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ARTICLE

MODELING OF AN ENTREPRENEURIAL INFRASTRUCTURE SUPPORT SYSTEM IN THE REPUBLIC OF TATARSTAN

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ABSTRACT

This article contains a description of the entrepreneurial infrastructure development methodology in a localized system. The given analysis reflects the outcome of the study on effectiveness of the entrepreneurial infrastructure in the Republic of Tatarstan and Kamsk innovative and technological industrial cluster. The methodology is based on the forming of infrastructure parameters as a system of interaction between agents. The multi-agent nature of relationships includes several effects of infrastructure synergy, like market, innovation, investment, logistics, social and synergy of labor force. The integrative effect of the infrastructure determines the level of infrastructure development of the localized system at a given point in time. This article disclosures the parameters selection algorithm of the entrepreneurial infrastructure. Within the framework of the algorithm, the most significant synergy effects of interaction between infrastructure agents and the integration effect are being determined. As the results of an economic modelling this paper concludes with recommendations regarding the development of infrastructure support for the Kamsk innovative and technological industrial cluster. The proposed approach combines the theory of entrepreneurship, methods of economic modelling and scenario forecasting. The combination of theoretical, methodological and practical approaches allows to shape perspectives on strategic infrastructure development at the localized system level.

INTRODUCTION

KEY WORDS
entrepreneurship, entrepreneurial infrastructure, regional economy, cluster.

The development of a governance model for the entrepreneurial infrastructure support provides a new understanding on the process of establishing an infrastructure complex. The essence of the infrastructure support process is not limited to the identification of the macroeconomic indicators of economic performance. Infrastructure development contributes to the achievement of effectiveness on cooperation between market agents and entrepreneurs. Economic efficiency from infrastructure support is reflected in participating agents' real income growth. In a macroeconomic sense, the infrastructure provides a gross domestic product growth.

The determination of the interaction effectiveness (synergistic units) is an important aspect in a development of the entrepreneurial infrastructure governance model. The interaction effectiveness contributes to the income growth of each participant of that interaction and the overall integrative effect, which is expressed in the relative change of infrastructure in relation to its previous state.

MATERIALS AND METHODS

The infrastructure parameters development algorithm is designed to establish a regional entrepreneurial infrastructure, where the principal entity governing the development of the infrastructure is administrative bodies, responsible for the promotion of entrepreneurship in the region.

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At the first stage of the infrastructure support model's parameters generation process, the benchmark indicators for participant's interaction in the infrastructure development process are being determined, as for entrepreneurs, infrastructure owners (agents) and investors, and government agencies.

At the second stage of the infrastructure support model's parameters generation process, key indicators of synergy from interaction are being determined. Both quantitative and qualitative indicators can be used as criteria.

At the third stage, it is expected to determine the weighting factors of the previously identified types of synergy from agents interaction. Based on the divergence of interaction indicators within the infrastructure support, there is a need to develop a consolidated evaluation system for provided indicators, which indicates the degree of inclusion of various indicators in the overall impact of infrastructure support.

In order to determine the integral indicators of infrastructure support it is recommended to use the alternatives assessment methodology through quantitative and qualitative (expert) criteria by applying the Harrington scale to bring all parameters in line with the consolidated measurement system.

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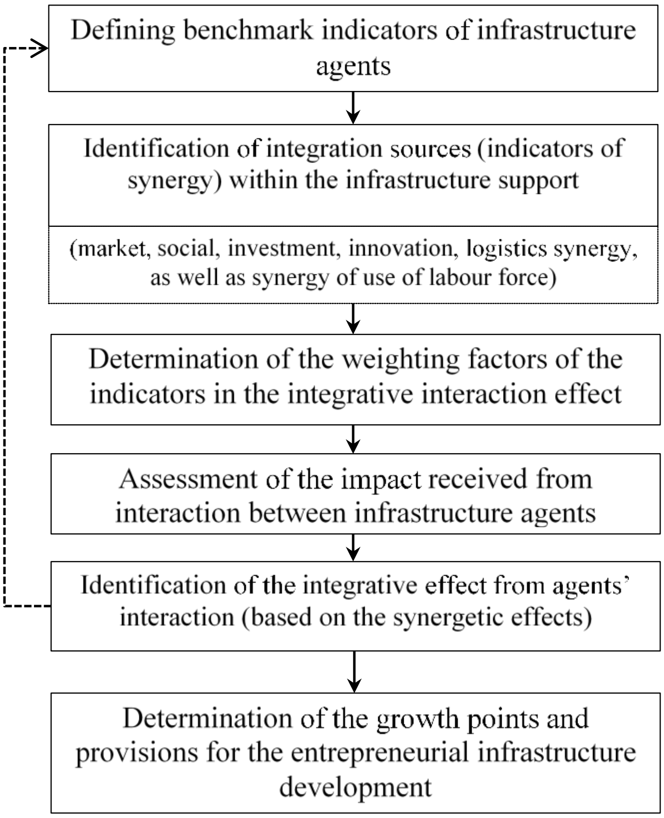

