BUSINESS CONSULTANCY PROJECT

“OPTIMIZATION OF BAKU-SUMQAYIT PASSENGER TRAIN”

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Abstract

Today urbanization and globalization has become a constant process, which has a huge impact on the lifestyle of people. According to the modern research, more that 50 % of worlds' population live in cities and by 2030, 6 out of 10 people will live in cities. Growth of population, popularity of tourism, globalization trends, work preferences and many other factors tremendously increase transportation needs. People choose public transport for long and short distances, and, since modern life style promote "time is money" slogan, people prefer transport which is fast, comfortable, safe along with the ability to combine travel with work. All these options are offered by public railway transport.

Railway is one of the most ancient and popular transport system in the world, efficiently used both for cargo and public transportation, and despite all evident benefits of airplanes for Transocean routes and very long distances, railway keeps strong positions due to lower price and no need for long registration process and necessity to loose extra 2 hours in the airport.

In this Research Paper I have chosen the topic of passenger railway transportation efficiency increase due to several reasons. First, I myself work in ADY- a national freight and passenger transportation services provider in Azerbaijan, being one of the largest State-owned entities (SOEs) with the sole shareholder – The Government of Azerbaijan. Second, nowadays Azerbaijan lives the stable population growth, urbanization and needs the better development of infrastructure, where public transport is an integral part. Finally, I assume that since Governments become more conscious about environment, there should be projects on the increase of level of population awareness about ecology, and obviously, electrified railway is more preferable than diesel and gasoline vehicles, polluting atmosphere, creating traffic jams, and carrying less amounts of passengers.

In this Paper I have focused on the most popular passenger route- Baku-Sumgayit-Baku, which was launched in 2015, so I could gather more than 3 years data on its usage.

For the aims of this Research I have used such analytical tools as SWOT analysis, PEST and Porter's Five Forces, in order to be able to evaluate internal and external factors of public railway transportation in Azerbaijan, as well as the potential and weaknesses of ADY itself. Also, I have developed my proposals for efficiency increase, such as developing new pricing strategy and new transport schedule, which will serve better for the passengers, based on the analysis of alternative methods of transportation and Survey results. The results of my analysis have been set up in the form of recommendations to this BCP.

Key Words: ADY, Railway, Transportation, Passengers, Efficiency.

Acronyms

ADB - Asian Development Bank

ADY – Azerbaijan Railways

AFD – Agence Francaise De Developpement

AR – Azerbaijan Republic

AZN – Azerbaijan manat (national currency of Azerbaijan)

BC – Before Christ

BCP – Business Consultancy Project

BTK – Baku-Tbilisi-Kars

CAREC - Central Asia Regional Economic Cooperation

EBRD – European Bank for Reconstruction and Development

ERA - European Railway Agency

EU – European Union

EUR – Euro, National currency of EU

GDP – Gross Domestic Product

HR – Human Resources

HSBC - Hong Kong and Shanghai Banking Corporation

HSE – Health, Safety & Environment

ID – Identification Card

IFRS – International Finance and Reporting Standards

IT – Informational Technologies

LLC – Limited Liability Company

SOEs – State Owned Enterprise

SOFAZ – State Oil Fund of Azerbaijan

US/USA – United States/United States of America

USD- US Dollar (National currency of USA)

