INVESTMENT PROJECT

HIGH-SPEED STRING TRANSPORT

COMMERCIAL OFFER

MOSCOW 1996

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Drawn up by A.E. Younitsky

Moscow, 1996

1. SUMMARY AND BACKGROUND

The present Offer has been drawn up by Anatoly E.Younitsky, theauthor and designer of the string transport systems (STS) to attractinvestors, business partners. The amount of investments is US$ 35,000,000 (for US conditions) or US$ 8,000,000 for costs in one of the CIS countries. The investment is needed to complete the designing, itscarrying structure, supports, the transport module, the auxiliary systems and to erect a pilot stretch and a pilot module. It will allow to promote the STS at international markets as a radically new product and to gain leadership in a niche to be created by then.

The idea originated in 1982 after first publications in the USSR about non-rocket transport system "Global Transport Vehicle" (GTV). The most expensive component of the project is the trestle embracing the earth along a latitude stretching for of thousands of kilometers. Hence the project suffered a lot of criticism by numerous opponents. The strive to make the trestle simpler and cheaper has led to the development of the string transport structure to be implemented independently.

Self-supported studies of the STS idea were started in 1988 in the "Star World" Company established in Gomel (Belarus) through the initiative of the USSR Federation of Cosmonautics, which existed until the collapse of the USSR in 1991.

In 1994 an agreement was concluded with Alexander Kapitonov, an investor from Mozyr (Belorussia). Limited liabilities companies NTL (Minsk) and NTL Neue Transportlinien GmbH (Herten, Germany) were established. Simultaneously an international application "Linear Transport System" was registered PCT/1894/00065 dated 08 April 1994 to perform international patent search so far accomplished. After international expertise first patents of the Russian Federation and South African Republic were granted (the patenting is underway in 20 countries). Yet, since the investor failed his obligations to finance because of lack of means and interests quite foreign to science and technology (reselling raw materials). The author's nomination as the general designer was not supported nor remuneration was paid or the intellectual property and copyright of the STS project were protected.

2. DESCRIPTION

At present the world economy lacks transport communications to combine the advantages of the most popular transport means (auto- and railway vehicles, civil aviation, sea transport and trains on magnetic suspension and would allow to overcome their major disadvantages. Ford within five years created manufacturing facilities for production of vehicles which transformed the economy of many countries and lifestyle of millions and which for decades now has been returning huge gains.

The STS transport is the right solution because its routes are cheaper to erect than railways and motor roads, yet moving with the speeds of suspended trains (500 km/h and up). The STS will be ecologically cleaner, safer than electrically driven vehicles, cheaper than cars because the modules is simpler in design and easier to operate.

The main expected profits are:

(1) from selling licences for research and development results;

(2) from attracting contractors to erect transport line;

(3) from financing, commerce and production by using the means of investors, share holders, banks, financial and official structures, manufacturers, foundations and individuals both for implementation of the project, erection of separate lines. It will be implement through the own effort and placing orders among qualified bodies in the CIS, USA, Germany, Japan, France and other countries.

3. PRODUCT DESCRIPTION

The final product of the STS roject will include two major components:

(1) erection (similarly to motor roads and railways);

(2) machine building (similarly to the rolling stock, i.e. automobiles for motor roads and trains for railways).

3.1. The final erection product will be completed STS transport lines, such as two rail-strings produced in a specific manner. The strings in the rails will be made from separate steel wires tensioned to a total force of several hundred tons and suspended on light supports 5-50 m tall spaced 20-100 m. Power is delivered through wheels contacting with the strings. The STS route structure is designed so as to carry the wheels of vehicles. The structure has a perfectly smooth jointless surface ("the silky way"), its rectilinearity is governed by the string sagging under gravity between supports. While consumption of materials is low (about 100 kg per run meter or slightly more than for one rail) the string will be as rigid as existing bridges, it will sag under the weight of modules as much as 1/1000...1/10000 per leg.

Fig. 1-8 show the STS versions for various geographical conditions. Other design, fabrication and operation features are disclosed in Appendix 1.

The operation life with relevant profits is like railways one hundred and more years. This portion is conservative, its basic parameters (like track width) are not to be modified.

3.2. Machine building end products will STS modules with any feasible variety of parameters (body shape and design, motor power, rated speed, number of passengers, etc.) like a modern automobile. These products can be easily updated and improved (made more comfortable, safer, speedier, cheaper, better looking, etc.), hence, like automobiles, there will be new generations every 10...20 years.