Fig. 1: The entrepreneurial infrastructure parameters development algorithm within the localized system based on the agents interaction.

Source: compiled by the author.

Standard assessment scale for expert values is shown in [Table 1].

Table 1: Harrington alternatives assessment scale

Rating in numerical scale	Harrington scale		
	Rating in a verbal scale	Score ranges	Average score
1	Very low (very bad)	0-0.2	0.1
2	Low (bad)	0.2-0.37	0.28
3	Medium (satisfactory)	0.37-0.63	0.5
4	High (good)	0.63-0.8	0.71
5	Very high (perfect)	0.8-1	0.9

At the fourth stage, performance indicators are being identified for each group of interaction synergy sources. Special indicators of interaction effectiveness (ECk) are defined as elasticity for a linear mathematical dependency model. A composite indicator of the synergy effect is the average of specific indicators:

$$ЭC_k = b * \frac{k}{E} \qquad (1)$$

Where:

ЭCk – performance indicators from interaction of K indicator (special synergy effect);
E – value of the objective interaction function (can be represented by a specific quantitative parameter, such as added value, additional income, turnover, output at comparable prices, number of jobs, etc. – depending on the type of synergy).
b – coefficient of the independent variables in linear function of the form E = b*k + a.

At the fifth stage, the integral indicator of infrastructure support is being identified, with a conclusion on sustainability of the existing state of the entrepreneurial infrastructure.

$$\text{Э}C_{int} = \sqrt{\frac{\sum_{k=1} \text{Э}C_k * w_k}{n}}, \quad (2)$$

Where:

ЭCint. – weighted average (integral) of performance indicator from interaction – synergy effect with this type of agents interaction.

wk – weight of the special synergy effect in various types of interaction.

The interpretation of the development sustainability enables to describe qualitatively the state of the infrastructure at the current time. At the same time, the threshold limits of a sustainable development index are being set between 0 and 1.

There are 5 levels of infrastructure sustainability that can be distinguished [Table 2].

Table 2: Assessment of the entrepreneurial infrastructure's integration effect from the sustainability of infrastructure development perspective

Sustainability level	Range	Sustainable development assessment
1	$0.8 < Э_{int} < 1$	Enhanced level of infrastructure sustainability
2	$0.6 < Э_{int} < 0.8$	Moderate infrastructure sustainability
3	$0.4 < Э_{int} < 0.6$	Insufficient infrastructure sustainability, signs of instability
4	$0.2 < Э_{int} < 0.4$	Unsustainable infrastructure sustainability
5	$0 < Э_{int} < 0.2$	State of complete unsustainability, crisis state

Source: compiled by the author.

In the event of the integral effect exceeding the optimal point (equal to 1), the synergy sources that have proven to be the most effective within the integration will form the basis for obtaining a provision in order to develop further the entrepreneurial infrastructure.

The resources constituted within the interaction will be considered as 'growth points' to forge a new state of the entrepreneurial infrastructure system.

RESULTS AND DISCUSSION

In order to introduce the infrastructure model, a correlation and regression analysis of the activities of small and medium-sized enterprises of the Republic of Tatarstan and the Kamsk innovative and technological industrial cluster (as the subject of the multi-agent integration) was carried out.

The benchmark figure of the interaction between the infrastructure agents within the model represents the turnover of one enterprise entity (cluster resident) - OBMSP.

The following were selected as parameters for the effectiveness of entrepreneurial support:

- Overall investment in development of infrastructure facilities (including budgetary and extra budgetary sources) per one enterprise entity (cluster participant) – OOI;
- Average number of employees in one enterprise entity (cluster participant) – CHR;
- Volume of shipped goods per one enterprise entity (cluster participant) – Product;
- Output per worker in enterprise entity (cluster participant) – SVR.

