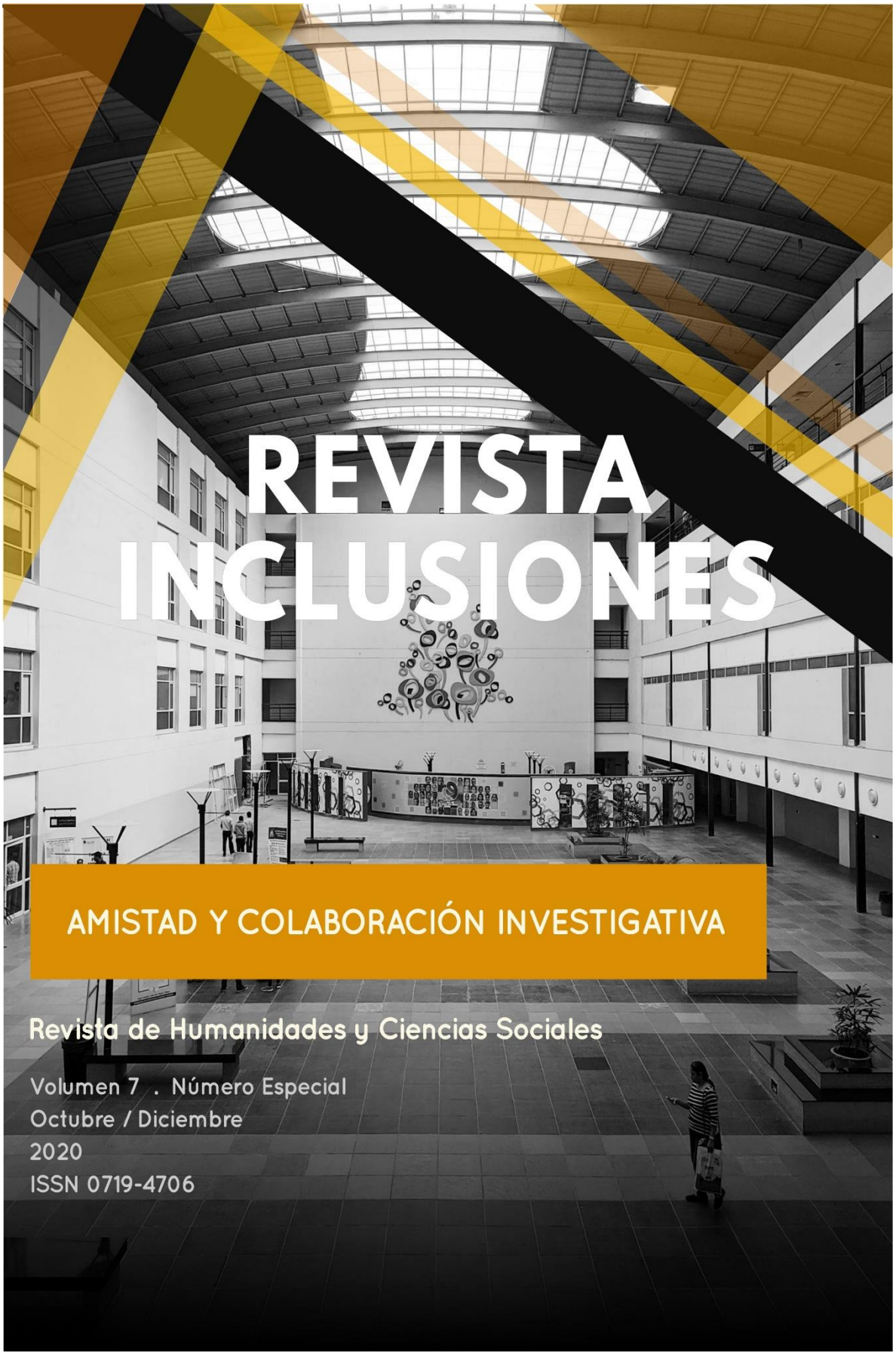


REVISTA INCLUSIONES

AMISTAD Y COLABORACIÓN INVESTIGATIVA

Revista de Humanidades y Ciencias Sociales

Volumen 7 . Número Especial
Octubre / Diciembre
2020
ISSN 0719-4706

REVISTA
INCLUSIONES M.R.
REVISTA DE HUMANIDADES
Y CIENCIAS SOCIALES

CUADERNOS DE SOFÍA
EDITORIAL

REVISTA
INCLUSIONES M.R.
REVISTA DE HUMANIDADES
Y CIENCIAS SOCIALES

CUADERNOS DE SOFÍA
EDITORIAL

REVISTA INCLUSIONES M.R.
REVISTA DE HUMANIDADES Y CIENCIAS SOCIALES

CUADERNOS DE SOFÍA EDITORIAL

REVISTA
INCLUSIONES M.R.
REVISTA DE HUMANIDADES
Y CIENCIAS SOCIALES

CUADERNOS DE SOFÍA
EDITORIAL

Editorial Cuadernos de Sofía
Santiago – Chile
OBU – C HILE

Indización, Repositorios y Bases de Datos Académicas

Revista Inclusiones, se encuentra indizada en:

CATÁLOGO

BIBLIOTECA UNIVERSIDAD DE CONCEPCIÓN

REVISTA INCLUSIONES M.R.
REVISTA DE HUMANIDADES Y CIENCIAS SOCIALES

CUADERNOS DE SOFÍA EDITORIAL

ISSN 0719-4706 - Volumen 7 / Número Especial / Octubre – Diciembre 2020 pp. 436-446

MODELS AND MECHANISM OF TECHNOLOGY TRANSFER UNDER CONDITIONS OF DIGITALIZATION OF AGRICULTURAL ECONOMY: THEORY AND METHODOLOGY

Ph. D. Nadezhda Viktorovna Ukolova
Saratov State Agrarian University, Russia
ORCID: 0000-0002-9416-924X
ukolovanv@sgau.ru
Ph. D. Elena Vasilyevna Vasilyeva
Saratov State Agrarian University, Russia
ORCID: 0000-0003-0455-6164
vasilievaev2574@yandex.ru
Ph. D. Sergey Vladimirovich Monakhov
Saratov State Agrarian University, Russia
ORCID: 0000-0002-0260-6319
monahovsv@mail.ru
Ph. D. Juliya Anatolyevna Shikhanova
Saratov State Agrarian University, Russia
ORCID: 0000-0003-2645-584X
anna310395@mail.ru
Ph. D. Vyacheslav Gennadievich Korostelev
Institute of Agrarian Problems of the Russian Academy of Sciences, Russia
ORCID: 0000-0002-8082-7643
vkor2006@yandex.ru