3.3. Research and development achievements will be intermediate products. The STS is a comprehensive project, so the state-of-the-art of automobiles aviation, railway transport and others can be employed. In return the STS achievements can be employed in other industries with a greater economic effectiveness. For example, the studies of dynamics of the string route strictures can already serve to introduce new designs of bridges across the seas up to 2000 m deep (this is the author's available know-how). Implementation of just one such project (e.g. a bridge across the Gibraltar straits) will fully cover the investments for research and development of the STS project.

4. MARKET PROSPECTS

4.1. Trade space

There are no geographic or economic restrictions for the trade space since basically any state needs high-speed, cheap and ecologically clean transport means. The most promising potential are large countries, such as Russia, Canada, Australia, needing a better transport network; the USA, Japan, Germany, France and others needing a novel high-speed network, island countries, such as Japan, the UK, Taiwan and others to establish links with the mainland. Implementation can be started with local routes (e.g., from and to airports) or with international routes, such as Beijing - Seoul - Tokyo.

There is a significant potential on any continent, specifically in Western Europe. For example, the Council of Ministers of the European Community has approved the basic plan of high-speed lines until 2010. The total cost of such network to cover the entire continent, including the former USSR, is 300 billion ECU. The main lines are estimated 70 billion ECU. The Maastriht Agreement came into force on the 1st of November 1993. Article 12 envisages to develop transeuropean telecommunications nets, energy and transport networks. The transport infrastructure made new high-speed lines a priority with the allocation of about 50 billion ECU.

A prediction for 2010 is that high-speed lines will earn 72% of the total transport returns instead of 10% at present.

4.2. Market capacity

The market capacity will expand together with the addition of more and more STS lines. If the networks becomes comparable with the existing motor ways the STS may become the leading transport in the world economy to undertake a significant proportion of the passenger cargo traffic. Initially the market capacity will be governed by the feasibility's of a specific route.

For example, the passenger traffic between Beijing - Seoul - Tokyo can be expected 100 thousand passengers a day with the ticket price US$ 50 (the route is 1,900 km long, the tentative cost is US$ 65 billion). Operation during 5 years will pay back all the expenses for research, development and earn a profit of US$ one billion.

4.3. Competition

An organisation structure should be established together with the investor at the stage of research and development. The structure will become the major owner of the results (patents, know-how, engineering skills), manufacturing techniques, etc.) and correspondingly the main STS route developer. The structure should take into account the interests of both the investor investing money and the author investing intellectual property. No competition will be waged with the existing transport corporations until the time an order is received to erect a definite STS route. Partners can be identified among aviation, automobile building, railway, construction and energy companies to attract them to the development of the rolling stock, control systems, power supply, supports, etc.

Upon completion of research and development the decision about erection of definite routes will be made after feasibility's studies following the common practice of selection of a specific version of implementing transport communications (motor road, railway, airport or a train on magnetic suspension, etc.).

4.4. Competition advantages

The STS transport has basically all advantageous parameters over the existing overland transport:

- it is ecologically cleaner than the electromobile since it can do without batteries, erection of main roads or trestles;

- it almost occupies no land for erection and operation which is specifically significant in industrial zones (the existing network of transport, energy or any other communications, or the existing living quarters, etc.) as well as on virgin lands (saving the existing biocenosis even in fragile ecosystems, such as tundra or permafrost);

- it will be the most economical transport, since the main energy losses will be governed exceptionally by aerodynamics (the STS motor will have efficiency over 90%), the aerodynamic parameters can be made perfect because the module will have no protruding parts (a STS passenger module has already been tested in the aerodynamic tube and manifested the aerodynamic resistance Cx=0.075);

- it will be easy in operation because of its simple design and gentle to control (there are only two parameters to maintain the specified speed and distance between running vehicles allowing to computerize traffic and run the vehicles without drivers);

- its erection will cost one order of magnitude less (versus the passenger traffic) than automobiles and railways);

- it will be highly comfortable in motion (because the running structure is a silky" way practically without vibration, noise, overloads and other negative factors, such as exhaust or smell of fuel will be absent completely;

- it will run in any weather, disregarding fog, ice, wind, sand storms, etc.;

