NEURON SOUNDWARE

# Explore how

we recognize broken machines using sound

# Neuron soundware works with market leaders

*We are proud to cooperate with amazing partners and well-known companies.*

Neuron soundware is accelerated by Plant 4.0, Plug and Play,
Bind 4.0, Airbus Bizlab, and SAP Industry 4.0.

*You cannot plan production efficiently without predicting unpleasant events in operations. Early diagnostic tools are crucial for managing any modern utility company. That is why we believe Neuron soundware technology has contributed to our reliable operation*

**Tomas Pleskac**

Vice Chairman of the Board of Directors of ČEZ and Chief Renewable Energy and Distribution Officer

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# Neuron soundware offers its proven AI-based monitoring platform

**30** company members

**4** years in operation

**€ 6+ Mill.** investment raised

*Our artificial intelligence software recognizes abnormal noises from both regular machine hum and surrounding sounds. The automated sound analysis represents the next level of predictability. The solution enhances industrial assets operation as well as manufacturing process quality.*

**Pavel Konecny**
founder and CEO of Neuron soundware

## Take a look at our journey

### 2016

- founded by Pavel Konecny in Prague
- named “Idea of the Year 2016” in the Czech Republic for their solution combining AI and IoT

### 2017

- € 600,000 investment by J&T Ventures
- featured in Forbes Next

### 2018

- classified as “Cool Vendor in Acoustic Technologies for Predictive Maintenance” by Gartner
- won 3rd place in the CEE startup competition Power Up! by InnoEnergy

### 2019

- € 5.75 million investment by investment funds – Inven Capital (ČEZ Group) and Lead Ventures (MOL Group)

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## Don’t rely on people to notice there is something wrong

Operators can usually tell if the machine doesn’t sound right. But they are not always around, and have other responsibilities to attend to.

## Without Neuron soundware

Humans aren’t always present, paying attention, and possessing the right knowledge. Also, their tools aren’t always the most trustworthy ones.

### Tools

- Human ears
- Experience
- Intuition

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# Increase productivity with AI-based predictive maintenance services

Developed for machine protection, our digital ears and brain allow you to fix machines before they break. Make your work easier with artificial intelligence technology.

## With Neuron soundware

Sensors record audio data, which is then automatically evaluated by AI.

### Tools

- Automatic data collection
- Artificial Intelligence prediction
- Continuous analysis

### Results

- Failures or abnormal behaviors of machines detected
- Production breakdowns prevented
- Remote monitoring

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# All-in-one software for predictive maintenance by Neuron soundware

Let our AI-based platform discover abnormal behaviors and predict malfunction

### Service activation

Everything goes quick and easy – we do our best to ensure smooth installation and operation of our solution.

### End-to-end solution

Our technology applies to many types of machines, such as engines, compressors, pumps, turbines, robots, and many other types of equipment.

### Analytics and monitoring platform

The users diagnose machine conditions in real-time, manage system alerts, and browse, search, listen to, visualize, and label recorded audio data.

### Extensive database

Our solution is built on top of an extensive recording database of warning sounds. We also design a scalable infrastructure capable of processing high volume data.

TensorFlow Keras docker

kubernetes Google Cloud

### Solution benefits:

- Real-time asset monitoring
- Early warnings of machine failures
- Improved overall equipment effectiveness (OEE)
- Continuous service improvement
- Possibility of fully autonomous offline mode
- Friendly visual dashboards
- Advanced edge computing
- Available on all devices (mobile, tablet, laptop, and desktop)

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# A suite of hardware products to complete the solution

Whether you need a standalone device or a pocket-sized soundcard with a mobile app, there is a gadget for you.

## nBox – recording & edge computing device

*Let the smart device monitor the machines for you*

Install this standalone device on any asset and start the automatic audio monitoring. The device records sound, and uses edge computing to run complex machine learning algorithms. It prevents failures without the need to transfer data to cloud storage.

### Key features:

- processor with Chip RK3399, 6x ARM Cortex, 1.2 GHz
- ARM Mali-T860MP4 GPU
- 2 GB RAM
- 32 GB eMMC storage
- connectivity provided via Wi-Fi, 3G/4G, and Ethernet
- power supply via 12–18 V DC with 2.5 A load
- consumption of 660 mA DC
- uses piezo, airborne, condenser, and ultrasonic sensors/microphones, and MEMs accelerometers

## nCard – mobile recording gadget

*Listen to your machines anytime, anywhere*

Record the machine's sound into your mobile phone via the nCard gadget, and use the Android app to upload it to the cloud for real-time analysis.

### Key features:

- audio quality 20–22 Hz
- 2x mini XLR connector as sensors input
- connection provided by USB 2.0 port
- Android mobile app
- app saves recordings as FLAC audio files (supports any external USB microphone)
- app uploads via mobile networks (Wi-Fi/LTE) and supports offline recording

## Sound sensor – our standard sensors

*Leverage our sound recording experience*

When working on standard projects, we use durable piezo-microphones. This structure-borne sensor moves in correlation to the machine's motion, which results in a voltage signal. For temporary installations, we provide the suitable cable version and wireless modification.

