



# Transportation Edition Off-highway and Special Vehicles

Electrical design and documentation  
for the off highway and special vehicles industries



## Introduction

Off-highway or special vehicles are the modern-day work horses often involved in safety or time-critical operations. The industry is diverse and consists of multiple market sectors; agricultural with tractors and combine harvesters, construction with trucks and backhoes and public service vehicles with fire trucks and buses.

The challenges faced by electrical and fluid engineers in this sector are similar to the mainstream automotive sector; the vehicles consist of a chassis with all the usual electrical requirements but they also contain control systems for the specific features such as hydraulics for backhoes and fire trucks or drives and sensors found in combine harvesters.

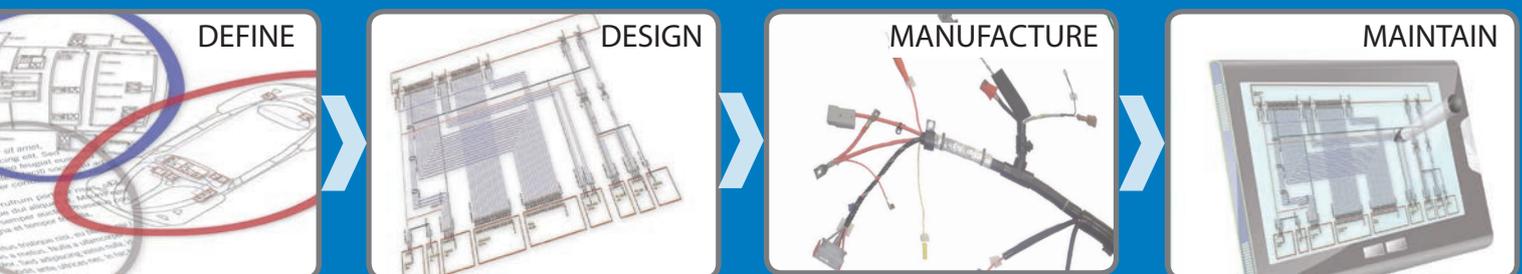
The industry often works closely with its supply chain for the development and delivery of its harnesses. This presents challenges in the transfer of data and the communication of production requirements.

Zuken's E<sup>3</sup>.series is used for documenting and detailing electrical and fluid projects. Its flexibility supports the entire design process, from definition and design, through manufacturing and maintenance. Its unique architecture ensures that all stages are fully synchronized.

E<sup>3</sup>.series has been chosen and successfully adopted by hundreds of special vehicles OEMs worldwide who appreciate its design process flexibility and ability to integrate with existing processes.

### Common challenges

- Quality documentation
- Creating full digital mockups
- Producing field service documentation
- Supply chain integration
- Mixed electrical and fluid design



“ In the same way that our vehicles are highly customizable, so is the functionality within E<sup>3</sup>.series that allows us to realize this. ”

Graeme Shields, Design Manager, Emergency One

## Define

### Parts management

To control and manage parts used in the vehicle, E<sup>3</sup>.series comes with its own parts library, has its own library and data management system and has links to all major PLM systems.

### Electrically aware parts library

Intelligent parts libraries help drive the design, with automatic part selection and real-time design rule checks to prevent errors.

### Centralized parts library

Centralizing parts libraries enables customers to control which parts are used in designs, avoid duplication, and ensure consistent quality. With the library stored in Oracle or Microsoft SQL and using standard replication tools, companies with multiple sites ensure parts libraries are consistent between locations. For smaller design groups, E<sup>3</sup>.series comes complete with an out-of-the-box Microsoft Access database.

### Upfront planning with topology design

With E<sup>3</sup>.topology engineers can begin their designs at an architectural level, sketching their ideas at the system level which later feeds into the detailed design. Sheets created in E<sup>3</sup>.topology can represent chassis or complete vehicles and the connections represent harnesses. Alternate configurations can be quickly checked and reports detail the harnesses, including cost and weight estimates.