WB – World Bank

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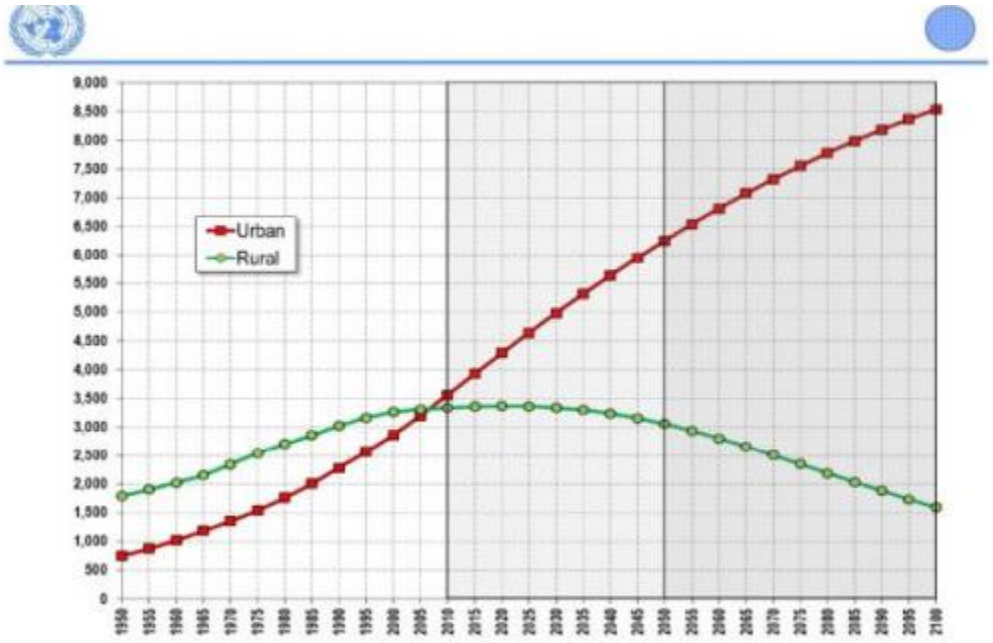
1. Introduction

1.1. Rationale of the Research

Today urbanization and globalization has become a constant process, which has a huge impact on the lifestyle of people. According to the modern research, more that 50 % of worlds' population live in cities and by 2030, 6 out of 10 people will live in cities. The tendency will only grow and reach 7 out of 10 by 2050 (Marijan Rajsman, 2013). These trends are demonstrated on the Figure 1 below. Moreover, modern terms of doing business almost omit distances, people travel worldwide for their business aims, and many of them do the business internationally or even globally. Additionally, people more and more choose to live and work distantly – they may live in a suburb and work in the business downtown skyscrapers, or even work in another city or country, which is very popular in many EU countries. Growing tourism trends are also to be to mention. All these have become a big challenge for passenger transportation, bringing additional needs for infrastructure development, schedule and routes optimization, pricing strategies flexibility and different social discount programs.

Figure 1 - World: Urban and rural Population 2010-2100



(Source: United Nations, Department of Economic and Social Affairs, Population Division (2012): World Urbanization Prospects, the 2011 Revision. New York)

Increasing cities result in increased need for public urban transportation, which includes metro, rail, buses, trams and, in some cities, water trams. Every city develops its transport systems due to its technical, geographical, economic, infrastructural and legal factors, as well as amount of population, their level of income, national culture and preferences.

According to Rajsman the main transportation system in cities with up to 100.000 inhabitants is the bus transportation system, but the increase of city's size and transport demand, the dominant system becomes the tramway. In developed countries, such as EU and US, local and regional trains are the most popular way of passenger transport (Marijan Rajsman, 2013)

Azerbaijan in located on the shore of the Caspian Sea, with its capital – Baku, being the main seaport of the country, as well as the largest air and railway hub. Being one of the main oil extractors in the Soviet Union, Azerbaijan, after its collapse, inherited a large and developed transportation infrastructure, along with the staff education system. Thus, there are Maritime Academy, preparing staff for Marine freight and passenger transportation, National Aviation Academy of Azerbaijan, Baku College of Communication and Transport. But after the collapse of Soviet Union Azerbaijan faced such challenges as lack of supply, repair and operational support, old coach fleet with 20% of the rail operating fleet 11-15 years old, 65%- 16-20 years old and 15% more than 20 years old. Out of a total fleet of 729 passenger coaches, only 490 were operational, with the rest being out of use awaiting repair or beyond their standard permitted service life (Wilson, 2006)

Azerbaijan Railways (further – ADY) is the national state-owned rail transport operator in Azerbaijan. Since 2010 ADY has been implementing different reforms in order to improve railway transportation system, meet the demands of the economy and citizens in Azerbaijan. One of the initiatives was the introduction of Baku – Sumgayit speed train. Sumgayit is located 30-40 km to the north from Baku and is the third largest city in Azerbaijan with population of 339 thousand people. It was founded in 1949 and became an industrial center in a short period during the Soviet period. After the collapse of the Soviet Union industries stopped their activities, however, new industries have lately been created.

