AMERICAN UNIVERSITY OF ARMENIA

FINAL PROJECT REPORT

Raw materials procurement for "ARMENMOTOR" Plant

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1. Executive summary

The production of the "ARMENMOTOR" Plant receives raw materials (magnetic steel, wire and aluminum) from Russia and some other CIS countries. Therefore functioning, profitability of the plant , cost and competitiveness of its production are highly dependent on reliability and stability of procurement channels. Current blockade of Armenia and deep economic crisis deteriorate the industrial environment and hinder the existence of the stable transportation routs and channels.

a. Project Objectives

The presented research project is aimed to identify, develop and optimize the raw materials procurement channels for "ARMENMOTOR" plant.

The current turbulent situation in Russia and other CIS countries as well as the permanent blockade of Armenia necessiates the thorough consideration of different risk factors tied to the transportation problem. The effort was made in the current research to address these factors. They are identified, assessed and quantified along with nominal costs involved. The objectives of the project are:

- identification of existing and potential transportation channels and routs;
- evaluation of storage facilities at the plant;
- elaboration and segmentation of possible transportation schemes;
- analysis of other significant factors , i.e. safety and speed of delivery;
- integer programming and EOQ analysis applied to transportation problem;
- recommendations of the optimal action to be taken, based on the above criteria.

b. Findings:

1.Storage capacities of the plant:

The plant totally can store 6,000 tone of raw materials. The policy of the plant is to keep 3 months safety stock, which totally sums 2,100 tones of raw materials.

2.Production capacities:

Sea transportation can be used as an intermediate service for avoiding the dangerous railroad rout in Abkhasia

c. Technique used.

The approach that is used in the present study consists of the following stages:

1. The delivery routs provided by services of different transportation companies are identified;

2. Based on that routs transportation schemes are developed and segmented;

3. Risk and nominal cost constituent factors are calculated for the transportation schemes;

4. Integer programming model is conducted with target function aimed to channels with minimal costs of transportation;

5. EOQ analysis is conducted for the transportation channels identified at the integer programming analysis.

To verify validity of the model two scenarios with different weights of risk factor and capacities of the transportation channels are tested and compared.

d. Brief recommendations.

Based on the information compiled and on the results of the transportation models simulated it can be recommended to "ARMENMOTOR" to deliver wire (420 tons) and aluminum (1275 tons) from the suppliers' sites to the Stavropol by trucks and then transfer them to the planes for the further shipment to the Yerevan. The "Imak" company can be contracted to serve the whole that transportation channel. About 6,650 tons of enameled wire should be delivered to the Russian port on Black Sea (Novorossiysk) by the train and then transferred to the ship for further delivery to the Batumi. For sea delivery "Net" and "TECH" companies are to be bid. Then the freight is to be delivered to Yerevan either by the train if situation will allow ("TECH" can be contracted), or by truck columns.For latter one the Transportation Ministry is to be contracted to organize. About 5 (350 tons) wagons of magnetic steel should be tried to deliver directly from the supplier's site to the plant via Georgia during the year. About 2 trucks of the wire should be delivered directly from the supplier's site to the plant by the plant's trucks during the year.

Maximum production capacities of the plant is 100.000 units (engines) monthly. Currently plant is operating at 30% of its maximum capacity.

3. Information on suppliers:

As a suppliers of "ARMENMOTOR" can serve the industrial centers or xchanges in Russia that can sell the raw materials the plant is interested in (namely [illegible] steel, enameled wire, primary and secondary aluminum)

The plant currently processes the raw materials bought in 1992 from the following metallurgical plants: Cherepovets, Novolipetsk, Temirtay, "Kirgizkabel", Cable Plant", "Chuvash kabel", "Zakavkazkabel", Tursun Zade, Novokuznetsk,
Kamensk- Uralski, Alma-Ata, "Ukrgermet", Alma-Ata, Krasnoyarsk.
There is also one former supplier of the enameled wire that satisfied 100% of the plant's needs at former times. It is "Kamakabel" (Perm). But now the price demanded by it is too high. Therefore the plant refused to co-operate with that supplier. The information on the capacities of raw materials currently delivered from the suppliers of the plant can be found in appendix 1.

Among major exchanges that trade ferrous and non-ferrous metals should be mentioned Moscow Exchange of Non-ferrous Metals (MENM), Exchange of Metals, "Russian Metal" Exchange and Moscow Commodity Exchange in Moscow region and Production Commodity Exchange (Perm), Construction Commodity Exchange (Ekaterinburg) and Asian Exchange (Ulan-Ude) are other large regional exchanges.

4. Information on shippers:

Transportation is one of the most critical issues for plant. Trying to maintain control on its transportation channels, the plant has exercised corporate vertical integration, becoming co-owner of "Yeravia" air transporting company.

Four possible transportation means that can be used for delivery of raw materials are: Air, Train, Sea and Motor transportation's.
The transportation by railroad is a very productive and powerful, but because of blockade it is a difficult to use it now.
During blockade, because of unavailability of train transportation several enterprises started to use air transportation. Several new companies which provided with air transportation service were developed. Even taking into consideration safety of this transportation mean, several enterprises can not afford to use that very expensive transportation service.
By speed of delivery, carrying capacity predictability of delivery time motor transportation can be sited in between the air and railroad shipments.

Air transportation can be considered as a most dependable but also a most expensive procurement channel.

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3. INTRODUCTION.

a. Project goals

The presented research project is aimed to identify, develop and optimize raw materials procurement channels.
Recently happened political and economical changes in former USSR cause several unpredictable problems for industrial organisations. Transition from the centralized to the market economy created a situation when several functions (such as mandatory supply of raw materials , financial sources, etc.). of centralized structures passed to companies and organizations. They make now their own decisions and sometimes are not willing to provide their former partners with raw materials under risky terms. In fact, the plant has not efficient marketing structures that would be responsible for procurement of raw materials.

Collapse of the former USSR aggravates the situation, destroying industrial environment. Now the plant operate at 30% of its capacity. The company delivers necessary capacities of raw materials by air shipments that are very expensive and affect the profitability of the company.
Baffled by the new term in the matter the plant searches new solutions for procurement problem under changin conditions. At present the company cannot determine degree of efficiency of its existing procurement channels. The pla now relies on former procurement channels that might not be optimal for the present plant's state and country economical and political conditions. This is because of the absense in the plant's organizational structure of marketi structures or procedures at the plant that would allow to monitor changing conditions for procurement and pick the be options.

Unstable and unreliable procurement channels force the plant to establish highed mark-up margins for the prices its production in order to secure from expenses incurred by delays and recesses.Absence of the comprehensive strategy tackle the transportation problem narrows the range of the targeted consumer groups and makes the production le competitive even within CIS countries' markets.

Therefore, current study is aimed to assess all possible procurement channels and applying the transportation model t simulate and elaborate the best ones. Furthermore, the project is aimed to create working transportation model that will allow make corrections in the transportation system exercised by plants. The model is sensible to a wide range of inside and outside environmental factors affecting procurement problem at the plant. The model is due to necessary corrections and adjustments that are to be made as any descrepancies between course of simulated actions and real actions undertaken will occur.

b. Project constraints .

Applying the elaborated transportation model to the real life one should bear in mind that even the most sophisticatec model can not foresee and anticipate all contingencies occured in the real environment. Though, the presented model simulate two possible scenarios that to some degree can hedge against possible descrepancies of final recommendations, their occurac

nevertheless is limited. In coming chapters are discussed some approximations that have been applied to the model. Therefore obtaining results of the simulation one should take second look. The criteria of their correctness are:

1. The results of two scenarios simulated must not differ a lot. If they do, that should indicate about relatively high unpredictability of the situation at least by means of the model and corrections are to be made to either or both of the:

a. limiting constraints of the integer programming part;

b. Risk reflecting parameters of the model (EOQ programming);

2. The results should be assessed in context of the current real environmen to see if they correspond to the common perception of the conditions of the environment.

4. METHODOLOGY

Raw data organization.

The data for transportation problem is organized according to the segmentation of the prospective routs and adjusted for some intangible parameters such as risk. Coming analysis includes EOQ analysis, supported with integer programming analysis, necessary for determination of the quantities shipped via different routs. The following steps should be undertaken:

1. Determination of the quantitative parameters necessary for EOQ model creation. The constant demand EOQ model with backordering should be applied

2. The costs of procuring an item that were calculated for EOQ analysis as well as constraints for different channels capacities should be applied for Integer programming analysis. The analysis is aimed to determine carrying capacities for all elements of segments comprising three basic scemes of transportation (See exhibits 1, 2, 3). As these capacities are identified the EOQ analysis is to be completed .

3. Actual EOQ analysis is carried out with estimated variables

Segmentation Analysis.

Segments, sections and elements of the procurement lines

Segments carry the names of countries.

Sections can be identified according to their country affiliation, besides there can be several sections within one country. Each section may provide several transportation means thus being comprised of several elements.

The sections with their elements (disposed in increasing cost sequence) are:

Segment Russia.

Sections:

1a. Supplier/Producer site - Yerevan

Elements:

a) Air transportation

b) Railroad transportation

c) Motor transportation

1b. Supplier/Producer site - Transit warehouse point (Krasnodar or Stavropol)

Elements:

a) Railroad transportation

b) Motor transportation

c) Air transportation

2a. Transit warehouse point - ports (Novorossiysk; Odessa)

2b. Transit warehouse point - Georgian border.

Elements:

a) Railroad

b) Motor

2c. Transit warehouse point - Yerevan

Element:

a) Air Transportation

b) Motor

Segment Georgia.

Sections:

1. Russian port (Novorossiysk; Odessa)- Georgian port (Poty; Batumi)

Elements:

a) Water

2a. North Georgian border - Tbilisi

2b. Georgian port - Tbilisi

Elements:

a) Railroad

b) Motor

2c. Georgian port - Armenian border (Airum railroad station)

a) Railroad

b) Motor

3. Tbilisi (FOB point) - Armenian border (Airoum railroad station)

Elements:

a) Railroad

b) Motor

Segment Armenia.

1. Armenian border (Airoum .road station) - Yerevan

Elements:

a) Railroad

b) Motor

Later on each section will have a letter in a brackets before it denoting segment affiliation:

R - for Russia

G - for Georgia

A - for Armenia

For example: Section (R)1b., element b.

Segmentation according to the delivery patterns.

After organization of the data in given way the group felt more rational to depict transportation alternative schemes a it is presented in Scemes (See Exibits 1;2; 3).

The segments here are presented according to the complete routs rather than their country affiliation. These schemes are base on the segmentation above, but rather reflect the other dimention of freight delivery problem. That dimention referrs to the decision whether to ship the freight directly from the producer's site to the plant, to store raw materials at the transshipment point or trnasfer the freight from one transportation mean to another at the transportation point without an interim storage.

Two schemes (Exhibits 2 and 3) reflect alternative transportation decisions when deliveries occur with inermediary storage at the transshipment point (Exhibit 1) and without, when arriving to the point where freight should be transferred ont other transportation mean (let's say form truck coming form supplier site to the ship at the Novorossiysk) it is loaded immediately. . In real life there can be some delays. And in the coming "EOQ analysis" chapter some assumptions reflecting risk of such a delay are made. Some other assumptions are made as well. Thus Russian ports are considered as an transshipment points, and Section 2a. (**R**) is just neglected. Several sections that just comprise on rout that can be carried out by one transportation mean during one trip are combined into one rout (for example: Sections 2b. (**R**), 2a. (**G**), and 3 (**G**) are combined into one rout that corresponds to X21).

To facilitate the furhter analysis let's call the sections of schemes 1 and 2 that deliver the freight up to the transshipmnet poin **the primary sections**, and sections that deliver from the transshipment point to the plant's site **secondary.**

Influential Factors Quantifying.

In the coming "Findings" chapter of the present study that referres to the information about segmentation all costs mentioned reflect only money segment of the total price of shipment operations. However this segment can be only a small fraction of the total actual cost that the shipment entails. Under current unstable situation the risk cost fraction of that total c

can be considerably high. Therefore the research was carried out in order to try to measure a different aspects of the risk entailed, quantify they and express in money equivalents. As a monetary unit the dollar have been chosen, since it has a much less inflation rate than rouble. The exchange rate of $1= 1,100 rubles have been chosen and all nominal prices hereinafter are expressed in dollars. The total price of any delivery operation thus comprised its nominal (monetary) and risk equivalent segments.

Thus the task is now to quantify the risk. For that the first step that should be undertaken is to determine what aspects of the risk can be assessed. In other words, it should be determined in which directions the risk should be measured. The group found the analogue of such analysis in "Marketing Channels" book, and found it appropriate to use for our scrutiny. They are:

1. Availability
2. Dependability
3. Capability
4. Frequency of the transportation.

The next step is to assign weights to the factors according to their importance. The group estimates are the following:

1. Availability of the transportation mean should be accounted for 30%
2. Dependability should be accounted for 30% as well;
3. Capability should carry 25% weight of the total score;
4. Frequency should be accounted for 15% of the total score.

As estimates have been done , the next step is to bring them to the dollar equivalents. As a comparison benchmark for such quantification the cost of insurance services provided by "TECH" company have been used. The company asks for 12-20% of the value of the freight as a price for its inshurance (See Appendix A). Assuming the freight to be carried out by train let's determine cost of insurance for one wagon(70 tons of freight). Freight should be weighted according to the plant's annual demand proportion for magnetic Steel, Enameled wire and primary and secondary aluminium. thus their proportional weight and their costs in one wagon (70 tons) will be following:

	Weight (tons)	Cost ($)
Magnetic steel	44.54	2,024.54
Enameled wire	6.36	11,563.63
Aluminium:		
a. Primary	6.36	2,890.09
b. Secondary	12.73	3,471.81
TOTAL	**70**	**$19,950.16**

That will correspod to the cost: 19,950.16/70 = $285 / ton of freight delivered by ship and then by train, or to the 285 * 0.16 $45.6 / ton of insurance costs or, in other words to the riskyness of the transportation. At the same time we come up with tot segment scores of 2.25 and 2.05 of riskyness for truck and water deliveries in Georgia. Thus, total score for them will be 4.5

Matching costs of insurance and riskyness total scores one can see that latter is 10 times as low as cost of insurance. Thus multiplier of 10 should be applied to all weight coefficients

Sections characteristics:

Russia:

	Grading features			
	Availability	Dependability	Capability	Frequency
Rail	1	4	1	2
Truck	2	3	3	3
Water				
Air	3	1	4	1
Weight coefficients	3	3	2.5	1.5

	Section score (Grading features * Weight coefficient):				**Total Score:**
Rail	3	12	2.5	3	**20.5**
Truck	6	9	7.5	4.5	**27**
Water	0	0	0	0	**0**
Air	9	3	10	1.5	**23.5**

Georgia:

	Availability	Dependability	Capability	Frequency
Rail	2	3	2	3
Truck	2	2	3	2
Water	3	1	1	4
Air				
Weight coefficient:	3	3	2.5	1.5

	Section score (Grading features * Weight coefficient):				**Total Score:**
Rail	6	9	5	4.5	**24.5**
Truck	6	6	7.5	3	**22.5**
Water	9	3	2.5	6	**20.5**
Air	0	0	0	0	**0**

Armenia:

	Grading features			
	Availability	Dependability	Capability	Frequency
Rail	1	1	2	3
Truck	3	2	3	2
Water				
Air				
Weight coefficient:	3	3	2.5	1.5

	Section score (Grading features * Weight coefficient):				Total Score:
Rail	3	3	5	4.5	**15.5**
Truck	9	6	7.5	3	**25.5**
Water	0	0	0	0	**0**
Air	0	0	0	0	**0**

Economic order quantity (EOQ) analysis.

The EOQ analysis that is to be conducted should be constant demand EOQ analysis, since the plant builds its production to the inventory. Then, because the extra costs are involved in the plant's falling short of its production capacity, th EOQ model should be with backordering.

The EOQ analysis in the present research is aimed :

1. To assign all parameters necessary for the constant demand EOQ model with backordering analysis of the procurement of all types of raw materials use in the production process to each element of all segments identified in three freight delivery schemes.

2. To identify the size and the frequency of shipments to be made by the channels identified by Integer Programming analysis.

As an unit for EOQ analysis have been chosen the carrying capacity of the transportation unit of particular element. Thus, for train it is 70 tons (one wagon); for motor transportation - 10 tons (for Caucasus region) or 15 tons (for Russia); for sea - 10 or 70 tons depending on subsequent the trasportation means (truck or train) and 35 tons for plane transportation. This is donen order to avoid LTL delivery capacities estimates. Let's say,using one ton as a unit for EOQ analysis we came up with 80 tons as an EOQ to be delivered by railroad. But, since the carrying capacity of one wagon is 70 tons, one of two wagons will go not fully loaded (only 10 tons). In order to eliminate such a deficiencies in analusis the mentioned unit for EOQ analysis have been chosen.

The following variables should be determined separately for each element:

1. F = fixed cost per order. This parameter is tied to the riskyness scores of the segments, since each time ordering itself envolves some risk. The F is calculated by the formula:

F = (Total score of the element)*f ; where f is the coefficient that reflects relative costs that ordering of various transportation means etails envolved. The f is assigned as follows:

	Air	Rail	Motor	Water
F	1.5	2	3	4

For the sceme without intermediary storage the F for the primary sections is equal to the sum of the risk scores of its and subsequent secondary sections' elements.

2. **A** = annual quantity of the particular raw material shipped via particular shipping element.

3. **C** = cost of procuring an item. The cost should incorporate nominal cost and risk equivalent cost.

For calculation of the procurement costs three factors are accounted for. Two of them are risk reflecting factors an third one is just nominal cost factor.They are :

a. R-Total risk score of the particular element. Risk reflecting factor.

Weight assigned (W_R) - 0.3 (Scenario 1.); 0.1 (Scenario 2.)

b. T- Time during which the delivery occurs. Risk reflecting factor.

Weight assigned (W_T)- 0.3 (Scenario 1.); 0.1 (Scenario 2.)

c. Pr-The nominal cost of delivery by given element. Nominal cost factor.

Weight assigned - 1.

The assumption is made that under conditions of the efficient charter design plains and trucks will go in both ends f loaded (TL). Since the raw material does not carry an added value and, therefore, has less value, the fraction of its delivery the overall **nominal** charter cost is assumed to constitute 1/3, whereas the weight of the final product delivery in the **nomina** charter cost is assumed to be equal to 2/3.

$C(Total) = (R * (W_R) + T * (W_T)) *$ Carrying capacity of the unit (tons) + Pr * 1 / 3

The calculation of the procurement costs for sea section is done separately for railroad and truck deliveries. Procurement cost for each of them is equal to the sum of procurement costs for water delivery of the quantity equal to the carrying capacity of approprate element (wagon or truck) plus procurment cost of one unit of that element.

4. h = Annual cost per dollar value of holding items in inventory. The storage cost at the plant's site have been indicated by the administration to be h=0.3. The storage cost at the transshipment warehouse is stipulated to be equal 5% of cost of the goodsstored. Assuming , that annual rate for such a storage can amount to 7% the h=0.07.

5. P = the cost of being short one item for an entire year. P will differ for different schemes of transportation (with transshipment storage and without transshipment storage) and incorporate :

a. For the sceme of direct delivery:

-Cost of shortage at the plant's site

b. For the scheme with intermediary storage

- Cost of shortage at the plant's site;
- Cost of shortage at the transshipment point;
- Cost of shortage at the subsequent transportation stages that might be exposed to the risk of failure due to such a shortage;

c. For the scheme with the freight transferred:

- Cost of shortage at the plant's site;
- Cost of shortage at the subsequent transportation stages that might be exposed to the increased risk of failure due to such a shortage;

In order to clarify how these costs were calculated let's move backward form the plant's site:

1. Cost of shortage at the plant site.

It is incorporated into all sections of all three schemes of transportation and is equal to:

$P_{pl} = (I * Q_i / 1100) * D * (D / SS) * k_p$;

where I - the cost of the plant staying idle per ton of supplied raw materials for entire year (rub);

Q_i - weight of the given raw material in the total quantity of raw materials consumed;

1100 - exchange rate of the ruble to the dollar;

D - Carrying capacity of the transportation unit (wagon, truck, etc.)for the given element (tons);

SS - Safety stock at the plant's site for given raw material (tons);

k_p - coefficient that reflects the impact of the size of the safety stock on the total cost of shortage at the plant's warehouse.

2. Cost of shortage at the **subsecuent** section.

Comprised of two items reflecting the fractions of order and procurement costs of the subsequent section. It is equal to

$P_{sub} = C * k_c + F * k_f$

For the scheme with intermediate storage the impact of the mentioned type of shortage is less, snice it is presumed that there will be some amount of the raw materials stocked at the transshipment point that can be delivered instead of the amout short. Therefore, coefficients assigned are equal:

$k_c = 0.05$; $k_f = 0.8$

For the scheme were no storage is occured at the transshipment point the coefficient, reflecting the impact of the procurement cost of subsequent transportation section on the shortage cost will be higher:

$k_c = 0.35$; $k_f = 0.8$

Calculating shortage costs ,one should bear in mind that for calculation of the cost of shortages at the plant's site and at the subsequent section adjustments should be made for carrying capacities of current element and subsequent elements. Let's say that shortage at plant's site have been calculated for truck delivery (D_1 = 10 tons) and the truck delivery appears to be the subsequent section for current railroad delivery (D_2 = 70 tons). At that rate both P_{pl} and P_{sub} are to be multiplied by D_2/D_1=70/10 = 7.

3, Cost of shortage due to excessive storage time at the transshipment point.

Is attributed only to the **primary sections** of the scheme with intermediary storage at the transshipment point. Assuming that the average excessive storage time due to late delivery will be equal 8 days, the total formula will be:

$P_{w/h} = 8 * C_s * D / 1100$;

where C_s - Cost of the storage of one ton of raw material per day (currently is equal to 90 rub)

Jeneral asumptions

1. Since sea delivery section starting with water element then diverges into two elements (motor and railroad) in to facilitate calculations it is assumed that probability of the freight delivery either by truck or railroad within that section same. In other words it is assumed that of 8 tons arrived 7 would be picked up by the railroad and one by the truck, thoug there are separate quantities to be identified for these two elements (X19, X20).

P.S.: If the given segment crosses two or more countries as a score, indicating the riskiness of the freight should b taken the biggest score among all related to the countries to be crossed, assigned to the particular transportation mean. Th the delivery occurs by direct freight by truck form the producer's site to the plant among three socres asigned to three coun for truck dleivery (Russia-27; Georgia - 22.5; Armenia - 25.5) the one that will be assigned is 27.That coefficient will be u in F, C, and P calculations.

Integer programming.

As the procurement cost are identified for the EOQ model, they can be used for the formulation of the target functi for the Integer Programming.

