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To cite this article: E A Afonichkina *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **302** 012092

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Parameters and characteristics of the strategic development portfolio of the Arctic corporation

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Abstract. This article addresses the problem of interaction between the participating countries of the Arctic corporate system, which is essential for the development of Arctic territories in circumpolar countries. The authors propose the structure and elements of efficient Arctic systems, examine the typology of the existing Arctic systems, and identify the vector of strategic development for complex Arctic systems. The development of such systems should be determined by the strategic development portfolio, which would ensure implementation of the development vector.

1. Introduction

Efficient development of complex systems, especially those involving transnational activities, requires a well-defined vector of strategic development that would make allowance not only for the basic growth areas and capacity to change the strategic vector in accordance with the changes in the external environment, but also for the potential risks associated with economic development and for the harmony between the interests of all participants of the corporate system [1,2,7]. This is particularly vital for economic systems, which are oriented towards developing the northern territories, sustaining their ecological integrity, and determining the social policy for the indigenous population of these territories [3,4].

When it comes to international corporations operating in the northern territories within the framework of international Arctic development programs, it is possible to determine the structure of such Arctic systems, which is a three-level hierarchy with two types of control centers [5]. The first type is represented by the Head Control Center of the Arctic Corporation (AC), the second – by national control centers for the management of national agents. In spite of the fact that all agents are involved in the implementation of the systemic development strategy, each of them has its own interests, authority, resources, and needs. Taking into account the harmonization of interests, strategic operations within a single business chain, and the balance of other resources in the course of development requires not just a development strategy, but a complex of strategic development variations oriented towards the most probable future changes in the external environment [6].

Such a range of alternatives for strategic development is usually represented as a strategic development portfolio that includes a set of potential functional development strategies for different conditions of the external environment and internal growth factors. The budget and strategic plan for the development of such a portfolio require: - rational choice of the basic version of the development



strategy, - identification of functional growth strategies with temporal characteristics in the strategy structure, - distribution of strategic operations between the agents of the economic system in accordance with the potential opportunities for their implementation and the balance of interests and resources, - evaluation of the efficiency of each variation of the strategy and the strategic portfolio as a whole.

The difficulty of forming a strategic portfolio also has to do with the specific features of multi-level economic systems with distributed national control centers, which demand that a complex system of interactions in many directions between centers, agents, the Global Control Center, objects of the external environment, etc. is organized. Thus, the structure of interactions between the participants of such a consortium comprises relations in the following areas: - finance, - resources, - performance, - information integration, - monitoring of Arctic phenomena, - material production, - transportation, etc.

2. A generalized model of the Arctic corporation structure

In order to reflect the system of interactions between active elements within the framework of strategic operating activities, let us denote by $\{R^{a_{ij}}\}$ the multitude of interactions between the agents; by $\{R^{aU_i}\}$ – the multitude of interactions between the agents and the control center; by $\{R^{Ua_i}\}$ – the multitude of interactions between the control center and the agents; by $\{R^{ax_{ij}}\}$ – the multitude of interactions between the agents and the external participants in operating and investment activities; by $\{R^{UX_{ij}}\}$ – the multitude of interactions between the control center and the external participants in operating and investment activities. Then, let us denote the multitude of interactions between the AC participants by $(\{R^{a_{ij}}\}, \{R^{aU_i}\}, \{R^{Ua_i}\}, \{R^{ax_{ij}}\}, \{R^{UX_{ij}}\}) \in \llbracket \tilde{R} \rrbracket$.

