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ASSESSMENT OF THE TIN INDUSTRY CREATION PROSPECTS IN THE REPUBLIC OF KAZAKHSTAN

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The modern industrial corporations are deeply integrated which is expressed in a variety of connections and interactions. Key among these are technological connections based on which the commodity and cash flows are generated. The global innovative economy impacts economic activity integration and consolidation parameters, leading to organization of strategic management and value creation chains in mesoeconomic network structures with a single logistic center, intangible assets and a special system of long-term contracts.

Product fabrication in the mineral resources sector is primarily associated with the large highly efficient companies. Meanwhile present competition in the global resource extraction and a need in further development and growth of the companies, especially in the resource-based economies, become a stimulus for implementation of large-scale strategic projects involving exploration of new mineral resources. As a rule, strategic projects in mineral sector have impact on the population and various business actors, on the development of an industry, a region and a country as a whole.

Strategic investment projects in the mining sector are often implemented in complicated organizational, technical and economic setting, including poor infrastructure, harsh natural climatic and geographical conditions, lack of qualified staff, a need in large-scale funding, a need to mitigate material adverse effect on the environment. Large-scale projects implemented in the frontier regions have significant impact on the development of resource-based economies and cross-border cooperation.

Selection of a modality for implementation of the mining project and assessment of its effects can be based on the added value concept, which maximizes the value growth. Value creation pattern depends on a number of production stages, depth of diversification, production capacity, company assets and range of products. Here it is important to consider not only project's positive NPV, but also emerging additional effects related to project integration and implementation in the value chain.

The purpose of the study is to justify a methodic approach based on the value chain to the assessment of effects of a large-scale mining project, which may have impact on a holding, a region, national economy and cross-border cooperation.

The research carried out helped to justify the use of the added value concept for deciding on the type of project for the field development, the basic and additional effects of a large-scale mining project have been revealed and possible organizational and economic framework for creation of tin industry in the Republic of Kazakhstan has been proposed.

Key words: mining project, tin industry, value chain, cross-border cooperation.

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Introduction. Studies united under the umbrella of the value chain concept have been reviewed in the papers [10, 12-14], etc. This approach was placed at the forefront to analyze the product value creation process in the integrated company (at several interrelated stages) with a view to increase efficiency and competitiveness of a system as a whole. It shall also be taken into account that the competitiveness of the whole chain (system) is affected both by the processes of added value creation and its distribution between chain participants creating the end product. That's why a managing entity (the corporate center) in the chain shall set proportions for added value distribution between the chain participants.

In scientific literature the challenges of efficient implementation of a large investment project at regional level have been reviewed in papers [2, 6] and at a microlevel (level of the company) in papers [5, 7, 11]. Despite extensive research efforts in the field of investment analysis, the definition of strategic project has not been given so far, with that many researchers highlight its major attributes, such as focus on achievement of strategic competitive advantages, systematic approach to project development and implementation, long-term nature. There is no unified classification of projects, in particular, in paper [8] an attribute is proposed which has the highest relevance for the research purposes: an economically



distinct project integrated in the company. The paper [11] examines some of the aspects of added value creation in the course of strategic project implementation.

Of particular interest for the projects in mineral resources sector are the effects occurring in the related and adjacent industries. Such effects may create prospects for cross-border cooperation. The basis of the cross-border cooperation is a process of creating connections and contractual relations in the frontier areas in order to find solutions to common or identical issues. Cross-border cooperation implies engagement in a dialogue in all life spheres of all social groups of population and administrative bodies. Presently only first efforts are made in the Russian science to research cross-border cooperation in a systematic manner [3, 9]. A support system for cross-border cooperation is also in its infancy.

Methodic approach to determining the effects of strategic project based on the value chain in the mineral sector has been tested in the context of a large project for tin deposit development in the Republic of Kazakhstan and creation on this basis of an innovative specialized industry in the country. Today Kazakhstan is purchasing Russian tin, meanwhile for over decade exploring its own mineral resources and building plans to produce ready metal in the quantities exceeding the current production in Russia. Several versions of tin deposit development project have been drafted, it was postponed several times and has not yet been implemented. Justification of methodic approach is based on the following research findings: 1) assessment of current state and development prospects of the global tin market; 2) analysis of investment appeal of tin industry creation and development; 3) design of value chain in tin industry; 4) organizational and economic framework for strategic mining project implementation with account of cross-border cooperation.