Fecha de Recepción: 22 de mayo de 2020 – **Fecha Revisión**: 30 de mayo de 2020

Fecha de Aceptación: 10 de septiembre 2020 – **Fecha de Publicación**: 01 de octubre de 2020

Abstract

In the article, the authors consider the theoretical and methodological aspects of technology transfer in the modern agricultural economy. The works of prominent scientists of Russian and world economic science are analyzed. The most promising models of technology transfer are considered taking into account the capabilities of information and communication technologies and the formation and development of the digital economy in agriculture. In the article, the authors associate the further development of technology transfer with the improvement of the technology transfer mechanism based on the creation of technology transfer centers, as well as the creation of scientific and technological platforms, which will reduce the time for technology transfer from the development stage to its mass use. In their article, the authors identify the main types of the organizations' interaction in the process of technology transfer. It is concluded that the creation of effective models and the improvement of the technology transfer mechanism should help to increase the efficiency of interaction among all participants in the technology transfer and the effective development of agriculture.

Keywords

Technology transfer – Digital economy – Models – Agriculture

Para Citar este Artículo:

Ukolova, Nadezhda Viktorovna; Vasilyeva, Elena Vasilyevna; Monakhov, Sergey Vladimirovich; Shikhanova, Juliya Anatolyevna y Korostelev, Vyacheslav Gennadievich. Models and mechanism of technology transfer under conditions of digitalization of agricultural economy: theory and methodology. Revista Inclusiones Vol: 7 num Especial (2020): 436-446.