- it will be highly safe surviving any hazards (earthquakes, landslides, hurricanes, floods, etc.) because if one or several adjacent supports collapse the span between other supports will just become longer, while the whole system will remain operable, absence of the human factor in controlling the vehicle and the entire traffic allow to reduce the emergencies essentially to zero;

- it will be a universal transport type since it can run both on land and over the sea;

- it will last longer than railways or motor roads (the STS components experiencing dynamic effects are stronger and more durable than the traditional concrete and hard tar, the operation conditions are softer than those to which the rails and sleepers are exposed to, also there will be no joints, the string will be more rectilinear reducing the contact stresses in the "wheel-string" couple; also the STS will not accumulate irreversible deformations of earth banks over years since there will be none;

- no additional supports will be needed to cross deep abysses, straits, other obstacles up to 5 km, STS routes will be able to ascend and descend over mountains at an angle 45-60 degrees (because of the special design of the modules);

- consumption of materials, hence the cost of STS routes, will little depend upon the relief and its parameters, hence they can be easily run over deserts, marshy land, shallow lakes, permafrost, taiga, tundra, ocean shelf, mounts, etc.

One of the major STS advantages is that with a better comfort than automobiles, it will be cheaper and accessible even for kids because the terminal is just entered into the controlling computer.

The main advantage of the STS tracks is their cheapness due to economical consumption of materials for the track structure and supports and no need to erect high bridges and pathways. Moreover, the STS needs traditional materials, its design is easily implementable and erected. The passenger and cargo traffic will have the corresponding cost.

A one kilometer of the double STS track will cost within 1 million US Dollars on plains and 1.5 US Dollars in urban communities. This advantage is specifically essential when the STS is compared with other specific versions of competing high-speed roads under construction.

For example, erection of the "Transrapid" route in Germany (with the magnetic suspension) from Berlin to Hamburg about 300 km long has been projected to cost 19 billion DM. These means are sufficient to erect the STS track over 10 thousand km long, for example, London - Paris - Berlin - Warsaw - Minsk - Moscow - Vladivostok - Tokyo.

The Government of the Russian Federation has adopted a decision to erect a high-speed railway from Saint-Petersburg to Moscow 600 km long. Letting alone the ecological problems which the railway is going to create the foreign experts have estimated its cost at 8...10 billion US Dollars. This cost would cover a STS from Saint-Petersburg to Moscow to Khabarovsk and to Vladivostok.

The ticket to go along the plain STS track for 1000 km would be within US $ 60 (with the double-way passenger traffic 10 thousand a day), US $ 15 (50 thousand passengers) and US $5...10 (100 thousand passengers and more). It is less than the cost of a high-speed and a standard railway.

Appendix 1 gives a more detailed comparison of the STS system and existing transport systems.

The STS Project was demonstrated at the Leipzig (March and April 1995) and Hannover (April 1996) Fairs as an operating model (1:5 scale) and was highly rated by experts. The advantages of the STS were acknowledged by the leading transport research center of the Russian Federation - the Petersburg State University of Transport (the Minutes of the Scientific Council Meeting of the University - see Appendix 2).

4.5. Market strategy

During research and development the market strategy is in the leading development of both the overall STS design and accompanying programs, components, units, processes and intellectual property protection (by patenting and identification of the know-how, etc.). Therefore, by the time of R&D completion the company which implements these tasks should expand into a powerful corporation with its own research, designing and production facilities.

This stage will end in the erection of the pilot route and the pilot vehicle and run tests.

Lack of means to solve the entity of tasks at this stage or dependence upon the structures with dubious capital expecting immediate profits may nullify the idea itself to reach the full-scale implementation of the project.

A big portfolio of orders for projecting and erecting STS routes globally can be expected after demonstration of the operability and advantages of the STS over other transport systems on the pilot stretch.

5. MARKETING

5.1. Marketing at the R&D stage will include the following:

- a promotion campaign to raise means for the full-scope R&D and mass production;
- exploration of demand and conclusion of contracts with definite customers - governments or companies existing or specifically set-up (upon R&D completion).

5.2. Marketing plan

5.2.1. At the R&D stage the marketing strategy will be based on a broad promotion of the STS basic concept as the cheapest, economical and ecologically clean transport to foster demand and accumulation of the portfolio of orders by the time the STS comes into full production.

5.2.2. Pricing policy

The intermediate product will be research and technological results, the know-how. The prices under licence to utilize the R&D results will be based on the know-how completeness, the demand and the world prices for the licences of this sort.