Even though railway network of ADY is rather wide and still in the process of broadening, for the aim of this Research I have decided to analyze the optimization of operation of Baku-Sumgayit- Baku speed trains, launched in 2015.

1.2. Problem Statement and Research Objectives

The formulation of the problem of scientific research is, in fact, the crystallization of the intent of scientific work. Therefore, the correct problem statement is the key to success. In order to correctly detect a problem, it is necessary to understand what has already been developed in the chosen topic, what is poorly developed, and that nobody touched at all, and this is possible only on the review of the available literature.

The clear problems statement often has no less importance than the solution of them. Essentially, it strongly determines the research strategy in general and the orientation of the scientific research. It is assumed that formulating a scientific problem is to demonstrate the ability to distinct the paramount from the secondary,

to observe the existing progress of science in this field and what is still to be investigated about the topic of the research.

The literature on railway scheduling is very broad. Optimization of railway scheduling can be made in several ways: through minimization of the costs, through minimization of passenger waiting times which increases customer satisfactions, through maximizing revenues and so on. Some papers tried to estimate the most commonly used routes and tried to increase the satisfaction of those users. The approach taken in those papers was to estimate origin-destination matrix through simple counting method at each railroad or through surveys/interviews with passengers (Jörnsten K., 1993)

Another method of optimization is to increase the customer satisfaction. One way to do so, is to decrease the amount of the heavy crowding in the trains. This can be done through estimating maximum number of travelers in a certain period, so that correct number of trains would be scheduled during that period (Bussieck, 1996) More detailed analysis of such optimization would require taking cost constraints into account as well (Claessens, 1995)

As we discuss in the methodology section, the optimization problem we face has natural constraints due to the number of trains available and the structure of the railways. Therefore, the problem we face is more like a constrained optimization. Several papers have dealt with such constrained optimization problems in public transportation (Serafini, 1989)

One of the aims of this Business Consultancy Project is developing the optimal schedule for Baku-Sumgayit trains. However, due to some unpredicted changes such as preferences of people, prices of close substitutes, number of the trains available, and so on, the calculations made based on collected data may not be perfect. Therefore, once the optimal schedule is designed and implemented for several months, it can be re-optimized based on the collected data. In fact, this becomes a current trend in the railway industry: they shift from planning in advance and in detail to effective real-time control method (Caprara A., 2007)

The main Research Objectives of this Business Consultancy Project are:

Developing Optimal Schedule: Based on the data we will obtain from ADY and the ideal time of departure that we will estimate through the surveys, we will construct optimal schedule both for weekdays and weekend, which will minimize the waiting time of the passengers and maximize revenue without increasing costs as much.

Defining Pricing Strategy: Based on the past behavior of the passengers on both price and schedule change and based on the information on frequency of usage collected through survey, we will design several pricing strategies which will mainly differentiate frequent users and students from the remaining customers.

Thus, the **Problem Statement** of this BCP can be formulated in the following way **– The Optimization of Baku-Sumgayit Passenger Train's Operational Activity.**

1.3. Research Question

A research question is the core of any research project. It outlines the main questions that should be asked by a researcher in order to achieve the research objectives, defines the methodology and guides the researcher during all stages of his work. It usually begins with the research problem and covers the areas of concern, conditions to be improved, challenges to be overcome and questions that need answer.

As we know there are three types of the Research question - Descriptive, Observational-Relational, and Causal (Kirkpatrick, n.d.)

For the aims of this Research the Descriptive type of Research question has been chosen.