## Design

### Links to manufacturing

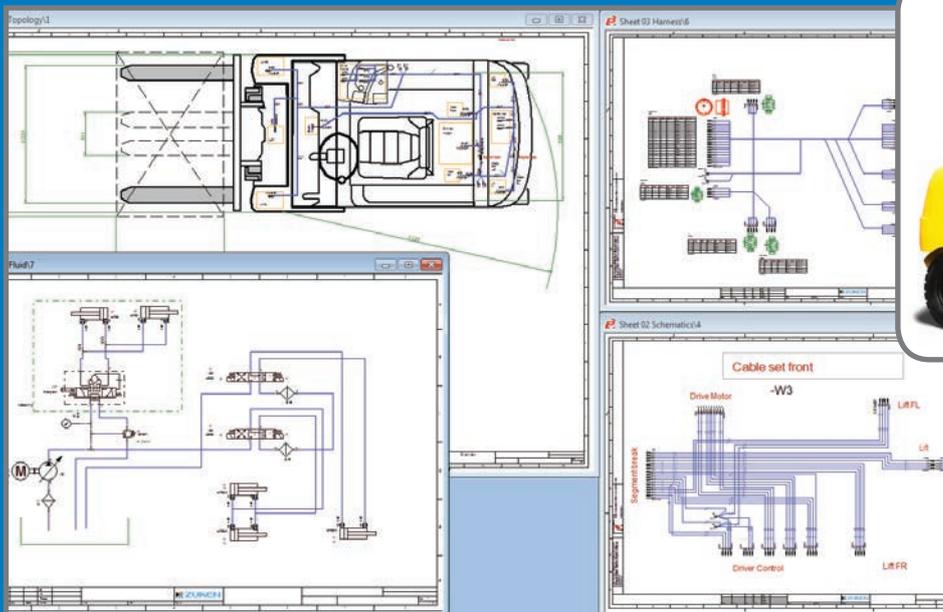
With its unique object-oriented architecture, E<sup>3</sup>.series ensures that detail added anywhere in the design filters through to production. Schematic, harness or panel designs are all views of the same information; a change in one is immediately reflected across all, ensuring accurate information passes from design through to manufacturing.

### Mixed electrical and fluid

E<sup>3</sup>.series facilitates combined electrical and fluid design. Intelligent sheet types control what type of symbols are used on each sheet ensuring the correct placement of electrical, fluid and mechanical elements. Icons in the device tree keep track of what is used or available. Changes to the device properties in either the electrical or fluid schematic are reflected across both systems, and users can easily navigate between them.

### Intelligent block designs

To cater for increased use of ECUs in the industry, E<sup>3</sup>.series provides special block functionality. Blocks can either be predefined or created dynamically on the fly. They represent components, black boxes (such as ECUs), or with the use of hierarchy, entire systems. For ECUs or PCBs (supplied externally or developed in-house) blocks can be dynamically controlled by PCB applications such as CR-5000, where changes to signal and connector information will automatically update the block.



Integrated topology,  
schematic and fluid  
design

# Design

## MCAD integration

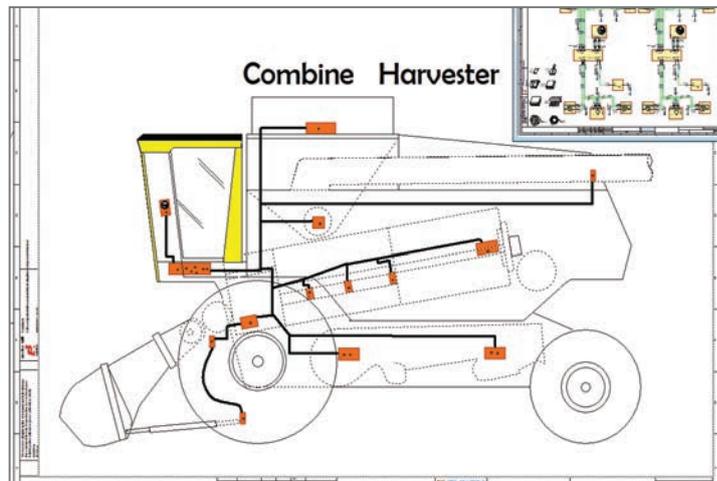
E<sup>3</sup>.3D Routing Bridge enables companies to integrate their electrical harness designs with all major MCAD solutions. Electrical harness details such as connectors, terminals, splices and netlists are transferred to the MCAD system where harness engineers route the cables in the 3D mechanical space. The length and structure of the harness is transferred back into E<sup>3</sup>.series where the final details are compiled for manufacturing.

