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Economic, environmental and social impacts of the Kashagan oilfield development

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ABSTRACT OF THESIS submitted by:

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The Republic of Kazakhstan is characterized as a country, which focuses on the extraction of natural resources, especially fossil fuels. Kazakhstan takes 12th place in terms of total deposits of oil in the global list of countries, which possess oil resources. The petroleum industry of Kazakhstan is rapidly developing and the new oilfield Kashagan is an example of the fact that Kazakhstan strengthens development of this sphere through the investigation new oilfields. The Kashagan oilfield was the biggest oilfield, which was discovered for the last forty years. The oilfield refers to the group of giant oilfields with recoverable reserves of 13 billion barrels of crude oil. Because of the difficulties in management, Kazakhstan has attracted international companies in order to create consortium of international companies with one main operating company North Caspian Operating Company (NCOC).

It is important to mention that Kashagan is the first offshore oilfield in Kazakhstan. It is situated in the northern part of the Caspian Sea, which has severe climatic characteristics and fragile ecosystem with considerable population of sturgeon and such representative of rare fauna as Caspian seal. In addition, the region of the Kashagan oilfield exploration has already problems with environment such as air and water contamination because of other onshore oilfields. The scientific interest of this work is to compare and make conclusion regarding economic, environmental and social impacts. The comparison of impacts is done through converting all impacts into financial flows in order to draw a parallel between the amount of money, which will be spent on environmental, social issues and economic revenue from the project.

The case study of Kashagan oilfield will disclose the evaluation of environmental, social and economic consequences through STELLA software, which is the tool of the system thinking for education and research. This program makes possible to conduct modelling of impacts while taking into consideration social, environmental and economic impacts, which are expressed in monetary flows (USD$). In addition, the conceptual model of impacts was also important due to the fact that the issue of the Kashagan oil field development was keenly discussed in Kazakhstan, but there were no attempts to represent the consequences in system thinking conceptual model and to evaluate potential financial flows of the Kashagan oilfield project throughout a particular period of time.

Keywords: Oil industry, Kashagan, sustainable development, sustainability assessment modelling, STELLA modelling.

Contents

1. Introduction

One of the associations regarding the Republic of Kazakhstan is the commitment of the country to oil and gas industry. The history of Kazakhstan's oil industry begins at the end of the 18th century. During the period of the Soviet Union, more attention was paid to oil and gas reserves' geological investigation. After obtaining independence, Kazakhstan met with managerial difficulties in this sphere. However, the current president of the Republic of Kazakhstan, Mr. Nazarbayev, identifies as a priority to develop oil and gas industry and to reach the goal of getting into the list of the most developed countries with a stable economic situation. After twenty-three years of independence, Kazakhstan has become a competent member of international organizations like the United Nations, OECD and the Shanghai Organization Cooperation, which proves that in a short period of time, the country has achieved international recognition. The country's current oil and gas industry is one of the predominant spheres with one major national company and international companies that are operating on the territory of Kazakhstan.

The fact that at present renewables are supposed to be mainstream and humanity has begun the new Decade of Sustainable Energy for All (SE4ALL) with the promotion of clean, accessible energy source (Ren21 2010). The Republic of Kazakhstan has also implemented national strategies such as the 'Framework of the Republic of Kazakhstan transition to a "green economy" ' and the 'Strategy of Sustainable Energy Future of Kazakhstan until 2050' with the aim to reach more than 33 percent of renewable energy production in total share by 2030 (Ministry of Energy of Kazakhstan 2013). In contrast, there is a list of documents (The State Program on Forced Industrial-Innovative Development of Kazakhstan for 2015–2019 and Oil and gas sector development Program in the Republic of Kazakhstan until 2020) that emphasize the intensification of oil production by 125% from the level of 2009 (Ministry of Energy of Kazakhstan 2014). Thus, these facts shows that Kazakhstan gives priority to further reinforcing the oil and gas industry rather than facilitating the development of more sustainable types of fuel.

Within the established frameworks of state programs, a major role is given to the development of the Kashagan oilfield, which is an offshore field in the northern part of the Caspian Sea. The Kashagan oilfield refers to the group of unique supergiant oilfields. Such countries like Iraq, Saudi Arabia, Kuwait, China, Mexico and Kazakhstan have that kind of

oilfield. The total deposits of the Kashagan oilfield are estimated in 4.8 billion tonnes of oil. The Kashagan oilfield is a large-scale project, which involves not only Kazakhstan's government, but also major international oil corporations such as Eni (Italy), Royal Dutch Shell (UK/Netherlands), ExxonMobile (USA), Total (France),SNPC (China), Inpex (Japan).

As the Kashagan project is a modern day project, the company-operator of Kashagan strives to operate as sustainable as possible, which means that the project will contribute to the region of operating. That is why there is an academic interest in conducting the analysis of potential economic, social and environmental impacts on the region of oil extraction, which is Atyrau oblast (region) of Kazakhstan.

The involvement of international companies shows that the development of Kashagan seems reasonable and, as a result, this oilfield brings benefits to all stakeholders. Another point is that the involvement of such experienced companies will guarantee the compliance of requirements regarding social responsibility and environmental awareness. Due to the severe climatic characteristics such as long winter with an ice-covered period, the oilfield represents a unique combination of environmental challenges. However, despite this dubious fact, the group of international companies takes a decision to carry out the exploration of the Kashagan oilfield within the framework of the country's industrial development. It is worth mentioning that the Kashagan oilfield will bring beneficial consequences in the Atyrau region's economic and social spheres. However, due to the fact that Atyrau region is the main oil and gas oriented region of Kazakhstan, people from Atyrau region suffers from existing pollution from current oil and gas production. Moreover, from a geographic standpoint, the region of extraction has a difficult situation in terms of environmental conditions such as severe climatic characteristics and problems with water quality. In addition, the Caspian region is a unique land closed sea, which is the home for many rare species including Caspian seal *(lat.Phoca caspica)* and Beluga sturgeon *(lat. Huso huso).* That is why the rapid development of oil industry in the Caspian region can damage the fragile ecosystem.

The possible consequences of the Kashagan oilfield development on the social sphere of Atyrau region will facilitate the development of other spheres, for instance food industry. Therefore, the introduction of a new oilfield which is estimated as one of the greatest oilfield explored for the last forty years will cause a substantial change within the country. In order to assess the possible environmental, social and economic consequences of the Kashagan oilfield

development, all facts should be taken into account. For instance, the severe climatic conditions of the region will cause difficulties in oil extraction and thus will have potential risk on the environment. Because of the complexity of the oilfield, it is important to conduct the analysis of potential impacts and risks of the Kashagan oilfield development. The identification of the extent of economic, environmental and social impacts is needed in order to make forecast of future development of the oilfield and its contribution to the Atyrau region.

The result is presented in conceptual model of economic, social and environmental impacts and in basic numeric model with the help of system thinking STELLA software, which will describe the amount of money spent on economic, environmental and social impacts during the period of forty years. In case of Kashagan oilfield, the individual set of indicators divided into categories will be used. The sources of data will include official documents and brochures of the North Caspian Operating Company, which is the company-operator of Kashagan oil field. Besides this, all information that was published online will also be taken into consideration.

Conducted analysis will show the contribution of the Kashagan oilfield to economic, environmental and social spheres of the extraction region, which is important due to the current mainstream of achieving sustainable development in the sphere of oil and gas.

Project aims and objectives

The aim of the project is to assess the contribution of Kashagan oilfield's development to economic, environmental and social spheres of the Atyrau region, which is the closest administrative area to the oilfield.

Through developing the conceptual model of impacts the following research question will be answered: What potential economic, environmental and social impacts of Kashagan's oilfield development will be for the region of extraction? In order to achieve the aim the following objectives will be fulfilled:

- To collect data concerning Kashagan oilfield development
- To identify different approaches of evaluation environmental, economic and social consequences of oilfield development
- To construct the conceptual model of Kashagan oilfield development's impacts
- To create the basic numeric model of Kashagan oilfield development for period of forty years
- To develop different scenarios based on price and extraction rate

- To analyze and to make a conclusion concerning future economic, environmental and social impacts of Kashagan oilfield development through the developed model

2. Background information

This chapter discloses the general information about the petroleum industry of Kazakhstan, economic, environmental and social situation about the region of extraction and the main characteristics of the Kashagan oilfield. Providing this information is important in order to become familiar with the current situation.

2.1. History of oil and gas industry in Kazakhstan

The first oilfield on the territory of Kazakhstan was explored in 1899. This year began the epoch of petroleum industry. After the collapse of the Soviet Union in 1991, Kazakhstan actively began the policy of attraction investment in oil and gas industry. The result of this policy was that the total capital, which was attracted in Kazakhstan, was estimated in more than forty billion of USD, which is the same amount of the Kashagan oilfield development costs.

During the period of Kazakhstan's independence the oil and gas industry was prosper and leading sphere of national economy (Kazakhstan:OIl & Gas Report 2014) .The period of oilfields' exploration is continuing and the number of oilfields is expanding. It is important to mention that the main role in oil and gas industry development belongs to several oil and gas oriented companies which currently develop 86% of Kazakhstani oil. These companies are: Tengizshevroil, MangistauMunaigaz, KazMunaiGaz, Karacahaganak Petroleum Operating B.V. KazMunaiGaz is the only national company which does not have any international investors (Klimenko 2005).

2.2. Production of oil in Kazakhstan

Kazakhstan possesses the largest proven oil reserves on the territory of the Caspian region. 30% of the country's GDP is accounted by the rapidly developing petroleum industry (Jumadilova 2012). Kazakhsan also benefits from oil export. The total number of reserves in 2014 was estimated 31.1 billion barrels of oil and which are situated in 169 oilfields on the territory of Kazakhstan (Kazakhstan:OIl & Gas Report 2014).The oil deposits are localized predominantly in western part of the country. Kazakhstan has the second place in turns of oil deposits on the territory of post-soviet union countries. The biggest onshore oilfields are Tengiz, Karachaganak, Uzen, Zhanazhol and Kumkol groups of oilfields. To 2024 the forecast is to reach 32.4 billion barrels of oil (Kazakhstan Oil & Gas Report 2011).The Caspian offshore has the maximum potential because of the huge oilfield of Kashagan, which is situated in the northern zone of the Caspian Sea. From the period of international companies' participation in

Kazakhstan's oil and gas sector, the realization of oil became technically and financially feasible. According to the Global Trade Information, the export of light, sweet and crude oil is approximately 1.4 million bbl/d (U.S. Energy Information Administration 2014). According to Oil and Gas Outlook's long-term forecast in 2020 exports will compound 1 931 000 b/d (Figure 1)Kazakhstan's exports of oil exceed Azerbaijan but stand behind Russia.

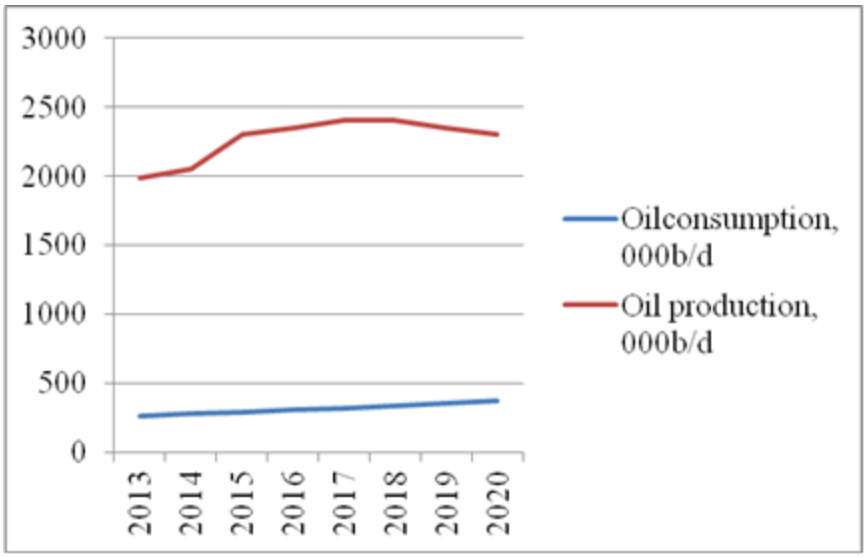


Figure 1.Oil consumption and production from 2013 to 2020

The routes of exports include the route through the Caspian Sea to European markets and via pipeline to China. The future of Kazakhstan oil industry will depend on the development of three major oil and gas fields: Tengiz, Karachaganak and Kashagan, because of the huge deposits of oil and gas. Table 1 discloses the main characteristics of oilfields. Kazakhstan's two largest projects, Tengiz and Karachaganak, accounted for 48% of the country's production in the first nine months of 2014, according to data published by Energy Intelligence (Energy Intelligence 2014). A third large project, Kashagan, is due to start production in 2016 or 2017, with the combined output of all three projects likely to account for more than half of Kazakhstan's total production going forward. Table 1 shows the main characteristics of Kazakhstan's major oilfields with mentioning name, participating companies and the year of beginning and the amount of oil production.

It is undoubtedly true that strategic reserves of oil are still increasing in Kazakhstan and this will cause further development of petroleum industry and will take the main tendency of growth.

Table 1. The main characteristics of Kazakhstan's major oilfields

Source (U.S. Energy Information Administration 2014)

Name of oil field	Participating companies	Start year	Oil production
Tengiz(&Korolev)	Chevron, ExxonMobil,KazMunaiGaz, LukArco(Lukoil and BP)	1991	581 thousand bbl/d is a total liquids production in 2013 Over 800 thousand bbl/d is a is a potential total liquids production with further development
Karachaganak	BG, ENI, Chevron,Lukoil, KazMunaiGaz	1984	222 thousand bbl/d is a total liquids production in 2013. Potential production volumes are under consideration
Kashagan	KazMunaiGas, Eni, ExxonMobil, Shell, Total, CNPC,Inpex	2016/2017 (expected)	370 thousand bbl/d is liquids processing capacity with current development of 1.500 thousand bbl/d potential pproduction

3. Literature review

This chapter consists of two parts. The first part gives the brief characteristic of the Kashagan oilfield's main properties and gives general information regarding social and environmental situation in Atyrau region. The second part deals with a description of different techniques of the economic, environmental and social impacts' evaluation in the oil and gas industry.

3.1. Case study of oil exploration in Atyrau region, Kazakhstan

The oil and gas industry is recognized as the dominate sphere of economic and political development of the Republic of the Kazakhstan. According to actual Minister of Oil and Gas, Mr. Karabalin, this sphere is responsible for twenty-five percent of GDP and two third of national budget (Policy and society 2015). For the period of twenty-three years of Kazakhstan's independence oil and gas industry has become the main contributor to social and economic reforms in Kazakhstan.

The realization of Kashagan's oil will have immediate effect on the territory, which is close to the northern part of the Caspian Sea. This region is Atyrau oblast, which is one of the fourteen administrative regions of Kazakhstan. Atyrau region is geographically located in the western part of the country. The administrative city is Atyrau with a population of 180 000 people. The economy in the region directly depends on industrial output. For example, the oil and gas industry (mining and mine workings) as a dominate sphere accounts for 91.9 percent of total economic output in Atyrau region (Figure 2). Atyrau region is also the main contributor to the country's GDP, because of the financial input from the oil and gas industry (Committee on Statistics 2014a). The main contribution to GRP comes from large-scale industry. Huge enterprises employ a large number of people. The contribution from small and medium-sized businesses is small. According to Atyrau region Development Program for 2011-2015, the main goals of future development are the following (Development Programm 2010):

- Increase in productivity in the manufacturing industry by not less than 1.5 times;
- Increase the level of domestic construction materials – 80%;
- Decrease of GRP energy intensity by not less than 10%;
- Increased health services within primary health care (PHC)
- Decrease of unemployment rate to 5.5%;

- Increase of the proportion of population using imported water to 11.9% (because of bad quality of drinkable water);
- Increase the share of alternative energy sources in total energy consumption by 2015 to more than 1.45%.

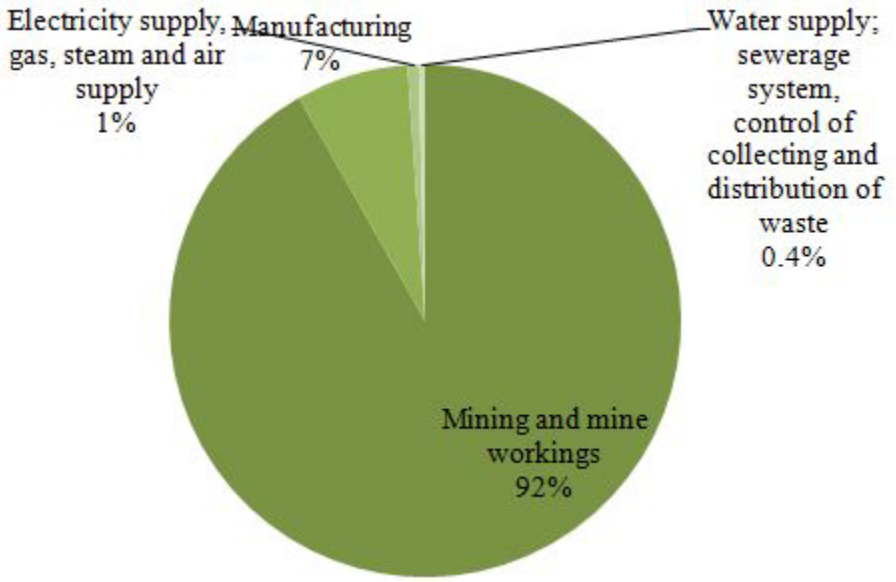


Figure 2. Production of goods and services in Atyrau region

Source: (Committee on Statistics 2014a)

There is no doubt that the development of Kashagan oilfield will cause changes in the economic, environmental and social situation in the region of extraction. Atyrau region has already experience of international companies' activities on its territory. That is why the expectations of stakeholders will take into account different aspects.

Table 2 discloses the main expectations of different stakeholders such as republican authorities (ministries of national economy, ministry of oil and gas, ministry of energy of the Republic of Kazakhstan), regional authorities, which include administrative centers of Atyrau region, local communities and Non-Governmental organizations of Atyrau region concerning the development of Kashagan oilfield. These expectations have economic, social and environmental orientation. The role of environmental performance consists of the actions that will be related to biodiversity conservation, solving the problem of abandoned wells and others. Expectations concerning social aspect include the creation of new work places and the conducting the projects of road reconstruction. Economic expectations imply the stability of economic situation in Atyrau region and in the whole country.