Raw materials carried by particular transportation element are assigned as follows:

X1 - Mg. Steel delivered by plane to the transshipment point for storage;

X2 - Wire delivered by plane from supplier's to the transshipment point for storage;

X3 - Aluminium delivered by plane from producer's site to the transshipment point for storage;

X4 - Mg. Steel delivered by the railroad to the transshipment point for storage;

X5 - Wire delivered by railroad from supplier's to the transshipment point for storage;

X6 - Aluminium delivered by railroad from producer's site to the transshipment point for storage;

X7 - Mg. Steel delivered by the truck to the transshipment point for storage;

X8 - Wire delivered by truck from supplier's to the transshipment point for storage;

X9 - Aluminium delivered by truck from producer's site to the transshipment point for storage;

X10 - Mg. Steel delivered by air to the Russian port for direct delivery to the Georgian port;

X11 - Wire delivered by air tothe Russian port for direct delivery to the Georgian port;

X12 - Aluminium delivered by air to the Russian port for direct delivery to the Georgian port;

X13 - Mg. Steel delivered by the railroad to the Russian port for direct delivery to the Georgian port;

X14 - Wire delivered by railroad from supplier's to the Russian port for direct delivery to the Georgian port;

X15 - Aluminium delivered by railroad from producer's site to the Russian port for direct delivery to the Georgian port;

X16 - Mg. Steel delivered by the truck to the Russian port for direct delivery to the Georgian port;

X17 - Wire delivered by truck from supplier's to the Russian port for direct delivery to the Georgian port;

X18 - Aluminium delivered by truck from producer's site to the Russian port for direct delivery to the Georgian port;

X19 - The freight delivered from the transshipment warehouse to the plant's site by railroad (via sea);

X20 - The freight delivered from the transshipment warehouse to the plant's site by track (via sea);

X21 - The freight delivered from the transshipment warehouse to the plant's site by track (via Caucasus);

X22 - The freight delivered from the transshipment warehouse to the plant's site by plane;

X23 - Direct delivery of the mg. steel from the supplier's site to the plant by plane;

X24 - Direct delivery of the wire from the supplier's site to the plant by plane;

X25 - Direct delivery of the alluminium from the supplier's site to the plant by plane;

X26 - Direct delivery of the mg. steel from the supplier's site to the plant by railroad;

X27 - Direct delivery of the wire from the supplier's site to the plant by railroad;

X28 - Direct delivery of the allumunium from the supplier's site to the plant by railroad;

X29 - Direct delivery of the mg. steel from the supplier's site to the plant by truck;

X30 - Direct delivery of the wire from the supplier's site to the plant by truck;

X31 - Direct delivery of the alluminium from the supplier's site to the plant by truck;

X32 - Mg. Steel transferred from the truck on the plane at the point in Russia for further shipment to Yerevan without interim storage;

X33 - Wire transferred from the truck on the plane at the point in Russia for further shipment to Yerevan without interim storage;

X34 - Alluminium transferred from the truck on the plane at the point in Russia for further shipment to Yerevan without interim storage;

X35 - Mg. Steel transferred from the railroad on the plane at the point in Russia for further shipment to Yerevan without interim storage;

X36 - Wire transferred from the railroad on the plane at the point in Russia for further shipment to Yerevan without interim storage;

X37 - Alluminium transferred from the railroad on the plane at the point in Russia for further shipment to Yerevan without interim storage;

X38 - Raw materia transferred from the plane on the truck at the point in Russia for further shipment to Yerevan without interim storage.

X 39 - Raw materials transferred from the railroad to the truck at the point in Russia for further shipment to Yerevan witho interim storage.

Because of the limited capacity of QuickQuant program the number of variables is restricted within 40. Therefore for Integ Programming model purposes the primary and secondary aluminiums were combined into one unit. Due to that restrictions following approximations were made:

1. The costs of the procurement of the magnetic steel, enameled wire and aluminium by the air and railroad with subsequent transfer onto trucks without intermediary storage, were combined into two: one for air primary section and one the railroad primary section. The total cost is comprised weighted costs of all raw materials for each of these sections.

2. Delivery capacities for the channels X32 - X39 are determined by the carrying capacities of the units of the prim sections of that channels.

3. The ports in Russia are considered as a transshipment points.

Constraint functions.

There are two types of constraint formulas applied to the present integer programming problem. They are:

1. Constraints related to the required capacities of the raw materials:

1.1 For magnetic steel:

35X1 + 70X4 + 15X7 + 35X10 + 70X13 + 15X16 + 35X23 + 70X26 + 10X29 + 35X32 + 35X35 + 6.36X38 + 6.36X39 = 7,000 tons/annually;

1.2 For enameled wire:

35X2 + 70X5 + 15X8 + 35X11 + 70X14 + 15X17 + 35X24 + 70X27 + 10X30 + 35X33 + 35X36 + 0.9X38 + 0.9X39 = 1,000 tons/annually;

1.3 For alluminium:

35X3 + 70X6 + 15X9 + 35X12 + 70X15 + 15X18 + 35X25 + 70X28 + 10X31 + 35X34 + 35X37 +2.72X38 + 2.72X39 = 3,000

Note that the sum of coefficients of X38 and X39 of these tree formulas is equal to the carrying capacity of that channel (1 tons).

2. Constraints related to the maximal capacity of some channels:

2.1. Constraints related to the maximal loading/unloading capacities of Black Sea ports. As it was indicated by "TECH" company's representative the maximal capacity of the Batumi they have contracted to is equal to 1000 tons daily TaEstimating the frequency of the deliveries via Batumi to be:

- 2 times during the week for scenario 1(104,000 tons/annually);

- 3 times during the week for scenario 2 (156,000 tons/annually) the constraint function will be:

5X10 + 35X11 +35X12 + 70X13 + 70X14 + 70X15 + 15X16 + 15X17 + 15X18 + 70X19 + 10X20 < Max. Capacity

2.2. Constraints, related to the maximal capacity of the deliveries from the producer's site to the plant performed by ucks. There are two different estimates of that capacity for two scenarios. They are:

-120 trucks for the scenario 1;

-200 trucks for the scenario 2.

X29 + X30 + X31 < Max. Capacity

2.3. Constraints, related to the quantity of wagons that the plant can avail itselve in Georgia:

X13 + X14 + X15 + X19 <140

2.4. Constraints related to the number of plane that can perform deliveries to Yerevan. That capacity is restricted by he capacity of airports in Yerevan. There are two different estimates of that capacity for two scenarios. They are:

-200 planes for the scenario 1;

-312 planes for the scenario 2.

2.5 Constraints, related to the maximal number of wagons that can pass Georgian railroad during the year. There are wo different estimates of that capacity for two scenarios. They are:

-3 wagons for the scenario 1;

-6 wagons for the scenario 2.

5.FINDINGS.

Storage capacities of "ARMENMOTOR" plant.

As we were told by the chief of the Storage department of the plant current storage capacities and safety stocks at the plant are the following:

Raw materials	Storage capacities (tons)	Safety Stock (tons)
Magnetic Steel	2000 - 3000	1200

Enameled Wire	2000	200 - 300
Aluminum	1000 - 2000	700

Production capacities

Maximum production capacities of the plant is 100,000 units (engines) monthly. Currently plant is operating at 30% of its maximum capacity.

For production of 30,000 engines plant need 650,000 KW/hours power.

Cost of plant being idle is 2,220,000 rubles per day.

Plant has increased its production capacity from 10,000 engines in May 1993 to 30,000 engines in July 1993.

Information on Raw material suppliers.

A. Producers of raw materials.

As prospective departure points can serve the industrial centers or exchanges in Russia that can sell the raw materia the plant is interested in (namely magnetic steel, enameled wire, primary and secondary aluminium)

The plant currently processes the raw materials bought in 1992 from the following metallurgical plants:

Type of raw material	Center	Capacity supplied (tons) 1992	1993
Magnetic steel	Cherepovets		6,000
	Novolipetsk	1,107	3,550
	Temirtay (Karaganda)		
Enameled wire	"Kirgizkabel" (Kainda)		140
	"Cable Plant" (Pskov)	112	25 +
	"Chuvash kabel" (Cheboksari)		
	"Zakavkazkabel" (Armenia)	209 supplied (526 contract	
Aluminium: a) Primary	Tursun Zade (Tajikistan)		69
	Novokuznetsk		420
	Kamensk- Uralski		128
	Alma-Ata (Corporation)		3,000
b) Secondary	"Ukrgermet" (Charkov)	71	3,000
	Sukhoy Log	128	
	Alma-Ata (Corporation)		3,000 (possibility)
	Krasnoyarsk		2,000

There is also one former supplier of the enameled wire that satisfied 100% of the plant's needs at former times. It is "Kamakabel" (Perm). But now at he price demanded by it is too high. Therefore the plant refused to co-operate with that supplier.

Because of the erratic and unreliable functioning of the transportation channels via Caucuses region and high inflatic rate in a ruble area suppliers prefer to contract the plant on a short term (up to year) basis. The typical contract specifies an initial delivering amount of the particular raw material under fixed price, then it stipulates that further payments should be made on a F.O.B. origin basis at a price, corresponding to the spot price on a moment of shipment that both contracting part will agree upon. Contracts usually provide no quantity discounts.

As we were told at the Ministry of Material Resources among Russian industrial centres that supplied Armenia with required raw materials up to 1990 are:

Type of raw material	Center	Capacity supplied (tons)
Magnetic steel	Novolipetsk metallurgical works	14,000
	Cherepovetsk metallurgical works	3,000
	Verkhneisetsk met. works (Sverdlovsk. district)	11,000
Enameled wire	Moscow cabel plant	1,400
	Tomsk cabel plant	
	"Chuvashcabel"	
	"Kamkabel"	
	"Podolsk kabel"	
Aluminium a) Primary	"Bratsk"	17,000
	"Samara" (aluminium blanks)	32,000

B. Exchanges.

Among major exchanges that trade ferrous and non-ferrous metals should be mentioned Moscow Exchange of Non ferrous Metals (MENM), Exchange of Metals, "Russian Metal" Exchange and Moscow Commodity Exchange in Moscow region and Production Commodity Exchange (Perm), Construction Commodity Exchange (Ekaterinburg) and Asian Exchan (Ulan-Ude) are other big regional exchanges. Among other metal trading exchanges are Mariupol Universal Commodity Exchange, Omsk Commodity and Raw Material Exchange, Sverdlovsk Commodity Exchange etc.The peculiarity of exchan prices is that often they can be often lower than the price set by producers. Thus in 1992 the price for primary aluminium s by Novokuznetsk Metallurgical Plant (120,000-130,000 rub/ton) exeeded the price for that product at the exchanges (100.0

rub/ton). This is because transactions made at exchanges ar often unreliable since occur via intermediaries. Therefore big consumers prefer to deal with producers directly bypassing middlle entities.

Type of raw material:	Price as of 1992*	Prices (rub/ton): "ARMENMOTOR" bought price (1992)	W/S Price at the Min. Mat. Res. stores* (As of May 20 1993)	Exchange price/Date/ Exchange name
Magn. Steel	22,000	35,000	23,000	
Enameled Wire		1,500; 600-1000 from "Zakavkazkabel"		
Complect: ПСЛДЛТ (6,037.1 kg) ПЭТВ-2 (4,916.1 kg)				8,157,796/ 06.10.92 "MAGBI" (Magnitogorsk)/
Aluminium Primary A7 (in ingots)	80,000	400,000	100,000	200,000 (1 ton)/ May 1993; 220,000 (3 tons)/ June 1993/ Yer. Raw. Mat. Comm. Exch.
A6 (in ingots)				110,000(10 tons)/ 09.10.92/ Sverdl.Comm.Exch

Aluminium Secondary AK5M2	60,000	250,000	70,000	65,000 (60 tons)/ 08.10.92; 67,000 (60 tons)/ 09.10.92 Sverdl. Comm. Exch/

Detailed information on shippers.

General Information

Transportation is one of the most critical issues for plant. Trying to maintain control on its transportation channels, the plant has exercised corporate vertical integration, becoming co-owner of "Yeravia" air transporting company.

Examining logistics of transportation channels of the plant one should bear in mind that the plant is the mass production manufacture, that builds to inventory. Under present unstable conditions and especially taking in account two factors mentioned above, strategically such a business specialization is not strategically justified. To see why let's analyze all transportation operations exercised by the plant.

Raw materials shipments for the plant do not tie to specific final production orders and aimed just to replenish inventory stock. They are made whenever transportation channels are available. Shipments do not count for optimal inventory size and such a practices can be justified by high inflation rate and unsafe and unreliable transportation routs. Since these conditions hinder required turnover rate of the capital an inventory stocked can better maintain value. The plant traditionally ships its raw materials by train. Now such a shipments can be late for 3-4 months or even more. In order to maintain relative flexibility the plant now is building contractual vertical marketing branch, renting storage facilities in Stavropol and Krasnodar using them as an intermediary trains-shipment points. They are aimed to stock procured raw materials for further shipments to the plant's site and compile the final product lines for further sales to the final customers.

Their role is to exercise **accumulation**. That warehouses allow the plant to take ownership to some raw materials, which are highly exposed to inflation, or which production or contacts with supplier can be jeopardized in future because of very erratic and turbulent market situation in CIS countries.

Water transportation

Prospective ports

As most eligible departure ports should be considered:

- Ilyichovsk (5 kilometers from Odessa, Ukraine)

The Ilyichovsk is a very powerful port and provides with service almost all Russia and Ukraine..

- Novorossiysk (Russia)
- Sevastopol (Military port, Ukraine)
- Yeysk (Russia)
- Timrugi(Russia)

Sevastopol now is closed port, but in the case of agreement with Government of Russia it will be possible to deliver construction materials via that port.

Major feature of ports should be considered their loading/unloading capabilities.

Destination Ports:

The following ports should be considered:

- Poti (Georgia)
- Batumy (Georgia)

Batumi and Novorossiysk ports are specialized for sea-container loading/unloading operations (Source: Mr. Ara Oghanjianian, General director of North-East Trans stock company).

The other ports located in Abkhasia are not eligible as far as there is no railroad connection with Armenia.

Batumi - Batumi should be considered the largest port of Georgia. At present port is overloaded since it supplies whole Caucuses region (including Armenia, Georgia, Azerbaijan) with consignments from outside. Batumi has no water b therefore it is open port with unsafe shoving conditions for large ships.

Poti - Poty is less loaded. Poty has water break and can provide safe shoving conditions for ships under any weather. The railroad branch that ties Poty with main Tbilisi branch, goes through politically unstable region (Mingrelia).Therefore it has unsafe cargo conditions for valuable consignments.

Timrugi - Port on Asov sea. Timrugi is relatively less congested than other ports, which makes him attractive for small shipments.

Railroad

Not before long the 80% of all cargo deliveries entered into Armenia through the two branches via Azerbaydjan. The rest 20 per cents of all cargo deliveries came via Georgia. Azerbaydjan direction comprised two branches:

- Norashen: entering capacity - 20 pairs of trains per day;
- Idjevan: entering capacity - 6 pairs of trains per day;

Currently is operating railroad routes Batumi-Yerevan and Poti-Yerevan. Because of unstability in Georgia railroad routes sometimes stop operating, after blow of railroads. It should be mentioned that after each railroad blow the reconstruction process is taking approximately 7-8 days. It means that during that period of time the deliveries via that segment of railroad are impossible

There is one more branch entering directly to disaster area from Turkey (Akhourian). The advantage of that branch is that its narrow track way enters directly into Arevic storage facility in Giumry. As a disadvantage can be considered its carrying capacity being 25 tones per wagon. The peculiarity of the rout via Turkey is that if your consignment crosses the border while entering to Turkey the intermediary will service you. That will end up with additional mark up prices (There is no information about the transportation via Turkey).

The transportation by railroad is a very productive and powerful, but because of blockade it is a difficalt to use it now.

Armenian railway facilities are (in units):
- electrical locomotives - 110
- thermal locomotives - 100
- wagons - 4700

Not before long the 80% of all cargo deliveries entered into Armenia through the two branches via Azerbaidjan. The rest 20 pe cents of all cargo deliveries came via Georgia. Azerbaidjan direction comprised two branches:

- Norashen: entering capacity - 20 pairs of trains per day;
- Idjevan: entering capacity - 6 pairs of trains per day;

Carrying capacity per wagon;

- 75 tones of metal per wagon;

The extension of the routs in Azerbaidjan :

a) via Norashen is approximately 850 kilometrs;

b) via Idjevan is approximately 950 kilometrs;

Azerbaidjan routs will not be included in owr estimation, because of blockade(they do not operate)

As a result of blockade in 1992 the branches via Azerbaidjan were not in operation:

- Idjevan - 274 days
- Norashen - 169 days

The number of wagons not delivered via these branches was:

- Idjevan - 620
- Norashen -17650

Also should be mentioned that after each railroad blow the reconstruction process is taking approximately 7-8 days means that during that period of time the deliveries via that segment of railroad is impossible

There is one more branch entering directly to disaster area from Turkey (Akhourian). The advantage of that branch that its narrow track way enters directly into Arevic storage facility in Giumry. As a disadvantage can be considered its carrying capacity being 25 tones per wagon. The peculiarity of the rout via Turkey is that if your consignement crosses the border while entering to Turkey the intermidiar will service you. That will end up with additional mark up prices (There is information about the transportation via Turkey).

Motor transportation

By speed of delivery, carrying capacity predictability of delivery time motor transportation can be sited in between the air a railroad shipments. The mai criticism of representatives of the plant refers to unsafety of motor shipments. Particularly the not trust private motor carriers that do not provide any insurance for their deliveries. However the were more positive abou idea of participating in motor columns forming by the Ministry of Automobile Transportation. These columns are forming 1-1.5 months. Typically they comprise 200-300 trucks and are excorted by Armenian Police squads. Destination point usu is Krasnodar. One thing that gives advantage to state motor carrier services is its being within state structure that allows to apply arbitration for different deviations from terms of contract and if not to get proportionate compensation (there still wi

some) but also have an influence on state officials, responsible for that deviations. that will allow the plant to maintain relative control while not bearing a risk of ownership of trucks.

That **specialized transportation participant** should be included to the marketing channel that is most sensitive to transportation problems. That will be CIS wholesale channel that whould provide services via commission merchants in Moscow and Kharkov. Becides trucks can provide supply services to the plant. The "ARMENMOTOR" can build contractual agreements with other clients of Ministry of Automobile Transportation, sharing costs of transportation. The edge there is in use of empty trucks that will be back to the Yerevan from Krasnodar that is one of the in-transit warehouse points for the plant.

The better predictability of delivery time and possibility to monitor delivery stages will allow the plant to apply **total cost analysis** improving both **transportation** and **inventory costs** accountability.

Air Transportation

Company name	Distance exercised	Cost per Kg.	Information date	Cost per Kg.	Information date	Operation time
"LUSAN"	YEREVAN-KRASNODAR	160-170 rub.	April 15	250 rub.	June 15	one week
"GYOUD"	YEREVAN-MOSCOW	175-187.5 rub	April 10	80 RUB	May 12	2 to 3 weeks
"IMAK"	YEREVAN-STAVROPOL	80 RUB	May 12	140-150 rub	June 14	one week
"BABIK:	YEREVAN-KRASNODAR	130-135 rub	April	140-150 RUB	June 22	2 weeks
"NET"	YEREVAN-KRASNODAR	170-175 RUB	June 21	130-140 rub	June 15	2 weeks

6.CONCLUSIONS.

A. Substantiation of conclusions.

As we can see the all channels indicated by QuickQuant analysis for both the worst case scenario 1 and optimistic scenario 2 as a best (X13, X18, X26, X30, X31, X33, X34) refer to the deliveries without use of intermediate storage capacities. They refer to:

X13 - Mg. Steel delivered by the railroad to the Russian port for immediate delivery to the Georgian port);

X18- Aluminium delivered by trucks to the Russian port for immediate delivery to the Georgian port ;

X26 - Mg. Steel delivered by railroad directly from the producer's site to Yerevan;

X30 - Enameled wire delivered by trucks directly from the producer's site to Yerevan;

X31 - Aluminium delivered by trucks from the producer's site to Yerevan;

X33 - Enameled wire delivered by truck to the transshipment point for immediate further delivery by air to Yerevan;

X34 - Aluminium delivered by truck to the transshipment point for immediate further delivery by air to Yerevan .

The mentioned channels' persisting as a best ones under both scenarios indicates, that the particular solution has sufficient stability towards reasonable changes of political situation as well as to the reasonable fluctuation of interpreting input data which requires some degree of judgement (time and grade coefficients' and sections' capacities changing). Minor changes occur only in the carrying capacities of some channels that are chosen:

	Best Case Scenario 2.	Worst Case Scenario1.
X13 (wagons/annually)	94	97
X26 (wagons/annually)	6	3
X18 (trucks/annually)	1	1
X30 (trucks/annually)	2	2
X31 (trucks/annually)	1	1
X33 (trucks/annually)	28	28
X34 (trucks/annually)	85	85

That changes occur in the railroad channels and indicate the leading position of the railroad delivery compared with others. estimates of the model reffering to the channel X26 are consistent with the former practices exercised by the plant. when al deliveries were made by that channel (direct railroad deliveries from the supplier's site to the plant via Azerbaidjan. And th gives an ecidence of the overall principles of the present model being correct.

Next by its importance come motor freight elements in Russia tied to the air freight channel from Russian transshipment point to Yerevan (section 2c.(R) element a.) (X33, X34). Total capacity indicated by Integer Programming for the latter is (28 + 85) * 15/35 = 49 planes/annually. Then come direct deliveries by trucks from the producer sites to the plant site. The capacity of that channel is only 3 trucks annually.

And finally there is one truck to be carried freight by sea channel.

B. Major criterias for the best options.

It is obvious that real strategy that the plant will choose to pursue will not resemble exactly these two simulated scenarios. But due to them some generalizarions and conclusions can be made.

Interpreting output data the consideration should be given to the channels whose capacities fluctuate the most for given two scenarios. Usually that indicates that the given channels are the binding constraints for the target function. Therefore,a ways should be sought to maximally enlarge the capacities of these channels (in our case X13, X26). At the same time the extention of the channels' capacities should not occur at the expence of either nominal or risk constituents of the total cost of the channel's unit.In light of the mentioned above it appeared to be clear that because of the beneficiary nature of the railroad channels, indicated by integer programming simulation an effort to be applied to find ways that would allow to enlarge particularly channel X26.

Next by importance come the most mighty channels. The careful second look should be given to them, especially to their exposure to the quick changes in their maximal capacities that could affect the targeted capacities of that channels. In the current simulation such a channels can be considered to be the channels X33, X34. Obviously they are among the least proned to the fluctuations in the schemes. Therefore they are appropriate for a large delivery capacities. Such a mighty channels are the riskiest in the scheme chosen.

Last consideration should be given to the smallest capacities bearing channels. The question should be asked, wether it is appropriate to use such a channels. Wouldn't they require exessive financing in terms of ordering and fixed costs compared with their capacity. If it is the case, their capacities, because of being negligeble can be attached to the bigger ones. That must not increase total cost a great deal. Such a situation we can see in a case with channel X18. It may be attached to either one of the channels X33 or X34. However,since that channel have never been exercised by the plant, the consideration for it can be given as a testing option of that channel. If it will be a success some future changes related to the increase of its capacity can be done with the accompanying new simulation of the appropriately adjusted current model.

Major input characteristics.

The imput parameters can be devided according to their affiliation to :

1. EOQ analysis:

A. Parameters that refer to the plant :

1. Annual storage cost of the raw materials at the plant's storage capacities (% of the total cost);
2. Annual cost of the plant staying idle (rub/ton);

B. Parameters refering to the risk factors:

1. Capability;
2. Availability;
3. Dependability;
4. Frequency of all elements for three countries;
5. Durations of the shipments occured by different sections;
6. Weight coefficients for time and grades reflecting the risk;
7. Weight coefficients assigned to the order and procurement costs of the subsequent sections for the determination of the costs of shortages for sections.;

C. Parameters refering to the intermediary storage at the transshipment point:

1. Mean time raw materials to be stored;
2. Annual storage cost of one item of the element to be stored (% of the cost of the raw materials);
3. Daily costs of the storage of one ton at the warehouse (rub);

Almost all parameters, mentioned above should have twoversions to be applied for two scenarios.

7. RECOMMENDATIONS

A. Detailed information on the companies to be contracted.

"NET" Company.

"NET" transportation company have been founded in 1991 onthe basis of the Ministry of Material Resources. Currently is the major state contracted private transportation company in Armenia. The major shareholder of the compai the Ministry of Material Resources. Because of the experience and state support is worthy to be contracted.

" TECH" Company.

"TECH" transportation company is a relatively new transportation service provider. It have been established on the basis of the "TECH" banking corporation. Because of both the financial support provided by the corporation and the insurance services provided by the company it should be considered as a possible channle participant (Channel 13.)

"Imak" Company.

"Imak" transportation company is a relatively less size and is not financially backed. Nevertheless, the company can fully serve the channels 33 and 34. That will provide better co-ordination between truck and air deliveries. Therefore it is eligible for contracting.

B. Recommendations on how to build the working model.

1.Frequency of the updating the input data.

Updating the input data the following strategy is tobeused:

1. The group shouldbe created to maintain contacts with all transportation companies mentioned in appendix and a ne onesthat would be apporpriate. The group should also assess changes in capacities of the channels for Integer Programming model. Once in 1.5 -2 months the changes in the costs of the transportation services as well as capacities of the channels shou be plugged into Integer Programming model and simulated again.

2. If the simulation of the Integer Programming will lead to the changes in channels to be used or the capacities of th channels, the EOQ modelis to be simulated again.

At the beginning of the applying the model the results simulated should be compared after implementation with the re results of its implementation.Particularly, the real total costs should be compared to the estimated ones. Proseeding from the difference revealed the adjustmentsshould be made in appropriate input characteristics of the model. The simulation of the model for the first year of the implementation of the model should occur onse in a month, in order to adjust the model.

2. Interpretation of the output data.

The main criteria for evaluation of the validity if the simulation made is the degree of the consistency of the results received by the two scenarios. The resemblence ofthese two indicates the good degree of precision of the data obtained.

