



Article

Design of Personal Trajectories for Employees' Professional Development in the Knowledge Society under Industry 5.0

Ekaterina V. Orlova

Department of Economics and Management, Ufa State Aviation Technical University, 450000 Ufa, Russia; ekorl@mail.ru

Abstract: The main feature of Industry 5.0 is “personalization”, linked not only to provide customers with personalized products, but also, in our opinion, to ensure personalization in labor relations with employees, since it increases human value through human–machine collaboration. The human capital quality determines a significant contribution not only to the labor productivity growth, but also to extend a social communication, loyalty and employees' trust. The study proposes the new methodological approach for corporate human capital assessment and management (CHCM) over new conditions of digital transformation. The CHCM uses methods of system analysis and synthesis, expert assessments, descriptive statistical analysis and survey. The novelty of CHCM is that, firstly, it reflects all the essential features and properties of human capital under emergence of new professions; secondly, it combines and comprehensively uses both quantitative and qualitative methods for human capital assessment, reflecting the subjective and objective aspects of human capital measurement; thirdly, it allows to create warranted management decisions about individual trajectories of professional development of employees, ensuring the continuous growth of individual, corporate and social wealth. It is proved experimentally that the implementation of individual trajectories for employees' professional development provides 2–3 years' perspective on companies' performance growth.

Keywords: human capital; employee assessment; labor performance; individual trajectories of professional development; organizational innovation; knowledge society



Citation: Orlova, Ekaterina V. 2021. Design of Personal Trajectories for Employees' Professional Development in the Knowledge Society under Industry 5.0. *Social Sciences* 10: 427. <https://doi.org/10.3390/socsci10110427>

Academic Editor:
Svetlana Drobyazko

Received: 24 September 2021
Accepted: 2 November 2021
Published: 6 November 2021

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2021 by the author. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Development of digital technologies, Internet of Things, big data and big data analytics, as well as artificial intelligence have led to a new phase of economic development—an intellectual economy. This economy is based on the use of intelligence as the main factor of social and economic activity. As shown in (Autor et al. 2020), on changes in the labor market in the period 1984–2005, employment is growing in two areas—in the area of simple and low-paid tasks and, conversely, in the area of complex tasks and those requiring non-standard thinking. In the area of routine manual labor, employment is declining. The reason for this is that it is unprofitable to automate cheap and simple work, and it is almost impossible to automate creative work. It is more profitable to entrust automatic and robotic systems to a rather expensive but easily automated intellectual routine. That is, specialists with average skills are under the threat of digitalization.

The development of science and innovation expands the field that will be robotized and automated. In the intellectual economy, two poles may emerge: mass standardized products and services with an emphasis on automatic solutions, and customized goods and services with an emphasis on communication and solving non-standard problems. Most jobs will grow in the field of customized solutions, although some of those will develop and maintain automatic systems. For potential employees, this means choosing one of the following decision strategies: They are to develop creativity and communication or to extend their knowledge and skills in information technology and data processing methods, or to use both of these strategies in a balanced way.

The existing conditions of technological development inevitably change the labor nature and its conditions. The employee's portrait is becoming more and more multifaceted due to the expansion of various human activities, including activities in the digital space. Therefore, development of approaches, methods and techniques for modeling, assessing and managing human capital (HC) as the most important resource of the companies is relevant, both socially and economically.

Thus, the company will ensure a strong relationship between financial capital and HC, on the one hand, and economic growth and development, on the other. Whether timely and reasonable investments will facilitate corporate HC management and predetermine an economic growth and development of a corporate—this investigation is aimed at solving this issue.

The research *hypothesis* is two interrelated and complementary points:

- Firstly, the objective needs to make changes and adjustments to the corporate HC assessment methodology. These changes are due to the digital transformation of the economy and new requirements for the employees' competencies in terms of their knowledge and skills;
- Secondly, the formation of a complex of individual management decisions directed on employees' development based on a new approach for corporate HC assessment contributing to the growth of private (resource) and general (system) indicators of the company's efficiency. The set of management decisions will facilitate the growth of individual, corporate and social wealth.

The *purpose* of the research is to develop the corporate human capital management (CHCM) methodology based on the new methodology for human capital assessment in a company and the scheme for design individual trajectories for employees' professional development. Implementation of this methodology would improve the HC quality, increase the company efficiency and contribute to social wealth. The main steps of the research are in the following fields:

1. Study state-of-the-art trends and features of new professions and approaches for employees' professional development;
2. Define the modern interpretation of the concept of "human capital", suggest a HC typology, critically analyze existing methods for HC assessment in a company;
3. Develop a new methodology for corporate human capital management, including a module for its assessment and a module for support managerial decisions on individual trajectories for employees' professional development;
4. Draw up a cognitive diagram for identification human capital factors influencing companies' efficiency;
5. Test the proposed methodology on the oil-producing company data and prove its social and economic efficiencies.

In this paper, we develop and apply the CHCM methodology according to the following structure. In Section 2, we review the current state of the use and features of human capital in different levels of economy, highlighting the existing *gap* between required new competencies, knowledge, skills and health potential, jointly forming the HC concept of employees' over economic digital transformation, and ability of existing methods and models to correctly identify corporate human capital, taking into account all these features. In addition, this section summarizes the existing classifications of human capital, and points out strengths and weaknesses of existing methods for human capital assessment at the corporate level. In Section 3, we detail the proposed CHCM methodology. In Section 4, we apply the developed CHCM methodology using data collected in a company from the oil sector. Finally, in Section 5, we set out the conclusions and future work.

2. Literature Review: Human Capital Features and Its Assessment over Digital Transformation of Economy

2.1. Future Key Competencies of Employees in Digital Economy

Over the past few decades, there have been significant changes in all spheres of human activity. There are globalization processes, changes in consumer preferences and modernization of management models. Data, information and knowledge have become the main management object in the fourth industrial revolution. The labor nature changes and new challenges appear under the digitalization of business processes, and it transforms employees' tasks. This, on the one hand, changes professions, contributes to the new ones and leads to the eradication of retired professions, but, on the other hand, it causes unemployment.

In this new paradigm, professionals would have specific skills, often referred to as 21st century skills. They would allow specialists to work more efficiently, move between industries and be in demand at the same time. There are various approaches to identifying the key competencies that are most in demand in the near future. Let us consider some of them.

1. The Ministry of Economic Development of the Russian Federation determines the digital economy key competencies concept ([Ministry of Economic Development of Russia 2020](#)). Digital economy key competencies are competencies that provide an employee to solve a given task or achieve a given result under global digitalization of social and business processes. There are the following:

- Communication and cooperation in the digital environment is the ability of an employee to find out various digital tools to interact with others and achieve his goals;
- Self-development under uncertainty reflects a person's ability to self-study, to set educational tasks for solving problems and to choose tools to solve appeared problems, including digital tools;
- Creative thinking is the ability to generate new ideas, rebuild known techniques to decide problems, and to generate alternative decisions options and new, more efficient algorithms;
- Information and data management characterizes the ability to search for information necessary for decide emerging problems using digital tools;
- Critical thinking over digital environment assumes the ability to assess information, its reliability, and to build logical conclusions based on input information and data.

2. The World Bank's World Development Report "Digital Dividends" identifies three main groups of skills that are most in demand in the digital economy ([World Bank Group 2016](#)):

- Cognitive skills combine mathematical and cognitive skills such as logical and creative thinking, problem solving, memory and quick thinking;
- Social and behavioral skills associated with the ability and willingness to gain new experience, make decisions, carry out interpersonal communications, make compromises if necessary, and also reflect such personal characteristics as conscientiousness and emotional stability;
- Technical skills focused on the professional component, imply knowledge of specific methods, the ability to work with mechanisms and tools, as well as others acquired in the training course and skills required to work in a specific conditions.

3. The World Economic Forum describes ten key skills for effective employment in the fourth industrial revolution. This list includes customer focus, critical thinking, complex problem solving, decision making rate, creativity, the ability to work with people, coordination and interaction skills, the ability to coordinate and negotiate, emotional intelligence and cognitive flexibility ([Whiting 2020](#)).

4. DigComp (the European Digital Competence Framework offers a tool to improve citizen's digital competence) developed a digital competence model, which includes ([Carretero et al. 2017](#)): problem solving, communication and cooperation competence,

competence in information and data, competence of digital content creation and security competence.

5. Burning Glass (Burning Glass Technologies delivers job market analytics that empower employers, workers and educators to make data-driven decisions) conducted a labor market analysis and built a model for the fundamental skills of the digital economy (Markow et al. 2018). In this model, key skills are combined into four blocks:

- Human Skills characterize analytical skills, including critical thinking, creativity, willingness to communicate and cooperation;
- Domain Knowledge includes knowledge in the sphere of economics, marketing, research and product development, public relations and human resource management, including talent development;
- Digital Building Block Skills combine skills in software development, data analysis and information security;
- Business Enabler Skills include decision making, project management, visualization and data transfer.

The detailing of specific competencies within the selected blocks is continuously refined based on real-time analysis using artificial intelligence technologies of hundreds of millions of jobs and real career moving.

6. The target competency model—2025 compiled on the research results “Russia 2025. From Personnel to Talents” conducted by BCG, has three levels of the competencies/skills hierarchy (cognitive, socio-behavioral and informational), which are then detailed to the level of specific competencies (Boutenko et al. 2017):

- A group of cognitive skills/competencies combines self-development and involves learning, perception of criticism and feedback, curiosity, organization (organization of their activities and resource management), management skills (prioritization, setting goals and objectives, team building, motivation and delegation), as well as solving non-standard tasks and adaptability;
- A group of socio-behavioral skills includes interpersonal and communication skills, as well as intercultural interaction skills;
- A group of digital skills integrates information management and systems design.

7. The Atlas of New Professions (Agency for Strategic Initiatives 2015) highlighted the following super-professional skills that are in demand in the future: multilingualism and multiculturalism, cross-industry communication skills, customer focus, the ability to manage projects and processes, work under high uncertainty and rapid task conditions change, creativity, work in a team, programming and management of complex automated systems, work with artificial intelligence, systems thinking, lean manufacturing skills, ecological thinking, attention management, critical thinking, awareness, emotional intelligence, work with consumer changing queries.

8. Analysis and generalization of various models were carried out by ECOPSY Consulting Company. They constructed the model included ten clusters of the most demanded competencies of the “specialist of the future” (Bezruchko et al. 2018): interaction and cooperation; analytical thinking and problem solving; innovation and creativity; learnability and open thinking; digital knowledge and skills; awareness and self-control; interdisciplinary and intercultural interaction; ethics and social responsibility; performance management; focus on results achievement. Study (Morrar et al. 2017) notes that along with technological innovation in Industry 4.0, social innovation should also be implemented.

In the period of the fourth industrial revolution and digital transformation, Industry 5.0 provides a vision for companies and industries that goes beyond the categories of efficiency and productivity as the only goals, but enhances the role and contribution of industry to society. The Industry 5.0 vision places employees’ wellbeing at the center of the production process and uses new technologies to create prosperity beyond jobs and growth while respecting the planet’s production constraints. This concept complements the existing Industry 4.0 approach, specifically placing research and innovation at the

service of the transition to a sustainable, people-centered and sustainable industry. In this paradigm, industry can play an active role in solving society's problems, including resource conservation, climate change and social stability.

The main feature of Industry 5.0 is "personalization", linked not only with providing customers with personalized products, but also, in our opinion, to ensure personalization in labor relations with employees, since it increases human value through human-machine collaboration. Therefore, the role of human and social capital under Industry 5.0 are increased and it should be appropriately taken into account in the Knowledge Society.

2.2. Concepts of "Human Potential" and "Human Capital" as Assessment Objects

A review of the main challenges associated with HC (Kuzminov et al. 2018) made it possible to formulate a number of key conclusions that are fundamental for understanding what measures are needed to improve its quality and contribution to economic growth and development. Changes in three sectors should provide a breakthrough development:

- Education, which is assigned a leading role in the HC formation;
- Health care system is to provide a life expectancy at birth exceeding 80 years;
- Social support system intended for reducing poverty and improving the life quality of older age population groups.

