

Artículo de investigación

Information support system for regional human resource development

Sistema de soporte de información para el desarrollo de recursos humanos regionales
Sistema de apoio à informação para o desenvolvimento de recursos humanos regionais

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Abstract

In this paper we suggest a concept of information support system for human resource management at a regional level. We identify the main factors that affect quantitative and qualitative characteristics of regional human resource, including educational system, demographic and migration processes, and present a concept of the Program for its development. As a tool for information support of the Program we propose a distributed information system with interfaces for various groups of users: regional administration, population and organizations. To assess the effectiveness of the activities of the Program we suggest a decision support system based on the agent model of regional human resource dynamics. The model reflects demographical situation in the region, migration flows, educational system, economy and social environment in the region and functions of the regional administration.

Keywords: decision support system, information system, interface, human resource, agent modeling

Resumen

En este documento, sugerimos un concepto de sistema de soporte de información para la gestión de recursos humanos a nivel regional. Identificamos los principales factores que afectan las características cuantitativas y cualitativas del recurso humano regional, incluidos el sistema educativo, los procesos demográficos y de migración, y presentamos un concepto del Programa para su desarrollo. Como herramienta para el soporte de información del Programa, proponemos un sistema de información distribuido con interfaces para varios grupos de usuarios: administración regional, población y organizaciones. Para evaluar la efectividad de las actividades del programa, sugerimos un sistema de apoyo a las decisiones basado en el modelo de agente de la dinámica regional de recursos humanos. El modelo refleja la situación demográfica en la región, los flujos migratorios, el sistema educativo, la economía y el entorno social en la región y las funciones de la administración regional.

Palabras claves: Sistema de apoyo a la decisión, sistema de información, interfaz, recursos humanos, modelado de agentes.

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Resumo

Neste artigo, sugerimos um conceito de sistema de suporte à informação para a gestão de recursos humanos em nível regional. Identificamos os principais fatores que afetam as características quantitativas e qualitativas dos recursos humanos regionais, incluindo o sistema educacional, os processos demográficos e de migração, e apresentamos um conceito do Programa para o seu desenvolvimento. Como ferramenta de apoio informacional ao Programa, propomos um sistema de informação distribuída com interfaces para vários grupos de usuários: administração regional, população e organizações. Para avaliar a eficácia das atividades do programa, sugerimos um sistema de apoio à decisão baseado no modelo de agente da dinâmica dos recursos humanos regionais. O modelo reflete a situação demográfica na região, os fluxos migratórios, o sistema educacional, a economia e o meio social da região e as funções da administração regional.

Palavras-chave: Sistema de apoio à decisão, sistema de informação, interface, recursos humanos, modelagem de agentes

Introduction

The solution of the problem of human resource management is the most important direction for creating conditions for sustainable social and economic development of the region. The urgency and social importance of human resource management is connected with the following reasons:

- quality of human resource management affects all categories of the population;
- educational structure of working-age population is of great importance for the social and economic development of the region;
- direct impact on the dynamics of human resources is limited due to social and economic reasons;
- market mechanisms for regulating educational structure of working-age population do not provide the required balance of human resources in accordance with the trends of social and economic dynamics in the region.

During transition to the information society, human resource becomes one of the most important resources for social and economic development, and accordingly requirements to the quality of its management are increased (Watkins, 1991; Torraco, 2001). Practical experience shows that effective management of the target parameters of social and economic development of a city, a region or a country as a whole is realized through the informational infrastructure (McLean et al, 2004). In this paper we analyze the dynamics of the human resource of the region, identify the main factors affecting quantitative and qualitative characteristics and

present methods and tools for informational support of human resource management at the regional level.

Research Methods

The core of the research is an agent-based computer model of regional human resource, reflecting sex-age structure and qualification of population, production, employment and educational institutions in the region. Application of agent-based approach allows to analyze influence of macro-level administrative decisions on the behavior of micro-level objects. In the model there are actors who can make decisions and change their behavior: agents, organizations and public administration.

Scenario analysis is used to study simulation results. When performing scenario calculations, various combinations of environmental parameters are set, which are uncontrollable and unpredictable. After a series of calculations, consequences of various control actions in conditions of different scenarios are evaluated.

Methods of demographic and social analysis are used to reproduce dynamics of the population and migration processes among regions. Demographics is important in forecasting human resource development, since individuals are participants in various socio-economic relations, acting as labor, consumers, taxpayers, students.

