Case study: Cluster HMI - from prototype to production-ready

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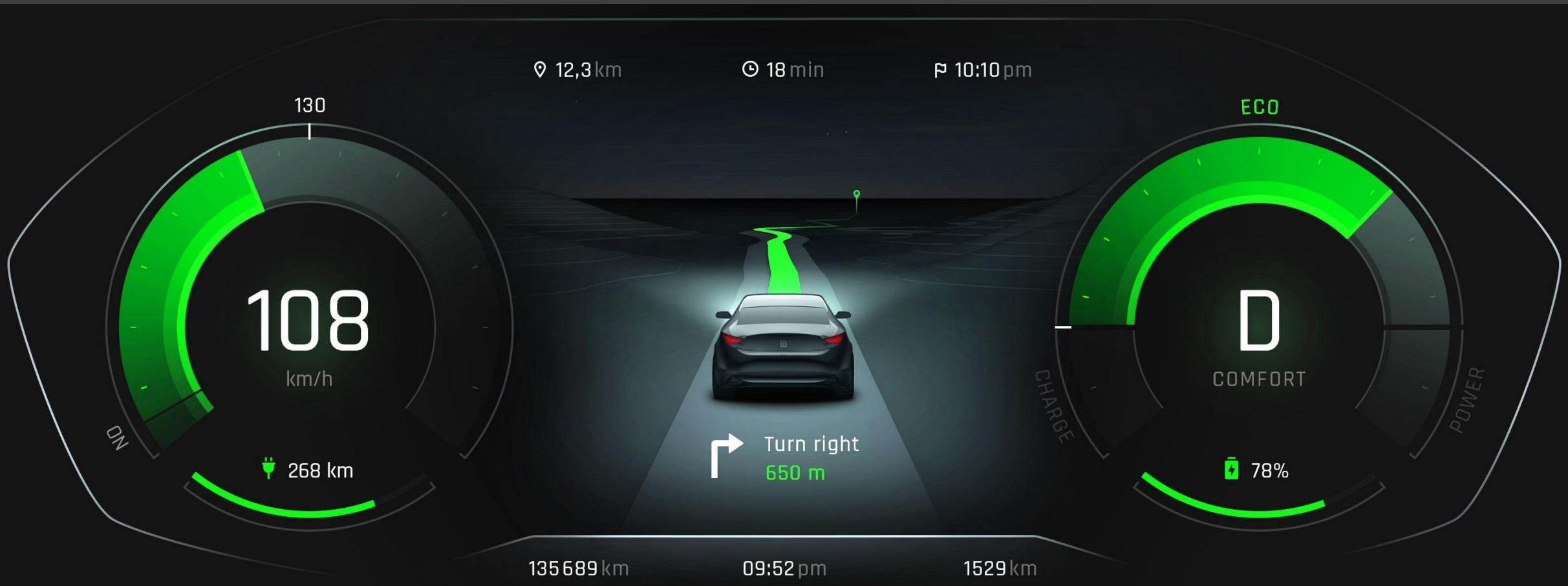


About Elektrobit (EB)

Technical competencies

EB's technical core competencies are development of automotive-grade (software) products and engineering services.

Global presence

Development and business offices in Austria, China, Finland, France, Germany, India, Israel, Japan, Romania, and USA.

Employees

More than 2200 employees* worldwide. Spans three continents and ten countries.

Continental AG

Wholly owned, independent subsidiary of Continental AG.

Consistent growth

Average growth (CAGR) > 10 %

100+ million

Over 100 million vehicles on the road and one billion embedded devices.

*May 2018, incl. Argus, excl. e.solutions.

Driving technology further — products & solutions

Automated driving

- Hardware and software products for development, test, visualization, and validation.
- Key software components to bring automated driving functions and systems to serial production.