Table 2. The expectations of stakeholders regarding Kashagan project

Source: (Official web resource of Atyrau region)

Stakeholder	Main expectations
Republican authorities Relevant ministries	Compliance with legal requirements
	Socio-economic stability
	Providing local employment (nationalization of the personnel)
	Promotion of economic diversification in regions and Kazakhstan
	Support in solving social problems of the regions
Regional authorities (akimats)	Creation of new workplaces
	Mutual planning and cooperation regarding issues of further employment for released staff
	Implementation of educational projects (English language courses)
	Cooperation in training courses for doctors and teachers
Local Communities	Provision of local employment opportunities, including creation of new workplaces
	Assistance in public infrastructure development (roads)
	Engagement with local communities on the Project ‘s future development plans
	Involvement in decision-making process at the Company’s level
	Preservation of traditional economic activities (fishing)
	Raising public awareness about issues of the Company’s liability insurance in case of environmental damage to the flora and fauna of the Caspian Sea
	Ensuring safety of industrial operations (control and reduction of industrial emissions from the plant / air pollution)
	Ensuring safety of sulfur storage and transportation
Non-Governmental Organizations	Participation in Reputation Survey
	Participation in public hearings, including hearings on annual environmental action plans and new projects
	Ensuring safety of marine operations (presentation of the strategy on oil spill prevention and response)
	Information sharing on issues of the Company’s liability insurance in the case of environmental damage to the flora and fauna of the Caspian Sea

Thus, Atyrau region as a main region will undergo changes in economic, social and environmental sphere. However, the Kashagan oilfield development is the greatest expectation of different stakeholders from global to local levels. It is expected that the Project of Kashagan oilfield development will facilitate Kazakhstan becoming the largest energy player around the world, as the global energy market will receive a huge amount of oil. Moreover, the Kashagan field will stimulate offshore development of other sectors in Kazakhstan's territory of Caspian Sea that were considered to have a high potential capacity. Kashagan will play a key role in increasing national reserves, production and export of Kazakh hydrocarbon products.

3.1.1. The environmental situation of Atyrau region

The region of exploration is traditionally one of the most environmentally unfriendly regions, due to the long-term contamination from oil and gas industrial plants, which operate there (Dzhakupova 2014). The presence of oil and gas operating companies has led to the deterioration of air, water and soils.

The specific problems of Atyrau region include radioactive soil contamination around the nuclear test site, which is situated there. The region has extensive areas of oil spillages and as a result the formation of oil-contaminated soils. The long history of the petroleum industry in Atyrau region is also the reason for the high level of air pollution (Akhmetov 2006). In addition, there is a problem of abandoned oil wells, some of which are underwater or in a flood zone (Kuterbekov 2012). The government is going to solve this problem, but there is no relevant information of the chosen method. The danger of abandoned oil wells exists because of the leaking of significant quantities of greenhouse gas methane. Emissions from these oil wells are not under control, which means that the environmental conditions become poor each year. The list of general environmental issues regarding Atyrau region includes the problem of the access to drinking water, emission from various gaseous and solid waste products from processing and production plants, and the storage of wastes from oil and gas industry (Askarova and Mussagaliyeva 2014). According to the news articles, the problem of mass murrain has occurred several times and the reason is still unclear. Local people complain that they lose sheep, camels, horses and even dogs due to the bad environmental situation.

Figure 3 provides the data of pollution from stationary sources in Atyrau region for the period from 2004 till 2013. It is clear that the tendency of air pollution is upstream. The peak

of pollution was in 2013 with the amount of almost 140 000 tons of pollutants. Atyrau region has also high emissions of solid and gaseous pollutants in the air (Committee on Statistics 2014b). Air pollution from oil fields in Atyrau city causes 5 million USD$ loss per year. Despite this fact, the real annual abatement costs devoted to air pollution reduction are about 0.46 million USD$ (Netalieva, Wesseler et al. 2005).The Kashagan oilfield will increase the loading upon environment including enhancing negative emissions in the atmosphere.

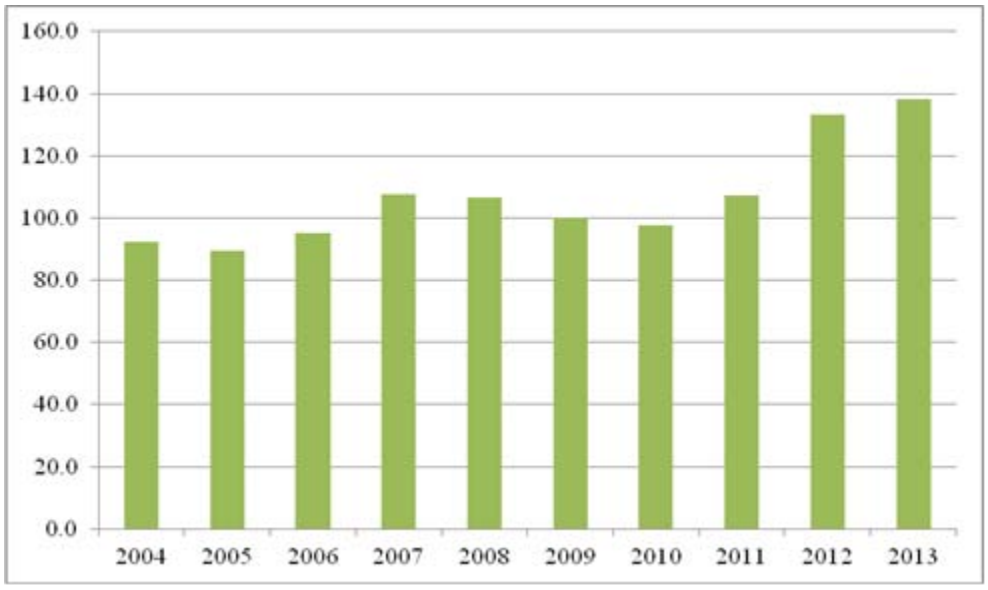


Figure 3. Air pollution in Atyrau region from 2004 till 2013, thousands of tons

Source: (Committee on Statistics 2014b)

3.1.2. The social situation of Atyrau region

The population in Atyrau region has a tendency of growth and the annual increase is about 10 000 people. The population of the rural area is increasing while the population of urban area is decreasing. One of possible reason is that people strive to leave city due to unpleasant environmental conditions.

Atyrau region has the first place in terms of the nominal income of population per capita. This indicator is higher than the average figure in the Republic of Kazakhstan by 1.8-2.1 times. Atyrau region has approximately the same figures with the capital of the country Astana city and the biggest populated city of Kazakhstan Almaty. The nominal income indicator in Atyrau region is higher than the minimal living wage in 7.1 times (Committee on Statistics 2014a). The minimal living wage in Kazakhstan is 115 USD$.

The situation with the unemployment rate has improved from 2003 till 2012 due to the creation of new workplaces for local people. In 2012 the unemployment rate was 5.7 (Figure 4).

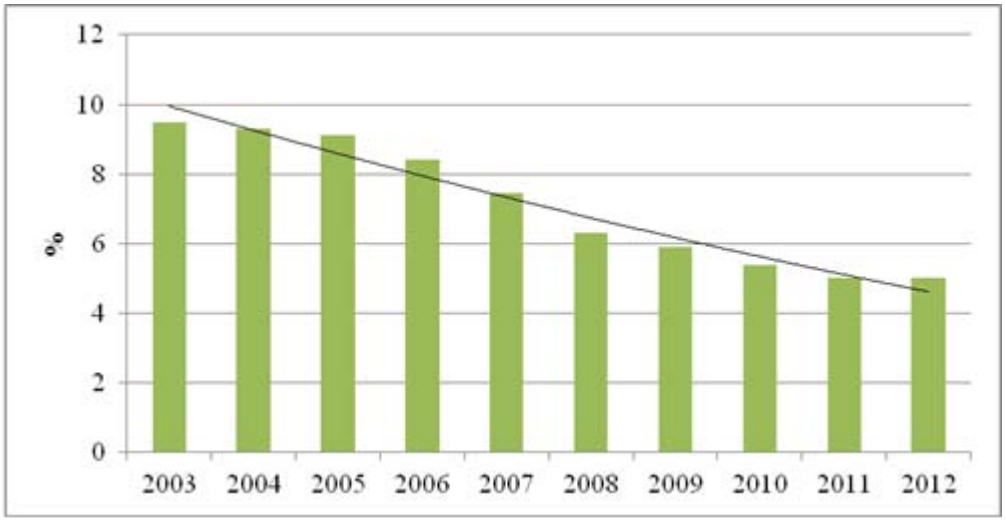


Figure 4. Unemployment rate in Atyrau region from 2004 till 2012

Source: (Committee on Statistics 2014a)

It is important to mention that according to the data of the Agency of Statistics, the share of investments in health care and social services is relatively small and has a tendency of going down in Atyrau region (Committee on Statistics 2014a). The share of investments from state and private sources has not exceeded 1 % for the period of four years from 2008 till 2012 (Figure 5). The share of investment in education is lower than the national average investment share in Atyrau region.

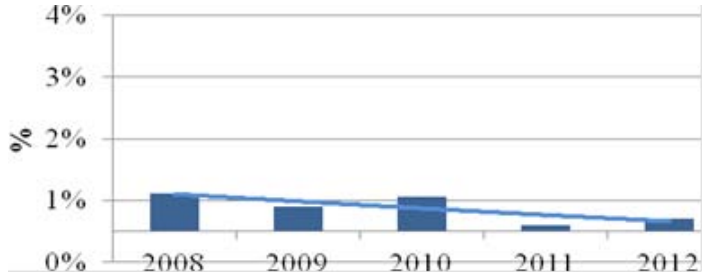


Figure 5. The share of investments from state and private sources in Atyrau region

Source: (Committee on Statistics 2014a)

The summary of Atyrau region's environmental and social situation is presented below:

- Atyrau region depends significantly on the income from oil and gas industry. A huge contribution to economic and social spheres of the region is made by private operating companies;

- The environmental situation in Atyrau region is characterised with the long-time contamination of different natural components such as air and soils by wastes and emissions from the oil and gas industry. The existing issue of abandoned oil wells is a pressing problem in this region;
- According to the data of the Agency of Statistics, there is a high increasing proportion of the rural population in the Atyrau region;
- The share of investment in healthcare and education is low in Atyrau region.

On the other hand, the following facts and trends can be classified as the positive sides of the situation in the Company's region of operations:

- The unemployment rate is relatively low and constantly declining u in Atyrau region from 2010 to 2012;
- Atyrau region is a leader in terms of average cash income per capita in the Republic of Kazakhstan. However, this region is not pleasant in terms of environmental situation.

3.2. The main characteristics of the Kashagan oilfield

The project of the development Kashagan oilfield is one of the most complex projects in the world. The oilfield is located in the northern offshore part of the Caspian Sea 80 km from Atyrau city (Figure 6). Besides, the Kashagan oilfield, there are Kalamkas More, Aktote, Kairan and Kashagan SouthWest offshore oilfields, which are parts of the Kashagan project (Wood Mackenzie 2015).Kashagan was discovered in June 2000 by the first exploration well (Kashagan East-1). Kashagan West extension was confirmed in 2001 with the consortium's second well (Kashagan West-1). Kalamkas More was discovered in 2002, again with the first well drilled on the structure. Aktote and Kashagan Southwest were both discovered in 2003 and Kairan in 2004.

The oil of Kashagan oilfield is heavy crude with relatively medium sulfur content, but high content of paraffins, H_2S and CO_2. For instance, Arab Light crude oil has gravity (API) 32.8 and 1.97 % of sulfur content (Table 3) (Wood Mackenzie 2015). Thus, the quality of Kashagan's oil can be described as medium.

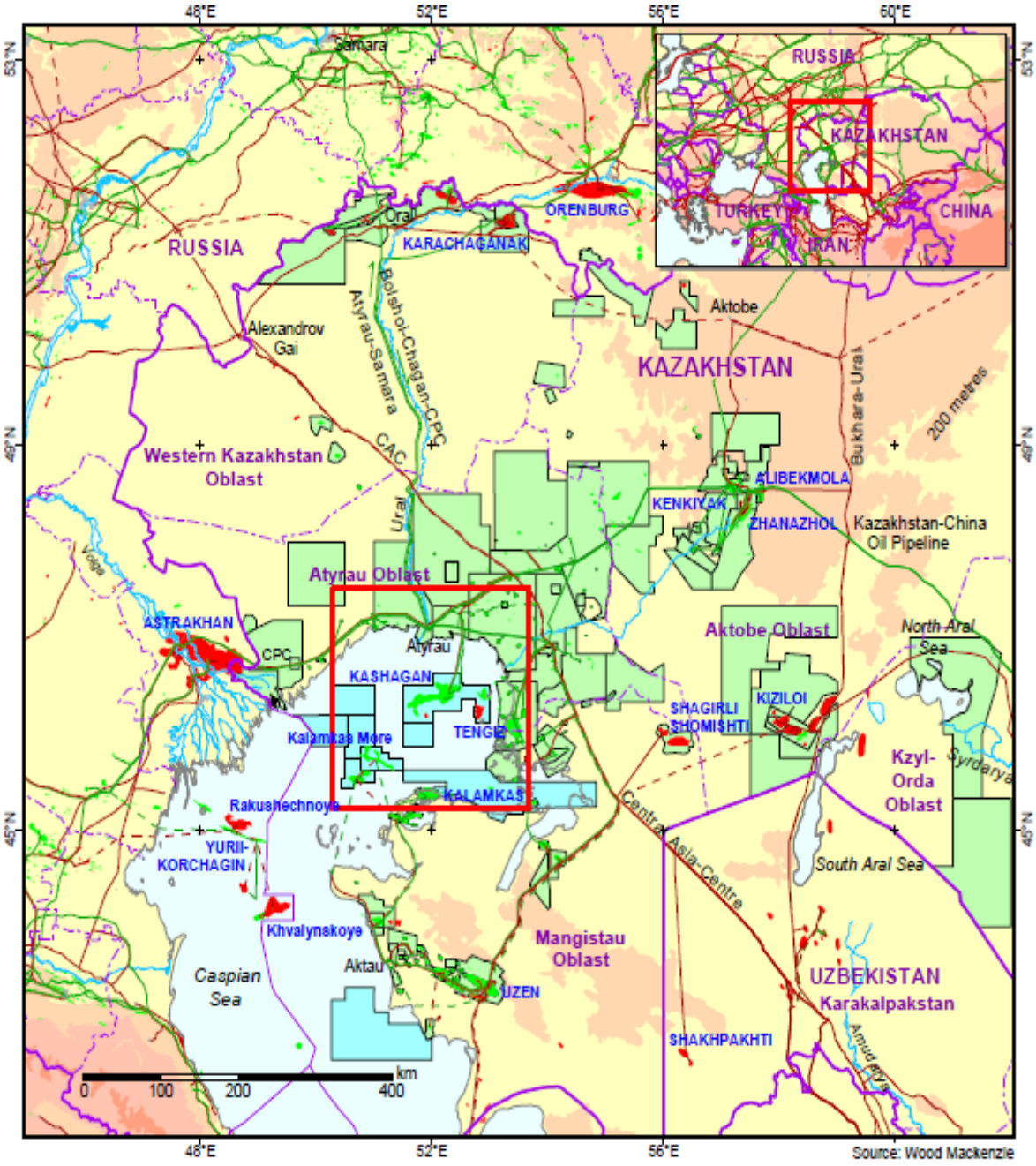


Figure 6.The location of Kashagan

Source: (Wood Mackenzie 2015)

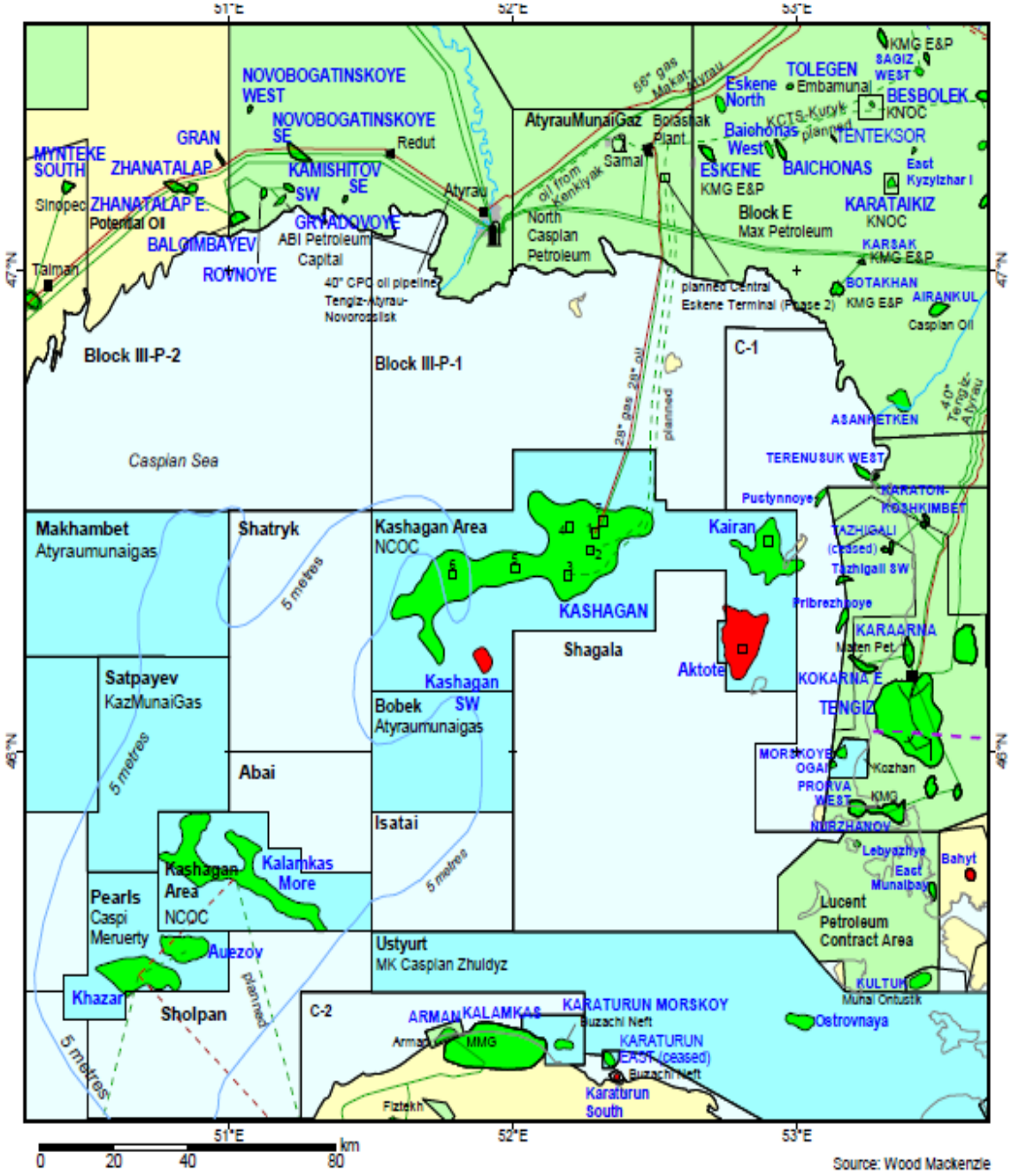


Figure 7. The location of Kalamkas More, Aktote, Kairan, Kashagan SouthWest oilfields

Source: (Wood Mackenzie 2015)

Table 3. The main characteristics of the Kashagan oilfield

Source: (Wood Mackenzie 2015)

Hydrocarbon Quality		**Main characteristics**	
Gravity (°API)	45	**Sector, Basin**	Offshore, Precaspian
Sulphur (%)	0.5 - 0.7	**Total area**	5.643 km^2
Paraffins(%)	5	**Water depth**	1-10 m
GOR(scf/bbl)	2,850	**Recoverable reserves (oil)**	5.787 mmbbl
H_2S (ppm)	150,000	**Recoverable reserves (gas)**	1.959 bcf
CO_2 (%)	4		

The contact area of the Kashagan project includes the super-giant Kashagan field and its four offshore oilfields. Due to the complexity of extraction, the timetable of exploration includes several phases(Wood Mackenzie 2015). The first phase began in 2013, after significant delays and cost overruns the first oil was achieved. This year was also marked with a serious environmental problem as gas leakage on the pipelines to shore. This incident resulted in full pipelines replacement and the production was stopped. The production of oil is supposed to start in 2016-2017. The peak of oil extraction is supposed to be in the 2030s (Wood Mackenzie 2014). Table 4 discloses the specific features of the project. The final expiry date of Kashagan oilfield project is December 2041.

