



Svyaz engineering KB, LLC

Information memorandum

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Information memorandum

- This presentation contains a review of the **Research & Production Facility for the manufacturing of printed circuit boards in Dubna, Moscow region – Svyaz engineering KB, LLC.**

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|--|---|
| Location | Dubna, Moscow region |
| Commissioning | August, 2015 |
| Business segment | complete cycle facility for the manufacturing of double-sided and multilayered printed circuit boards, oriented on prototyping, small-scale and multiproduct manufacturing. |
| Staff | 180 – 350 employees (1 – 3 shifts) |
| Estimated capacity Project investment | 55 000 m ² of printed circuit boards per year EUR 62 mln |



Pic. 1. Layout of the factory in Dubna
Source: materials of Svyaz engineering KB, LLC

- In 2015, an ultramodern factory for the manufacturing of printed circuit boards with an estimated capacity of 55 000 m² of printed circuit boards per year was commissioned in Dubna.
- The Research & Production Facility project was developed to meet the requirements for the manufacturing of hi-tech and super hi-tech printed circuit boards ensuring high quality of the end product.
- The factory is tooled up with equipment from the leading world manufacturers, including **Atg Luther & Maelzer GmbH, Atotech Chemeta, Burkle, Waxco, MEC Company Ltd, PAL, Orbotech, Printprocess AG, Schmid, Schmoll**, etc., imported from Germany, Sweden, Switzerland, Israel and the United States.
- As of the end of 2015, actual investments into the creation of the Research & Production Facility accounted for RUB 3,075 mn, with 65% of the total amount of investments financed at the expense of an attracted loan and 35% financed at the expense of the founder – Svyaz Engineering KB.
- Svyaz engineering KB, LLC is a subsidiary of **CJSC Svyaz Engineering** that is a leading manufacturer of industrial electronics and electrical goods at the Russian market.

Competitive advantages of Svyaz engineering KB, LLC

1 Location in SEZ Dubna.

- Tax preferences in the form of reduced profit tax rate, contributions to extra-budgetary funds and a 10-year tax holiday for land and property taxes.
- Foreign goods, including equipment, can be imported to the territory of SEZ customs-free and VAT-free.

2 Ultramodern imported equipment.

- Imported equipment from the world leading manufacturers has been purchased for the express purpose of tooling up the factory.
- The equipment was commissioned in the second half of 2015 and has minimum physical wear.

3 Technologies unparalleled at the Russian market

- For the first time since 1991, a full-cycle facility for the manufacturing of double-sided and multilayered printed circuit boards has been created from scratch in Russia.
- Possibility of manufacturing advanced hi-tech quality printed circuit boards of a wide range.

4 Own R&D and DE

- The factory provides all the possibilities for performing own Research & Development (R&D) and Development Engineering (DE) works aimed primarily at developing new technologies of manufacturing printed circuit boards and enhancing the existing technologies.

5 Proximity to the customers of printed circuit boards

- Fast manufacturing and shipment to the end customer compared to manufacturers from South-East Asia and Europe.
- Fast order processing due to prompt interaction with customers and product designers.

Reference information

- **Printed circuit board** – the basis of any electronic product.
- It is a plate manufactured from a dielectric with at least one electrically conductive circuit (usually formed by printing). A printed circuit board (PCB) is designed for electrical or mechanical connection of a variety of electronic components or specific electronic assemblies. PCB electronic components are connected to conductive pattern components by soldering, wire-wrapping, riveting or pressing in, resulting in a packaged electronic circuit or a loaded printed circuit board.
- **Scope**
- Printed circuit boards are used in such spheres as industrial electronics, including safety systems, retail equipment, medical equipment and a variety of meters, car electronics, telecommunications equipment, military electronics and special-purpose electronics, consumer electronics, other types of radio-electronic equipment.
- **Accuracy classes for the manufacturing of printed circuit boards**
- Accuracy class determines the basic structural components and the minimum design dimensions of printed circuit boards. The higher the accuracy class, the more complex is the manufacturing of printed circuit boards involving more advanced equipment. The table implies that, according to the current revision of GOST 53429-2009, **Svyaz engineering KB, LLC** corresponds to accuracy class 6.

| Hole diameter | With metallization | Maximum hole diameter deviation for accuracy class, mm | | | | | | |
|------------------------------|-----------------------------------|--|--------------|--------------|--------------|--------------|-----------------------|--------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Up to 0.3 inclusive | Without metallization | - | - | - | ±0.02 | ±0.02 | ±0.02 | ±0.02 |
| | With metallization without fusing | - | - | - | -0.03 | -0.03 | -0.02 | -0.02 |
| | | - | - | - | -0.07 | -0.07 | -0.06 | -0.06 |
| | With metallization and fusing | - | - | - | - | - | - | - |
| From 0.3 up to 1.0 inclusive | Without metallization | ±0.10 | ±0.10 | ±0.05 | ±0.05 | ±0.05 | ±0.025 | ±0.02 |
| | With metallization without fusing | +0.05; -0.15 | +0.05; -0.15 | +0; -0.10 | +0; -0.10 | +0; -0.10 | -0.025; -0.075 | -0.02; -0.05 |
| | With metallization and fusing | +0.05; -0.18 | +0.05; -0.18 | +0; -0.13 | +0; -0.13 | +0; -0.13 | - | - |
| Over 1.0 | Without metallization | ±0.15 | ±0.15 | ±0.10 | ±0.10 | ±0.10 | ±0.05 | ±0.03 |
| | With metallization without fusing | +0.10; -0.20 | +0.10; -0.20 | +0.05; -0.15 | +0.05; -0.15 | +0.05; -0.15 | +0; -0.10 | -0.02; -0.08 |
| | With metallization and fusing | +0.10; -0.23 | +0.10; -0.23 | +0.05; -0.18 | +0.05; -0.18 | +0.05; -0.18 | - | - |

Table 1. Accuracy classes for the manufacturing of printed circuit boards
Source: GOST 53429-2009

Reference information

Types of printed circuit boards

- Printed circuit boards are classified into three main categories:

1. The first classification of printed circuit boards depends on the **number of layers**. Depending on the number of layers with the electrically conductive pattern, printed circuit boards are classified into:

single-sided (SPCB): one layer of foil attached to one side of the dielectric sheet;

double-sided (DPCB): two layers of foil;

multilayered (MPCB): foil is applied not only to the two sides of the board, but also to the inner layers of the dielectric; Multilayered printed circuit boards are manufactured by attaching several single-sided or double-sided boards.

2. Depending on the **base material properties**, printed circuit boards are classified into:

rigid;

flex;

flex-rigid.

3. Depending on the **type of materials in the basis of printed circuit boards**, PCB are classified into:

composite plastic materials (fiber-glass plastics) – glass textolite, geax;

the basis of printed circuit boards may be a **metal base**, covered with dielectric (anodized aluminum), copper foil of tracks is put over the dielectric;

in microwave boards or boards operating under temperatures of up to 260 °C, **PTFE**, reinforced with glass fabric and **ceramics** are used; flex boards are made of polyamide materials – **kapton**.

Scale of orders

- A significant factor determining the price is the volume and scale of orders – from prototyping to mass production, when the number of orders exceeds 10,000 dm².