The next step is to compare the results obtained with the real conditions of the channels indicated. If they do not correspond the appropriate changes are to bemade and the model is to be simulated again.

As a major criteria for the best option is to compare final results generated by quantitative analysis with real properties of the channels chosen. If they are not consistent, appropriate input parameters should be reevaluated and answers should be jenerated again. Thus, for example, final estimate of 8 wagons delivered via Georgia can be seen as controversal an changes can be made in constraint formulas of Integer programming. Then results are to be generated again

8. IMPLEMENTATION PLAN AND COSTS.

A. Sequence of specific steps should be done for implementation of proposed recommendations.

As we have found, the most profitable transportation companies are "TECH","NET","Imak" and also the Mini Transportation. The main purpose of the factory is to find the company with least costs of shipment. That is why the p should implement the strategy of bidding among the prospective transportation companies. In different conditions of transportation these free companies and the Ministry of Transportation will be able to suggest the different prices (cost Client). So according to owr recommendations the free prospective transportation companies are above mentioned com Also the plant should contact with Ministry of Transportation. So during the implementation of each of the section of r supplyer's site to Yerevan the plant should make bidding among all these companies and Ministry of Transportation.

B. Associated costs and sources.

As written in the brief recommendations, free private companies -"Imak" ."NET" and "TECH"-are most profi reliable among all private transportation companies in Armenia. They can provide with unique and less costly service Some costs associated with these companies:

Channels X18, X33, X34

-"Imak"- makes all its shipments by planes and tracks. For the plant it presumed to be contracted to deliver 42 enameled wire and 1275 tons of alluminium first by trucks and then by planes. One truckload delivery of the enameled the Stavropol performed by that company costs $908.3 and for alluminium it is equal to $1,059.34 per truck (See App For 28 trucks of Enameled wire it will amount to the $25,432.4 and for 85 truck of alluminium deliveries it is equal to $90,043.9, totalling to the $115,476.3 annually. Respective numbers for air deliveries will be:

-For wire - 12 planes - $6,545

- For alluminium - 37 planes - $201,818.18

Total for air 49 planes - $208,363.18

Thus total amount to be paid to the "Imak" is equal: $115,476.3 + $208,363.18 = $323,839.48

Since the capacity of the channel X18 is equal to only one truckload delivery of alluminium and one of 37 pl delivering aluminium goes half loaded, these 15 tons can be merged to the channel X34 adding to it one more truck de Thus, truck deliveries costs will amount to the $25,731.6.

Total costs for the channels X33 and X34 will be equal:

	X33 (Wire)	X34 (Aluminium)
Motor	$25,432.4	$91,103.24
Air	$6,545	$201,818.18
Total	$31,977.4	$292,921.42

Total cost of transportation exercised by "Imak"-$324,898.82

Channel X13

-"TECH"- makes its transportation on trains and ships. The transportation via sea from Port Novorossiysk to port Batumi costs 45-50$ per tone. If we will multiply this number by 70 tones (The loading capacity of one wagon) we will receive 70*($45-$50)=$3,150-$3,500 per one wagon. The transportation by railroad from Port Batumi to Yerevan costs $109 per one wagon (per 70 tones). So the transportation of 70 tones from port Novorossiysk to Yerevan will cost $3,259-$3,609 per one wagon. Accounting for 95 wagons of delivery, total cost will be:

$3,500 * 95 = $332,500

Cost of insurance, provided by the "TECH" company is equal to 16% of the cost of 6,650 tons of the magnetic steel will be equal to : 6,650 * 0.16 * $45.4 = $48,305

-"NET"- The sea transportation made mainly from Port Yeysk to Port Batumi. The transportation costs $34-$36 per one tone. If we will multiply it by 70 tones we will get 70 * ($34-$36)= $2,380-$2,520 per one wagon. The transportation by railroad is the same. So the total cost of transportation from Yeysk to Yerevan will be $2,489-$2,629 per one wagon.

$2,500 * 95 = $237,500

Taking in account that the bid can be organized among these two companies as well as the higher reisk, associated witl "NET" transportation services the target cost at which either of these twwo companies should be contracted to is equal to $290,000 for delivery services plus $40,000 for insurance services or total $330,000.

To that should be added costs of delivery of 95 wagons freight carried from the supplier's site to the Russian Port. For magnetic steel it will amount approximately to the $113.25 * 95 = $10,758.75

The total costs of the channel are equal approximately to the $340,758.75

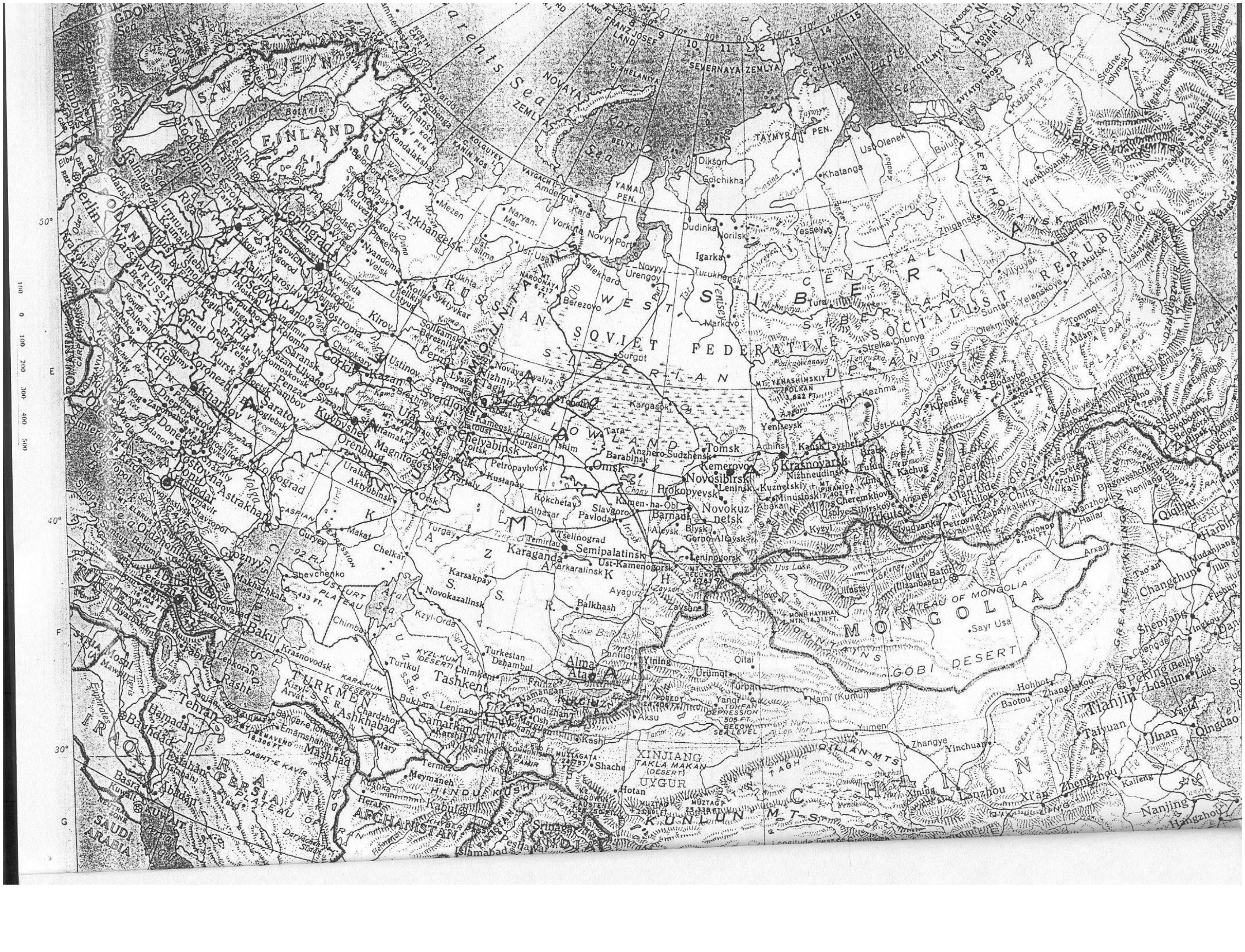
- Also in brief description was mentioned Transportation Ministry. It makes all its transportations mainly by tracks with loading capacities 10 tones. These tracks costs 1,600,000 rubles per truck from Batumi to Yerevan ($1,454).

Maximal freight capacity for truck deliveries from Batumi to Yerevan is equal to 665 trucks (10 tons each). which by far exceeds the estimated channel capacity of the element.

Channel X30.

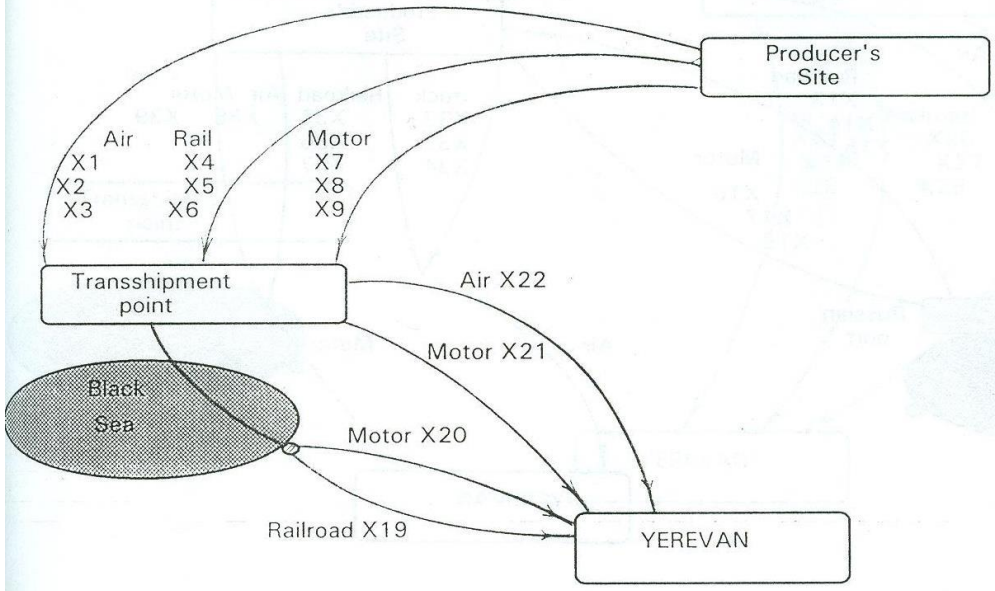
"ARMENMOTOR " can serve this channel by its own tracks. The transportation of these tracks to Stavropol and back to Yerevan costs 3,500,000 rubles ($3,182). One third of that amount can be attributed to the raw materials delivery costs (provided that the final production will be shipped in the reverse direction). Thus , the delivery of raw material from Batumi to Yerevan by one truck will cost $106.06. For two trucks that will make $212.12 annually.

EXHIBITS.



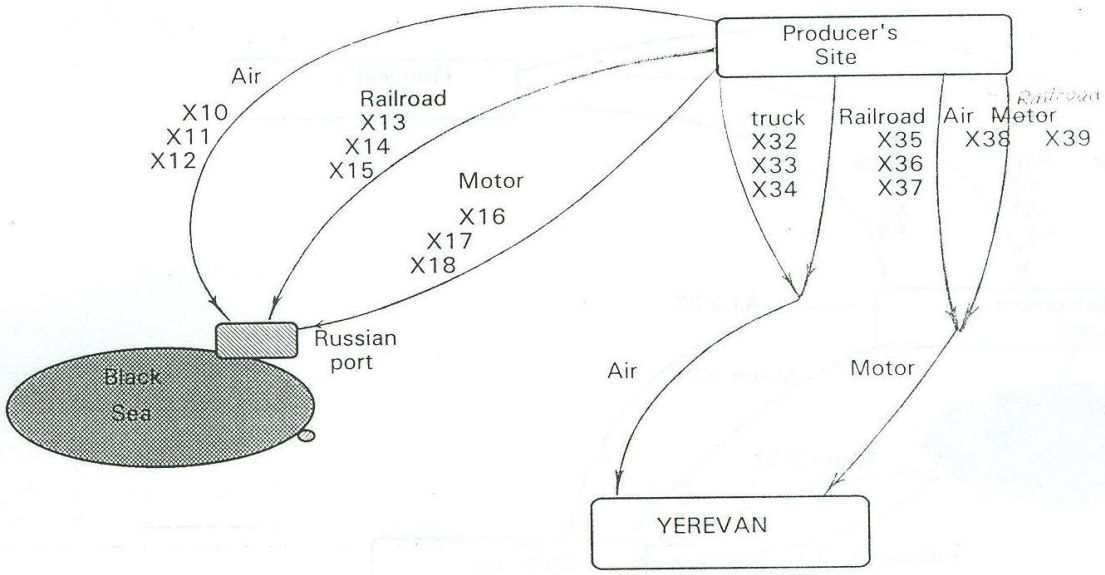
SWEDEN
FINLAND
Barents Sea
Kara Sea
Laptev Sea
NOVAYA ZEMLYA
FRANZ JOSEF LAND
SEVERNAYA ZEMLYA
TAYMYR PEN.
YAMAL PEN.
POLAND
ROMANIA
TURKEY
IRAQ
IRAN
SAUDI ARABIA
AFGHANISTAN
MONGOLIA
CHINA
RUSSIAN SOVIET FEDERATIVE SOCIALIST REPUBLIC
WEST SIBERIAN LOWLAND
CENTRAL SIBERIAN UPLANDS
KAZAKH S.S.R.
UZBEK S.S.R.
TURKMEN S.S.R.
URAL MOUNTAINS
GOBI DESERT
PLATEAU OF MONGOLIA
TAKLA MAKAN (DESERT)
KUNLUN MTS.
GREATER KHINGAN RA.
Caspian Sea
Aral Sea
Lake Baykal
Lake Balkhash
Moscow
Leningrad
Berlin
Warsaw
Stockholm
Helsinki
Riga
Minsk
Kiev
Kharkov
Odessa
Rostov-na-Donu
Volgograd
Astrakhan
Saratov
Kuybyshev
Kazan
Gorki
Sverdlovsk
Chelyabinsk
Orenburg
Perm
Ufa
Arkhangelsk
Murmansk
Baku
Tbilisi
Yerevan
Tehran
Baghdad
Tashkent
Samarkand
Ashkhabad
Alma-Ata
Frunze
Karaganda
Semipalatinsk
Omsk
Novosibirsk
Tomsk
Kemerovo
Barnaul
Novokuznetsk
Krasnoyarsk
Irkutsk
Ulan-Ude
Chita
Yakutsk
Norilsk
Dudinka
Igarka
Ulan Bator (Ulaanbaatar)
Peking (Beijing)
Tianjin
Shenyang
Changchun
Harbin
Qiqihar
Lanzhou
Xi'an
Taiyuan
Jinan
Qingdao
Nanjing
Urumqi
Kabul
Mashhad

Exhibit 1.
SCHEME 1
(With Storage at the transshipment point)



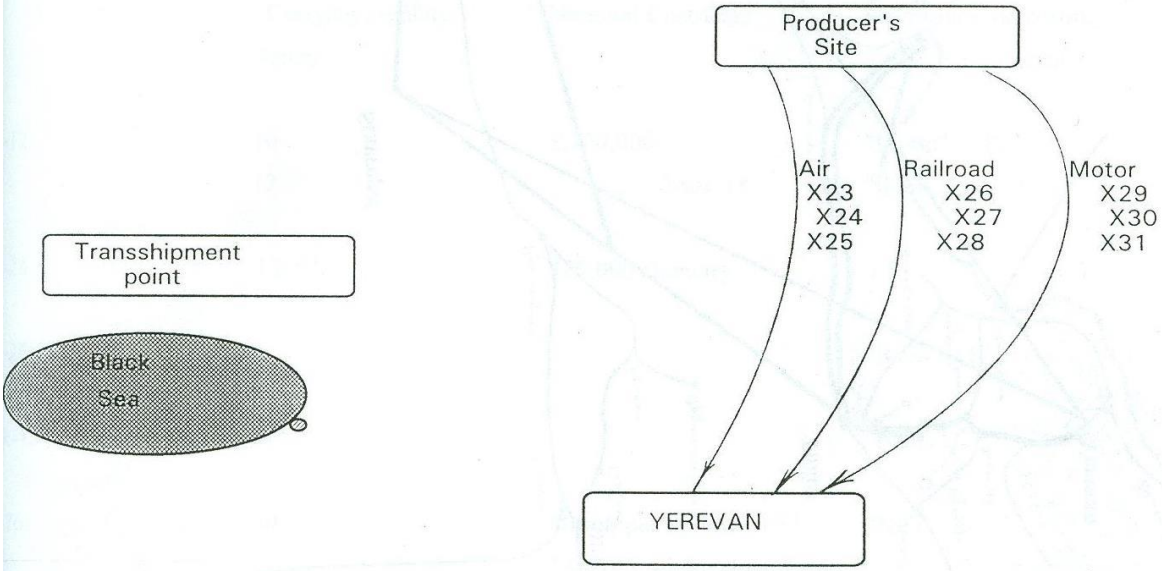
Appendix 2.

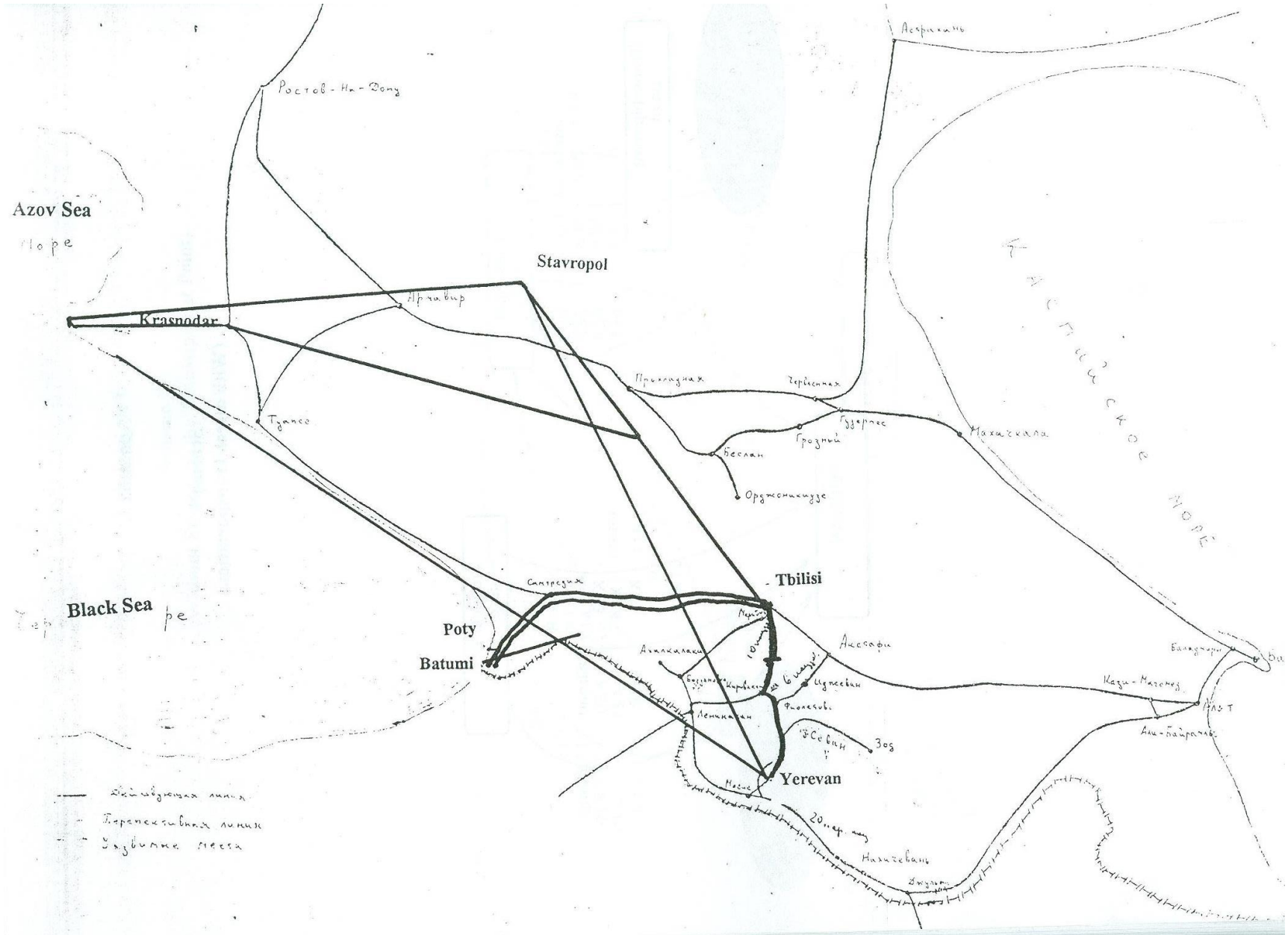
Scheme 2
(Without Storage at the Transsipment Point)



Appendix 3.

Scheme 3
(With direct Transportation)




Azov Sea
Black Sea
Stavropol
Krasnodar
Tbilisi
Poty
Batumi
Yerevan
Ростов-На-Дону
Туапсе
Грозный
Беслан
Махачкала
Тбилисское море

IL-76	35	7-7.5 mln rub./plane /April 10	"Gyoud"/ Moscow
	40	80 rub per kg / June 4	"IMAK" / Krasnodar
	35	80-100 rub/kg/ March 22	"NET" / Moscow
		4,5-4,9 mil. rub./plane /June 4	"NET"/Krasnodar

2. Section (R)2c.; element a. (Transit warehouse point - Yerevan)

Krasnodar-Yerevan rout is denoted as K and Stavropol-Yerevan as S, no letter stands if any departure place can be served :

Planes:

	Carrying capacity (tons):	Nominal Cost/Date	Companies/ departure point
An-12	10	1,700,000/	"Lusan" K
	12	/May 18	"Babik"/ K
An-24	3.2-5	420,000 /January	/ S
An-26	3		"Babik" / K
Yak-42	8		"Babik" /
IL-76	40	80 rub per kg/March 22	"NET" / K
		130-135 rub/kg /June 4	
	35	4,500,000 / May 18	"BABIK" / K
	35	80 rub per km / June 4	"IMAK"

Complementary costs:

The peculiarity of air transportation companies contracting is that the client has to rent airplane for round trip. Therefore the client either has to find some other entity who would like to transport its freight in reverse direction or plan his own transportation in a way when the plane would be utilized loaded in both directions. Anyway the plane allowed to stay at the airport no more than 5 hours after lending. During that time the freight should be delivered and new freight loaded. The

EXHIBIT 4.

Segmented routs of shipments.

Exhibit 5.

Air transportation

1. Section (R)1a. ; Element a. (Supplier/ Producer site - Yerevan)

Plane:	Carrying capacity (tons):	Nominal Cost/Date	Companies/ departure point
An-12	10-12	3.5-4 mln. rub/plane /April 10	"Gyoud" / Moscow
	10		"Lusan" /within CIS
An-26	6	4 mln /plane /April 10	"Gyoud"/ Moscow

3. Section (G)2c, element b. (Georgian port - Airoum railway Station)

"NET" transportation company can deliver with excorting a cargo from Batumi to Airoum in 24 hours.

Complementary costs:

Excorting services provider can be "Arakial" company. The company has contacts with Georgian police and can provide excorting services in Georgia. Excorting of one loaded truck costs 350,000-400,000 rub, empty - 300,000 rub. Maximum number of trucks in the excorted column -25 vehicles.

Excorting services of motor columns of Armenian police cost 200,000 rub (as of May 1993)

(See detailed information in the list of interviewed companies.)

Sea transportation

Segment: Georgia

Section (G)1., element a.

rts	Carrying capacity (tons):	Nominal Cost/Date	Companies
vorosiysk - Batumi	up to 1000 daily	40,000 rub/ton /June 3 $40-50/ton /June 9	Min. of Construction* TECH

Loading /Unloading costs:

vorosiysk:

loading cost at the marshalling yard . sorting and loading to the ship carriages - 300 rub+$6/ton

pplying carriages to the marshalling yard and carrying to the port - 2424 rub/carriage

aning of the carriage after unloading - 846*2 rub /carriage

ading to the barge - 190 rub+$5/ton

company can find the partner for sharing costs of plane renting availing itself with with specialized services of airport disputcher directly on plane arrival or "Babik" transportation company that can find a partner in advance.