Table 4. Specific features of the Kashagan project

Source: (Wood Mackenzie 2014)

Period	**Duration**	**Specific features**
Period 1 (2014 – 2019)	4-5 years	low capital expenditures start of production
Period 2 (2020 – 2030)	10 years	high capital expenditures start of the construction of infrastructure for new projects
Period 3 (2031 – 2041)	10 years	low capital expenditures

On 18 November 1997, the North Caspian Sea Production Sharing Agreement (NCSPSA) was signed, and in 1998 an international consortium - Offshore Kazakhstan International Operating Company (OKIOC) – was formed in order to produce hydrocarbons within the 5,600 square kilometers NCSPSA contract area (North Caspian Sea Production Sharing Agreement). It was decided that a single company should operate the development, and Eni was named Operator in 2001 and a new operating company “Agip KCO” was formed. In May 2005 KazMunayGas,

the only national company joined the Consortium. In order to facilitate effective management a new operating company was founded. On 22 January 2009, the new operating company, North Caspian Operating Company B.V. (NCOC), officially became Operator under NCSPSA, with taking previous responsibility of Agip KCO (NCOC Fact sheet undated).

The biggest percent in the project belongs to the national oil and gas company "KazMunayGas" (16.88%), Eni, Exxon Mobil, Royal Dutch Shell and Total have 16.8 % under the agreement. Chinese National Petroleum Company (CNPC) has 8.33 % and Japanese company "Inpex North Caspian Sea" holds 7.56 % of the project (Wood Mackenzie 2015). At present, the Kashagan project is the biggest ongoing in Kazakhstan, and the most technically challenging in the world.

According to the Factsheet of NCOC the positive aspects of the development are:

- Unlocking the Kashagan field will help to diversify global energy supply and security.
- Between 2005 and mid 2011 the Consortium spent close to US $7.5 billion on local goods and services.
- During peak periods of 2010 the Consortium employed around 35,000 Kazakh citizens (over 80% of those employed on the project in Kazakhstan are Kazakh citizens).
- Between 1998 and the end of 2010, more than 136 Social Infrastructure Projects (SIP) were completed in the Atyrau and Mangistau regions.
- In 2010, 84 Sponsorship and Donations (S&D) projects in the Mangistau and Atyrau regions, and one project to assist flood victims in Kyzylagash, received support.

As the Operator, the NCOC (North Caspian Sea Venture Values):

- Defines and steers the overall strategy of the NCSPSA venture;
- Ensures planning and coordination;
- Manages geological and conceptual studies;
- Engages with stakeholders, in particular government authorities.

However, due to the high degree of technical complexity and the biggest risk of negative impact upon the environment, the Kashagan project seems controversial and doubtful. That is why the Kashagan project requires detailed analysis of economic, environmental and social consequences.

3.3. Overview of economic, environmental and social impacts' assessment of oil and gas industry

This subsection discloses different techniques of economic, environmental and social impacts' assessment of oilfield development.

3.3.1. Environmental Impact Assessment in oil fields

The initial technique, which is mandatory before the beginning of any potentially damaging environment activities is environmental impact assessment (EIA). As Kashagan oilfield is located on the territory of the Republic of Kazakhstan, under the Kazakhstani regulations, the environmental impact assessment (EIA) is mandatory for oil and gas industry in accordance with the real Environmental Code of the Republic of Kazakhstan (Environmental Code 2007). The process of EIA is sponsored by the operating company. The group of people who conduct EIA is responsible for the authenticity and quality of the assessment. The control of environmental regulations' compliance is the main responsibility of environmental protection department's authorized representative.

Besides the evaluation of direct impacts, EIA must take into account side and cumulative effect, which can emerge some time later after the realization of project. According to the Environmental code of the Republic of Kazakhstan, environmental impact assessment should take into consideration the assessment of the following components (Environmental Code 2007):

- Atmospheric air, excluding greenhouse gas emissions;
- Ground and surface water;
- The surface of the reservoir's bottom
- Landscape
- Soils
- Plants
- Animals
- Ecosystems
- Human health
- Social sphere of local people (employment rate, education, transport)

Environmental impact assessment should also take into account both positive and negative consequences of future extraction activities upon the environment and public health. Before the realization of EIA the list of documents should be collected. This list should include

technical economic evaluation, the description of environmental conditions of the proposed extraction region, the description of the project with the main characteristics of emissions, wastes, information of alternative projects and the description of potential impacts upon environment and human health and socio-economic situation of the region and many other documents (Environmental Code 2007). The point is that the EIA of Kashagan oilfield is not available for people despite the ratification of Aarhus convention by Kazakhstan. The situation can be explained by the dubious decision in terms of environmental security of the oilfield.

According to international guidelines of EIA, there are several stages that should be accomplished in the framework of EIA. The first step is project registration, which include obtaining the permission before commencement of construction and operations. Project screening implies the confirmation of the need of assessment. Scoping phase is the phase of identifying environmental and social receptors. Identification of impacts takes into account the following aspects: physical footprint (physical presence, noise and light), routine discharges, non-routine discharges, air emissions, waste management, oil spill risk, socio-economic impacts, cumulative and trans boundary impacts (Tullow OIl 2012).

3.3.2. Sustainability Assessment Modelling (SAM)

The next technique is on the front burner due to the attempt to make a calculated assessment of the proposed activities. According to the official document of United Nations CTAD, 1996, transnational corporations should be invited to participate at the international level in assessing the practical implementation of moving towards internalization of environmental costs and co-operation in developing methodologies for the valuation of non-marketed natural resources. This implies that companies should pay attention not only to sustainability reporting, but also to evaluate sustainability performance or in other words what impacts their activities have on sustainable development (Baxter, Bebbington et al. 2002). As the Kashagan oilfield referred to the transnational companies' consortium, this issue is of great interest for the future development of the oilfield.

One of the possible mechanisms of evaluation is through sustainability assessment modelling (SAM). Sustainability Assessment Modelling is an accounting technique that takes into consideration social, environmental and financial impacts and resource uses for specific projects. The main idea of such type of modelling is converting all impacts into financial flows both positive and negative (Bebbington, Brown et al. 2007). SAM is a useful tool for evaluating

sustainability in different types of business. Initially the model was developed for the hydrocarbon oilfield of British Petroleum Company. Besides this, SAM could be used in forestry, oil and gas industry, bio fuel production. It has also been used in order to evaluate energy extraction from an existing landfill, a tree planting scheme and a salmon farm (Bebbington, Brown et al. 2007).

The general idea of the SAM is that it allows tracking impacts of a project over its full life cycle. The Sustainability assessment model consists of performance indicators in order to measure the full cost environmental, economic and social impacts. The indicators are combined in 4 categories (Bebbington and Gray 2001) :

- Economic
- Resource Usage
- Environmental
- Social

The approach of sustainability assessment model is that all indicators that are selected then monetized into a financial equivalent. The ultimate result of assessment could be the Sustainability Assessment Model Indicator SAMi, which reflects the percentage of sustainability of company.

The SAM Indicators

Economic indicators reflect the total income generate by the project. In the case of oil industry the number of barrels which the field will produce, multiplied by the relevant oil price.

The resource usage indicators compound natural consumable resources as well as intellectual capital and infrastructure. The figures for resource use are taken primarily from the open literature.

The environmental indicators could be pollution impacts (emissions from fossil fuel), nuisance impacts (visual impacts), footprint and biodiversity impacts and formation of wastes.

Social impacts have three categories. The first is positive social value arising from job creation. The negative one includes values from negative health and the safety impacts of jobs. The third group encompasses taxes generated by the project and other social benefits, such as investment in infrastructure of the region and education (Hamilton 1997).The final social

category requires an estimate of the external benefits arising from the use of the products. For a hydrocarbon development, three primary benefits are generated: mobility (via refined fuel), heating (which is either a direct result of combusting oil based products or comes via the use of oil and gas in power supply) and the oil and gas based products (which include the likes of pharmaceuticals, plastics and other chemicals) (Cavanagh, Frame et al. 2006).

As a result of assessment, a pattern of positive and negative impacts of the company will arise. It is obvious that the social and economic impacts will be positive. In contrast, environmental impact will be negative (Cavanagh, Frame et al. 2006) . The advantages of the SAM are that it will provide a clear graph of positive and negative externalities of the process and this can be turned to the index which will provide the percentage of sustainability. SAM is a relatively easy tool to assess sustainability and it will help to improve the situation with sustainability awareness among companies. Sustainability assessment model is not so strict in the case of using indicators, thus it makes possible to evaluate the company's performance through developing your own set of indicators based on availability of data (Cavanagh, Frame et al. 2006).

The possible problems arising from using the model can include a tendency to reduce non-economic value to dollar terms, which than may be trade-off an overemphasis on deriving values in dollar terms (Baxter, Bebbington et al. 2002).

3.3.3. Full Cost Accounting (FCA)

FCA is an approach based on prices and costs in the system which can reflect environmental and social externalities and show sustainability performance of that system. FCA reveals a great variety of methods and evaluation techniques, which can be applied by different subjects of evaluation (Bebbington, Gray et al. 2001) .

Costing externalities is the set of environmental impacts, expressed in physical terms which are deemed to arise from a set of activities (Bebbington, Gray et al. 2001). The challenge for FCA is to translate these physical quantities into monetary quantities.

In general, Full Cost Analysis (FCA) is a process with two definite characteristics. The first one is that externalities are identified as arising from a particular set of activities. Second is that the externalities can be measured in physical monetary terms. FCA process is four stages approach (US Environmental Protection Agency 1996).

- Stage 1. Identifying the cost objective.

- Stage 2. Definition of the scope or limitations of analysis (depends on the availability of data)
- Stage 3. Measure external impacts
- Stage 4. Cost external impact (monetization of the externalities, determination the full cost)

Such method focuses on 'real' or market-based prices and such approach is more 'straightforward and uncontroversial'

However, there is a difficulty to estimate the full cost of resource use. The rent could be estimated in a variety of ways (net price approach, present value approach or the user cost method) (CICA 1997). The important issue is that there is the possibility of mistake in a calculation of future costs.

The prices are governed by constraints and rules. This method includes the variety of mechanisms such as:

Environmental taxes can be set on fuel, carbon emissions and waste disposal

Environmental grants aim to encourage more appropriate options regarding reducing costs.

Environmental regulations can be a set of special standards for operating procedures in a certain area.

Environmental fines and penalties are strict measurements of not to break the structural rules which were set by government.

Environmental quotas are a system of restricting the volume of a resources' extraction. An example can be fishing quotas or a tradable pollution permits.

4. Methodology

This section discloses the methodological view of the research. The chapter also includes the possible limitations of the case study research. The described methods in literature review allow applying each method to a certain extent for the evaluation of Kashagan's consequences.

The procedure of environmental impact assessment defines the framework of environmental consequences. In the case of sustainability assessment modelling technique for the Kashagan oilfield, the individual set of indicators is used. The idea of transferring all the impacts from the development of oilfield into financial flows is credited. The sources of data will include official documents and brochures of North Caspian Operating Company, which is the company operator of the Kashagan oil field. In order to calculate potential damage of operating works the Ecological code of the Republic of Kazakhstan will be used. In addition, all information that was published online is also taken into consideration.

In order to make FCA applicable to Kashagan oilfield's consequences estimation, the approach of the law, market instruments and structural change is used. This approach is based on government actions in the sphere of moving towards achieving more sustainable prices and costs for the damage of environment.

Finally, the STELLA software is used for visualization of the processes' inter-linkages and for the fulfillment of forecast and future development's scenarios. The main limitation of the method to choose was a problem with data and appropriate software availability. Due to the availability of STELLA software, the choice was made to use it in order to combine different methods of evaluation and to represent the analysis of the Kashagan oilfield development's economic, social and environmental consequences.

The main idea of this chapter is to introduce the chosen method and to describe the mechanism of STELLA modelling software, which was used in order to calculate financial flows from economic, environmental and social impacts. The chapter also discloses limitations of the chosen method.

4.1. Research design

Research design is presented in Table 5 with identification of stages, research objectives and description of each stage.

Table 5. Research design

Stages	Research objectives	Description
The creation of conceptual model of economic, environmental and social impacts	1 To collect data concerning Kashagan oilfield development 2 To identify different approaches of evaluation environmental, economic and social consequences of oilfield development 3 To construct the conceptual model of Kashagan oilfield development's impacts	The analysis of economic, environmental and social impacts of the Kashagan oilfield development through deep research of official documents from the company operator.
The creation of basic numeric model	4 To create the basic numeric model of Kashagan oilfield development for the period of forty years in STELLA software	Basic numeric model was created with applying official accessible data regarding money spent on economic, environmental and social issues.
The development of different scenarios	5 To develop different scenarios based on price and extraction rate 6 To analyze and to make a conclusion concerning future economic, environmental and social impacts of Kashagan oilfield development through the developed model	The development of different scenarios based on the variations of the extraction of oil barrels rate (according to the phase of project) and oil price (Brent platform).

4.2. Data collection

Collection of data includes different sources such as information from news and internet sites. The information concerning economic, environmental and social impacts was provided by

the company-operator. The list of documents includes more than ten documents regarding economic, environmental and social aspects of the Kashagan oilfield's development.

4.3. Design of conceptual model of economic, environmental and social impacts in STELLA software

'Stella is a dynamic modelling system in which relational models are built by creating a pictorial diagram of a system and then assigning the appropriate values and functions to it' (Hirst 2000). In the case of the Kashagan oilfield's impacts analysis, this program was used in order to build conceptual model of economic, environmental and social impacts and to make the forecast of financial flows during a 40 years period.

4.3.1. STELLA software

'STELLA is the leading systems modelling tool for education and research, used at all educational levels to stimulate learning for subjects such as economics, physics, literature, calculus, chemistry, and public policy. STELLA models allow you to communicate how a system works – what goes into the system, how those inputs impact the system, and what the outcomes are'(Official web resource of STELLA software).

Stella is a well-known system dynamics modelling tool, which helps to combine conceptual diagrams and converts them into numeric computer models. Although it can be very useful, especially in participatory modelling, it lacks the power and flexibility of a programming language. This software allows making dynamic analysis of the process with different scenarios application. There is a great variety of examples with STELLA software (Naimi and Voinov 2012). The models, which were developed with STELLA reflected such ecological problems as eutrophication, water table variation and also reflect issues dealing with economic factors and management. The combination of economic and ecological characteristics can be presented as integrated modelling.

Ecological modelling is increasing in importance to facilitate the development of sustainable management planning of terrestrial ecosystems and integrating social and economic objectives (Larocque, Bhatti et al. 2015). However, few modelling software platforms integrate software components or applications to facilitate the interpretation of simulation results. STELLA is a good example of recent modelling platform, which provides a clear interpretation of the process with understandable the ability to show the forecast of this process.

The STELLA software uses its own set of tools. The information about tools, which has been applied in the model, is described below:

Table 6. The main modelling instruments of STELLA

Source: (Hirst 2000)

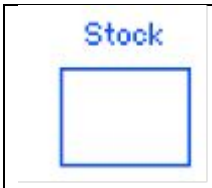
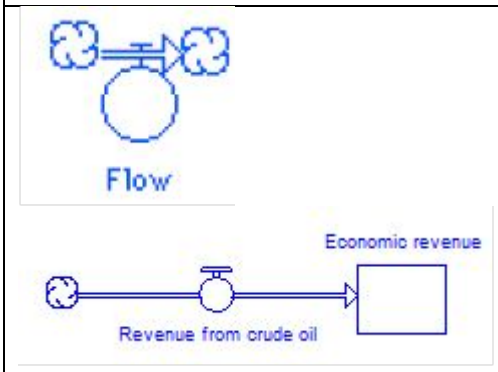
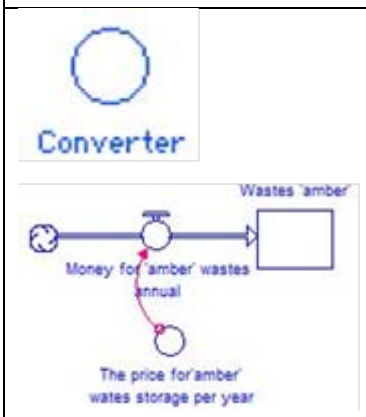
	This tool represents the Stock. In our case the stock is used for accumulation of money during the period of time spent on different issues concerning economic revenue, environmental and social costs.
	Flows specify the monetary movement during a period of time, for instance financial flow of money spent on waste storage or water treatment. A flow also shows that the amount of money is increasing each year in the Stock. The example is the stock, which reflects the economic revenue of the Kashagan project.
	Converter reflects the formula of calculation of the final amount of money. For instance, in order to calculate the charge for waste storage, the converter will show the price for waste storage per year in accordance to the Law of Kazakhstan and the accumulation of money will be each year. Action connector (red line) transmits the result to flow.

Figure 8 reflects the principle of oil price calculation. The converter of oil price growth rate (%) multiplied by the oil price and then multiplied by the amount of extracted oil barrels per year. As a result we receive the estimated crude oil price per year.