1. Assessment of current state and development prospects of the global tin market. The global tin market is highly consolidate with several major manufacturers in two geographical areas: Central America (Bolivia and Peru) and South-East Asia (Indonesia, Malaysia, China). Over one third of global tin is produced in Indonesia, in China tin production is aimed at covering the domestic needs [4]. According to estimations global reserves of tin ores comprise 4,800 thousand tons calculated as metal. Structure of tin reserves* is presented in Table.

Global reserves of tin ores in 2016

Country	Reserves, k.t	Share, %	Country	Reserves, k.t	Share, %
China	1,500	31.3	Malaysia	250	5.2
Indonesia	800	16.7	Thailand	170	3.5
Brazil	700	14.6	Peru	130	1.7
Bolivia	400	8.3	Other countries	180	3.8
Australia	370	7.7	Total Reserves	4,800	100
Russia	350	7.3			

Among CIS countries Russia has sufficient tin reserves, but they are concentrated in remote areas of the Far East, including the Chukotka Autonomous District (mining closed in the early 1990s), Primorsky Region, Khabarovsk Region and Yakutia. Until recently Russia had well-developed tin ore extraction and tin concentrate processing production.

Kyrgyzstan has several fields with complex and difficult-to-beneficiate ores. The only consumer of the product from Sarydzhazskoye tin ore field was Novosibirsk Tin Plant (NOK JSC), the concentrates produces are low-grade.

The only in Kazakhstan and the largest in Central Asia is Syrymbet tin deposit. According to international JORC classification deposit mineral resources include 94.5 mln t of ore and 463.5 kilo t of tin in metal with average concentration of 0.49 %. Besides in future it is planned to

* U.S. Geological Survey, 2016, Mineral commodity summaries 2016 [Digital source]. – U.S. Geological Survey, 202 p. – Access mode: <http://dx.doi.org/10.3133/70140094>.



re-equip a mining and beneficiation plant for tantalum-tin ores in the Eastern Kazakhstan, which has not been in operation for the last 10 years.

Depletion of deposits of tin with high metal content and the high costs of its extraction in Russia, Mongolia and Kazakhstan, on the background of growing demand led to reduction in global tin reserves to critical level. After the global market conditions improved the running mining plants began to expand their mineral base, and new tin mining projects appeared in Australia and Canada. Besides there is a channel for tin supply from Congo to Malaysia, but it is closed for other countries due to adoption of convention on 'conflict' metal [15]. A possibility that new producers will enter the market to compete with existing leaders is vague.

According to International Tin Research Institute (ITRI)* the position of top ten producers in the market is rather stable. Refined tin production by top producers in 2015 is next, kilo.t:

«Yunnan Tin» (China)	75.5	«EM Vinto» (Bolivia)	12.1
«Malaysia Smelting Corp» (Malaysia)	30.3	«Guangxi China Tin» (China)	11.1
«PT Timah» (Indonesia)	27.4	«Gejiu Zi-Li» (China)	11.0
«Minsur» (Peru)	20.2	«Thaisarco» (Thailand)	10.5
«Yunnan Chengfeng» (China)	16.6	«Metallo Chimique» (Belgium)	8.9

Analysis of production volumes revealed that 4 out of 10 largest tin enrichers are Chinese companies, which is explained by high domestic demand from automotive and electronic industry, as well as unprecedented state support.

Increase in stock prices and rapidly growing consumption were a consequence of dramatic changes in the global tin consumption structure, that changed market position in the global market opening new development prospects for the industry. Industry development was triggered due to emergence of new tin applications, adoption of higher environment protection standards in the developed countries and subsequent enactment of stringent laws concerning products containing toxic metals. Tin is an irreplaceable metal for electronics, chemical and food industry, as well as for high-tech industry. As distinct from most other metals, the structure of the tin application in the world has changed revolutionary over the last decades. With account of macroeconomic forecasts demand for tin increased due to discovery of new tin applications**.

Out of CIS countries Russia is the only one producing refined tin in the volume equal to 0.5-1.5 % of the global output, and its production is not stable. A large producer of tin metal, alloys and solders since 1940s was Novosibirsk Tin Plant JSC (NOK JSC), included in the list of Russia's strategic organizations. NOK is a monopolist in the Russian market of tin and solders for metallurgic, defense, automotive, food, radio-electronic and machine engineering industries of Russia and CIS countries. NOK has tin mining facilities in Russia and Kirgizia. The product consumers are over 800 companies in Russia, CIS countries, Europe, USA and Republic of Korea. Tin refining capacity is up to 20 kilo t of metal per annum. Plant development strategy for the years to come assumed increase in tin output to the target level of 6-8 kilo t per year, which would not make Russia a global industry leader, but would abundantly cover domestic needs. The company management faces challenges in bringing these plans to life due to both external complications and internal corporate issues. Thus NOK was forced to sell one of its entities, Sakha-Olovo LLC, in response to existing corporate conflicts.