Airport disputcher demands 50% of the cost that the partner he would find will agree to pay as its share.

Loading unloading of An-12 plane (10 tons) in March 1993 cost **20,000** rub..

Motor transportation

Name of the company	Distance exercised	Cost per Kg.	Information date	Cost per Kg.	Information date	Operation time
AUTOMOBILE TRANSPORTATION MINISTRY	YEREVAN-STAVROPOL	40-50 rub	June 24	30-50 rub	March 13	1-1.5 month
	YEREVAN-KRASNODAR	50-60 rub		30-50 rub		
"NET"	YEREVAN-DJULFA(Iran)	0.034$	June 24	0.034$	June 7	2 weeks

1. Sections (R)2a., 2b.; element b. (Transit warehouse point - Ports (2a.)/ Georgian border (2b.))

One specialized participant identified - "IMAK" transportation company. The company has its own truck fleet in Russia. Carrying capacity of one truck is 15 tons. One kilometer of transportation costs 250 rub per truck (as of July 14). another shipper who provided such service up to March 22 (the date of our inquiry) but now seased such a services is "NE transportation company. The carrying capacity of trucks that "NET" had under its discretion was 20 tons per truck and it $1.5 per kilometer per truck for Russia - Western Europe freights services.

The group feels that some Russian and Ukrainian motor companies that could perform similar services also can b found .

2. Section (R)2c. ; element b. (Transit warehouse point - Yerevan)

Currently only one Ministry of Automobile Transportation performs such a services. Ministry organizes excorted motor columns (200-300 vehicles) to Krasnodar or Stavropol once in 1-1.5 months. Hiring of one truck to Krasnodar cost 300,000-350,000rub.

Potential service provider can be "Babik" transportation company. Now it is shut down truck delivery services be of an unstable situation in Georgia.

Segment Russia; section 1b; element a.; (Supplier/Producer site- **Krasnodar)**

Departure points	**Distance**	**Costs (rub)**
Cherepovets	2057	120,401
Kharkov	805	56,222
Karaganda	3497	193,066

Segments: Georgia - Armenia

Segment Georgia ;section 2b.;element a. - **Segment Armenia;** section 1; element a.

(Georgian port - Yerevan)

Railway transportation

Name of the company	Distance exercised	Cost per Kg.	Information date	Cost per Kg.	Information date	Insurance	Operation time
"TECH"	NOVOROSIYSK-BATUMI(ship)-	0.0355-0.040$	June 14	0.15$	May 03	Escorting Insurence 12-20% cargo price	45 days
	BATUMI-YEREVAN(train)	6 rub or 0.006$					
	TOTAL	0,041-0.046					
				5.1 rub	May 14		
MINISTRY OF RAILROAD TRANSPORTATION	BATUMI-YEREVAN(train)	5.1 rub	May 14				

Complementary costs:

Excorting services:

TECH company - 12-20% of the cost of the cargo (See appendix 2.)

NET company - 10% of the cost of the cargo

Preliminary Total Cost Analysis

Freight cost - $8.5/ton

Demurage of the carriage at the marshalling yard- 3530 rub/carriage

Batumi:

Barge open unloading - $5 /ton

Barge close unloading - $8/ton

Storage - $0.2-0.3/ton

Source: Ministry of Construction

Services provided by "NET" company:

Ports	Loading into ship $/ton	Shipping cost $/ton	Loading into wagon at destination port $/ton	Total $/ton
Yeysk- Batumi	10	18	9	34-36
Timrugi - Batumi	10	18	9	37

Railway transportation

Segments: Russia - Armenia

Segment Russia; section 2c; element a.

Departure points	Distance	Costs (rub)
Cherepovetts	3,687	203,408
Karaganda	4074	224,359
Cheboksari	3129	177,419
Kharkov	2460	141086
Omsk	4099	224359
Pskov	3699	203,408
Novolipetsk	2673	151,429

APPENDICES.

Here are presented some rough calculations for costs associated with final production delivery from Krasnodar to Yerevan of 20 tons of raw materials (or one container):

Cost account	Motor/warehouse TL*	railroad/warehouse TL	Air-direct (IL-76) LTL*
Plant to warehouse or customer			
Local motor services		14,000	18,000
Transport intercity	350,000	11,000	4,500,000
Taxes, custom clearance	13,000	13,000	10,000
Police excorting services	2,000		
TOTAL	365,000	28,000	4,528,000
Warehouse in Krasnodar			
Local motor services		15,000	18,000
Rent (115 rub per day)	1,020 (for 8 days)	2,040 (for 16 days)	
TOTAL	1,020	17,040	18,000
SYSTEM TOTAL COST	366,020	45,040	4,546,000

*- Costs for air and motor transportation can be sufficiently reduced by settling contractual agreements with other companies for cost sharing for extensive usage of transportation means (trucks and planes) hired for roundtrip services.

APPENDIX A.

Excel Model for the Determination of the EOQ Parameters

Sections characteristics:						
Russia:		Grading features				
		Availability	Dependability	Capability	Frequency	
	Rail	1	4	1	2	
	Truck	2	3	3	3	
	Water					
	Air	3	1	4	1	
Weight coefficients		3	3	2.5	1.5	
		Section score (Grading features * Weight coefficient):				Total Score:
	Rail	3	12	2.5	3	20.5
	Truck	6	9	7.5	4.5	27
	Water	0	0	0	0	0
	Air	9	3	10	1.5	23.5
Georgia:		Grading features				
		Availability	Dependability	Capability	Frequency	
	Rail	2	3	2	3	
	Truck	3	2	3	2	
	Water	4	1	1	4	
	Air					
Weight coefficient:		3	3	2.5	1.5	
		Section score (Grading features * Weight coefficient):				Total Score:
	Rail	6	9	5	4.5	24.5
	Truck	9	6	7.5	3	25.5
	Water	12	3	2.5	6	23.5
	Air	0	0	0	0	0
Armenia:		Grading features				
		Availability	Dependability	Capability	Frequency	
	Rail	1	2	2	3	
	Truck	3	3	3	2	
	Water					
	Air	2	1	4	1	
Weight coefficient:		3	3	2.5	1.5	
		Section score (Grading features * Weight coefficient):				Total Score:
	Rail	3	6	5	4.5	18.5
	Truck	9	9	7.5	3	28.5
	Water	0	0	0	0	0
	Air	6	3	10	1.5	20.5
Annual cost of holding items at the transshipment point					0.07	
Annual cost of holding items in inventory at the plant's site					0.3	

Cost of the plant staying idle (rub./day):			2,220,000			
Plant's production capacity (Motors/monthly):			30,000			
Cost of staying idle per ton of supplied raw materials/year:				18647733600	rub	
Segments, sections and elements of the procurement lines.						
Segments carry the names of countries.						
Sections can be identified according to their country affiliation, besides there can be several sections withi						
	The sections with their elements (disposed in increasing cost sequence) are:					
	Segment Russia.					
Sections:						
	1a. Supplier/Producer site - Yerevan					
		Elements:				
a) Air transportation						
					Grading features:	
		Distance:	Annual demand (tons)		Price ($	Wheighted Pri
Magnetic Steel:			1992	1993	C74/1000*2945.45*1.01+26	
Cherepovets		2,660		6,000	10531.426	63188555.82
Novolipetsk		1,820	1,107	3,550	8032.50619	28604316.82
Temirtay		2,950			11394.1483	0
Mean weighted price per 35 tons:						**9611.819124**
Enameled Wire:						
Kainda		3,000		140	11542.8935	1616005.09
Pskov		2,650	112	30	10501.6769	326812.1859
Cheboksari		1,960		141.15	8448.99282	1192575.337
Mean weighted price per 35 tons:						**10076.78808**
Aluminium a. Primary						
Tursun-Zade		2,520		69	10114.9393	697930.8145
Novokuznetsk		3,780		420	13863.319	5822593.984
Kamensk-Uralski		2,520		128	10114.9393	1294712.236
Alma-Ata		2,940		3,000	11364.3992	34093197.69
Mean weighted price per 35 tons:						**11586.51776**
b. secondary						
Kharkov		1,680	71	3,000	7616.01956	22853466.05
Sykhoy log		2,240		128	9281.96608	1188091.658
Krasnoyarsk		4,000		2,000	14517.798	29035596
Mean weighted price per 35 tons:						**10350.45899**
Moscow		2,100			8865.47945	0
Samara (Kuybishev)		1,820			8032.50619	0
Krasnodar		1,000			5593.0845	0
Mean distance:		2,478		Mean weighted distance per		10209.28453
Total:			1,418	18,606		
The prices for round trip flights are calculated as follows						
As a basic cost have been taken the cost of round trip flight Yerevan - Krasnodar - Yerevan						

Then its costs have been segmented to: a. Variable cost (Fuel Cost) - 70% of the total cost:						
			b. Fixed cost (cost of lending and taking off and profit)			
These are: V.C.=$2,945.45; F.C.=436.36+909.1+1,272.72=$2,618.18						
Taking these costs as a basic we can compute costs to any other point with known distance:						
	T.C=Distance to the point I/Distance to the Krasnodar*V.C.*K+F.C.					
	Where K is coefficient reflecting an extra expences tied to longer distance					
	K = 1.01					
Freight costs are considered to be only for raw materials deliveries. Therefore						
total cost of the roundtrip can be separated by its final product delivery segment						
(2/3 of the total roundtrip cost) and raw materials delivery segment (1/3 of the total						
delivery cost).						
	Time1	Section 1	Price1	Time2	Section 2	Price2
Weight coefficient	0.3	0.3	1	0.1	0.1	1
Score	1	23.5	Seller's + frei	1	23.5	Seller's + freig
C(Tot. procur. cost) = (Sect. tot. score * Sect. coef. + Time * Time Coef.+ Price Coef. *Selling Price)*10+						
Cost of shortage is determined by cost of plant's staying idle annually, weighted						
according to particular raw material segment in the final production times coefficient S, reflecting						
effect of particular quantity short on production process: S = carrying capacity/Safety Stock						
S = Carrying Capacity (Air; railroad; truck)/ Safety Stock * k; Where k reflects the degree of						
influence of the capacity unit being short. Hereafter we accept k=0.1:						
For Magnetic Steel (Air): P=(66600000*212.8/1100/380)*35*35/1200*0.1						
	Cost of shortage ($/35 ton) (P1)	Seller's price($/ton)	Procurement Cost $/35 tons(C1)	Cost of shortage ($/35 ton) (P2)	Seller's price($/ton)	Procurement Cost $/35 tons(C1)
Magn. Seel (X23)	969117.0644	45.4	5050.18971	969117.0644	45.4	4878.689708
Enam. Wire (X24)	248676896	1,818.20	67253.1794	248676896	1,818.20	67081.67936
Alumin.prim. (X25	248676896	454.55	20028.6726	248676896	454.55	19857.17259
Aluminium (sec.)	249070372.1	272.73	13252.953	249070372.1	272.73	13081.453
Annual cost per dollar value of holding items in inventory at the plant's site is :					h=	0.3
Order Cost F(1):	35.25			Order Cost F(2):	35.25	
	35.25				35.25	
	35.25				35.25	
	35.25				35.25	
b.Railroad						
					Grading features:	
		Distance:	Annual demand (tons)		Price ($ per 3	Wheighted Pri
Magnetic Steel:			1992	1993		
Cherepovets		3,687		6,000	185	1110000
Novolipetsk		2,673	1,107	3,550	137.66	490216.8962
Temirtay		4,120			204	0
Mean weighted price per 70 tons:						**167.5619787**
Enameled Wire:						
Kainda		4,800		140	240	33600

Pskov		3,699	112	30	185	5757.2
Cheboksari		3,129		141.15	156.11	22034.9265
Mean weighted price per 70 tons:						**197.3071718**
Aluminium a. Primary						
Tursun-Zade		3,981		69	201.06	13873.14
Novokuznetsk		2,973		420	137.66	57817.2
Kamensk-Uralski		3,125		128	157.83	20202.24
Alma-Ata		4,912		3,000	248.08	744240
Mean weighted price per 70 tons:						**231.167426**
b. secondary						
Kharkov		2,460	71	3,000	128.26	384871.0646
Sykhoy log		3,091		128	156.11	19982.08
Krasnoyarsk		5,480		2,000	276.77	553540
Mean weighted price per 70 tons:						**186.894139**
Moscow		2,835			143.2	0
Samara (Kuybishev)		2,548			128.68	0
Krasnodar		1,630			75.5	0
Mean distance:		2,478		Mean weighted distance per		185.7943571
Total:			1,418	18,606		

	Time for transportation by train from Russia to Armenia also plays role and assessed					
	to be 65 days. Since train passes all trhee segment countries the highest segment scor					
	among these three should be chosen :					
	Time 1	Section 1	Price 1	Time 2	Section 2	Price 2
Weight coefficient	0.3	0.3	1	0.1	0.1	1
Score	70	24.5		60	24.5	

C(Tot. procur. cost) = (Sect. tot. score * Sect. coef. + Time * Time Coef.)*70 + Price Coef. * Price Coef.

	Cost of shortage ($/70 ton) (P1)	Selling price1($/ton)	Procurement Cost $/70 tons (C1)	Cost of shortage ($/70 ton) (P2)	Selling price2($/ton)	Procurement Cost $/70 tons (C1)
Magn. Seel (X26)	1938234.129	45.4	5330.06198	1938234.129	45.4	3937.061979
Enam. Wire (X27)	1377166.355	1,818.20	129455.807	1377166.355	1,818.20	128062.8072
Alumin.prim. (X28	1377166.355	454.55	34034.1674	1377166.355	454.55	32641.16743
Aluminium (sec.)	1383724.29	272.73	21262.4941	1383724.29	272.73	19869.49414
			Order Cost (F1= Tot. Score * 2)			Order Cost (F2= Tot. Score * 2)
			49			49

.Truck (plant's fleet)

he prices for round trip flights are calculated as follows:
s a basic cost have been taken the cost of round trip flight Yerevan - Krasnodar - Yerevan exercised by
3 ARMENMOTO Then costs have been segmented to:

. Variable cost (fuel, driver costs, spare parts, etc.):
). Fixed cost (cost of customs clearing, loading/unloading, etc.)
hese are: V.C.=(11,500,000/3+(Total Distance -1650)*2*250 rub; F.C.= 3000000/3 rub.; where
Tot.Distance - 1650) is the distance from the supplier's site to the transshipment point;
aking these cost T.C=Distance to the point I/Distance to the Krasnodar*V.C.*K+F.C.

Price=((11500000/3+(Distance-1650)*2*250)/1100+3000000/1100/3)/3						
					Grading features:	
		Distance:	Annual demand (tons)		Price ($	Wheighted Pri
Magnetic Steel:			1992	1993		
Cherepovets		3,687		6,000	1773.28283	10639696.97
Novolipetsk		2,673	1,107	3,550	1619.64646	5767674.436
Temirtay		2,950			1661.61616	0
Mean weighted price per 10 tons:						**1718.049362**
Enameled Wire:						
Kainda		4,800		140	1941.91919	271868.6869
Pskov		3,699	112	30	1775.10101	55241.14343
Cheboksari		3,129		141.15	1688.73737	238365.2803
Mean weighted price per 10 tons:						**1817.371398**
Aluminium a. Primary						
Tursun-Zade		3,981		69	1817.82828	125430.1515
Novokuznetsk		2,973		420	1665.10101	699342.4242
Kamensk-Uralski		3,125		128	1688.13131	216080.8081
Alma-Ata		4,912		3,000	1958.88889	5876666.667
Mean weighted price per 10 tons:						**1912.502088**
b. secondary						
Kharkov		2,460	71	3,000	1587.37374	4763248.247
Sykhoy log		3,091		128	1682.9798	215421.4141
Krasnoyarsk		5,480		2,000	2044.94949	4089898.99
Mean weighted price per 10 tons:						**1768.441625**
Moscow		2,835			1644.19192	0
Samara (Kuybishev)		2,548			1600.70707	0
Krasnodar		1,630			1461.61616	0
Mean distance:		2,478		Mean weighted distance per		1771.787908
Total:			1,418	18,606		

Freight costs are considered to be only for raw materials deliveries. Therefore total cost of the roundtrip can be separated by its final product delivery segment (2/3 of the total roundtrip cost) and raw materials delivery segment (1/3 of the total delivery cost).

Time for transportation by truck from Russia to Armenia also plays role and assessed to be 24 days. Since train passes all trhee segment countries the highest segment scor among these three should be chosen :

	Time 1	Section 1	Price 1	Time 2	Section 2	Price 2
Weight coefficient	0.3	0.3	1	0.1	0.1	1
Score	24	28.5		0.16	28.5	

C(Tot. procur. cost) = (Sect. tot. score * Sect. coef. + Time * Time Coef.)*10 + Price Coef. * Price Coef.

	Cost of shortage ($/10 ton) (P1)	Selling price($/ton)	Procurement Cost $/10 tons (C1)	Cost of shortage ($/10 ton) (P2)	Selling price($/ton)	Procurement Cost $/10 tons (C2)
Magn. Seel (X29)	39555.79855	45.4	1184.18312	39555.79855	45.4	1055.343121
Enam. Wire (X30)	28105.43581	1,818.20	18945.2905	28105.43581	1,818.20	18816.45047

lumin.prim. (X31	28105.43581	454.55	5340.5007	28105.43581	454.55	5211.660696
luminium (sec.)	28252.65476	272.73	3474.28054	28252.65476	272.73	3345.440542
rder Cost (F1 = Tot. Score * 3):		85.5	Order Cost (F2 = Tot. Score * 3):			85.5
		TRANSSHIPMENT POINT STORAGE SCHEME				
ections:						
. Supplier/Producer site -Transshipment point (Novorossiysk, Krasnodar, Stavropol)						
Air transportation						
					Grading features:	
		Distance:	Annual demand (tons)		Price ($	Wheighted Pri
agnetic Steel:			1992	1993	C74/1000*2945.45*1.01+26	
herepovets		1,773		6,000	7893.67731	47362063.88
ovolipetsk		910	1,107	3,550	5325.3431	18963919.54
emirtay		2,950			11394.1483	0
ean weighted price per 35 tons:						**6945.129153**
nameled Wire:						
ainda		3,667		140	13526.1632	1893662.843
skov		1,767	112	30	7873.84462	245034.0445
heboksari		1,176		141.15	6116.66769	863367.6447
ean weighted price per 35 tons:						**9648.287104**
luminium a. Primary						
ursun-Zade		2,062		69	8751.89219	603880.5609
ovokuznetsk		3,780		420	13863.319	5822593.984
amensk-Uralski		1,512		128	7116.2356	910878.1573
lma-Ata		3,593		3,000	13308.0035	39924010.51
ean weighted price per 35 tons:						**13066.45375**
secondary						
harkov		840	71	3,000	5117.09978	15354932.48
ykhoy log		1,344		128	6616.45165	846905.8109
rasnoyarsk		4,000		2,000	14517.798	29035596
ean weighted price per 35 tons:						**8821.652553**
loscow		1,260			6366.55967	0
amara (Kuybishev)		910			5325.3431	0
rasnodar		0			2618.18	0
ean distance:		2,478		Mean weighted distance per		8699.560467
otal:			1,418	18,606		
he prices for round trip flights are calculated as follows:						
s a basic cost have been taken the cost of round trip flight Yerevan - Krasnodar - Yerevan						
hen its costs have been segmented to: a. Variable cost (Fuel Cost) - 70% of the total cost:						
			b. Fixed cost (cost of lending and taking off and profit)			
hese are: V.C.=$2,945.45; F.C.=436.36+909.1+1,272.72=$2,618.18						
aking these costs as a basic we can compute costs to any other point with known distance:						
	T.C=Distance to the point I/Distance to the Krasnodar*V.C.*K+F.C.					
	Where K is coefficient that accounts for an extra expences tied to a longer distance					

	K = 1.01					
	Time 1	Section 1	Price 1	Time 2	Section 2	Price 2
Weight coefficient	0.3	0.3	1	0.1	0.1	1
Score	1	23.5	Seller's + frei	1	23.5	
C(Tot. procur. cost) = (Sect. tot. score * Sect. coef. + Time * Time Coef.)*35 + Price Coef. * Price Coef.						
Cost of shortage per 35 tons at a given stage of transportation includes cost of 35 tons short at the plant						
plus the cost of 35 tons short for subsequent delivery stages. Latter include cost for sea transportation						
which is determained by weighted costs of sea delivery's subsequent elements' shortage costs plus						
cost of 35 tons short for planned sea delivery. Latter includes 80% of the missed order cost plus 5%						
of the procurement cost for 35 tons. Truck and train shortage costs will be weighted according to their						
maximal carrying capacities for Georgia (10 tons for truck and 70 tons for railroad).						
To that also should be added the cost of storage at the transshipment warehouse, which is equal						
to the cost of storage for 8 days (mean total arrival rate to the transhipment point of alternative						
transportation means: Cw = 8 * 90rub/1100 *(unit weight)						
P=35/10*10/80*(Cost of Shtge by sea - motor dellivery)+ 35/70*70/80*(Cost of shtge by sea- rail delivery)						
p=35/10*10/80*($B525+SUM(0.05*$C525,$D525*0.8))+ 35/70*70/80*($B504+SUM($C504*0.05+$D504*0.						
	Cost of shortage ($/35 tons) (P1)	Seller's price($/ton)	Procurement Cost $/35 tons (C1)	Cost of shortage ($/35 tons) (P2)	Seller's price($/ton)	Procurement Cost $/35 tons (C2)
Magn. Seel (X1)	850673.4872	45.4	8791.37915	850673.4872	45.4	8619.879153
Enam. Wire (X2)	604490.6884	1,818.20	73542.5371	604490.6884	1,818.20	73542.5371
Alumin.prim. (X3)	604490.6884	454.55	29232.9537	604490.6884	454.55	29232.95375
Aluminium (sec.)	607374.8414	272.73	18624.4526	607374.8414	272.73	18624.45255
Order Cost (F1 = Tot. Score * 1.		35.25	Order Cost (F2 = Tot. Score		35.25	
	Annual cost per dollar value of holding items in inventory is :				h=	0.07
Railroad						
		Distanse:				
					Grading features:	
		Distance:	Annual demand (tons)		Price ($ per	Wheighted Pri
Magnetic Steel:			1992	1993		
Cherepovets		3,687		6,000	110	660000
Novolipetsk		2,673	1,107	3,550	118.3876	421586.5307
Temirtay		3,497			176	0
Mean weighted price per 70 tons:						**113.2551341**
Enameled Wire:						
Kainda		4,150		140	206.4	28896
Pskov		2,049	112	30	111	3454.32
Cheboksari		1,479		141.15	109.277	15424.44855
Mean weighted price per 70 tons:						**153.5425632**
Aluminium a. Primary						
Tursun-Zade		3,331		69	172.9116	11930.9004
Novokuznetsk		2,323		420	118.3876	49722.792
Kamensk-Uralski		1,475		128	126.264	16161.792
Alma-Ata		4,262		3,000	213.3488	640046.4
Mean weighted price per 70 tons:						**198.4688649**
b. secondary						
Kharkov		810	71	3,000	51	153036.21
Sykhoy log		1,441		128	109.277	13987.456

Krasnoyarsk		3,830		2,000	221.416	442832
Mean weighted price per 70 tons:						**118.9266119**
Moscow		1,185			114.56	0
Samara (Kuybishev)		898			77.208	0
Krasnodar		0			0	0
Mean distance:		2,478		Mean weighted distance per		132.0887472
Total:			1,418	18,606		

Time for transportation by train from Russia to Armenia also plays role and assessed to be 65 days. Since train passes all trhee segment countries the highest segment scor among these three should be chosen :

	Time 1	Section 1	Price 1	Time 2	Section 2	Price 2
Weight coefficient	0.3	0.3	1	0.1	0.1	1
Score	12	20.5		7	20.5	

C(Tot. procur. cost) = (Sect. tot. score * Sect. coef. + Time * Time Coef.)*70 + Price Coef. * Price Coef.