Introduction

In the context of the digitalization of the economy, technology transfer is one of the fundamental sources of economic independence of the country's agricultural sector, as it provides farmers with the availability of modern agricultural technologies. In addition, thanks to digitalization, it becomes possible to combine the entire production chain - from fundamental developments to the final result of creating a new type of product. Technology transfer in agriculture is the foundation for building the agriculture of the future. It is intended as an effective way to transfer new developments of agricultural producers on favorable terms, both from the point of view of the developer and that of the consumer.

Key aspects of scientific research by scientists are confirmed by the fact that, despite a significant number of theoretical scientific developments, the technology transfer mechanism itself needs to be improved based on the accumulated knowledge and capabilities of the digital economy.

It is worth considering the fact that technology acquires the quality of a technological basis only if it is in demand in agriculture and introduced into the production process, that is, mastered by farmers. The transfer of technology, intellectual property in its various forms, as a rule, occurs through corporations, scientific and research institutes, through the creation of research universities, as well as the development of the scientific potential of universities.

In the context of the development of digital technologies, the main sources of this information are Internet resources created by organizations that develop and disseminate these technical tools and innovative scientific products. As practice shows, the results of production and commercial activities are higher for those organizations that use modern technology.

Methods

Theoretical and methodological foundations for developing the category of technology transfer are disclosed in the works of prominent scientific researchers such as Y. A. Schumpeter[1], H. Pack and K. Saggi[2], J.H. Dunning[3], E. Mansfield[4], D. Teece[5], H. Bresman[6], A. Inkpen[7], Galimova M.P.[8], Kokhno P., Kokhno A.[9] and others.

[1] J. Schumpeter, The Theory of Economic Development (Cambridge: Harvard University Press, 1934).

[2] H. Pack y K. Saggi, “Inflows of foreign technology and indigenous technological development”, Review of Development Economics Vol: 1 num 1 (1997): 81–86.

[3] J.H. Dunning, “Location and the multinational enterprise”, Journal of International Business Studies Vol: 29 num 1 (1998): 45–52.

[4] E. Mansfield; A. Romeo y S. Wagner, “Foreign trade and US Research and Development”, Review of Economics and Statistics num 61 (1979): 49–53.

[5] D. Teece, “Technology transfer by multinational firms: The resource costs of transferring technological know-how”, Economic Journal num 87 (1977): 242–249.

[6] H. Bresman; J. Birkinshaw y R. Nobel, “Knowledge transfer in international acquisitions (2009 decade award winning article)”, Journal of International Business Studies num 41 (2010): 5–17.

[7] A. Inkpen, The management of international joint ventures: An organisational learning perspective (London: Routledge, 1995).

The concept of technology transfer began its formation under the influence of previously existing areas in economic theory – they are: marginalism, Keynesianism, institutionalism. The term "technology transfer" has its roots in the adoption by the US Congress in the early 80s of the 20th century of two laws - the Bay-Dole law, according to which patent rights to R&D results developed with budget money can be transferred free of charge to organizations ready to engage them into commercial circulation and the Stevenson-Widler Act, which made it possible to commercialize developments not brought to patent protection: technical documentation, inventions, software[10].

The development of economic ideas is mediated by a number of features determined by the progressive pace of production development, the introduction of information and telecommunication technologies, which has a direct impact on the formation of the category digital economy and technology transfer.

The purpose of the study was to highlight effective models and improve the mechanism of technology transfer, their adaptation in the digitalization of the agricultural economy.

In the study, when developing a technology transfer model, methods for constructing graphic images and complex analysis were used. To determine the method of evaluating the effectiveness of technology transfer, a mathematical method was used.

Results

Technology transfer was originally a university activity. Indeed, higher education institutions constantly offer continuing education programs for workers in the real sector of the economy, conduct scientific seminars, conferences, and exhibitions.

The bases of technology transfer in modern conditions are scientific and research-and-production organizations. Modern innovative technologies are developed mainly in technology transfer centers at higher educational institutions and research institutes. It is important to note that, in addition to the production of the technologies themselves, these organizations are also involved in accumulating available technologies and using digital systems distribute information on portals and specialized centers on the Internet.