Based on the existing and potential level of the functional types of economic potential of AC development available to each participant (active element – AE) and their cooperation on achieving the target functions of development, it is possible to set the vector of strategic development as a system of development parameters

$\{S\} = (\llbracket \tilde{R} \rrbracket, P, W, C_{AC})$, where $\llbracket \tilde{R} \rrbracket$ is the set of interactions between the participants of the Arctic corporation, P is the necessary level of economic potential for AC development, C_{AC} is the set of target functions of AC development, including individual goals of the AE (C_{AE}), W is the dynamic factors of the external (Arctic) environment; however, considering that the overall economic development potential is the sum of the potentials of active elements and additional capabilities of the AC itself, we get $P = P_{AC} = \bigcup_{i=1}^m P_{AE} + \Delta P_{AC}$, where ΔP_{AC} represents the potential capacity for action of the AC system as a whole. Accordingly, the vector of strategic development can be written as $\{S\} = (\llbracket \tilde{R} \rrbracket, (\bigcup_{i=1}^m P_{AE} + \Delta P_{AC}), W, (C_{AC}/C_{AE}))$, where the expression (C_{AC}/C_{AE}) stands for the achievement of the goals of the AC through the implementation of the development strategy with allowance for the possible harmonization with the private goals of the active elements of the corporate system.

Let us define the problem of managing the Arctic economic system (ES) by finding the admissible vector for the management [5,9] of AC development based on portfolio development strategies $\{F^d_j\}$, for which efficiency (Ψ_{AC}) would be maximum,

$$\Psi_{AC} = \langle \{U \Psi_{aj}\}, P, W, \Delta \varphi \rangle \rightarrow \max \quad (1)$$

with restrictions on: the types of operating activities of the AE, $(V_1, V_2, \dots, V_m) \in S_C$;

- the composition of the finite structure of the AC ($S_C, \Psi_{AC}, \Psi_{aj}$);

- the level of the system-wide economic development potential ($P(S_0) \geq P_{SD}$).

If the target function of the development strategy Ψ_{AC} is represented as a countable criterion of profitability $H(S_j)$ formed by the AC in conjunction with the system's assets and agents (participants) (a_{ij})

$$H(S_j) : \{S_{ij}\} \rightarrow \{\Psi^d_{AK}\}. \quad (2)$$

The profitability function depends on many factors and is a retarded function that can be described by a discounted value.

Another factor of strategic efficiency involves the coordination and interaction between agents ($a_i \{R\} a_j$) in operational strategic value chains, where each agent applies a pre-agreed strategy $s(a_j)$, which does not contradict the system-wide strategy (s_o), ($s(a_j) \in s_o$) $\subset \{S\}$.

The system-wide strategic portfolio includes the current strategies of the elements as well as potential strategies aimed at changing the external environment W and the level of development potential (P).

3. Defining the budget structure of the strategic development portfolio

In order to implement such a portfolio, it is necessary to draw up a budget of the AC development strategy distributed between funding sources, agents, business chains, strategic mechanisms and instruments, $B(S)$. The structure of the strategic budget determines efficiency of the alternative strategy and the portfolio as a whole. The budget of the portfolio is its important element and should reflect the versatile strategic vision of the portfolio oriented towards developing a strategy that would be adequate to particular conditions of the external environment. There can be multiple – generally N – versatile, most probable changes in the environment, also referred to as alternatives. Then, the generalized structure of the strategic portfolio includes N directions for the strategic development of the ES, each direction determining strategic activities targeted at the corresponding business environment. Different versions of the strategy can be ranked by several criteria: - probability of the strategic alternative, - budget size of the strategic alternative, - efficiency of alternative strategies, - conformity of interrelated strategic initiatives, etc.

For example, if the portfolio structure (P^D) is divided into N sub-portfolios, each of which is oriented towards specific environmental factors and their values, it allows for a preliminary ranking of alternative events (changes in the external environment) by event probability.

Let the dynamic factors of the external environment W define N possible events that the enterprise needs to respond to in order to adjust the management process and prevent a deterioration in their performance (w_1, w_2, \dots, w_N) $\in W$. Each possible event w_j is described by a multitude of factors, $w_j = \Psi(\hat{f}_1, \hat{f}_2, \dots, \hat{f}_m)$.

For each possible event w_j , the enterprise should provide an adequate strategy for its development $S(w_j)$, which is described by the corresponding multitude of external factors ($\hat{f}_1, \hat{f}_2, \dots, \hat{f}_m$), $S(w_j) = S(\Psi(\hat{f}_1, \hat{f}_2, \dots, \hat{f}_m)) = S_j$.