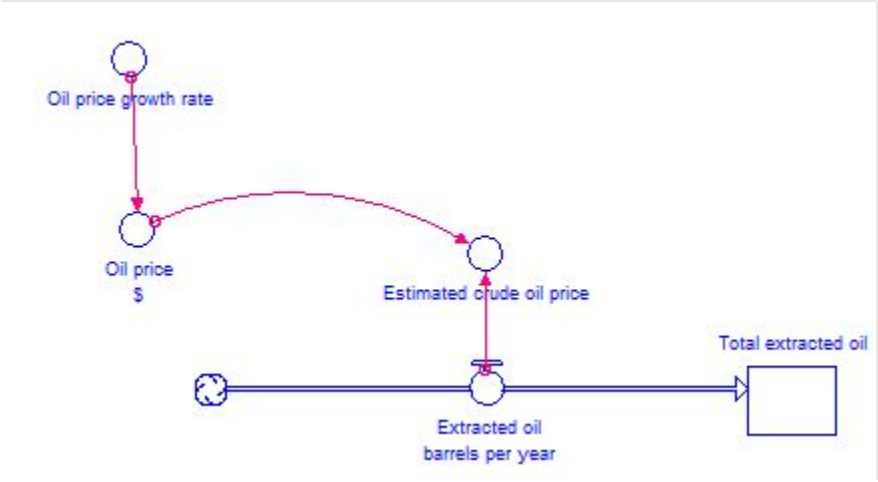


Figure 8. The conceptual model of oil price calculation

4.4. Design of basic numeric model of impacts in STELLA

The design of the conceptual model of the oilfield's impacts takes into account the basic principles, described earlier. The idea of all converters is transferring the processes to unit of money (USD$) by multiplication. The conceptual model of Kashagan's impacts includes stocks, flows, and converters. The basic numeric model has the same idea as the conceptual model, but in contrast it has fewer indicators due to the lack of information.

4.4.1. Scenarios development

The basic numeric model develops 4 different scenarios depending on oil price and amount of extracted oil barrels. Scenarios will focus mostly on the extraction rate, because in case of the Kashagan oilfield, the amount of extracted barrels of oil will play significant role due to the huge difference in extracted barrels on the first, second and third stages. The current situation with oil price is unstable, that is why the focus has been done on the amount of extracted oil. In addition, in order to take into consideration oil price fluctuations, the fourth scenario will describe oil price, which is higher than current price and the average extracted barrels of oil. Suggested scenarios reflect the probable situation, which will happen with Kashagan in order to demonstrate the economic revenue and expenses on environmental and social issues. The result of the model is presented in a form of bar chart and graph (Figure 9, Figure 10). The number of 1e+011 represents $1*10^{11}$, 5e+010 represents $5*10^{10}$, and in the same way for all graphs.

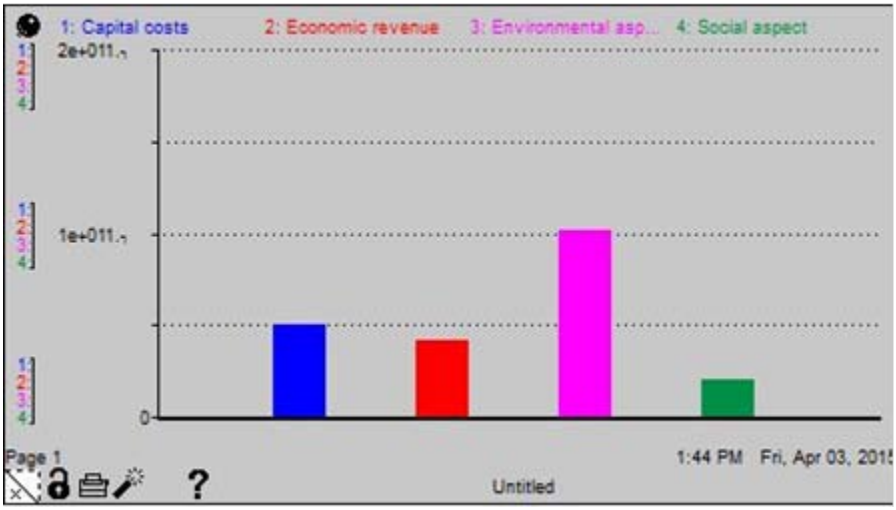


Figure 9. The example of bar chart in STELLA

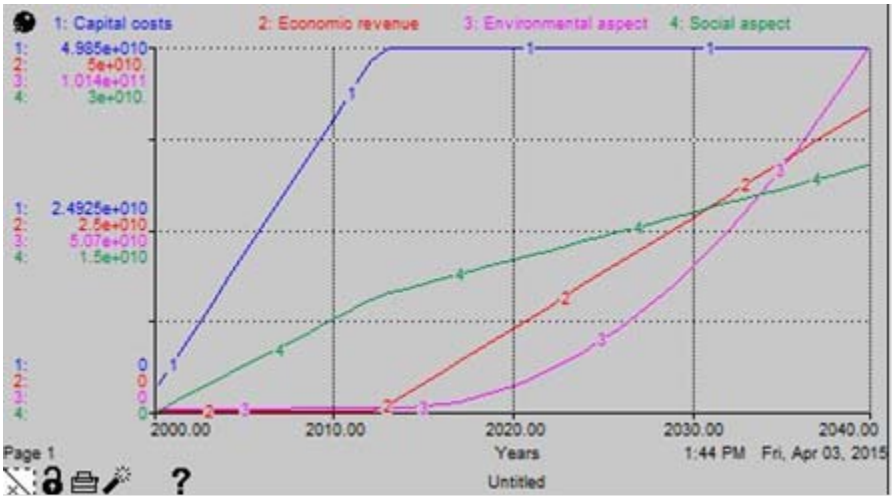


Figure 10. The example of graph in STELLA

5. Kashagan oilfield's contribution to the economic, environmental and social spheres of Kazakhstan

This chapter takes into account economic, environmental and social impacts of the Kashagan oilfield's development. All the impacts represent flows of money that will be spent on different issues in terms of environmental and social aspects. Economic impacts represent monetary flows that will be received from the realization of oil. In the final section there will be a comparison of these types of impacts.

5.1. Sustainable development principles and objectives of NCOC

The company-operator of the Kashagan oilfield strives to accomplish the principles of sustainable development in accordance with the obligations that the members of the project are following. The principles that have been indicated and defined include (North Caspian Sea Venture Values 2008):

- To perform all petroleum operations diligently, safely and efficiently in accordance with International Good Oilfield Practice (IGOFP) and highest reasonable international conservation and environmental standards taking into account the special ecological characteristics of the Caspian Sea
- In case of emergency, to take appropriate measures and make the expenditures necessary for protection of health, life, the environment and property
- To give preference to Kazakhstani suppliers of services and materials
- To employ Kazakhstani citizens and provide training to personnel and transfer of technology
- To fund social and other infrastructure projects
- To take all measures consistent with IGOFP (i) to control flow and prevent loss or waste of Petroleum, (ii) to prevent any injurious water ingress into and damage to Petroleum bearing strata and (iii) to manage reservoir pressure
- Not to flare any gas except in the cases of emergencies or for safe operations

All these goals and objectives show that the company endeavors to obtain a balance between economic revenue and social and environmental issues by taking into account public health, safety, environmental security and social aspects (NCOC Code of Conduct 2013).Thus, the strategic goals of the company are the following (Sustainable Development Management System Manual undated):

Health and Safety: ensuring the health and safety of personnel and local communities.

- Environment: minimizing any impact upon the environment.
- Compliance: compliance with Kazakhstani law/regulations.
- Local content: annual maximizing of local content in terms of local contractors/suppliers, nationalization of the workforce and meeting NCSPSA workforce category targets.
- Social investments performance: maximizing the long-term benefit of social infrastructure projects under the project's member commitment, by ensuring sustainable development principles.

5.2. Economic impacts

The economic aspect of the Kashagan project will include issues concerning costs (capital, operating and costs of transportation), the expected extraction of oil in different phases and the tax regime of the project in order to reflect the revenue from the project.

5.2.1. Capital and Operating costs of the Kashagan project

The project of the Kashagan oilfield development is one of the most expensive projects, which is located on the territory of the Republic of Kazakhstan. According to the information from the internet, the capital costs from the beginning of the project until 2015 form 48 billions $USD. The next second phase of the development will require another sum of money. Operating costs will rise from the year of the production's beginning and in accordance with experts' forecast will reach 797.601 million $USD (Wood Mackenzie 2014).

5.2.2. Transportation costs

Once exports begin, transport costs will vary between the different routes, which will be used (Babali 2009).

• Caspian Pipeline Consortium: transportation from Atyrau, with final delivery to Augusta, incurs a tariff of US$4.03/bbl and a loading charge of US$1.32/bbl (2015 terms). This gives a total cost of US$5.35/bbl (Guliyev and Akhrarkhodjaeva 2008).

• UAS pipeline: the route incurs a tariff of US$5.48/bbl (2015 terms). This includes transportation costs via Russia's Transneft system to the Black Sea, port costs and tanker costs to Augusta (Wood Mackenzie 2014).

• Kazakhstan-China pipeline: future exports to China are assumed to incur a tariff of US$8.80/bbl (2015 terms). The point of sale will be Alashankou, on the Kazakhstan-China border (Guliyev and Akhrarkhodjaeva 2008).

• Aktau port: exports shipped from Aktau to either Makhachkala (Russia) or Baku (Azerbaijan) will incur an average tariff of US$8.32/bbl (2015 terms). The final point of sale is Augusta (Guliyev and Akhrarkhodjaeva 2008).

5.2.3. The amount of oil production in different phases

Phase One (**Experimental Program**) was intended to test design concepts and optimize operations. However, it is a significant project in its own right. It is developing Kashagan East, with first oil in September 2013. Ultimate Phase One capacity will be **370,000 - 450,000 b/d** from three 150,000 b/d trains (Wood Mackenzie 2014).

Phase Two remains at the conceptual stage. The original proposal involved full development of Kashagan East, as well as production from Kashagan West. Full-scale sour gas re-injection will be implemented, with all gas handling taking place offshore. Phase Two will add **750,000 b/d** of oil production capacity (Wood Mackenzie 2014).

Phase Three remains highly conceptual. The original proposal involved full development of Kashagan West and the Aktote and Kairan satellites (tied back to Kashagan East). Wood Mackenzie expects Kashagan oil production to peak at **906,000 b/d** in (Wood Mackenzie 2015). Including Kalamkas More, output from the contract area will peak at **997,000 b/d** in the same year.

Figure 11 reflects the all financial flows from operating, building and transportation costs. Operating, capital costs and transportation are presented in the form of stocks, which implies that the amount of money was accumulated during the period from 2000 to 2013 years. Transportation expenses will depend on the type of transportation routes.

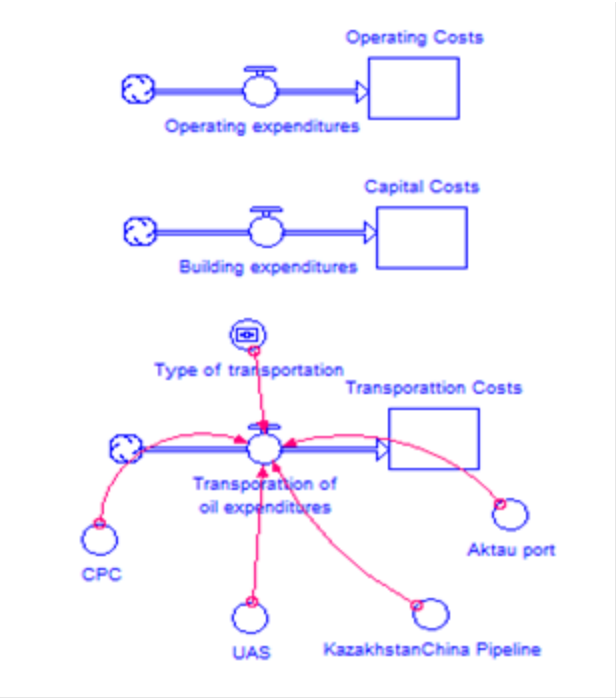


Figure 11. The conceptual model of capital, operating and transportation costs of the Kashagan project

5.2.4. Tax regime of the project

The project of the development Kashagan oilfield is international and has a special North Caspian Sea Production Sharing Agreement with conditions. It was signed in 1997 and currently the share of the national operator is the highest 16.88% out of 100%. The agreement has its own complex tax regime. According to Ernst and Young Kazakhstan and Wood Mackenzie, the tax regime in the Kashagan project has the following character (Ernst&Young 2014),(Wood Mackenzie 2015).

Royalty

A royalty is agreed upon as a percentage of the lease, minus what was reasonably used in the Lessee's production costs. The payment rate is agreed in accordance with the oil extraction. Table below provides the rate of the tax (Table 7).

Table 7. The approximate payment of royalty

Source: (Wood Mackenzie 2015)

Oil Price/ Brent ($US/bbl)	Priority payment (%)
<55	2
<85	3.5

<130	5
<190	7.5
>=190	12.5

The company is permitted to use the money from produced oil to recover capital and operational expenditures, known as "cost oil". The remaining money is known as "profit oil", and is split between the government and the company

Cost Oil

According to the agreement, the maximum cost recovery is from 80% of revenues until payback is achieved. The agreement with the government stipulated that, if commercial production (minimum 75,000 b/d) was not achieved by October 2013, additional Phase One start-up costs would not be recoverable.

Profit oil

In order to calculate Profit oil a complex matrix that takes four values should be done: R-Factor; volume percentage (on Kashagan); project IRR; and volume percentage.

R-Factor

The R-Factor is calculated by taking the cumulative deflated value of cost recovery plus the contractor share of profit oil less taxation, divided by cumulative deflated costs (operating, development, E&A and bonuses) (Figure 12)

Contractor's Profit Oil based on R-Factor

R-Factor	Contractor Share
<=1.4	90%
1.4-2.6	(90%-(66.67% x (RF-1.4)))
>=2.6	10%

Source: Wood Mackenzie

Figure 12. Profit oil based on R-Factor

The internal rate of return (IRR)

IRR is calculated based on a cash flow stream generated by taking the value for each period of (cost recovery + contractor share of profit oil) less (taxation + operating costs + development costs + E&A costs + bonuses)(Figure 13).

Contractor's Profit Oil based on Project IRR

Project IRR	Contractor Share
<=17%	90%
17-20%	(90%-(26.67 x (IRR-17%)))
>20%	10%

Source: Wood Mackenzie

Figure 13. Profit oil based on Project IRR

Profit tax

Profit tax is applied according to a sliding scale and varies depending upon the project IRR (Figure 14).

Profit Tax

Project IRR, %	Profit Tax, %
up to 20	30
20-22	34
22-24	38
24-26	42
26-28	48
28-30	54
over 30	60

Source: Wood Mackenzie

Figure 14. Profit tax of oilfield project in Kazakhstan

Furthermore, there are two types of bonuses: signature bonuses and commercial discovery bonuses (Ernst&Young 2014). Corporate Income Tax is calculated as 20 % from taxable income. There are subtractions of company's activity oriented towards revenue generation, such as superannuation payment, maintenance costs, development expenditures, exploration costs, scientific research costs and others.

The tax regime of the Kashagan project is complicated and depends on many factors of current economic situation and the amount of extracted barrels. Figure 15 represents tax regime in a way of conceptual model. The sharing agreement of the project has advantages and disadvantages for the country, where the oilfield is situated. However, the national company,

which possesses the highest participation interest, will receive more benefit from this project than other stakeholders.

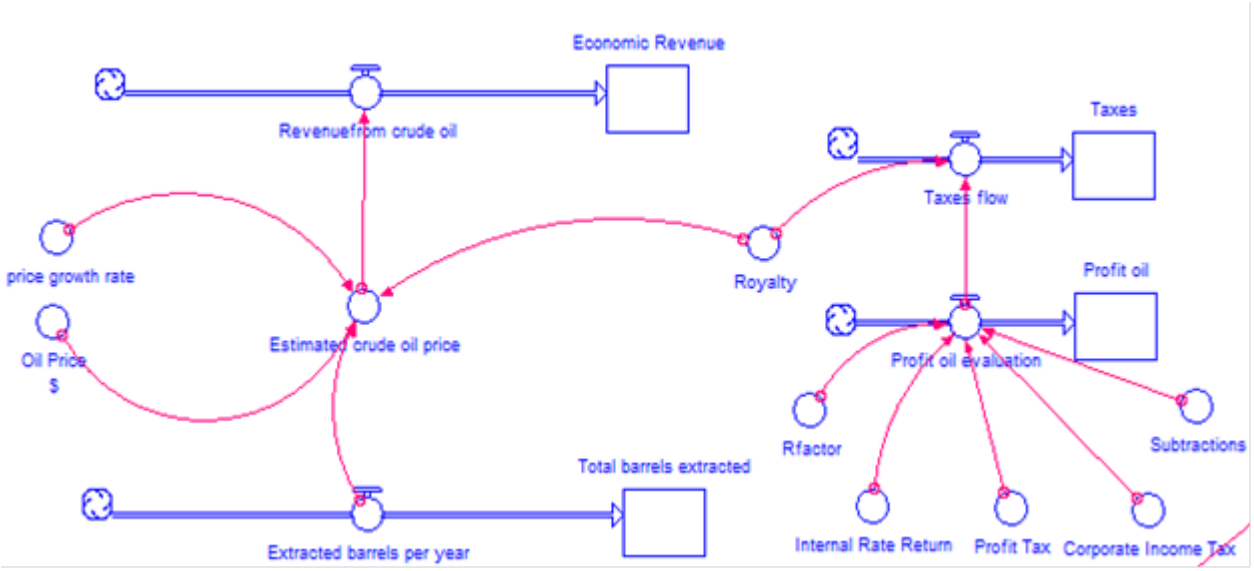


Figure 15. The conceptual model of tax regime in the Kashagan project

5.2.5. Local procurement

According to official published documents the company-operator of Kashagan oilfield is oriented to the improvement of economic situation in the region of extraction. The first direction is the enhancement of local content in the project by attracting local procurement and suppliers (Sustainable Development Charter 2010).

- **Procurement.** NCOC attempts to purchase local products and services.
- **Suppliers.** NCOC strives to strengthen cooperation with local suppliers.
- **Transfer of know-how and experience**. NCOC and its Agent Companies strive to support professional development for employees at counterparties in Kazakhstan, through Brochure (Local Goods Materials and services 2011).
    - Strengthening local content and its possibilities through the transfer of experience and know-how
    - Supporting the development of local companies in accordance with the terms of the NCSPSA, including through the organization of cooperation between international and domestic companies.

