many days of sales it is necessary to observe pairs of stores in order to receive reliable comparison result. If this observation period turns out to be too long, it is necessary to increase the granularity of the context we are measuring. For example, you can measure sales by day/shop, or you can measure sales by day/shop/product. And so on, until we get an acceptable measurement time, while not introducing too much noise into the measurements.

2. Proper selection of pilot and control magazines. What is the difficulty of the task? Pilot and control magazines should not differ before the start of the pilot (neither in the averages nor - preferably - in the variances of the target values). Let's imagine what happened if we took a flagship store in Moscow as a pilot one, and a small store from the region as a control one. It would turn out that the Moscow store greatly outperforms the regional one in sales, but this, of course, is not due to the matrix. Therefore, you need to select comparable stores that, before the pilot, practically did not differ in their behavior.

3. Properly taken measurements. The fact is that sales are influenced by a large number of different factors. No matter how many pilot and control stores are chosen, it may turn out that they sell differently due to random factors, and not due to different matrices. Accordingly, it is necessary to prove mathematically that the measured effect is statistically significant.

Each of these items is described below.

Observation Period Estimation

The number of observations is the product of the group size (A/B) and the length of the time interval during which the pilot is conducted. The time section can be different (depending on the characteristics of the target metrics): hour, day, week, month, etc. For example, if the minimum number of observations is 100,000, then you can pilot on 10,000 clients for 10 days (if the metric is daily) or on 5,000 clients for 20 days. You can go from the opposite. Depending on the volume of clientele and the time that the company is willing to spend on the pilot, you can calculate what minimum effect can be caught at a certain level of significance (usually they

Table 3
Stages of the experiment on assortment management in retail stores

Pilot stage	Stage content
Calculation/updating of the customer needs tree	Calculation of a new customer needs tree Interpretation (pegging)
Forming new assortment matrices	Calculation of assortment matrices Consideration of additional factors (for example, goods that cannot be excluded from the matrix) Accounting for premium stores and needs
Preparing points for the pilot	Selection of pilot and control stores Cleaning stores from old goods through sales and export Delivery of missing goods
Holding a pilot	Selling new assortment in pilot stores Operational control holding pilot Regular monitoring of the effect
Evaluation of results	Evaluation the pilot results Making a decision about the success of the pilots

Source: compiled by the author.

talk about 95% significance level) and dependence on the values of errors 1 and 2 -cities.

Formation of the pilot and control group

After the formation of the pilot design (duration of the pilot + group size), the formation of the control and pilot groups begins. If we talk about customers, then in the case of a large audience, it is better to make a random stratified sample of the desired size. As stratification parameters, you can use such as city, salary level, marital status, field of activity, age, gender, etc. Similarly, a control group is generated from the remaining clients in the same stratified and random way. At this stage, you should check if there is an effect on the target metrics in the pre-pilot period, thereby making sure that the formed groups are identical in their behavior before the start of the pilot.

In the case of offline stores, there is no way to select groups in the same way as online experiments. It is necessary to come up with other ways to select a control group. In order to assess honestly the pilot changes, it is necessary to find a control group that would be as similar as possible to the experimental one during the pilot period.

As soon as the groups are formed and the identity of the groups on the pre-pilot is visible in the context of the target metrics of interest, you can start running the pilot and introduce the desired changes on the clients of the target group. After the required amount of time, the effect is evaluated. The effect estimate is a point estimate coupled with a confidence interval that covers the true effect value with a certain probability (usually 95%).

It should be noted that it is desirable to estimate the errors of the 1st and 2nd kind of the group selection algorithm. For this, groups are formed on the pre-pilot (pseudo-pre-pilot) and the effect is evaluated on the pre-pilot (pseudo-pilot). In our paradigm, there should be no effect on the pre-pilot, since there was no effect.

Type 1 error is a situation where an effect was identified, but in fact it does not exist.

Type 2 error is a situation where the effect could not be identified, but it actually exists.

In order to achieve an increase in the accuracy of estimates and narrowing of confidence intervals, different approaches are used related to the transformation of the initial data in such a way that the point estimates do not change, but their accuracy increases.

When the pilot is over, the effect and confidence interval are calculated.

Working with a retailer with offline stores is significantly different from the usual online A / B tests. As a rule, the technique is associated with online metrics: how affected conversion changes, return rate, CTR, etc. Most of the experiments are related to interface changes: the banner was rearranged, the button was recolored, the text was replaced.

In live stores of classic retailers, changes are much more complicated than changes in the site interface. This imposes restrictions on the metrics. Basically, margin and revenue are considered. Both margin and revenue are volatile metrics; they are measured in thousands, hence the standard deviation is measured in thousands.

The formula for calculating the number of store days says that the larger the variance, the more data is needed for any meaningful conclusions. To catch the effect even in tenths of a percent with such a large variance in revenue, pilots need to spend six months in stores.