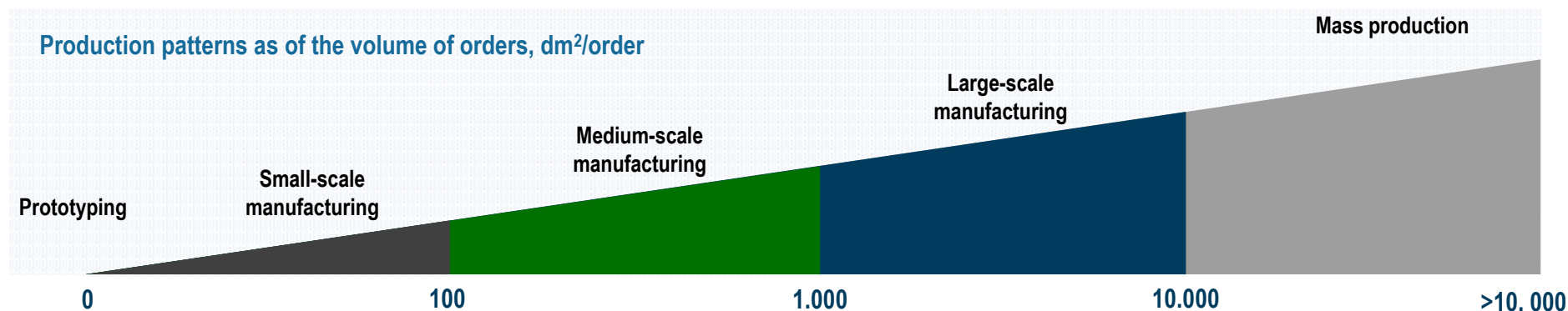


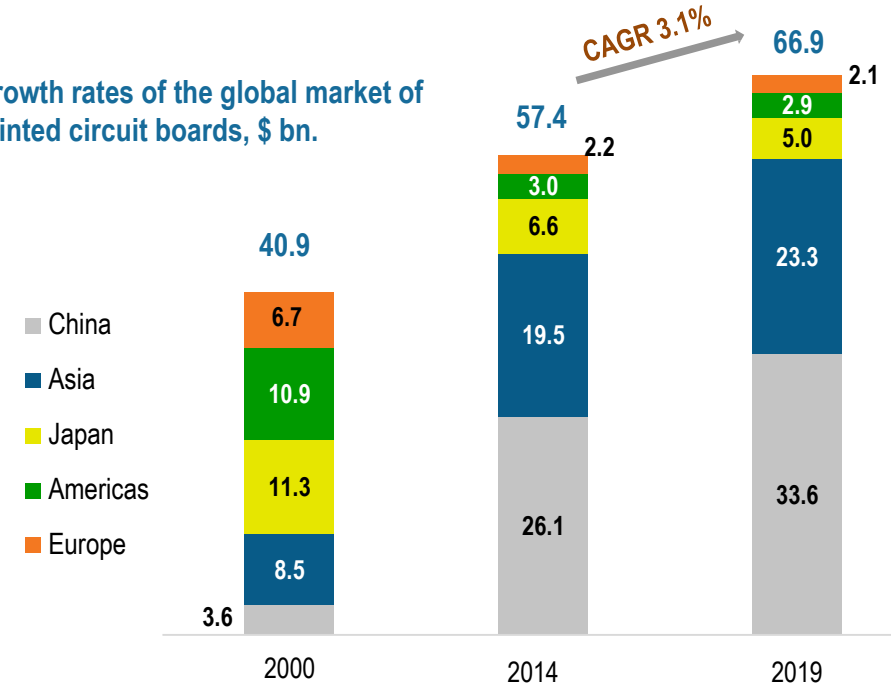
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Global market of printed circuit boards

- In 2014, the size of the global market of printed circuit boards accounted for **\$57.4 bn.**, equalling 3.3 bn. m² in physical terms.
 - China accounts for about a half of the market of printed circuit boards, simultaneously demonstrating the highest expected production growth rates – 5.2% per year in 2014 - 2019.
 - Total growth rates in 2014 – 2019 are expected at 3.1%**, due to the introduction of innovation technologies and equipment requiring hi-tech and knowledge-intensive printed circuit boards.
- Main engines of growth of PCB market:
1. Spread of the Internet of things and miniaturization of components;
 2. Rising demand for cloud services and technologies;
 3. Development and upgrading of A&D industries;
 4. Development of robotics industry;
 5. Increasing significance of intellectual property protection and transaction security;
 6. Tightening of environmental standards for printed circuit boards manufacturers and upgrading of production technologies thereof to minimize environmental damage.

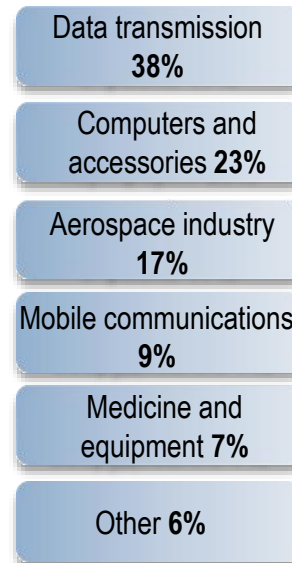
Growth rates of the global market of printed circuit boards, \$ bn.



Pic. 3 Growth rates of the global market of printed circuit boards Source: Prismark Partners – World PCB Report, May 2015

Major consumers of printed circuit boards

- According to statistics, in 2014, the top-5 consumers of printed circuit boards – **Apple, Bosh, Cisco, Ericsson and Huawei** – generated 29% of revenue for the industry.
- The major segment of printed circuit boards is comprised by utility systems technologies (data transmission), as well as computing and data storage technologies (computers and accessories), the key drivers for which are enhancement and implementation of high-speed data transmission concepts (LTE, 5G), end product miniaturization, enhancement of equipment security and system reliability.

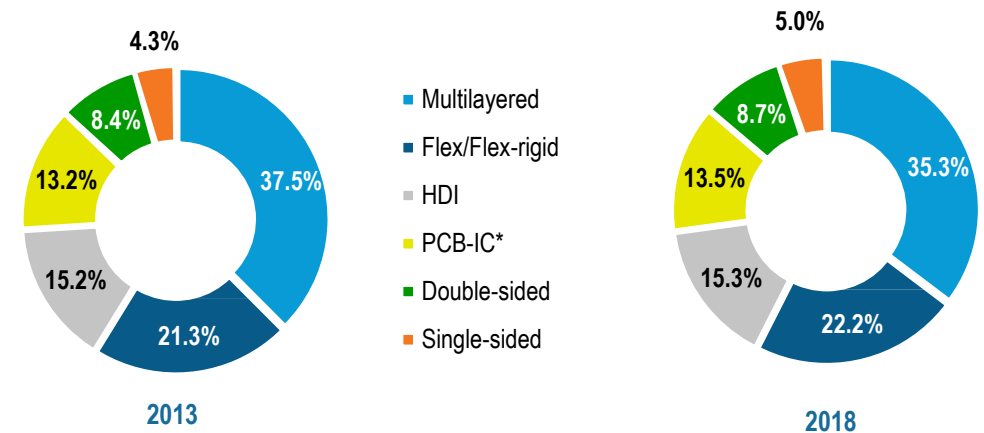


Pic. 4. World consumers of printed circuit boards Source: TTM Technologies, 2014

Printed circuit boards manufacturers and technologies

- The most promising technology is the production of **Flex/R-Flex** printed circuit boards that will be expanding rapidly at a rate of 5.3% per year.
- The market is also characterized by a rapid expansion of the innovative PCB-IC (**IC Substrate**) technology growing at a rate of 4.9% per year, used in the segment of high-performance computer processors, communications, car manufacturing and industry.
- Knowledge-intensive technologies of printed circuit boards production (**Flex/R-Flex, IC Substrate**) allow to reduce the dimensions of the end product, simultaneously increasing their complexity and performance while maintaining stability of the board.
- The segment of **multilayered circuit boards** will retain the leading position with the largest share of the market in money terms, and will also produce moderate growth rates (3.2% per year) due to consistent growth of production of computers and communication devices.
- Single-sided printed circuit boards, with a growth of 7.6% per year, will retain an insignificant share of the market thanks to demand from the segment of simple industrial electronic devices.

Growth rates of printed circuit boards production, %



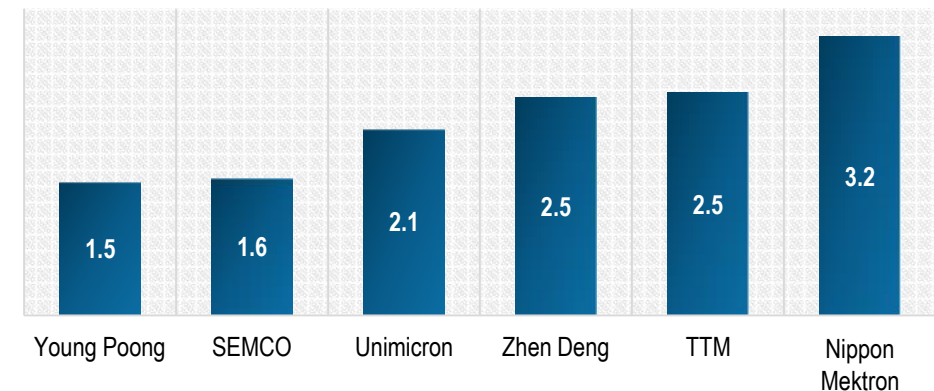
*Printed circuit boards with integrated circuits

Pic. 5. Growth rates of printed circuit boards production, Source: Prismark Partners (2014), AT&S

World manufacturers

- **Top 10** manufacturers controlled about **33%** of the market of printed circuit boards in 2014
- Thanks to the scale of manufacturing capacities and global market reach, top manufacturers are present in all the segments of printed circuit boards production technologies.
- Companies' products share the common service segments, including communications and instrument engineering, radio engineering and electronics, space and aircraft industries, car manufacturing and medicine.