### Key features:

- piezo-ceramic element with high measurement sensitivity
- records audio frequency 7–30 kHz
- compact design
- high-temperature durability from -40°C to 150°C
- cables connecting the edge device are up to 50 m long and contain an built-in amplifier
- removable and mounted easily via a glued bolt or neodymium magnets

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# Neuron soundware's technology applies to various types of assets and services

We offer a wide range of industry-tailored solutions in both areas: heavy-duty and manufacturing.

## HEAVY-DUTY

### Energy & Electricity
- CHP units
- Wind turbines
- Transformers

### Engines & Turbines
- Diesel engines
- Electric enginest
- Turbines

### Pumps & Compressors
- Rotary
- Progressing cavity
- Piston and others

### Cranes
- Tower
- Port
- Mobile

### Robotics
- Industrial robots
- Brakes & engines
- Arms and tools

### Transportation
- Point machines
- Escalators
- Conveyor belts
- Warehouse

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## MANUFACTURING

### Packaging
- Shrink-wrap machines
- Filling machines
- Labeling machines

### Printing
- Press and print
- Laminators
- Trimmers

### Food processing
- Portioning machines
- Cutting machines
- Conveyor belts

### Textiles
- Spinning machines
- Weaving machines
- Cutting machines

### Plastic and rubber
- Cutting machines
- Injection-moulding
- Blow-moulding

### Metal and wood
- Cutting
- Sawing
- Sharpening
- CNC machinery

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# See some examples of quality issues we work on

Neuron soundware's quality control solutions are a natural ally to quality and maintenance departments.

## Manufacturing process monitoring

Sometimes workers or robots cannot make quality checks of each manufacturing step on the fly. Our solution hears those steps and evaluates whether they have been completed successfully.

**For example, we monitor sound events of manual/robotic steps in car assembly:**

- POPP clamp closing
- Electrical connector plugging
- Seal insertion into car body
- Robotic drilling and chip extraction
- Robotic hammering

### Completed!

*We designed acoustic checks to make sure the drilling stops when the chips aren't extracted properly. Our alert system is set up to ensure the production team is notified when chip extraction gets interrupted.*

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## End-of-line Testing Solutions

EOL Testing is usually performed by human operators or sound recording systems combined with human supervision. That often results in an error and consequent unpredictable costs. The AI-driven method enhances the accuracy of these checks.

**For example, we monitor EOL testing of combustion engines, automotive sub-assemblies, and home appliances:**

- Roof systems
- Door systems
- Windshield wipers
- Refrigerators

### Completed!

*Electric motors of the windshield wipers were made and assembled together with the gear mechanism, so they needed thorough monitoring. We standardized and enhanced the human detection of faulty ones via two sets of acoustic checks.*

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# Neuron soundware provides Solution as a Service

Take a look at how the start of our cooperation goes and what value you get, within just a few weeks.

## 1 Installation and Device Activation

- Order online
- Receive hardware and installation manuals
- Install sensors and IoT devices (self-install or with our direct support)
- Verify internet connectivity and activate the system

## 2 Data Collection and Algorithm Calibration

- Obtain an initial set of recordings, both regular sound and anomalies
- Activate user accounts in Neuron soundware's portal, validate and label data
- Receive a calibrated version of the algorithm to start the monitoring service

## 3 Ongoing service

- Enable notification channels for your staff (e-mail, text message)
- Receive algorithm updates as more data is collected and labeled
- Discuss and plan progress with our customer support

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# ROI Calculator

We also offer you a tool to find out about your Return on Investment into the Neuron soundware solution.

## Neuron soundware assists you in many areas

- Equipment and energy costs
- Maintenance labor costs
- Availability for production
- Increased safety
- Reputation risk
- Wrench time
- Revenue impact

## Example of the ROI acknowledged by a Neuron soundware's client

Reduced losses of more than € 100,000 annually by avoiding unplanned downtime. Earned at least € 75,000 by minimizing the time spent on maintenance. Added other savings, and it came to over € 200,000 in total costs saved.

**With a relatively low investment in the monitoring solution, the annual return was 20x the initial cost!**

## Too good to be true?

Ask for our ROI Calculator, and see how it is.