Vehicle infrastructure

- AUTOSAR standard
- Single- & multi-core OS
- Functional safety OS
- Embedded security
- Automotive networks, e.g. Ethernet

Connected car

- Intelligent big data analytics & online diagnostics
- Scalable backend infrastructures
- Cyber security solutions plus modular add-ons by Argus
- Software updates over the air

User experience

- Navigation client for connected use cases
- Electronic horizon provider enabling map-based ADAS functions
- Model-based development of multimodal user interfaces
- Augmented reality solutions

Consulting services

- Consulting services for functional safety and software architectures
- Lean software development
- Established agile processes

Verification and validation

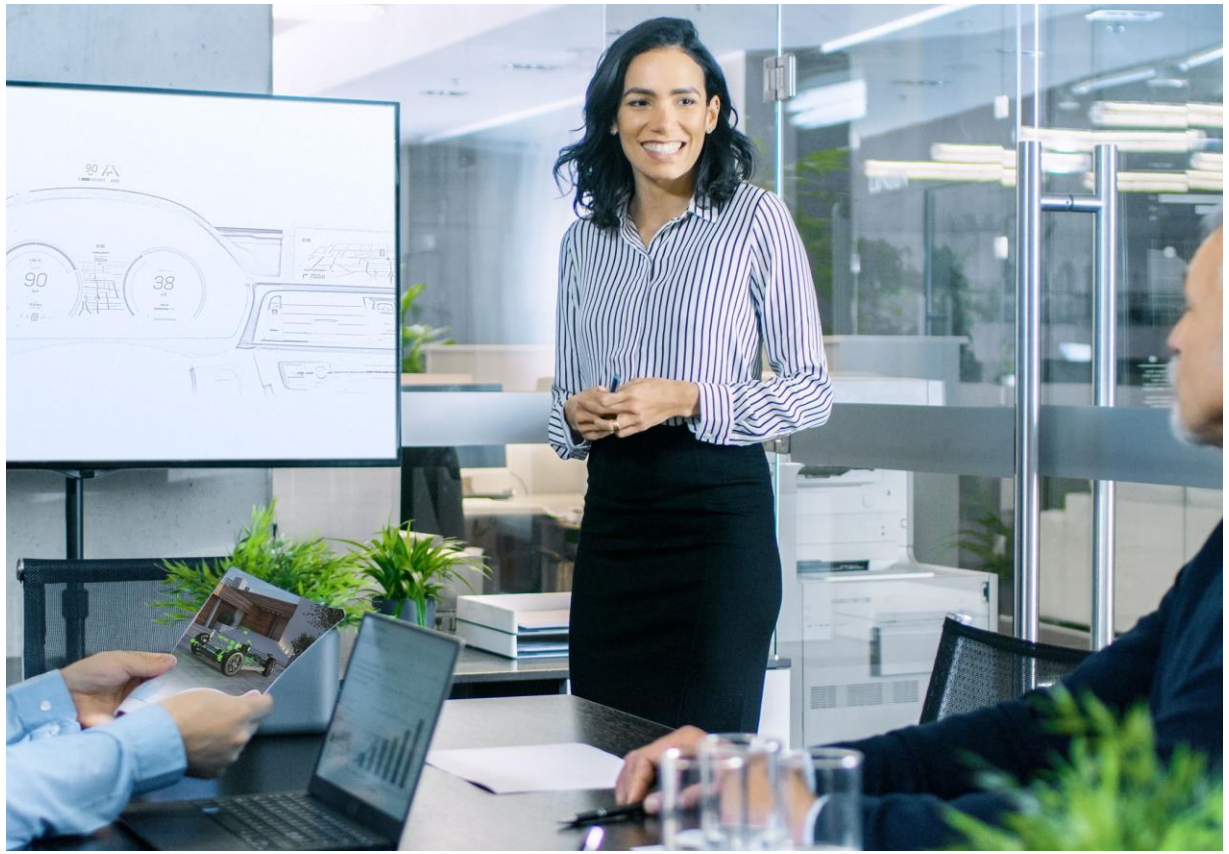
- End-to-end testing of complex embedded software systems
- Test concept development
- Independent verification and validation of software systems

