Enabling the Digital Twin for Mechatronic Systems with Electrified Component Data

Joachim Frank
Managing Director Zuken E3 GmbH, Ulm
# 40 Years of Success and Innovation in Electronic and Electrical Engineering

<table>
<thead>
<tr>
<th>Founded</th>
<th>1976</th>
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<tbody>
<tr>
<td>Revenue Year ended March 2018</td>
<td>23 582 000 JPY / ~185M EUR</td>
</tr>
<tr>
<td>Corporate Headquarters</td>
<td>Yokohama, Japan</td>
</tr>
<tr>
<td>European Headquarters</td>
<td>Munich, Germany</td>
</tr>
<tr>
<td>North American Headquarters</td>
<td>Westford, Massachusetts</td>
</tr>
<tr>
<td>Stock Listing</td>
<td>Tokyo Stock Exchange Level-1</td>
</tr>
<tr>
<td>Employees</td>
<td>1,200</td>
</tr>
<tr>
<td>Operational Excellence</td>
<td>Profitable, no debt</td>
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</table>

**Zuken Inc.**  
Worldwide Headquarters  
Yokohama, Japan

**Zuken GmbH**  
European Headquarters  
Munich, Germany

**Zuken USA Inc.**  
North American Headquarters  
Westford, Massachusetts
Zuken is an engineering-driven organization focused on customer value

<table>
<thead>
<tr>
<th>Six Development Centers</th>
<th></th>
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<tbody>
<tr>
<td>R&amp;D Headquarters</td>
<td>Yokohama, Japan</td>
</tr>
<tr>
<td>SI and EMC</td>
<td>Paderborn, Germany</td>
</tr>
<tr>
<td>Electrical and Fluid</td>
<td>Ulm, Germany</td>
</tr>
<tr>
<td>Automotive and Transportation</td>
<td>Erlangen, Germany</td>
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<tr>
<td>PCB and Routing</td>
<td>Bristol, United Kingdom</td>
</tr>
<tr>
<td>Advanced Packaging</td>
<td>San Jose, California, USA</td>
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<table>
<thead>
<tr>
<th>Development and Support Engineers</th>
<th></th>
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<tbody>
<tr>
<td>Worldwide Staffing</td>
<td>500</td>
</tr>
<tr>
<td>Average Tenure</td>
<td>&gt; 10 years</td>
</tr>
</tbody>
</table>

Engineering Resources

- **40%**

R&D Investment

- **25%**
What we do
Markets and industries

We provide software and services for electronic and electrical product development

- Industrial Machinery
- Consumer Electronics
- Power
- Life Sciences
- Automotive / Special Vehicles
- Railway
- Aerospace
- Military / Defense
Enabling the Digital Twin for mechatronic systems with electrified component data

- Cable harness, control cabinet and fluid development based on mechanical and electrical information
- Complete digital information for production, documentation and commissioning
- Production-oriented development without prototype construction
- (Component-) Data are the foundation
- Introduction of the E3 component Cloud
Industry trends

- In the Automotive industry
  - CASE: Connected, Autonomous, Shared/Service, Electric

Changing from “Car manufacturer” to “Mobility service company”
Industry trends

- In the Machinery industry
  - IoT, Industry 4.0, Smart Factory

Factory which autonomously perform optimal production = CASE
Industry trend: Digitalization

Business Digitalization

Creates new values and business opportunities

- Corporate Management
- System Planning
- Production
- Sales/Marketing
- Value
- Business Strategy
- Product Development
- Logistics
- Support/Service

Technologies
- IoT
- Industry 4.0
- Industrial Internet
- AI / BigData
- Digital Twin
- Cyber Physical System
- etc.
Mechatronic System Design

- mech. position number
- el. product designation
- -M1
- 901
To realize “Business Digitalization”

- Systems & Wiring design information have to be digitalized as part of “Digital Twin”
Regarding the entire product development process there are two main things to keep in mind when working with both E-CAD and M-CAD. They are the…

- Installation of panels and mounting plates
- Wiring and cable harness creation
Digital Twin in Electrical Engineering