The development of new technologies is directly carried out by scientists of higher educational institutions and research institutes. In the future, they patent their intellectual products and sell them to potential customers. New technologies are also being developed

---

[8] M. P. Galimova, Technology transfer: criteria for choosing a business model. In: Ismagilova L. A. (ed.) Management of the economy: methods, models, technologies, materials of the XVI International Scientific Conference (Ufa: Ufa State Aviation Technical University, 2016) y M. P. Galimova y T. A. Gileva, Technology Transfer in the Digital Economy: Criteria for Choosing a Business Model. In: Digital Economy and Industry 4.0: Problems and Prospects. Proceedings of a Scientific and Practical Conference with International Participation (St. Petersburg: Peter the Great St. Petersburg Polytechnic University, 2017).

[9] P. Kokhno y A. Kokhno, “Technology transfer: concepts and models”, Society and economics num 10 (2013): 96-111.

[10] I. I. Ignatov, “The role of the Bayh-Dole act-1980 in the transfer of scientific knowledge and technology from American universities to the corporate sector: the results of the thirty-year journey”, Management of Science and Scientometricsnum 12 (2012): 159-188.

in specialized centers at enterprises[11]. These are mainly large enterprises with their own specialized centers. In modern conditions, a significant role in the development of new technologies is given to technology transfer centers, which accumulate existing developments and ready-made intelligent products and disseminate information about them on the Internet through specialized portals and sites.

In this regard, it is important to improve the technology transfer mechanism, taking into account the development of the information and communication technology sector based on the construction of modern technology transfer models. So, in our opinion, the most effective among the existing models of technology transfer is the linear model of technology transfer.

The basis of this model is that innovative technologies are created by scientists for production. But not all of these developments are implemented in enterprises. The main reason is that technologies are created without reference to a specific consumer. A linear model can be represented schematically in the form of the following scheme[12] (Table 1).

Process	***Research***		***Development***		***Distribution***
Unit					
Location	University, state, private research laboratories	University, state research laboratories, industrial (private) research laboratories	Scientific research and development work	Agricultural producers	Agricultural organizations, peasant farms, personal subsidiary plots
Performers of work. Laboratory technical staff.	Lab scientists supported by technical staff	Scientists and engineers in laboratories supported by technical staff	Scientists and engineers in laboratories; engineers and technicians designing, manufacturing and testing prototypes	Pilot production (highly skilled workers)	Workers of agricultural organizations, peasant farms
Output Results	Scientific knowledge, ideas, scientific articles	Patents, scientific articles	Patents, specifications	New Products and Processes	Massive use of technology
	Science		**Technology**		**Market**

Table 1

Modern linear model of technology transfer in agriculture, adapted by the authors

The linear model represents only the first stage on the path to the real system of interconnections and mutual influences of the subjects and objects of the innovation process itself and, subsequently, the transfer of technologies, which in reality should take

[11] The list of technology transfer centers by regions of the Russian Federation. Retrieved from gov.cap.ru › home › 15 › Innov › Centr_tt_ru

[12] System analysis of technology transfer. Retrieved from www.vneshmarket.ru

into account the interests of all participants at all stages of technology transfer. The creation of new technologies should, in the first place, be based on the needs of a specific area of agricultural business.