National capital, along with natural, material and physical capital, includes human capital. In a wide understanding HC is considered as intensive productive factor in the economy, society and family, which includes a part of labor resources, knowledge and intelligence, tools of human labor, one's environment and labor activity. In a narrow understanding, human capital unites intelligence, health, quality and productive work and life quality.

The origins concept of HC goes back to the work of A. Smith in the 18th century. He emphasized the importance of "acquired and useful abilities of all residents or members of society" (Smith 1776), while the individual bears the costs of obtaining such abilities, after their acquisition they turn into "capital embodied and realized in his personality". When analyzing surplus value, K. Marx divided capital into constant and variable, while he noted that only variable capital creates surplus value (Marx and Engels 1960). The practical implications of the idea of interpreting the abilities of individuals as a kind of capital, i.e., asset did not gain widespread acceptance until the 1960s, when economists began to incorporate this concept into their research. This breakthrough partly reflected the view that the concept of HC can explain the high difference between an increase in a country's output and an increase in the traditional inputs (land, labor and capital) used in its production. The category of "human capital" was introduced by T. Schultz (1971) in the late 1960s. Later, G. Becker's theory of HC received a powerful impetus for development; in particular, it became the basis for the Human Development concept (Becker 1966, 1976).

There are many definitions of HC used in the scientific literature, but most of them focus on the economic return on investment in HC. As the economy becomes more and more knowledge-intensive and globalized, the economic role of HC as a guarantee of an individual's competitiveness and the success of a country's economy as a whole becomes more important than ever before. However, investment in HC also provides also non-economic benefits, such as better health, higher personal well-being and stronger social cohesion. These broad benefits are viewed by many authors as important benefits like higher wages and economic growth.

In essence, two different research objects can be distinguished (United Nations 2016; United Nations Development Programme 2019): HC as a set of knowledge and skills (both associated with a specific workplace and with productive labor in general) and human potential, reflecting not only knowledge and skills, but others important aspects of individual potential like health, psychological state and adaptive capabilities (Figure 1). These characteristics, on the one hand, affect individual value as an employee and the prospects for investment return, and, on the other hand, they reflect the life quality of each particular individual.

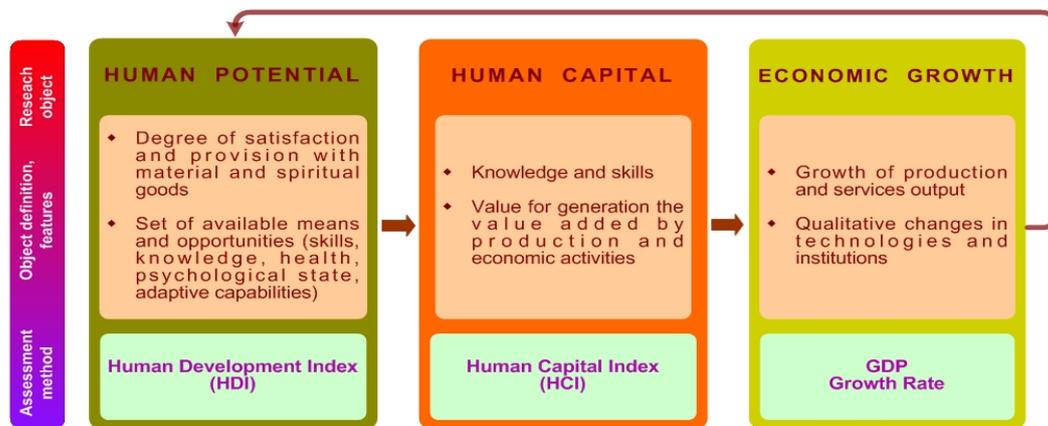


Figure 1. The relationship of physical (human) potential with human capital and economic growth under paradigm of United Nations Development Program (United Nations 2016; United Nations Development Programme 2019).

Each of these elements contains specific indicators, twenty-one indicators in total. HC is defined as the weighted sum of these indicators and is used to compare regions and countries.

2.3. HC Types

There are many different approaches to systematization of HC. For the purpose of sustainable community development, authors (Roseland and Spiliotopoulou 2016) use the term “Community Capital” to include natural, physical, economic, human, social and cultural forms of capital. In the works of (Flores et al. 2020a, 2020b), human-oriented architecture and human-centric architecture model are proposed. In their paradigm HC (workforce) based on competence, human life cycle and environment scenario. The companies’ HC could include organizational (structural) capital (Youndt 2000), social and consumer capital (Edvinsson and Mallone 2007) as a component of intellectual capital in the form of skills and knowledge accumulated by the company, as well as nonphysical resource for creating added value (Samad 2020; Gratton and Ghoshal 2003). In (Armstrong 2008), great attention is given to the institutional components of a companies’ HC.

Broadly elements of HC can be classified according to the following features—subject used, performance form, structured elements, types and components, level of system, generational archetypes, accumulated potential (or human life cycle stages) and riskiness (Figure 2). Consideration of specific type of HC determines its properties, assessment methods and management tools.

Indeed, depending on the level of the system within which HC is considered (we distinguish the macro-level—the level of regions and countries; the micro-level—the level of specific companies; and the nano-level—the level of a specific person), characteristics and properties of the HC will vary.

When considering the system level of specific employees who form the total capital of the company, the following types of capital can be distinguished:

- Health capital as a health potential that allows a person to use their skills and knowledge in a workspace;
- Educational capital as a complex of skills and knowledge received in educating;
- Professional capital as qualifications, general and special skills, working experience);
- Intellectual capital reflects a person’s ability like creativity, ability to research and decide new challenges;
- Cultural capital as mentality, upbringing, ethics, empathy;
- Social capital as an ability to establish relationships with other persons in the workspace and external social institutions, to use social activities;
- Organizational capital like motivation for different activities, responsibility, initiative, ability to set up goals, to achieve results;

- Entrepreneurial capital reflects the ability of a person to form innovation as well as to commercialize their results under risk.

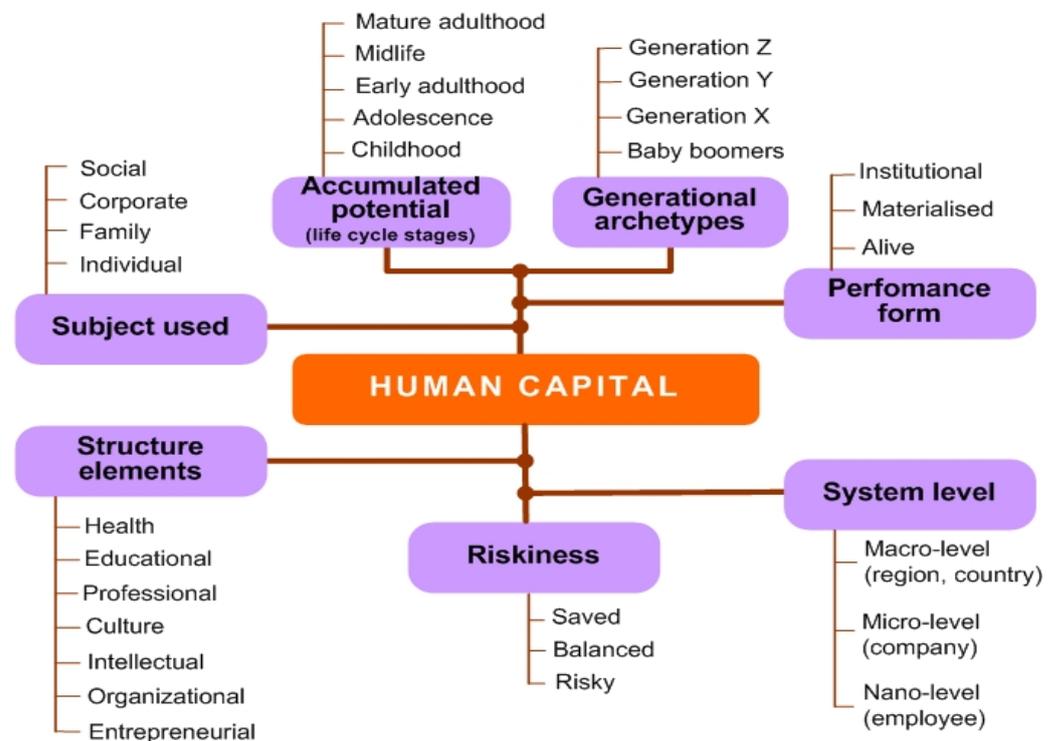


Figure 2. HC typology.

When considering system-level companies, we distinguish the following types of corporate HC:

- Organizational (or structural) capital reflects the potential of the company, it is organizational structure, management rules and regulations, corporate culture;
- Production capital is formed by a set of knowledge, skills and abilities of employees used to conduct production activities and solve current problems;
- Social capital characterizes interpersonal interaction in the organization, is reflected in the norms, values, trust and social ties,
- Market capital reflects relationships between company and its stakeholders, business reputation and the practice of resolving conflicts with stakeholders;
- Intellectual (or innovative) capital includes the competence of employees, patents, know-how, developed software, licenses and other intellectual assets.

Having identified the main components of HC, its properties and features, one can proceed to the stage of its assessment. Considering the HC of specific employees, (Heckman and Kautz 2012; Robles 2012) provides a set of competences to be assessed: core competences and interaction competences. Core competences of a person reflect “support internal thinking and controlling before any interaction or engagement into an activity to the outer world” (Garashkina and Druzhinina 2020) and include the following:

1. Self-awareness is a person’s awareness of oneself as different from other people and the world. This is the perception of one’s own uniqueness and independence, wholeness. It includes the following components: a person’s understanding of their needs, desires, thoughts, emotions and motives, as well as an individual’s understanding of the specifics of their relationship with the world and themselves. A well-known competence for this capacity is emotional intelligence, as this is the ability to control and discriminate the use of one’s emotional status. In other words, it is the ability to control self-emotions, i.e., stress or anxiety, and also to understand them in other individuals.

2. Cognitive functioning is the ability to understand the physical world through the processes of the mind, and it supports the capacity of learning of the person (Heckman and Kautz 2012). The best-known competence is Intelligent Quotient (IQ), which normally measures capacities like memory, math, reading/literacy, coordination and analytical thinking.
3. Interaction competencies allow you to interact with the external environment through results or actions. There are two main ways to do this: interacting with people and doing a job or task.
4. Interaction with people can be supported by the use of soft or social skills (Robles 2012). These skills enable a person to communicate, work and collaborate with others.
5. The work performance can be developed through the use of hard or technical skills (Zakovorotny et al. 2019), and most people should have some degree of skill by the time they move into a new position or role.
6. The stage of digital transformation of economic and production systems is pushing people to become interactive and actively support online interactions. This is reflected in digital skills (Mikhnenko 2021).

In (Latov and Tikhonova 2021), it is noted that HC is the main resource of the future post-industrial society and the knowledge economy. Professionals are viewed as a special social subject characterized by their small numbers and heterogeneity. In the work of (Karavay 2021), it is shown that the accumulated HC of professionals is higher than that of other non-physical workers, and they are characterized by a very strong differentiation in the quality of HC. To ensure sustainable economic growth and social development, all groups of factors—technologies, institutions, human capital—must develop in concert and, in a certain sense, be synchronized in their dynamics (Aganbegyan 2017; Orlova 2021a).

The choice of a particular side of HC determines its characteristic properties, methods of assessment and management.

2.4. Methods for Corporate HC Assessment and Management

The core element for construction the HC concept is the selection and justification of assessment methods. Depending on the consideration level and the subject used, there are many methods designed to assess HC in order to identify and manage it.

Considering the personnel assessment at the level of an employee in the Talent Management (TM) section of management, we note that methods aimed at obtaining feedback at work (Orlova 2016; Church et al. 2019) for the purpose of performance management have become widespread recently. For personnel assessment and development, the following stages are usually performed: assessment of the employee's performance, potential assessment, career planning, training and career mentoring, personnel rotation and the study of competencies in behavior.