Results and Discussion

- **Strategy of regional human resource management.** Human resource in the qualitative aspect is determined by demographic

and migration processes, its quantitative character depends on the educational system in general and the professional retraining programs in particular (Metcalf & Rees, 2005). In a market economy direct management of human resource is impossible, in contrast to the planned economy of the USSR, where number and structure of

employees was determined in advance, as well as their distribution by regions and organizations. In the current conditions, influence on human resource is indirect and connected with educational system and economy of the region (Figure 1).

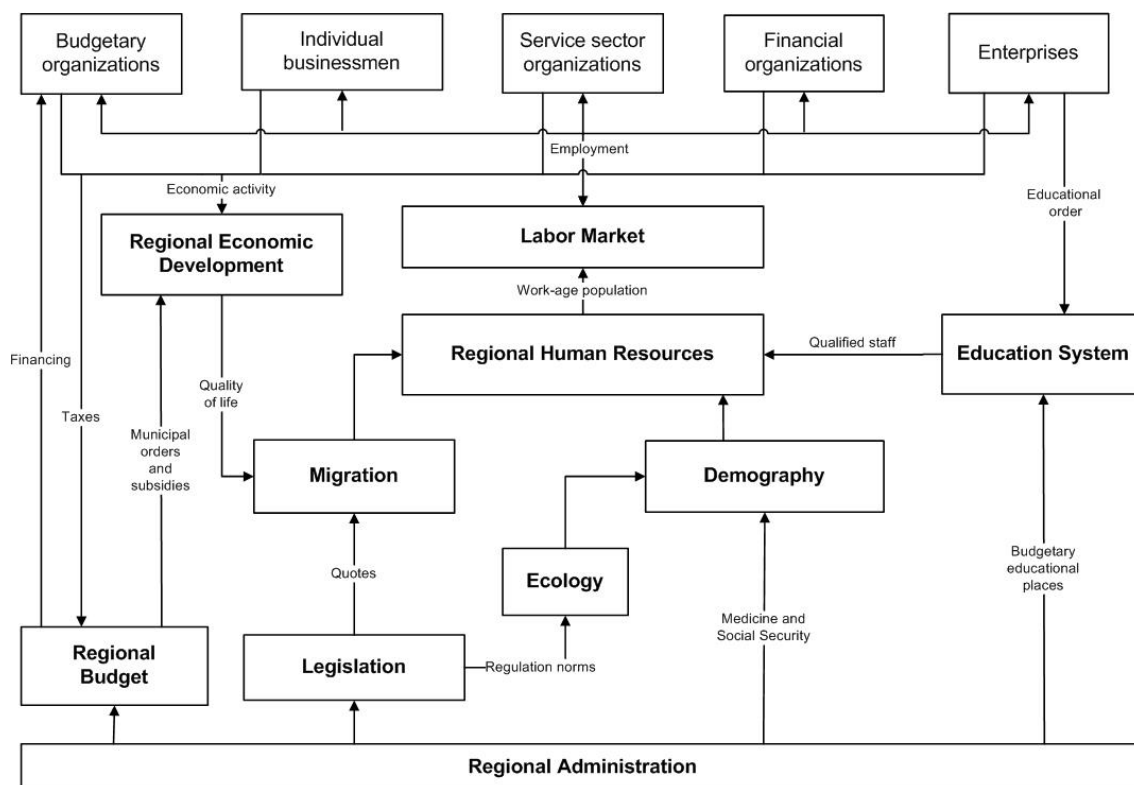


Figure 1. Human resource in the regional socio-economic system

Administrative influence on demographic processes is indirect. The key channels are social security system: maternity transfers, transfers for low-income families with children, maternity capital. An important contribution to demographic processes is made by quality of medical care and ecology.

Migration processes in most regions of Russia are of a similar nature: there is an outflow of highly skilled labor to large cities and abroad and an inflow of low-skilled workers from the CIS countries. Immigration can be regulated legislatively by quoting the number of migrants and execution of the established requirements, whereas processes of resettlement of Russian citizens are only indirectly affected. The inducement for specialists to remain in their native regions is created primarily by economic

development, which increases employment, incomes and quality of life.

The educational system is regulated by setting the number of budgetary educational places and their distribution by groups of specialties. There are also educational orders from large enterprises, which provide targeted training of specialists for the industry.

Within the framework of our research we elaborate the Program for regional human resource development (on the example of Belgorod region), which includes the following tasks:

- harmonization of the labor force structure and labor market in the region;

- strengthening links between educational institutions and enterprises in the region;
- designing an information support system for the human resource management;
- identification of factors that motivate people to change the region of residence by conducting sociological surveys and statistical analysis of their results;
- developing a plan of the Program activities that affect different groups of the regional population;
- evaluation of the effectiveness of the Program activities on the basis of computational experiments on the agent-based simulation model of the region.