## Variants and options

For companies whose vehicles contain variants and options, E<sup>3</sup>.series allows users to combine all variants and options into a single project, then configure a complete design including all documentation, manufacturing outputs and bills of materials. For more complex requirements, the E<sup>3</sup>.series packages and configurations utility allows designers to configure their options via a configuration interface.

## Design verification

The increasing complexity of vehicle design and excessive cost of field repairs mean an intensified effort is needed to get things right during the design phase. E<sup>3</sup>.series supports this process through its integration with MCAD systems for full digital mockups and electrical verification. For full simulation, E<sup>3</sup>.series integrates with Synopsys Saber.

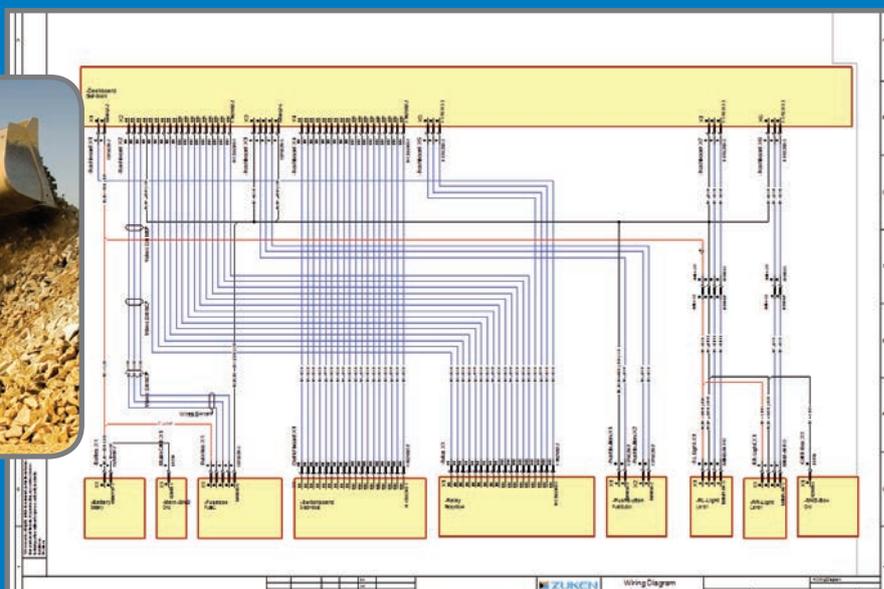


Topology module linked to schematic

## Integration between electrical and mechanical engineering

Supported MCAD tools:

- Autodesk Inventor
- Dassault CATIA V5
- PTC Creo Direct
- PTC Creo Parametrics
- Siemens NX
- Siemens SolidEdge
- SolidWorks 3D CAD



# Manufacture

## Harness creation

Whether carrying out build-to-print or working with your supply chain, E<sup>3</sup>.series will accelerate your harness creation. Alternate views of connectors and splices are laid out on either a 1:1 scaled formboard sheet or on a cable layout sheet. Changes to either the schematic, cable or formboard design are immediately reflected across the entire project. Automatic part selection at the design phase ensures accurate details are passed to manufacturing, placing the focus on designing products, and not on tool usage.

## Panel design

Working in either two or three dimensions, E<sup>3</sup>.panel enables engineers to layout components inside panel enclosures. Intelligent automatic snapping points ensure parts are easily placed in the correct location. With keep-out and height restrictions, component clashes are avoided.

E<sup>3</sup>.panel+ autoroute feature automates wire routing within the panel based on the connectivity from the schematic. Once routed, various outputs are available, including links to automatic wire preparation machines.

## Review and markup

To assist in the prototyping and manufacturing phases, E<sup>3</sup>.view and E<sup>3</sup>.redliner allow installation and production teams to reference native E<sup>3</sup>.series projects. E<sup>3</sup>.redliner is an intelligent markup tool that uses special view-only documents for its annotations. Markups are loaded back into the native E<sup>3</sup>.series project and an intelligent search feature helps designers navigate to each note and recommendation.