By making a probabilistic assessment $P(w_i)$ of the different states of external events w_i and ranking possible external events by event probability, it is possible to obtain ranks $R(w_i)$ of the following type $R(P(w_1)) \succcurlyeq R(P(w_2)) \succcurlyeq \dots \succcurlyeq R(P(w_N))$.

Such priorities of external factors determine the structure and priorities of possible strategic alternatives in the strategic portfolio. Then, the structure of the strategic portfolio P^D itself can be represented as a collection of possible strategic alternatives (S_1, S_2, \dots, S_N) $\subseteq P^D$.

It should be noted that each strategic alternative is actually a system of functional strategies for each agent that operates within the framework of each specific functional strategy, i.e. $S_i = \{s_{i1}, s_{i2}, \dots, s_{ik}\} \subseteq w_i$.

According to the typology of business chains, each active element a_j performs the operational elements of one or multiple strategic initiatives and generally implements a number of functional strategies $s(a_j)$, $s(a_j) \ni \{s_1(a_j), s_2(a_j), \dots, s_k(a_j)\}$.

With regard to the possible variations of strategic initiatives adequate to the conditions of the external environment, it should be noted that the efficiency of a strategy depends, among other things, on the level of the strategic development budget. Therefore, each variation of the strategy requires a strategic budget that would meet certain criteria in terms of size, task synchronization, and performance.

Given that the strategic budget comprises the budgets of the functional strategies of the active elements, it is necessary to allocate local budgets for each agent of the AC.

When determining the size of the budget, several components (sources) of budget content need to be assessed. In particular, these include revenues generated by the participant (B_{ai}) and transfers from

the budget of the national control center (B_N) to the budget of the Head Control Center (B_0), i.e. the functional strategy budget for an active element is

$$B(s_j) = B_{ai} + B_0 + B_N. \quad (3)$$

Let us examine the structure of budget expenses for an individual participant B_{ai} , which should reflect the expenses and revenues for each agent in the AC structure. We shall assume that the participant's operating expenses on strategic activities depend on the estimated management budget. i.e. the content of the strategy itself (s_j) and the intensity of interactions with the other AC participants during strategy implementation, ($\{r_j\}$). Then, let us define the cost function of the i participant (active element of the AC - a_i) as $c_i(a_i) = c(s_j, r_i, a_i)$, depending on the content of the selected strategic alternative (s_j), $\{s_j\} \in S_i$, system of interactions according to the management strategy $r_i \in \{R\}$, where $\{R\}$ is the multitude of possible interactions between agents involved in the implementation of the strategy s_i , $i = 1, n$ and the capabilities of the participant in terms of size and structure of its own potential for strategic development.

Extrapolating this category of expenses to all AC participants, let us denote the budget element by

$$C_{AC}^a = \sum_{i=1}^n c(a_i) = \sum_{i=1}^n \sum_{j=1}^k \sum_{l=1}^y c(a_i, s_j, r_l)$$

We shall also assume that the participating agents of the AC can be arranged in accordance with the priorities in creating customer value by a set of performance criteria or by the level of budget expenses as a ranked list by preference relation, $a_1 \succcurlyeq a_2 \succcurlyeq \dots \succcurlyeq a_n$. We shall designate the agent with the highest priority (preferred) in an ordered sequence (a_1) as the more important participant. This preference relation can be used when budget sources reach critical values in the budgetary funding of this budget element.

Examining the structure of the budget component BN, we can emphasize that each national control center has its own budget; then the total budget for this element for the AC takes the form $C_{AC}^N = \sum_{i=1}^n B_{Ni}$.

Then, defining all elements of the strategic budget of the AC, we get

$$C_{AC} = C_{AC}^a + C_{AC}^N + C_0. \quad (4)$$

The strategic development budget for each active element of the AC can be generally defined as

$$C_{AE}^a = C_{AC}^a + (C_{AC}^N)/k + (C_0)/n, \quad (5)$$

where k is the number of national control centers, and the value $(C_{AC}^N)/k$ reflects the average budget size of a national control center for the corresponding active element of the group, n is the number of active elements in the AC structure, and the value $(C_0)/n$ reflects the average budget size of the Head Control Center for each active element functioning within the framework of the strategic development initiative.