Below we can see the main characteristics of good research questions:

- ✓ Feasible
- ✓ Clear
- ✓ Significant
- ✓ Ethical (Writing Research Questions, 2009)

For the aims of this Research, I have addressed the following research question: **How to optimize the Baku-Sumgayit Train operational activity and enhance the efficiency?**

To answer this research question, the following sub-questions will be used:

1. *What is the frequency of the usage of Baku-Sumgayit-Baku speed trains?*
2. *Do our customers prefer one-way trips or round trips? Who is our current and potential customer?*
3. *What are the alternative methods of transportation? Who are our main competitors on the market?*
4. *What is the ideal time for the departure for our passengers?*

Each of these questions should be deeply analyzed.

The frequency of the usage: For each train, we want to estimate what percentage of the users are daily users and what percentage are using this train rarely. This proportions will be an estimator for the true proportion of the daily users for each train. Given the actual usage levels, using these proportions, we will be able to estimate the number of daily users for each train. This information is useful in analysis of new pricing strategies Monthly pass card users that we discuss in that section purely depends on the daily users, as they are the ones who are target audience for these pass cards.

One-way or round-trip: We want to estimate the overall percentage of people who use this train in both directions. Once again, this information will be useful in analysis of new pricing strategies.

Alternative methods of transportation: We want to understand the percentage of the users who use our trains, and those who use alternative methods of transportation, and which ones. This analysis will help us in several ways. First, it will help us to understand the price elasticity of demand: if people treat this trains as their only option, they are less price sensitive as opposed to the people who may use bus or taxi as alternative method of transportation. Secondly, it will help us to estimate the percentage of the users that we may attract by optimizing our schedule. That is, if a person uses a bus as an alternative method of transportation, then since the price of the buses are cheaper and the schedules are pretty much fixed, the main reason to use this alternative is the low price of the buses. On the other hand, taxi prices are at least as much as the train price, but their schedule is more flexible. Therefore, if a person uses taxi as alternative method of transportation, this maybe mainly due to the convenience of the schedule. Therefore, re-optimizing the schedule, may help us to attract the people who use taxi as alternative method of transportation.

Ideal time of departure: Although the previous three items will be useful for us for the reasons described above, the main purpose of the survey will be to collect the ideal time for departure. Information ADY possess is the number of passengers using each specific train. Changes in the schedule are usually done based on the actual number of users. However, without knowing the ideal departure time for the passengers, it is impossible to estimate the usage level under new schedule. For example, it is possible that some passengers who are using 8:00am train would prefer to have used an earlier train, if there was one, and some passengers using this 8:00am would use a later train. Therefore, for some passengers the ideal time of departure maybe earlier than the actual time of departure, but since there is no train at that time, they wait for this one, and for some passengers the ideal time of departure maybe later than the actual time of departure, but since the later train is too late for them, they take this train and arrive earlier than they need to. For each train, we designed train-specific time interval, so that people can pick their ideal time of departure for this train. Except for the first and the last train, and also for the trains just before and just after the afternoon break, for each train we designed an interval of 40 minutes (20 minutes before and 20 minutes after), giving 9 options with difference of 5 minutes, including the actual time of departure as one of the options (Aslanov, 2018)

1.4. Research Approach, Research Design and Research Methods

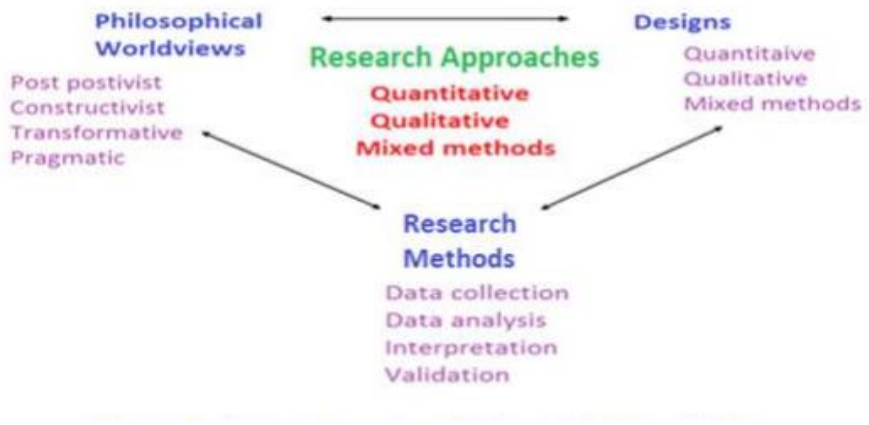
Before starting to write any academic paper, it is essential to define certain research approach, research design research methods, data collection tools, data processing and interpretation and techniques in order to be able for the systematic study of a problem. Therefore, a research approach means the strategy for research that combines the steps from broad assumptions to certain methods of data collection, analysis, and interpretation. First, it is essential to decide which research approach will be used to study the problem.