Scientific works about HC assessment and management at the company (corporate) level have a common goal—forming a sustainable human resource management (HRM) system. The challenge of career management within human resource development systems is also actively discussed in scientific works. It is proposed to use various factors to achieve greater efficiency (Steelman and Williams 2019; Zhang et al. 2019; Hernaus et al. 2019). Moreover, these factors are not independent, but often have close correlations (Alzyoud 2018; Hitka et al. 2019; Stokowski et al. 2018; Fang et al. 2018), which would complicate finding specific mechanisms for career-managing regular and continuous employees' assessment to evaluate the degree of goal achievement (Dickmann and Cerdin 2014).

Analysis of scientific articles and monographs devoted to methods for assessing human capital at the corporate level revealed two groups of approaches that differ in the ways of assessing the contribution of human capital to the companies' efficiency, as well as the systematic (not limited to the level of the company) category of human capital. They also differ from each other in the factors that determine human capital, the methods of their measurement and assessment, as well as the mechanisms of human capital impact on the companies' performance. These are the following united groups of approaches:

- Approaches and methods which are aimed at the cost measurement of the contribution of human resources to the achievement of the company's goals. They assess the impact of human resources and human capital on general (system) indicators such as profit margins and profitability.
- Approaches and methods which take into account the needs of employees, their protection and further development, and focus on assessing the impact and human capital on private (resource) indicators of the company's performance, for example, labor productivity.

Some approaches to assessing HC at the corporate level are aimed at the cost measurement of the contribution of human resources to the achievement of the company's goals. Findings from the point of view of strategic analysis, improvement of organizational culture of a company and connection with stakeholders and qualitative description of the relationship between corporate social responsibility and strategic HRM are given in (Jung and Takeuchi 2018). Many researches are focused on social capital of a company defined for a community or society as a whole (Barrena et al. 2011; Hasan et al. 2017; Lins et al. 2016). The mutual influence of the level of social capital present in society and corporations operating in that society is discussed in (Barrena et al. 2011; Hasan et al. 2017). The work of (Lins et al. 2016) discusses the role of social capital with particular emphasis on corporations, arguing that social capital contributes substantially to firm value. Before studying a firm's intellectual capital in the form of investments in R&D and other intangible investments, it has been pointed out as an obvious necessity to safeguard the future livelihood of the firm.

The HC assessment system makes it possible to identify the relationship between the characteristics of human resources, such as skills, competencies and behavior, and the value created for shareholders and, in a broader sense, for the company's stakeholders. Such system is based on accounting, which distinguishes between two main streams of HC assessment: one associated with labor accounting, and the other with management accounting. Although both of them pursue the same ontological goal of visualizing and measuring the contribution of the labor force, the former proposes a metric for reporting the value of human assets in financial reporting, the latter for determining indicators for making managerial decisions on mobilizing and managing human resources in order to increase their contribution into company cost.

Other concepts and approaches additionally take into account the employees' interests, their protection and further development and focus on assessing the impact of HC (and intellectual capital as its part) on company performance (Servaes and Tamayo 2017). Special indicators are applied to measure the degree of sustainability of HRM and additionally include the measurement of favorable conditions for the development of human capital (or human potential). The indicator-based toolkit allows to formulate recommendations for HC expanding and improving. At the same time, the control process consists in establishing the relationship between strategic objectives, operations and indicators related to HC as the main component of the company's capital (Osranek and Zink 2014). A more complete understanding of strategy implementation requires the integration of ideas from the company level (micro-approach) to the level of individual employees (nano-approach) (Guthrie and Murthy 2009). The nano-approach is based on methods of psychological measurement and focuses on understanding the thoughts, feelings and actions of people. The micro-approach is related to sociology and economics. It aims to study organizations and markets.

Most management research studies the phenomena and processes associated with HC, focusing on one systemic level of analysis (employee level, company level and region or country level). However, in recent years, researchers have developed a more sophisticated understanding of phenomena using a “multilevel lens” that helps in understanding the context of human behavior and highlighting the various consequences affecting the levels of social organizations (Hitt et al. 2007; Verma and Dewe 2008).

Regardless of the system level at which HC is considered, there are the costs, or investment method, the method for investments return assessment; and benchmarking, or the comparative method, which is based on comparing the HC of different workers, companies, regions or countries.

The most widespread is the investment method (Schultz 1971; Becker 1966, 1976; Hickman and Olney 2009). HC is identified and measured like intangible assets. The initial cost includes the costs associated with the determination of a person as a capital unit:

- Reproductive costs associated with the birth and upbringing of children, their education in the field of general knowledge;
- Expenses for maintaining physical and psychological health (clinical examination, labor protection, insurance);
- Cost for recruiting and personnel adapting;
- Costs associated with additional vocational education (professional retraining and/or advanced training programs);
- Other corporate costs associated with the harmonious inclusion of a person in the sphere of companies’ concerns.

Sometimes the initial cost includes only recruiting costs, retraining costs, cost for advanced training and cost for labor protection. The residual value of HC is defined as the initial or replacement value minus depreciation. Physical deterioration is understood as the loss of health, natural and acquired skills, and obsolescence occurs due to the age characteristics of a person or due to the obsolescence of knowledge in the context of technological changes or the withering away of professions. Depreciation costs are estimated taking into account the number of years during which this employee bring income to the company, or the period of time when professional qualities are still valuable. The costs associated with hiring and adapting personnel are defined as a single long-term investment, and all subsequent investments are similar to the cost of repairing fixed assets. If the employee who is invested leaves, this is considered as a direct loss of the company.

The method for future income assessment or investment efficiency method evaluates the company income, which will be obtained through additional employees’ experience and qualifications. At the level of an individual employee, these incomes are defined as the ratio of the cumulative annual incremental wage in total value of direct costs and lost opportunities cost. Enterprise-level revenues are estimated as the expected revenue growth from additional HC expenditures. Investments are divided into single (direct) and indirect investments in the form of lost profits from the distraction of workers from their main activities. The lost profit in the cost structure can be significant values associated with a decrease in the workers’ productivity, the marriage due to insufficient qualifications or other reasons.

The limits of applicability, advantages and disadvantages of the listed methods are summarized in Table 1. Thus, the cost method, despite its relative simplicity, does not give a complete and real assessment of HC. Some types of costs are difficult to estimate (for example, the costs associated with the acquisition of experience and special skills). The income method despite its versatility and assessment of prospects, which is important for making managerial decisions, is quite difficult to calculate. The comparative method, despite its realism, does not always form acceptable results for making management decisions, since the results strongly depend on the comparison object.

Table 1. Advantages and disadvantages of HC assessment methods.

Method	Advantages	Disadvantages
Investment (cost)	Easiest calculation	Incomplete assessment of actual HC; difficulty in estimating some costs
Investment efficiency (returns)	Versatility; prospects assessment over time and using different HC features	Complexity in calculations; usage predicted data for calculations; probabilistic and subjective assessment
Comparative (benchmarking)	Data driven; shows the efficiency of HC usage under existing conditions	Difficulties in analogs finding for comparison; does not reflect development prospects

We generally characterize the expected positive effect from HC investments of a company, associated with the following results:

- Growth of economic and social efficiency of a company and other additional competitive advantages;
- Development of individual HC—personal career, intellectual, innovative achievements of employees and a wage increase;
- Maintaining an employees' health and working capacity;
- Providing feedback from internal environment (for example, quick feedback from the labor market about lack of personnel with appropriate qualifications);
- Fulfillment of the government contracts in case the investment was made by federal or municipal authorities.

So, each of the considered methods for HC assessment has its own characteristics and disadvantages, but their application is mainly complicated by the lack of data for the calculation, as well as the usage of qualitative indicators that determine the subjective nature of the estimates obtained.

Thus, HC at the level of a specific employee is a set of knowledge, skills and abilities, the state of physical and mental health, affecting the results of their labor activity and income. At the company level HC represents an economic resource, which reproduction requires, in contrast to physical capital, constant motivation. HC is a means for stability and increasing the company competitiveness and it is a discounted value of all expected income from labor. At the state and regional level, HC is formed by investments to accumulation the knowledge and intellectual components, to improving life quality, to education, health, safety and culture. HC is a complex and intensive factor in social and economic development. It contributes to improving the labor quality and labor productivity.

Summarizing all the ways of presenting HC, as well as the methods of its analysis at the company level, we combine many publications, focusing on the main features of the corporate HC. The main studies about corporate HC description, measurement and management, as well as the methods used can be found in Table 2.

An analysis of existing approaches, methods and tools for assessing and managing the HC of companies showed that there is a *gap* between the need to take into account all aspects of company's HC over digital transformation and the possibility of existing approaches to such assessment and management. Assessment the corporate HC in different scientific works is formed from one side—from the standpoint of employees' competence or employees' health of or motivational characteristics, etc. However, a comprehensive assessment of the HC on corporate level, reflecting all these different employees factors and features, including: education, health, qualifications, involvement and motivation, as well as social skills, communication, interprofessional skills under requirements of new professions and quick adaptive abilities, which is the basis for the formation management decisions on individual and corporate HC development, is absent in existing scientific works on the topic.

Table 2. Corporate HC related studies.

Subject of Study and Highlights	Methods of Study	References
Propose human-centered architecture and a human-centered architectural model. HC is based on competencies, human life cycle and scenarios of the external environment	Information system development/use/support	(Flores et al. 2020a, 2020b)
Consider companies' HC that includes organizational (structural) capital, social and consumer capital as a component of intellectual capital in the form of skills and knowledge accumulated by the company	Qualitative analysis	(Youndt 2000; Edvinsson and Mallone 2007)
Studying of institutional components of the company's HC	Qualitative analysis	(Armstrong 2008; Latov and Tikhonova 2021; Aganbegyan 2017)
Examines the features of corporate HC and its management using generations theory	Expert measures	(Demartini and Paoloni 2014)
Shows that factors of a company's HC are not independent but often have a close correlation. Points out on the complexity of building specific mechanisms for career management	Correlation analysis	(Steelman and Williams 2019; Zhang et al. 2019; Hernaus et al. 2019; Alzyoud 2018; Hitka et al. 2019; Stokowski et al. 2018; Fang et al. 2018)
Analysis HC metrics and measures based on human cost HC Scorecard system used to compare companies; performance	Accounting Benchmarking	(Nikitochkina 2021)
Propose subjective self-ratings of employees as to their individual HC and its converting to objective measurements	Expert measures	(Bassi and McMurrer 2005)
Development HC strategy of a company. Description of the relationship between corporate social responsibility and strategic HRM. Focus on social capital, economic performance and society wealth	Strategic analysis	(Jung and Takeuchi 2018; Barrena et al. 2011; Hasan et al. 2017; Lins et al. 2016; Massingham et al. 2011)
Measurement of effectiveness of leadership development programs. HR analysis as a driver and a measuring tool to support organizational change	HC metrics (indexes analysis)	(Scott et al. 2006; Boudreau et al. 2011)
Emphasizes the importance of measuring what adds value gives HC to a Bank. Recognition people as a central component of the company and the most important element of the add value	Indexes analysis	(Hoffman et al. 2012; Whitaker and Wilson 2007)
Using times series to build up data about HC and its comparison over time	Times series analysis	(Chynoweth 2015)
Cause-effect relationships between HR processes and product shrink	Structural equations modelling	(Lengnick-hall and Lengnick-hall 2003)
HC-related measurements within the company's intellectual capital relating to company strategy: product development, improvement of personal skills, creating knowledge and competences within current and future technologies	HC metrics (indexes analysis)	(Douthit and Mondore 2014)
Explore HR quantitative and qualitative data across organization and its analyses as "capability metrics" to the business unit leader	HC metrics	(Mouritsen et al. 2014)
Model for support decision making. Analysis relations of HC data and its impact on managerial effectiveness and engagement. Using HC measures for the diagnosis of business problems and sales effectiveness	Descriptive measures	(Haube 2015; Human Capital Management Institute (HCMI) 2016; Smith 2013; Fuller 2016)
Corporate performance dashboard with greater emphasis to HR data in decision making	Information system development/use/support	(Hesketh 2014; Sparrow et al. 2010)

Companies evaluating HC select the assessment method that is most convenient in the existing conditions and suitable for provide formulated goals. In some cases, the assessment requires qualitative characteristics and subjective indicators that reduce objectivity and distort the result of the HC assessment. In this case, the indicators that form the HC are correlated. All this limits the use of only economic and statistical methods for HC assessment. In addition, the conditions and nature of work in the era of the fourth industrial revolution require taking into account many characteristics that reflect digital competencies, communication and social adaptation of workers. This determines the use, along with quantitative indicators and economic and statistical methods, qualitative characteristics and expert assessments.