Of course, no one will agree to conduct a pilot for six months. Therefore, we decided to move to the revenue or margin of the product category, rather than the entire store. The variance of this metric is expected to be much lower than that of the entire store metric. This allows you to measure a smaller effect.

6. Methodology for conducting experiments on assortment management in retail stores

In the course of the work, a list of tasks was developed that must be consistently solved for successful assortment management experiments in retail stores (Table 3).

The experiment was conducted in retail stores. 5 product categories participated in the pilot:

1) category of small household appliances (hereinafter referred to as SHA) 1;
2) category of large household appliances (hereinafter referred to as LHA) 2;
3) LHA category 3;
4) LHA category 3 and SHA category 4;
5) accessories category 5.

For each of the presented categories, pilot stores were identified based on the principle of maximum availability of goods from new matrices in them. For each pilot store, a control store was selected based on the principle of sales similarity. With the directors of the stores, in which the piloting of the categories of large-sized equipment was carried out, an agreement was passed on the import of new matrix goods.

As a result of applying the developed methodology, matrices were obtained for pilot store-category pairs. The analysis of these matrices for their discrepancy gave the following results:

1. Comparison of the matrix of each pilot store with the matrix of the corresponding control store:

MM = (P ∩ C) / (C),

where CM is the matrix match, P is the matrix of the pilot store, K is the matrix of the corresponding control store, P ∩ C is the number of intersecting articles in the pilot and control matrix.

2. Calculation of the arithmetic mean coincidence of matrices for all pairs of MM magazines:

Category	MM
SHA Category 1	36%;
LHA Category 2	48%;
LHA Category 3	56%;
LHA and SHA Category 4	61%;
Accessories category 5	82%.

As you can see, the matrices of control and pilot stores coincide from 36 to 82% depending on the category. This indicates a significant difference between the matrices.

Table 4
Change of assortment matrices in relation to pre-pilot ones (%)

Category	Share of new articles	Share of withdrawn articles
SHA category 1	34	70
LHA category 2	50	54
LHA category 3	52	43
LHA and SHA category 4	24	37
Accessories category 5	34	16

Source: compiled by the author.

Table 4 shows how the methodology changed the matrices in relation to the pre-pilot matrices of the same store.

The shares are calculated according to the following formulas:

Share of new articles = (Number of new articles) / (number of articles in the pre-pilot matrix);

Share of withdrawn articles = (Number of withdrawn articles) / (number of articles in the pre-pilot matrix).

As you can see, the matrices have changed significantly since the beginning of the pilot, the spread of changes varies significantly depending on the categories. Thus, the share of new articles in various categories is in the range from 24 to 50%, the share of withdrawn articles - in the range from 16 to 70%.

It should be noted that before receiving the final matrix, the category manager looks at the optimizer's proposals and makes his own changes to the matrices. During the pilot process, the share of acceptance by category managers of the optimizer's proposals was at the level of about 70%, depending on the product group, this indicator could differ by +/- 10 pct

The analysis suggests that our tool does indeed perform significant actions on the assortment matrix. Now we need to check what are the results of these changes.

7. Research results

As a result of the experiment, two components can be distinguished:

1. 1. Operational assessment - an assessment that allows you to monitor the main indicators necessary for the pilot on a regular basis. From this assessment, no precise conclusion can be drawn about the effect, its main purpose is to ensure the conduct of the pilot.
2. Final assessment - an assessment that is carried out based on the results of the pilot with all the features

necessary for statistical confirmation of the effect. It can also be carried out during the pilot period, but up to a certain number of observations it does not allow any accurate conclusions to be drawn.

Dashboards were developed in the Power BI program to conduct a rapid assessment. Thanks to these dashboards, the team could constantly monitor the dynamics of indicators important for the pilot and make operational decisions necessary for the successful conduct of the pilots. For example, it was possible to see the availability of items added to the matrix and the average availability of the matrix items in the pilot and control stores, and based on this make decisions in order to increase these indicators in the pilot stores to a level comparable to the control stores.

Dashboards also show serious deviations in product revenue, if any exist. Small deviations on them are difficult to notice, but large ones became signals for the need for further analysis.

Despite the impossibility of drawing accurate conclusions about the success of the pilots based on dashboards, they were very useful in the process of operational management of experiments.

Table 5 shows an assessment of the effects after the introduction of pilot experiments on the management of the assortment matrix.

As a result of the pilots, confirmed effects were obtained from new matrices in two categories out of five. In two categories, the effect was not confirmed. It can be assumed that the lack of effect in the two categories is associated with a significant gap in the availability of "new recommended" and "old" products.