Input data for the Republic of Tatarstan given in [Table 3].

Table 3: Input data for modeling of an entrepreneurial infrastructure of the Republic of Tatarstan for 2013-2018

Parameter / Period (years)	OBMSP, m. roubles	OOI, m. roubles	CHR, person.	Product, m. roubles	SVR, m. roubles
2013	17.99251	10.5022074	8	30.45014	3.91
2014	18.55316	11.01400134	8	33.3081	4.24
2015	18.80911	12.4694995	8	37.51187	4.90
2016	19.62118	11.73801752	7	36.26528	5.09
2017	20.00278	13.7233113	7	39.29445	5.48
2018	20.54125	14.67102702	7	41.22728	5.85

The results of the effectiveness analysis of the infrastructure of the Republic of Tatarstan are highlighted in [Table 4].

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Table 4: Descriptive statistics on assessment of effectiveness of the Republic Tatarstan entrepreneurial infrastructure

Parameter	Estimate	Standard Error	T Statistic	P-Value	
CONSTANT	21.4163	9.58412	2.23456	0.2679	
OOI	0.127102	0.320626	0.39642	0.7597	
CHR	-0.910777	1.34219	-0.678575	0.6204	
Product	0.0879761	0.476348	0.184689	0.8837	
SVR	-0.0202595	3.47653	-0.00582751	0.9963	
Analysis of Variance					
Source	*Sum of Squares*	*Df*	*Mean Square*	*F-Ratio*	*P-Value*
Model	4.55179	4	1.13795	14.02	0.1947
Residual	0.0811808	1	0.0811808		
Total (Corr.)	4.63297	5			

Source: compiled by the author.

The results of the effectiveness analysis of the infrastructure of the Republic of Tatarstan show that there is no relationship between the outcome indicator and independent variables (the significance level of the model is greater than 0.05 with a 95% probability). Infrastructure investments, generated through fixed-assets investments, also demonstrate the poor effectiveness (less than 25%). This analysis suggests a desultory governance of the entrepreneurial infrastructure at the regional level, since the investment funds allocated for the development of small and medium-sized enterprises were ineffective for enterprise entities activity.

In the cluster type of infrastructure governance model, as one of the types of multi-agent interaction within the framework of infrastructure governance, most parameters of the effectiveness of entrepreneurial support becoming relevant (coefficients less than 0.05 with a probability level of 95%, or the determination coefficients is above 95%). The exception is the parameter of the overall investment per one cluster participant, which is irrelevant in the multiple regression.

During the implementation of large infrastructure projects, the investment pool is constrained by the conditions of the cluster's functioning system, which results in the unequal distribution of investments and high costs for the establishment of infrastructure.

Table 5: Descriptive statistics on assessment of effectiveness of the Kamsk innovative and technological industrial cluster's entrepreneurial infrastructure

Parameter	Estimate	Standard Error	T Statistic	P-Value	
CONSTANT	-174.994	12.4475	-14.0586	0.0452	
OOI	0.038028	0.0184197	2.06453	0.2872	
CHR	2.03209	0.0570506	35.6191	0.0179	
Product	-0.185743	0.0168391	-11.0305	0.0576	
SVR	64.7371	2.92022	22.1686	0.0287	
Analysis of Variance					
Source	*Sum of Squares*	*Df*	*Mean Square*	*F-Ratio*	*P-Value*
Model	3.15979E7	4	7.89947E6	1220207.40	0.0007
Residual	6.47388	1	6.47388		
Total (Corr.)	3.15979E7	5			
R-squared =	100.0 percent		R-squared (adjusted for d.f.) =		99.9999 percent
Standard Error of Est. =	2.54438		Mean absolute error =		0.747096

Source: compiled by the author.

The extracted multiple regression equation becomes:

OBMSP = -174.994 + 0.038028*OIC + 2.03209*CHR – 0.185743*Product + 64.7371*SVR

For the purpose of refining the synergetic effects from the interaction between the agents, a correlation analysis was carried out on the main effectiveness parameters of the Kamsk innovative and technological industrial cluster (the KITIC) participating enterprises over the period 2013-2018 [Table 6].