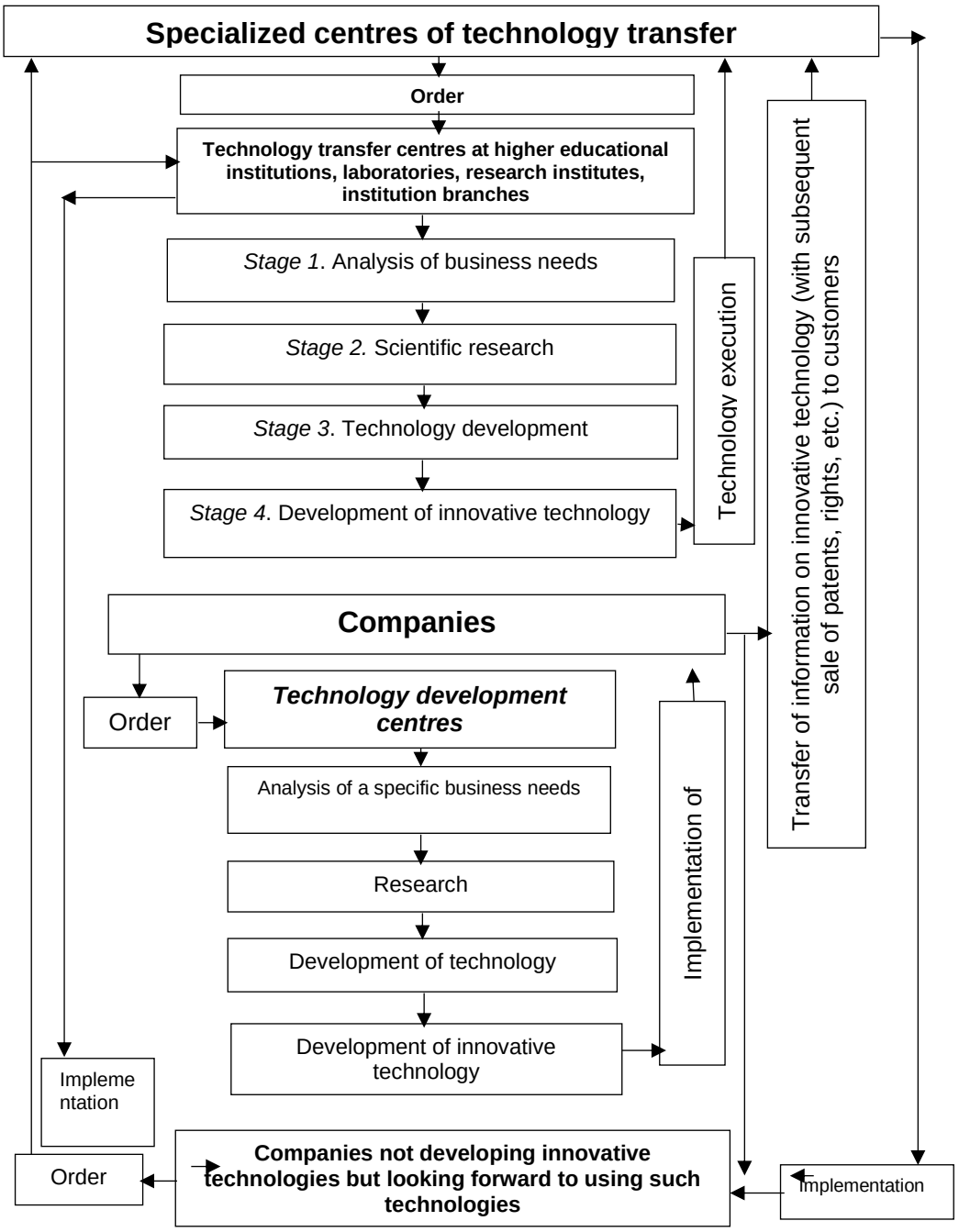


Figure 1
The mechanism of interaction of organizations in the field of technology transfer with production structures (proposed by the authors)

In this regard, the mechanism of interaction of organizations in the process of technology transfer with production structures, in which supply and demand are intended

to stimulate the development of production in all areas of the economy (including agriculture), deserves special attention. Moreover, this interaction is based on the use of digital technologies (Figure 1).