Thus, expression (4) determines the generalized budget size of the budget for the strategic development of the AC, and the budget of an individual active element of the AC is averagely determined by expression (5).

In order to further identify the budget elements of the development strategy, it is necessary to identify the most important components that play a major role in the formation of the strategy and determine its efficiency.

4. A model of the strategic development portfolio and methods of its creation

Strategic analysis of management functions shows that the AC development strategy (S^0) can be defined as a function of the following internal and external parameters of the economic environment: - internal factors of the environment, $\{X\}$; - target functions of the agents in the AC development strategy, $\{x_i\}$; - degree of harmonization of the interests of agents operating in the associated business chains within the strategy, $\{z_i\}$; - the agent's roles (operating activities) in the business chains of the system-wide strategy, $s(a_i)$; - level of economic development potential of the agent a_i , $(PD(a_i))$; - systems of interaction between agents in the AC structure, $(a_i\{R\}a_j)$; - synergy and risks in the process of corporate interaction, ΔE ; - external factors of the environment, $\{Y\}$; - market conditions, $\{y_i\}$;

dynamics of the external environment, (T); - existence of strategic management zones, $\{w_i\}$; - predictability of potential changes in the external environment, $(P(y_i), \Delta T)$; - information transparency, $\{I\}$; - openness of external markets, $\{B_i\}$, etc.

Then, the functional description of the development strategy can be provided in the form of the following function:

$$S^0 = \Psi(\{X\}, \{Y\}) = \Psi(\{\{x_i\}, \{z_i\}, s(a_i), PD(a_i), \{R\}, \Delta E\}, [\{y_i\}, T, \{w_i\}, (P(y_i), \Delta T), \{I\}, \{B_i\}]) \quad (6)$$

Formalization of the strategic initiative from the multitude of AC development strategies will amount to defining and formally describing each parameter from (6).

Then, the strategic development portfolio (P^D) should include alternative variations of development strategies oriented towards different values of internal and external factors, namely

$$P^D = \{S^0, S_1, \dots, S_N\} \quad (7)$$

where S^0 is the basic variation of the development strategy oriented towards the most probable condition of the environment, while (S_1, \dots, S_N) are the alternative development strategies with allowance for the potential changes in the dynamics of the environment.

Each strategy in the portfolio needs to be assigned a strategy efficiency function $G(S)$ to assess its adequacy and rationality of implementation under different environmental conditions.

Then portfolio (7) can be written as

$$P^D = \{(S^0, G(S^0)), (S_1, G(S_1)), \dots, (S_N, G(S_N))\}. \quad (8)$$

The strategy efficiency assessment function ($G(S)$) mostly relies on the strategic activities of each participant, the current level of economic development potential, the system of interactions between agents in the implementation of strategic initiative operations in the AC structure, and the synergy (risk) effect. In this case, the efficiency function can be expressed as

$$G(S) = f(S^0) = (s(a_1), PD(a_1)), (s(a_2), PD(a_2)), \dots, s(a_n), PD(a_n)), \{(a_{ij})\{R\}(a_{ji}), \Delta E\}. \quad (9)$$

Assessment of the efficiency function through the profitability indicator H shows that this function is multivariate and depends on the degree of strategy implementation by each corporate agent and the level of their cooperation on strategy implementation.

The efficiency function of the portfolio itself can be represented through the efficiency of the agent strategies and the potential synergistic effect $G(P^D) = G(S^0, S_1, \dots, S_N)$.

Using the profitability indicator (H), let us define the portfolio efficiency function as

$$H(P^D) = H(G(S^0, S_1, \dots, S_N)).$$

This function ensures the formation of a certain range of values of profitability from the implementation of the strategic portfolio of systemic development, i.e.

$$H(G(S^0, S_1, \dots, S_N)) \rightarrow [H^*(P^D) \div H_0(P^D)], \quad (10)$$

where $H^*(P^D)$ is the margin portfolio efficiency value for the optimal (best) scenarios of strategic choice and agent cooperation on strategy implementation, $H_0(P^D)$ is the minimum portfolio efficiency value for the pessimistic (not best) strategic variations of development management and significant risks arising from irrational interactions between agents in the implementation of strategic operations.