The pricing policy during full production will be based on more expensive ticket prices (yet competitive with the railway, air and automobile transport prices) with their gradual reduction to attract more clients, to increase sales and the share in the transport market.

5.2.3. Demand motivation

To motivate demand a powerful promotion campaign will be needed in the mass media. To promote lobbies will be needed in governments of different countries.

6. ABOUT THE AUTHOR

Anatoly E. Younitsky, born in 1949, graduated from the Belorussian Polytechnic Academy in 1973. Engineer of Transport Communications. The author of 70 inventions, 22 have been implemented in Belarus and CIS countries (including 7 inventions in defence). In 1990 he resigned from his state employment and established his own company. He is the author of the STS project and its general designer (See Appendix 3 for more detail). Resides in Gomel.

During 14 years the author, essentially without means, advanced from the original idea or from nil to the integral development of all the aspects of the program: designs of supports, route structure, construction techniques, the transport module concept, configuration of its parts and units, aerodynamics, traffic management, feasibility studies, R&D and pilot tests plans, etc. The Know- the author has accumulated significant engineering understanding, the know-how, technical, technological and other solutions. This effort might have required years for a skilled team, though, even amply financed, might still fail to reach the same solutions. Just an insignificant portion of these results was reflected in 1995 in the manuscript "Earth and Space String Transport Systems" (see Appendix 1). The best solutions were omitted because of their patent eligibility.

7. PLAN OF ACTIONS

The company set up together with the investor rents premises for its office, laboratories, designing rooms, recruits staff necessary for R&D.

Investor will finance the project and the author will carry out the project management as a chief designer. The author will invest as his share his intellectual property: patents, patent applications, know-how, engineering knowledge on STS design, project techologies, R&D processing and other project developments.

Simultaneously:

- the R&D results are patented;
- demo models are made and the test field is constructed to test low and moderate speeds;
- research and development are effected;
- designing and tests are carried out;
- promotion is undertaken.

After three years of intense R&D when basic STS components, the olling stock and auxiliary system (terminals, power supply, control systems, etc.) have been designed, the promotion campaign is started to attract shareholders. Considering strong attractiveness and high profitability substantial financial means can be raised amounting to millions and billions of dollars. It will allow to create a commercial and production structure for specific projects of the STS route in addition to research. Two next years will be devoted to specific versions of STS high-speed routes to be offered to governments alongside with an intense promotion campaign.

Dozens, even hundreds of versions of definite STS routes can be proposed for all continents. If anyone is implemented, it will be enough to cover expenses for R&D and to yield profits. Another fact is important: that research and production facilities will be established allowing to become leaders for decades to come.

8. FINANCIAL PLAN

With the total investments US$ 8 million for the Belorussian conditions and the CNS or US$ 35 million it will take five years to complete comprehensive research, development, designing and creation of the research and production facilities (Table 1).

Appendix 4 shows the structure of research, development and designing with the account of the payroll of the permanent and contracted staff for the stages of development of the global design, draft project, individual designs, tests, working drawings cost of materials, standard pieces and work with clients. Because the tables are rather cumbersome with itemized costs (hundreds of items) they are not enclosed.

9. LIST OF ASSUMPTIONS

The assumptions can be made in respect to the STS routes of different length for various countries.

9.1. An assumption can be made regarding a definite STS route for example, to link the US Pacific and Atlantic coasts Los-Angeles - Denver - Lincoln - Chicago - Cleveland - Philadelphia - New York 4000 km long. Time en route is 8-10 hours (one night), the ticket price is within US$ 100. Considering cheap tickets and that dozens of millions live along the route, the traffic will reach 100 thousand passengers a day (if at least one of those living along the route uses it once a year). Say, if the double-track would cost US$ 6 billion (or US$ 1.5 million per km, including the cost of the rolling stock, terminals and infrastructure, its cost will be paid back within two years, after that the annual profit will run to US$ two billion. If the tickets are priced higher, the profit will go up since the trip from Los-Angeles downtown to New York downtown will not be two much longer than a flight (at a price several times less).

If a railway is erected instead of the STS route its cost will exceed US $ 50 billion.

9.2. A STS route from the Airport of Sheremetyevo to the downtown Moscow about 50 km long with the time of travel 20 minutes will cost US$ 1 per passenger The route will cost US$ 95 million (with the terminals and intermediate stations. The cost of the project is estimated at US $ 800 million.