Thus, all this determines the need to develop a new universal approach and method for HC assessment at a company level, using HC as an economic productive resource, free from the shortcomings of existing methods. The new approach should adequately reflect and give a relevant assessment of the actual HC of the company in order to form individual trajectories of professional development ensuring the quality improvement not only individual and corporate HC but also continuous growth of social wealth.

We suggest the new methodology for corporate human capital management (CHCM), which is further considered in detail.

3. CHCM Methodology

CHCM methodology is a complex system for human capital management in a company. It is based on the method for HC assessment and a scheme for designing individual trajectories for employees’ professional development.

CHCM differs from the existing ones in that it:

- Reflects all the essential features and properties of HC—education, health, qualifications, involvement and motivation, as well as social skills, communication, interprofessional (interdisciplinary) skills under the emergence of new professions;
- Combines and comprehensively uses both quantitative and qualitative methods for HC assessment, reflecting the subjective and objective aspects of HC measurement;
- Allows to create warranted management decisions about individual trajectories of professional development of employees, ensuring the continuous growth of individual, corporate and social wealth.

The conceptual diagram of CHCM is shown in Figure 3 and is aimed toward HC management. The methodology is implemented in stages.

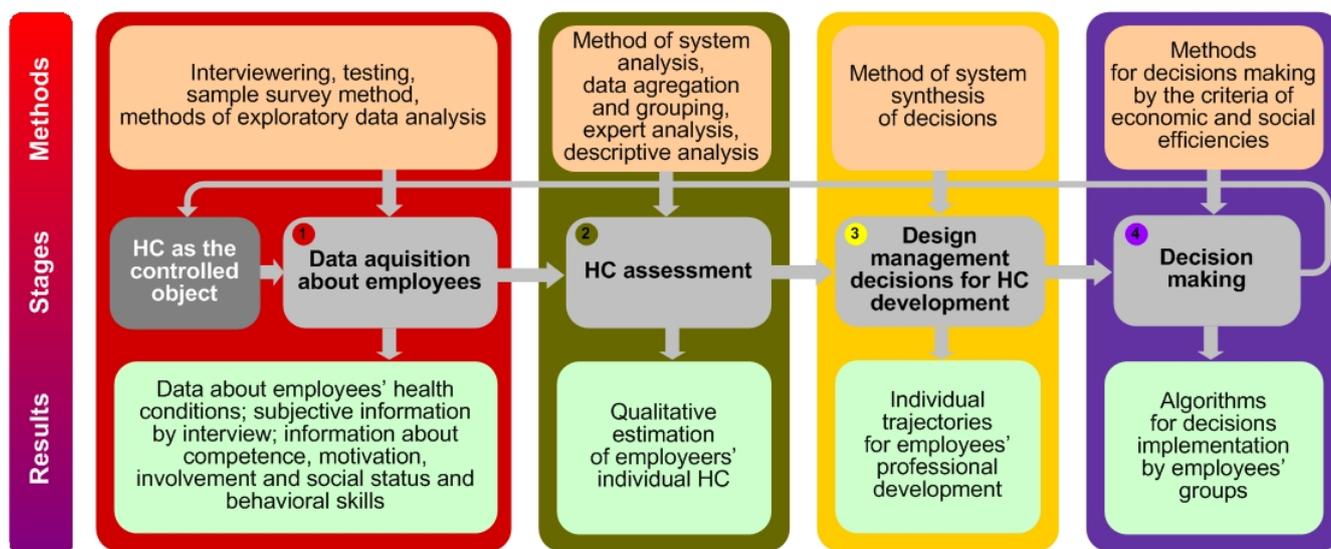


Figure 3. Conceptual scheme of the CHCM methodology.

Stage 1. Data acquisition about employees' health status, competence, motivation and social status and behavioral skills. Examination of the company's employees is carried out by five tracks—health quality (track 1), major competencies (track 2), interdisciplinary competencies (track 3), motivation and involvement (track 4) and social status and behavioral skills (track 5). The methods used at this stage are: medical examinations, questionnaires and testing. The result of this stage is objective data about health state of employees, age, education, professional experience and competencies, as well as subjective information about the health state, its quality, motivation, work involvement and behavioral skills.

Stage 2. HC assessment. An exploratory data analysis is carried out. For the assessment, employees are examined by five tracks—track 1 is to assess the health quality, track 2 is intended to assess major competencies, track 3 is to assess interdisciplinary competencies, track 4 is to assess motivation and involvement, and track 5 is to assess social status and behavioral skills. A detailed description of the score for each track is given below. The result of this stage is a numerical assessment of the employee's individual HC.

Stage 3. Design management decisions for HC development. It is based on the assessment results obtained from the previous Stage 2. For each assessment track, depending on the score, the employee is assigned to one of five groups, for which differentiated management decisions are proposed. The result of this stage is individual trajectories for employees' professional development for each track.

Stage 4. Decision making. The management decisions about individual trajectories of professional development developed at the previous stage of the CHCM are assessed according to the criteria of economic and social efficiency. The result of this stage are algorithms and methods for implementing management decisions by employee groups.

Let us consider in more detail all HC characteristics used for its assessment according to the selected tracks over Stage 2—HC assessment.

Track 1. Health quality assessment. It is the most important characteristic of HC and one of the factors affecting the efficiency of the company. An employee's health affects not only a person's life expectancy, but also determines their ability to work. In the previous studies of the author (Orlova 2020a, 2020b), it was proved quantitatively the significant correlation of the employees' health quality and their labor productivity. It was also shown that it is beneficial for the employer from the economic efficiency criteria to develop and implement projects to preserve the personnel health. There was also proposed the model for assessing the impact of health quality on labor productivity. When forming the trajectories of professional development, the employee's age is also taken into account in accordance with generation theory (Nikitochkina 2021; Orlova 2019, 2020c, 2021b). Separately, we note the issue of data confidentiality. The process of questioning and collecting data about the health status of employees is voluntary. Employees are advised that their data will not be transfer to third parties and will be used by the company solely for the purpose of forming individual trajectories of professional development.

Track 2. Major competencies assessment. This block evaluates the core competencies of the employee, the quality of their education and professional experience. The first component reflects the personal ability to solve a certain professional problems. The component for assessing education quality represents aggregate quantitative and qualitative data about education, measured by two indicators: the number of years that the employee studied at school, secondary specialized educational institution or higher education institution; and the quality of education—educational institution status, specialty and educational institution country. The component associated with the assessment of professional experience is focused on identifying skills and knowledge, accumulated in the developed professional tasks. This component is measured by the number of years worked in a particular profession sphere.

Track 3. Interdisciplinary competencies assessment. This component is an assessment of specific skills that allow specialists to work more efficiently, generate innovations over the fourth industrial revolution, and remain in demand in the labor market. It evaluates knowledge of foreign languages, multiculturalism, cross-industry communication skills,

customer focus, the ability to manage projects and processes, work in a high uncertainty and rapid change in task conditions, the ability to create, the ability to work in a team, programming skills and management of complex automated complexes, knowledge of methods and models of artificial intelligence and their application for specific applied problems, systems thinking, lean manufacturing skills, ecological thinking, mastery of methods of attention management, critical thinking, awareness and emotional intelligence.

Track 4. Motivation and involvement assessment. The component assesses how much the conditions and various incentive methods used in the enterprise affect the employee's motivation and encourage him to work more efficiently and better in order to achieve the set goals. In this study, motivation and involvement are used as qualitative characteristics that reflect the subjective attitude of each employee's propensity to intensive work and the tasks being solved.

Track 5. Social status and behavioral skills. This block identifies the social position occupied by a social individual in society or a separate social subsystem. It is determined by characteristics specific to a particular society and includes economic, nationality, age and other characteristics. Social status is characterized by power and/or financial capabilities, by specific skills or abilities, such as charisma. Social status indicators are: real estate and other property that the employee has, income level, lifestyle, relations between people in the social system, distribution relations, consumption relations, a person's place in the political system hierarchy and ethnic origin. These characteristics directly or indirectly affect the HC quality.

3.1. Technique for Human Capital Assessment

To assess human capital, we suggest various tools and techniques, as presented in Tables 3–5:

- Subjective observations—questionnaires (1.1–1.4; 5.2–5.5.), business cases (3.3), business games (3.1; 3.2), interviews (4.2) and creative tasks (4.3);
- Objective observations—medical examination (1.5), testing (2.1–2.6), education matching (2.7) and assessment of income level (5.1).

Table 3. Assessment of human capital components (Track 1, Track 2).

Track 1. HEALTH Quality Assessment			Track 2. Major Competencies Assessment		
Assessment Tool	Max. Score	Weight Coeff.	Assessment Tool	Max. Score	Weight Coeff.
1.1. Personality questionnaire	200	0.2	2.1. Assessment of major competencies	300	0.3
1.2. Estimation the frequency of health-related websites viewing	200	0.2	2.2. Assessment of analysis of verbal and numerical information	100	0.1
1.3. Evaluation of medical institutions attendance	200	0.1	2.3. Assessment of abstract thinking	100	0.1
1.4. Assessment of well-being	200	0.2	2.4. Assessment of management skills	100	0.1
1.5. Comprehensive medical examination	200	0.3	2.5. Assessment of general knowledge about national country	100	0.1
			2.6. Assessment of professional experience	100	0.1
			2.7. Assessment of education matching	200	0.2
Total score	1000	1	Total score	1000	1

Table 4. Assessment of human capital components (Track 3, Track 4).

Track 3. INTERDISCIPLINARY Competencies Assessment			Track 4. Motivation and Involvement Assessment		
Assessment Tool	Max. Score	Weight Coeff.	Assessment Tool	Max. Score	Weight Coeff.
3.1. Business game “Corporate Management”	300	0.3	4.1. Personality questionnaire	300	0.3
3.2. Business game “Innovative and technical solutions”	300	0.3	4.2. Interviewing by a professional psychologist	300	0.3
3.3. Creative task	400	0.4	4.3. Business assessment game	400	0.4
Total score	1000	1	Total score	1000	1

Table 5. Assessment of human capital components (Track 5).

Track 5. Social Status and Behavioral Skills		
Assessment Tool	Max. Score	Weight Coeff.
5.1. Assessment of income level	200	0.1
5.2. Lifestyle assessment	200	0.2
5.3. Assessment of marital status	200	0.2
5.4. Professional position assessment	200	0.2
5.5. Assessment of social communication	200	0.3
Total score	1000	1

Each assessment tool is expertly assigned the maximum possible score and weighting factor, depending on its significance and degree of influence on human capital. The aggregate score is calculated as a weighted sum of points for each track, and then these values are summarized to find out the final score. The final score could be from 0 to 5000 points.

Each assessment tool is expertly assigned the maximum possible score and weighting coefficient, depending on the significance and degree of influence on HC. As a result of assessment for all blocks, an employee can score from 0 to 5000 points. The aggregate score is defined as the sum of points scored for each block, and within the block, the final score is found as a weighted sum of points for all measured characteristics. The final score A^k by a specific k -th employee based on the assessment results is determined as the sum of the points A_i^k scored for individual i -th assessment tracks:

$$A^k = \sum_{i=1}^n A_i^k,$$

where i is the track number, n is the number of evaluation tracks.