- Control cabinet development based on mechanical and electrical information
Harness design process with E³.formboard

- Example

- E³.schematic
- E³.cable
- E³.formboard

E³.3DRouting Bridge

Import

Cable harness structure

E³.HarnessFlattening

2D

XML

ZUKEN definition of XML file

3D

XML

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Fluid Design with E³.fluid

- **E³.fluid**
  - For hydraulics, pneumatics, lubrication and cooling
  - Complete solution easy to use

- **Complete documentation**
  - Fluid plan
  - Specific reports
  - Production documentation
  - Customer documentation
  - Manufacturing and service
Cabinet Layout with E³.panel

- **E³.panel**
  - For Cabinet layout and wiring
  - Complete solution easy to use

- **Layout module for E³.schematic and E³.cable**
  - 2D / 3D cabinet layout
  - Automatic routing
  - Manufacturing integration
    - Labeling
    - Strip- cut- and mark machines
    - Drilling and milling
    - Specific reports
Nailboard Drawings with E³.formboard

- **E³.formboard**
  - For scaled nailboard drawings
  - Complete solution easy to use

- **Layout module for E³.cable**
  - Specific sheet layouts
  - Automatic functions
  - Manufacturing integration
    - Labeling
    - Strip- cut- and mark machines
E³.series – The Electrical Engineering System for all Industries

- Automotive
- Motorcycle
- Agriculture machinery
- Construction machinery
- Aerospace
- Rolling stock
- Boats and ships
- OA machinery
- FA machinery
- Production facility
- Industrial plant
- Others (Electrical equipment)
Digital Manufacturing

- Tool for exporting templates with drill holes and cutouts in DXF format from E³.panel
  - DXF format can be imported by numerous machining centers for further processing
  - Can be displayed in E³.series
Digital Manufacturing

- **Labeling**
  - Print labels
  - Integrated labeling systems

- **Wire manufacturing with bundling**
  - Add pin terminals
  - Print source / destination pin
  - Create wire bundles

- **Milling and drilling**
  - Create specific configurations
Assisted Wiring: E³.WiringCockpit

- Paperless wiring
- Highlighted wires
  - Current wire
  - Wire in chain
E3.series is based on Components

- Work with complete and proofed data
- E³.series is able to check based on these data e.g.
  - Wire size - > cross-section on physical pin
  - Count of connected wires
  - Collision control in cabinet
  - ...
- Easy creation of BOM
Digital Data boosts wire production

- Example: Komax automatic crimping machine TopConvert
Component Cloud Data Quality – What to expect

- **Component**
  - Material Master data
  - Technical data
  - Properties and classification aligned to eCl@ss

- **Symbols**
  - Electrical Schematic Symbols based on IEC 60717
  - fluid schematic Symbols based on ISO 1219
  - Formboard symbols in original and scaled views

- **Models**
  - 3D Models
  - Enabled for automated routing
  - With STEP and DXF views
E3 Component Cloud – Who is Who

Providing high quality one-stop Component Service powered by:

**CADENAS**
- Parts management for mechanical CAD and E3.series
- > 500 Manufacturer catalogues available
- Parts are sponsored by manufacturers
- tool chain for engineering and sourcing

**ECAD-PORT**
- Standardization of E3.series components
- Component database creation service
- Supporting manufacturer and users in E3.database
- Global network of E3.series service suppliers

**ZUKEN**
- E3.series: Electrical wiring, control systems and fluid engineering software
- Component based and object orientated system with powerful check capabilities
- World wide sales and support

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Keeping track of Component lifecycle –  
What kind of support is delivered by CADENAS?  
- Product Change Notifications possible? -

**1st Case:**
- Downloading components from Component Cloud
- No business relationship in place between cloud and user
- Updates can be triggered manually

**2nd Case:**
- PARTsolutions with Component Cloud functionality as enterprise solution in place
- Regular catalogue updates by CADENAS possible
- PARTmanagement as single source of truth for all material using systems in enterprise communicates also PCNs
E3.Component Portal