The second direction is the development of small and medium-sized business. According to Local Content Development Program for 2011-2015, the company-operator contributes to the initiation and participation in assistance to industrial enterprises through dialogue with the stakeholders, with the aim of diversifying other economic sectors and creating the most sustainable assets possible for Kazakhstan (Local Content Development Program 2011–2015 2012).

In addition, there is a list of documents, which is responsible for economic contribution to the region of operation. *NCOC Local Content Policy* states that NCOC and its Agent Companies have an obligation to support the sustainable development of Kazakhstan's industrial potential and to maximize the local content in their projects. The document also describes their approach to meeting this obligation. The policy takes account of the government requirements for developing local content in foreign projects, which are defined in the National Program for the Development of Kazakhstani Content in Kazakhstan in 2010-2014. *The Local Content Development Programme 2011-2015* has been developed by NCOC with the aim of ensuring maximum compliance of the Company's activities with the requirements and standards of the NCSPSA and legislation in Kazakhstan. The program aims to identify key areas of collaboration with Kazakhstani producers and suppliers of goods and services for the Venture, and to define a five-year strategy for increasing local content in the Company's projects.

The evaluation of economic impacts was made in accordance with existing documents which has an orientation to improve the current economic situation by the described mechanisms: local procurement, local suppliers and the nationalization of personnel of company-operator and members of the consortium. Each Agent is responsible for planning and implementing the necessary actions and events to achieve the goals of the NCSPSA and the legislation of Kazakhstan in terms of local content (NCOC Local Content Policy Undated).

The issue of local procurement and suppliers is of great importance in Kazakhstan due to the published law, starting from 1st January 2014 the Republic of Kazakhstan Law on Local Procurement which protects the local suppliers of goods, works (GWS) and services and encourages the development of such national suppliers (Yerkebulanov 2015). According to the local content development program, NCOC and the Agents aim at the involvement of local suppliers of GWS, which satisfy the client’s requirements on price, quality, safety, availability.

According to the data, in the first nine months of 2013 NCOC and the Agents spent USD 2.8 billion on the procurement of GWS. USD 900 million or 32.13% was spent on the procurement of locally produced GWS. The greatest amount of funds was spent on services from local suppliers (45.8% of the total volume of services provided). The share of local goods accounted for 9.3% of the total amount of goods purchased by NCOC and the Agents. 22.9% was spent on purchasing local works (Figure 16).

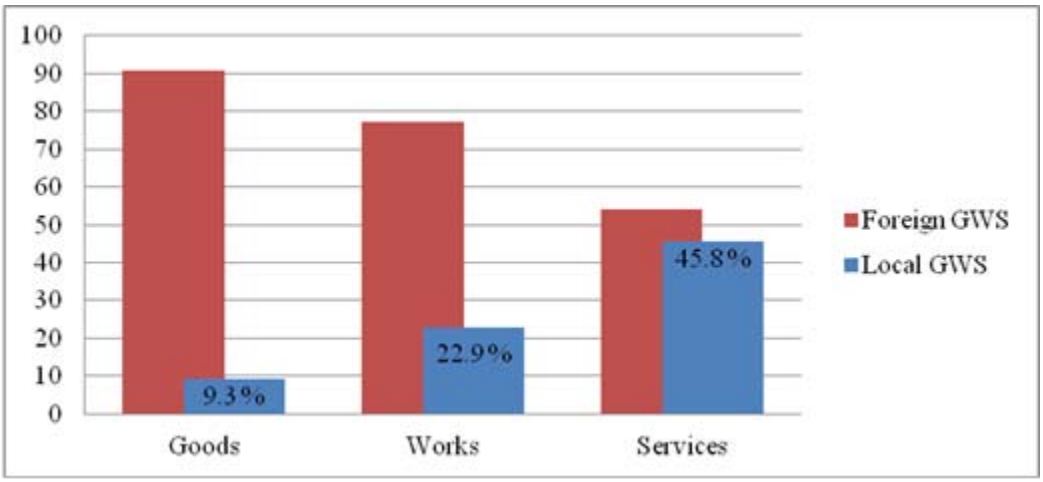


Figure 16. Procurement of GWS for the first nine month of 2013

Source: (NCOC Local Content Policy Undated)

The structure of the procurement has the following character (Figure 17). The biggest share of procurement, 44% takes commissioning operations and works for the early period of the project (NCOC Procurement Procedure 2013). Mechanical operations and civil offshore works have 9 and 8%. The other types of GWS include installation works, major work on the connection process and other works (Figure 17).

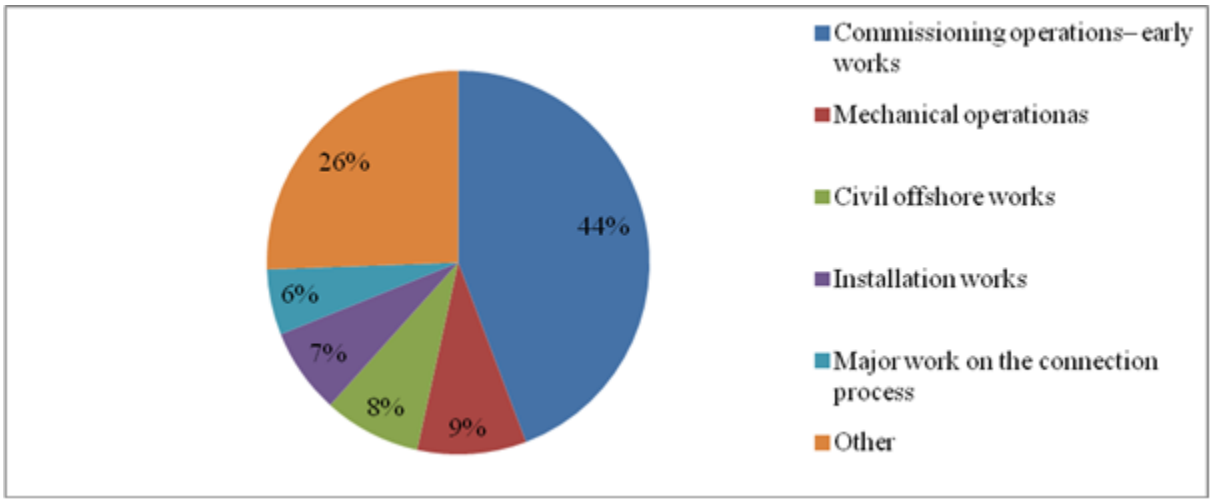


Figure 17. The structure of GWS in the Kashagan project

Source:(NCOC Procurement Procedure 2013)

According to the *NCOC Local Content Policy* at the end of the third quarter of 2013, the database of suppliers approved for cooperation for the Project purposes included 6,210 companies. 2,813 suppliers of these companies or 45% were Kazakhstan companies. According to the available data, the structure of transferred technologies from international companies to the company operator, 88% has been transferred through software. Equipment and technical literature both have 6% of transferred technologies (Figure 18).

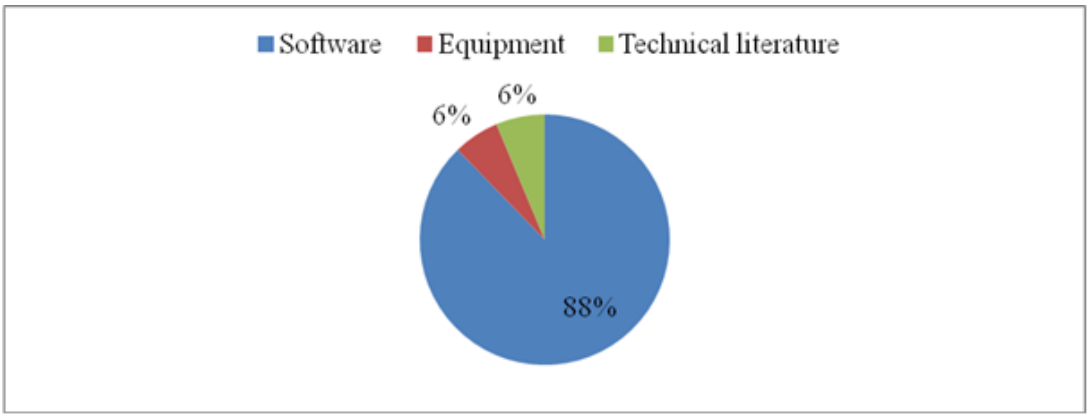


Figure 18. Transferred technologies from international companies

Source: (NCOC Procurement Procedure 2013)

The conceptual model of local procurement implies financial flows, which were spent on different types of local work (Figure 19).

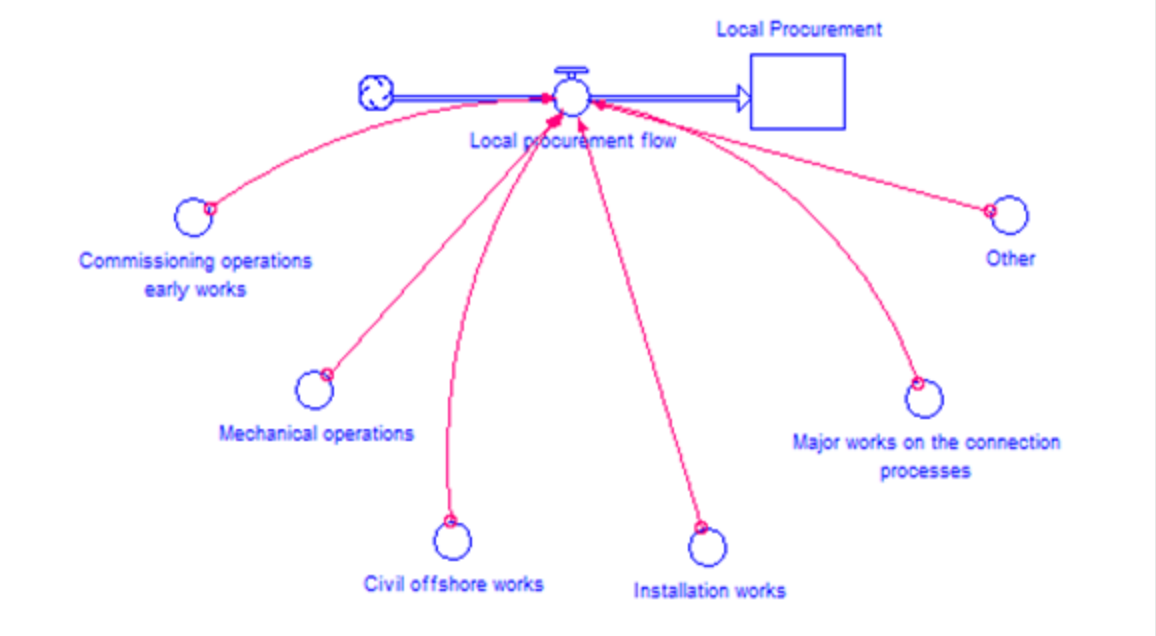


Figure 19. The conceptual model of local procurement

An important direction in the economic aspect of sustainable development of a company is the involvement of transferring technologies and experience and increasing in the professionalism of the personnel of Kazakhstani suppliers by organizing different events. According to the latest data (NCOC Local Content Policy Undated), NCOC achieved the following results within the program of improving the qualifications of local suppliers over the first three quarters of 2013:

- 56 local companies successfully underwent qualification audits to identify instances of non-compliance with the requirements of the Venture for four commodity groups: seismic surveys, waste storage and disposal, environmental advisory services, and drilling services;
- 339 local companies participated in 24 general education seminars on health and environment, the preparation of tender documentation, prequalification, and quality assurance and control.
- 198 employees from 7 local companies were trained in such high-demand working specializations as servicing electrical equipment, transportation of hazardous cargo, welding, installation of concrete and reinforced structures, safety of operators of high pressure vessels, etc.

- 29 local companies obtained certificates in ISO 9001, ISO 14001, ISO 22000 and OHSAS 18001

The role of the development of local content which includes the purchase of locally produced goods, work and services, the stimulation of local manufactures is extremely important due to the immediate effect on the region of exploration. The average annual percentage of local procurement over almost 8 years was 31% of the total amount of funds expended on GWS. The share of NCOC in the total amount of local procurement of GWS was 1% (Local Goods Materials and services 2011).

The immediate effect of economic contribution of the development of the oilfield will also emerge in the creation of a professional and economically efficient system of supply chain, which may be employed in the different sectors of the economy at the national and international levels. The conducted analysis of Kashagan's economic impacts showed that the tax regime of the project depends on the extraction rate. However, as Kazakhstan obtains the biggest share in the projects, there is possibility that with the current tax regime the country will receive profit, which will make citizens of Kazakhstan wealthier.

It is important to note that the Kashagan project was a contributor to the local procurement of the region. This means that for the period of construction works the citizens of Kazakhstan has demand on the compliance of mechanical operations, installation works and other. The percentage of technology transferred from international companies was remarkable, especially in terms of software.

Figure 20 reflects the full conceptual model of Kashagan oilfield's economic impacts taking into consideration capital, operational, transportation costs, taxes, economic revenue and local procurement.

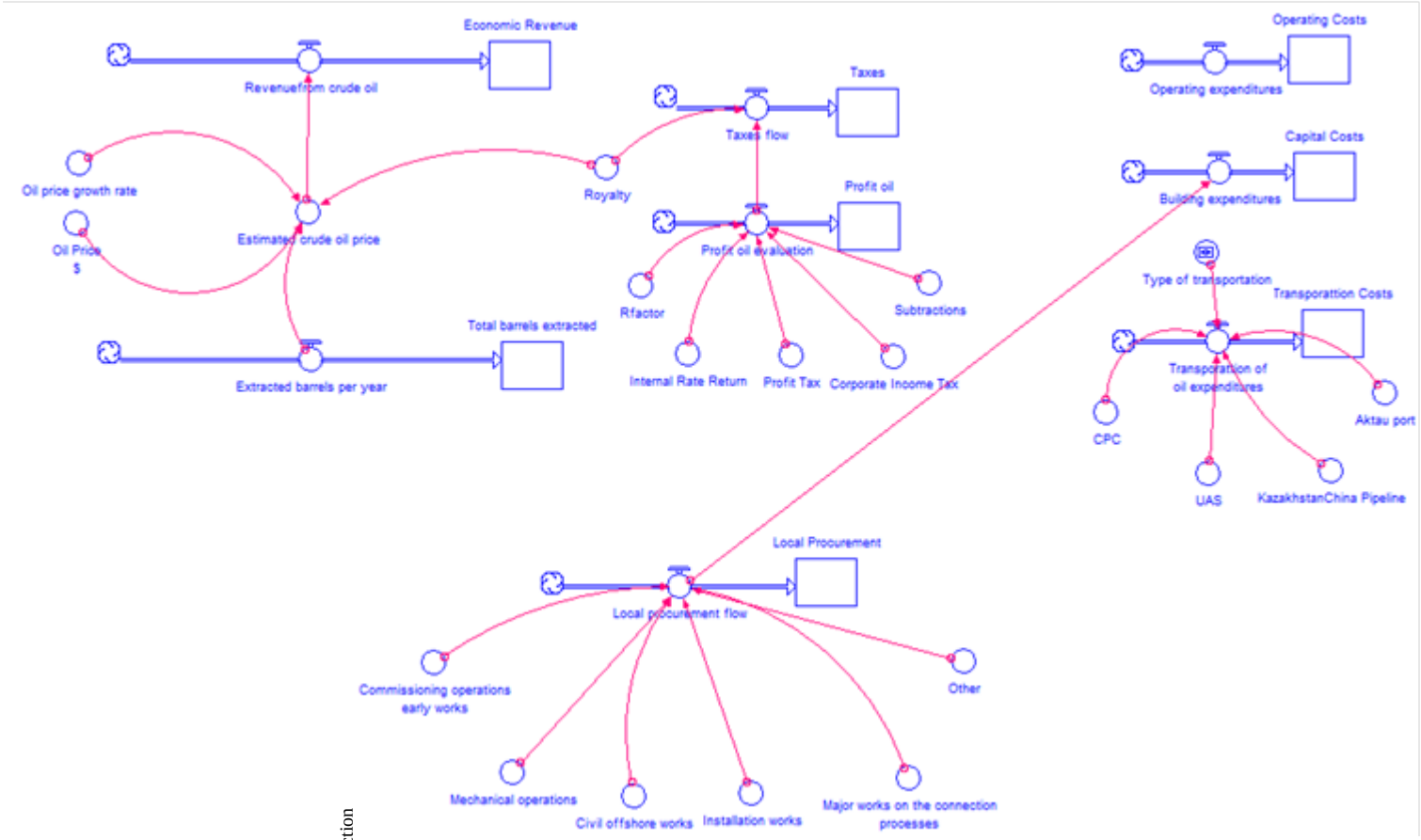


Figure 20. The full conceptual model of Economic impacts

5.3. Environmental impacts

This section introduces the general information regarding geographic characteristics of the Caspian region including climate and biodiversity. In addition, there is the analysis of potential environmental risks concerning the functioning of the Kashagan oilfield. The subsection discloses the negative environmental impact on atmosphere with taking into account waste storage and water treatment.

5.3.1. The geographic characteristics of the Caspian Sea

The Caspian Sea is the biggest inland water body in the world (Figure 21). The water surface is more than 390 thousand km^2. The east part of the northern Caspian Sea and the east part of the middle part belong to the Republic of Kazakhstan. The east part of the northern part is shallow water (filling out only 1 % of the water) area with low coastline and low angles of the bottom. The average depth is 8-10 meters. In contrast, the depth of the middle part is 300 meters and the maximum is 700 meters (Dobrovolsky 1969). The relief of the bottom has islands and pitting. The relief of the terrain represents the Caspian plain. The Caspian Sea is in an enclosed basin with no outflows. Over 130 rivers flow into the Caspian, including the Volga River and the Ural (NCOC Biodiversity 2011). The Ural and Zhayik rivers influence the hydrological regime of the Sea. The northern part has untended coastline with several bays. Another distinctive feature of the Caspian Sea is the variations of water levels. The reasons for these fluctuations are not clear, but there is an assumption that it connects with the seismic activity of the region.

Figure 21.The parts of the Caspian Sea

Source: (NCOC Biodiversity 2011)

5.3.2. Climate

The temperature of the Caspian region in summer time is more or less distributed evenly. In contrast, winter months are characterized by huge difference in temperature's distribution. The average multi-year temperature of summer months (July-August) is +24˚+26˚C. The absolute maximum on the east side was +42 +43 C. In autumn, the temperature varies from 9-13 C. In the coldest months, the temperature of the North-Eastern part of the Sea is -9 -10 C. The temperature's minimum is in February, when the temperature of water is -0.1 -0.5 (Dobrovolsky 1969). From autumn the region of the North Caspian Sea is under the influence of Siberian anticyclone and because of this, North Caspian Sea is covered by huge ice sheet, which prevents shipping and devastates the coast hydro technical facilities. Low salinity (1-2%), due to the in-flow of fresh water from the Volga, combined with shallow waters and winter temperatures below minus 30 degrees mean that the northern part of the Caspian Sea freezes for nearly five months of the year (Dobrovolsky 1969). Long ice coverage prevents workers making extraction works properly.