Cost of shortage per 70 tons at given stage of transportation includes cost of 70 tons short at the plant plus cost of 70 tons short for subsequent delivery stages. Latter include cost for sea transportation which is determained by weighted costs of sea delivery's subsequent elements' shortage costs plus cost of 70 tons short for planned sea delivery. Latter includes 80% of the missed order cost plus 5% of the procurement cost for 70 tons. Truck and train shortage costs will be weighted according to their maximal carrying capacities for Georgia (10 tons for truck and 70 tons for railroad).
To that also should be added the cost of storage at the transshipment warehouse, which is equal to the cost of storage for 8 days (mean total arrival rate to the transhipment point of alternative transportation means: Cw = 8 * 90rub/1100 *(unit weight)
P=70/10*10/80*(Cost of Shtge by sea - motor dellivery+ 70/70*70/80*(Cost of shtge by sea- rail delivery)

	Cost of shortage ($/70 ton) (P1)	Seller's price($/ton)	Procurement Cost per 70 ton (C1)	Cost of shortage ($/70 ton) (P2)	Seller's price($/ton)	Procurement Cost per 70 ton (C2)
Magn. Seel (X4)	1701346.974	45.4	3973.75513	1701346.974	45.4	3483.755134
Enam. Wire (X5)	1208981.377	1,818.20	128110.043	1208981.377	1,818.20	127620.0426
Alumin.prim. (X6)	1208981.377	454.55	32699.4689	1208981.377	454.55	32209.46886
Aluminium (sec.)	1214749.683	272.73	19892.5266	1214749.683	272.73	19402.52661
Order Cost (F1 = Tot. Score * 2):		41	Order Cost (F2 = Tot. Score		41	

Annual cost per dollar value of holding items in inventory is : h= 0.07

Truck (plant's fleet)		Distanse:				
					Grading features:	
		Distance:	Annual demand (tons)		Price ($	Wheighted Pri
Magnetic Steel:			1992	1993		
Cherepovets		3,687		6,000	848.01	5088060
Novolipetsk		2,673	1,107	3,550	614.79	2189310.225

Temirtay		2,950			678.5	0
Mean weighted price per 10 tons:						**762.0282958**
Enameled Wire:						
Kainda		4,800		140	1104	154560
Pskov		3,699	112	30	850.77	26475.9624
Cheboksari		3,129		141.15	719.67	101581.4205
Mean weighted price per 10 tons:						**908.299479**
Aluminium a. Primary						
Tursun-Zade		3,981		69	915.63	63178.47
Novokuznetsk		2,973		420	683.79	287191.8
Kamensk-Uralski		3,125		128	718.75	92000
Alma-Ata		4,912		3,000	1129.76	3389280
Mean weighted price per 10 tons:						**1059.344835**
b. secondary						
Kharkov		2,460	71	3,000	565.8	1697801.718
Sykhoy log		3,091		128	710.93	90999.04
Krasnoyarsk		5,480		2,000	1260.4	2520800
Mean weighted price per 10 tons:						**840.405764**
Moscow		2,835			652.05	0
Samara (Kuybishev)		2,548			586.04	0
Krasnodar		1,630			374.9	0
Mean distance:		2,478		Mean weighted distance per		844.0654684
Total:			1,418	18,606		

Freight costs are considered to be only for raw materials deliveries. Therefore total cost of the roundtrip can be separated by its final product delivery segment (2/3 of the total roundtrip cost) and raw materials delivery segment (1/3 of the total delivery cost).

Time for transportation by truck from Russia to Armenia also plays role and assessed to be 24 days. Since train passes all trhee segment countries the highest segment scor among these three should be chosen :

	Time 1	Section 1	Price 1	Time 2	Section 2	Price 2
Weight coefficient	0.3	0.3	1	0.1	0.1	1
Score	7	27		4	27	

C(Tot. procur. cost) = (Sect. tot. score * Sect. coef. + Time * Time Coef.)*15 + Price Coef. * Price Coef.

Cost of shortage per 15 tons at given stage of transportation includes cost of 15 tons short at the plant plus cost of 15 tons short for further delivery stages. Latter includes weighted cost for sea transportation which is determained by weighted costs of subsequent elements' shortage costs plus cost of 15 tons short for planned sea delivery. Latter includes 80% of the order cost plus 5% of the procurement cost for 15 tons. truck and train costs will be weighted according to their maximal carrying capacities (10 tons for truck and 70 tons for railroad).

To that also should be added the cost of storage at the transshipment warehouse, which is equal to the cost of storage for 8 days (mean total arrival rate to the transhipment point of alternative transportation means: Cw = 8 * 90rub/1100 *(unit weight)

P=15/10*10/80*(Cost of Shtge by sea - motor delivery)+ 15/70*70/80*(Cost of shortage at sea-rail delivery)+ Cost of storage at the plant's site

Assuming the initial delivery to be carried out by 1 truck that will amount to :						
	Cost of shortage ($/15 ton) (P1)	Seller's price($/ton)	Procurement Cost $/15 tons (C1)	Cost of shortage ($/15 ton) (P2)	Seller's price($/ton)	Procurement Cost $/15 tons (C2)
Magn. Seel (X7)	364574.3517	45.4	1596.0283	364574.3517	45.4	1489.528296
Enam. Wire (X8)	259067.4379	1,818.20	28334.2995	259050.7343	1,818.20	28227.79948
Alumin.prim. (X9)	259067.4379	454.55	8030.59484	259050.7343	454.55	7924.094835
Aluminium (sec.)	260303.5035	272.73	5084.35576	260286.7999	272.73	4977.855764
Order Cost (F1 = Tot. Score * 3):		81	Order Cost (F2 = Tot. Score * 3):			81
	Annual cost per dollar value of holding items in inventory is :				h=	0.07
			Q=sqrt(2A*F/h*C)			
	Segment Georgia					
	Sections:					
	1. Transshipment point (Novorossiysk,Yeysk)- Georgian Port(Batumi)					
A)Sea						
	1. Sea- Rail (X19a) (1item is equivalent to 70 tons)					
	Time 1	Section 1	Price 1	Time 2	Section 2	Price 2
Weight coefficient	0.3	0.3	1	0.1	0.1	1
Score	45	23.5	45	30	23.5	45

C(Tot. procur. cost) = (Sect. tot. score * Sect. coef. + Time * Time Coef.)*70 + Price Coef. * Price Coef.

Cost of shortage for sea freight includes cost of 70 tons short at the plant plus cost of 70 tons short for planned railroad delivery. Latter includes 80% of the order cost plus 5% of freight expenses.

Assuming the initial delivery to be carried out by 1 truck that will amount to :

	cost ($/70 ton) (P1)	Procurement Cost per 70 ton (C1)	Order Cost (F1= Tot. Score * 4)	cost ($/70 ton) (P2)	Procurement Cost per 70 ton (C2)	Order Cost (F2= Tot. Score * 4)
Magnetic Seel	1938312.504	1483.5	94	1938287.654	419.5	94
Enameled Wire	1377244.73	1483.5	94	1377219,88	419.5	94
Aluminium (prim.)	1377244.73	1483.5	94	1377219.88	419.5	94
Aluminium (sec.)	1383802.665	1483.5	94	1383777.815	419.5	94
	1. Sea- Motor (X20a) (1item is equivalent to 10 tons)					
	Time 1	Section 1	Price 1	Time 2	Section 2	Price 2
Weight coefficient	0.3	0.3	1	0.1	0.1	1
Score	45	23.5	45	30	23.5	45

C(Tot. procur. cost) = (Sect. tot. score * Sect. coef. + Time * Time Coef.)*10 + Price Coef. * Price Coef.

Cost of shortage for sea freight includes cost of 10 tons short at the plant plus cost of 10 tons short for planned truck delivery. Latter includes 80% of the order cost plus 50% of freight expenses as it is stipulated by "TECH" transportation company's agreement.

Assuming the initial delivery to be carried out by 1 truck that will amount to :

	shortage at plant ($/10 ton)	Procurement Cost per 10 tons (C)	shortage cost ($/10 ton) (P1)	shortage at plant ($/10 ton)	Procurement Cost per 10 tons (C)	cost ($/10 ton) (P2)
Magnetic Seel	39555.79855	1009.590909	39674.6781	39555.79855	940.590909	39671.22809
Enameled Wire	28105.43581	1009.590909	28224.3154	28105.43581	940.590909	28220.86535
Aluminium (prim.)	28105.43581	1009.590909	28224.3154	28105.43581	940.590909	28220.86535

Aluminium (sec.)	28252.65476	1009.590909	28371.5343	28252.65476	940.590909	28368.0843
	cost ($/10 ton) (P1)	Procurement Cost per 10 ton (C1)	Order Cost (F(1)= Tot. Score * 4)	cost ($/10 ton) (P2)	Procurement Cost per 10 ton (C2)	Order Cost (F(2)= Tot. Score * 4)
Magnetic Seel	39674.67809	250.5	94	39671.22809	98.5	94
Enameled Wire	28224.31535	250.5	94	28220.86535	98.5	94
Aluminium (prim.)	28224.31535	250.5	94	28220.86535	98.5	94
Aluminium (sec.)	28371.5343	250.5	94	28368.0843	98.5	94
2. Georgian port (Batumi)- Yerevan						
a. Railroad (X19b)						
	Time 1	Section 1	Price 1	Time 2	Section 2	Price 2
Weight coefficient	0.3	0.3	1	0.1	0.1	1
Score	9	24.5	80	5	24.5	80
		MAX(G33,G49)				
C(Tot. procur. cost) = (Sect. tot. score * Sect. coef. + Time * Time Coef.)*70 + Price Coef. * Price Coef.						
	cost ($/70 ton) (P1)	Procurement Cost per 70 ton (C1)	Order Cost (F1= Tot. Score * 4)	cost ($/70 ton) (P2)	Procurement Cost per 70 ton (C2)	Order Cost (F2= Tot. Score * 4)
Magnetic Seel	1938234.129	783.5	49	1938234.129	286.5	49
Enameled Wire	1377166.355	783.5	49	1377166.355	286.5	49
Aluminium (prim.)	1377166.355	783.5	49	1377166.355	286.5	49
Aluminium (sec.)	1383724.29	783.5	49	1383724.29	286.5	49
Total		**2267**			**706**	
b. Motor (X20b)						
	Time 1	Section 1	Price 1	Time 2	Section 2	Price 2
Weight coefficient	0.3	0.3	1	0.1	0.1	1
Score	5	28.5	909.090909	3	28.5	909.0909091
C(Total procurement cost) = Sect. tot. score * Sect. coef. + Time * Time Coef. + Price Coef. * Price Coef.						
	Cost of shortage ($/10 ton) (P1)	Procurement Cost per 10 tons (C1)	Order Cost (F1= Tot. Score * 3)	Cost of shortage ($/10 ton) (P2)	Procurement Cost per 10 tons (C2)	Order Cost (F2= Tot. Score * 3)
Magnetic Seel	39555.79855	1009.590909	85.5	39555.79855	940.590909	85.5
Enameled Wire	28105.43581	1009.590909	85.5	28105.43581	940.590909	85.5
Aluminium (prim.)	28105.43581	1009.590909	85.5	28105.43581	940.590909	85.5
Aluminium (sec.)	28252.65476	1009.590909	85.5	28252.65476	940.590909	85.5
Total		**1260.090909**			**1039.09091**	
	Transshipment point - Yerevan					
A. Air transportation						
	Time 1	Section 1	Price 1	Time 2	Section 2	Price 2
Weight coefficient	0.3	0.3	1	0.1	0.1	1
Score	1	23.5	1848.48485	1	23.5	1848.484848

C(Total procurement cost) = Sect. tot. score * Sect. coef. + Time * Time Coef. + Price Coef. * Price Coef.

	Cost of shortage ($/35 ton) (P1)	Procurement Cost per 35 tons (C1)	Order Cost (F1= Tot. Score * 3)	Cost of shortage ($/35 ton) (P2)	Procurement Cost per 35 tons (C2)	Order Cost (F2= Tot. Score * 3)
Magnetic Seel	484558.5322	2105.734848	81	484558.5322	1934.23485	81
Enameled Wire	344291.5887	2105.734848	81	344291.5887	1934.23485	81
Aluminium (prim.)	344291.5887	2105.734848	81	344291.5887	1934.23485	81
Aluminium (sec.)	346095.0208	2105.734848	81	346095.0208	1934.23485	81
B. **Motor**						
	Time 1	Section 1	Price 1	Time 2	Section 2	Price 2
Weight coefficient	0.3	0.3	1	0.3	0.3	1
Score	45	27	4242.42424	45	27	4242.424242

C(Total procurement cost) = Sect. tot. score * Sect. coef. + Time * Time Coef. + Price Coef. * Price Coef.

	Cost of shortage ($/10 ton) (P1)	Procurement Cost per 10 tons (C1)	Order Cost (F1= Tot. Score * 3)	Cost of shortage ($/10 ton) (P2)	Procurement Cost per 10 tons (C2)	Order Cost (F2= Tot. Score * 3)
Magnetic Seel	39555.79855	4458.424242	81	39555.79855	4458.42424	81
Enameled Wire	28105.43581	4458.424242	81	28105.43581	4458.42424	81
Aluminium (prim.)	28105.43581	4458.424242	81	28105.43581	4458.42424	81
Aluminium (sec.)	28252.65476	4458.424242	81	28252.65476	4458.42424	81

Final consideration should be given to the alternative without transhipment point.

At that rate EOQ will be the same for tied to each other subsequent transportation segments.
In order to come up with EOQ imput data for that:
1. All procurement costs of subsequent sections for particular raw material weighted according to their carrying capacities (10 vs 70 tons) should be added.
2. Cost of shortage per 35 tons at given stage of transportation includes cost of 35 tons short for subsequent delivery stages. Latter include cost for sea transportation which is determained by weighted costs of sea delivery's subsequent elements' shortage costs plus cost of 35 tons short for planned sea delivery. Latter includes 80% of the missed order cost plus 35% of the procurement cost for 35 tons. Truck and train shortage costs will be weighted according to their maximal carrying capacities for Georgia (10 tons for truck and 70 tons for railroad).
P=35/10*10/80*(Cost of Shtge by sea - motor dellivery)+ 35/70*70/80*(Cost of shtge by sea- rail delivery)
3. Order cost should be determined as the sum of appropriate total scores for comprising the sea delivery can be incorporated in one weighted score: Fs=Tr. (Sc.*1+Rr.Sc.*7)/8

	1. Producer site-Sea				
A. **Truck**					

	cost ($/15 ton) (P1)	Procurement Cost per 15 ton (C1)	Order Cost (F1= Tot. Score * 4)	cost ($/15 ton) (P2)	Procurement Cost per 15 ton (C2)	Order Cost (F2= Tot. Score * 4)
Magn. Steel (X16)	364662.3809	1922.186459	218.0625	364577.2774	1587.68646	218.0625
Enam. Wire (X17)	259155.4671	28660.45764	218.0625	259070.3636	28325.9576	218.0625
Al. Prim. (X18)	259155.4671	8356.752999	218.0625	259070.3636	8022.253	218.0625
Al. Sec.	260391.5327	5410.513927	218.0625	260306.4292	5076.01393	218.0625
B. Air						
	Cost of shortage ($/35 ton) (P1)	Procurement Cost per 35 tons (C1)	Order Cost (F1= Tot. Score * 3)	Cost of shortage ($/35 ton) (P2)	Procurement Cost per 35 tons (C2)	Order Cost (F2= Tot. Score * 3)
Magn. Steel (X10)	850878.8889	9552.414868	172.3125	850680.3139	8848.91487	172.3125
Enam. Wire (X11)	604696.09	74303.57282	172.3125	604497.515	73771.5728	172.3125
Al. Prim. (X12)	604696.09	29993.98946	172.3125	604497.515	29461.9895	172.3125
Al. Sec.	607580.2431	19385.48827	172.3125	607381.6681	18853.4883	172.3125
C.Railroad						
	cost ($/70 ton) (P1)	Procurement Cost per 70 ton (C1)	Order Cost (F1= Tot. Score * 4)	cost ($/70 ton) (P2)	Procurement Cost per 70 ton (C2)	Order Cost (F2= Tot. Score * 4)
Magn. Steel (X13)	1701757.778	5495.826563	178.0625	1701360.628	3941.82656	178.0625
Enam. Wire (X14)	1209392.18	129632.114	178.0625	1208995.03	128078.114	178.0625
Al. Prim. (X15)	1209392.18	34221.54029	178.0625	1208995.03	32667.5403	178.0625
Al. Sec.	1215160.486	21414.59804	178.0625	1214763.336	19860.598	178.0625
T.Sh.C.=70/10*70/490*($B542+SUM(0.35*$C542,$D542*0.8))+70/70*420/490*($B521+SUM($C521*0.35+						
	2. Producer Site - Air					
A. Truck						
	Total shortage cost ($/15 ton) (P)	Procurement Cost per 15 ton (C)	Order Cost (F= Tot. Score * 4)	Total shortage cost ($/15 ton) (P)	Procurement Cost per 15 ton (C)	Order Cost (F= Tot. Score * 4)
Magn. Steel (X32)	208011.574	8966.100266	116.25	207985.849	8259.35027	116.25
Enam. Wire (X33)	208011.574	35704.37145	116.25	207985.849	34997.6214	116.25
Al. Prim. (X34)	208011.574	15400.66681	116.25	207985.849	14693.9168	116.25
Al. Sec.	208011.574	12454.42773	116.25	207985.849	11747.6777	116.25
B.Railroad						

	cost ($/70 ton) (P1)	Procurement Cost per 70 ton (C1)	Order Cost (F1= Tot. Score * 4)	cost ($/70 ton) (P2)	Procurement Cost per 70 ton (C2)	Order Cost (F2= Tot. Score * 4)
Magn. Steel (X35)	970720.6788	8185.224831	76.25	970600.6288	7352.22483	76.25
Enam. Wire (X36)	970720.6788	132321.5123	76.25	970600.6288	131488.512	76.25
Al. Prim. (X37)	970720.6788	36910.93856	76.25	970600.6288	36077.9386	76.25
Al. Sec.	970720.6788	24103.99631	76.25	970600.6288	23270.9963	76.25
	3. Producer Site - Truck					
B. Air (X38)						
	Cost of shortage ($/35 ton) (P1)	Procurement Cost per 35 tons (C1)	Order Cost (F1= Tot. Score * 3)	Cost of shortage ($/35 ton) (P2)	Procurement Cost per 35 tons (C2)	Order Cost (F2= Tot. Score * 3)
Magnetic Steel	850878.8889	24395.864	197.25	850680.3139	24224.364	197.25
Enameled Wire	850878.8889	89147.02195	197.25	850680.3139	89147.022	197.25
Al. Prim.	850878.8889	44837.4386	197.25	850680.3139	44837.4386	197.25
Al. Sec.	850878.8889	34228.9374	197.25	850680.3139	34228.9374	197.25
Weighted Mean		33928.4894			33819.353	
C.Railroad (X39)						
	(P1)	Cost per 70	(F1= Tot.	(P2)	Cost per 70	(F2= Tot.
Magnetic Steel	970720.6788	35182.72483	203	970600.6288	34692.7248	203
Enameled Wire	970720.6788	159319.0123	203	970600.6288	158829.012	203
Al. Prim.	970720.6788	63908.43856	203	970600.6288	63418.4386	203
Al. Sec.	970720.6788	51101.49631	203	970600.6288	50611.4963	203
Weighted Mean		51973.59248			51483.5925	

APPENDIX B.

Integer Programming Simulation Results.

QuickQuant Plus Report
SOLUTION TO INTEGER PROGRAM

ROBLEM: Transportation Channels' Capacities determina Date: 07-30-19
Scenario 1. Channels Capacities

FORMULATED INTEGER PROGRAM

inimize C =

+ 8791.38 X1	+ 73542.53 X2	+ 29232.95 X3	+ 3973.75 X4
+ 128110 X5	+ 32699.47 X6	+ 1596.03 X7	+ 28334.3 X8
+ 8030.59 X9	+ 9552.41 X10	+ 74303.57 X11	+ 29993.99 X12
+ 5495.83 X13	+ 129632.1 X14	+ 34221.54 X15	+ 1922.18 X16
+ 28660.46 X17	+ 8356.75 X18	+ 2267 X19	+ 1260.1 X20
+ 4458.42 X21	+ 2105.73 X22	+ 5050.19 X23	+ 67253.18 X24
+ 20028.67 X25	+ 5330.06 X26	+ 129455.8 X27	+ 34034.17 X28
+ 1184.18 X29	+ 18945.29 X30	+ 5340.5 X31	+ 8966.1 X32
+ 35704.37 X33	+ 15400.67 X34	+ 8185.22 X35	+ 132321.5 X36
+ 36910.94 X37	+ 33928.49 X38	+ 51973.59 X39	

bject to:

1:	+ 35 X1	+ 0 X2	+ 0 X3	+ 70 X4	
	+ 0 X5	+ 0 X6	+ 15 X7	+ 0 X8	
	+ 0 X9	+ 35 X10	+ 0 X11	+ 0 X12	
	+ 70 X13	+ 0 X14	+ 0 X15	+ 15 X16	
	+ 0 X17	+ 0 X18	+ 0 X19	+ 0 X20	
	+ 0 X21	+ 0 X22	+ 35 X23	+ 0 X24	
	+ 0 X25	+ 70 X26	+ 0 X27	+ 0 X28	
	+ 10 X29	+ 0 X30	+ 0 X31	+ 35 X32	
	+ 0 X33	+ 0 X34	+ 35 X35	+ 0 X36	
	+ 0 X37	+ 6.36 X38	+ 6.36 X39		= 700
2:	+ 0 X1	+ 35 X2	+ 0 X3	+ 0 X4	
	+ 70 X5	+ 0 X6	+ 0 X7	+ 15 X8	
	+ 0 X9	+ 0 X10	+ 35 X11	+ 0 X12	
	+ 0 X13	+ 70 X14	+ 0 X15	+ 0 X16	
	+ 15 X17	+ 0 X18	+ 0 X19	+ 0 X20	
	+ 0 X21	+ 0 X22	+ 0 X23	+ 35 X24	
	+ 0 X25	+ 0 X26	+ 70 X27	+ 0 X28	
	+ 0 X29	+ 10 X30	+ 0 X31	+ 0 X32	
	+ 35 X33	+ 0 X34	+ 0 X35	+ 35 X36	
	+ 0 X37	+ .9 X38	+ .9 X39		= 100
3:	+ 0 X1	+ 0 X2	+ 35 X3	+ 0 X4	
	+ 0 X5	+ 70 X6	+ 0 X7	+ 0 X8	
	+ 15 X9	+ 0 X10	+ 0 X11	+ 35 X12	
	+ 0 X13	+ 0 X14	+ 70 X15	+ 0 X16	
	+ 0 X17	+ 15 X18	+ 0 X19	+ 0 X20	
	+ 0 X21	+ 0 X22	+ 0 X23	+ 0 X24	
	+ 35 X25	+ 0 X26	+ 0 X27	+ 70 X28	
	+ 0 X29	+ 0 X30	+ 10 X31	+ 0 X32	
	+ 0 X33	+ 35 X34	+ 0 X35	+ 0 X36	
	+ 35 X37	+ 2.72 X38	+ 2.72 X39		=
4:	+ 0 X1	+ 0 X2	+ 0 X3	+ 0 X4	
	+ 0 X5	+ 0 X6	+ 0 X7	+ 0 X8	
	+ 0 X9	+ 35 X10	+ 35 X11	+ 35 X12	