2. Analysis of investment appeal of tin industry creation and development. Investment appeal of large investment projects in tin industry depends on the market conditions, forecasted demand trends, mining, processing and transportation costs, i.e. ability to create added value and its size.

The feature common to most non-ferrous metals traded at the stock exchange is the excessive production and production facilities, but situation with tin is different. The tin market has gradu-

* The top 10 tin producers in 2015 [Digital source]. – Access mode: <https://www.itri.co.uk/market-analysis/news-2/the-top-10-refined-tin-producers-of-2015>.

** Analysts' tin price forecasts raised//Market analysis/18 April 2012. URL: http://www.itri.co.uk/index.php?option=com_zoo&task=item&item_id=2410&Itemid=143.



ally become rather stable and favorable for producers with a continuing global supply deficit [1]. It is expected that rapid demand growth at traditional tin consumption markets will continue, and it will be hard to cover it with the existing production facilities. Developing Asian economies and progress in high-tech sectors drive demand for tin, which is increasingly sought after by innovative industries.

Appeal of investments in the tin industry is especially illustrative on example of a mono-producer Malaysia Smelting Corporation (MSC), which is a vertically integrated group of companies with mineral base in Indonesia and Malaysia. Until 2008 MSC had interest in gold and silver mining and in oil and gas business. The main objective of vertical integration of the companies is winning leadership in the rapidly growing market of solders. A brief SWOT analysis of the company revealed its strengths [4]: highly qualified management; diversified international customer base; strong market position, including in implementation of innovative tin applications; stable and growing profit; availability of financial resources. The company weaknesses are: low profit rate (7 %); high dependence on metal prices and raw materials supply conditions; significant investments; slow turnover of working capital; significant volumes of uncontrolled reserves outside the country; investments in 'conflict' zones (Congo); no end consumers among the customers (poor control over marketing and pricing); high share of short-term borrowed funds.

Costs in tin industry depend on the process of tin-containing ore processing, which includes the following stages [4]: ore extraction; external supply of ore and concentrate; melting of tin concentrate; purchase of raw tin under the supply and tolling agreements; raw metal refining, production of ingots; production of finished products (solders); distribution through internal and external channels to producers of electronics, chemicals, medicines, to the open market of metals (LME, KLMM), to metal selling agents; trade in futures, options and physical metal through a metal exchange, sales to investment funds.

The main competitive advantage in tin mining and tin concentrate production is the operating and long-term mineral base with average concentration of tin in the ore localized in existing mining industrial centers with developed transport infrastructure. That's why investment appeal of the tin industry depends on a properly designed value chain.

3. Design of value chain in tin industry. In the Northern Kazakhstan Syrymbet and Donetskoe tin ore fields were discovered and explored, opening opportunities for creating a new for the country tin ore industry. Syrymbet field is a unique tin deposit. License for its geological exploration and development until 2028 has been issued for Syrymber JSC, a branch of Lancaster Group Kazakhstan, a Kazakhstani investment company. Deposit has been developed since 2001, the development was several times interrupted for different reasons.

The main industrially valuable component in the ore is tin, mostly represented by cassiterite. The tin concentration varies from 0.44 to 0.8 % and averages 0.6 %, the ore contains tungsten (0.172 %), silver in concentrations reaching 4 g/t and gold in concentrations not exceeding 0.15 g/t, molybdenum (0.022 %), zinc (0.026 %). The projected mine capacity is 1 mln t of ore, the life of mine is 14 years. Losses – 2-3 %, impoverishment – 7 %. Due to lack of workforce in the area of works it is planned to organize rotational workshifts.

All studies conducted to select the beneficiation process characterize the ore as being difficult to beneficiate. It is explained by a high content of fine particles (sludge) of gangue mineral and considerable content of ferrous minerals with high specific weight hindering extraction of cassiterite into the concentrate. On the basis of the conducted research a beneficiation process flow was recommended based on gravitation methods ensuring production of concentrate of virtually any quality. The beneficiation process flow assumes production of two types of concentrates: high grade concentrate with 45.32 % tin content; high grade intermediate product with 4.90 % tin content with tin extraction to ultimate 56.1 % concentrate.