Taking into account the portfolio effect function in the form of AC profitability (10) from the implementation of the variable development strategy and the cost structure (budget) of the portfolio (3), the portfolio efficiency indicator (E_{PD}) can be estimated as

$$E_{PD} = [H(G(S^0, S_1, \dots, S_N))]/[C_{AC}^a + C_{AC}^N + C_0]. \quad (11)$$

Considering that

$$C_{AC}^a = \sum_{i=1}^n c(a_i) = \sum_{i=1}^n \sum_{j=1}^k \sum_{l=1}^y c(a_i, s_j, r_l)$$

the efficiency function (11) will take the form

$$E_{PD} = [H(G(S^0, S_1, S_2, \dots, S_N))]/[C_{AC}^N + C_0 + \sum_{i=1}^n \sum_{j=1}^k \sum_{l=1}^y c(a_i, s_j, r_l)]$$

If we formulate this efficiency indicator in the form of growth rate (ΔE_{PD}), the growth rate of the efficiency of the AC development strategy can be represented as

$$\Delta E_{PD} = ([H(G(S^0, S_1, S_2, \dots, S_N)] - [C_{AC}^N + C_0 + \sum_{i=1}^n \sum_{j=1}^k \sum_{l=1}^y c(a_i, s_j, r_l)]) / [C_{AC}^N + C_0 + \sum_{i=1}^n \sum_{j=1}^k \sum_{l=1}^y c(a_i, s_j, r_l)])$$

Here, the numerator of this expression in the form of the difference between the profitability indicator (H) and the total expenditure of all corporate agents (C_{AC}) yields the absolute target efficiency function, and the efficiency growth rate will be positive under the following condition

$$H(G(S^0, S_1, S_2, \dots, S_N)) > (C_{AC}^N + C_0 + \sum_{i=1}^n \sum_{j=1}^k \sum_{l=1}^y c(a_i, s_j, r_l))$$

and negative if this condition is not met.

When assessing the strategic activity of each participant within the framework of the determined strategic development alternative, the AC Control Center provides a list of the necessary strategic activities (within each participant's strategy), budget C_{AC}^{ai} , $i = 1 \dots N$, and, knowing the participant's profitability parameter $H(a_i)$, assigns the direction (vector) and incentive function ($\delta(a_i)$) for the active element; the latter should be higher than the agent's expenses on the implementation of strategic activities $c(a_i, s_i, r_i)$, i.e. $\delta(a_i) > c(a_i, s_i, r_i)$.

During the implementation of a strategy that generates specific strategic values, each agent chooses strategic activities that would maximize the difference between incentive payments ($\delta(a_i)$) and expenses, i.e. $[\delta(a_i) - c(a_i, s_i, r_i)]$.

Given the variability of the profitability function, in order to obtain the maximum profitability value for the variable development strategy, it is necessary to solve the following problem:

$$[\delta(S_i) - \sum_{i=1}^N c(a_i, S_i, r_i)] \rightarrow \max_{S_i \in \{S\}}$$

This problem can be solved according to the following rule:

$$\text{Argmax}_{S_i \in \{S\}} [\delta(S_i) - \sum_{i=1}^N c(a_i, S_i, r_i)]$$

5. An algorithm for the formation of an efficient strategic portfolio

The management policy established by the Control Center is characterized by the following rule for selecting a rational strategic alternative: - the Control Center shall select incentive functions that are adequate to the vector of strategic development directions in order to obtain the maximum expected value of its target function if the participant rationally chooses its strategic activities in this direction.

$$E(H(G(S^0, S_1, S_2, \dots, S_N)) - \sum_{i=1}^n \sigma_i(\{S_i\})).$$

Generalizing the conditions for the selection and formation of the strategy variation, let us formulate an algorithm that would involve the following stages:

1. Selecting a generalized development strategy,
2. Determining development goals based on the prediction of the potential environmental conditions and the major factors.
3. Identifying alternative development strategies with allowance for the variables, according to expression (6).
4. Developing variable strategies and assessing their efficiency.
5. Identifying the parameters of the portfolio: - efficiency (E_{PD}), efficiency growth rate (ΔE_{PD}).