5.3.3. Biodiversity

The Caspian Sea is marked by rich biological diversity. Unique onshore ecosystems and habitats are home for rare and endemic species, some of which are endangered and protected. It is important to note that 194 types of species are listed in the Red Data Book of the Republic of Kazakhstan, which is an inventory that was established for documenting rare and endangered species of animals and plants that exist on the territory of Kazakhstan.

The reason of high degree of biodiversity in the Caspian aquatic environmental system is the landlocked location from the oceans and low salinity of the water. 'The northern Caspian region includes two important wetlands, the Volga and Ural deltas, which provide habitats for migrating birds and endemic fish species'(NCOC Biodiversity 2011).

The Caspian Sea is the place where the Caspian seal and five species of sturgeon, including beluga sturgeon are found (Figure 22). On the onshore territory rare mammals such as Saiga is living.

Figure 22.The rare representatives of Caspian fauna: Caspian seal (lat.Phoca caspica) and Beluga sturgeon (lat. Huso huso)

5.3.4. Negative environmental impact on atmosphere. Associated petroleum gas and greenhouse gas emissions

The biggest concern regarding air pollution is linked to emissions during the flaring of associated gas and transfer of sulfur compounds from wastes. The Kashagan oilfield has a high-pressure and a high content of 'sour gas'. Due to the high gas content in the oil, the amount of associated gas is 52 trillion cubic feet (North Caspian Sea Production Sharing Agreement 2001). During the first phase one part of the associated gas will be re-injected offshore and the other will be sent to the onshore processing facility (Bolashak) (Figure 23). After the treatment, 'sweetened' gas will be used for onshore and offshore power generation. The company-operator has mentioned the possibility of selling (NCSPSA Greenhouse Gases Policy 2012).

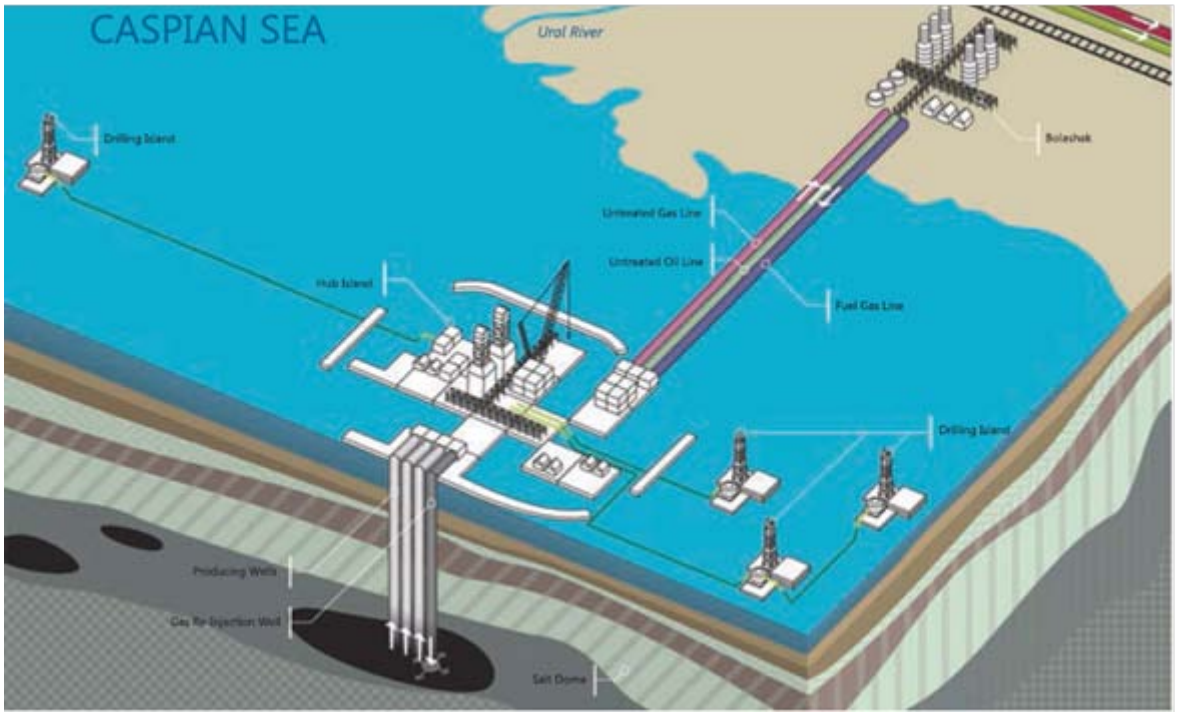


Figure 23. The concept of the development

The issue of associated gas flaring is a critical problem for the Kazakhstan oil and gas sector. Despite the fact that Kazakhstan has adopted the Global Initiative of associated gas flaring reduction, which was proposed by the World Bank in 2002, the Ministry of Environmental Protection has revealed more than eight thousand violations concerning associated gas flaring with fines exceeded 39 million USD$. Another governmental program of the 'Zhasyl Damu' organization is devoted to the reduction of greenhouse gas emissions in accordance with Kyoto Protocol compliance. Kazakhstan launched the own carbon trading system in 2013, and in accordance with the program, the excess of allocated quotas for greenhouse gas emissions will be calculated as 5 monthly calculation index. Before 2013, this amount was a 10 monthly calculation index. At present, this amount corresponds to approximately 100 USD$. The amount of money is substantial, because the company-operator intends to emit more than 140.000 tons of CO_2 per year, which is why there is a possibility to exceed the limit and to be fined by the governmental body.

The Law of Environmental Protection of Kazakhstan was developed as the basic act, which aims to create a framework of policy instruments and sets the legal, economic and social framework for environmental management in oil and gas industry (Palerm, Rudenko et al. 2005). The current system of mandatory environmental taxes is imposed for atmospheric emissions in case of environmental permit's excess. The local governmental bodies are responsible for allocation of quotas and determination of the emission's limit or permit for

one year (Environmental Code 2007). 'In Kazakhstan, permitting involves obtaining various permits from multiple authorities at different administrative levels, resulting in an overly complex and confusing system' (Palerm, Rudenko et al. 2005). In the case of the exceeding the limit, the governmental bodies of environmental protection will impose taxes. This same sort of situation is for waste storage. The disadvantages of this system are the late approval of emissions permit, the late submission of data on the amounts burned. Thus, environmental protection measures may not be completed according to plan, which will result in the suspension of activity, fines and criminal cases.

The established quantity of emissions limit for the Kashagan project of CO2 for 2013 was 148.566 tons. As the Venture plans to become the leading oil producer in Kazakhstan, it cannot comply with the given commitments on greenhouse gas emissions due to the huge amounts of extracted barrels. The Company will have to incur significant expenses in the payment of fines for exceeding limits (Table 8) or for the purchase of additional quotas, which would appear to be a dubious solution as the national system of trading greenhouse gas emissions is still controversial.

Table 8. Rates of charge from associated gas flaring, in accordance with the law of the Republic of Kazakhstan

Source: (Environmental Code 2007)

Types of pollutants	**Rates of charge for 1 tone, USD$**
Sulfur dioxide	107
Nitrogen dioxide	107
Smoke	128
Hydrogen sulphide	664
Hydrocarbons	24
Carbon oxides	7.8
Methane	0.4
Merkaptan	106770

Table 9. Rates of charge from waste storage, in accordance with the law of the Republic of Kazakhstan

Source: (Environmental Code 2007)

Types of wastes	Rates of charge for 1 tone, USD$
'red' list if wastes	75
'amber' list of wastes	43
'green' list of wastes	11
Sulfur (technical and elemental)	40

5.3.5. Waste management. Sulfur storage

The issue with sulfur is also extremely important due to the negative environmental impact. One of the reasons is that Kashagan oil has to a high content of sulfur dioxide and hydrogen sulfide, which is the final product of gas flaring. The negative experience of open sulfur storage at other oilfield in the Atyrau region (Tengizchevroil field) shows that this issue requires particular care. This is why the company operator indicates that it has developed a plan for the disposal of sulfur, where 80% of sulfur will be returned to the field through a system of re-injection of high-sulfur gas (Environmental Protection Strategy 2010).

The company has involved the mechanism of a closed, hermetically sealed facility for sulfur storage (Figure 24). The facility will have sensors for monitoring. Before selling, the sulfur will again be turned into a liquid, and then will be turned into solid granules. This technology makes it possible to avoid the creation of dust. During the first phase of the development, an average 1.1 million tons of sulfur will be produced from the process of removing hydrogen sulfide.

There will be a danger in the case of accident with sulfur, because of the close location of Atyrau city (30 km) and possible adverse effects on human health. 'The particles of sulfur can penetrate deeply into sensitive parts of the lungs and can cause or worsen respiratory disease, such as emphysema and bronchitis, and can aggravate existing heart disease, leading to increased hospital admissions and premature death'(Environmental Protection Strategy 2010).The maintenance of secure sulfur storage is an extremely important issue that must be taken into deep consideration.

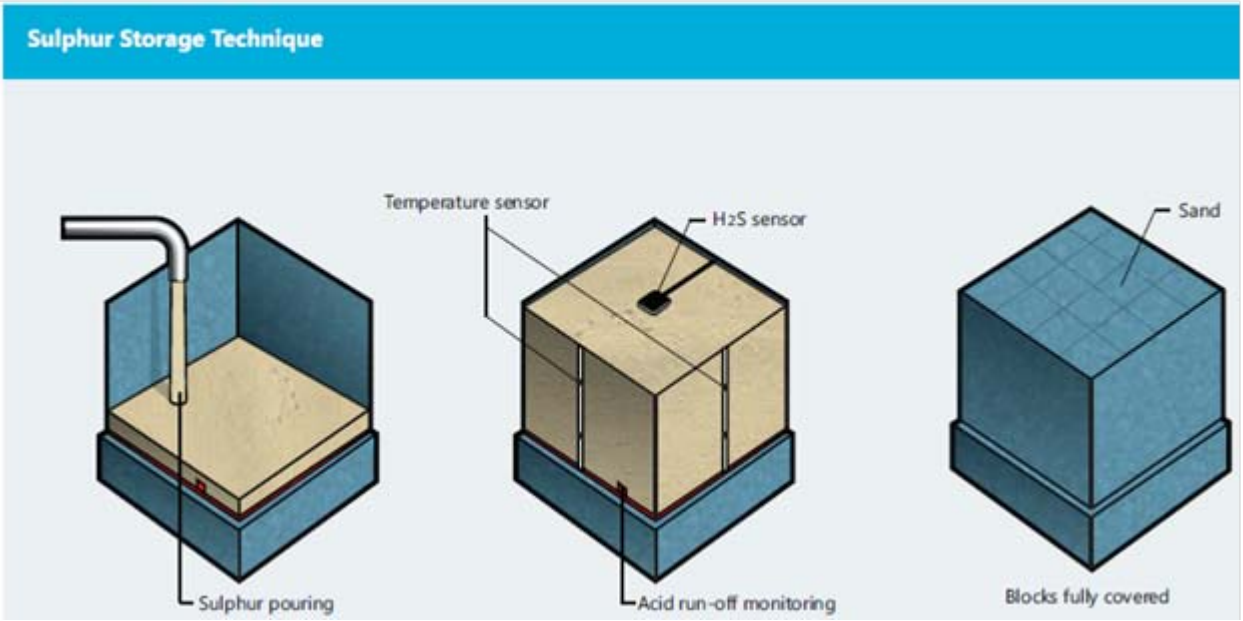


Figure 24. The facility of sulfur storage at Kashagan oilfield

Source: (Environmental Protection Strategy 2010)

5.3.6. Waste management. Other wastes

Waste management is supposed to be in accordance with the NCSPSA Waste Management Strategy. The main waste management objectives are to prevent and minimize the formation of waste and also to arrange for responsible waste storage, processing and disposal in accordance with the requirements of the legislation of the Republic of Kazakhstan

The formation of wastes is the inevitable process of oilfield development. The company indicates two categories of waste (NCSPSA Waste Management Strategy 2011):

- Municipal wastes;
- Industrial waste, including, drilling mud, oil-contaminated waters and liquid process wastes.

According to national classification of wastes, industrial wastes refer to ‘green’ and ‘amber’ lists of wastes. The oilfield will not have the most hazardous wastes from the ‘red’ list. The ‘green’ list of wastes include waste wood, municipal wastes, paper wastes, food wastes, medical wastes. The amount of ‘green’ list wastes will be 5369 tons per year. The ‘Amber’ list of wastes will be 2883 tons per year (NCSPSA Waste Management Strategy 2011). The wastes from lists will require the charge for one tone in accordance with the law of the Republic of Kazakhstan. The environmental taxes of wastes storage is in accordance with Table 9.

The positive aspect which was mentioned is that waste management of the Kashagan oilfield excludes the potential negative impact of waste on sea water. Municipal waste is transferred to specialized enterprises for further disposal or processing.

5.3.7. Formation of wastewater and water consumption

The water of the Caspian Sea is used as the source of water supply in oilfield. After desalination, the water is spent on technical and household needs (NCSPSA Waste Management Strategy 2011). The treated wastewater sludge is dried and collected in containers, which are then recycled by a contracting waste management company. The waste water will be transferred to Bautino base for further purification. Sewage disposal will be used again in the technological process. After treatment; the water will fill out containment ponds for natural evaporation. The design of the ponds prevents the water from leaching into the soil. Monitoring wells have been built to monitor the quality of groundwater and react promptly to any breakdown in the integrity of the ponds.

NCOC expects that water consumption during the exploitation and construction will be from

- Consumption of potable water with good quality
- Consumption of fresh technical water for technical and technological uses
- Consumption of sea water for technical and technological uses

The approximate amount of water consumption will be 3 million m^2 per year. The waste water treatment facilities will approximately cost 1.5-2 million USD$. The purification of 1 m^3 of water in Kazakhstan varies from 41-150 USD$. Thus, the annual waste water treatment will require ($123-450$ million). On an average, the expenses on water purification will be 150 USD $ million per year.

According to articles from the news, the environmental department of Atyrau region has made a negative conclusion regarding atmospheric emissions and water purification. In addition, the issue of sulfur storage requires more attention. The reason of the negative conclusion regarding emissions is the excess by 34 times above the acceptable amount. In 2013, the first trial year of exploitation, NCOC intended to emit the maximum amount of 2277 per year in the first turn of project, 8632tons in the second and 15470 tons in the third turn. However, the actual amount of emissions in 2013 was 78 279 tons, which exceed the initial maximum amount by 5 times. This situation was an extreme violation of environmental law of the Republic of Kazakhstan and the amount of environmental fines was considerable. 2013 was also marked with the leakage of associated petroleum gas during the test run mode,

which resulted in accidental flaring of CO2, sulfur and other pollutants. For the period of one year of exploitation the company operator was fined 700 million USD$. Another violation was concerning industrial wastewater. According to environmental department of Atyrau, NCOC pour wastewater into drains without any purification. Moreover, there is no information about building wastewater treatment facilities.

At present the environmental aspect of Kashagan oilfield is very controversial and needs naming and shaming. The Kashagan oilfield represents the contradiction of environmental governance of Atyrau region and stakeholders of the project. The delay of the beginning of commercial production of oil is due to the environmental issues. If the best happened, the realization of oil at the Kashagan oilfield will be environmentally safe, but the current situation does not allow for a positive conclusion. 25 shows environmental impacts of Kashagan oilfield development with taking into account financial flows from air emissions, wastes storage, environmental fines etc.

The conclusion of environmental impacts of the Kashagan oilfield development is the following:

The northern part of the Caspian Sea is a very sensitive environmental area with abundant and diverse fauna and flora, including a number of endemic species. It is estimated that the Caspian Sea is home to approximately 100 and 126 species and subspecies of fish. About 20 to 30 of these are of commercial importance. Sturgeons are considered the most valuable commercial species in the Caspian Sea. The Caspian Sea is also home to seals and the coastal wetlands attract a variety of birds, a number of which are included in the Red Data Book of the Republic of Kazakhstan. Thus, the biodiversity of the region must be taken into deep consideration with:

- Protection of the Caspian Seal population;
- Preservation of the habitat for migratory birds, which have their migration stops along the coastline of the Caspian Sea;
- Preservation of sturgeon population.

The issue of atmospheric emissions including emissions from associated petroleum gas flaring and greenhouse gas emissions has a complicated character due to the discrepancy between environmental permissions and actual amount of emissions.

The waste water treatment and water consumption will lead to huge financial expenses and there is a concern regarding water shortage in Atyrau region due to the water consumption for industrial needs

The availability of a huge amount of environmental fines proves that the Kashagan oilfield is controversial. In recent years, environmental governance of Atyrau region has become increasingly aware of the need for strict environmental legislation and to demonstrate good practice. Equally, companies are now conscious of the need to better manage the impact of their operations on the environment. Public awareness of environmental issues is higher than ever before, and expectations of the way that companies appropriately manage their impact are very high.

The risk of an accidental situation is also important. In order to prevent the accidental oil spills, company-operator should take into account the recommendations of environmental impact assessment and environmental department of Atyrau region. The contingency plan of the oilfield development should take into account economic and environmental consequences of potential oil spill.