9.3. During the recent years it is projected to erect in Russia about 2,300 km of new main oil pipelines and a double pipeline from Yamal to Europe. Their cost is estimated at US $ 8 billion.

Within the framework of the present project it is possible to erect a cargo-passenger STS route from Tyumen to Western Europe 5 thousand km long. The cost of the route erection would be the same US $ 8 billions.

It will ensure passenger traffic 50 thousand per days (18.3 million passengers a year) and 200 thousand tons to cargo per days (73 million tons a year). The cost would US $ 5 per passenger for 1,000 passenger-kilometer, for cargoes US $ 3 for 1,000 ton-kilometer.

This cargo traffic of 50 million tons a year may include oil, oil products and liquefied gas, the rest may be coal, iron ore, fertilizer, chemical products, industrial goods and food, etc. The minimum distance between passenger vehicles in the transport traffic would be 500 meters (for five seaters), between the cargo transport modules with the carrying capacity 2,000 kg would be 100 meters.

Table 1.

Summary calendar plan of financing R&D under STS Project

Items	US$, million						
	Local total.		Inc. USA cond				
	RB	USA	1-st	2-nd	3-rd	4-th	5-th
1. Designing and fabrication of the transport module pilot model	0.8	4	0.5	1	2.5	-	-
2. Designing of the STS transport line pilotleg	0.4	2	0.5	0.5	1	-	-
3. Erection of the pilot leg 5 km long	2.5	10	-	1	2	7	-
4. Designing and fabrication of the equipment to construct the pilot leg	0.4	2	0.5	0.5	1	-	-
5. Validation and tests of the transport line components at the stage of disigning the pilot leg	0.6	3	0.5	1	1.5	-	-
6. Validation and tests of the transport module components at the stage of development of the pilot model	0.8	4	0.5	1.5	2	-	-
7. Validation and tests of the route pilot leg and the module pilot model	0.5	3	-	-	-	1	2
8. Expenses for creating jobs at the R&D stage	0.5	2	1	0.5	0.5	-	-
9. Unforeseen expenses	1.5	5	0.5	1	2	1	0.5
Total	8	35	4	7	12.5	9	2.5

APPENDICES

1. A. Younitsky. "Earth and Space String Transport Systems", 337 pp, Gomel, 1995.
2. Minutes of the Scientific Council Meeting of the Petersburg State University of Transport dated March 20, 1996.
3. Curriculum Vitae.
4. STS R&D Structure.
5. Promotion.

Appendix 2

Approved:
Vice Rector of the University,
Professor V.V. Sapozhnikov

MINUTES
of the Meeting of the Academic Board
of the Petersburg State University of Transport Communications

March 20, 1996 Saint-Petersburg

Subject: "String Transport System"

Reported by A.E. Younitsky, General Designer of the NTL GmbH Company,
(Minsk, Republic of Belarus)

Participants:
V.V. Sapozhnikov, Professor, Vice Rector
L.N. Pavlov, M.A., Vice Rector, Research
M.N. Novikov, D.A., Professor, Head of the Department "Electrical Machines"
A.N. Lyalinov, D.A., Professor, Department "Civil Mechanics"
A.I. Khozhainov, D.A., Professor, Head of the Department "Electrical Engineering"
A.T. Burkov, D.A., Professor, Head of the Department "Railways Power Supply"
V.M. Petrov, D.A., Professor, Head of the Department "Survey and Erection of Railways"
M.F. Makhnovskiy, M.A., Assistant Professor, Department "Civil Mechanics"
O.I. Borshchev, M.A., Assistant Professor, Department "Strength of Materials and Structures"
V.M. Varentsov, M.A., Assistant Professor, Department "Railways Power Supply"
G.E. Sereda, M.A., Assistant Professor, Department "Electrical Engineering"
I.V. Gurlov, M.A., Assistant Professor, Department "Electrical Machines"
S.A. Gulin, M.A., Assistant Professor, Department "Electrical Machines"
Ya.Y. Parmas, M.A., Senior Researcher, Department "Electrical Machines"
V.S. Trofimov, M.A., hief of the Laboratory "Design and Transport"
G.L. Andreev, M.A., Assistant Professor, Department "Engineering Graphics"
A.P. Epifanov, D.A., Professor, Department "Electrical Machines"
V.M. Pivovarov, Designers' Team Chief, Special Machine Building Designing Bureau
M.V. Zhilin, Designers' Team Leader, Special Machine Building Designing Bureau
V.S. Zharkevich, Chief Designer of the Belorussian Designing Institute, the "Transport" Studio, (Minsk)

Presentation of A.E. Younitsky

The NTL GmbH has developed a string transport system (STS) including the string track structure suspended 10-50 m high in alternating anchored and carrying supports.