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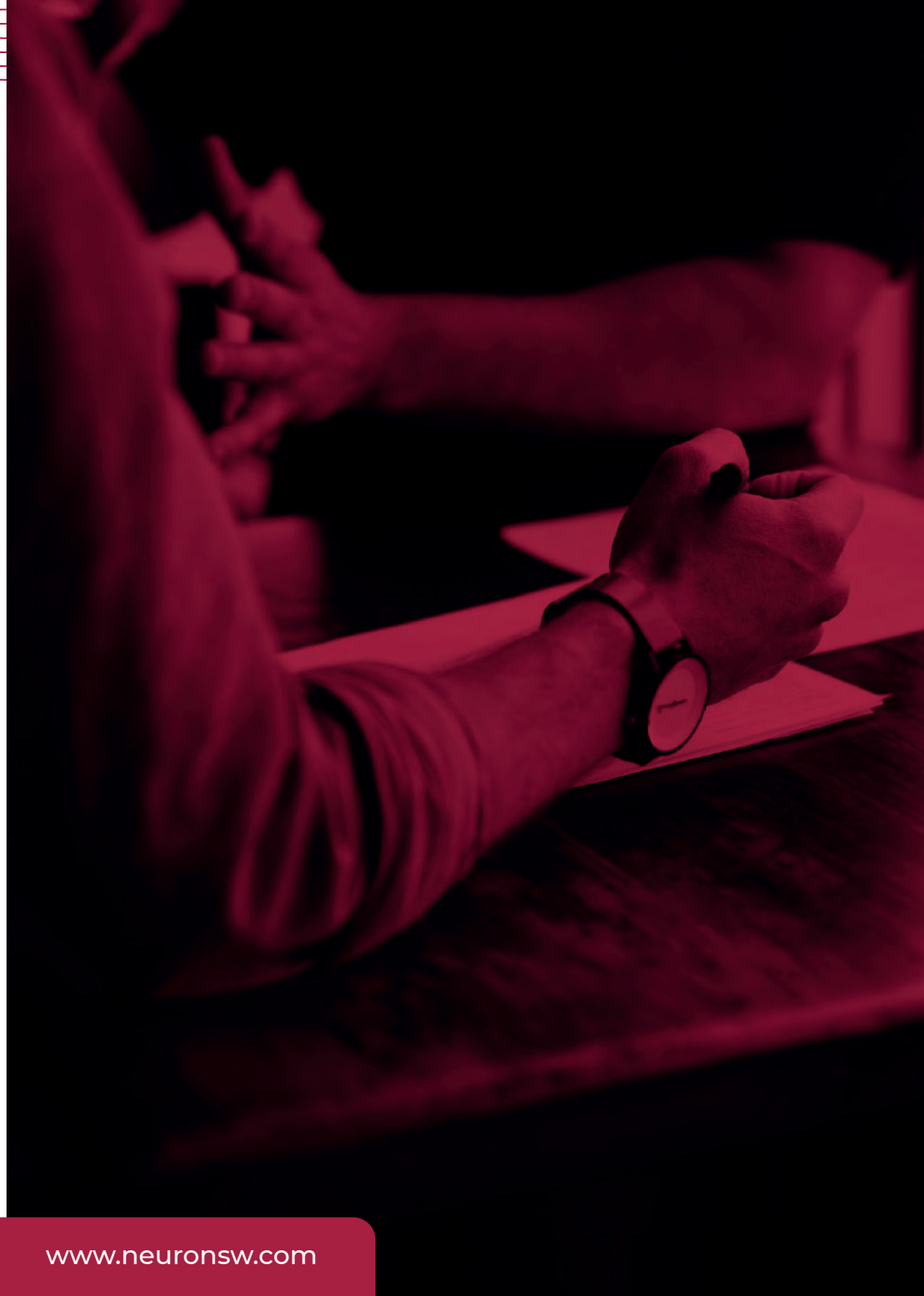
**Neuron soundware's**
**Acoustic Academy**

# Unique solution for unique projects

Is your project quite specific and you aren't sure if we can help? Yes, we can.

No matter how different your project is, Neuron soundware can take care of it. Both our team and our technology are flexible, and we enjoy new challenges.



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# Neuron soundware's Acoustic Academy

Do you have an asset or process with any acoustic or vibration attributes that would be better off under control?

Our acoustic services for predictive maintenance are designed for cooperation with OEMs and customers interested in medium to long-term development.

**The Acoustic Academy's iterative development approach consists of the following key steps:**

1 → 2 → 3 → 4

### Data Acquisition

- Record data for the agreed time (or supply an external source of ready-to-use data)
- Check data integrity and interpret major events (label data where possible)
- Simulate anomalies/failures where possible

### Data Exploration

- Apply unsupervised learning and analyze
- Match labels and time stamps
- Test and evaluate pre-trained algorithms

### Algorithm Development

- Decide on the best ML approach
- Design and train the algorithm
- Test and optimize learning

### Algorithm Deployment and Validation

- Measure performance on test data
- Deploy the algorithm in an online dashboard
- Validate algorithm in real conditions

We provide our expertise and experience in acoustics, hardware, and software development – as well as data science and machine learning development towards achieving the goals set out by the Academy plan.

**All you have to do is get in touch with us and apply.**

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Want to explore possible cooperation?

# Let us know!

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