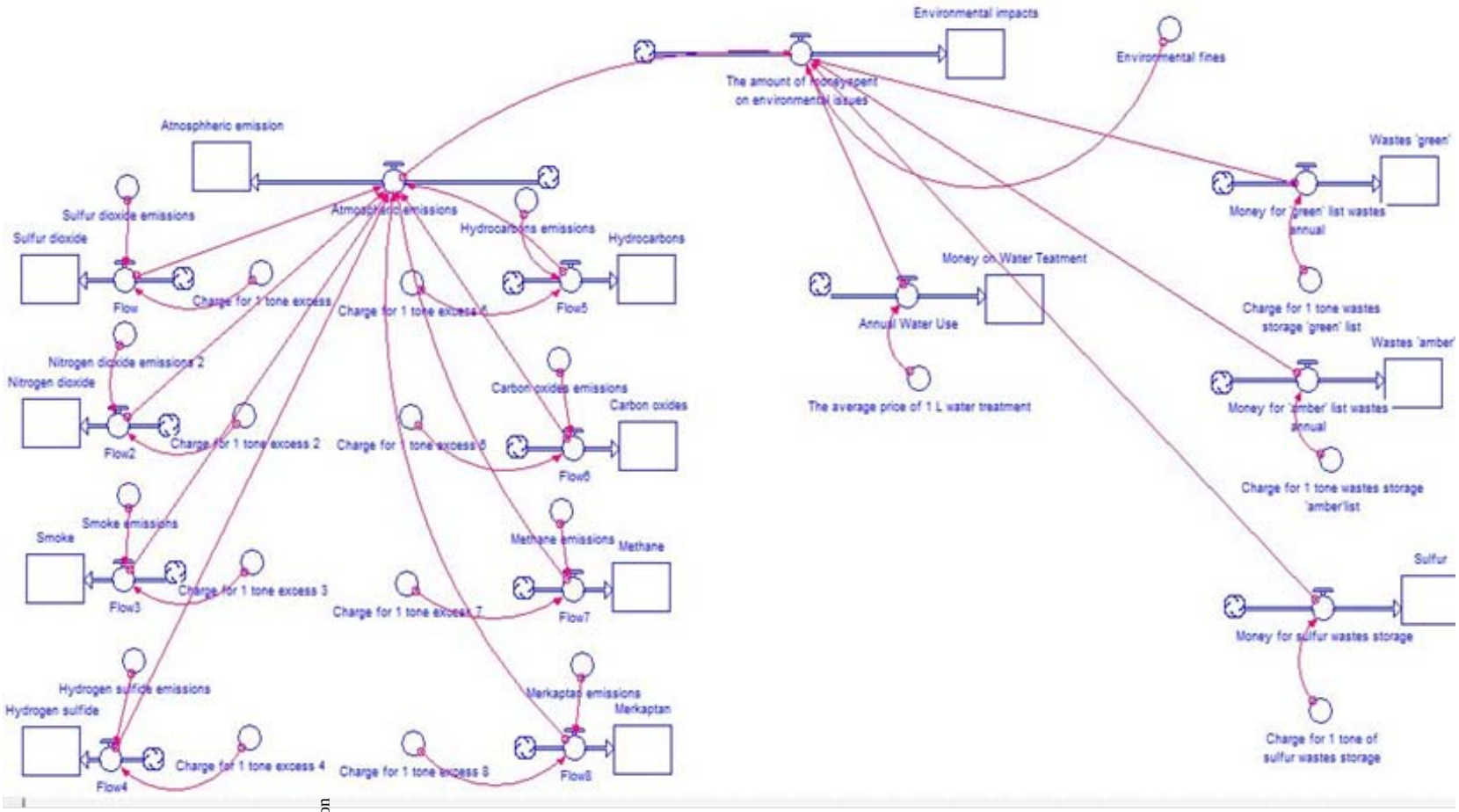


Figure 25. Environmental impacts of the Kashagan oilfield in the form of STELLA conceptual model

5.4. Social aspect

From the social contribution standpoint, the development of Kashagan will bring positive changes in the social life of Atyrau region. In comparison with environmental impacts, the development of the Kashagan oilfield will improve the social situation in the region. The company-operator emphasizes the importance of social sphere of the region. It is worth noting, that working in oil and gas industry is high-prestige due to high salaries and public image (Jäger 2014). The Atyrau region is a leader among the average salaries in Kazakhstan, the average amount of salary is 1000$ (Committee on Statistics 2014a). However, due to severe environmental conditions and the deterioration of health, people do not have a high desire to move to this region for work purposes.

NCOC prioritizes several directions in social sphere development. These directions are (NCOC Societal brochure 2012):

- Recruitment and nationalization of personal
- Training and professional development of personal
- The involvement of Social Infrastructure Projects (SIP)
- Sponsorship and charitable projects

5.4.1. Recruitment and nationalization of personal

At present there are 35.000 people who work on the Kashagan project. The recruitment process involves three levels: the level of NCOC, the level of companies-agents, and the level of the contractors and subcontractors. The main requirement for potential employee is the appropriate specialization and knowledge of English language. Because of that, there are a lot of people who transfer their work sphere from education to the oil and gas industry due to a good knowledge of English language and high salaries.

The other issue concerning recruitment deals with foreign specialists. The fact is that expats receive a higher salary than local people. There was a negative experience of social strike in 2011 in another oil-oriented region (Zhanaozen city, Mangystau region). The reason of the strike was discontent concerning labor conditions which includes the high difference between salaries among local and foreign specialists. This example shows that Kazakh people can have negative attitude to international companies which attracts expats for work.

The situation with migration is becoming a problem, because companies-contractors often attract low-paid workers from less wealthy-region, not from Atyrau region. Hence, this

is a source of concern for local authorities and dissatisfaction of local people. Both external and internal migration has a strong effect on the labor market.

The Kashagan project is international and this has created a multinational character in company. However, according to the rules and conditions of hiring foreign employers of the Republic of Kazakhstan, the company is obliged to attract at least 70% of local people for work places of top managers, directors of structural divisions and 90% of specialists that meet the qualification requirements established by job evaluation (Nationalization Policy 2013). In 2013 the level of nationalization of the workforce was 79%. The level of nationalization among top-managers and directors was 56% (Nationalization Policy 2013). This can be explained by the lack of appropriate knowledge of local employees and high competition with foreign employees. Besides the level of nationalization, the monetary contribution to social development of the region will be the huge money flow from salaries. With 35.000 employees and the average salary of 1000 USD$, there will be an annual 35.000.000 USD$ income to local people. This fact will certainly be considered in model of impacts.

According to available data, the labor input was more than 95.000 man-hours from March 2013 till February 2014(NCOC Manpower Plan 2011). Due to the finish of construction works, labor input was decreasing. The level of nationalization was increasing from 73% to 81% (Table 10). This shows that the company strives to increase the amount of local employees with taking into account the professional development of Kazakhstani workers by the organization of trainings and internships.

Table 10.Labor input and the level of nationalization on Kashagan project, thousand man-hours

Source: (Recruitment and Resourcing Policy & Procedure 2012)

	March 2013	April 2013	May 2013	June 2013	July 2013	August 2013	Septe mber 2013	Octob er 2013	Nove mber 2013	Decem ber 2013	Januar y 2014	Februa ry 2014
Labor input	15,070	14,349	13,959	10,960	5,587	5,602	5,570	4,995	4,854	4,852	4,852	4,852
Labor input (foreign citizens)	3,998	3,513	3,274	2,307	1,026	1,029	981	964	894	900	900	900
Labor input (Kazakhstani citizens)	11,072	10,836	10,685	8,653	4,562	4,574	4,590	4,032	3,960	3,952	3,952	3,952
Nationalizatio n of the personnel	**73%**	**76%**	**77%**	**79%**	**82%**	**82%**	**82%**	**81%**	**82%**	**81%**	**81%**	**81%**

5.4.2. Training and professional development of personal

NCOC pays attention to training and professional development of employees. Training and career enhancement are provided to citizens of Kazakhstan. The company has founded the Atyrau Training Centre, the place where people receive training. According to available

data more than **151million USD$** was spent on maintenance of the centre in order to create specific conditions for training (NCOC Manpower Plan 2011). More than 1.000 specialists of technical and production services have been trained within the framework of the training program. The budget of training local company employees was **USD$ 53 million** from the period 2002 to 2013.

The program of training employees has taken into account the training of governmental officials. According to official data, the number of people who were trained was 784. More than 1,938 of the Company's local specialists were trained in 2012. In total, more than 12,000 local employees have been trained since 1998 (Training and Development Procedure undated). NCOC is open for students and according to existing cooperation with several universities, such as Atyrau State University named after Dosmukhamedov, Atyrau Oil and Gas Institute, Atyrau Engineering and Humanitarian Institute and 9 colleges, NCOC attracts students for internships and work on Kashagan.

There is a mention about the International Posting Program, which aims to send candidates for internship abroad. The result of the program is 32 completed internships and the number will increase. The annual budget of the program is 20 million USD $(NCOC Scholarship Policy 2012). However, this number seems suspicious. The situation with money manipulation in Kazakhstan is widespread, and there were cases when oil companies 'spent' money on training purposes, but in sober fact spent it on private purposes. Thus, the claimed amount of money spent by NCOC for training purposes is impressive. In addition, some programs are expected to have an annual budget which will guarantee the maintenance of manpower development.

Kazakhstan has already had good experience in realization of social activity programs by international companies that work in Kazakhstan. One of these companies is ArcelorMittal Temirtau. Their social activity included building of schools and kinder gardens. The same expectations are for the NCOC Company. According to the social activity, company-operator is willing to develop local communities through the implementation of social infrastructure projects and the performance of sponsorship and charitable events.

5.4.3. Social Infrastructure Projects (SIP)

The most important aspect about social contribution of Kashagan development is that the company will allocate 1% of the project's development expenditure to the social infrastructure projects (SIP) (Procedure for Managing the Social Infrastructure Projects

Process 2010). The forecast is that the company-operator will spend 508 million USD on social projects.

The social infrastructure projects imply the putting up of money to:

- ✓ Education
- ✓ Healthcare
- ✓ Infrastructure
- ✓ Culture and Sport

The mechanism of implementation the social infrastructure project requires cooperation with local authorities (akimats). SIP selection criteria are also in effect at Operator level. When selecting social investment facilities, the Company is governed by the following principles (Procedure for Managing the Social Infrastructure Projects Process 2010):

- Implementation of the social infrastructure projects will benefit society as a whole;
- The Project complies with SIP cost effectiveness requirements aimed at ensuring the region's social development;
- The SIP user/beneficiary can assume commitments relating to the future operation and maintenance of the SIP facility after its handover;
- The SIP is a sustainable development project in the region.

For the oil and gas oriented region, the projects regarding life conditions such as housing improvement, public health promotion, opening youth centers for children and organizing recreational areas with good environmental conditions are of great importance, because Atyrau region as an industrial region has environmental problems and as a result problems with human health.

Moreover, due to the transition to the production stage and the increase of total capital expenditure, it is anticipated that the amount of money for social infrastructure projects will fall in the first period (2014-2019). Most of the SIP facilities for Phase 1 will be completed by 2015-2016. An increase in the SIP budget is only planned for the second period (2019−2030) with the development of new Kashagan objects. This situation will entail social dissatisfaction.

5.4.4. Sponsorship and charitable projects

This sphere of social contribution is significant and the experience of the National Oil and Gas Company 'KazMunaiGas' is an example to follow, because they have implemented a lot of charitable events such as visiting and supporting financially orphanages. In addition,

this company takes obligation to be a sponsor of different events (Official web resource of KazMunayGaz). A new international NCOC was allocated the annual budget for sponsorship and charitable projects in the amount of USD 1.5 million (Sponsorship and Donations Procedure 2013). Support is provided to projects which will be implemented in the centers of the Atyrau region. On average, up to USD 30,000 is allocated for one project (Sponsorship and Donations Procedure 2013). During this procedure requests are reviewed in several stages, including a legal due diligence of the beneficiary, and also an assessment of the priority implementation of the Project. The priority of projects is evaluated by the following criteria (Sponsorship and Donations Procedure 2013):

- The assistance of the project to the local community,
- The level of engagement of the local population within the framework of the project,
- The sustainability of the project (possible use of the project's results over the long term),
- The compliance of the project with the requirements of the Sustainable Development Strategy, the project's impact on local communities

The situation with social contributions through financial support of charitable events and social infrastructure projects of the Kashagan oilfield is really inspirational because of the claimed budget. However, it is impossible to know for sure, how it will works after the beginning of the oilfield's commercial production.

5.4.5. Health, safety and environment (HSE)

HSE is top priority policy for the oil and gas field. The HSE procedure is not mandatory in Kazakhstan. However, companies prefer to be involved in this system in order to guarantee the HSE performance. The system of management should be based on well-recognized international standards such as ISO 14001:2004, EMAS and OHSAS 18001:1999.22 (Palerm, Rudenko et al. 2005).The company should use stringent health and safety standards, involve modern equipment and rely on the best practices in oil and gas sphere. As Kashagan is an international project, there is possibility that the best practices of Chevron, Shell and other's participants will be taken into consideration.

NCOC has mentioned that close attention is paid to safety issues both at NCOC and at the Agents' levels. The company has a HSE department, which aims to comply and involve HSE procedures. The HSE management system of NCOC was certified in accordance with

ISO 14001 and OHSAS 18001 standards in 2011(Health Safety and Environment Policy 2010).

Occupational Health and Safety Adisory Services (OHSAS) standard shows the creating of healthy, safe and supportive environment which helps the organization to flourish. The standard takes into account occupational health, health and safety, occupational hygiene aspects. ISO 14001 is oriented on environmental management.

However, there is not enough evidence of proposed measures concerning health, safety and environment. The increase of oil production on Kashagan will cause a deterioration of human health and first of all the workers are at risk.

The conclusion regarding social impacts of the development of Kashagan oilfield is the following:

- NCOC has a wide range of projects devoted to social contribution of the Atyrau region. The biggest amount of money will be allocated for training purposes.
- The fact that the company will donate 1% of the project development expenditures on social infrastructure purposes, which include such spheres as education, health, infrastructure and sport will create a positive image of company in the Atyrau region.
- The promotion of English language programs in order to enhance interest among Kazakhstani people to learn the language and to obtain work place in international company such as NCOC
- The availability of OHSAS and ISO 14001 standards allows considering that there will be compliance with HES principles. However, there is no public access to the information of measurements regarding health, safety and environment.

The final conceptual model of Kashagan oilfield's social impacts is below (Figure 26). The model relies on all official and open information concerning social contribution of NCOC. The model reflects all financial flows that have already been spent or have annual budget. The more detailed information is described in the last chapter.

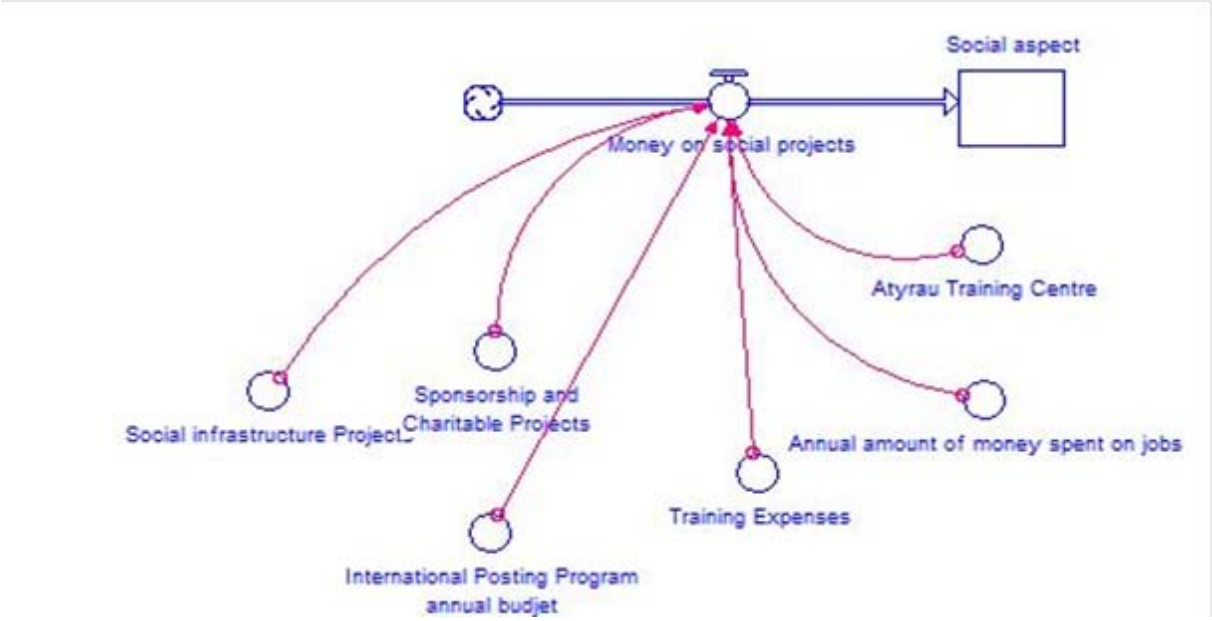


Figure 26. The conceptual model of Kashagan's social impacts

6. The description of "Kashagan oilfield's impacts" basic numeric model

In order to develop scenarios for the full model of impacts, it is important to take into account detailed and clear information concerning every indicator. However, there is a difficulty to get the required information. For this reason, the basic numeric model was created. The basic numeric model consists of economic, environmental and social impacts. Moreover, the model will take into account different scenarios depending on oil price and the amount of extracted barrels. The idea of the model is the conversion of economic, environmental and social impacts into financial flows (USD$) for the period of 40 years, from 2000 till 2040.

The model consists of three main flows which represent economic, environmental and social aspects of Kashagan oilfield's development. Each flow has its own set of indicators with the main criteria of data availability.

Economic aspect of the basic numeric model

The distinctive feature of economic flow is that the calculation of estimated crude oil price is based on the current prices of Brent platform (Figure 29). The price is calculated in accordance with extracted barrels of oil per year. Moreover, according to the International Energy Agency, oil price will rise 1.7% every year until 2040. This fact is also taken into account and presented as a converter which influences oil price. Thus, due to the variation of extraction rate, the model tests different scenarios of economic revenue during three phases of the project. In addition, the model takes into account capital costs of the project in order to make comparison with economic revenue after the beginning of the project.

Environmental aspect of the basic numeric model

The environmental aspect of the model consists of three parts. The first aspect concerns the approximate amount of money which will be spent on water purification. In order to treat 1 m^3 water in Kazakhstan it is supposed to spent an average 90 $ USD. Because of the fact that the consumption of water on the Kashagan oilfield is supposed to be around 3 million m^3, the expenses will compound 270 million $ USD per year.

The second aspect of environmental aspect deals with wastes storage. The rates of waste storage are calculated in accordance with Environmental Code of the Republic of Kazakhstan (Table 9). According to available data, the oilfield will produce 'amber' and 'green' wastes that should have tax.

The third aspect is environmental fines, which the Kashagan oilfield has already, due to the leakage while the first trial start in 2013. The company-operator of Kashagan was fined

by Environmental department of Atyrau region. This fact was taken into account and reflected in the basic numeric model (Figure 28).

Social aspect of the basic numeric model

Social impacts include the amount of money spent on social projects such as Social Infrastructure Projects, Sponsorship and charitable events, International posting program, Training expenses including Atyrau training centre, Local procurement and approximate annual amount spent on jobs (Figure 27). Moreover, the model takes into consideration the fact that for instance international posting program has annual budget and accounts the amount of money every year. In contrast, some expenses are calculated as onetime expenses during the period from 2000 to 2013.

Some components of environmental aspects are also calculated per year, whereas some of them are assumed to be onetime costs. For instance, environmental fines are calculated as onetime costs, whereas money spent on waste storage and water treatment is calculated annually.