The score A_i^k by the k -th employee on the i -th track is determined as the weighted average of the points a_{ij}^k scored by this employee using the j -th objective assessment tool (j_{obj}) in the i -th track of assessment and \bar{b}_{ij}^k scored by this employee using the j -th subjective assessment tool (j_{subj}):

$$A_i^k = \sum_{j_{obj}} w_{ij} a_{ij}^k + \sum_{j_{subj}} w_{ij} \bar{b}_{ij}^k,$$

where w_{ij} are weight coefficients for the j -th assessment tool on the i -th track. Detailed assessment of score \bar{b}_{ij}^k and w_{ij} are given in Section 3.2.

To assess HC, both qualitative and quantitative studies are carried out. The results of the qualitative analysis are transformed into a point system for forming an overall assessment. The minimum number of points that can theoretically be assigned to an employee is 0 and the maximum is 1000 points. Table 6 shows description of the assessment tool for track 1—employee health quality assessment, as well as questions for questionnaire and score. The health self-assessment questionnaire is given in Appendix A.

Table 6. Employee health quality assessment: description of the assessment tool, questions for questionnaire (a typical questionnaire is presented in Appendix A) and score.

Indicator	Characteristic	Question Number	Score (for Each Indicator)		
			10	20	40
1.1. Chronic diseases	Diseases that can be controlled but not completely cured	3, 8, 11, 16, 19, 21, 22, 29	Yes	Do not know	No
1.2. Feeling unwell	An employee’s health state, which does not allow to fully carry out their labor activity	1, 9, 10, 13, 14, 17, 27	Yes, almost every day	Sometimes	No, I always feel very cheerful
1.3. Self-reported health as weak and unsatisfactory	An employee’s overall assessment of their health	2, 4, 5, 7, 15, 18, 24, 26, 28	Yes	Do not know	No
1.4. Bad habits and inadequate nutrition	Habits that negatively affect employee health Food that eliminates harmful or useless substances in the diet	12, 25, 30, 6, 20, 23	Yes	Do not know	No
1.5. Comprehensive medical examination	Objective monitoring of the health status of an employee in a medical institution	-	More than 5 diseases is identified, including chronic ones	Revealed 1–5 diseases	No disease is identified

The proposed methodology of HC management has the following advantages:

- It considers not only quantitative but also qualitative HC properties and characteristics, which can be used to assess an actual or planned investments in HC;
- It able to assess the impact of dissimilar factors, both qualitative and quantitative, on labor efficiency as well as on operational efficiency of a company;
- It provides a quick assessment of the level and quality of human capital through simplified (express version) testing, cases and questionnaires based on digital technologies and special software;
- The final assessment of the level and quality of human capital is the basis for design a complex of management decisions, aimed at supporting individual trajectories of employees’ professional development.

All these are the tools for labor productivity management, for involvement and motivation of employees, ensuring the innovative decisions for new emerging challenges increasing and contribute to the decision-making rate growth over actual projects.

3.2. Organization of Expert Group Work for the HC Assessment

At the stage of HC assessment over CHCM, along with an objective assessment of employees, we use expert (subjective) assessment methods. Method of expert assessments is a recognized scientific method for solving poorly formalized problems. The essence of an expert assessment method is in the rational organization of experts’ analysis of the problem with a quantitative judgments assessment and processing of their results. The generalized opinion of an experts group is accepted as a solution to the problem—that is, it gives an overall assessment of employees for a number of indicators. The general functional diagram, illustrating the process of employees’ expert assessment, is shown in Figure 4 and consists of a number of steps (A1–A8).

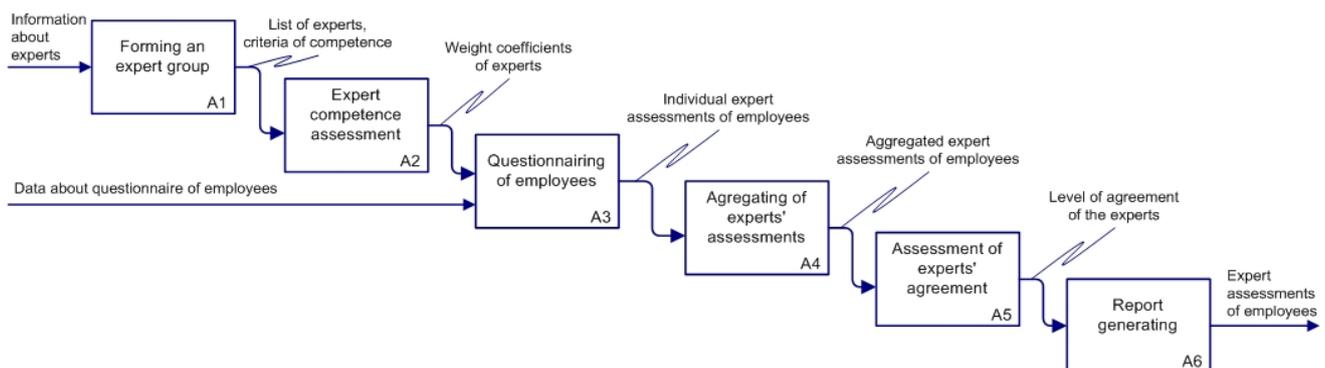


Figure 4. Functional diagram of the organization of the expert group work.

At the first step, we select experts who have a broad outlook and knowledge of the subject area, the availability of scientific papers and practical experience, the ability to solve creative problems, independence of thought, and self-criticism. For the problem of HC assessment, three experts are selected having all listed characteristics. Further the level of expert's competence is assessed according to five equally important criteria:

- Education level: secondary (1 point); specialized secondary (2–4 points); higher (5–8 points); academic degree (9–10 points);
- Compliance with the educational profile of the subject area (in a specific field of the company): does not correspond (1 point); not very consistent (2–4 points); more or less consistent (5–8 points); corresponds (9–10 points);
- Experience in the subject area: absent (1 point); low (2–4 points); not very high (5–8 points); high (9–10 points);
- Administrative and economic independence in this area: none (1 point); low (2–4 points); medium (5–8 points); high (9–10 points);
- Ability to solve creative problems and experience of participation in peer review: absent (1 point); low (2–4 points); medium (5–8 points); high (9–10 points).

The calculation of the total assessment of the expert's competence level is carried out as the weighted average score of the expert according to five criteria (with equal weight coefficients): $r_s = \sum_l o_l c_l$, where c_l —assessments of each s -th expert on l -th criterion, o_l —weight coefficient of the l -th criterion.

Aggregating of experts' assessments is realized in the following way. For each measured characteristic for each k -th employee when using the j -th tool (j_{subj}) in the i -th assessment track, the aggregated group expert assessment of HC is obtained on the basis of calculating the weighted average from the assessments of each s -th expert, taking into account the weight coefficient of the expert's competence:

$$\bar{b}_{ij}^k = \sum_s r_s (b_{ij}^k)_s.$$

Weight coefficients w_{ij} are calculated as a weighted sum of the weighting coefficients $(x_{ij})_s$ assigned by each s -th expert for the j -th assessment tool on the i -th track, taking into account the expert's competence:

$$w_{ij} = \sum_s r_s \cdot (x_{ij})_s.$$

Since the HC assessment uses indicators measured in quantitative scales, and the expert assessments for each employee are statistical distribution series, the assessment of the consistency of experts' judgments (agreement of the experts) is based on the concept of compactness, a visual representation of which is provided by statistical information on the measurement results, and also geometric interpretation of examination results. The assessment of each expert is represented as a point in some space, in which there is a concept of distance. If the points characterizing the assessments of all experts are located at a short distance from each other, i.e., form a compact group, this can be interpreted as a good consistency of expert opinions. If points in space are scattered over considerable distances, then the agreement of experts' opinions is not high.

When evaluating one parameter of an employee, all expert opinions can be represented as points on a number axis. These points can be considered as realizations of a random variable, and therefore the statistical characteristics of the grouping are used to estimate the grouping and scatter of points. The center of the points group is defined as the mathematical expectation (sample mean \bar{b}_{ij}^k) or as a median, and the spread is quantified by the standard deviation of a random variable σ_{ij}^k :

$$\sigma_{ij}^k = \sum_s r_s \left(\left(b_{ij}^k \right)_s - \bar{b}_{ij}^k \right)^2.$$

As a measure of the consistency of expert assessments, i.e., the compactness of the location of points on the numerical axis, the ratio of the standard deviation to the mathematical expectation of a random variable is used $V_\sigma = \frac{\sigma}{\bar{b}}$ (indices i, j, k are omitted). This indicator is a measure for homogeneity of statistical set.

The criterion for the consistency of expert opinions is the indicator of expert assessments variation V_σ . If $V_\sigma \leq 33\%$ then the experts' estimates are consistent. If $V_\sigma > 33\%$ then the expert assessments are not in agreement and a revision of the expert assessments is required.

3.3. Decision Making: Design of Individual Trajectories for Employees' Professional Development

The developed technique for human capital assessment provides a basis for formulate the management decisions for enhancing employees' potential and increasing human capital quality. Management decisions should be personal and depend on the assessed level of human capital. We define these management decisions as individual trajectories for employees' professional development. A set of decisions are developed for each assessment track and the content depends on the total score of the employee. The overall trajectory of the employee's professional development is determined by the composition of management decisions from each track.

We propose a map for designing individual trajectories of professional development of the company's employees. The map includes five sectors, allocated according to five tracks for assessing human capital. Depending on the assessed score for each employee, certain management decisions are formed for them, aimed at quality of human capital improving (Figure 5).

3.4. Cognitive Structuring of the Problem of Corporate HC Management

The problem of corporate HC management is being weakly structured, since the object of management is characterized by many qualitative factors and dependencies. One common method for making decisions and modeling possible situations and scenarios for such problems is the cognitive structuring method (Axelrod 1976; Bryson et al. 2004). The stages of cognitive structuring are:

- Scheme a conceptual diagram of a problem situation;
- SWOT-analysis of a problem situation;
- Design a cognitive model (map) of a problem situation.

The main concern of cognitive structuring and construction of a cognitive map is in clarifying knowledge about the subject area by localizing important factors and other characteristics of the problem situation. A poorly formalized cognitive map is a structure of cause-and-effect influences of the studied weakly structured situation.

We study the factors in the contour of the problem of HC management. We distinguish following factor groups:

- Factors of economic efficiency of the company;
- Factors of relationships with stakeholders;
- Factors characterizing the company's HC;
- Social and sociocultural factors;
- Factors of the effectiveness of the health care system;
- General economic factors.