Major manufacturers of printed circuit boards, 2014, \$ bn.



Pict. 6 Major manufacturers of printed circuit boards, 2014 Source: Prismark Partners – World PCB Report, May 2015

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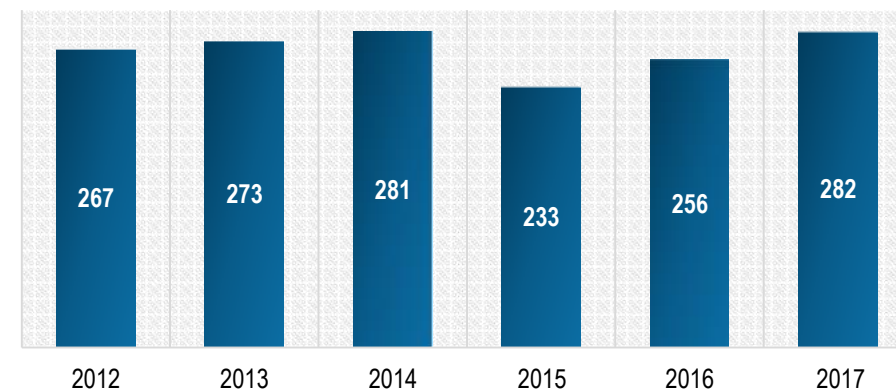
Russian market of printed circuit boards

- In 2015, the size of the Russian market of printed circuit boards accounted for **\$233 bn.** (0.4% of the global market).
- The basic trends determining the development of the Russian market of printed circuit boards:
 1. Import substitution factor – localizing foreign OEM-companies' production in Russia;
 2. Ruble devaluation – 20 – 40% price advantage compared to imports;
 3. Increasing demand at the Russian end products market primarily due to orders of aerospace and defence equipment.

Segmentation according to the types of printed circuit boards

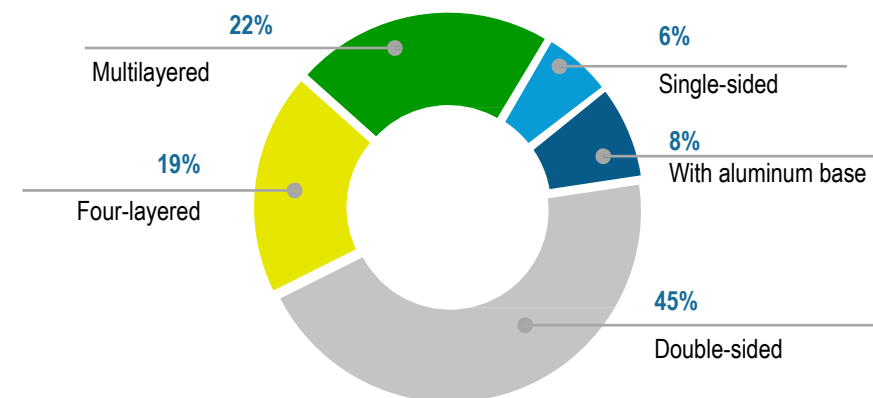
- The current state of the Russian market is characterized by the domination of double-sided and multilayered printed circuit boards segments.
- The current trend in the market consists in the substitution of the simplest PCB types with multilayered PCB due to:
 1. Functional improvement of the end products;
 2. Increasing complexity of the end products;
 3. Introduction of advanced high-performance microprocessors
 4. Decreasing output of civilian industry in Russia (industrial electronics).
- It is worth emphasizing that the share of Flex/Flex-rigid printed circuit boards will be growing at a rate outstripping the growth rates of the Russian as a whole (2% of the market in 2014).
- The market of microwave-based printed circuit boards (5% of the market in 2014) will continue expanding along with the rise in operating frequency of telecommunications and radar equipment.

Growth rates of the Russian market of printed circuit boards, \$ bn.



Pic. 7. Growth rates of the Russian market of printed circuit boards.
Source: SOVEL LLC, 2015; RGG Capital analytics

Cost segmentation of the market according to the types of printed circuit boards, 2014



Pic. 8. Cost segmentation of the market according to the types of printed circuit boards, 2014
Source: SOVEL LLC 2015

Printed circuit boards exports and imports, 2014

Imports

- Printed circuit boards exports are imported to Russia through 5 supply channels, the largest of which is comprised by Russian traders/suppliers – \$110 mn.
- The largest suppliers of imported printed circuit boards are LLC Rezonit (imports), NPK Expert, NCAB Group Russia, Service Devices, Finline.
- Imported products are characterized by medium- and large-scale manufacturing, in which 1- and 2-sided printed circuit boards predominate.

| Imports category | Volume, \$ mn. | Volume % |
|---|----------------|----------|
| Russian traders | 110 | 55% |
| Foreign traders' and manufacturers' offices | 30 | 15% |
| Global companies' assembly facilities | 27 | 14% |
| Directly to Russian OEM-companies | 22 | 11% |
| Contract manufacturers | 9 | 5% |



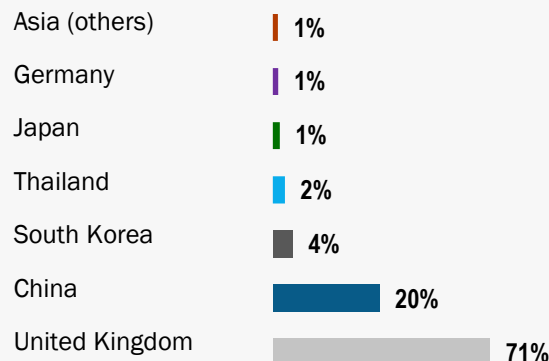
Domestic production

- Domestic production of printed circuit boards is predominantly carried out by independent PCB manufacturers and institutional manufacturers, such as LLC Rezonit (own production), LLC Electroconnect, LLC TECHNOTECH, RPA MARS and LLC TABERU.
- The products manufactured by these companies predominantly fall within the category of medium-scale manufacturing and prototyping, while large-scale and mass production is carried out by the only major Russian manufacturer – Rusalox.

| Production category | Volume, \$ mn. | Volume % |
|---|----------------|----------|
| Russian manufacturers (independent manufacturers and institutional manufacturers) | 66 | 78% |
| Own production of PCB, OEM-companies | 18 | 22% |

Imports structure

- In 2014, the main sources of imports of printed circuit boards were the United Kingdom and China, with respective shares of 71% and 20%.



Exports structure

- The main export destinations for the Russian produce of this category in 2014 were India and Belarus.

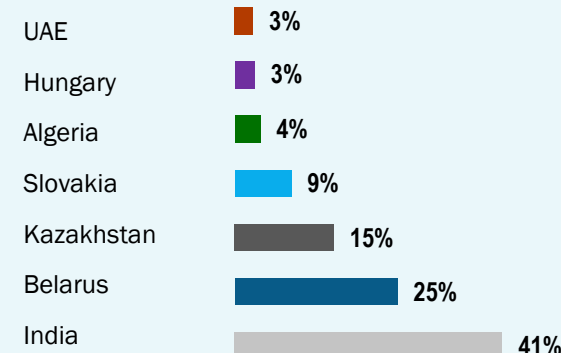


Table 2.3. Printed circuit boards imports and exports, 2014
Source: SOVEL LLC 2015

Pic. 9,10. Printed circuit boards imports and exports, 2014
Source: trendecomy.ru, 2014

PCB consumption structure in Russia, 2015

- Domestic consumers ensuring demand for printed circuit boards in Russia can be conventionally divided into 4 groups, in which $\frac{3}{4}$ of demand is ensured by investment goods markets and state defence and security expenditure.
- Therefore, the state – through companies under its control and defence needs – is the largest consumer of printed circuit boards.