6. Selection of the most rational strategic alternative by the AC agent:

- the participants select those strategies from the portfolio, which yield the maximum of their target profitability function;
- cooperation on joint operations within a strategic alternative requires the harmonization of interests, target functions, and the level of development potential,
- formation and assessment of the budget of the strategic development portfolio require the integration of assets and capital in order to achieve system-wide goals.

7. Solving the problem of selecting the optimal strategy for the participant within the size of the strategic budget of the national centers and the Head Control Center with allowance for the scope of incentives for the participants' activities.

The implementation of this algorithm implies the following conditions for the formation of the strategic portfolio and selection of strategic alternatives:

- the participants work within an open intra-corporate environment;
- the AC system itself is open and transparent;
- strategic operations are performed in full accordance with the requirements of the national Head Control Center;
- the authority and responsibility for the decisions taken in the context of strategic development are observed;
- strategic alternatives are adopted in accordance with the current level of the participant's strategic development potential;
- strategic operations and the selected activities are implemented with the highest efficiency;
- all corporate participants are engaged in strategic value chains;
- interactions between the participants make up network structures;
- the multitude of interactions reflects the functional relationships of the activity (investment, financial, resources, marketing, production, etc.)
- any alternative development strategy is a set of functional strategies that determine the process of development management aimed at achieving the required target functions (oriented towards all corporate participants).
- cost functions $c(S_i)$ are nonnegative and increasing by S_i .

For assessing the level of the economic development potential, which is an important factor determining efficiency of the strategic development, let us state that the distribution of the economic development potential in implementing the variable development strategy is also defined by a certain cost function $c(S_i)$, the rules of distribution of expenses for the participant's strategic initiatives being as follows:

- if zero action is selected, the expenses are zero, $c(S_i) = 0$, $\forall r \in R$;
- as the scope of strategic initiatives performed by the participant increases, expenses grow proportionally, $c(S_i) > 0$;
- as the management and technical competencies of the participant improve, expenses are reduced, $c(S_i) < 0$;
- as the synergistic effect of the strategic portfolio PD increases, expenses are also reduced, $c(S_i) < 0$.

6. Conclusion

In order to produce an efficient strategy with the marginal level of efficiency, the strategic development portfolio includes different variations of development strategies adapted to specific most probable and possible conditions of the environment. Additionally, each time when significant changes occur in the environment, the AC adaptively transitions to a new alternative development strategy corresponding to the environmental factors. The selected strategic alternative is distributed among the participants according to operational procedures, taking into account allocation of the participant's budget and stimulation of operations. This adaptive management procedure prevents

deterioration of economic conditions, improves the efficiency of development management and ensures sustainability of the target performance functions.

The specific features of the AC with multiple control centers include horizontal and vertical interactions between the centers. Equilibrium in the presence of several centers is characterized by the fact that the AE receives not only a compensation of its expenses for implementing the action, but also an additional rent for selecting no action that would be more beneficial to any one of the centers. Apart from that, equilibrium in a model with multiple national centers also has the following specific features:

- the centers should be able to predict the potential national interests and strategies;
- in case of any deviation from the system-wide strategy, the remaining centers can form a coalition to reduce the appeal of their own interests and incentives;
- in addition to finding the optimal incentive functions in this AC, it is necessary to find the equilibrium states of the centers when none of the centers will gain advantage from changing its strategy from the equilibrium strategy to another one with its own benefit, provided that other centers use the equilibrium (system-wide) strategy.

7. Acknowledgements

This paper is based on research carried out with the financial support of the grant of the Russian Science Foundation (Project No. 14-38-00009). Peter the Great St. Petersburg Polytechnic University.

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