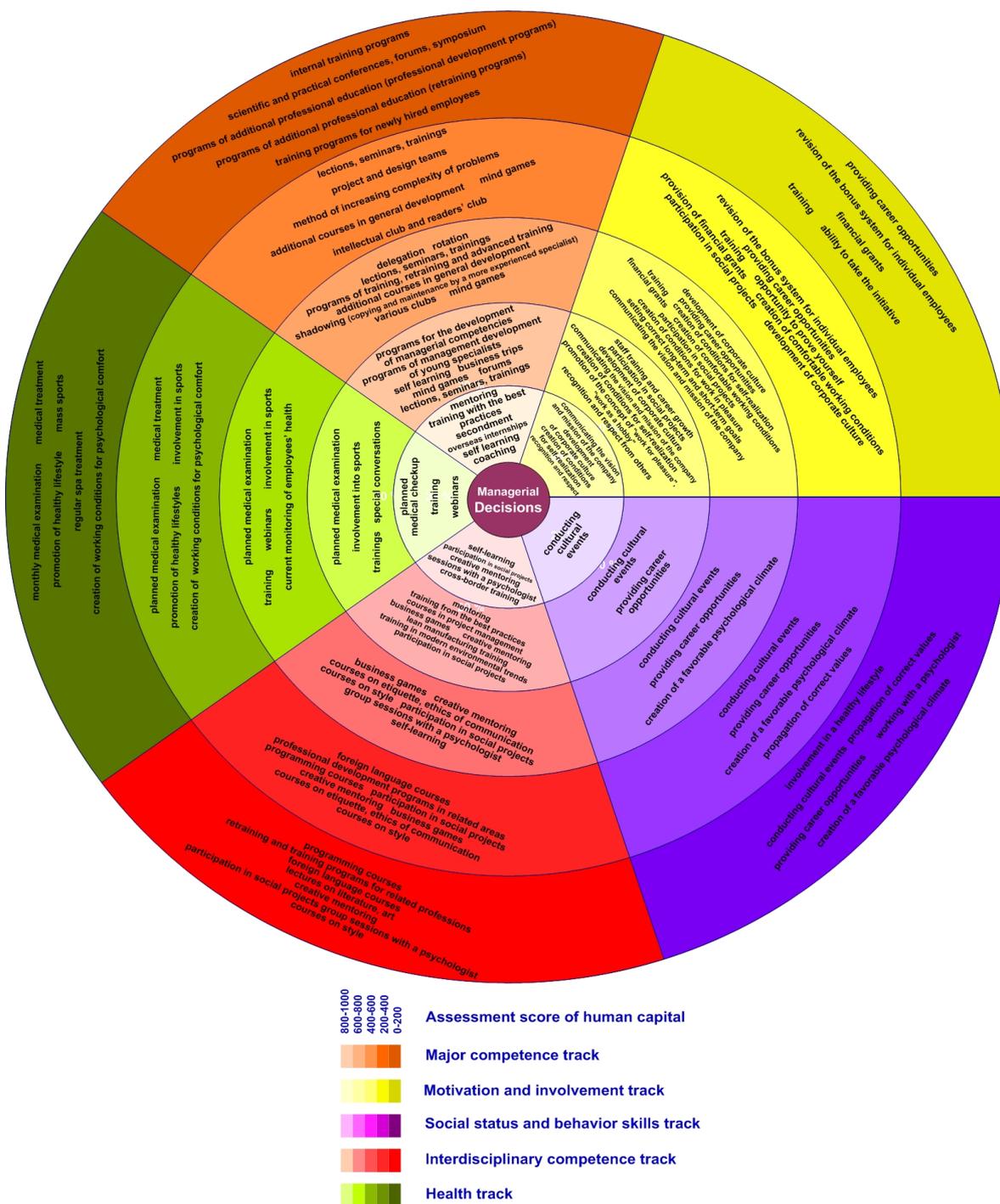


Figure 5. Management decision for human capital development by different tracks.

We compose the cognitive diagram to visualize the causal relationships of factors that determine the HC quality, on the one hand, and the impact of HC on the company efficiency as a whole and its private performance indicators, on the other hand (Figure 6).



Figure 6. Poorly formalized cognitive diagram for HC factors depending on a companies' efficiency.

A detailed presentation of the problem will allow, on the basis of the cognitive diagram, to select groups of target and control factors and to carry out further detailed structural analysis and scenario modeling for various situations.

Investments in a HC development have always caused great doubts and contradictions among the employer. This is due to that investments return is not always obvious, and the return period is not short. At the same time, the effects obtained from these investments are of a different nature. These are quantitative effects such as an increase in labor productivity, revenue growth, profit growth, a decrease in the risk of staff turnover and qualitative effects—an increase in the involvement and motivation of employees, the development of social ties, the growth of innovative ideas and a willingness to change the nature of work under digitalization. These effects, in turn, determine the acceleration of the investment return, affect the company size, its reputation and prestige, and directly contribute to the capitalization growth.

The reasons to develop and implement individual trajectories of professional development are well-founded. According to a LinkedIn survey, in 2021, more than half of HR teams focused on corporate investment in the company's talent. This strategy is quite justified, since modern employees, especially those belonging to generations Y and Z, are

not inclined to work for the sake of work and simply to provide basic life support needs. They strive for constant growth, development, communication with management on the basis of partnership rights. In these conditions, investments in HC will help companies retain ambitious and promising employees, reduce staff turnover and reduce the cost of finding, hiring and adapting new specialists, and increase the company's prestige.

In improving skills, improving health, broadening knowledge and increasing resilience boost productivity, a company becomes more flexible and ready for innovations, and they develop social connections not only inside but also outside the company. Individual trajectories for professional development will improve social ties within an organization, which is proven in the following research. Thus, in (Bloom et al. 2013), it was established that a high level of social capital allows decentralization in decision making within a company. Decentralization, in turn, can improve the productivity and increase a company size and, as a result, its market share. Moreover, the work statistically proved that the effect of the penetration of digital technologies used by a company on its productivity is higher if the company is decentralized.

In the theoretical research by (Bolino et al. 2002; Orlova 2017a, 2017b), a number of hypotheses were put forward regarding the sources of social capital. The participation of employees in the social life of the company increases the likelihood of acquaintance with other employees, thereby increasing the number of connections, having a positive effect on the structural aspect of social capital. The loyalty of employees, that is, their willingness to sacrifice their own interests for the sake of the company interests; their willingness to follow the rules and regulations of the company; the functional participation of employees, that is, employees taking on more responsibility than formal agreements require; as well as the participation of employees in social life of the company, increase the sympathy of employees in relation to each other and the trust level in the company. All this together enhances the cumulative effect of the social capital development. The participation of employees in the social life of the company and their willingness to express constructive comments, has a positive effect on the cognitive aspect of social capital. Thus, developed social ties have a positive effect on the results of the company's economic activities and on the involvement and satisfaction of employees.

The development of inter-disciplinary competencies and creative mentoring help to unleash the employees' potential, adjust objectives and use new knowledge in their work. When the company creates conditions for development and comfortable work, employees respond in good way; they advise the company to their friends and give positive feedback. Such employees convey a much more reliable and positive image of the company than the most effective advertising. The report (Gallup 2019) notes that engaged employees can increase a company's sales by 20%. Hence, investing in talent can be the fastest way to increase a company's profile and its competitiveness.

4. Experimental Results: Evaluation of CHCM Methodology Efficiency

We conducted an experimental study to assess the expected efficiency of the CHCM methodology. The experiment was carried out at a large oil-producing company. About a hundred specialists of engineering and technical profile took part in the experiment. The sample of the individual human capital assessment results in the department of contracts support is presented in Table 7.

Table 7. Human capital assessment results in the department of contracts support.

Employee ID	The Value of Human Capital by Assessment Tracks					Total Value of HC
	Track 1	Track 2	Track 3	Track 4	Track 5	
001	654	765	420	761	821	3421
002	591	587	370	401	655	2594
003	390	802	453	765	675	3085

Based on the assessment results for all employees, management decisions were modeled, aimed at the development of individual trajectories for professional development. A sample of management decisions for employees of the contract support department is presented in Table 8. These decisions are aimed at increasing the quality of human capital and will contribute to the growth of labor productivity and other indicators of the company's efficiency; see Figure 4.

Table 8. Management decisions: individual trajectories for employee professional development.

Employee ID	Management Decisions				
	Track 1	Track 2	Track 3	Track 4	Track 5
001	<ul style="list-style-type: none"> – planned medical examination; conversations, trainings; – corporate discounts on gym membership, wellness programs 	<ul style="list-style-type: none"> – lectures, seminars, over specialty; – mind games; – online courses at a foreign university; 	<ul style="list-style-type: none"> – creative mentoring; courses on etiquette, style; – business games; – participation in social projects: volunteering 	<ul style="list-style-type: none"> – participation in social projects: volunteering; – development of corporate culture; – the opportunity for self-realization: participation in scientific, conferences; 	<ul style="list-style-type: none"> – conducting cultural events
002	<ul style="list-style-type: none"> – routine medical examination; training, health webinars; – corporate discounts on gym membership, wellness programs 	<ul style="list-style-type: none"> – programs of training, retraining and advanced training; – lectures, seminars, trainings over specialty 	<ul style="list-style-type: none"> – foreign language courses; – training on related profession; – participation in social projects: volunteering; – creative mentoring courses on etiquette, style 	<ul style="list-style-type: none"> – participation in social projects: volunteering; – development of corporate culture; – the opportunity for self-realization: participation in competitions, conferences; – material incentives and career 	<ul style="list-style-type: none"> – conducting cultural events; – providing career opportunities
003	<ul style="list-style-type: none"> – medical examination and treatment; training, health webinars; – corporate discounts for the gym, health programs 	<ul style="list-style-type: none"> – mentoring; – secondment, overseas internships 	<ul style="list-style-type: none"> – business games; – creative mentoring – participation in social projects: chess club; – lectures from professional speakers 	<ul style="list-style-type: none"> – participation in social projects: chess club – development of corporate culture; – the opportunity for self-realization: participation in competitions and conferences 	<ul style="list-style-type: none"> – conducting cultural events; – providing career opportunities

We also assess an investment into HC, which includes the following components: expenses for training and professional development, expenses for employee health improvement, expenses for occupational safety and health and other social expenses. To predict the effectiveness of the proposed management decisions, we compare labor productivity growth rate, wage growth rate and investment in human capital growth rate for different periods of time (Table 9). Indicators of the wages growth rate and investments growth rate for the prediction period were calculated taking into account the inflation index and the planned values of investment costs and wages. The prediction for the labor productivity growth rate was carried out using the positive dynamics in labor efficiency under implementation of management decisions.

Table 9. Growth rates for labor productivity, wages and human capital investments.

Indicator	2020/2019 (Fact)	2021/2020 (Prediction)	2022/2021 (Prediction)
Labor productivity growth rate	1.03	1.03	1.07
Wage growth rate	1.10	1.09	1.08
Investment to HC growth rate	1.03	1.09	1.10

We have proved that labor productivity growth rate is less than wage growth rate as well as less than investment in human capital growth rate for 2020 in relation to 2019. Such an outstripping growth in wages and labor productivity indicates an imbalance in indicators and an ineffective personnel management system. The proposed decisions aimed at the development of human capital and improving its quality in the context of

individual trajectories of professional growth in the period 2021–2022, and these provide a decision support system meant to reduce the gap in the growth rates of key indicators of the personnel management system. This implies that investment return into HC is relevant in the long term. As an implementation result of the supposed CHCM, the company expects (on the basis of prediction results) an increase in revenue by 5–7% and increase in net profit by 2%.

This statement is substantiated by calculations of the revenue change ΔR due to the growth of labor productivity: $\Delta R = \Delta LP \cdot NE$, where NE is number of employees, ΔLP is change in labor productivity (in absolute terms). In net profit NP calculating we consider investment to HC I_{HC} growth: $NP = R - I_{HC}$.

5. Discussion of Results

Hypothesis 1 about the objective needs to make changes and adjustments to the corporate HC assessment methodology under digital transformation of the economy and new requirements for the employees' competencies in terms of their knowledge and skills, has been confirmed. The proposed methodology for HC assessment is designed to identify the portrait of an employee and takes into account traditional characteristics such as age, education, professional experience and competencies, and additional characteristics—namely, social status, level and quality of health, interdisciplinary competencies, motivation and involvement—and provides a comprehensive assessment of corporate HC under digital transformation and meets the trends of Industry 5.0. Based on the results of the HC assessment, we have developed a set of management decisions for the formation of individual trajectories of professional development, aimed at increasing labor productivity. Hypothesis 2 about contributing these management decisions to the growth of private (resource) and general (system) indicators of the company's efficiency has been verified. It is shown that investments into corporate HC predetermine economic growth and development of the company.

We also point out that the proposed CHCM methodology provides not only a human capital quality improvement but also establishes a strong relationship between human capital quality improvement and labor productivity growth and other indicators. CHCM affects the transformation of the entire workforce as the most valuable asset of the company, contributing to innovative development through creativity, greater involvement, professionalism and responsibility. It is especially important under digital transformation of the economy and society, since companies' human capital quality improvement is a valuable factor for sustainable development and competitiveness.