| | Domestic investment goods markets | State defence and security expenditure | Foreign markets, exports of Russian products | Domestic consumer markets (consumer expenditure) |
|---------------------------|--|--|--|---|
| Market share, 2015 | 20% | 40% | 16% | 7% |
| Market share, 2017 | 25% | 53% | 17% | 8% |
| Contents | Industrial electronics, major part of communications and navigation equipment, computers, security systems, lighting equipment, as well as medical and retail equipment manufactured in Russia. | Procurement of arms and defence equipment. | Exports of arms, electronic systems and equipment. Special-purpose systems supplied in package with arms predominate in the exports of Russian electronic equipment. | Car electronics, consumer electronics, mobile phones and smartphones; TV, audio and video equipment; computers, laptops and tablets; home appliances, electricity meters, lighting equipment and some other groups of products sold retail. |
| Drivers | In 2016, should the price advantage of Russian goods persist, the industrial manufacturing of import substituting goods might be expected to expand. High wear of infrastructure will not allow to defer infrastructural investments into infrastructural segments to a later period. | The share of the state armaments procurement program in the budget structure of the Ministry of Defence is increasing year on year: from 37% in 2013 up to 59% by 2017. It is not the demand that will be limiting output, but the possibilities of the defense industry to expand manufacturing capacities. | Exports of civilian products will be growing due to significant price advantage that the Russian enterprises obtained after the Ruble devaluation. The expansion of defense equipment exports is limited by high pressure of business on defense enterprises and prioritization of the state defense order. | Moderate market growth is due to declining sales of durable goods and household incomes. |
| Consumers | The major corporate customers are oil and gas companies, Russian Railways, generating and metallurgical companies. | Structures under control of the Ministry of Defense of the Russian Federation, as well as JSC Concern VKO "Almaz-Antey", JSC United Aircraft Corporation | Major customers from India, Belarus, Kazakhstan. | Samsung and LG factories. General Satellite, LVS-group, JSC Avtoelektronika, Avtopribor, Sony, Philips. |

Pic. 11. PCB consumption structure in Russia, 2015
Source: SOVEL LLC 2015

Russian manufacturers of printed circuit boards

- Currently, the main competitor of **Svyaz engineering KB, LLC** in the high accuracy class (6) is FSUE Ryazan State Instrument Plant. The output of products for sale to third-party customers are limited by RSIE's internal orders.
- Therefore, **Svyaz engineering KB, LLC** occupies the niche of an independent Russian manufacturer of accuracy class 6 printed circuit boards.
- The table below provides the list of independent Russian manufacturers of printed circuit boards that can potentially compete with **Svyaz engineering KB, LLC**.

| Company | City | PCB accuracy class | Max number of layers | Note |
|---|---------------|--------------------|----------------------|--|
| | Moscow | 6 | 24+ | Focus – multilayered printed circuit boards, 70% of orders from the defense sector |
| FSUE Ryazan State Instrument Plant | Moscow | 6 | 24+ | Possibility of third-party order is limited |
| Izhevsk Radio Plant LLC IRZ-Photon | Izhevsk | 5 | 24+ | Possibility of third-party order is limited |
| FEPC OJSC RPA Mars | Ulyanovsk | 5 | 24+ | 80% of orders comes from military equipment manufacturers. Currently upgrading production in order to be able to manufacture accuracy class 7 products |
| JSC NITSEVT | Moscow | 5 | 24+ | Focus – multilayered printed circuit boards, 90% of orders comes from the defense sector |
| LLC TECHNOTECH | Yoshkar-Ola | 5 | 24+ | Predominantly, orders of defense and aerospace equipment |
| LLC Rezonit, GTM-Group | Zelenograd | 5 | up to 16 | Wide range of products, focusing on printed circuit boards prototypes |
| LLC TABERU | Moscow | 5 | up to 16 | The current capacities of the plant are utilized practically to the full |
| LLC Electroconnect, PS-Electro Group of Companies | Novosibirsk | 5 | up to 16 | Planned, small-scale orders, 80% of products for civilian sector |
| JSC ELARA | Cheboksary | 4 | up to 22 | Possibility of third-party order is limited |
| JSC Technosvyaz | Yekaterinburg | 4 | up to 16 | Serial production, predominantly civilian and military appliances |
| LLC RUSALOX | Vladimir | 4 | up to 8 | Mass production of printed circuit boards, predominantly 1- and 2-sided types |
| JSC Centre of perspective technology and apparatus | Moscow | 4 | up to 8 | 90% of workload is ensured by 50 customers, suffering from staff scarcity. |

Table 4. Russian manufacturers of printed circuit boards
Source: RGG Capital analytics

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Svyaz engineering KB, LLC

Svyaz engineering KB, LLC is a subsidiary of Svyaz Engineering, CJSC incorporated in June 2010 within Dubna Special Economic Zone and represents a Research & Production Facility to develop prototypes and new technologies for production of PCBs.

In 2015, a hi-tech factory was commissioned in Dubna that develops and implements cutting-edge technologies using engineering materials to manufacture new generation printed circuit boards.

| | |
|---------------------------|---|
| Location | Dubna, Moscow region, August |
| Commissioning | 2015. |
| Business segment | complete cycle facility for the manufacturing of double-sided and multilayered printed circuit boards, oriented on prototyping, small-scale and multiproduct manufacturing. 180 – 350 employees (1 – 3 shifts) |
| Staff | 55 th.m ² of printed circuit boards |
| Estimated capacity | per year |
| Project investment | EUR 62 mn. |



| | |
|----------------------------------|-----------------------|
| Land plot | 2.4 Ha |
| Research and production building | 12,000 m ² |
| Administrative building | 725 m ² |

Peculiarities of the factory

- The Research & Production Facility Svyaz Engineering KB is located on the territory of the Technological Innovation Special Economic Zone “Dubna”.
- Production is tailored to the needs of designers and manufacturers engaged in prototyping and small-scale manufacturing.
- The Research & Production Facility project was developed to meet the requirements for the manufacturing of hi-tech and super hi-tech printed circuit boards ensuring high quality.
- In order to meet high product requirements, the factory is tooled up with equipment from the leading global manufacturers operating based on ultramodern processes.
- The facility provides the floor for R&D works, aimed at development of new technologies of manufacturing of printed circuit boards, as well as enhancement of the existing technologies, training of highly qualified process engineers and designers.
- The design of the Facility was developed by the Moscow Design Institute Ipromashprom JSC, engaged in designing machine-building and instrument-making enterprises for over 75 years.
- Good location (proximity to Moscow and research centers).

Source: Svyaz engineering KB, LLC materials, Pic. 12.
Layout of the factory in Dubna

About the company

- **CJSC Svyaz Engineering** is the parent company of Svyaz engineering KB, LLC; it is a leading manufacturer of industrial electronics and electrotechnical products at the Russian market.
- Starting from 2007, CJSC Svyaz Engineering has been actively surveying the market of printed circuit boards, the current state of the industry and competitive environment. Based on the economic and marketing survey, as well as taking own needs and related industries' needs into account, the decision was made to establish own hi-tech facility for the manufacturing of printed circuit boards.

| | |
|---------------------------------|---|
| Location | Moscow |
| Establishment date | 1997 |
| Business segment | contract manufacturing of electronics, development of radio-electronic and electrotechnical equipment for the energy sector, communications and other industries. |
| Manufacturing capacities | full cycle factory in Moscow (25,000 m ²), factory in Azov (36,000 m ²), printed circuit boards factory in Dubna (12,700 m ²) |
| Staff | around 1,000 employees |



Factory in Moscow, commissioned in 2006

Laboratory facilities equipped with ultramodern instruments and stands for R&D and DE, as well as installation and design departments are available



Factory in Azov, commissioned in 2012

Full cycle of metalworking and radio-electronic equipment production.

Pic. 13,14. CJSC Svyaz Engineering Factories
Source: CJSC Svyaz Engineering materials

SEZ Dubna advantages

- Since 2010, **Svyaz engineering KB, LLC** has been the resident of the Technological Innovation Special Economic Zone Dubna.
- SEZ Dubna offers ample opportunities for innovation business development, manufacturing of knowledge-intensive products and introduction thereof to the Russian and international markets:
 1. Transport availability;
 2. Preferential lease of land plots (building road access and utilities);
 3. Free connection to utility infrastructure;
 4. Tax benefits;
 5. Customs benefits;
 6. Concentration of a large number of Technological Innovation organizations on the territory of the SEZ.

Customs preferences

- Foreign goods, including equipment, can be imported to the territory of SEZ customs-free and VAT-free.
- At the level of value-added over 50%, the product is deemed to be manufactured on the territory of the Russian Federation (for companies that acquired resident status prior to 01.01.2012).

Tax preferences

- Contributions to extra-budgetary funds – 14%;
- Profit tax – 13.5%;
- 10-year tax holiday for land and property taxes;
- Possibility of attributing R&D expenditure to costs during the respective period



Pic. 15,16. SEZ Dubna pictures Source: <http://dubna-oez.ru/>

Production technologies

Russia's first ever

For the first time since 1991, a full-cycle facility for the manufacturing of double-sided and multilayered printed circuit boards has been created from scratch.