The string rails are electrically insulated and act as current bus bars to convey energy to the transport means. The Transport means is a wheel vehicle carried by string rails weighing 2,000-5,000 gross accommodating 3-20 passengers.

A great tensioning force of the string (100-500 tons) and a particular design of the rail, a fast velocity of the vehicle (up to 300-500 km/h) make the track structure highly smooth. The main components and design features have been disclosed. The results of investigation of the dynamics of vibrations of the track structure, scaled tests of the vehicle model in the aerodynamic tube, design indicators of the feasibility's and other STS features have been explained.

The main results of the presentation are described in the author's publication "String Transport Systems" published by the NTL GmbH in Gomel in 1995.

Questions: A.N. Lyalinov, M.N. Novikov, A.I. Khozhainov, G.E.Sereda,
V.M. Petrov, O.I. Borshchev, V.M. Vorontsov, L.N. Pavlov,
M.F. Makhovskiy, M.V. Zhilin, et al.
Discussion: A.I. Khozhainov, V.M. Petrov, A.N. Lyalinov, M.N. Novikov,
L.N. Pavlov, et al.

The discussion revealed:

1. The need, uniqueness and practical expediency of implementation of the STS Project in its immediate application for the geographic and climatic conditions of the North-West of Russia
2. The complexity of the problem under study.
3. The feasible effectiveness of the implementation based on the transition from a planar railway system to the three-dimensional system.

The Board recommends the following:

1. To accomplish a more detailed study of the traction drive, reliability problems and the safety of the string transport system in its integrity.
2. To erect a pilot leg to validate the main design parameters and the STS' behavior in operation.
3. To attract the research potential of the Transport Research School and the University of Petersburg.
4. To try to get finances for the R&D and erection of the pilot leg of the novel transport system.

Chairman of the Session signature L.N. Pavlov

Secretary signature V.S. Trofimov

March 21, 1996

Appendix 3

STS Project Chief Developer:
Anatoly E. Younitsky
Address: 246028, Republic of Belarus
Gomel, Kirov St. Bldg. 90, Apt. 40
Telefon: 0232/57-20-57 (Gomel)

1. Education

Graduate of the Belorussian State Polytechnic Academy, majoring in transport communications, Minsk

1973

Graduate of the Academic Course of Patent Studies, Certified Patents Scientist
1984

2. Professional background (during the last decade)

Chief of the Patents Bureau of the Institute of Mechanics of Metal-Polymer Systems of the Belorussian Academy of Science, Gomel, Belorussia
1985

General Manager of the Center "Star World" (established with the support of the USSR Federation of Cosmonautics), Gomel, Belarus
1988

General Designer and Cofounder of NTL Neue Transportlinien GmbH, Herten, Germany
1994

General Designer and Cofounder of NTL Ltd., Minsk, Belarus
1994

3. Other achievements

Merited Inventor of the Institute of Mechanics of Metal-Polymer Systems of the Belorussian Academy of Science 1987, 1984, 1983

Member of the SSR Federation of Cosmonautics (Section "Non-Rocket Space Transport Means") 1986

Vice-Chairman of the Organizing Committee of the 1-st National Scientific Conference "Rocketless Space Industrialization: Problems, Ideas, Projects", Gomel April 26-28, 1988

Full Member (Academician) of the Academy of New Thinking, Moscow, Russian Federation 1996

Member of the International Academy of Information Processes and Technologies, Minsk, Belorussia 1996

Author of over 50 Scientific Publications (Journals "Izobretatel i Ratsionalizator", "Avtomobilnyje Dorogi" and others) 1982-1995

Author of over 70 Inventions (Machine Building, Construction, Transport, Defence), 22 introduced into production in Belarus, Russian Federation and other CIS countries (total economic effect over US$ 10 million) 1980-1995

Author of the Publication "Earth and Space String Transport Systems", 337 pp.
1995

Author of Fundamentally Novel Non-Rocket Transport System "Global Transport Vehicle" for Large Scale Outer Space Exploration
1977

Author of Fundamentally New Overland Super-Speed String Transport 1982