COMPONENTS OF RESEARCH APPROACH: There are 3 (three) basic components of a research approach- philosophical world view, research design and research methods. Moreover, the chosen research

approach must match the selected research design and methods. Research design is the overall strategy, chosen to approach the problem and integrate various components of the study in a logical way, leading to the efficient problem solving.

Finally, the research methods are ways to get the information and address the research question. The choice of these methods may differ due to the nature of research problem. For example, when choosing a qualitative research approach, the researcher must also choose a qualitative research design. This interconnection is demonstrated on the Figure 2 below (Grover, 2015)

Figure 2 - Interconnection. Philosophical worldview, Design and Research Method ((Grover, 2015)



As we know, there are 3 (three) methods of research approach:

- ✓ Quantitative - approach, measuring in numbers. The data is collected by individual or group interviews, using participatory research, documents analysis and ethnographic study;
- ✓ Qualitative – approach, using words and images. The data is collected by written surveys and is preferred for demographic study, statistical analysis and experimental study.
- ✓ Mixed – combining both previous methods.

For the aims of this Business Consultancy Project the quantitative method has been chosen, because the Research questions of this study implies working with numbers and figures, making the statistical analysis of the data collected and statistical interpretation of the data. The primary data was collected by means of a short survey (Appendix 2), designed particularly for this research and combining all necessary questions. It was spread among the passengers of Baku-Sumgayit-Baku speed trains by the employees of ADY. The Questionnaire consists of 4 (four) multiple choice questions, which make the survey very strict and monosemantic. This method of survey has its pros and cons – it gives a respondent enough time to think over his answer, but it is cost effective when reaching a large audience.

In this Research the Case Study Design was used, as we are applying a particular research problem of a particular company and doing an in-depth study of it. Even though this design is often criticized for being

biased and requiring longer time, it is gaining popularity among the researchers, because it is not restricted by a certain research approach, but, being empirical, can be applied to both qualitative and quantitative research, depending on a case studied (S. Teegavarapu & J. D. Summers, 2008)

1.5. Scope and Limitations

Since the objective of this BCP is to optimize the train schedule and to propose new pricing strategies, the following data was collected:

- The information about usages of each train for past 3 (three) years. For years of 2015 and 2016, we only have daily total number of passengers using the train. However, for 2017 and 2018 we have the number of passengers using each of the trains during the day, and the distribution of the stations "from which - to which" they were travelling.
- The schedule changes made during past 3 (three) years
- The price changes made during past 3 (three) years

However, ADY does not possess some other important information about passengers, such as what proportion of passengers are daily users, what proportion use round-trip/one-way, what is the ideal time of departure for people and so on. In order to obtain this information from passengers, we plan to conduct survey among the passengers for period of 2-3 weeks. The main purpose of this survey was to give us information on:

- The frequency of the usage of passengers: whether they are daily users or one-time users.
- Whether people use the train for one direction or for round-trip.
- The alternative methods of transportation people use.
- Ideal time people would like to take the trains.

1.6. Feasibility and motivation

Given that I have obtained most of the data from ADY directly, analyzing those data would not require much of the time. As for the survey, I needed 2-3 consecutive weeks to conduct it in every one of 11 (eleven) trains in each direction. Since we have not required same people to fill the survey twice, I believe most of the customers who are daily users were surveyed within the first week of surveys, while the surveys from remaining customers was collected during following 2 (two) weeks. Once having collected all the data, I needed 2-3 months to analyze the data, design optimal schedule for the trains, which requires solving constrained optimization problem, and design new pricing strategies.