The model demonstrates the financial flows of money, which will be received from the revenue of oil production with taking into account environmental expenses which will be supposed to spend on environmental taxes, water purification, waste storage and social expenses which will be allocated for the development of local employees. The model will make possible the comparison between all these flows in order to see the difference between economic revenue and environmental costs or between expenses that will be spend on social contribution and expenses that will be spent on environmental issues.

Moreover, the model reflects the monetary flow of capital costs of the Kashagan project in order to make comparison after the start of the project.

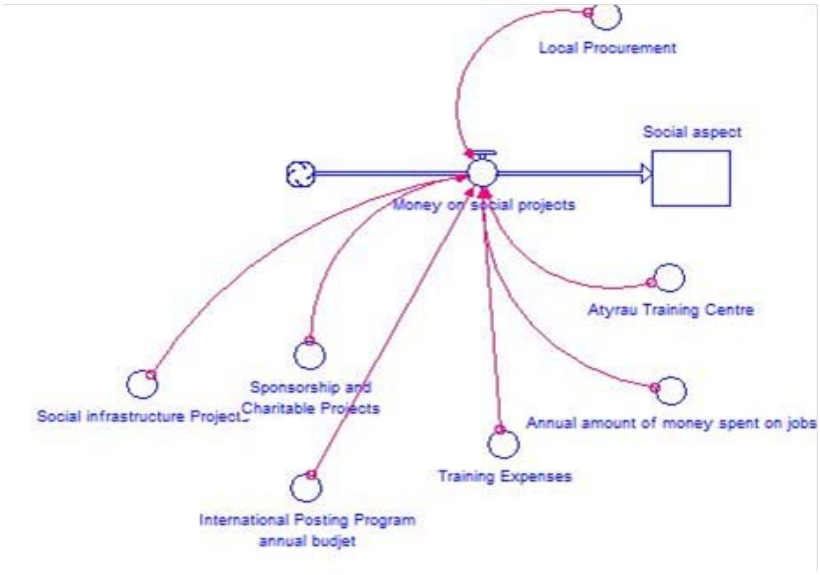


Figure 27. Social aspect of basic numeric model of Kashagan's impacts

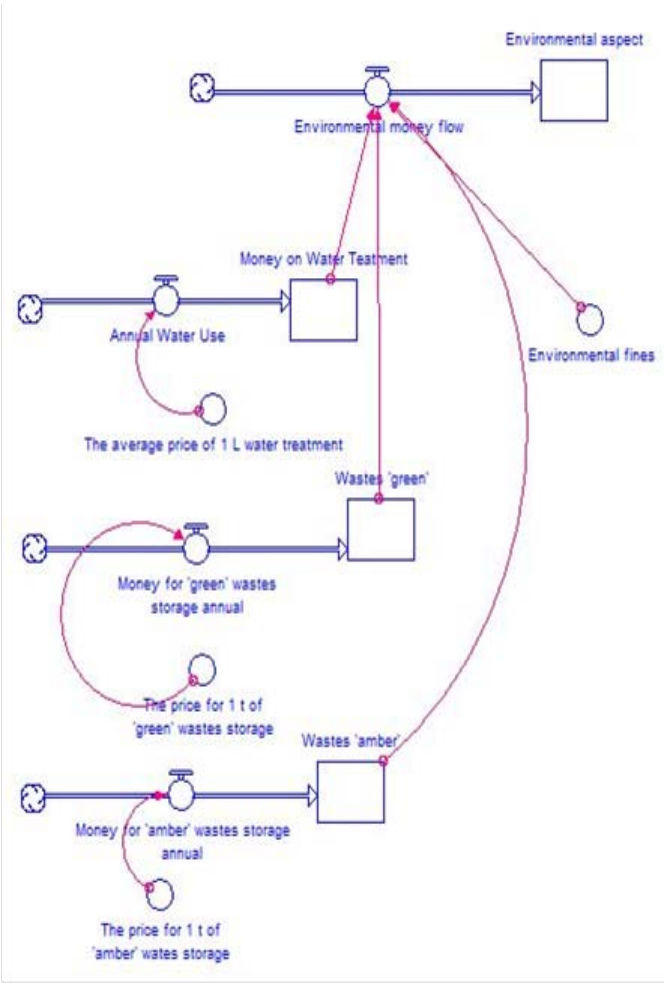


Figure 28. Environmental aspect of basic numeric model of Kashagan's impacts

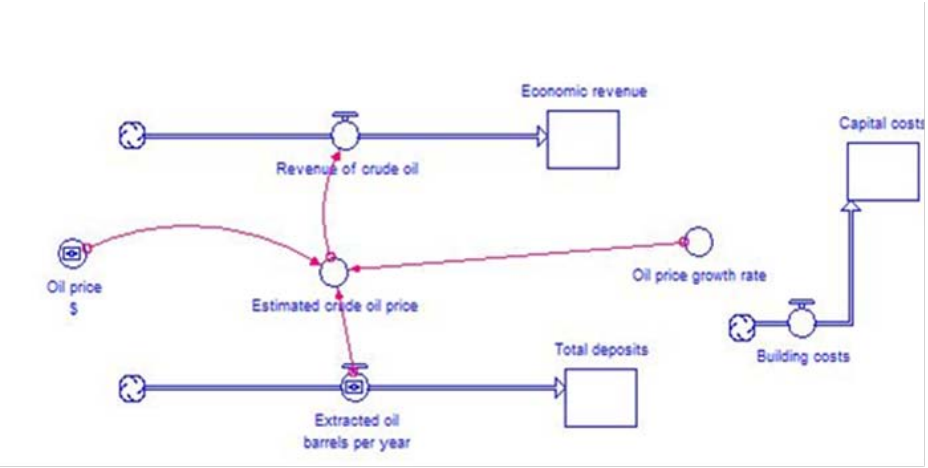


Figure 29. Economic aspect of basic numeric model of Kashagan's impacts

6.1. Scenarios' simulation

The result of the model is represented by graphs. The bar charts accumulated economic, environmental and social money flows. The model took into account four scenarios, depending on the amount of extracted oil barrels. The amount of extracted oil barrels was calculated in accordance with a claimed extraction rate by company-operator in different phases of oilfield development. The scenario 1, 2 and 3 has the same oil price 63.20 USD$ (the current oil price of Brent platform June 5th2015).

Scenario 1

During the period of forty years (2000-2041) with oil price 63.20 USD$ and oil extraction of 54.750.000 barrels per year, the highest financial expenses will be spent on environmental issues (Figure 30) The reason of this is the huge amount of environmental fines due to leakage of sulfur and other greenhouse gases in 2013. In the period of exploitation, the economic revenue will exceed the amount of the project's capital costs. Money spent on social issues will accrue the minimal number. The main result of this scenario is that during the period of Kashagan oilfield's functioning, the economic revenue from the realization of crude oil will not exceed the amount of money spent on environmental issues. Such scenario seems very unpleasant as for the company-operator as for the government of the Kazakhstan. The low price on oil will cause crisis in the country and the development of Kashagan will be economically unfeasible.

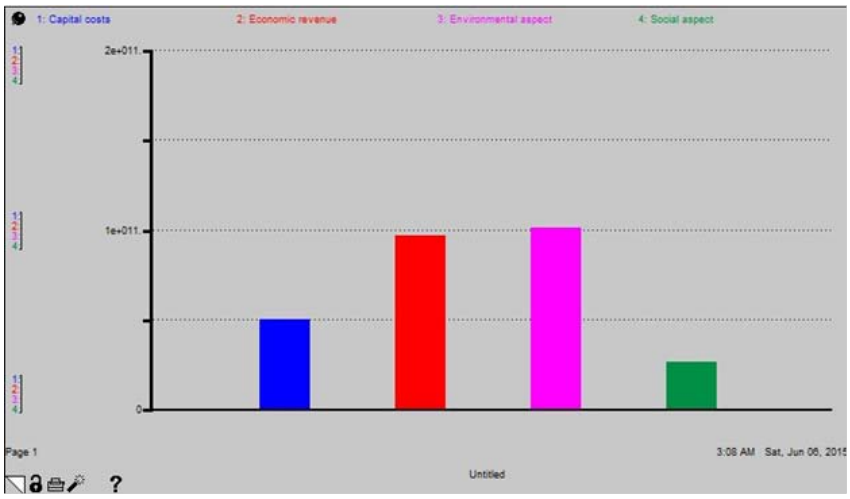


Figure 30. Scenario 1 simulation

Scenario 2 and Scenario 3

During the period of forty years (2000-2041) with oil price of 63.20 USD$ and oil extraction of 273.750.000 barrels per year, the highest financial flow will be economic revenue from the realization of oil (Figure 31). The same result will be from the third scenario with maximum oil extraction of 363.905.000 barrels per year (Figure 32). Economic revenue will exceed environmental costs by more than four times, capital costs more than nine times and social costs more than seven times. However, environmental expenses are significant, exceeding capital and social costs. Environmental costs will be even higher than capital costs of the project which is 48 billion USD$. However, social contribution for the period of forty years will be also significant.

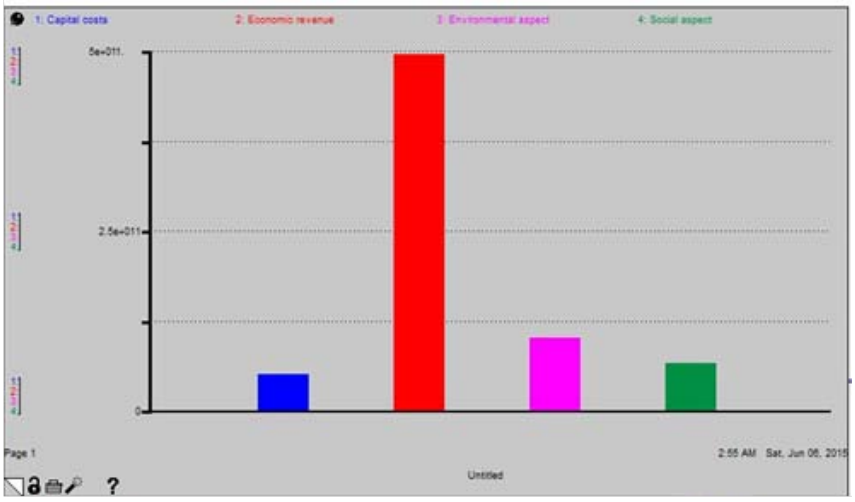


Figure 31. Scenario 2 simulation

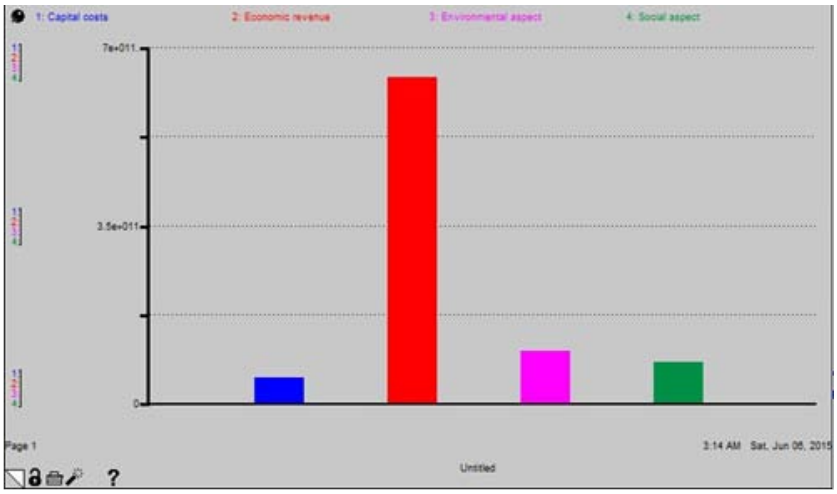


Figure 32. Scenario 3 simulation

Scenario 4

The fourth scenario was developed on the condition of an oil price of 89 USD$ and extraction of oil of the first phase 54.750.000 barrels per year (Figure 33). The result is that in the period of forty years with the minimal amount of oil extraction, the economic revenue will exceed environmental, capital and social costs. Figure 33 reflects the accumulation of money during the period. The current situation concerning oil price changes rapidly, so this scenario is likely to happen in the nearest future.

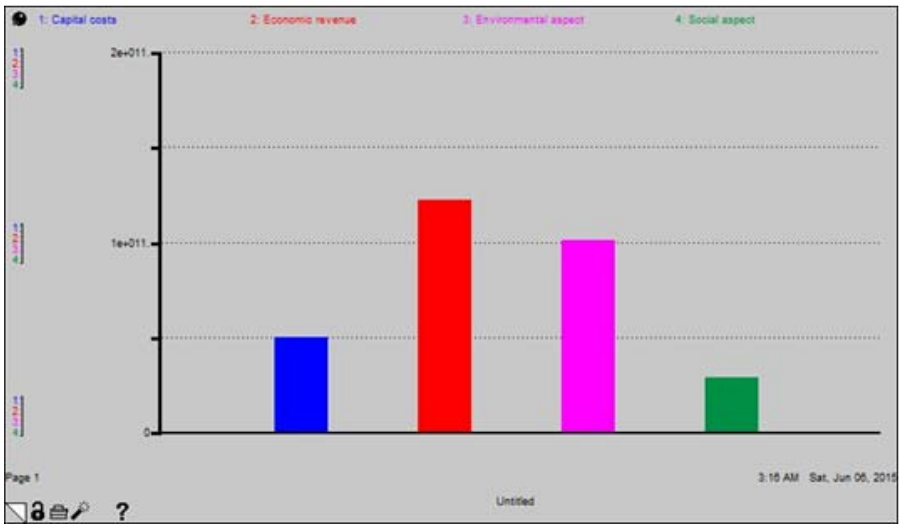


Figure 33. Scenario 4 simulation

The available data provide a means of creation of a basic numeric model of Kashagan oilfield's impacts. Due to the current situation with global oil prices the first scenario is probable and the result of this scenario is not optimistic. However, in the case of the increase of oil extraction, which will surely happen because of the existing plan, the economic revenue of oilfield will be enormous. Environmental costs will be considerable and for the period of forty years will be equal to capital costs of the project. Social contribution of the oilfield will have a minimum flow of money, which is seven times less than economic revenue.

Kazakhstan relates to the group of countries which has substantial revenue from oil extraction and export. That is why the change of oil price will have immediate impact on the GDP of country. In 2012, every one dollar change in oil price in Kazakhstan correlates to 100 million USD$ change in budget revenues (Kaiser and Pulsipher 2007). This is the main risk in countries with petroleum industry.

'The budget of Kazakhstan is set on the price of oil being $103 per barrel, and the budget for 2015 is pinned on oil being $90 a barrel, though this forecast is being revised down to a possible $80 a barrel. Also, like Russia, the Kazakh state has large reserve funds -- $21 billion in currency reserves and $76 billion in the state's National Fund. As oil prices slump and the expansion of oil production faces delays, the Kazakh government will have to either start spending its reserves or cut state spending across the board'(Stratfor Geopolitical Diary 2014). Economic issues in Kazakhstan can quickly spiral into protests and violence among the population (Kazakhstan:OIl & Gas Report 2014). Nevertheless, the government of the Republic of Kazakhstan has long-run expectation regarding oil price(Stratfor Analysis 2013).

7. Conclusion

The conducted analysis showed that the Kashagan oilfield was complicated and in some aspects was problematic. The environmental aspect of the oilfield's development must be taken into account first and foremost. The Kashagan oilfield represents challenging conditions due to natural characteristics such as severe climate and the peculiarities of oil's occurrence. All these facts make someone sit up and take notice concerning the future harm that Kashagan will make while the extraction of hydrocarbons. Another outrageous issue is the huge amount of environmental fines, which already have been detected. The situation with high pressure in oil wells can cause numerous leakages and as a result cause considerable environmental harm and financial penalization. Even with the availability of documents regarding health, safety and environment, there is a high risk because one serious accident has already occurred. The Caspian Sea is a unique ecosystem with rare representatives of flora and fauna. The rapid progress of oil extraction in this region can cause significant problems with the ecosystem's condition. The issues regarding waste storage, water treatment seems unsolved yet. Thus, the risk of an accident is increasing. The developed models showed that the environmental expenses of the Kashagan oilfield is remarkable and exceed expenses that focused on social issues. All these facts must be taken into deep consideration in order to make sustainable compliance of oil extraction and production.

The contribution to the social aspect of the Atyrau region's development will have favourable impacts due to the availability of a great number of programs devoted to the social contribution of the region. The list of programs includes student supportive events, training and professional development of local employees and the involvement and sponsorship of social infrastructure projects. The development of the Kashagan oilfield will have immediate effect on the creation of work places. However, there is a risk that people with good knowledge of English language will move from their initial occupation (for instance teaching) to the sphere of oil and gas. The further deterioration of water and air quality can be another negative impact on the social life of the region and it can cause social discontent.

The positive economic contribution of the Kashagan oilfield will be the stimulation of local market by the process of purchasing local goods and services. During the construction phase, Kazakhstani companies have taken beneficial position.

Economic contribution of Kashagan will be also significant due to the large amount of oil extraction. As scenarios showed, with the current relatively low oil price, the project will be financially feasible and financial flows during the 40 years period from export of oil will

exceed the capital costs of the project. Nevertheless, there is a potential risk concerning the oil price for the Republic of Kazakhstan, because the economy of the country is oriented on the oil industry. The fact that Kazakhstan has strong dependence on oil price and that is why there is a risk of crisis due to the low price on oil. Thus, the project of Kashagan has not a hundred percent guarantee of the pleasant situation in future.

Another negative point that could happen with the petroleum industry in Kazakhstan is the phenomena of 'Dutch disease' that affects countries with oil resources. It is supposed that the oil boom makes the economy richer and better. The development of oil and gas industry strengthens the national currency and more and more money comes into the country. But the problem occurs in the export of goods because the other sectors of the economy become no longer competitive in comparison with countries, which do not export oil. The country becomes dependent on oil and more people strive to get a job in oil industry. Moreover, there is a risk of corruption on local and national level due to the huge amount of money.

The government of the Republic of Kazakhstan must continue the strict control of the violations from North Caspian Operating Company, which operates the development of the Kashagan oilfield. Because only governmental control could handle the situation concerning negative impacts upon environment. In order to avoid governmental fines, the company-operator must improve properly the Health, Safety and Environment system, with taking into deep consideration the problem regarding greenhouse gas emissions and other issues like sulfur storage. The information concerning environmental aspects of the oilfield must become accessible for public in order to get involve society in the future development of the region. In addition, with the current unstable situation with oil price, the future life of the petroleum industry of Kazakhstan seems unclear.

However, the government of Kazakhstan has expectations regarding the increase of oil prices. At best, the Kazakhstan will prosper and the contribution to economic and social situation will happen. At worst, the development of country will be limited to the petroleum industry

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