	+ 70 X13	+ 70 X14	+ 70 X15	+ 15 X16
	+ 15 X17	+ 15 X18	+ 70 X19	+ 10 X20
	+ 0 X21	+ 0 X22	+ 0 X23	+ 0 X24
	+ 0 X25	+ 0 X26	+ 0 X27	+ 0 X28
	+ 0 X29	+ 0 X30	+ 0 X31	+ 0 X32
	+ 0 X33	+ 0 X34	+ 0 X35	+ 0 X36
	+ 0 X37	+ 0 X38	+ 0 X39	
C5:	+ 0 X1	+ 0 X2	+ 0 X3	+ 0 X4
	+ 0 X5	+ 0 X6	+ 0 X7	+ 0 X8
	+ 0 X9	+ 0 X10	+ 0 X11	+ 0 X12
	+ 0 X13	+ 0 X14	+ 0 X15	+ 0 X16
	+ 0 X17	+ 0 X18	+ 0 X19	+ 0 X20
	+ 0 X21	+ 0 X22	+ 0 X23	+ 0 X24
	+ 0 X25	+ 0 X26	+ 0 X27	+ 0 X28
	+ 1 X29	+ 1 X30	+ 1 X31	+ 0 X32
	+ 0 X33	+ 0 X34	+ 0 X35	+ 0 X36
	+ 0 X37	+ 0 X38	+ 0 X39	
C6:	+ 0 X1	+ 0 X2	+ 0 X3	+ 0 X4
	+ 0 X5	+ 0 X6	+ 0 X7	+ 0 X8
	+ 0 X9	+ 0 X10	+ 0 X11	+ 0 X12
	+ 1 X13	+ 1 X14	+ 1 X15	+ 0 X16
	+ 0 X17	+ 0 X18	+ 1 X19	+ 0 X20
	+ 0 X21	+ 0 X22	+ 0 X23	+ 0 X24
	+ 0 X25	+ 0 X26	+ 0 X27	+ 0 X28
	+ 0 X29	+ 0 X30	+ 0 X31	+ 0 X32
	+ 0 X33	+ 0 X34	+ 0 X35	+ 0 X36
	+ 0 X37	+ 0 X38	+ 0 X39	
C7:	+ 0 X1	+ 0 X2	+ 0 X3	+ 0 X4
	+ 0 X5	+ 0 X6	+ 0 X7	+ 0 X8
	+ 0 X9	+ 0 X10	+ 0 X11	+ 0 X12
	+ 0 X13	+ 0 X14	+ 0 X15	+ 0 X16
	+ 0 X17	+ 0 X18	+ 0 X19	+ 0 X20
	+ 0 X21	+ 1 X22	+ 1 X23	+ 1 X24
	+ 1 X25	+ 0 X26	+ 0 X27	+ 0 X28
	+ 0 X29	+ 0 X30	+ 0 X31	+ 0 X32
	+ 0 X33	+ 0 X34	+ 0 X35	+ 0 X36
	+ 0 X37	+ 0 X38	+ 0 X39	
C8:	+ 0 X1	+ 0 X2	+ 0 X3	+ 0 X4
	+ 0 X5	+ 0 X6	+ 0 X7	+ 0 X8
	+ 0 X9	+ 0 X10	+ 0 X11	+ 0 X12
	+ 0 X13	+ 0 X14	+ 0 X15	+ 0 X16
	+ 0 X17	+ 0 X18	+ 0 X19	+ 0 X20
	+ 0 X21	+ 0 X22	+ 0 X23	+ 0 X24
	+ 0 X25	+ 1 X26	+ 1 X27	+ 1 X28
	+ 0 X29	+ 0 X30	+ 0 X31	+ 0 X32
	+ 0 X33	+ 0 X34	+ 0 X35	+ 0 X36
	+ 0 X37	+ 0 X38	+ 0 X39	
C9:	+ 0 X1	+ 0 X2	+ 0 X3	+ 0 X4
	+ 0 X5	+ 0 X6	+ 0 X7	+ 0 X8
	+ 0 X9	+ 0 X10	+ 0 X11	+ 0 X12
	+ 0 X13	+ 0 X14	+ 0 X15	+ 1 X16
	+ 1 X17	+ 1 X18	+ 0 X19	+ 1 X20
	+ 1 X21	+ 0 X22	+ 0 X23	+ 0 X24
	+ 0 X25	+ 1 X26	+ 0 X27	+ 0 X28
	+ 0 X29	+ 0 X30	+ 0 X31	+ 0 X32

```
          + 0 X33          + 0 X34          + 0 X35          + 0 X36
          + 0 X37          + 1 X38          + 1 X39                    <        35

:10:      + 3.5 X1       + 3.5 X2       + 3.5 X3         + 7 X4
            + 7 X5           + 7 X6       + 1.5 X7     + 1.5 X8
          + 1.5 X9           + 0 X10          + 0 X11          + 0 X12
            + 0 X13          + 0 X14          + 0 X15          + 0 X16
            + 0 X17          + 0 X18          - 7 X19          - 1 X20
            - 1 X21        - 3.5 X22          + 0 X23          + 0 X24
            + 0 X25          + 0 X26          + 0 X27          + 0 X28
            + 0 X29          + 0 X30          + 0 X31          + 0 X32
            + 0 X33          + 0 X34          + 0 X35          + 0 X36
            + 0 X37          + 0 X38          + 0 X39                    =
```

DETAILED RECORD OF LINEAR PROGRAMS EVALUATED IN SOLVING INTEGER PROGRAM

Problem Number	Cost Lower Bound	Parent Problem	Branching Variable	Problem Status
1	2889268.000			
2	2905900.200	1	X33 (< 28)	
3	Infeasible	1	X33 (> 29)	
4	2905903.200	2	X13 (< 97)	
5	2906018.800	2	X13 (> 98)	
6	2906113.000	4	X14 (< 0)	
7	2947491.200	4	X14 (> 1)	
8	2906069.000	5	X27 (< 0)	
9	2947480.800	5	X27 (> 1)	
10	2906282.000	8	X14 (< 0)	
11	2947657.000	8	X14 (> 1)	
12	2906116.000	6	X4 (< 0)	
13	2906645.000	6	X4 (> 1)	
14	2906698.500	12	X5 (< 0)	
15	2948236.200	12	X5 (> 1)	
16	2906922.000	10	X5 (< 0)	
17	2948402.000	10	X5 (> 1)	
18	2906858.000	13	X13 (< 96)	
19	2906763.500	13	X13 (> 97)	
20	2908811.800	14	X26 (< 2)	
21	2906756.000	14	X26 (> 3)	
22	2907977.500	21	X34 (< 85)	
23	Infeasible	21	X34 (> 86)	
24	2907027.000	19	X27 (< 0)	
25	2948225.800	19	X27 (> 1)	
26	2906861.000	18	X4 (< 1)	
27	2907390.000	18	X4 (> 2)	
28	2907443.500	26	X5 (< 0)	
29	2948981.200	26	X5 (> 1)	
30	2908076.500	16	X34 (< 85)	
31	Infeasible	16	X34 (> 86)	
32	2907667.000	24	X5 (< 0)	
33	2949147.000	24	X5 (> 1)	
34	2907603.000	27	X13 (< 95)	
35	2907508.500	27	X13 (> 96)	
36	2909556.800	28	X26 (< 2)	
37	2907501.000	28	X26 (> 3)	
38	2908722.500	37	X34 (< 85)	
39	Infeasible	37	X34 (> 86)	

40	2907772.000	35	X27 (< 0)
41	2948970.800	35	X27 (> 1)
42	2907606.000	34	X4 (< 2)
43	2908135.000	34	X4 (> 3)
44	2908188.200	42	X5 (< 0)
45	2949726.000	42	X5 (> 1)
46	2908821.500	32	X34 (< 85)
47	Infeasible	32	X34 (> 86)
48	2908412.000	40	X5 (< 0)
49	2949892.000	40	X5 (> 1)
50	2908243.500	22	X15 (< 0)
51	2910176.200	22	X15 (> 1)
52	2908143.500	30	X28 (< 0)
53	2910154.800	30	X28 (> 1)
54	2908348.000	43	X13 (< 94)
55	2908253.500	43	X13 (> 95)
56	2908409.500	52	X15 (< 0)
57	2910342.000	52	X15 (> 1)
58	2910301.500	44	X26 (< 2)
59	2908246.000	44	X26 (> 3)
60	2909107.000	50	X6 (< 0)
61	2910921.200	50	X6 (> 1)
62	2909467.500	59	X34 (< 85)
63	Infeasible	59	X34 (> 86)
64	2908516.800	55	X27 (< 0)
65	2949715.500	55	X27 (> 1)
66	2908351.000	54	X4 (< 3)
67	2908880.000	54	X4 (> 4)
68	2908933.000	66	X5 (< 0)
69	2950471.000	66	X5 (> 1)
70	2909272.800	56	X6 (< 0)
71	2911087.000	56	X6 (> 1)
72	2909566.500	48	X34 (< 85)
73	Infeasible	48	X34 (> 86)
74	2909156.800	64	X5 (< 0)
75	2950636.800	64	X5 (> 1)
76	2908988.500	38	X15 (< 0)
77	2910921.000	38	X15 (> 1)
78	2909715.500	20	X27 (< 0)
79	2950274.200	20	X27 (> 1)
80	2908888.500	46	X28 (< 0)
81	2910899.500	46	X28 (> 1)
82	2909093.000	67	X13 (< 93)
83	2908998.500	67	X13 (> 94)
84	2909154.500	80	X15 (< 0)
85	2911087.000	80	X15 (> 1)
86	2911046.500	68	X26 (< 2)
87	2908991.000	68	X26 (> 3)
88	2909851.800	76	X6 (< 0)
89	2911666.000	76	X6 (> 1)
90	2910212.500	87	X34 (< 85)
91	Infeasible	87	X34 (> 86)
92	2909261.500	83	X27 (< 0)
93	2950460.500	83	X27 (> 1)
94	2909096.000	82	X4 (< 4)
95	2909625.000	82	X4 (> 5)
96	2909678.000	94	X5 (< 0)
97	2951216.000	94	X5 (> 1)
98	2909222.200	60	X31 (< 2)
99	2909577.000	60	X31 (> 3)

100	2910017.500	84	X6 (< 0)	
101	2911832.000	84	X6 (> 1)	
102	2910311.500	74	X34 (< 85)	
103	Infeasible	74	X34 (> 86)	
104	2909275.500	98	X18 (< 0)	
105	2909453.000	98	X18 (> 1)	Integer
106	2909901.500	92	X5 (< 0)	
107	2951381.800	92	X5 (> 1)	
108	2909388.000	70	X31 (< 2)	
109	2909742.800	70	X31 (> 3)	
110	2909298.000	104	X9 (< 0)	
111	2909612.500	104	X9 (> 1)	
112	2910721.500	110	X25 (< 0)	
113	2911384.000	110	X25 (> 1)	
114	2909441.200	108	X18 (< 0)	
115	2909618.800	108	X18 (> 1)	Integer
116	2909463.800	114	X9 (< 0)	
117	2909778.200	114	X9 (> 1)	

SOLUTION TO INTEGER PROGRAM

Original Variable	Value	Status
X1	0.00000	integer
X2	0.00000	integer
X3	0.00000	integer
X4	0.00000	integer
X5	0.00000	integer
X6	0.00000	integer
X7	0.00000	integer
X8	0.00000	integer
X9	0.00000	integer
X10	0.00000	integer
X11	0.00000	integer
X12	0.00000	integer
X13	97.00000	integer
X14	0.00000	integer
X15	0.00000	integer
X16	0.00000	integer
X17	0.00000	integer
X18	1.00000	integer
X19	0.00000	integer
X20	0.00000	integer
X21	0.00000	integer
X22	0.00000	integer
X23	0.00000	integer
X24	0.00000	integer
X25	0.00000	integer
X26	3.00000	integer
X27	0.00000	integer
X28	0.00000	integer
X29	0.00000	integer
X30	2.00000	integer
X31	1.00000	integer
X32	0.00000	integer
X33	28.00000	integer
X34	85.00000	integer
X35	0.00000	integer
X36	0.00000	integer

X37	0.00000	integer
X38	0.00000	integer
X39	0.00000	integer

Objective Value: C = 2.909453E+06

QuickQuant Plus Report
SOLUTION TO INTEGER PROGRAM

ROBLEM: Transportation Channels' Capacities determina Date: 07-31-19
Scenario 2. Channels' capacitie

FORMULATED INTEGER PROGRAM

inimize C =

```
+ 8619.88 X1   + 73542.53 X2   + 29232.95 X3    + 3483.75 X4
 + 127620 X5   + 32209.47 X6    + 1489.53 X7    + 28227.8 X8
+ 7924.09 X9    + 8848.91 X10  + 73771.57 X11  + 29461.99 X12
+ 3941.83 X13  + 128078.1 X14  + 32667.54 X15   + 1587.68 X16
+ 28325.96 X17  + 8022.25 X18      + 706 X19    + 1039.1 X20
 + 4458.42 X21  + 1934.23 X22   + 4878.69 X23  + 67081.68 X24
+ 19857.17 X25  + 3937.06 X26  + 128062.8 X27  + 32641.16 X28
 + 1055.34 X29 + 18816.45 X30   + 5211.66 X31   + 8259.35 X32
+ 34997.62 X33  + 14693.91 X34  + 7352.22 X35  + 131488.5 X36
+ 36077.94 X37  + 33819.35 X38  + 51483.59 X39
```

ubject to:

```
C1:      + 35 X1      + 0 X2       + 0 X3      + 70 X4
          + 0 X5      + 0 X6      + 15 X7       + 0 X8
          + 0 X9     + 35 X10      + 0 X11      + 0 X12
         + 70 X13     + 0 X14      + 0 X15     + 15 X16
          + 0 X17     + 0 X18      + 0 X19      + 0 X20
          + 0 X21     + 0 X22     + 35 X23      + 0 X24
          + 0 X25     + 70 X26     + 0 X27      + 0 X28
         + 10 X29     + 0 X30      + 0 X31     + 35 X32
          + 0 X33     + 0 X34     + 35 X35      + 0 X36
          + 0 X37   + 6.36 X38   + 6.36 X39              =      70

C2:      + 0 X1      + 35 X2      + 0 X3       + 0 X4
         + 70 X5      + 0 X6      + 0 X7      + 15 X8
          + 0 X9      + 0 X10     + 35 X11     + 0 X12
          + 0 X13     + 70 X14     + 0 X15     + 0 X16
         + 15 X17     + 0 X18      + 0 X19     + 0 X20
          + 0 X21     + 0 X22      + 0 X23     + 35 X24
          + 0 X25     + 0 X26     + 70 X27      + 0 X28
          + 0 X29     + 10 X30     + 0 X31     + 0 X32
         + 35 X33     + 0 X34      + 0 X35     + 35 X36
          + 0 X37     + .9 X38     + .9 X39               =      10

C3:      + 0 X1      + 0 X2       + 35 X3      + 0 X4
          + 0 X5     + 70 X6      + 0 X7       + 0 X8
         + 15 X9      + 0 X10     + 0 X11      + 35 X12
          + 0 X13     + 0 X14     + 70 X15     + 0 X16
          + 0 X17     + 15 X18     + 0 X19     + 0 X20
          + 0 X21     + 0 X22      + 0 X23     + 0 X24
         + 35 X25     + 0 X26      + 0 X27     + 70 X28
          + 0 X29     + 0 X30     + 10 X31     + 0 X32
          + 0 X33     + 35 X34     + 0 X35     + 0 X36
         + 35 X37   + 2.72 X38   + 2.72 X39              =      30

C4:      + 0 X1      + 0 X2       + 0 X3       + 0 X4
          + 0 X5     + 0 X6       + 0 X7       + 0 X8
          + 0 X9     + 35 X10     + 35 X11     + 35 X12
```

```
          + 70 X13      + 70 X14      + 70 X15      + 15 X16
          + 15 X17      + 15 X18      + 70 X19      + 10 X20
           + 0 X21       + 0 X22       + 0 X23       + 0 X24
           + 0 X25       + 0 X26       + 0 X27       + 0 X28
           + 0 X29       + 0 X30       + 0 X31       + 0 X32
           + 0 X33       + 0 X34       + 0 X35       + 0 X36
           + 0 X37       + 0 X38       + 0 X39                 <    156

C5:        + 0 X1        + 0 X2        + 0 X3        + 0 X4
           + 0 X5        + 0 X6        + 0 X7        + 0 X8
           + 0 X9        + 0 X10       + 0 X11       + 0 X12
           + 0 X13       + 0 X14       + 0 X15       + 0 X16
           + 0 X17       + 0 X18       + 0 X19       + 0 X20
           + 0 X21       + 0 X22       + 0 X23       + 0 X24
           + 0 X25       + 0 X26       + 0 X27       + 0 X28
           + 1 X29       + 1 X30       + 1 X31       + 0 X32
           + 0 X33       + 0 X34       + 0 X35       + 0 X36
           + 0 X37       + 0 X38       + 0 X39                 <

C6:        + 0 X1        + 0 X2        + 0 X3        + 0 X4
           + 0 X5        + 0 X6        + 0 X7        + 0 X8
           + 0 X9        + 0 X10       + 0 X11       + 0 X12
           + 1 X13       + 1 X14       + 1 X15       + 0 X16
           + 0 X17       + 0 X18       + 1 X19       + 0 X20
           + 0 X21       + 0 X22       + 0 X23       + 0 X24
           + 0 X25       + 0 X26       + 0 X27       + 0 X28
           + 0 X29       + 0 X30       + 0 X31       + 0 X32
           + 0 X33       + 0 X34       + 0 X35       + 0 X36
           + 0 X37       + 0 X38       + 0 X39                 <

C7:        + 0 X1        + 0 X2        + 0 X3        + 0 X4
           + 0 X5        + 0 X6        + 0 X7        + 0 X8
           + 0 X9        + 0 X10       + 0 X11       + 0 X12
           + 0 X13       + 0 X14       + 0 X15       + 0 X16
           + 0 X17       + 0 X18       + 0 X19       + 0 X20
           + 0 X21       + 1 X22       + 1 X23       + 1 X24
           + 1 X25       + 0 X26       + 0 X27       + 0 X28
           + 0 X29       + 0 X30       + 0 X31       + 0 X32
           + 0 X33       + 0 X34       + 0 X35       + 0 X36
           + 0 X37       + 0 X38       + 0 X39                 <

C8:        + 0 X1        + 0 X2        + 0 X3        + 0 X4
           + 0 X5        + 0 X6        + 0 X7        + 0 X8
           + 0 X9        + 0 X10       + 0 X11       + 0 X12
           + 0 X13       + 0 X14       + 0 X15       + 0 X16
           + 0 X17       + 0 X18       + 0 X19       + 0 X20
           + 0 X21       + 0 X22       + 0 X23       + 0 X24
           + 0 X25       + 1 X26       + 1 X27       + 1 X28
           + 0 X29       + 0 X30       + 0 X31       + 0 X32
           + 0 X33       + 0 X34       + 0 X35       + 0 X36
           + 0 X37       + 0 X38       + 0 X39                 <

C9:        + 0 X1        + 0 X2        + 0 X3        + 0 X4
           + 0 X5        + 0 X6        + 0 X7        + 0 X8
           + 0 X9        + 0 X10       + 0 X11       + 0 X12
           + 0 X13       + 0 X14       + 0 X15       + 1 X16
           + 1 X17       + 1 X18       + 0 X19       + 1 X20
           + 1 X21       + 0 X22       + 0 X23       + 0 X24
           + 0 X25       + 0 X26       + 0 X27       + 0 X28
           + 0 X29       + 0 X30       + 0 X31       + 0 X32
```

```
          + 0 X33        + 0 X34        + 0 X35        + 0 X36
          + 0 X37        + 1 X38        + 1 X39                 <        35

C10:      + 1 X1         + 1 X2         + 1 X3         + 1 X4
          + 1 X5         + 1 X6         + 1 X7         + 1 X8
          + 1 X9         + 0 X10        + 0 X11        + 0 X12
          + 0 X13        + 0 X14        + 0 X15        + 0 X16
          + 0 X17        + 0 X18        - 1 X19        - 1 X20
          - 1 X21        - 1 X22        + 0 X23        + 0 X24
          + 0 X25        + 0 X26        + 0 X27        + 0 X28
          + 0 X29        + 0 X30        + 0 X31        + 0 X32
          + 0 X33        + 0 X34        + 0 X35        + 0 X36
          + 0 X37        + 0 X38        + 0 X39                 =
```

DETAILED RECORD OF LINEAR PROGRAMS EVALUATED IN SOLVING INTEGER PROGRAM

Problem Number	Cost Lower Bound	Parent Problem	Branching Variable	Problem Status
1	2653564.200			
2	2670156.500	1	X33 (< 28)	
3	Infeasible	1	X33 (> 29)	
4	2670159.500	2	X13 (< 94)	
5	2670160.000	2	X13 (> 95)	
6	2670227.000	4	X14 (< 0)	
7	2711647.000	4	X14 (> 1)	
8	2670164.200	5	X27 (< 0)	
9	2711636.500	5	X27 (> 1)	
10	2670235.000	8	X14 (< 0)	
11	2711651.800	8	X14 (> 1)	
12	2670230.200	6	X4 (< 0)	
13	2670404.500	6	X4 (> 1)	
14	2671141.000	12	X5 (< 0)	
15	2711895.000	12	X5 (> 1)	
16	2671203.500	10	X5 (< 0)	
17	2711899.800	10	X5 (> 1)	
18	2670475.200	13	X13 (< 93)	
19	2670407.800	13	X13 (> 94)	
20	2670483.000	19	X27 (< 0)	
21	2711884.500	19	X27 (> 1)	
22	2670478.200	18	X4 (< 1)	
23	2670652.200	18	X4 (> 2)	
24	2671389.000	22	X5 (< 0)	
25	2712143.000	22	X5 (> 1)	
26	2671451.500	20	X5 (< 0)	
27	2712147.800	20	X5 (> 1)	
28	2670723.000	23	X13 (< 92)	
29	2670655.800	23	X13 (> 93)	
30	2670731.000	29	X27 (< 0)	
31	2712132.500	29	X27 (> 1)	
32	2670726.000	28	X4 (< 2)	
33	2670900.200	28	X4 (> 3)	
34	2671636.800	32	X5 (< 0)	
35	2712391.000	32	X5 (> 1)	
36	2671699.500	30	X5 (< 0)	
37	2712395.800	30	X5 (> 1)	
38	2670971.000	33	X13 (< 91)	
39	2670903.500	33	X13 (> 92)	

40	2670979.000	39	X27 (< 0)
41	2712380.200	39	X27 (> 1)
42	2670974.000	38	X4 (< 3)
43	2671148.200	38	X4 (> 4)
44	2671884.500	42	X5 (< 0)
45	2712638.800	42	X5 (> 1)
46	2671947.200	40	X5 (< 0)
47	2712643.500	40	X5 (> 1)
48	2673605.200	14	X26 (< 5)
49	2671198.800	14	X26 (> 6)
50	2671219.000	43	X13 (< 90)
51	2671151.500	43	X13 (> 91)
52	2671226.800	51	X27 (< 0)
53	2712628.200	51	X27 (> 1)
54	2672370.000	49	X34 (< 85)
55	Infeasible	49	X34 (> 86)
56	2672365.500	16	X34 (< 85)
57	Infeasible	16	X34 (> 86)
58	2671222.000	50	X4 (< 4)
59	2671396.000	50	X4 (> 5)
60	2672132.500	58	X5 (< 0)
61	2712886.800	58	X5 (> 1)
62	2672195.000	52	X5 (< 0)
63	2712891.500	52	X5 (> 1)
64	2673853.200	24	X26 (< 5)
65	2671446.500	24	X26 (> 6)
66	2671467.000	59	X13 (< 89)
67	2671399.500	59	X13 (> 90)
68	2671474.800	67	X27 (< 0)
69	2712876.200	67	X27 (> 1)
70	2672618.000	65	X34 (< 85)
71	Infeasible	65	X34 (> 86)
72	2672613.500	26	X34 (< 85)
73	Infeasible	26	X34 (> 86)
74	2671470.000	66	X4 (< 5)
75	2671644.000	66	X4 (> 6)
76	2672380.500	74	X5 (< 0)
77	2713134.500	74	X5 (> 1)
78	2672443.000	68	X5 (< 0)
79	2713139.500	68	X5 (> 1)
80	2674101.200	34	X26 (< 5)
81	2671694.500	34	X26 (> 6)
82	2671714.800	75	X13 (< 88)
83	2671647.500	75	X13 (> 89)
84	2671722.500	83	X27 (< 0)
85	2713124.200	83	X27 (> 1)
86	2672866.000	81	X34 (< 85)
87	Infeasible	81	X34 (> 86)
88	2672861.200	36	X34 (< 85)
89	Infeasible	36	X34 (> 86)
90	2671717.800	82	X4 (< 6)
91	2671892.000	82	X4 (> 7)
92	2672628.500	90	X5 (< 0)
93	2713382.500	90	X5 (> 1)
94	2672691.000	84	X5 (< 0)
95	2713387.500	84	X5 (> 1)
96	2674349.000	44	X26 (< 5)
97	2671942.500	44	X26 (> 6)
98	2671962.800	91	X13 (< 87)
99	2671895.200	91	X13 (> 88)