Unparalleled technologies

The factory is designed for the manufacturing of super hi-tech printed circuit boards, accuracy class 6. The technology envisages manufacturing of multilayered (up to 25 layers) Flex/Flex-rigid boards with metal and ceramic base.

Ultramodern imported equipment.

At design and construction stages, ultramodern technologies of utility systems, clean room facilities, environmental and fire safety systems were used. The most modern equipment from leading international manufacturers was installed.

R&D

The factory provides the floor for R&D works for the development of new technologies of manufacturing of printed circuit boards, as well as upgrading of the existing technologies, training of highly qualified specialists and process engineers.



Pic. 17,18. Pictures of factory equipment
Source: Svyaz engineering KB, LLC

Ultramodern imported equipment.

- Engineering capacities of the factory provides the opportunities of multiproduct manufacturing, including manufacturing of super hi-tech printed circuit boards meeting the most modern requirements. The factory uses the equipment from the leading world manufacturers, including **Atg Luther & Maelzer GmbH, Atotech Chemeta, Burkle, Waxco, MEC Company Ltd, PAL, Orbotech, Printprocess AG, Schmid, Schmoll**, etc., imported from Germany, Sweden, Switzerland, Israel and the United States.
- Possibility of manufacturing super hi-tech printed circuit boards, multilayered (up to 25 layers), Flex/Flex-rigid, with metal and ceramic base, boards on microwave dielectrics (Rogers, Arlon, Taconic, PTFE, Teflon).

Expansion of manufacturing capacities

- In the near future, the factory plans on expanding the assembly and clean room facilities.

Svyaz engineering KB, LLC products

- The factory was designed for the purpose of establishing **domestic production of hi-tech printed circuit boards** with multiple layers and high accuracy class properties.
- The facility is oriented on **prototyping, medium-scale and multiproduct manufacturing** of hi-tech printed circuit boards.
- The range of factory manufacturing capacities includes such categories of boards as microwave boards, Flex-rigid, with blind and buried vias, with integrated circuits.
- As of today, manufacturing of single-sided and double-sided printed circuit boards, as well as of multilayered printed circuit boards (up to 20 layers) of accuracy class 5 on aluminum base and on FR4 materials and microwave dielectrics is smooth-running.
- Currently, manufacturing capacities are being expanded in order to accomplish more hi-tech orders. Manufacturing capabilities are not limited to the properties listed above thanks to ultramodern equipment at the factory.

Key parameters of Svyaz engineering KB, LLC products

| | | |
|---|--|-------------|
| Board thickness | 0.5 – 4 mm | |
| Layers thickness | 0.086 - 1.5 mm | |
| Number of layers | up to 20 | |
| Small drilled hole used | 0.1mm | |
| Ratio of hole diameter to board thickness | D < 0.2 mm | 1:6 |
| | D > 0.2 mm | 1:10 |
| Ratio of blind hole diameter to depth | 1:1 | |
| Trace/space | | |
| Positive technology | 9 mcm foil | 75/75 mcm |
| | 12 mcm foil | 100/100 mcm |
| Negative technology | 18 mcm foil | 125/125 mcm |
| Finishing covering | hot-dip tinning, ENIG, ImmSN, Galvanic gold | |

Table 5. Key parameters of Svyaz engineering KB, LLC products
Source: Svyaz engineering KB, LLC

Examples of manufactured printed circuit boards



Picture 19



Picture 20



Picture 21

- Pictures 19 and 20 demonstrate multilayered printed circuit boards (4, 5 layers) of accuracy classes 4 and 5 with ENIG used as finishing covering.
- Picture 21 demonstrates a multilayered printed circuit board (6 layers) of accuracy class 5 with HASL as finishing covering.



Picture 22



Picture 23



Picture 24



Picture 25

- Picture 22 demonstrates a 4-layered printed circuit board of accuracy class 4 with red solder mask. Picture 23 demonstrates an 8-layered printed circuit board of accuracy class 4. ENIG is used as finishing covering of the boards.
- Pictures 24 and 25 demonstrate double-sided and multilayered printed circuit boards of accuracy class 3 with ENIG and HASL used as finishing covering.

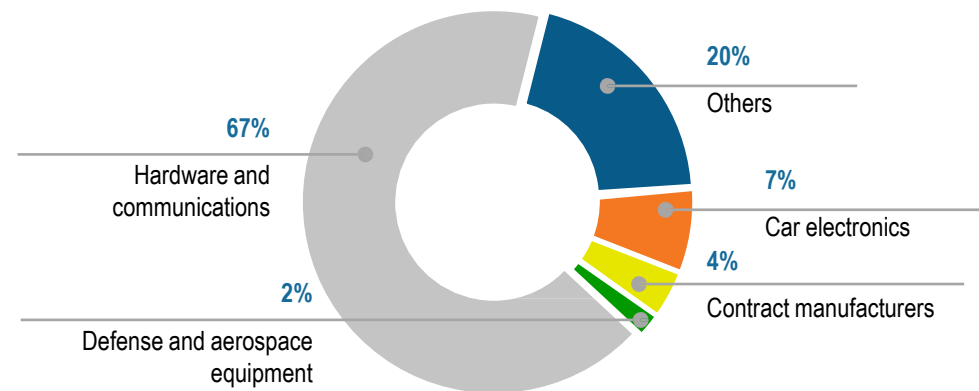
Pic. 19-25. Pictures of Svyaz engineering KB, LLC products
Source: Svyaz engineering KB, LLC

Svyaz engineering KB, LLC customers

- A consistently **high interest in factory's products** on the part of potential customers in Russia is due to obvious economy on the price of domestically manufactured boards, as well as to fast manufacturing and delivery.
- The structure of potential volume of orders of **Svyaz engineering KB, LLC** in relation to consumer segments is predominantly comprised by the orders from the communications equipment segment (67%) – power supplies, telecommunications and server hardware, data transmission.
- The Company plans on intensifying efforts on making contracts with companies from hi-tech sectors, such as robotics, aviation device engineering, space device engineering, nuclear industry, naval control systems.
- It is worth mentioning the following representatives of the factory customer base:

- | | |
|---------------------------------|---|
| ▪ OJSC Saransk Television Plant | ▪ OJSC NII Atoll |
| ▪ SPE Digital Solutions | ▪ OJSC NPF Start |
| ▪ LLC ElectroSpetsKomplekt | ▪ Microlab Electronics Company Limited |
| ▪ LLC Firm Alekto-Electronics | ▪ National Research Nuclear University |
| ▪ SKTB ES NPO Elektronika | ▪ MEPhI |
| ▪ Concord Impex Ltd | ▪ CJSC ELSY |
| ▪ CJSC NPF Dolomant | ▪ LLC GREENMAX |
| ▪ LLC ALT Master | ▪ JSC Moscow Center of SPARC Technologies |
| | ▪ LLC SI BOARDS |

Structure of potential volume of orders of Svyaz engineering KB, LLC according to segment, 2015-2016



Pic. 26. Structure of potential volume of orders of Svyaz engineering KB, LLC
Source: Svyaz engineering KB, LLC