According to the statistical assessment results, the total revenue of organizations (variation 7.09%) and number of high productivity jobs (coefficient of variation 6.22%) appear to be the most stable parameters throughout the research period. The performance of the cluster as a multi-agent infrastructure model reveals a steady growth in turnover, while maintaining the growth of high productivity jobs. At the same time, the volume of shipped goods is most volatile parameter, indicating of emerging external changes in cluster functioning, which has impact on the cluster's output.

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Table 6: Statistical results of the assessment of effectiveness parameters of the KITIC participating enterprises for the period 2013-2018

Parameter	OOI (m. roubles)	CHVRM (m. roubles)	ONIR (thous. units)	SVR (m. roubles)	OOP (m. roubles)	SVO (m. roubles)
Mean	54138.0	112.873	571.703	6.305	176412.	278098.
Standard deviation	14203.4	7.02578	72.1786	1.53994	91280.7	19720.6
Coefficient of variation	26.2355%	6.22448%	12.6252%	24.4242%	51.7429%	7.09123%

Source: compiled by the author.

A pairwise regression analysis of the parameters was conducted to assess the synergistic effects. Six pairs of observations, that meet the criterion of the overall significance of the pair regression model and the Durbin-Watson criterion to detect the presence of autocorrelation, were selected of all presented set. The research resulted in the following figures.

Table 7: Regression characteristics of KITIC infrastructure parameters interaction

Parameter	Correlation	R^2	Durbin-Watson	P-Value	Coefficient
OOP - CHVRM	0.918323	84.33%	0.4304	0.0097	11927.6
CHVRM - OOI	0.945533	89.40%	0.2521	0.0044	0.000468
ONIR - OOI	0.939839	88.33%	0.6551	0.0053	0.004776
ONIR - SVR	0.953342	90.89%	0.8316	0.0032	44.6738
OOP - OOI	0.996267	99.25%	0.8456	0	6.4027
ONIR-CHVRM	0.989135	97.84%	0.1331	0.0002	10.1596

Source: compiled by the author.

At the next stage of the model introduction, an assessment of the special synergy effect of infrastructure agents interaction (based on elasticity indicators) and integral synergy effect from infrastructure agents interaction was conducted.

Table 8: Identification of the synergetic effects from interaction of KITIC's infrastructure agents

Interaction parameters	E (elasticity)	Type of synergy	Weight	Weighted score
OOP - CHVRM	7.6316	market	0.2227	2.8885
CHVRM - OOI	0.2244	synergy of labour force	0.1363	0.0009
ONIR - OOI	0.4523	investment	0.159	0.0052
ONIR - SVR	0.4928	innovation	0.2727	0.0181
OOP - OOI	1.6642	logistics	0.2045	0.1158
ONIR-CHVRM	2.0059	innovation	0.2727	0.2992
	Composite (integrative) synergy effect			0.689484

Source: compiled by the author.

According to the statistical assessment results, the total revenue of organizations (variation 7.09%) and number of high productivity jobs (coefficient of variation 6.22%) appear to be the most stable parameters throughout the research period. The performance of the cluster as a multi-agent infrastructure model reveals a steady growth in turnover, while maintaining the growth of high productivity jobs.

Based on the results of the synergetic effect assessment, the following patterns of the development of relationships between the infrastructure agents can be identified.

The agents' goal is to export output by creating a high productivity jobs, which is characterized by a market synergy of interaction. Meanwhile, forming an investment provision for creation of a high productivity jobs takes on great significance, since the labor resources synergy level in investing into the cluster is minimal compared to other types of synergy of agents interaction.

Generally, the effect of infrastructure agents' integration within the multi-agent model, which is introduced through a cluster structure, can be defined as 'moderately sustainable'. In order to develop further and move to a higher level of integration sustainability the certain activities on creation of high productivity job opportunities and distribution of an investment resources from the perspective of agents' goals in interrelation among the cluster participants should be implemented.

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CONCLUSIONS

The development of an entrepreneurial infrastructure support system in the Republic of Tatarstan entails strategic planning of key indicators of infrastructure support.

The deliverables of the infrastructure support provide an improvement of the productivity of entrepreneurial structures and an increase in the competitiveness of their products, a growth in the share of entrepreneurial structures in the regional economy (increase in entrepreneurial activity), an enhancement of living standards, a growth in the proportion of entrepreneurial output in the structure of GRP, etc.

Social and economic benchmarks that are set in the regions' small enterprises development programs should be addressed in relation to the establishment of a strategy for the development of the infrastructural support system.

CONFLICT OF INTEREST
There is no conflict of interest.

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