Participants of the Program are regional administration, enterprises and organizations of the region, educational institutions for the training and retraining of personnel and population of the region.

- **Information support of regional human resource management.** For the informational support of human resource management in a region we propose a distributed information system that is designed for interaction of different groups of users: regional administration, population and organizations of the region, including educational institutions. For each group of users, special interfaces are developed (Figure 2):

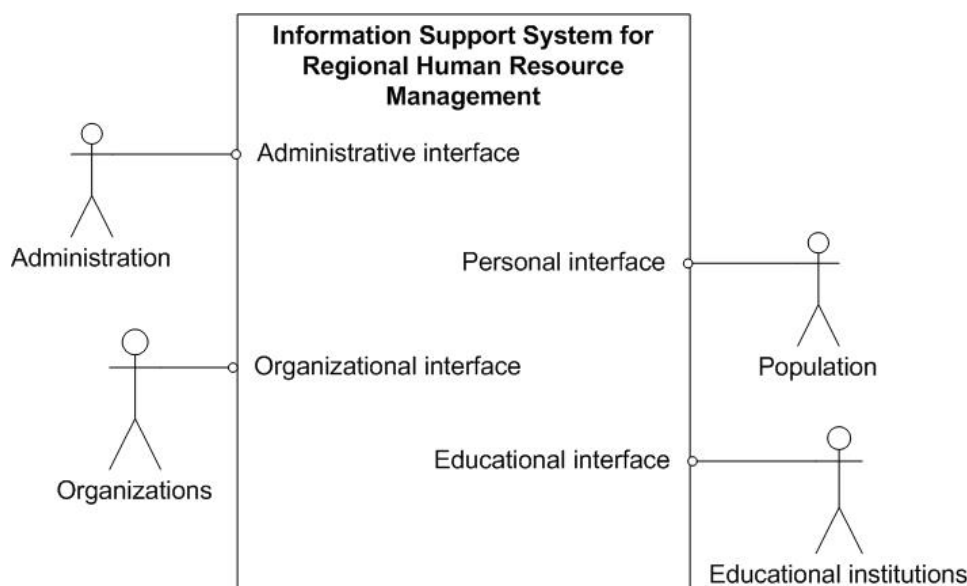


Figure 2. Interfaces of the information support system for human resource management

1. Administrative interface. Regional administration and coordinators of the Program input information on activities that are planned to stimulate development of the regional human resource. This interface provides aggregated information collected from all other sources and grouped according to the information requirements of the particular administrative organization. The administration of the region, in addition to access to the collected information, has the opportunity to assess effectiveness of

the Program activities through a decision support system, which is based on an agent model of regional human resource dynamics.

2. The interface for population. This interface is designed for two tasks: 1) conducting sociological surveys among various groups of population aimed at determining factors that influence on choice of the specialty and the region of residence, and 2) registration of various groups of population in order to post a

resume and view relevant information. The first group of the population is represented by schoolchildren and university entrants, who choose a specialty and an educational institution, and want to interact with a regional organization for the period of training, possibly partly employed. The second group consists of unemployed people who are interested in employment in certain organizations. The system monitors vacancies of relevant qualifications and organizes interviewing with the employers.

3. The interface for organizations. Enterprises and organizations interested in implementing the Program for the regional human resource development register on the portal of the information system. Through this interface, information is gathered about the expected need for additional staff and its required qualification, as well as strategies for the development of the organization and expected dynamics of production and sales for further use in forecasting socio-economic development of the region. In turn, information about students and graduates on key groups of specialties interested in working in this field becomes available for the registered organizations.

4. The interface for educational institutions. The registered regional educational institution input information about the number of budgetary educational places at various levels of education and groups of specialties. For convenience of further use by entrants this information is aggregated across all educational institutions of the region and grouped by specialties.

- Forecasting dynamics of regional human resource using methods of agent-based modeling.

To assess the effectiveness of the management activities by the Program coordinators and regional administration we propose a decision support system based on an agent model of the regional human resource dynamics. We have chosen agent-based modeling as a main method in this study, since it allows to reflect dynamics of a macro-system as a result of the interaction of micro-level objects. The concept of agent-based modeling is widely applied in the analysis of economic, financial, social and environmental processes (Barros, 2012; Bonabeau, 2002; Macy & Willer, 2002; Tesfatsion, 2002).

The model includes a number of interrelated modules: "Demography and Migration", "Education", "Economy", "Social environment" and "Regional Administration", each of those reflects significant factors affecting the quantitative and qualitative composition of the labor force (Figure 3). The geography of the model is set of territorial units corresponding to the districts of the region; regional center and other towns are set separately.