Key representatives of Svyaz engineering KB, LLC customer base, 2015-2016

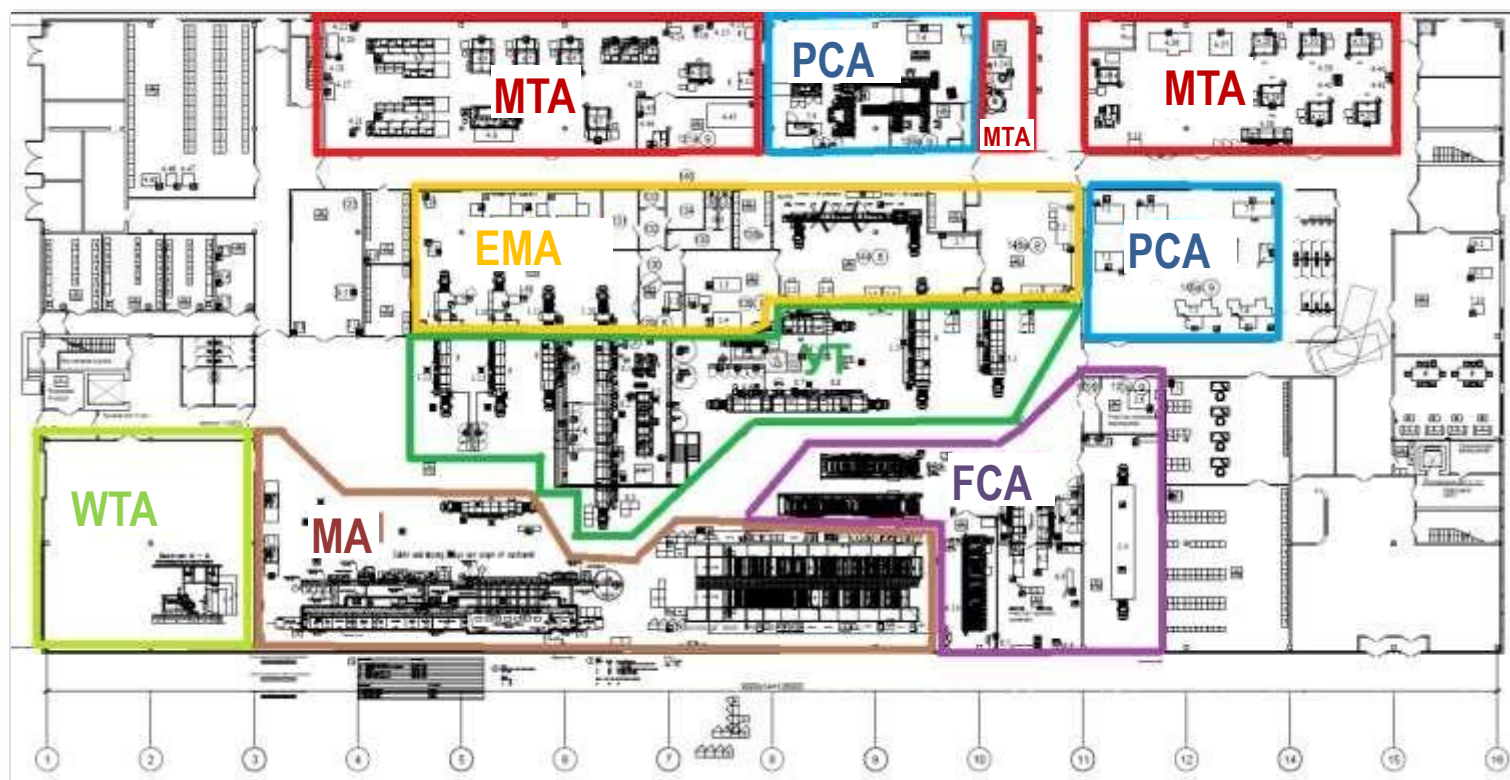


Pic. 27. Key representatives of Svyaz engineering KB, LLC customer base
Source: Svyaz engineering KB, LLC

Factory manufacturing capacities

- Total area of the printed circuit boards factory is 12 th.m².
- Estimated capacity of the factory is 55 th. m² of printed circuit boards per year, work in three shifts. Output depends on components complexity.
- At design and construction stages ultramodern technologies of utility systems, class 8-9 clean room facilities, environmental and fire safety systems were used, ultramodern manufacturing equipment from the top international manufacturers, including Schmid (Germany), Printprocess (Switzerland), Polar (United States), PAL (China), Orbotech (Israel) was purchased.
- The facility provides the floor for R&D and DE works, the primary objective of which consists in development of new technologies of manufacturing of printed circuit boards, as well as in enhancement of the existing technologies.

- “MTA” – machine-tool area
- “PCA” – press and control area
- “EMA” – exposure and masking area
- “EA” – etching area
- “MA” – metallization area
- “FCA” – finishing covering area
- “WTA” – water treatment area



Pic. 28. Schematic layout of the factory, 2015
Source: Svyaz engineering KB, LLC

I. Exposure and masking area (EMA)

- Dimensional distribution of the printed circuit board in accordance with design specifications is transferred to the material. Polymerization of required areas is accomplished by UV-radiation through a special screen. The final process is the development of the half-finished product by means of dissolving and removing the photoresist from the unirradiated areas to obtain the base of the required product.



ITC SC 3000
solder mask spray coating system
(Germany)



PrintProcess LAYUP 2 assembly-
before-pressing system
(Switzerland)



PrintProcess APOLLON-DI-A11-4/158
direct exposure machine (Switzerland)



OLEC AT30-8000 CL
exposure machine (United States)

II. Metallization area (MA)

- In this area the required surface of the printed circuit board is coated with copper. The aim of this process is to create a required current conductor. In this area the technology of horizontal metallization of printed circuit boards was used for the first time at a production line in Russia allowing to shorten the duration of the metallization cycle by 30-40%.



PAL vertical chemical galvanic line
(China)



Atotech horizontal chemical galvanic line
(Germany)



PLASMA MARCH plasma coating
machine (United States)



WISE Scrubstar deburring brushing
machine (Italy)

Pic. 29-36. Pictures of factory shop floor
Source: Svyaz engineering KB, LLC

III. Machine-tool area (MTA)

- Using the main processes of the area, the holes are made that are required for electrical connection of individual copper layers and mounts. Afterwards, the board is milled and a half-finished product is extracted from manufacturing format in this area. The area is equipped with an X-ray control system allowing to check the quality of drilling of multilayered printed circuit boards.



Schmoll SPEEDMASTER HDI 5 drilling machine (Germany)



Schmoll CUBE 6 drilling system (Germany)



Schmoll LASERFLEX laser cutting-drilling machine (Germany)



LHMT SCM 411 scriber (Germany)

IV. Etching area (EA)

- In this area chemical and galvanic processing of inner and outer layers of the printed circuit board is performed in order to obtain the final cut of the conductive pattern. Depending on the necessary – positive or negative processing technology – removal or development of resist materials and SN is performed in this area.



Schmid SES line (photoresist removal – alkali etching – metalresist removal) (Germany)



Schmid alkali dip regeneration system (Germany)



SIGMA acid dip regeneration system (Sweden)



Schmid DES line (photoresist development – acid etching – photoresist removal) (Germany)

Pic. 37-44. Pictures of factory shop floor

Source: Svyaz engineering KB, LLC

V Press and control area (PCA)

- In the process of manufacturing, the produced layers of the printed circuit board to be manufactured are subjected to quality control by means of Automatic Optical Inspection (AOI). At the pressing stage, the materials are pressed together, one upon another in accordance with the specified design, the inner layers are aligned in relation to each other and immobilized against dislocation.



Orbotech FUSION 22 automatic optical control system (Israel)



ATG A3030 adaptor-type test system (Germany)



Burkle Work Cell press system (Germany)



ATG A7a flying probe test system (Germany)

VI. Finishing covering area (FCA)

- In this area finishing covering is coated by immersion or galvanically.



ITC VDS 150C thermal hardening system (Germany)



Pentagal PENTA 550 hot-dip tinning system (Germany)



PPT galvanic gold coating system (Slovakia)



PPT ENIG and SN covering systems (Slovakia)

Pic. 45-52. Pictures of factory shop floor
Source: Svyaz engineering KB, LLC

VII. Water treatment area (WTA)

- The area houses a water and wastewater treatment facility for printed circuit boards production.



BMT – Baromembrane technologies (Russia)

Chemical analysis laboratory

- The laboratory is tooled up with devices and equipment necessary to carry out output quality control and to develop new types of printed circuit boards.



General layout of the laboratory



Microetch manufacturing

Quality Control Department

- Performance of factory's output quality control works.



Insulation resistance control



End product hole diameter control



End product visual inspections



Packaging of end products, ITC (China)

Certification and management quality system

Svyaz engineering KB, LLC boards quality, reliability and durability assurance is due to the management quality system complying with the requirements of IQNet International Certification Bodies' Association, **MS ISO 9001**, **GOST R EN 9100**, **GOST ISO 9001** standards.

Product design and manufacturing processes are controlled by the Russian and international quality management and certification system, subjected to inspections and full cycle of tests in compliance with the requirements of Russian and international standards.



In-process control

During manufacturing, the boards are subjected to automatic optical and electrical inspections, as well as to the full cycle of tests in compliance with the requirements of GOST R 55693-2013 and IPC-6012, with inspection and test results being documented.

Building relationship with customers

A special department allows to ensure prompt response to customers' complaints and claims.

Rigorous selection of suppliers

Suppliers of materials are selected thoroughly, including by means of third party audit.