The developed personnel assessment methodology is a new concept that substantiates the stages, methods and tools for its application. The technique provides a meaningful basis for design advanced computer-based system in the direction. The reliability of scientific statements, conclusions and recommendations is confirmed by the correct use of theoretical research methods and verified by the results of experiments and their implementation.

The design of this study is based on the general principles of scientific knowledge:

- The principle of determinism, which organizes scientific knowledge, requiring the identification of cause-and-effect relationships of phenomena and processes;
- The principle of correspondence, which indicates the continuity of scientific theories and consists in the assertion that any new scientific theory in the presence of an old, well-tested theory is not in complete contradiction with it, but gives the same consequences in a certain limiting approximation (special case);
- The principle of complementarity. According to this principle, for a complete description of phenomena, one should use two mutually exclusive ("additional") sets of classical concepts, the totality of which provides comprehensive information about these phenomena as integral.

We also use a system approach with its basic principles:

- The principle of hierarchy (the initial elements in relation to the whole and other parts take their corresponding places, and any system is assumed, in turn, to be a subsystem of higher levels of their general hierarchy); in this case, we described the CHCM as a subsystem of the overall operational management of a company;
- The principle of formalization (the use of formalized methods for describing and modeling the studied and projected processes);
- The principle of structuring (priority attention to the structure of the system, rather than to the properties of individual elements); we have formed the CHCM as a methodological approach to design a human resource management system (Figure 3);
- The principle of multilevel knowledge. This principle is manifested in the fact that the generalizations obtained in this work can be the basis for the formation of general theoretical provisions and concepts in terms of effective corporate management.

The disadvantages of the proposed methodology for HC assessment include the laboriousness of collecting initial data, questionnaires, surveys and processing of initial data. To reduce the time of data processing, we propose to develop an automated system, the use of ready-made testing systems for employees and their automated integration into the personnel assessment system of a company.

One of the directions for improving the CHCM methodology is the scenario forecasting for performance indicators like labor productivity growth, profit growth and others. We plan to use a simulation model built on the basis of a cognitive map (Figure 6).

The sphere of the scientific research improvement could be in the integration of management decisions and modeling the dynamics (as a roadmap) of the decisions implementation, taking into account the accumulation and synergetic growth of employee potential in different professional areas, which allows to reduce the time for decision implementation, provided the maximum possible effect.

6. Conclusions

HC is a complex and intensive factor in social and economic development. The processes of health improvement and expanding knowledge and skills provide resilience to external shocks and increase employees' productivity and make companies more flexible and ready for innovation. This is becoming increasingly important as the nature of work changes under innovative development.

The article considers the methodology for corporate human capital management (CHCM) based on a new method for human capital assessment and a scheme for design individual trajectories of employee professional development. This methodology ensures an increase the human capital quality and growth the company operational efficiency. The novelty of CHCM is that, firstly, it reflects the essential properties of HC—education, health, qualifications, involvement and motivation, as well as social skills, communication, interprofessional (interdisciplinary) skills under emergence of new professions. Secondly, it is based on a new scheme for HC assessment using the qualitative and quantitative HC characteristics and provides an assessment under high initial data uncertainty. Thirdly, it contains a fundamentally new scheme for supporting management decisions for design individual trajectories of professional development, which is a set of decisions for each employee's professional development adequate to their potential health, intelligence, social and career opportunities, and ensuring the continuous growth of individual, corporate and social wealth.

The validity of scientific provisions, conclusions and recommendations is confirmed by using the results of modern analytical and experimental research methods for management over organizational systems. The reliability of scientific statements and results is substantiated by analyzing experience and generalizing practice.

Experimental studies have been carried out based on actual data of an oil-producing company. It is shown that the proposed methodology facilitates toward labor productivity growth, income and profits of companies.

The theoretical significance of the results is due to its ability to identify companies' human capital features associated with human health quality, professional of interdisciplinary knowledge, skills and abilities, motivation and involvement in the labor process, and all of these are used in the human capital assessment subsystem. The practical value of the study is in the approach for human capital assessment and its development, which ensures labor productivity growth, companies' revenue and profit growth at minimal cost.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The author declares no conflict of interest.

Appendix A

Table A1. Health Self-Assessment Questionnaire.

Question Number	Question	Answer		
		Yes	Do Not Know	No
1	Does headache bother you?			
2	Do you easily wake up from any noise?			
3	Are you worried about pain in the heart?			
4	Do you think that your eyesight has deteriorated?			
5	Do you think that your hearing has deteriorated?			
6	Do you try to drink only boiled water?			
7	Do the younger ones give way to you in public transport?			
8	Do joint pain bother you?			
9	Does the change in the weather affect your well-being?			
10	Do you have periods when you lose sleep because of anxiety?			
11	Are you worried about constipation?			
12	Are you worried about pain in the liver (in the right hypochondrium)?			
13	Do you have dizziness?			
14	Has it become more difficult for you to concentrate now than in past years?			
15	Are you worried about the weakening of memory, forgetfulness?			
16	Do you feel a burning sensation, tingling sensation, "creeping creeps" in various parts of your body?			
17	Do you have noise in your ears?			
18	Do you keep one of the following medicines at home: validol, nitroglycerin, heart drops?			
19	Do you have swelling in your legs?			
20	Did you have to give up some of the dishes?			
21	Do you have shortness of breath when walking fast?			
22	Are you worried about lower back pain?			
23	Have you ever used any mineral water for medicinal purposes?			
24	Is it possible to say that you have become whiny?			
25	How often do you drink alcoholic beverages?			
26	Do you think that you have become less efficient than before?			
27	Are the periods when you feel joyful, excited, happy disappeared in your life?			
28	How do you assess your state of health (good, satisfactory, bad or very bad)?			
29	Do you often get colds and flu?			
30	Do you smoke?			

References

- Aganbegyan, Abel Gesevich. 2017. Investments in fixed assets and human capital: Two interconnected drivers of socioeconomic growth. *Studies on Russian Economic Development* 28: 361–63. [CrossRef]
- Agency for Strategic Initiatives. 2015. Atlas of New Professions. Available online: https://www.skolkovo.ru/public/media/documents/research/sedec/SKOLKOVO_SEDeC_Atlas_2.0.pdf (accessed on 1 August 2021).
- Alzyoud, Adel. 2018. The Influence of Human Resource Management Practices on Employee Work Engagement. *Foundations of Management* 10: 251–56. [CrossRef]
- Armstrong, Michael. 2008. *Strategic Human Resource Management*. London: Kogan Page.
- Autor, David, David Dorn, Lawrence Katz, Christina Patterson, and John Van Reenen. 2020. The Fall of the Labor Share and the Rise of Superstar Firms. *The Quarterly Journal of Economics* 135: 645–709. [CrossRef]
- Axelrod, Robert. 1976. *Structure of Decision: The Cognitive Maps of Political Elites*. Princeton: Princeton University Press, p. 404.
- Barrena, Martinez, Jesus Macarena Lopez-Fernandez, and Pedro Romero-Fernandez. 2011. Research proposal on the relationship between corporate social responsibility and strategic human resource management. *International Journal of Management and Enterprise Development* 10: 173–87. [CrossRef]
- Bassi, Laurie, and Daniel McMurrer. 2005. Developing measurement systems for managing in the knowledge era. *Organizational Dynamics* 34: 185–96. [CrossRef]
- Becker, Howard. 1966. *Modern Sociological Theory in Continuity and Change*. New York: Reinhart and Winston, p. 776.
- Becker, Gary. 1976. *The Economic Approach to Human Behavior*. Chicago: University of Chicago Press, p. 314.
- Bezruchko, Pavel, Yury Shatrov, and Maria Maksimova. 2018. Competence of an Unclear Future. Available online: <https://hbr-russia.ru/karera/professionalnyy-i-lichnostnyy-rost/p26131/> (accessed on 1 August 2021).
- Bloom, Nicholas, Benjamin Eifert, Aprajit Mahajan, David McKenzie, and John Roberts. 2013. Does Management Matter? Evidence from India. *Quarterly Journal of Economics* 128: 1–51. [CrossRef]
- Bolino, Mark, William Turnley, and James Bloodgood. 2002. Citizenship Behavior and the Creation of Social Capital in Organizations. *Academy of Management Review* 27: 505–22. [CrossRef]
- Boudreau, John, Ravin Jesuthasan, and David Creelman. 2011. *Transformative HR: How Great Companies Use Evidence-Based Change for Sustainable Advantage*. Jossey Bass: San Francisco.
- Boutenko, Vladislav, Konstantin Polunin, Ivan Kotov, Anton Stepanenko, Ekaterina Sycheva, Eugenia Zanina, Sofya Lomp, Vitaly Rudenko, and Elena Topolskaya. 2017. Russia 2025: From Cadres to Talents. Available online: <https://www.bcg.com/ru-ru/russia-2025-from-staff-to-talent> (accessed on 1 August 2021).
- Bryson, John, Fran Ackermann, Colin Eden, and Charles Finn. 2004. *Visible Thinking: Unlocking Causal Mapping for Practical Business Results*. New York: Wiley & Sons, p. 396.
- Carretero, Stephanie, Riina Vuorikari, and Yves Punie. 2017. The Digital Competence Framework for Citizens. Available online: [https://publications.jrc.ec.europa.eu/repository/bitstream/JRC106281/web-digcomp2.1pdf_\(online\).pdf](https://publications.jrc.ec.europa.eu/repository/bitstream/JRC106281/web-digcomp2.1pdf_(online).pdf) (accessed on 1 August 2021).
- Church, Allan, David Bracken, John Fleenor, and Dale Rose. 2019. *Handbook of Strategic 360 Feedback*. New York: Oxford University Press, p. 637.
- Chynoweth, Carly. 2015. Stop doing dumb things with data. *People Management*, November 23.
- Demartini, Paola, and Paola Paoloni. 2014. *Human Capital Assessment: A Labor Accounting or a Management Control Perspective? Management, Valuation, and Risk for Human Capital and Human Assets*. New York: Palgrave Macmillan. [CrossRef]
- Dickmann, Michael, and Jean-Luc Cerdin. 2014. Boundaryless career drivers—Exploring macro-contextual factors in location decisions. *Journal of Global Mobility* 2: 26–52. [CrossRef]
- Douthit, Shane, and Scott Mondore. 2014. Creating a business-focused HR function with analytics and integrated talent management. *People & Strategy* 36: 16–21.
- Edvinsson, Leif, and Michael Mallone. 2007. *Intellectual Capital: Realizing Your Company's True Value by Finding Its Hidden Brain Power*. New York: Harper Business.
- Fang, Wenjie, Yanting Zhang, Jiaojiao Mei, Xiaohui Chai, and Xiuzhen Fan. 2018. Relationships between optimism, educational environment, career adaptability and career motivation in nursing undergraduates: A cross-sectional study. *Nurse Education Today* 68: 33–39. [CrossRef]
- Flores, Emmanuel, Xun Xu, and Yuqian Lu. 2020a. A Reference Human-centric Architecture Model: A skill-based approach for education of future workforce. *Procedia Manufacturing* 48: 1094–101. [CrossRef]
- Flores, Emmanuel, Xun Xu, and Yuqian Lu. 2020b. Human Capital 4.0: A workforce competence typology for Industry 4.0. *Journal of Manufacturing Technology Management* 31: 687–703. [CrossRef]
- Fuller, Ryan. 2016. The paradox of workplace productivity. *Harvard Business Review*. Available online: <https://hbr.org/2016/04/the-paradox-of-workplace-productivity> (accessed on 21 August 2021).
- Gallup. 2019. Gallup 2016 Q12[®] Meta-Analysis Report. Available online: <https://news.gallup.com/reports/257567/gallup-q12-meta-analysis-report.aspx> (accessed on 1 August 2021).
- Garashkina, Natalia, and Anastasia Druzhinina. 2020. *Qualitology and Qualimetry in Social Work*. Moscow: Yurayt Publishing House, p. 183.
- Gratton, Lynda, and Sumantra Ghoshal. 2003. Managing personal human capital: New ethos for the 'volunteer' employee. *European Management Journal* 21: 1–10. [CrossRef]