## Tracking change

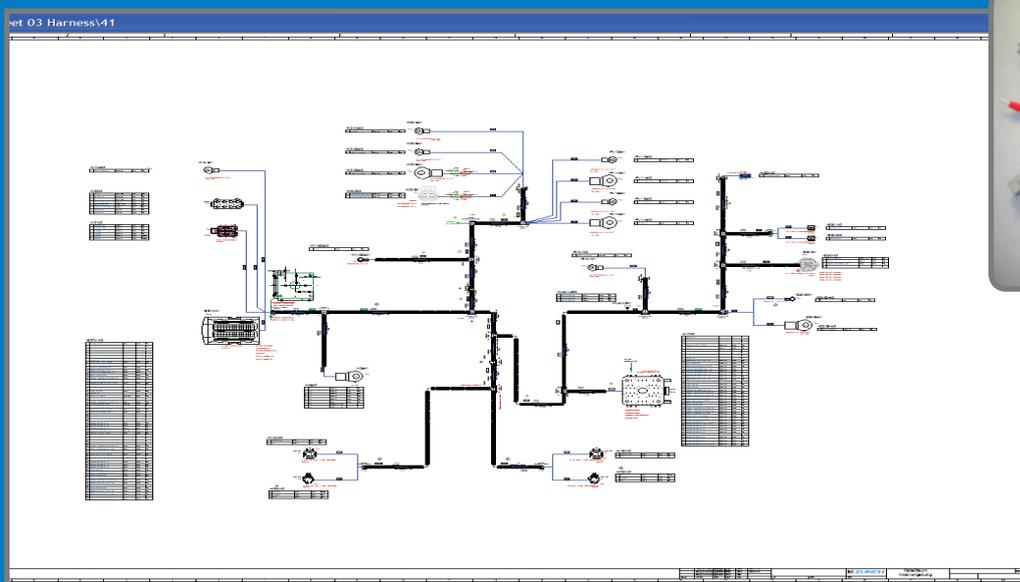
E<sup>3</sup>.Revision Management allows users to track changes that occur through all phases of the product lifecycle. Complete projects and sub-projects are passed through release or pre-release stages and locked down to prevent modification. E<sup>3</sup>.Revision Management records all graphical and textual changes, keeping a history of each change. The resulting data can be incorporated into the engineering change process.

## View and markup

- Create read-only view files
- View and print native E<sup>3</sup>.series files
- Markup field changes in E<sup>3</sup>.redliner
- Back annotate changes to the master project
- Jump-to functionality

## Panel manufacturing

- 1:1 scaled panel drawings
- Dynamic links to schematic
- Restricted area support
- Automatic wiring
- Shortest path algorithm
- Wire segregation
- Ducting fill degree



1:1 scale harness documentation

# Maintain

## Service documentation

In most cases the final phase of electrical project is the creation of service documentation – detailed schematic and wiring diagrams supplied to service outlets and field engineers. This work often requires a complete redraw of the wiring diagrams. Using the design data from E<sup>3</sup>.series, it is possible to automate the creation of these documents.

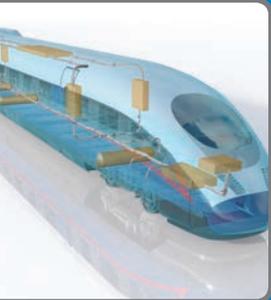
Alternate views of schematic data held in E<sup>3</sup>.cable enable the creation of wiring diagrams used for fault-finding and diagnosis. E<sup>3</sup>.view and E<sup>3</sup>.viewer Plus allow engineers to trace and highlight signals and wires out in the field. Technical service groups can highlight circuits and print out sections of the design to send to customers. The versatility of E<sup>3</sup>.series allows you to get your customers out of the garage and back in the field quickly.

# E<sup>3</sup>.series Industry Editions

Specially configured electrical design suites to meet the needs of key industries, E<sup>3</sup>.series Industry Editions evolved through working with key customers in each of these sectors and contain functionality core to these industries.