Copyright protection

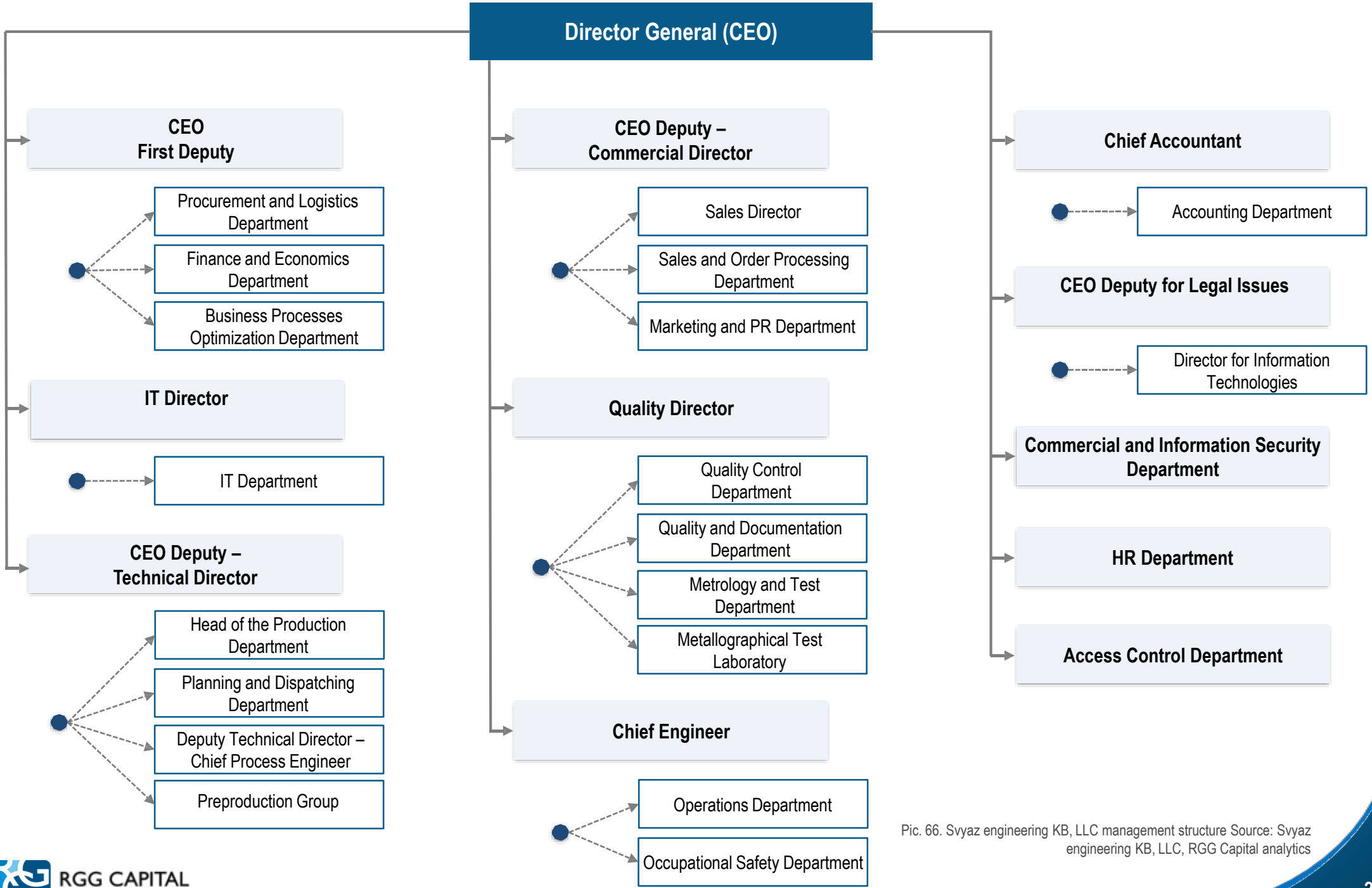
Issues of rights to intellectual property (industrial designs (prototypes) of printed circuit boards) might arise at the stage of R&E and DE and shall be settled at the level of bilateral contractual customer-contractor relations.

Full compliance with international standards

The factory has obtained all the necessary compliance and quality certificates.

Pic. 61-65. Pictures of Svyaz engineering KB, LLC certificates
Source: Svyaz engineering KB, LLC

Svyaz engineering KB, LLC management structure



Pic. 66. Svyaz engineering KB, LLC management structure Source: Svyaz engineering KB, LLC, RGG Capital analytics

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Svyaz engineering KB, LLC credit portfolio

- As of 31.12.2015, investments into the creation of the Research & Production Facility accounted for **RUB 3,075 mn.**, with 65% of the total amount of investments financed at the expense of an attracted loan and 35% financed at the expense of the founder – Svyaz Engineering KB.

Total financing

RUB 3,075 mn.

Shareholders' funds (MC)

RUB 500 mn.

Target financing (founder's loan)

RUB 568 mn.

Loan funds (at the rate as of the date of transfer)

RUB 2,007 mn.

PPF Bank loan funds

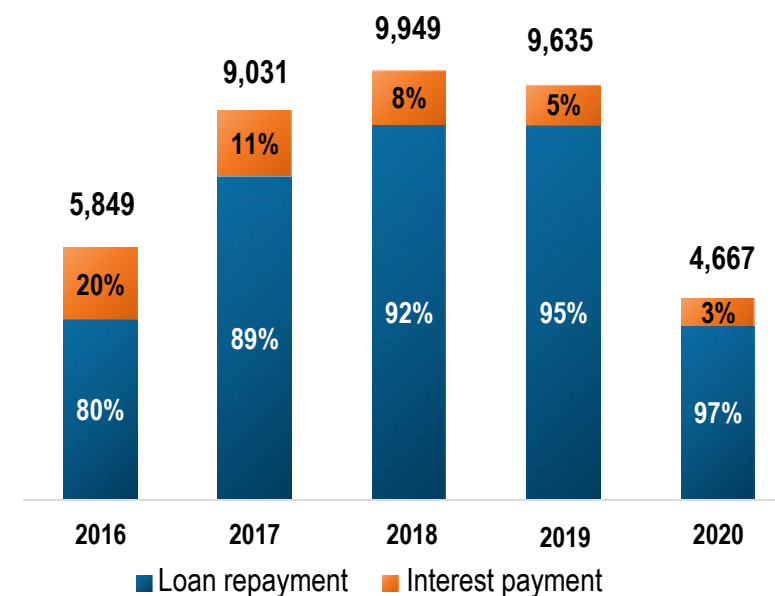
For the purpose of financing the project, in 2012 a loan agreement with PPF Bank (Czech Republic) for a credit facility for the construction of a Research & Production Facility and procurement of equipment by the General Contractor against the guarantee of the Czech state Export Guarantee and Insurance Corporation (EGAP).

- Total facility amount: EUR 39,983 mn..**
- APR: 6MEuribor+3%.
- Repayment of principal under the loan agreement is carried out on a quarterly basis from 2015 to 2020.
- Interest payments are carried out every half-year. As of 31.12.2015, the amount of the principal equals EUR 35.6 mn., there is no overdue debt.

Svyaz engineering KB, LLC shareholders' loan

- In 2012-2015, Company shareholders contributed RUB 568 mn. for the purpose of financing the project.
- Repayment of the debt with accrued interest is scheduled for late 2020 in the amount of RUB 1,171 mn.
- APR: 14.5%.

PPF Bank loan repayment schedule, mn. EUR, 2016 – 2020



Pic. 67. PPF Bank loan repayment schedule, mn. EUR, 2016 – 2020
Source: RGG Capital analytics

Factory assets

- The value of **Svyaz engineering KB, LLC** productive assets accounts for **RUB 2,761 mn.**
- The headings reflecting the major costs were divided into 3 groups listing the most expensive assets:
 1. Main manufacturing capacities;
 2. Factory infrastructure;
 3. Other assets.