The input of the model receives statistical information on the economic structures of the region, demographic and migration processes; assessment of the quality of life and the importance of factors influencing personal decisions, obtained through sociological surveys; data from the distributed information support system, including information on organizations and educational institutions in the region, and also plan of activities of the Program of the regional human resource development.

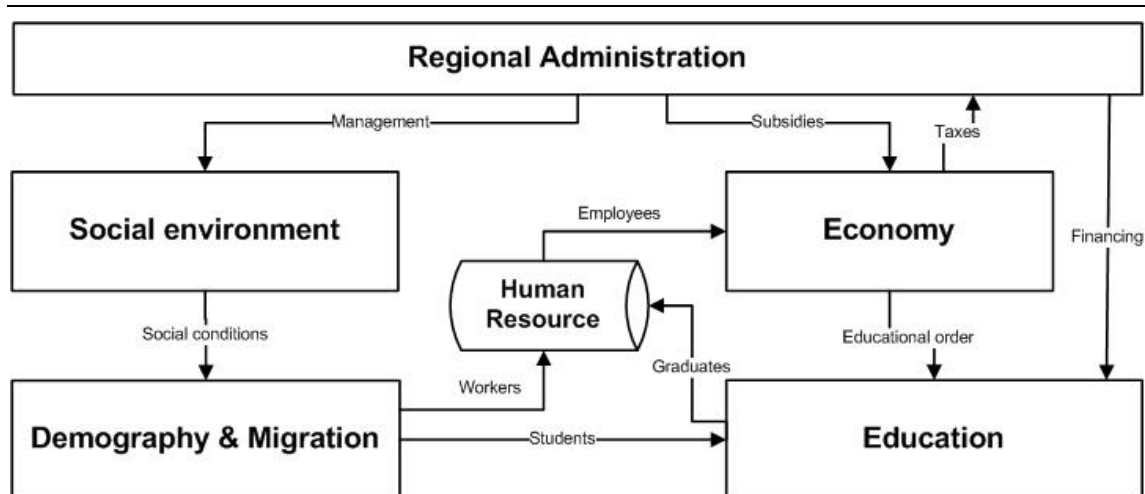


Figure 3. Module structure of the agent-based model of the regional human resource development

The module "Demography and Migration" generates agents representing population of the region, their grouping by households, resettlement by towns and districts (Mashkova, 2017a). During modeling time birth and death rates of agents are displayed, the creation of new households as a result of marriages and divorces, as well as immigration from the CIS countries within the set limits.

In the module "Education" educational institutions of various levels are created, including school, institutions of secondary professional and higher education. For each educational institution a list of educational places is formed, and agents of the corresponding age are assigned to them. During modeling time admission and graduation of agents from educational institutions is reflected.

In the module "Economy" organizations of various economic sectors are created, their production output is set, workplaces are formed. Agents are assigned to workplaces in accordance with their qualifications; workable unemployed agents are assigned to the employment centers.

The module "Social environment" reflects the quality and availability of housing, public transport system, the availability of kindergartens and other parameters that affect quality of life in the region. Institutes of administrative management implement activities of the Program for the development of the regional human resource under the established regulations.

Experimental studies on the agent-based model would allow to estimate impact of the activities of the Program on the dynamics of the regional

human resource (Mashkova, 2017b). The activities are aimed at different groups of population: students, graduates, employed and unemployed, and for each group the activities have different economic and social effectiveness. Examples of the Program's activities are creation of additional workplaces, promotion of small business, financing of retraining programs and provision of housing for young employees. As a result of a series of computational experiments, the impact of the proposed activities on the following program indicators is assessed:

- percentage of applicants with a high score of unified state examination, who chose to study in regional educational institutions;
- percentage of graduates of educational institutions in other regions that returned back to the home region;
- percentage of students in educational institutions of higher and secondary vocational education who have links with organizations in the region;
- percentage of graduates of educational institutions who exercise their professions in the organizations of the region.

Also, based on the results of modeling, the following statistical indicators are evaluated: the number and structure of migration flows in the region, the growth of the regional product in different economic sectors; dynamics of per capita income and wages of specialists of various qualifications.

Conclusion

The concept of information support of the regional human resource management

presented in this article is aimed at achieving goals outlined in the Strategy for spatial development of Russia and regional development strategies. Implementation of this concept is planned in the Belgorod region, where the first version of the distributed information support system will be tested. The collected data will be provided to the administration and put into the agent-based model of the regional human resource dynamics. It is also planned to conduct a series of sociological surveys among various population groups in Belgorod region to determine influence of various factors on the choice of the specialty, the sphere of employment and the region of residence. This would allow to suggest effective activities for the regional human resource development, the implementation of which would increase attractiveness of the region for high-skilled workers.

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