According to this mechanism, in the process of technology transfer three economic entities interact. They are represented on the market, and the interaction between which is not fully implemented. Currently, the creators of innovative technologies are laboratories (centres for the creation or transfer of technologies) at higher educational institutions and research institutes, as well as research centers (created at large enterprises). The latter create innovative technologies directly for the production needs of enterprises at which they are created. Intermediaries are specialized technology centers that post information on innovative developments on special portals on the Internet. There are consumers - enterprises that do not have specialized laboratories for the production of new technologies in their structure, but are ready to use such technologies in the production process. To create conditions for the realization of the interests of all participants in the process and the technology transfer market, it is important to establish the creation of new developments taking into account the needs of specific customers - enterprises. This problem is fully solved at enterprises that have their own structures for the development of new technologies in accordance with the needs of a particular enterprise. For this purpose, it is possible to organize the interaction of all manufacturers of new developments with intermediaries - specialized technology transfer centers. These centers accumulate a technology base that is already available and can be transferred to specific customers on a commercial basis, as well as orders of enterprises. At the same time, it is also important for higher education institutions and research institutes to carry out scientific innovation based on orders that come from specialized centers or directly from the enterprises themselves - customers of these technologies.

Enterprises that carry out their own scientific developments can also transmit information about these developments if they are willing to disseminate them. Information can be transmitted both to specialized centers and to other enterprises. Obviously, the interaction between the designated structures can be carried out on a commercial basis. It is also important to note that the effective dissemination and use of information about new technologies can only be done using information and communication technologies. This technology transfer mechanism is universal and can be used by agricultural business structures.

To implement the technology transfer, an interactive model can also be used, which we adapted for agriculture, Figure 2.

In the interactive model of technology transfer, there is a complete coverage of the innovation process from its idea and foundation, from fundamental discoveries.

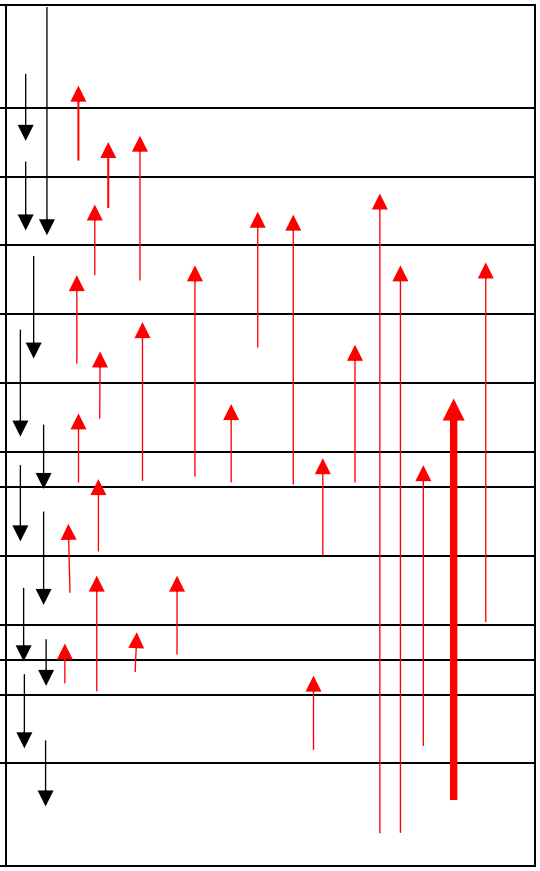
1.1.	Identification of new processes and phenomena in the agricultural sector of the economy (selection, livestock, etc.)	
1.2	Theoretical substantiation of processes and phenomena	
1.3.	The study of experience (domestic and foreign) in the study of the phenomena	
2.1.	Research (detailed analysis) of these processes	
2.2.	Generating ideas and finding ways to create technology	
2.3.	Testing the created technologies (mainly in the laboratory)	
2.4.	Testing, creating prototypes	
3.1.	Optimization of the created technologies, their correction	
3.2.	Scaling up production of new technology samples	
4.1.	Introduction into production	
4.2.	Advertising, marketing operations	
4.3.	Sales of innovative products, after-sales service	
4.4.	The use of innovative products (technologies) in production	

Figure 2
Interactive model of technology transfer in the agricultural sector of the economy
(adapted by the authors)

Discussion

American economist J.A. Schumpeter[13] presented a linear model, which boiled down to the fact that the innovations that are generated independently and outside the economy and its needs cause economic growth. The development of the theoretical research postulates of these authors is the research by H. Pack and K. Saggi[14] in the field of developing directions for enhancing technology transfer and increasing the efficiency of their absorption in economies of different levels. Proceedings of J.H. Dunning[15] and R.E. Caves[16] are devoted to the analysis of the impact of investments on the intensity of technology transfer and adaptation, as well as the limitations of this process in the face of a lack of intellectual potential. Research by E. Mansfield[17], D. Teece[18], H. Bresman[19], A.