100	2671970.500	99	X27 (< 0)
101	2713372.000	99	X27 (> 1)
102	2673114.000	97	X34 (< 85)
103	Infeasible	97	X34 (> 86)
104	2673109.000	46	X34 (< 85)
105	Infeasible	46	X34 (> 86)
106	2671965.800	98	X4 (< 7)
107	2672140.000	98	X4 (> 8)
108	2672876.500	106	X5 (< 0)
109	2713630.500	106	X5 (> 1)
110	2672939.000	100	X5 (< 0)
111	2713635.200	100	X5 (> 1)
112	2674597.000	60	X26 (< 5)
113	2672190.500	60	X26 (> 6)
114	2672210.500	107	X13 (< 86)
115	2672143.200	107	X13 (> 87)
116	2672218.500	115	X27 (< 0)
117	2713620.000	115	X27 (> 1)
118	2673361.800	113	X34 (< 85)
119	Infeasible	113	X34 (> 86)
120	2673357.000	62	X34 (< 85)
121	Infeasible	62	X34 (> 86)
122	2672213.500	114	X4 (< 8)
123	2672387.800	114	X4 (> 9)
124	2673124.200	122	X5 (< 0)
125	2713878.500	122	X5 (> 1)
126	2673187.000	116	X5 (< 0)
127	2713883.200	116	X5 (> 1)
128	2672374.800	56	X28 (< 0)
129	2674457.000	56	X28 (> 1)
130	2672458.500	54	X15 (< 0)
131	2674478.500	54	X15 (> 1)
132	2672463.200	128	X15 (< 0)
133	2674483.200	128	X15 (> 1)
134	2674844.800	76	X26 (< 5)
135	2672438.200	76	X26 (> 6)
136	2672458.500	123	X13 (< 85)
137	2672391.000	123	X13 (> 86)
138	2672466.500	137	X27 (< 0)
139	2713867.800	137	X27 (> 1)
140	2673609.500	135	X34 (< 85)
141	Infeasible	135	X34 (> 86)
142	2673605.000	78	X34 (< 85)
143	Infeasible	78	X34 (> 86)
144	2673732.000	130	X6 (< 0)
145	2674726.500	130	X6 (> 1)
146	2672461.500	136	X4 (< 9)
147	2672635.800	136	X4 (> 10)
148	2673372.000	146	X5 (< 0)
149	2714126.200	146	X5 (> 1)
150	2673737.000	132	X6 (< 0)
151	2674731.200	132	X6 (> 1)
152	2673434.800	138	X5 (< 0)
153	2714131.000	138	X5 (> 1)
154	2672622.800	72	X28 (< 0)
155	2674704.800	72	X28 (> 1)
156	2672706.500	70	X15 (< 0)
157	2674726.500	70	X15 (> 1)
158	2672711.200	154	X15 (< 0)
159	2674731.000	154	X15 (> 1)

160	2675092.800	92	X26 (< 5)
161	2672686.200	92	X26 (> 6)
162	2672706.500	147	X13 (< 84)
163	2672639.000	147	X13 (> 85)
164	2672714.200	163	X27 (< 0)
165	2714115.800	163	X27 (> 1)
166	2673857.500	161	X34 (< 85)
167	Infeasible	161	X34 (> 86)
168	2673853.000	94	X34 (< 85)
169	Infeasible	94	X34 (> 86)
170	2673980.000	156	X6 (< 0)
171	2674974.500	156	X6 (> 1)
172	2672709.500	162	X4 (< 10)
173	2672883.500	162	X4 (> 11)
174	2673620.000	172	X5 (< 0)
175	2714374.200	172	X5 (> 1)
176	2673985.000	158	X6 (< 0)
177	2674979.000	158	X6 (> 1)
178	2673682.500	164	X5 (< 0)
179	2714379.000	164	X5 (> 1)
180	2672870.500	88	X28 (< 0)
181	2674952.800	88	X28 (> 1)
182	2672954.500	86	X15 (< 0)
183	2674974.200	86	X15 (> 1)
184	2672959.000	180	X15 (< 0)
185	2674979.000	180	X15 (> 1)
186	2675340.800	108	X26 (< 5)
187	2672934.000	108	X26 (> 6)
188	2672954.500	173	X13 (< 83)
189	2672887.000	173	X13 (> 84)
190	2672962.200	189	X27 (< 0)
191	2714363.800	189	X27 (> 1)
192	2674105.500	187	X34 (< 85)
193	Infeasible	187	X34 (> 86)
194	2674101.000	110	X34 (< 85)
195	Infeasible	110	X34 (> 86)
196	2674228.000	182	X6 (< 0)
197	2675222.200	182	X6 (> 1)
198	2672957.500	188	X4 (< 11)
199	2673131.500	188	X4 (> 12)
200	2673868.000	198	X5 (< 0)
201	2714622.200	198	X5 (> 1)
202	2674232.800	184	X6 (< 0)
203	2675227.000	184	X6 (> 1)
204	2673930.500	190	X5 (< 0)
205	2714627.000	190	X5 (> 1)
206	2673118.500	104	X28 (< 0)
207	2675200.500	104	X28 (> 1)
208	2673202.500	102	X15 (< 0)
209	2675222.200	102	X15 (> 1)
210	2673207.000	206	X15 (< 0)
211	2675227.000	206	X15 (> 1)
212	2675588.800	124	X26 (< 5)
213	2673182.000	124	X26 (> 6)
214	2673202.200	199	X13 (< 82)
215	2673135.000	199	X13 (> 83)
216	2673210.200	215	X27 (< 0)
217	2714611.800	215	X27 (> 1)
218	2674353.500	213	X34 (< 85)
219	Infeasible	213	X34 (> 86)

280	2674611.800	278	X5 (< 0)	
281	2715366.000	278	X5 (> 1)	
282	2674976.500	264	X6 (< 0)	
283	2675971.000	264	X6 (> 1)	
284	2674674.500	270	X5 (< 0)	
285	2715370.800	270	X5 (> 1)	
286	2673800.500	144	X31 (< 2)	
287	2674238.800	144	X31 (> 3)	
288	2673805.000	150	X31 (< 2)	
289	2674243.500	150	X31 (> 3)	
290	2673963.000	286	X18 (< 0)	
291	2673937.000	286	X18 (> 1)	Integer
292	2673968.000	288	X18 (< 0)	
293	2673941.500	288	X18 (> 1)	Integer
294	2673862.500	168	X28 (< 0)	
295	2675944.500	168	X28 (> 1)	
296	2674897.000	64	X27 (< 0)	
297	2715330.000	64	X27 (> 1)	
298	2673946.000	166	X15 (< 0)	
299	2675966.000	166	X15 (> 1)	

BEST SOLUTION SO FAR (Not Confirmed as Optimal)

Original Variable	Value	Status
X1	0.00000	integer
X2	0.00000	integer
X3	0.00000	integer
X4	0.00000	integer
X5	0.00000	integer
X6	0.00000	integer
X7	0.00000	integer
X8	0.00000	integer
X9	0.00000	integer
X10	0.00000	integer
X11	0.00000	integer
X12	0.00000	integer
X13	94.00000	integer
X14	0.00000	integer
X15	0.00000	integer
X16	0.00000	integer
X17	0.00000	integer
X18	1.00000	integer
X19	0.00000	integer
X20	0.00000	integer
X21	0.00000	integer
X22	0.00000	integer
X23	0.00000	integer
X24	0.00000	integer
X25	0.00000	integer
X26	6.00000	integer
X27	0.00000	integer
X28	0.00000	integer
X29	0.00000	integer
X30	2.00000	integer
X31	1.00000	integer
X32	0.00000	integer
X33	28.00000	integer
X34	85.00000	integer

X37	0.00000	integer
X38	0.00000	integer
X39	0.00000	integer

Objective Value: C = 2.909453E+06

APPENDIX C.

EOQSimulation Results.

QuickQuant Plus Report
INVENTORY ANALYSIS--ECONOMIC ORDER QUANTITY MODEL WITH BACKORDERING

PROBLEM: X13 Date: 07-31-1993
EOQ. Scenario 1.

Parameter Values:
Fixed Cost per Order: k = 178.06
Annual Number of Items Demanded: A = 97
Unit Cost of Procuring an Item: c = 5495.82
Annual Holding Cost per Dollar Value: h = .3
Annual Cost of Being Short One Item: p = 1701758

Optimal Values:
Economic Order Quantity: Q = 4.579494
Economic Order Level: S = 4.575061
Time Between Orders (year): T = 4.721128E-02
Total Annual Relevant Cost: TC = 7543.114

PROBLEM: X26 Date: 07-31-1993
EOQ. Scenario 1.

Parameter Values:
Fixed Cost per Order: k = 49
Annual Number of Items Demanded: A = 3
Unit Cost of Procuring an Item: c = 5330.06
Annual Holding Cost per Dollar Value: h = .3
Annual Cost of Being Short One Item: p = 1938234

Optimal Values:
Economic Order Quantity: Q = .4289691
Economic Order Level: S = .4286155
Time Between Orders (year): T = .1429897
Total Annual Relevant Cost: TC = 685.364

PROBLEM: X30 Date: 07-31-1993
EOQ. Scenario 1.

Parameter Values:
Fixed Cost per Order: k = 85.5
Annual Number of Items Demanded: A = 2
Unit Cost of Procuring an Item: c = 1184.18
Annual Holding Cost per Dollar Value: h = .3
Annual Cost of Being Short One Item: p = 39555.79

Optimal Values:
Economic Order Quantity: Q = .9855645
Economic Order Level: S = .9767919
Time Between Orders (year): T = .4927823
Total Annual Relevant Cost: TC = 347.0093

PROBLEM: X33 Date: 07-31-1993
EOQ. Scenario 1.

Parameter Values:
Fixed Cost per Order: k = 116.25
Annual Number of Items Demanded: A = 28
Unit Cost of Procuring an Item: c = 35704.37
Annual Holding Cost per Dollar Value: h = .3
Annual Cost of Being Short One Item: p = 208011.6

Optimal Values:
Economic Order Quantity: Q = .7994155
Economic Order Level: S = .7602664
Time Between Orders (year): T = 2.855055E-02
Total Annual Relevant Cost: TC = 8143.45

PROBLEM: X34 Date: 07-31-1
EOQ. Scenario

Parameter Values:
Fixed Cost per Order: k = 116.25
Annual Number of Items Demanded: A = 85
Unit Cost of Procuring an Item: c = 15400.66
Annual Holding Cost per Dollar Value: h = .3
Annual Cost of Being Short One Item: p = 208011.6

Optimal Values:
Economic Order Quantity: Q = 2.091034
Economic Order Level: S = 2.045598
Time Between Orders (year): T = 2.460039E-02
Total Annual Relevant Cost: TC = 9451.068

QuickQuant Plus Report
INVENTORY ANALYSIS--ECONOMIC ORDER QUANTITY MODEL WITH BACKORDERING

PROBLEM: X13 Date: 07-31-19
X

Parameter Values:
Fixed Cost per Order: k = 178.06
Annual Number of Items Demanded: A = 94
Unit Cost of Procuring an Item: c = 3941.83
Annual Holding Cost per Dollar Value: h = .3
Annual Cost of Being Short One Item: p = 1701361

Optimal Values:
Economic Order Quantity: Q = 5.32235
Economic Order Level: S = 5.318653
Time Between Orders (year): T = 5.662074E-02
Total Annual Relevant Cost: TC = 6289.568

ROBLEM: X26 Date: 07-31-19
X

Parameter Values:
Fixed Cost per Order: k = 49
Annual Number of Items Demanded: A = 6
Unit Cost of Procuring an Item: c = 3937.06
Annual Holding Cost per Dollar Value: h = .3
Annual Cost of Being Short One Item: p = 1938234

Optimal Values:
Economic Order Quantity: Q = .7057881
Economic Order Level: S = .7053582
Time Between Orders (year): T = .1176313
Total Annual Relevant Cost: TC = 833.1113

ROBLEM: X30 Date: 07-31-19
X

Parameter Values:
Fixed Cost per Order: k = 85.5
Annual Number of Items Demanded: A = 2
Unit Cost of Procuring an Item: c = 1055.34
Annual Holding Cost per Dollar Value: h = .3
Annual Cost of Being Short One Item: p = 39555.79

Optimal Values:
Economic Order Quantity: Q = 1.043488
Economic Order Level: S = 1.035202
Time Between Orders (year): T = .5217438
Total Annual Relevant Cost: TC = 327.747

ROBLEM: X33 Date: 07-31-19
X

Parameter Values:
Fixed Cost per Order: k = 116.25
Annual Number of Items Demanded: A = 28
Unit Cost of Procuring an Item: c = 34997.62

Annual Holding Cost per Dollar Value: h = .3
Annual Cost of Being Short One Item: p = 207985.8

Optimal Values:
Economic Order Quantity: Q = .8070578
Economic Order Level: S = .7682747
Time Between Orders (year): T = 2.882349E-02
Total Annual Relevant Cost: TC = 8066.337

PROBLEM: X34 Date: 07-31-19
X1

Parameter Values:
Fixed Cost per Order: k = 116.25
Annual Number of Items Demanded: A = 85
Unit Cost of Procuring an Item: c = 14693.92
Annual Holding Cost per Dollar Value: h = .3
Annual Cost of Being Short One Item: p = 207985.8

Optimal Values:
Economic Order Quantity: Q = 2.139665
Economic Order Level: S = 2.095257
Time Between Orders (year): T = 2.517253E-02
Total Annual Relevant Cost: TC = 9236.26

Appendix D.

"TECH" Ltd. Technology of delivery and insurance of cargoes

CONFIRMED

General director "Tech" LTD

Arakelian

Date March 02 1993.

Technology of delivery and insurance of cargoes in route

YEREVAN-NOVOROSIYSK-YEREVAN

through port Batumi.

Cargoes are received for insurance and delivery to the Republic of Armenia, in cities:

Batumi-Georgia

Novorsiysk -Russia

Insurance and escorting of cargoes is exercised for Railway and Ship transportation.

If delivered from Republic of Armenia, cargo and trusty certificate of delivery is entertained by representatives of D "Tech". Cargo is sealed by the representative of LTD "Tech" and is presented for guard to armed security guard which sed cargo in the station "Ayrum" to "Liberty Bank" department of guarding and policy for further escorting.

In the port Batumi cargo is received by local representative of LTD "Tech", who organize unloading the cargo from n and loading it to the ship that follow to port Novorosiysk.

Novorosiysk cargo is received by representatives of LTD "Tech".

If necessary the cargo can be stored in whorehouses in Batumi as well as in Novorosysk.

The same scheme of escorting, delivery and transportation of cargoes is exercised in reverse way

Contracts for insurance and delivery are signed in Yerevan.

Contract for delivery and insurance of cargoes are registered and signed in the blanks of "Tech" LTD, where is ntioned the cost of escorting.

Insurance fee is determined according to the type of cargo and is from 12 to 20% of cargoes price

Insurance policy is starting its operation when all payments are done.

Contract for delivery of cargoes is formed separately, were are insured services indicated in the "list of services

List of services provided by "Tech' LTD.

-- ordering of rail vagons,containers and other means for delivery.

-- organization of loading unloading work

-- storage of cargoes in the inventories of Batumi and Novorosysk.

-- fright of ship

-- other services

Payments for services connected with deliveries are exercised in such an order:

50% of price for services are paid immediately after signing a contract, the rest is paid after the client give the cargo to "Tech' LTD.

Responsibility for delivered cargo is started after cargo is received and all payments are done, and finished in the point of destination when the client take the responsibilities for cargo.

The only base for "Tech' LTD for taking the cargo under their responsibility is the bank payment document which has to prove that money is transferred in the checking account of "Tech" LTD.

Exhibit E.

Information on the transportation companies

Date: May 03 1993

1. Name of the company "TECH"

2. Address: Baghramian-75, Tel: 27-16-90

3.Transportation means: Railroad, train, ship.

4. Carrying capacity (per model): 500 up to 2000 tons by Barge
above 2000 tons by ship

5. Transportation distance exercised (per model), cost per km:
NOVOROSIYSK--BATUMI(by ship or barge depended from quantity)
BATUMI--YEREVAN(by railroad)

6.Common routes (costs: complementary, nominal):
NOVOROSIYSK--BATUMI--YEREVAN
costs:
NOVOROSIYSK - BATUMI 45-50$/ton
BATUMI - YEREVAN : 120,000 rub/wagon

7. Delivery and lead (loading) time (per rout).
NOVOROSIYSK--YEREVAN 45 days (of which 3 days for transportation from BATUMI to YEREVAN.
Max capacity that can be loaded(unloaded) daily in BATUMI is1000tons

8. Types of services : Transportation, Insurance, Escorting
The company can conclude two contracts with a client:

First one- Insurance contract that insures delivery safety and payment for that service will make up 12 to 20 % of the value of the freight that both parties will agree upon.(See appendix 2)

Second contract referees to transportation services and specifies initial payment to be 50% of tentative transportation expenses and final payments that will make up the rest of really incurred transportation expenses.

Date: April 15 1993

1. **Name of the company** "LUSAN"

2. **Address:** Alaverdian St. 30, Tel: 56-05-82, 58-68-17, 58-91-32

3. Transportation means: Airplane, An-12

4. Carrying capacity (per model): 10 tons per plane(route)

5. Transportation distance exercised (per model), cost per km:
YEREVAN--KRASNODAR cost for one plane 1,600,000-1,700,000 rubles.

6. Common routes (costs: complementary, nominal):
CIS COUNTRIES and FOREIGN FLIGHTS

7. Delivery and lead (loading) time (per rout). After replacement of order 7 days(week).

8. Types of services: Airplane transportation

te: May 14 1993

1. Name of the company **MINISTRY OF RAILROAD TRANSPORTATION**

2. **Address:** Tigran Metsi - 50

Source: Chief economist Sarkisov Edward (Phone 57-38-42)

3. Transportation means: Railroad

4. Carrying capacity per railroad branch:

	Pairs of trains daily	wagons per train	Total weight daily
Sadakhlo	12	20	3800
Norashen	22	45	8000
Idjevan	5	20	1900

5. cost per km: 10.3 rub per 10tons/km + 20%markup

6.Complementary costs: local motor services- 14, 000 rub.

10. Impact on the company of recent political and economical changes:

In operation are only Georgian branches.

1993 January- February - 107 tons

1993 March - 38,000 tons

Date: March 13

1. Name of the company: **Automobile Transportation Ministry**

Freight Shipments Department (phone 56-55-43)

. Transportation means: trucks.

. Carrying capacity:

Mainly 10 tons per truck, several trucks that can carry 20 tons

. Cost per km: 125 - 130 rub/km

. Common routes: Yerevan - Stavropol; Yerevan - Krasnodar (via Georgia)

Nominal costs - 300,000 rub to one end per truck (Krasnodar)

omplementary costs: Police excerpting - 200,000 rub per escorting column

. Delivery and lead (loading) time - within month

Types of services: Organizes motor columns (200-300 vehicles each) once in a 1- 1.5 months.

). Impact on the company of the recent changes:

It is about a year the Ministry did not exercised deliveries of freights to Moscow.

Date: April 10

1. Name of the company: "Gyoud"

2. Address: Gaydar 8/1 #3 Yerevan 375063
Tel: 22-47-91 Fax: 22-48-03

3. Transportation means: airplanes

4. Carrying capacity per model:
IL-76 - 35 tons
An-12 - 10-12 tons
An-26 - 6 tons

5. Transportation distance exercised:
Moscow; Helsinki; Los Angeles

6. Common routs(costs):
MOSCOW: IL-76(40 toms) from 7 to 7.5 mil. rubles(cost for hiring the plane)

	An-12	from 3.5 to 4 mil. rubles
	An-26	4 mil. rubles
LOS ANGELES:	IL-76:	
	100-200 kg	2.5$/kg
	200-500 kg	2.3$/kg
	above 500 kg	2.0$/kg

7. Delivery and lead (loading) time (per rout)

MOSCOW 2 or 3 weeks

LOS ANGELES 35 days(or at the cost of 6.5$/kg for 6 days)

8. Types of services:

Date: May 11 1993

1. Name of the company YEREVAN AVIA

2. Address: 58+0121

3. Transportation means: Airplanes

4. Carrying capacity (per model): 30 tones(per plane)

5. Transportation distance exercised (per model), cost per km:

YEREVAN--GORKI

YEREVAN--VOLGOGRAD

YEREVAN--SANT PETERSBURG

6. Common routes (costs: complementary, nominal):

7. Delivery and lead (loading) time (per rout).

Loading-unloading is done in 5 hours, cost for loading(unloading) an 12 is 40,000 rubles

8. Types of services: Airplane transportation

Date: April 23 1993

1. Name of the company **ARAKIAL**

2. Address:, Hotel EREBUNI Tel: 56-55-46

3.Transportation means: Escorting

4. Carrying capacity (per model): Max 30 trucks
   Min 10 trucks

5. Transportation distance exercised (per model), cost per km:
Armenian-Georgian frontier (Stepanavan) to any frontier of Georgia.
Cost for escorting one truck is: 300,000 rubles if the truck is empty
350,000-400,000 rubles if truck is loaded
Max discount is from 10,000 to 20,000 rubles if order is placed for escorting more than 10 trucks.

6.Common routes (costs: complementary, nominal):
   Stepanavan-Batumi
   Stepanavan-Poti
   Stepanavan-Tskhinvali

7. Delivery and lead (loading) time (per rout).
Trucks are starting to follow the rout if minimum 10 trucks are accumulated. The managers of company are ble to escort trucks to any Georgian frontier in 3 days.

8. Types of services: Armed escorting is performed by 6 department of Georgian Internal Forces. Firm rakial has signed a contract with Georgian Council of Ministry, that allows to deliver cargoes in the territory of Georgia using department.

Even though Firm Arakial is not insuring the cargoes.

Date: May 12; July 14 1993

1. Name of the company IMAK

2. Address:, Isaakian St. 28 third flour Tel: 52-97-40, 599-983

3.Transportation means: Airplane (IL-76); trucks

4. Carrying capacity (per model): IL-76 (40 tons) 1 flight, number of flights depends from orders.
Truck - 15 tons/trailer

5. Transportation distance exercised (per model), cost per km:
YEREVAN--STAVROPOL 80 rubles/kg
Truck- 250 rub/km

6.Common routes (costs: complementary, nominal):
YEREVAN--STAVROPOL
Trucks: Freights services rendered only in Russia

7. Delivery and lead (loading) time (per rout).
1 week

8. Types of services: Airplane transportation

Date: May 18 1993

1. Name of the company Babik

2. Address:, Republican square, Tel: 58-38-21, 56-11-43, Fax: 52-86-13

3.Transportation means: Airplanes

4. Carrying capacity (per model):

YAK-42	8 tons
IL-76	35 tons
An-26	3 tons
An-12	12 tons

5. Transportation distance exercised (per model), cost per km:
IL-76 4.4 mil. rubles per plane

6.Common routes (costs: complementary, nominal):

YEREVAN--KRASNODAR

7. Delivery and lead (loading) time (per rout).

2 weeks

8. Types of services: Airplane transportation

Storage in Krasnodar 50 rubles/day for $1m^2$.

Date: June 4; July 14 1993

1. Name of the company **NET (North East Trans) Stockholders Company**

2. Address Tel: 53-80-51, 58-97-31

3. Transportation means: Airplane, Trucks, Train transportation, Contract with port Batumi for carrying cargoes from Russian ports(Yeysk, Timrugi) to port Batumi(Georgian port)

4.Carrying capacity (per model):

Ship: from 1500 to 3000 tons per ship

Airline: maximum 35 tons

Trucks: from 5 to 25 trucks

5.Transportation distance excercised (per model), cost per km.

YEREVAN-MEGHRI(BY TRUCKS)

YEREVAN-KRASNODAR (by airplane)- Flight: 3 hours (IL-76); 32 tons of fuel consumption

Cost of fuel: 108,000 rub/ton .

Total price of roundtrip - 6,100,000 rub . (to Krasnodar). Cost structure can be segmented as follows:

1. Fuel fraction - 70% of the total cost
2. Taking off and lending:

a. Krasnodar - 480,000 rub

b. Yerevan - tentatively about 800,000 rub.

Cost of one kilogram freight - 85 rub.

YEYSK-BATUMI(by ship)BATUMI-YEREVAN(by rail)

TIMRUGI-BATUMI(by ship)BATUMI-YEREVAN(by rail)

6. Common routs (costs complementary, nominal)

YEREVAN-KRASNODAR (by airline) 4,500,000 rubles

YEYSK-BATUMI(by ship) 34-36$

Loading into the ship in Yeysk	10$/ton
Delivery to port Batumi	18$
Loading into the vagon in Batumi	6-8$
	34-36$
BATUMI-YEREVAN	5.1 rubles/kg
For escorting	10% of cargoes price
Money paid to NET	6% of transportation costs

TIMRUGI[1]-BATUMI(by ship)		37$
Loading into the ship in Yeysk	10$/ton	
Delivery to port Batumi	18$	
Loading into the vagon in Batumi	9$	
	37$	
BATUMI-YEREVAN	5.1 rubles/kg	
For excorting	10% of cargoes price	
Money paid to NET	6% of transportation cost	

Delivery and lead (loading) time (per route).

