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Volume of investments required – \$ 20 million

Summary

1. **Production** – mobile programmed hardware control system for operation resource of technical objects (turbines, buildings, pipelines, etc.) and system-based appropriate services:
 - a) rotor balancing for multiple-seated power plants;
 - b) durability evaluation for engineering structures.
2. **Trade marks** – none.
3. **Sales 2007** –\$20 ths.

Company profile

Date of establishment – ZAO Vektornye Systemy was established in 2006 for the purpose of developing safety systems (resource monitoring) for technical objects based on 3D vector vibropacks produced by REM-vibro company (2002), which measure vibration parameters in a single point within the accuracy of a phase. At present its own sensors for 6D monitoring are designed. This allowed setting vibro-acoustic metrology up to the level of reliable quantitative measurements. A concept of vector vibration analysis is formulated, gas compressor units (GCU) monitoring for OAO Gazprom is completed, a system for data processing and visualization of the results is designed, requirements to mobile system for diagnostic monitoring of mechanical systems are formulated.

Description and value of capital assets – \$ 50 ths. Programmed hardware system for vector-phase reconstruction of wave deformation fields. Assembly workshop for production of vector vibropacks. A set of vibro-acoustic metrological and calibration tests.

Previous rounds of investments – private investor \$ 70 ths (2008).

Signs of public recognition – the Winner of the Competition of Russian Innovations (2005); the Winner of the Competition “Fundamentals of Engineering Sciences” RFFI (2006); Laureate of the Competition “Best Native Measuring Appliance”, etc.

Publications:

Sensors and Systems, No. 1, 2006 / publ. VAK. Vector vibration analysis – the technology of the XXI century.

Proceedings of Academy of Military Sciences, vol. I, 2008. Reconstruction of deformation fields in tasks for providing safety of mechanical systems.

Engine, No. 2. P. 24-46, 2008 / publ. VAK. Innovation abilities of programmed hardware reconstruction of deformation fields for diagnostic monitoring of power units for gas transport systems.

Number of employees: 5 persons.

Structure of ownership

Natural persons:	100%
3 persons	30% each
4 th person	10%
Aggregate share of government property	0%

Team

Orbachevsky Leonid Sergeevich – Director General, 58 y.o. Graduated from H.E. Bauman MSTU, Candidate of technical sciences, Master of technological management ANE, Academician of Russian AMTS. Developer of a professional standard for managers in the field of innovations.

Speransky Analoly Alekseevich – Head of Research, 62 y.o. The author of the concept “Vector vibro-acoustic metrology”. Graduated from S. Ordzhonikidze Moscow Aeronautical Institute, expert in the field of in-line simulation of aeronautical systems and operation of electric power installations.

Zakharov Konstantin Lvovich – Chief Designer, 52 y.o. The author of the concept “Vector-phase hydroacoustics” and the method of measuring full rotary-translational mechanical oscillations. Graduated from M.V. Lomonosov Moscow State University, Candidate of physical and mathematical sci. The leading expert in the field of underwater sound systems.

Production

A customer wishes trouble-free operation of power installations, engineering structures, etc. He wants to know durability (lifetime up to failure), the reason for vibration and reduce its amplitude in power installations (turbines) or reduce the engine noise (aircraft, for example). So, it is desirable to have an information and measuring system (programmed hardware system), which in the conditions of technical object operation on a real-time basis may indi-

cate a place of origin of vibration, excessive strain of the material (even short-term), in-service defects (fatigue cracks) etc., and, as far as possible, indicate their reasons and protection methods.

To-day, vibration monitoring systems are designed on 1D sensors, which are low informative and reducing vibration amplitude by up to an order of magnitude. The mobile programmed hardware system allows for solving these tasks by measuring 6 components of the deformation field in selected points to an accuracy of phase ratios. The services suggested are vibration adjustment and assessment of endurance of mechanical systems:

- 1) power installations and mechanisms converting energy to motion and vice versa (engines, turbines, compressors, generators, pumps, etc.);
- 2) power static structures, buildings, foundations, bearing structures, pipelines, bridges, tunnels and other components of natural and technical systems.

Compared with the known monitoring systems, the use of the system suggested increases reliability of estimate of the endurance by several times.

Priority for the vector-phase "Method of monitoring of machines and facilities" (reg. No. 2008115291 dated 22.04.2008) and Device for measuring full rotary-translational mechanical oscillations is declared.

Analogous devices do not allow measurements of all required components of deformation field in one point based on phase relations. The sensors suggested precede analogous ones by accuracy, frequency and temperature parameters. As a consequence, the data processing and visualization system gives the unexampled information volume.

Current state

A prototype of PHS RDP is designed, manufactured and tested by OAO Gasprom. A short-scale production of vector vibropacks is organized. A series of vector vibropacks of special application (high-temperature, seismicity sensitive, underwater sound, etc.) is to be developed. Test balancing of multiple-seated rotor was successfully performed. A lot of sensors are off-loaded to Aviaprom enterprises. A preliminary agreement for balancing of multiple-seated rotors (Atomash) is achieved. There exists a concernment of MChS (Russian Federation Ministry of emergencies) in monitoring of engineering structures.

Development strategy

Use of funds

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|---|-----|
| 1. R&D (Development and modification of sensors and mobile system for 6D monitoring, system adapting for Customer purposes) | 30% |
| 2. Acquisition of fixed assets (instrumentation stand Bruel & Kjer, processing equipment, special computers) | 10% |
| 3. Marketing | 20% |
| 4. Acquisition of current assets (manufacture of mobile systems, provision of services of vibration adjustment, balancing and monitoring) | 30% |
| 5. Other (IP protection, metering device settlement, change of schedules) | 10% |

Prospective outcome of investment

Establishment of certified full-scale production of vector vibropacks and derived mobile systems. Organization of vibration adjustment services for complex power installations and dynamic monitoring of structures. Individual solving of trouble-free operation problems for power installations and engineering structures.

Marketing and markets

The mobile system using 6-component sensors allows for monitoring and forecasting of endurance of production induced hazardous objects. Just in Russia, their registered number is over 1 million. The world market volume exceeds tens of billions USD. Providing a novel quality of monitoring (information value and reliability), the suggested technology will expel the older technology both in Russia and abroad.

In respect that comparable measuring elements and processing systems are absent, we plan to narrow the world leaders (for example, Bruel & Kjer) and, in prospect, to occupy 20-30% of the world market of monitoring systems. The forecast for the nearest 5 years is \$ 200 mln.

Market entry strategy: Updating and modification of the mobile system (2 years). Development of applications based on the mobile system and rendering of services: vibration adjustment, balancing, endurance monitoring, etc. Production and sales of certified series of measuring elements and mobile systems. Handling safety problems for the Customer.

Interaction with investor

We are ready to deliver 20% share. At the moment of investor withdrawal, the value of this share will be not less than \$ 200 mln.

Financial characteristics, \$ thousand

Data	Facts			Forecast	Forecast with the investment required			
	2005	2006	2007	2008	2009	2010	2011	2012
Sales	-	-	20	50	500	5 000	50 000	200 000
Operating income	-	-	-	5	100	1 000	10 000	40 000