[13] J. Schumpeter, The Theory of Economic Development…
[14] H. Pack y K. Saggi, “Inflows of foreign technology and indigenous technological development”, Review of Development Economics Vol: 1 num 1 (1997): 81–86.
[15] J. H. Dunning, “Location and the multinational enterprise”, Journal of International Business Studies Vol: 29 num 1 (1998): 45–52.
[16] R. E. Caves, Multinational enterprises and economic analysis (Cambridge: Cambridge University Press, 1996).
[17] E. Mansfield; A. Romeo y S. Wagner, “Foreign trade and US Research and Development”, Review of Economics and Statistics num 61 (1979): 49–53.

Inkpen[20] and several others in the field of knowledge and technology transfer within business entities.

Kokhno P., Kokhno A.[21] considered a modern understanding of the linear model of the innovation process, which traces the change and localization of processes, and performers, and the results of each of the stages. In their opinion, "A linear model is only the first approximation to a real network of interconnections and interactions between subjects and objects of the innovation process, which in reality is interactive at almost all stages of technology transfer, that is, the transfer of information about innovation at each transition from stage to stage".

Galimova M.P.[22] in her scientific works indicates that in the context of globalization, network business models based on platform solutions become the most effective. In her opinion, it is necessary to switch to hybrid business models that combine the advantages of direct and indirect commercialization of technologies. One of the most promising among the new hybrid technology transfer models is the open source crowdsourcing model.

Makarov I.M., Akhrem A.A., Bykov A.A., Vashevnik T.L., Rakhmankulov V.Z., Sitnikov I.V.[23] in the course of their scientific work revealed new mathematical models of technological transfer under the conditions of extremely limited investment resources and incomplete information on the directions of distribution of innovations. On the basis of the apparatus of the theory of logistic differential equations, new mathematical models of technological transfer were developed under conditions of extremely limited investment resources and incomplete information on the directions of distribution of innovations characteristic of the transitional economy of Russia. They discovered and studied the properties of these models that affect the dynamics of growth or attenuation of transfer processes. Based on the identified properties of the logistic models, methods for implementing the mechanisms of controlled change in the number of transfer participants for classes of transfer tasks with decomposable ones, i.e. multicomponent technologies, and a corporate association of market participants.

Conclusion

Technology transfer is the basis for the development of modern agriculture. In the context of the development of information and communication technologies, the main sources of this information are Internet resources created by organizations that develop

[18] D. Teece, "Technology transfer by multinational firms: The resource costs of transferring technological know-how", Economic Journal num 87 (1977): 242–249.
[19] H. Bresman; J. Birkinshaw y R. Nobel, "Knowledge transfer in international acquisitions (2009 decade award winning article)", Journal of International Business Studies num 41 (2010): 5–17.
[20] A. Inkpen, The management of international joint ventures: An organisational learning perspective (London: Routledge, 1995), 11-15.
[21] P. Kokhno y A. Kokhno, "Technology transfer…
[22] M. P. Galimova, Technology transfer: criteria for choosing a business model…; M. P. Galimova, T. A. Gileva, Technology Transfer in the Digital Economy… y M. P. Galimova, "Strategic and organizational aspects of the commercialization of innovations: business models of technology transfer", Innovative activity Vol: 4 num 43 (2017): 18-26.
[23] I. M. Makarov; A. A. Akhrem; A. A. Bykov: T. L. Vashevnik; V. Z. Rakhmankulov y I. V. Sitnikov, Mathematical modeling of processes of active technological transfer in extreme economic conditions. Research Report No. 97-01-00965 (Russian Foundation for Basic Research, 1997).

and (or) disseminate these technologies and innovative scientific products. As practice shows, the results of production and commercial activities are higher for those organizations that use modern technology.