I was appointed as a Deputy Chairman at Azerbaijan Railways in July 2016. As a curator of finance department, I have full access to all database that can be used as a research material. Therefore, obtaining past data on usages and any other necessary information for ADY would not be an issue.

Moreover, it allowed me to organize the surveys in the trains where ADY stuff appeared to be very helpful in conducting it.

1.7. Outline of the Thesis

This Thesis consists of 6 (six) chapters in the following manner:

Chapter 1 makes introduction to the Research Paper, explains the rationale of the study, gives information about the Problem Statement and research objective, states the research question and sub-questions, outlines the research approach, as well as highlights scope and limitations of the research, followed by feasibility and motivation description.

Chapter 2 gives the information about the Company (ADY), its history and background, main and secondary fields of operational activity, organizational structure, products and services provided. In this Chapter the information about Baku-Sumgayit Stadler is provided, as well as some graphics and charts, describing the amount of the passengers in this direction, the monthly tendencies, and preferences. SWOT analysis and Porter's 5 Forces analysis are included into this Chapter.

Chapter 3 is dedicated to the role and governmental support in the development of railway in Azerbaijan. This Chapter also includes PEST analysis.

Chapter 4 is called Literature review, because it highlights what has already been done in the field of the study, concerning railway efficiency, optimization and passenger transportation and pricing strategy.

In Chapter 5 the Methodology of the research is described, research instruments selected, as well as the ways and methods of data collection and data processing are depicted. Here we analyze validity and reliability of the research and pay attention to the ethical issues.

Finally, the Chapter 6 we dedicate to findings and discussions, data analysis, conclusions about preferable pricing strategy and optimal schedule, and give final conclusions and recommendations. Thus, here we try to answer our main research question.

2. Company Portfolio

2.1. History of ADY

Azerbaijan Railways SJSC (ADY) was first established in 1880. It is a national freight and passenger transportation services provider in Azerbaijan, being one of the largest State-owned entities (SOEs) with the sole shareholder – The Government of Azerbaijan. The development of railways in Azerbaijan started in

late 1870s due to the oil extraction boom and necessity for oil transportation. In 1878 the first railway of 20 (twenty) km length was built between Baku-Surakhani-Sabuncu.

Since then, the Azerbaijan railways have been developing and improving following the growing demand for cargo transportation. At present, the total length of railroad tracks is 2910.1 km, operational tracks are 2079.3 km long, 802.3 km of which are double tracks. 1241.4 km or 59.7% of the total length of the railroad are electrified, while 40.3% are still operated by diesel traction. 1527.7 km of tracks are equipped with the automated signaling system (Our History, n.d.)

The legal structure of ADY has been changing several times. During the Soviet period it was submitted to the "center" in Moscow. Later, after the collapse of the Soviet Union, it was submitted to the Ministry of Transport of Azerbaijan Republic. In its present form ADY was established in 2009 by the Decree of the President of Azerbaijan to reorganize the national rail operator into a separate state-owned legal entity. The current legal structure of ADY is shown on the Figure below.

Figure 3– Legal Structure of ADY

ADY includes several fully owned subsidiaries:

- ✓ Nakhichevan Railways LLC – provides freight and passenger transportation services on the territory of Nakhichevan Autonomous Republic;
- ✓ ADY Express LLC – provides freight forwarding services and its marketing;
- ✓ Capital Repair LLC – designs investment process with other units and facilitation of operational management of capital construction and repair works;
- ✓ Demiryolservis LLC – provide repair and reconstruction services, railways installation, production and sale/purchase of equipment and materials;
- ✓ Specialized Railway Enterprise 5 and 11 LLC – focuses on designing and construction works of bridges, subways, side streets, accesses to railway stations and other infrastructure projects;
- ✓ Other legal entities, such as "Office supply and services" LLC, Medical Sanitary Services, "ADY Property" LLC, Azerrail SCJC, Locomotive, ADY Container LLC and others (PWC, 2018)

The organizational structure of ADY is demonstrated in the Appendix 4 to this Research.

