



The **world's first** tool, which analyzes **product and process curves** on the basis of **artificial intelligence** for failure analysis and troubleshooting actions as well as to control and optimize products and processes.



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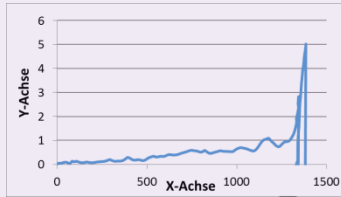


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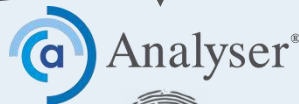
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Overview: The functionality of Analyser®

Product and process curves from sensor data



| Bauteil-Nr. | Merkmal X1 | Merkmal X2 | Merkmal X3 | weitere... |
|-------------|------------|------------|------------|------------|
| 10001 | 1200 | 12039.93 | 48.12 | |
| 10002 | 1176 | 11750.58 | 48.52 | |
| 10003 | 1230 | 11979.17 | 48.47 | |
| 10004 | 1206 | 12019.68 | 48.50 | |
| 10005 | 1212 | 11979.17 | 48.08 | |
| 10006 | 1188 | 11747.68 | 48.42 | |
| 10007 | 1170 | 11770.83 | 48.48 | |
| 10008 | 1212 | 11979.17 | 48.47 | |
| 10009 | 1224 | 12051.50 | 48.34 | |
| 10010 | 1230 | 11345.49 | 47.97 | |
| 10011 | 1218 | 11319.44 | 48.13 | |
| 10012 | 1272 | 11388.89 | 47.93 | |

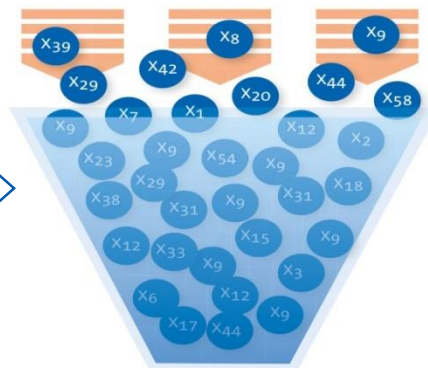


Our **patented**,
statistical **algorithm**

Self-learning based on
Artificial Intelligence AI

statistical
fingerprint

≥ 200 influencing variables X_i are possible



Controlling the relevant
influencing variables

Multiple non-linear
functions

$$Y = f(X_i)$$

X_9 X_{54} X_6

Significant influencing variables X_i

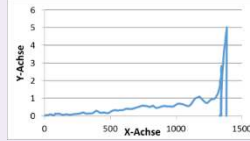
Failure types → cause-effect relationships → root causes → measures / solutions + recommendations for action + process control in real time

Overview: The advantages of Analyser®

Input

(Database / ME-System)

Process and product curves from sensor data



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Module Curve Analysis

- » Analyzes all **(sensor-) data** and recognizes **failure types** from product validation and process curves **fully automatic** and **in real time**
- » Offers **causes of failures**, **solutions**, **measures** and **recommendations for action**
- » **Supports** your employees to **solve problems**, reduces **failure rates** and **project duration**
- » The system for **preventive and reactive failure analysis** for robust products and processes

Module Transfer Function

- » For the first time, it detects unknown **cause-effect relationships** between requirements and influencing variables, which can be presented as **individual values** and **curves**
- » **Controls** and **optimizes** the **product** and **process parameters** based on the cause-effect relationships
- » Provides a **real-time** fulfilment of requirements and creates a **robust product** and **process design** through optimal **parameterization** and **tolerancing**
- » Processes **small series of measurements** and **large amounts of data** in **prototype** and **series production**

Increases **resource efficiency** through **failure prevention** in the areas of rework, warranty costs, warranty risks, material consumption, reject products, production and energy costs

- » **Automates** a **proven practice** in determining the cause-effect relationships for **robust products** and **processes**
- » Requires a **very little** Teach In / machine learning expenditure
- » Reduces over **50% of the failure / rework costs** and **warranty risks** even at steady series productions within 6-9 months
- » **Shortens** the project duration for process optimizations from the usual 2-3 months to only **8-10 hours**
- » Saves **expert knowledge** about products and processes in terms of failure types and cause-effect relationships in a transparent way and it is **accessible/ usable for everyone**



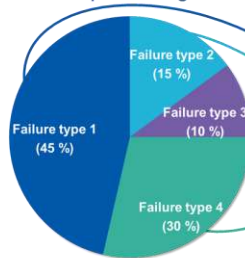
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Chart with failure types
and percentages