In 2007 construction of mining and processing plant began at the field, it's projected that it would be processing 1 mln t of ore per annum extracting more than 4.5 kilo t of tin with further capacity increase by a factor of 1.5. It was planned to supply 20 % concentrate under tolling agreement to NOK JSC, which is presently recognized to be a bankrupt.

Changed market conditions returned relevance to the review and revaluation of the project for deposit ores mining and processing with account of different organizational and economic mechanisms of interaction between mining business in Kazakhstan and metallurgical plants in Russia or China, or independent production of marketable products. Based on analysis of the Russian practice of tin deposits exploration the following factors have been revealed. Firstly, high capital cost for establishing refining facilities near transportation corridors. Secondly, high share of energetic and transport factors in the cost structure (60 %) of tin concentrate production (without account of by-products) from ledge ores extracted by underground mining. That's why competitiveness at external markets can be achieved by reducing energetic and transport component in production costs, modernization, logistic optimization and control over increase of tariffs by natural monopolies.

Technical and economic estimate was produced with account of four options of Syrymbet field development:

- 1) production of low-grade concentrate with 10 % tin content, but with high extraction rate of 65 %, and its further metallurgical refinement to get high-quality tin;
- 2) production of commercial concentrate (with tin content over 40 %) and middlings (4-5 % of tin) with lower total extraction rate of 50-55 % and further metallurgical refinement to get high-quality tin;
- 3) production of commercial concentrate (with tin content over 40 %) and middlings (4-5 % of tin) with total extraction rate of 50-55 %, further metallurgical refinement of middlings to sublimates, selling of produced sublimates and commercial concentrates;
- 4) production of commercial concentrate (with tin content over 40 %) and middlings (4-5 % of tin) with total extraction rate of 50-55 %, and further selling of products to NOK.

Estimations were made for all options and project efficiency rates were arrived at: internal rate of return is 35.5 %, 27.2 %, 29.5 %, 31.9 %; discounted payback period is 4.84 years, 6.26 years, 6.73 years and 5.29 years respectively. Based on comparison of indicators for all options of production process for treating the ores from Syrymbet field a conclusion can be made that the most efficient options are the first and the forth.

4. Organizational and economic framework for strategic mining project implementation with account of cross-border cooperation. The conducted analysis revealed that the Russian conditions of tin mining projects implementation are not favorable [1], which creates competitive advantages for tin industry establishment in Kazakhstan.

The Russian experience shows that the tin industry will not be able to become price-competitive at the global market without system support from the government and reduction of production costs. Reduction in product cost is possible by transferring some infrastructural costs to the government and optimization of tariff and tax regulation. That's why in Russian realities implementation of large-scale strategic projects in tin industry is not possible unless the areas and nature of state support get changed. First steps were made to boost the industry rehabilitation and development, as well as to implement new projects: from 2011 the Mineral Extraction Tax rate was brought to zero for the tin ore deposits in the Far East; customs duties for the import of equipment having no analogues in Russia were abolished; from 2012 a special import duty rate is applied to refined unprocessed tin, tin alloys and tin scrap equal to 0.2 euro per kg of net weight [1].

As compared to the Russian conditions tin industry in Kazakhstan has significant competitive advantages: good geographical location of mining facilities, possibility to implement modern mining and processing technologies, a possibility to choose such an organization and economic framework, that would ensure maximum efficiency of an industry as a whole.

That's why it was decided to implement a project for Syrymbet tin field development within the frames of a State Program for Accelerated Industrial and Innovative Development of the Republic of Kazakhstan in 2010-2014. Implementation of this project will allow to create a non-ferrous metallurgy sector brand new for the country. State support may help to create export-oriented production clusters in conjunction with the most capital-intensive stage of a process chain, development of 'higher' processing stages with account of forecasts for changes in the market needs. In order to ensure sustainable development of the industry a state may purchase ready metal at fixed prices for some period of time, and also facilitate stable cross-border supplies of tin-containing products to Asian and European markets [1].



In the opinion of industry experts [1] investors are interested in combining geologic survey, mining, processing and refining units in one chain. High competition requires that the companies interested in strengthening their positions in the metal market include in their structures elements of the entire production and distribution chain, as the synergy including transportation costs cutting, guaranteed supply of required feedstock, lower margin at all stages of cyclic metal market will give them an advantage over many other market participants. Production of affined tin is a capital-intensive process with the share of the product cost in the final product cost structure being over 90 %. Meanwhile design of the value chain shall be based on comparison of effects of autonomous full-cycle production in the Republic of Kazakhstan and effects associated with the division of labor, cooperation and market power of the producer when producing and selling the semi-products. So tin industry in Kazakhstan can be established based on one of the following organizational frameworks.