Main manufacturing capacities (machinery, plant and equipment)

RUB 1,058 mn. (40%)

- Mask storage systems
- Code scanners
- Autotitrators
- Photoresist process machines
- Half-finished printed circuit boards brushing machines
- Laser cutting-drilling machines
- Solder mask spray coating system
- Direct exposure machine
- Acid dip regeneration system
- Alkali dip regeneration system
- Assembly-before-pressing system
- Solder mask final dewatering system
- Exposure machine with photomask
- Centralized chip-evacuation system
- Drilling and drilling-and-milling machines
- Optical control systems
- Hot-dip tinning systems
- Chemical and galvanic lines
- Marking machines
- Press systems
- Biocular and metallographic microscopes
- Immersion protective covering and ImmSN coating vertical lines
- Flexible spindle drilling systems
- Base hole shaping X-ray system and spectrometer
- Automated lamination machines
- Automated loading systems
- Microetch manufacturing system

Printed circuit boards factory infrastructure (buildings, structures, roads)

RUB 1,694 mn. (60%)

- Power supply, heat network and heating main
- Administrative and production facility buildings
- Runoff and household sewage system, water treatment facility
- Road
- Water supply, fire safety system
- Elevators and other lifting devices
- Control and alarm systems
- Transformer station

Other assets (computers and accessories, production and household stock)

RUB 9 mn.

- Burglar-proof safe, conference tables, mounting tables
- Server hardware (server, transceiver, data storage system)
- Floor cleaning machine
- Dust removal system
- Motor vehicle
- Computers, monitors, laptops
- Forklifts
- Beam balance
- Metal containers
- Web-site

Table 6. List of factory assets Source: Svyaz engineering KB, LLC, RGG Capital analytics

Forecast of LLC Svyaz Engineering financial performance

- As of 31.12.2015, investments into the creation of the Research & Production Facility accounted for **RUB 3,075 mn**, with 65% of the total amount of investments financed at the expense of an attracted loan and 35% financed at the expense of the founder – Svyaz Engineering KB.
- Svyaz engineering KB, LLC anticipated financial performance indicators until 2024 are provided in the table:

| mn. RUB | 2016F | 2017E | 2018E | 2019E | 2020E | 2021E | 2022E | 2023E | 2024E |
|-------------------------------------|------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Revenue | 509 | 1,528 | 1,889 | 2,410 | 2,755 | 2,914 | 3,074 | 3,243 | 3,422 |
| <i>Annual growth</i> | | 200% | 24% | 28% | 14% | 6% | 5% | 6% | 6% |
| Prime cost | 442 | 1,066 | 1,320 | 1,643 | 1,855 | 1,965 | 2,076 | 2,194 | 2,319 |
| Raw materials costs | 266 | 804 | 996 | 1,273 | 1,452 | 1,535 | 1,619 | 1,708 | 1,802 |
| Core factory personnel | 28 | 42 | 54 | 61 | 65 | 69 | 73 | 77 | 81 |
| Support factory personnel | 68 | 101 | 129 | 144 | 155 | 164 | 173 | 182 | 193 |
| Production costs | 79 | 118 | 141 | 165 | 183 | 197 | 212 | 227 | 244 |
| Gross profit | 67 | 462 | 569 | 767 | 900 | 949 | 998 | 1,049 | 1,103 |
| <i>Gross margin</i> | -30% | 16% | 18% | 22% | 25% | 25% | 25% | 26% | 26% |
| Commercial and administrative costs | 111 | 110 | 121 | 132 | 140 | 146 | 153 | 160 | 167 |
| EBITDA | -44 | 352 | 448 | 635 | 760 | 803 | 845 | 889 | 935 |
| <i>EBITDA margin</i> | -9% | 23% | 24% | 26% | 28% | 28% | 27% | 27% | 27% |

Table 7. LLC Svyaz Engineering anticipated financial performance indicators Source: Svyaz engineering KB, LLC, RGG Capital analytics

Assumptions for financial performance indicators

Printed circuit boards sales plan

- The forecast has been made based on factory maximum estimated capacity accounting for 55 th. m²/year, as well as based on the assumptions regarding the product line groups ratios acquired through marketing surveys.

Printed circuit boards pricing

- Pricing is based on average prices of LLC Rezonit as the major manufacturer in the Russian market. Further on, these prices were adjusted for the EURO exchange rate growth and inflation rates.

Prices of raw materials

- Prices of raw materials were obtained through calculations as per standard specifications and forecasted with account for the EURO exchange rate growth, as most raw materials are purchased either in foreign currency, or are indirectly currency-dependent, as well as adjusted for inflation rates. Calculation of prices of raw materials demonstrates the trend toward decline in prices in the future.

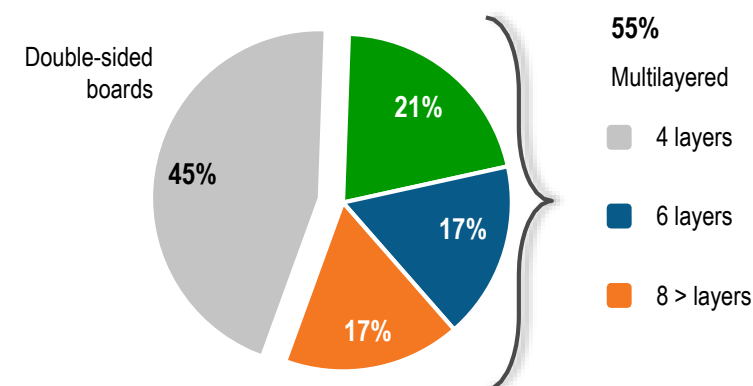
Personnel

- As of the early 2016, the number of factory personnel accounts for: 189 employees. In 2016 and in January-April 2017, the factory will be operating in 1 shift, afterwards – in 2 shifts. According to the forecast, the number of personnel will reach 301 employees by 2024.

Tax payments

- When calculating tax receipts to the budgets of all levels, the following tax benefits for SEZ Dubna were accounted for:
 - 10-year property tax holiday starting from registration (expires in 2025);
 - 5-year land tax holiday for the first 5 years after registration of ownership;
 - Reduction of the profit tax rate down to 13.5% (for the first 5 years until 2015);
 - 5-year transport tax holiday for the first 5 years.

Sales forecast for various types of printed circuit boards 2016



Pic. 68. Sales forecast for various types of printed circuit boards, 2016
Source: Svyaz engineering KB, LLC

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Investment proposal

Company manufactures printed-circuit boards. Its production package is unique for Russian Market. Factory unit with up-to-date imported equipment was commissioned in 2015.

Segment: Manufacturing of electronic components

Country: Russia

| (mn. RUB) | 2016E | 2017F | 2018F | 2019F | 2020F | 2021F | 2022F | 2023F | 2024F |
|---------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Revenue | 509 | 1,528 | 1,889 | 2,410 | 2,755 | 2,914 | 3,074 | 3,243 | 3,422 |
| EBITDA | (44) | 352 | 448 | 635 | 760 | 803 | 845 | 889 | 935 |
| EBITDA margin | (9%) | 23% | 24% | 26% | 28% | 28% | 27% | 27% | 27% |

Investment project: The factory was constructed in order to get domestic production of multilayer printed-circuit board with high precision class on the track, it was set in operation in 2015. Production area of 2.4 ha includes research and manufacturing complex with a total area of 12 thous. sq. meters and administrative building with the area of 0.7 thous. sq. meters, which meet highest process standard.

Location: Special economic zone in Moscow region
Commissioning: August 2015

Business segment: a full-cycle facility for the manufacturing of double-sided and multilayered printed circuit boards

Estimated capacity: 55 000 m² of printed circuit boards per year



Manufactured printed-circuit cards: single-sided, two-sided, multilayered (up to 25 layers), flexible, metal-based and ceramic-based flexible-hard cards. Corporate development plan includes manufacture of printed-circuit boards with build-in components.

Technology: at design and construction stages, up-to-date technologies of utility systems, clean room facilities, environmental and fire safety systems were used.

All the necessary arrangements are provided for performing **Research & Development (R&D)** and **Development Engineering (DE)** works aimed at developing new technologies of manufacturing printed circuit boards and enhancing the existing technologies. Quality management system meets the requirements of International Association of Certification authorities **IQNet**, standards **MS ISO 9001**, **GOST R EN 9100**, **GOST ISO 9001**.

Team: the company management and top team are highly skilled professionals with vast experience in electrotechnical sector. The staff was trained abroad by the equipment manufacturers. Staff: **about 200 people**.

Clients: the main clients of the factory are manufacturers of telecommunication equipment, auto electronics, as well as military and aerospace engineering.

Some clients of the Company:



Investment highlights:

- **Up-to-date factory in Russia** manufacturing printed circuit boards with imported equipment set in operation in 2015;
- The quality of product corresponds to the level of quality provided by the worldwide known external suppliers due to existence of in-house **R&D** and laboratory;
- Possibility of manufacturing advanced hi-tech quality printed circuit boards of a wide range;
- **Location** of the factory within **special economic zone** - lower tax rates, duty-free entry of the equipment and no VAT.