- Guthrie, James, and Vijaya Murthy. 2009. Past, present and possible future developments in human capital accounting: A tribute to Jan-Erik Gröjer. *Journal of Human Resource Costing & Accounting* 13: 125–42. [CrossRef]
- Hasan, Iftekhar, Chun-Keung Hoi, Qiang Wu, and Hao Zhang. 2017. Social Capital and Debt Contracting: Evidence from Bank Loans and Public Bonds. *Journal of Financial and Quantitative Analysis* 52: 1–31. [CrossRef]
- Haube, Jared. 2015. HR Analytics: A Look Inside Walmart's HR 'Test and Learn' Model. HR Daily. Available online: <http://community.hrdaily.com.au/profiles/blogs/hr-analytics-a-look-insidewalmart-s-hr-test-learn-model> (accessed on 21 August 2021).
- Human Capital Management Institute (HCMI). 2016. Imperial Services Sales Training ROI Case Study. Available online: <http://www.hcmint.com/thought-leadership/workforce-analyticscase-studies/> (accessed on 21 August 2021).
- Heckman, James, and Tim Kautz. 2012. Hard evidence on soft skills. *Labour Economics* 19: 451–64. [CrossRef]
- Hernaus, Tomislav, Dejana Pavlovic, and Maja Klindzic. 2019. Organizational career management practices: The role of the relationship between HRM and trade unions. *Employee Relations* 41: 84–100. [CrossRef]
- Hesketh, Anthony. 2014. *Case Study: Xerox*. London: Chartered Institute of Personnel and Development, Available online: http://www.valuingyourtalent.com/media/Case%20study%20-%20Xerox%20-%20PDF_tcm1044-5905.pdf (accessed on 21 August 2021).
- Hickman, Daniel, and William Olney. 2009. Globalization and Investment in Human Capital. *Industrial and Labor Relations Review* 64: 652–70. [CrossRef]
- Hitka, Miloš, Alžbeta Kucharčíková, Peter Štarchoň, Žaneta Balážová, Michal Lukáč, and Zdenko Stacho. 2019. Knowledge and Human Capital as Sustainable Competitive Advantage in Human Resource Management. *Sustainability* 11: 4985. [CrossRef]
- Hitt, Michael, Paul Beamish, Susan Jackson, and John Mathieu. 2007. Building theoretical and empirical bridges across levels: Multilevel research in management. *Academy of Management Journal* 50: 1385–99. [CrossRef]
- Hoffman, Carl, Eric Lesser, and Tim Ringo. 2012. *Calculating Success: How the New Workplace Analytics Will Revitalise your Organisation*. Boston: Harvard Business School Publishing.
- Jung, Yuhee, and Norihiko Takeuchi. 2018. A lifespan perspective for understanding career self-management and satisfaction: The role of developmental human resource practices and organizational support. *Human Relations* 71: 73–102. [CrossRef]
- Karavay, Anastasia. 2021. The state of human capital of Russian professionals. *Terra Economicus* 19: 124–37. [CrossRef]
- Kuzminov, Yakov, Lilia Ovcharova, and Lev Jakobson. 2018. *How to Increase Human Capital and Its Contribution to Economic and Social Development*. Moscow: Publishing House of the HSE, p. 63.
- Latov, Yury, and Natalia Tikhonova. 2021. A new society—A new resource—A new class? (to the 60th anniversary of the theory of human capital). *Terra Economicus* 19: 6–27. [CrossRef]
- Lengnick-hall, Mark, and Cynthia Lengnick-hall. 2003. *Human Resource Management in the Knowledge Economy*. San Francisco: Barrett Koehler Publishers.
- Lins, Karl, Henry Servaes, and Ane Tamayo. 2016. Social Capital, Trust, and Firm Performance: The Value of Corporate Social Responsibility during the Financial Crisis. *The Journal of Finance* 72. [CrossRef]
- Markow, Will, Debbie Hughes, and Andrew Bundy. 2018. The New Foundational Skills of the Digital Economy. Available online: https://www.burning-glass.com/wp-content/uploads/New_Foundational_Skills.pdf (accessed on 1 August 2021).
- Marx, Karl, and Friedrich Engels. 1960. *Critique of Political Economy*. Moscow: Politizdat, vols. 23–25, pp. 1960–62.
- Massingham, Peter, Thi Nguyet, Que Nguyen, and Rada Massingham. 2011. Using 360-degree peer review to validate self-reporting in human capital measurement. *Journal of Intellectual Capital* 12: 43–74. [CrossRef]
- Mikhnenko, Pavel. 2021. Economic and Statistical Analysis of Labor Productivity Growth Factors in Russian Industrial Enterprises. *Management Sciences* 11: 6–23. [CrossRef]
- Ministry of Economic Development of Russia. 2020. Order of the Ministry of Economic Development of Russia. In *On Approval of Methods for Calculating Indicators of the Federal Project Personnel for the Digital Economy of the National Program "Digital Economy of the Russian Federation"*; Moscow: Ministry of Economic Development of Russia. Available online: https://www.economy.gov.ru/material/file/bd31fe31b5135c35e402b702c346f304/41_24012020.pdf (accessed on 1 August 2021).
- Morrar, Rabeh, Husam Arman, and Saeed Mousa. 2017. The Fourth Industrial Revolution (Industry 4.0): A Social Innovation Perspective. *Technology Innovation Management Review* 7: 12–20. [CrossRef]
- Mouritsen, Jan, Per Nikolaj Bukh, and Bernard Marr. 2014. Reporting on intellectual capital: Why, what and how? *Measuring Business Excellence* 8: 46–54. [CrossRef]
- Nikitochkina, Yulia. 2021. Features of Human Capital Management of a Corporation in the Context of the Theory of Generations. *Terra Economicus* 19: 138–51. [CrossRef]
- Orlova, Ekaterina. 2016. Mechanism, Models and Control Algorithms for Productive and Economic System under Harmonization Criteria of Interested Agents. *Software Engineering* 7: 86–96. [CrossRef]
- Orlova, Ekaterina. 2017a. Control over Chaotic Price Dynamics in a Price Competition model. *Automation and Remote Control* 78: 16–28. [CrossRef]
- Orlova, Ekaterina. 2017b. The AI Model for Identification the Impact of Irrational Factors on the Investor's Risk Propensity. Paper presented at the 30th International Business Information Management Association Conference (IBIMA), Vision 2020: Sustainable Economic Development, Innovation Management, and Global Growth, Madrid, Spain, November 8–9; pp. 713–21.
- Orlova, Ekaterina. 2019. Model for Operational Optimal Control of Financial Recourses Distribution in a Company. *Computer Research and Modeling* 2: 343–58. [CrossRef]

- Orlova, Ekaterina. 2020a. Methods and Models of Data Analysis and Machine Learning in the Problem of Labor Productivity Management. *Software Engineering* 4: 219–29. [CrossRef]
- Orlova, Ekaterina. 2020b. Labour Productivity Management using Health Factors: Technique and Models. *Manager* 6: 57–69. [CrossRef]
- Orlova, Ekaterina. 2020c. Decision-Making Techniques for Credit Resource Management Using Machine Learning and Optimization. *Information* 11: 144. [CrossRef]
- Orlova, Ekaterina. 2021a. Innovation in Company Labor Productivity Management: Data Science Methods Application. *Applied System Innovation* 4: 68. [CrossRef]
- Orlova, Ekaterina. 2021b. Methodology and Models for Individuals' Creditworthiness Management Using Digital Footprint Data and Machine Learning Methods. *Mathematics* 9: 1820. [CrossRef]
- Osraneck, Regina, and Klaus Zink. 2014. Corporate Human Capital and Social Sustainability of Human Resources. In *Sustainability and Human Resource Management. CSR, Sustainability, Ethics & Governance*. Edited by Ina Ehnert, Wes Harry and Klaus Zink. Berlin/Heidelberg: Springer. [CrossRef]
- Robles, Marsel. 2012. Executive Perceptions of the Top 10 Soft Skills Needed in Today's Workplace. *Business Communication Quarterly* 75: 453–65. [CrossRef]
- Roseland, Mark, and Maria Spiliotopoulou. 2016. Converging Urban Agendas: Toward Healthy and Sustainable Communities. *Social Sciences* 5: 28. [CrossRef]
- Samad, Sarminah. 2020. Achieving innovative firm performance through human capital and the effect of social capital. *Management and Marketing* 15: 326–44.
- Schultz, Theodore. 1971. *Investment in Human Capital*. New York: American Economic Association.
- Scott, Harold, Peter Cheese, and Susan Cantrell. 2006. Focusing HR on growth at HarleyDavidson: Sustaining widespread success by prioritizing employee development. *Strategic HR Review* 5: 28–31. [CrossRef]
- Servaes, Henri, and Ane Tamayo. 2017. The role of social capital in corporations: A review. *Oxford Review of Economic Policy* 33: 201–20. [CrossRef]
- Smith, Adam. 1776. *An Inquiry into the Nature and Causes of the Wealth of Nations*. London: Boston Public Library, p. 510.
- Smith, Tracey. 2013. *HR Analytics: The What, Why and How*. Scotts Valley: CreateSpace Independent Publishing Platform.
- Sparrow, Paul, Shashi Balain, and David Fairhurst. 2010. *McDonald's UK: From Corporate Reputation to Trust-Based HR*. *Leading HR*. London: Palgrave Macmillan, pp. 209–30.
- Steelman, Lisa, and Jane Williams. 2019. *Feedback at Work*. Switzerland: Springer Nature, p. 280.
- Stokowski, Sarah, Bo Li, Benjamin Goss, Shelby Hutchens, and Megan Turk. 2018. Work motivation and job satisfaction of sport management faculty members. *Sport Management Education Journal* 12: 80–89. [CrossRef]
- United Nations. 2016. *Guide to Measuring Human Capital*. New York and Geneva: United Nations Economic Commission for Europe. Available online: https://www.unece.org/fileadmin/DAM/stats/publications/2016/ECECESSTAT20166_R.pdf (accessed on 1 August 2021).
- United Nations Development Programme. 2019. Human Development Report 2019. Beyond Income, Beyond Averages, Beyond Today: Inequalities in Human Development in the 21st Century. Available online: <http://hdr.undp.org/sites/default/files/hdr2019.pdf> (accessed on 1 August 2021).
- Verma, Shraddha, and Philip Dewe. 2008. Valuing human resources: Perceptions and practices in UK organizations. *Journal of Human Resource Costing & Accounting* 12: 102–23. [CrossRef]
- Whitaker, Debbie, and Laura Wilson. 2007. Human capital measurements: From insight to action. *Organization Development Journal* 25: 59–63.
- Whiting, Kate. 2020. The Top 10 Job Skills of Tomorrow and How Long It Takes to Learn Them. Available online: <https://www.weforum.org/agenda/2020/10/top-10-work-skills-of-tomorrow-how-long-it-takes-to-learn-them/> (accessed on 1 August 2021).
- World Bank Group. 2016. Report on the World Development "Digital Dividends". Available online: <https://openknowledge.worldbank.org/bitstream/handle/10986/23347/210671RuSum.pdf> (accessed on 1 August 2021).
- Youndt, Mark. 2000. Human resource configurations and value creation: The mediating role of intellectual capital. Paper presented at Annual Conference of the Academy of Management, Toronto, ON, Canada, August 4–9.
- Zakovorotny, Vilor, Michail Fleck, and Ekaterina Ugnich. 2019. A Synergistic Approach to Assessing the Human Capital of an Enterprise. *Scientific and Technical Statements of SPbSPU. Economic Sciences* 12: 161–73. [CrossRef]
- Zhang, Lu, Xiaochao Guo, Zhimei Lei, and Ming Lim. 2019. Social network analysis of sustainable human resource management from the employee training's perspective. *Sustainability* 11: 380. [CrossRef]