2.2. Products and services

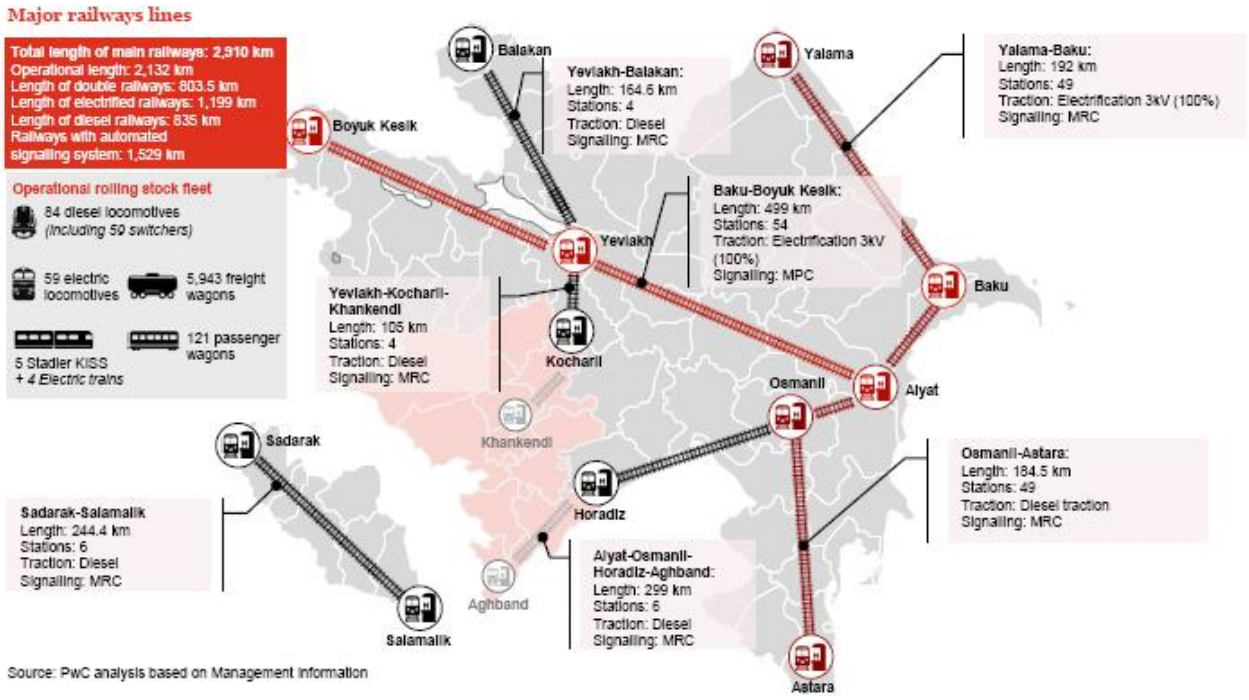
ADY is providing freight and passenger transportation services. Freight transportation accounts for 83 % of ADY's 2017 revenue. This revenue is separated into four segments – transit (32 % of ADY's 2017 freight revenue), import (37%), export (25%) and domestic (7%).

Passenger transportation accounts for 5 % of ADY's 2017 revenue, separated into two segments – local (57% of ADY's 2017 passenger revenue) and international (43%) passenger transportation (PWC, 2018)

In terms of local passenger transportation ADY offers transportation services to:

- ✓ Baku-Sumgayit (introduced in 2015)
- ✓ Baku-Suburbs (excluding Sumgayit)
- ✓ Regional lines. Below we can see the Map, demonstrating major railways lines of ADY

Figure 4 – Major railways lines



In terms of international transportation services ADY provides transportation to Ukraine, Russia and Georgia.

During 2013-2017 the revenue from passenger transportation has declined due to the several reasons:

- ✓ The closure and frequency reduction of several international routes as a result of lower occupation rates of these routes;