**Book of Knowledge -
Failure types + Root Causes**

| Failure causes | Failure types (Priority provided by Analyser) | | | | | | | | | |
|-----------------------|---|-----------------|-----------------|-----------------|-----------------|-----------------|-----|-----------------|--|--|
| | Priority | Failure cause 1 | Failure cause 2 | Failure cause 3 | Failure cause 4 | Failure cause 5 | ... | Failure cause n | | |
| Failure type 1 (45%) | 0,45 | 3 | 9 | 3 | 1 | 1 | ... | 9 | | |
| Failure type 2 (15%) | 0,15 | 9 | 3 | 3 | 1 | 1 | ... | 3 | | |
| Failure type 3 (10%) | 0,10 | 3 | 3 | 9 | 3 | 1 | ... | 1 | | |
| Failure type 4 (30%) | 0,30 | 3 | 1 | 9 | 1 | 3 | ... | 1 | | |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| Failure type n (...%) | 0,... | 1 | 3 | 3 | 9 | 3 | ... | 1 | | |
| Technical importance | | 3,9 | 5,1 | 5,4 | 1,2 | 1,6 | 0 | 4,9 | | |

**Book of Knowledge -
Root Causes and solutions / actions**

| Failure causes | Solutions / actions |
|-----------------|---------------------|
| Failure cause 1 | Solution 1 |
| Failure cause 2 | Solution 2 |
| Failure cause 3 | Solution 3 |
| Failure cause 4 | Solution 4 |
| Failure cause 5 | Solution 5 |
| ... | ... |
| Failure cause n | Solution n |

Priority of **Root Causes**

Priority of **solutions / actions**

It also creates an important contribution in **securing** new **products** and their **manufacturing processes**

- » Ensures **functional** and **robust products** and **processes**
- » Ensures **quality** and **reliability** of the products
- » Verifies **reliability & durability**
- » Automatically ensures **testing** and **control**, statistical process control

As soon as data is available, **all product validation & process curves** and **sensor data** can be processed in the Analyser®, e.g.:

Screw joints

- » Torque curve [Nm] over angle of rotation [°] with tightening strategies in several stages

Pressing processes

- » Force [N] by way [mm]

Acoustics / NVH & vibration issues

- » Vibrations, NVH issues (sound pressure level [dB] by number of rotations [rpm])
- » Acoustics and noise optimization at power trains
- » Sporadic noise issues at e.g. chassis & damper elements

Control & Control engineering products / SMD Lines

- » Absorption curves / angles of radar sensors for autonomous driving systems

Hysteresis loops

- » Materials engineering: stress-strain diagrams
- » Valves: Force [N] by way [mm] at certain waypoints and F_{\max}
- » Control engineering

Component constructions

- » Adhesive, cohesive and peel forces = f (viscosity, temperature, width / height, etc.)

Plastic injection molding

- » Pressure [Pa, bar, psi] by time [s] or way [mm]
- » Temperature [°C, °F] by time [s] or way [mm]
- » Optimization of the open / closed loop control technology

Extrusion of plastics / rubber

- » Profile geometry, hardness, force-elongation coefficient = f (X_i)

and many more...



5 Steps to fully automatic Causes Analyser®



Production and assembly processes

Digital monitoring and storage of process parameters and their curve characteristics.

Data interface, user interface

Flexible data interface to import curve data (online or via database).
Graphical user interface to display curve characteristics with their individual parameters.

Standard interface to standard sensor data and controls:
Analyser® ⇔ IPM 6.0 from CSP, our partner.

Book of Knowledge

Stored causes of failure, recommended measures and solution proposals to fix the failures (optional).

Effort: about 2 days for start filling

Teach-In process


One-time storage of curve specific expert knowledge for different failure types or other irregularities.

Effort: 10 - 20 min per new job sequence

Failure cause analysis

Automated analysis of the entire input data and identification of the occurred failure types. Graphic presentation of the results with failure type percentages and prioritized causes and measures / solutions (optional via Book of Knowledge).

Real time: 1 - 2 sec. from transmission of sensor data, up to presentation of failure types + measures



Implementation of Analyser®



- » **Practical**, client-based **installation** at the place of value creation
- » No extensive, company-wide software-roll-out necessary
- » Installation and integration into existing database systems / systems for sensor data recording usually in **less than a week**
- » Only about **2-3** man-days are required for the initial filling of the knowledge database, because after it the Analyser® saves the expert knowledge in a self-learning way
- » Afterwards, the **first projects** and work sequences can be analyzed and optimised **by your employees**

Do you have any questions or do you need more information?

We are glad to advise you in detail on your topics and projects.

Just contact us and visit us on our homepages:

Consulting & Engineering Services: www.mts-contech.de

Analyser® for Robust Design: www.contech-analyser.de



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