TIMRUGI-YEREVAN(ship-train)	From 1 to 1.5 month
YEYSK-YEREVAN(ship-train)	From 1 to 1.5 month
YEREVAN-KRASNODAR(airline)	one week
YEREVAN-MEGRI(tracks)	from one to two weeks

Types of services: NET can organize excorting from Yeysk (or Timrugi) to port Batumi by Russian Republic military ships, ıd alsow deleviery(in 24 hours) and excorting from Batumi to Armenian Republic railway station Ayrum.

NET has already signed a contract with representatives in port Batumi for loading/unloading 100,000 m^3 of different ndes of wood and 150,000 tons of metal in Batumi for satisfying construction materials demand in the Republic of Armenia, a new order will be placed Ara Ohandjanian(general director) insured us that their company is able to overlook the amounts ıat are already in the contract and if necessary to increase them. Also NET is able to offer insurence if delivery strategy is not orcmajour.

NET is equiped with computers and in a few minutes they calculated the cost for deleivering the cargo by train from atumi to Akhurian.

[1]Timrugi- railway is not reaching to port Timrugy 5 km. According to the contract of net with Timrugi port representatives for carring ınd loadind the cargo into the ship they required 19$ for 1 ton from which 10$/ton for carring cargo by trucks to ship and 9$ /ton (6+3) or loading cargo into the ship.
(6+3): 3$ is the amount that will be not mentioned in accounting documents. it has to be given as bribe.

Exhibit 3.

"ARMPROMSNABSBIT" Corporation Establishing Treaty

ESTABLISHMENT CONTRACT

YEREVAN City May 11 1993

We undersigned agrre about the following:

I. Establishment of the Limited Liability Company "ARMPROMSNABSBIT" as a newely created Company according to Republic of Armenia"s Law on "Enterprisees and enterpreniual activities, co-ordibnation with the Ministery of Industry of the Republic of Armenia, with the following purposes:

-- Supply with raw materials for Industry Ministry plants
-- Sale of inductrial products of Ministery plants
-- Organizing centralized transportation of goods in all conditions
-- Organizing production of industrial materials, products and complementary parts for Ministry plants needs
-- Organizing and implementing plans for economic development
-- Organizing Joint-venture with the forign companies
-- Commercial affairs
-- Macroeconomic affairs
-- Other type of industrial activites which permit the Law on Enterprises and Enterprenural activites.

II. The owner / founder of Limited Liability Company "ARMPROMSNABSBIT" are:

-- Juridical Persons - (see contract # 1)
-- Natural Persons - (see contract # 2)

III. Name of the company

Limited Liability Company "ARMPROMSNABSBIT"

IV. Location of the company

Abovian City, republic of Armenia

V. Authorized capital is to be at least 100 milion rubles

-- Entering fee for Juridical persons 1.0 million rubles for one voice, maximum 5.0 millions
-- Entering fee for phisical persons 50,000 rubles, maximum 1.0 million.

VI. Distribution of income among its members, according to their pies.

Contract # 1

Juridical persons as founders of
Limited Liability Company "ARMPROMSNABSBIT"

#	Full name , adress, phone, fax and telefax of founger organization	Bank reqvisits of founder organization	Ammount in authorized capital, decision of board signiture of president
1	2	3	4

Contract # 1

Phisical persons as founders of
Limited Liability Company "ARMPROMSNABSBIT"

#	Phisical persons Full name , adress, phone,	Passport issue date, working place adress	Ammount in authorized capital, decision of board signiture of president
1	2	3	4

Exhibit 5.

State Freight contracts from CIS countries to Armenia.

Calculation of transportation costs for Truck KAMAZ
YEREVAN-KRASNODAR-YEREVAN
Exercised distance 2400 km.

Mean net salary of driver	10,000
Income taxes(37%) 10,0000.37	3,700
Total	13,700
Fuel consumption	191,400

For 100 km-35 liters without cargo(empty car), for 2400km-**840 liters** ,

Every extra ton of cargo requires additional 1.3 liters of fuel

Truck Kamas max carrying capacity is 14 tons,

436 liters

Total.....

.....1276 liters

Price per liter is 150 rubles (June 20)

Oil consumption	22,968
for 1 liter of fuel is needed 0.06 liters of oil, price per liter 300 rubles	
Cost of repair for tires	12,960
24,000/60,000*18*18,000	
60,000-max. distance that one tire	
18-number of tires	
18,000 price of one tire	
Total 12,960 rubles	
Overhead	48,205
20% of (12,960+22,968+191400+3,700+10,00)=20% of 241,028	
Money paid to Scientific founds	1,205
5% of 241,028	
Money paid for repair of highways	5,808
2% of (241,028+1205+48,205)=2% of 290,438	
Profit of service provider	43,565
15% of expenses 15% of 290,438	
Value added tax	67,962
20% of (43,565+5808+290,438)=20% of 339,811	

Business trip expenses	20,000
10*2000	
10-number of business trip days	
2000-expense for one day	
TOTAl	**427,773**

Formula which would allow to find the transportation cost from YEREVAN-KRASNODAR-YEREVAN.

$$\underset{a}{S}+(1276XPf)+(76.56XPo)+(0.72XPt)+\underset{a}{(a}+\underset{b}{b}+\underset{c}{c}+S)X0.2+\underset{d}{d}0.02+0.15\underset{d}{d}+(\underset{d}{d}+\underset{e}{e}+\underset{f}{f})0.2+10K$$

S-*salary of the driver*

Pf-*price of fuel*

Po-*price of oil*

Pt-*price of tires*

K-*cost for business trip/per day*

General formula for finding transportation costs to any destination points

$$\underset{a}{S}+(0.5316XDXPf)+(0.5316XDX0.06XPo)+(D/60000XNtXPt)+\underset{a}{(a}+\underset{b}{b}+\underset{c}{c}+S)0.2+\underset{d}{d}X0.02+0.15\underset{d}{d}+$$
$$+(\underset{d}{d}+\underset{e}{e}+\underset{f}{f})0.2+10K$$

D-*distance*

Nt-*number of tires*

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1. Lawrence L. Lapin, San Jase State University "Quantitative Methods for Business Decisions (Fifth Edition)

2. Donald J.Bowersox, M. Bixby Cooper, Michigan State University "Strategic Marketing Channel Management"

3. Commercial herald (Moscow 20/92). Article: "Stock exchange, Pause. Crisis, Bankruptcy"

УТВЕРЖДАЮ:

Вице-премьер Республики Армения

В.Читечян

"30" 03 1993 г.

ТРАНСПОРТНАЯ СХЕМА (Вывоз из РФ)

Наименование продукции	Количество	Единица измерения	Точки вывоза из РФ	Способ транспортировки	Переход права собственности при пересечении границы	Орган РА координирующий транспортировку	Предпр.-экспед (указывает собственник)	Промежуточные точки	Лицензиат	Декларант
1	2	3	4	5	6	7	8	9	10	11
г. Ереван автомобильный	125.0	т.тн.								
из них	10.0	т.тн.	г. Краснодар	Авиатранспорт	Росконтракт-Арконтракт-Аргаэтопливо	Минэнерго			Росконтракт	Росконтракт
	20.0	т.тн.	г. Ставрополь	Авиатранспорт	Росконтракт-Арконтракт-Аргаэтопливо	Минэнерго			Росконтракт	Росконтракт
	3.0	т.тн.	г. Сочи	Авиатранспорт	Росконтракт-Арконтракт-Аргаэтопливо	Минэнерго			Росконтракт	Росконтракт
	10.0	т.тн.	г. Волгоград	через Волга-Дон на г. Батуми	Росконтракт-Арконтракт-Аргагросервис	Минсельхоз		порт Батуми	Росконтракт	Росконтракт
	30.0	т.тн.	г. Самара	через Волга-Дон на Батуми	Росконтракт-Арконтракт-Аргаэтопливо	Минэнерго		порт Батуми	Росконтракт	Росконтракт
	10.0	т.тн.	г. Тула	морем до Батуми, далее по ж/д. по РА	Росконтракт-Арконтракт-Аргаэтопливо	Минэнерго		порт Батуми	Росконтракт	Росконтракт
	5.0	т.тн.	г. Минводы	Авиатранспорт	Росконтракт-Арконтракт-Аргаэтопливо	Минэнерго			Росконтракт	Росконтракт
	10.0	т.тн.	г. Ставрополь	Авиатранспорт	Росконтракт-Арконтракт-Аргаэтопливо	Минэнерго			Росконтракт	Росконтракт
	10.0	т.тн.	г. Краснодар	Авиатранспорт	Росконтракт-Арконтракт-Аргаэтопливо	Минэнерго			Росконтракт	Росконтракт
	10.0	т.тн.	г. Саратов	Авиатранспорт	Росконтракт-Арконтракт-Аргагросервис	Минсельхоз			Росконтракт	Росконтракт
	10.0	т.тн.	г. Тула	морем до Батуми, далее по ж/д. по РА	Росконтракт-Арконтракт-Аргагросервис	Минсельхоз		порт Батуми	Росконтракт	Росконтракт
г. Гюмри для трактирных двигателей	17.0	т.тн.								
из них	4.0	т.тн.	г. Сочи/Адлер	Авиатранспорт	Росконтракт-Арконтракт-Главное управление авиации	ГУА			Росконтракт	Росконтракт
	4.0	т.тн.	г. Мин.Воды	Авиатранспорт	Росконтракт-Арконтракт-Главное управление авиации	ГУА			Росконтракт	Росконтракт
	2.0	т.тн.	г. Владикавказ	Авиатранспорт	Росконтракт-Арконтракт-Главное управление авиации	ГУА			Росконтракт	Росконтракт

1	2	3	4	5	6	7	8	9	10	11
3. Топливо дизельное	150.0	т.тн.								
из них	20.0	т.тн.	г. Туапсе	морем до Батуми, далее по ж/д. до РА	Росконтракт-Арконтракт-Аргагросервис	Минсельхоз		порт Батуми	Росконтракт	Росконтракт
	8.0	т.тн.	г. Махачкала	морем до Энзели, далее автомоб. до Кегри	Росконтракт-Арконтракт-Аргагросервис	Минсельхоз		порт Энзели	Росконтракт	Росконтракт
	30.0	т.тн.	г.Волгоград	морем до Энзели, далее автомоб. до Кегри	Росконтракт-Арконтракт-Аргагстопливо	Минэнерго		порт Энзели	Росконтракт	Росконтракт
	19.0	т.тн.	г.Волгоград	через Волга-Дон на Батуми	Росконтракт-Арконтракт-Аргагросервис	Минсельхоз		порт Батуми	Росконтракт	Росконтракт
	75.0	т.тн.	г.Туапсе	морем до Батуми, далее по ж/д. до РА	Росконтракт-Арконтракт-Аргагстопливо	Минэнерго		порт Батуми	Росконтракт	Росконтракт
4. Мазут топочный	460.0	т.тн.								
из них	400.0	т.тн.	г. Новороссийск	морем до Батуми, далее по ж/д. до РА	Росконтракт-Арконтракт-Аргагстопливо	Минэнерго		порт Батуми	Росконтракт	Росконтракт
	60.0	т.тн.	г. Одесса	морем до Батуми, далее по ж/д. до РА	Росконтракт-Арконтракт-Аргагстопливо	Минэнерго		порт Батуми	Росконтракт	Росконтракт
5. Пиломатериалы	80.0	т.куб.м.								
из них	15.0	т.куб.м	г.Волгоград	морем Энзели, далее автомоб. до Кегри	Росконтракт-Арконтракт-Аргагросервис	Минсельхоз		порт Энзели	Росконтракт	Росконтракт
	15.0	т.куб.м	г.Самара	морем Энзели, далее автомоб. до Кегри	Росконтракт-Арконтракт-Минстрой РА	Минстрой		порт Энзели	Росконтракт	Росконтракт
	30.0	т.куб.м	г. Новороссийск	морем Батуми, далее ж/д. до РА	Росконтракт-Арконтракт-ТПО Арждеспром	Минкатресурсов	Норт-Ист-Транс	порт Батуми	Росконтракт	Росконтракт
	10.0	т.куб.м	г. Новороссийск	морем Батуми, далее ж/д. до РА	Росконтракт-Арконтракт-ОДФ Аристройлесбукинторг	Минкатресурсов	Норт-Ист-Транс	порт Батуми	Росконтракт	Росконтракт
	10.0	т.куб.м	г. Одесса	морем Батуми, далее ж/д. до РА	Росконтракт-Арконтракт-ОДФ Аристройлесбукинторг	Минкатресурсов	Норт-Ист-Транс	порт Батуми	Росконтракт	Росконтракт
6. Стальной прокат	80.0	т.тн.								
из них	20.0	т.тн.	г. Таганрог	морем Батуми, далее ж/д до РА	Росконтракт-Арконтракт-предприятия Минпрома РА	Минпром		порт Батуми	Росконтракт	Росконтракт
			п. Керчь-пром	морем Энзели, далее автомоб. до Кегри				порт Энзели	Росконтракт	Росконтракт
	10.0	т.тн.	г. Волгоград г. Самара	морем Энзели, далее автомоб. до Кегри	Росконтракт-Арконтракт-Минстрой РА	Минстрой		порт Энзели	Росконтракт	Росконтракт
	10.0	т.тн.	г. Новороссийск	морем Батуми, далее ж/д. до РА	Росконтракт-Арконтракт-ОДФ Арметаллоптторг	Минкатресурсов	Норт-Ист-Транс	порт Батуми	Росконтракт	Росконтракт
	10.0	т.тн.	г. Одесса	морем Батуми, далее ж/д. до РА	Росконтракт-Арконтракт-ОДФ Арметаллоптторг	Минкатресурсов	Норт-Ист-Транс	порт Батуми	Росконтракт	Росконтракт

1	2	3	4	5	6	7	8	9	10	11

				ж/д. до РА	...-ОПФ Армметаллоопторг	...минатресурсов	Норт-Ист-Транс	порт Батуми	Росконтракт	Росконтракт

1	2	3	4	5	6	7	8	9	10	11
7. Трубы стальные	58.0	т.тн.								
из них	20.0	т.тн.	г. Волгоград г. Самара	морем Энзели, далее автомоб. до Мегри	Росконтракт-Арминконтракт-ОПФ Армтрубоптторг	Минматресурсов	Норт-Ист-Транс	порт Энзели	Росконтракт	Росконтракт
	10.0	т.тн.	г. Таганрог	морем Батуми, далее ж/д. до РА	Росконтракт-Арминконтракт-Армагросервис	Минсельхоз		порт Батуми	Росконтракт	Росконтракт
			г. Мариуполь	морем Энзели, далее автомоб. до Мегри				порт Энзели	Росконтракт	Росконтракт
	10.0	т.тн.	г. Одесса	морем Батуми, далее ж/д. до РА	Росконтракт-Арминконтракт-Армгазтопливо	Минэнерго		порт Батуми	Росконтракт	Росконтракт
	18.0	т.тн.	г. Новороссийск	морем Батуми, далее ж/д. до РА	Росконтракт-Арминконтракт-ОПФ Армтрубоптторг	Минматресурсов	Норт-Ист-Транс	порт Батуми	Росконтракт	Росконтракт
8. Алюминий первичный	12.0	т.тн.								
из них	3.0	т.тн.	г. Краснодар	Авиатранспорт	Росконтракт-Арминконтракт-Минпром РА (з-д. Каназ)	Минпром			Росконтракт	Росконтракт
	3.0	т.тн.	г. Самара	морем Энзели, далее автомоб. до Мегри	Росконтракт-Арминконтракт-Минпром РА (з-д. Каназ)	Минпром		порт Энзели	Росконтракт	Росконтракт
	3.0	т.тн.	г. Махачкала	морем Энзели, далее автомоб. до Мегри	Росконтракт-Арминконтракт-ОПФ Цветметоптторг	Минматресурсов	Норт-Ист-Транс	порт Энзели	Росконтракт	Росконтракт
	3.0	т.тн.	г. Красноводск	морем Энзели, далее автомоб. до Мегри	Росконтракт-Арминконтракт-ОПФ Цветметоптторг	Минматресурсов	Норт-Ист-Транс	порт Энзели	Росконтракт	Росконтракт
9. Алюминий вторичный	2.0	т.тн.								
из них	1.5	т.тн.	г. Новороссийск	морем Батуми, далее ж/д. до РА	Росконтракт-Арминконтракт-предприятия Минпрома РА	Минпром		порт Батуми	Росконтракт	Росконтракт
	0.5	т.тн.	г. Краснодар	Авиатранспорт	Росконтракт-Арминконтракт-ОПФ Цветметоптторг	Минматресурсов	Норт-Ист-Транс		Росконтракт	Росконтракт
10. Никель	0.14	т.тн.	г. Краснодар	Авиатранспорт	Росконтракт-Арминконтракт-ОПФ Цветметоптторг	Минматресурсов	Норт-Ист-Транс		Росконтракт	Росконтракт
11. Медь рафинированная (из давальческого сырья)	6.0	т.тн.								
из них	3.0	т.тн.	г. Краснодар	Авиатранспорт	Росконтракт-Арминконтракт-предприятия Минпрома РА	Минпром			Росконтракт	Росконтракт
	3.0	т.тн.	г. Махачкала	морем Энзели, далее автомоб. до Мегри	Росконтракт-Арминконтракт-предприятия Минпрома РА	Минпром		порт Энзели	Росконтракт	Росконтракт
[illegible]	[illegible]	т.тн.								
из них	0.6[illegible]	т.тн.	г. Краснодар	Авиатранспорт	Росконтракт-Арминконтракт-предприятия Минпрома РА	Минпром			Росконтракт	Росконтракт
	0.3[illegible]	т.тн.	г. Краснодар	Авиатранспорт	Росконтракт-Арминконтракт-ОПФ Цветметоптторг	Минматресурсов	Норт-Ист-Транс		Росконтракт	Росконтракт
13. Медный прокат	2.0	т.тн.	г. Краснодар	Авиатранспорт	Росконтракт-Арминконтракт-ОПФ Цветметоптторг, предприятия Минпрома РА	Минматресурсов	Норт-Ист-Транс		Росконтракт	Росконтракт

1	2	3	4	5	6	7	8	9	10	11
14. Летучий прокат	3.3	т.тн.								
из них	1.0	т.тн.	г. Краснодар	Автотранспорт	Росконтракт-Аркоктракт--предприятия Аминпрокс РА	Аминпром			Росконтракт	Росконтракт
	0.3	т.тн.	г. Краснодар	Автотранспорт	Росконтракт-Аркоктракт--ОПФ Цветметсплторг	Аминатресурсов	Порт-Ист-Транс		Росконтракт	Росконтракт
	2.0	т.тн.	г.Самара	морем Зизели, далее автомоб. до Кегри	Росконтракт-Аркоктракт--предприятия Аминпрокс РА	Аминпром		порт Зизели	Росконтракт	Росконтракт
15. Полиэтилен	2.0	т.тн.								
из них	0.5	т.тн.	г. Краснодар	Автотранспорт	Росконтракт-Аркоктракт--предприятия Аминпрокс РА	Аминпром			Росконтракт	Росконтракт
	1.0	т.тн.	г. Краснодар	Автотранспорт	Росконтракт-Аркоктракт--ОПФ Архимнефтьоптторг	Аминатресурсов	Порт-Ист-Транс		Росконтракт	Росконтракт
	0.5	т.тн.	г. Краснодар	Автотранспорт	Росконтракт-Аркоктракт--ТПО Аркасспром	Аминатресурсов	Порт-Ист-Транс		Росконтракт	Росконтракт
16. Полипропилен	0.1	т.тн.	г. Краснодар	Автотранспорт	Росконтракт-Аркоктракт--ОПФ Архимнефтьоптторг	Аминатресурсов	Порт-Ист-Транс		Росконтракт	Росконтракт
	0.2	т.тн.	г. Краснодар	Автотранспорт	Росконтракт-Аркоктракт--Аркагросервис	Аминсельхоз	Порт-Ист-Транс		Росконтракт	Росконтракт
17. Полистирол	0.3	т.тн.	г. Краснодар	Автотранспорт	Росконтракт-Аркоктракт--ОПФ Архимнефтьоптторг	Аминатресурсов	Порт-Ист-Транс		Росконтракт	Росконтракт
18. Смола ПВХ	0.5	т.тн.	г.Самара	морем Зизели, далее автомоб. до Кегри	Росконтракт-Аркоктракт--ОПФ Архимнефтьоптторг	Аминатресурсов	Порт-Ист-Транс	порт Зизели	Росконтракт	Росконтракт
19. Пластикат ПВХ	1.5	т.тн.								
из них	0.5	т.тн.	г. Краснодар	Автотранспорт	Росконтракт-Аркоктракт--Аминегпром РА	Аминегпром			Росконтракт	Росконтракт
	1.0	т.тн.	г.Самара	морем Зизели, далее автомоб. до Кегри	Росконтракт-Аркоктракт--ОПФ Архимнефтьоптторг	Аминатресурсов	Порт-Ист-Транс	порт Зизели	Росконтракт	Росконтракт
20. Пластификаторы	0.5	т.тн.								
из них	0.38	т.тн.	г. Краснодар	Автотранспорт	Росконтракт-Аркоктракт--предприятия Аминпрокс РА	Аминпром			Росконтракт	Росконтракт
	0.12	т.тн.	г. Краснодар	Автотранспорт	Росконтракт-Аркоктракт--ОПФ Архимнефтьоптторг	Аминатресурсов	Порт-Ист-Транс		Росконтракт	Росконтракт
21. Сода кальцинированная	2.0	т.тн.								
из них	0.5	т.тн.	г.Самара	морем Зизели, далее автомоб. до Кегри	Росконтракт-Аркоктракт--предприятия Аминпрокс РА	Аминпром		порт Зизели	Росконтракт	Росконтракт
	1.5	т.тн.	г.Самара	морем Зизели, далее автомоб. до Кегри	Росконтракт-Аркоктракт--ОПФ Архимнефтьоптторг	Аминатресурсов	Порт-Ист-Транс	порт Зизели	Росконтракт	Росконтракт

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22. Ацетон (бочки)	3.0	т.тн.	г. Новороссийск г. Краснодар	корея Батуми, далее ж/д. до РА Автотранспорт	Росконтракт-Ариконтракт--Минпром РА (з-д Химволокно)	Минпром		порт Батуми	Росконтракт	Росконтракт
23. Метанол (спецтара)	0.3	т.тн.	г. Новороссийск	корея Батуми, далее ж/д. до РА	Росконтракт-Ариконтракт--Минпром РА (з-д Поливинилацетат)	Минпром		порт Батуми	Росконтракт	Росконтракт
24. Аммиак (спецтара)	0.4	т.тн.	г. Новороссийск	корея Батуми, далее ж/д. до РА	Росконтракт-Ариконтракт--Минпром РА (НПО Наирит)	Минпром		порт Батуми	Росконтракт	Росконтракт
25. Каучук синтетический (бочки)	4.0	т.тн.	г. Новороссийск	корея Батуми, далее ж/д. до РА	Росконтракт-Ариконтракт--предприятия Минпрома РА	Минпром		порт Батуми	Росконтракт	Росконтракт
26. Толуол	0.8	т.тн.	г. Краснодар	Авиатранспорт	Росконтракт-Ариконтракт--Минпром РА (НПО Наирит)	Минпром			Росконтракт	Росконтракт

Мининистерство экономики РА — А. Егиазарян

Мининистерство финансов РА — Л. Бархударян

Министерство топлива и энергетики РА — М. Акопян

Министерство материальных ресурсов РА — В. Мелконян

Министерство промышленности РА — А. Сафарян

Министерство легкой промышленности РА — Р. Теймуразян

Министерство строительства РА — Г. Мартиросян

Министерство сельского хозяйства РА — А. Восканян

Министерство транспорта и сообщений РА — Г. Кочинян

Главное управление авиации РА — Ю. Мнацаканов

Управление железной дороги РА — А. Кандилян

Таможенное управление РА — Е. Абгарян