Firstly, establishment of a vertically integrated holding on the basis of the Syrymbet field and production of metallurgical products. This option has high technological and marketing risks, as this is the first time when such production is organized in the republic.

Secondly, harsh or mild integration (for instance, strategic partnership) assuming inclusion of the final production stage (production of tin solders) in the NOK production cycle. Close proximity of the Chinese market is a significant competitive advantage. The plant's tin concentrate production capacity is around 11 K t per annum, but this output is not reached due to the lack of feedstock, purchased abroad under the terms of 100 % prepayment*. The plant may operate at full capacity using the concentrates produced at Syrymbet JSC.

The third option is concentrate processing at NOK under the tolling agreement. This option becomes possible due to high market power of tin concentrate producers, who can dictate their terms of payment, contractual deadlines and requirements to financial solvency.

Possible option is a strategic alliance with the Russian consumers while expanding the solder, babbits and solder wire production in Novosibirsk region on the basis of the former tin plant with due regard of environmental issues.

If independent metal tin production is organized in Kazakhstan, the main Russian consumers shall be taken into account, which include the Magnitogorsk Metallurgical Plant (Chelyabinsk Region); Zavolzhye Engine Plant (Nizhny Novgorod Region); Saratovsteklo JSC (Saratov); Buzuluk Mechanical Plant and Buguruslan Plant Radiator (Orenburg region); Ulyanovsk Automobile Plant (Ulyanovsk); Gorky Automobile Plant (Nizhny Novgorod); Shadrinsk Auto Aggregate Plant (Kurgan Region). It's worth mentioning that the major Russian tin consumers are located in the regions either bordering with Kazakhstan or having good transport links and low transportation costs.

The goal of Syrymbet JSC is to create the first in the Central Asia metallurgical production of tin using the most efficient technology and complying with the best environmental standards**. According to the company plans the project milestones and deadlines include development of pre-bank technical and economic estimate – September 2013 through June 2015; bank technical and economic estimate – July 2015 through March 2016; detailed design/construction – April 2016 through November 2017, plant commissioning – December 2017. Equipment for the plant will be purchased in Russia, Kazakhstan and abroad.

It is expected that the ore mining and processing complex will affect the environment due to construction of surface facilities and beneficiation plant, waste rock dumps and tailing dam, use of water resources, traffic and product transportation. The assessment of environmental impact and environment protection activities of the management are presented in the research 'Assessment of Environmental Impact'. When carrying out exploration works the Company pays all required environmental charges, insures environmental risks and places the most stringent requirements to its contractors as concerns compliance with environmental safety of the works performed.

Syrymbet JSC is making its contribution to the social development of the region by funding social programs jointly with the local administration, training new staff and enhancing qualification of existing specialists, and is supporting the local providers of goods, works and services through implementation of a corporate sustainable development program.

* Annual reports for 2009-2010 of Novosibirsk Tin Plant JSC (NOK) [Digital source]. URL: <http://www.nok.ru>

** Ore Mining Company Syrymbet JSC. Official website. [Digital source]. URL: <http://www.syrymbet.kz>



Conclusions

1. There is stable demand at the global market of tin due to the stability of need in the metall. With account of macroeconomic forecasts and higher attention to the environmental safety issues, it is forecasted that demand for tin will grow due to dramatic changes in the structure of consumption.

2. Investment appeal of creating tin production industry is related to the growth of Asian economies, global supply deficit, development of innovative and high-tech sectors of industry, trend for tin prices growth, availability of mineral resources base, possibilities offered by a properly designed value chain.

3. Explored tin ore deposits will become a basis for creating a new for Kazakhstan tin industry. After comparison of several options for development of a unique Syrymbet field conclusions were made on higher efficiency of an option assuming production of low-grade concentrate with 10 % tin content, high extraction rate of 65 %, and its further metallurgical refinement to get high-quality tin; and of an option assuming production of commercial concentrate (with tin content over 40 %) and middlings with total extraction rate of 50-55 %, and further selling of products to NOK.

4. The tin industry in Kazakhstan has significant competitive advantages: good geographical location of mining facilities, possibility to implement modern mining and processing technologies, a possibility to choose such an organization and economic framework that would ensure maximum efficiency of an industry as a whole.

5. Synergy effects during establishment of tin industry in Kazakhstan can be gained by harsh or mild integration (for instance, strategic partnership) assuming inclusion of the final production stage (production of tin solders) in the NOK production cycle.

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