## E<sup>3</sup>.series Industry Editions:

- Machinery
- Mil/Aero
- Power
- Railway
- Systems
- Transportation



# E<sup>3</sup>.series Transportation Edition

## E<sup>3</sup>.cable

Enhanced functionality for designing cables and cable harnesses. Different views of the design enable specific documents to be created for production, start-up and service.

## E<sup>3</sup>.Extended Connector Handling

Standard connector representations for the automotive industry, showing continuation lines, backshell connections and block graphics.

## PDF Output

Produces intelligent, multi-sheet PDF design outputs, with full project structure and built-in hyperlinks.

## E<sup>3</sup>.step AP212/KBL Output

Part of the Vehicle Electric Container (VEC) standard, STEP AP212/KBL creates the exchange format of a vehicle wire harness between OEMs and their suppliers.

## Options

### E<sup>3</sup>.enterprise

The multi-user option for E<sup>3</sup>.series; allows multiple users to access the same project simultaneously with built-in access control and workflow capabilities.

### E<sup>3</sup>.EDM

Zuken proprietary library and data management system for managing native E<sup>3</sup>.series library and project data and documentation.

### E<sup>3</sup>.formboard

Creates build-to-print detailed 1:1 harness designs; linked dynamically to E<sup>3</sup>.schematic drawings.

## E<sup>3</sup>.Functional Design

For creating system functions and their effects. Links logical schematic designs into functional diagrams and enables basic harness structuring.

## E<sup>3</sup>.HarnessAnalyzer

Enables OEMs to collaborate with their suppliers effectively. View and analyze harness drawings in the standard HCV container data format.

## E<sup>3</sup>.panel

For general arrangement drawings of cabinet enclosures. Work in either 2D or 3D, place devices, cable ducts and mounting rails and prepare panels for manufacture.

## E<sup>3</sup>.panel+

Includes all of the functionality of E<sup>3</sup>.panel plus an automatic panel routing feature with a shortest path algorithm, segregation, and duct fill controls.

## E<sup>3</sup>.redliner

Markup documents in a protected read-only copy of the design. Playback and jump to all recommended changes in the master design.

## E<sup>3</sup>.Revision Management

Document all physical and graphical changes between design iterations. Automatically produce engineering change order documentation.

## E<sup>3</sup>.3D Routing Bridge

Transfer wire, cable and cable harness information to 3D MCAD systems. After routing, individual wire length data is transferred back to E<sup>3</sup>.series.

## E<sup>3</sup>.topology

Evaluate system harnesses early in the design flow for factors such as length, weight and cost. Enables tradeoff analysis of harnesses and sub-harnesses to optimize manufacturing, performance and cost.

## E<sup>3</sup>.view

Free-of-charge viewer for all E<sup>3</sup>.series projects and special viewer files.

“ I’ve been involved in harness design for a couple of years and have always dreamed of a process like this, and it’s paying off big time. ”

Yves-Michel Thibeault, Director of Engineering, A. Landry Fabrication

## About Zuken

### The Challenge.

More quality, more functionality, in less time, with less cost; it's a common story in today's market place.

The increased competition and requirement to operate on a global scale make these end-user demands ever more challenging to meet. So companies need to be innovative and dynamic to stay one step ahead of the game – this is where Zuken can help.

### What we do.

Zuken is a global provider of leading-edge software and consulting services for electrical and electronic design and manufacturing. Founded in 1976, Zuken has the longest track record of technological innovation and financial stability in the EDA and ECAD software industry.

The company's extensive experience, technological expertise and agility, combine to create world-class software solutions. Zuken's transparent working practices and integrity in all aspects of business produce long-lasting and successful customer partnerships that make Zuken a reliable long-term business partner.

### Security of Solid Foundations.

Zuken is focused on being a long-term innovation and growth partner. The security of choosing Zuken is further reinforced by the company's people – the foundation of Zuken's success. Coming from a wide range of industry sectors, specializing in many different disciplines and advanced technologies, Zuken's people relate to and understand each company's unique requirements.

For more information about the company and its products, visit [www.zuken.com](http://www.zuken.com).

# The Partner for Success

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Find out more  
about our  
Transportation  
Edition