Thus, we can conclude that the introduction of automation works and brings noticeable results. As part of the pilot implementation of the project, the result obtained translates into billions of rubles in revenue and EBITDA growth per

Table 5
Evaluation of the results of pilot projects on assortment matrix management

Category	Effect*
SHA category 1	Confirmed, + 2% to revenue
LHA category 2	Is not confirmed
LHA category 3	Confirmed, + 0.5% to revenue, + 5% to margin
LHA and SHA category 4	Is not confirmed
Accessories category 5	Confirmed, + 3% to revenue

* Confidence interval 95%.
Source: compiled by the author.

year. It is important to note that this effect will be especially noticeable for large retailers with multi-billion dollar annual turnover; for small and medium-sized companies it is necessary to conduct an additional assessment of the costs and benefits of implementing such a methodology.

8. Conclusions and recommendations on the formation of a methodology for various participants in the assortment management process

Assortment management in the field of safety and security has a number of features that must be taken into account when developing a methodology and conducting pilots.

Deficiencies. One of the key features is the presence of deficits. Some goods can be successfully delivered by the described tool to the matrix, but due to the fact that this product is in short supply, it simply will not get on the shelf, since there are not enough of it even in warehouses. Deficiencies are important to consider when conducting a pilot and operating an instrument.

Product Leadtime. The time it takes to ship an item from a warehouse to a store varies greatly by category and region. If phones are often sent by plane and they arrive in the first week after they hit the matrix, then household appliances can go for three weeks, a month or more. This is important to consider when evaluating the effect of pilots. It is possible that the product that was added to the matrix did not stay in the store for the entire duration of the pilot. This error in the pilot's assessment has a high risk of erroneous conclusions. Leadtime can be influenced by the choice for the pilot of stores that have minimal logistical "shoulders".

The two previous points are related to accessibility but are not exhaustive. When conducting pilots, it is worth regularly analysing the availability of goods in piloted categories and identifying anomalies with further clarification of their causes. Accessibility is one of the main factors influencing the success of pilots, so it should always be taken into account.

Store overload. Stores are overloaded to varying degrees, some of the goods may be delivered much more than provided. It is better not to carry out pilots in such stores, since the goods that will be sent may not get on the shelf or get there, but they are not in the conditions that the tool suggests. To reduce store overload, you can use sales and withdrawal of goods from the store during the pre-pilot period.

Brand zones. Many retailers have brand zones, and products from them cannot be removed from the store. Therefore, when conducting a pilot, it is better to avoid stores with a large number of brand zones in their assortment - they can create additional noise.

For companies in other retail industries

When managing the assortment, it is worth looking at the assortment through the prism of customer needs, formed on the basis of the analysis of customer behavior, and not only through the classical categorisation, which is built on the perception of customer needs based on the expert assessment of the category manager or the opinions

of suppliers. One of the best ways to understand needs is to collect and analyse customer behavior data. Thus, one can see features that may differ from the usual picture of categorical previous control.

When conducting pilots and implementing an assortment management methodology, it is important to take into account the specifics of the industry: the shortage of goods, the peculiarities of working with suppliers, the expiration date of the goods (if appropriate), the specifics of logistics, etc.

It is important to evaluate the potential benefits from the introduction of a new tool: are they sufficient to recoup the risks and costs of development and implementation. Perhaps the scale of the company or the peculiarities of the work will not allow you to recoup the investments and risks.

For category managers

It is very important that the tests and implementation of the tool are successful. Here, much may depend on the assistance of category managers. They can speed up or slow down testing and implementation. To get the maximum result from the implementation, it is worth taking an active position in the process of developing, testing and implementing the product. A quality product will free up a significant amount of time and labor resources from tasks that will be automated. The category manager will be able to direct the released resources to solving more creative tasks (working with a supplier, searching for new assortment niches, etc.).

For methodology developers

When developing a methodology, it is extremely important to take into account the peculiarities of the retail business and refine the methodology depending on it. The tool should be built into a user-friendly product with a clear and comfortable interface. The faster category managers get used to the product, the more effective the implementation will be. It is worth taking into account the opinion and experience of category managers when developing a methodology, conducting pilots - their comments can be useful for developing and further implementing the tool.

Also, to further improve the tool, you can add the following functions to it:

1. Accounting for promotional periods.
2. Improving the methodology so that one article can relate to several needs (now one article corresponds to one need).
3. Taking into account the peculiarities of the client's behavior on the site. Sessions using a filter depend on the filters on the site, its structure, and functions. Therefore, such sessions are not entirely clean in terms of identifying the real preferences and needs of the client, the interchangeability of goods.
4. When calculating the uniqueness indicator, not only views of product cards are taken into account, but also their conversion into a purchase, as well as cannibalisation.
5. Improving the calculation of BOT indicators (accounting for back margin).
6. Accounting for market data in the model.
7. Automatic recommendation for CDT interpretation.

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