Fundamental scientific research (which underlies innovative developments for implementation in production) is purely scientific, social in nature. Basing on them, scientific theories are being created. The very concept of the concept of technology transfer and commercialization appears only at the stage of applied research, which subsequently allows the creation of applied development.

It is necessary to distinguish three main types of inter-organizational interaction in the process of technology transfer. The first type: the transfer of technology by scientific and research organizations is possible at the R&D - research and development stage in industry or subordinate laboratories for subsequent refinement and bringing to the pilot production stage, with subsequent implementation in mass production. The second type: it is possible to transfer technology at the stage of completion of research and development from research organizations to existing commercial enterprises, firms for the final development of technologies on an industrial scale with their subsequent use directly in production. The third type: transfer of technology information to intermediary structures (specialized technology transfer centers) for the formation of databases for the subsequent implementation of these technologies to enterprises-customers. Creation of effective models and the improvement of the technology transfer mechanism should help to increase the efficiency of interaction among all participants in the technology transfer and increase the efficiency of production activities of agricultural business structures.

Acknowledgments

The reported study was funded by RFBR, project number 20-010-00324.

References

Bresman, H.; Birkinshaw, J. y Nobel, R. “Knowledge transfer in international acquisitions (2009 decade award winning article)”. Journal of International Business Studies num 41 (2010): 5–17.

Caves, R. E. Multinational enterprises and economic analysis. Cambridge: Cambridge University Press. 1996.

Dunning, J. H. “Location and the multinational enterprise”. Journal of International Business Studies Vol: 29 num 1 (1998): 45–52.

Galimova, M. P. “Strategic and organizational aspects of the commercialization of innovations: business models of technology transfer”. Innovative activity Vol: 4 num 43 (2017): 18-26.

Galimova, M. P. Technology transfer: criteria for choosing a business model. In: Ismagilova L. A. (ed.) Management of the economy: methods, models, technologies, materials of the XVI International Scientific Conference. Ufa: Ufa State Aviation Technical University. 2016.

Galimova, M. P. y Gileva, T. A. Technology Transfer in the Digital Economy: Criteria for Choosing a Business Model. In: Digital Economy and Industry 4.0: Problems and Prospects. Proceedings of a Scientific and Practical Conference with International Participation. St. Petersburg: Peter the Great St. Petersburg Polytechnic University. 2017.

Ignatov, I. I. "The role of the Bayh-Dole act-1980 in the transfer of scientific knowledge and technology from American universities to the corporate sector: the results of the thirty-year journey". Management of Science and Scientometricsnum 12 (2012): 159-188.

Inkpen, A. The management of international joint ventures: An organisational learning perspective. London: Routledge. 1995.

Kokhno, P. y Kokhno, A. "Technology transfer: concepts and models". Society and economics num 10 (2013): 96-111.

The list of technology transfer centers by regions of the Russian Federation. Retrieved from gov.cap.ru ›home / 15 / Innov / Centr_tt_ru.doc

Makarov, I. M.; Akhrem, A. A.; Bykov, A. A.; Vashevnik, T. L.; Rakhmankulov; V. Z. y Sitnikov, I. V. Mathematical modeling of processes of active technological transfer in extreme economic conditions. Research Report No. 97-01-00965. Russian Foundation for Basic Research. 1997.

Mansfield, E.; Romeo, A. y Wagner, S. "Foreign trade and US Research and Development". Review of Economics and Statistics num 61 (1979): 49–53.

Pack, H. y Saggi, K. "Inflows of foreign technology and indigenous technological development". Review of Development Economics Vol: 1 num 1 (1997): 81–86.

Schumpeter, J. The Theory of Economic Development. Cambridge: Harvard University Press. 1934.

System analysis of technology transfer. Retrieved from: www.vneshmarket.ru

Teece, D. "Technology transfer by multinational firms: The resource costs of transferring technological know-how". Economic Journal num 87 (1977): 242–249.

REVISTA INCLUSIONES M.R.
REVISTA DE HUMANIDADES Y CIENCIAS SOCIALES

CUADERNOS DE SOFÍA EDITORIAL