The prototype

Cluster instrument HMI project kick-off

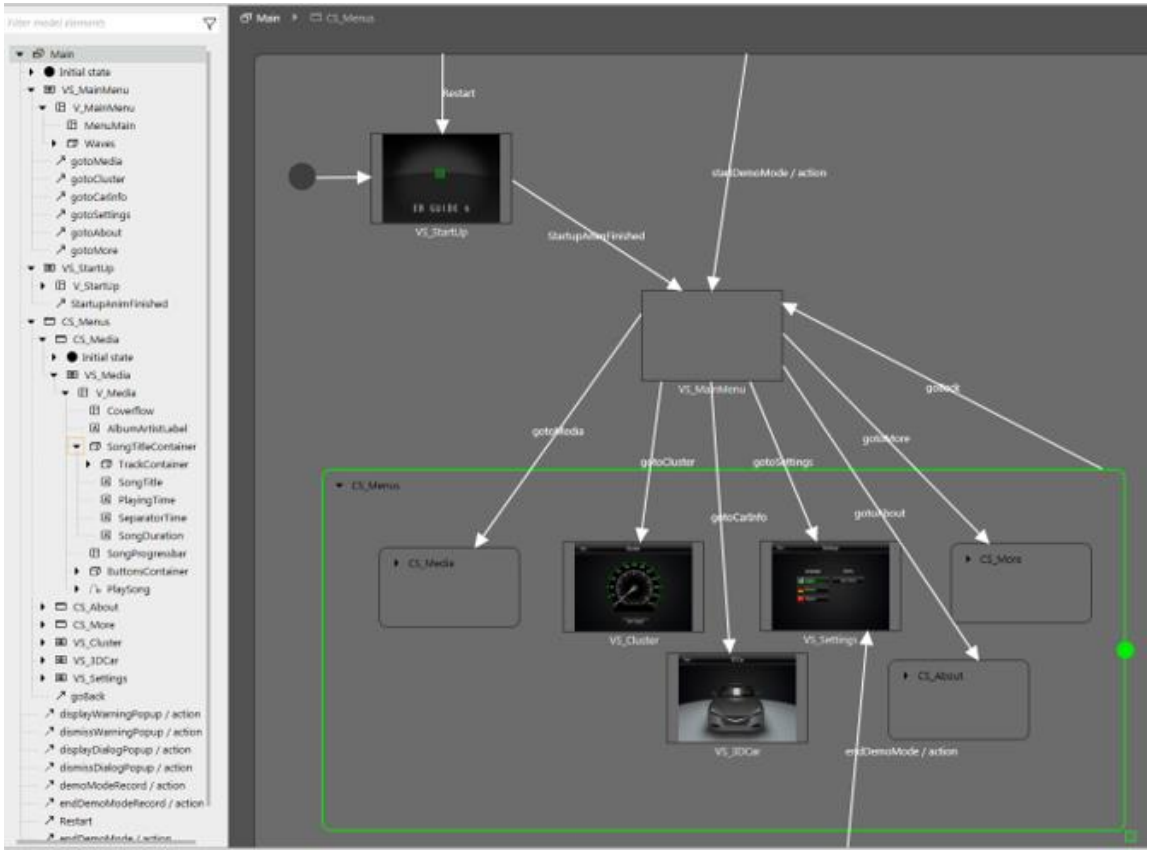
Request for a cluster HMI

- Team is requested to create a prototype for a cluster HMI.
- Customer already provided basic design prototype.
- Prototype is needed fast.
- Target hardware is roughly specified.
- Development should start immediately after the prototype has been finished.



First implementation of prototype with EB GUIDE

- Implementation on desktop PC
- Simple state machine with a couple of views
- Views based on design prototype by hand
  (or .psd import by EB GUIDE)
- Data is hard-coded in data pool, can be manipulated in EB GUIDE Monitor.
- Basic design demo without data providers is running on PC after couple of hours.



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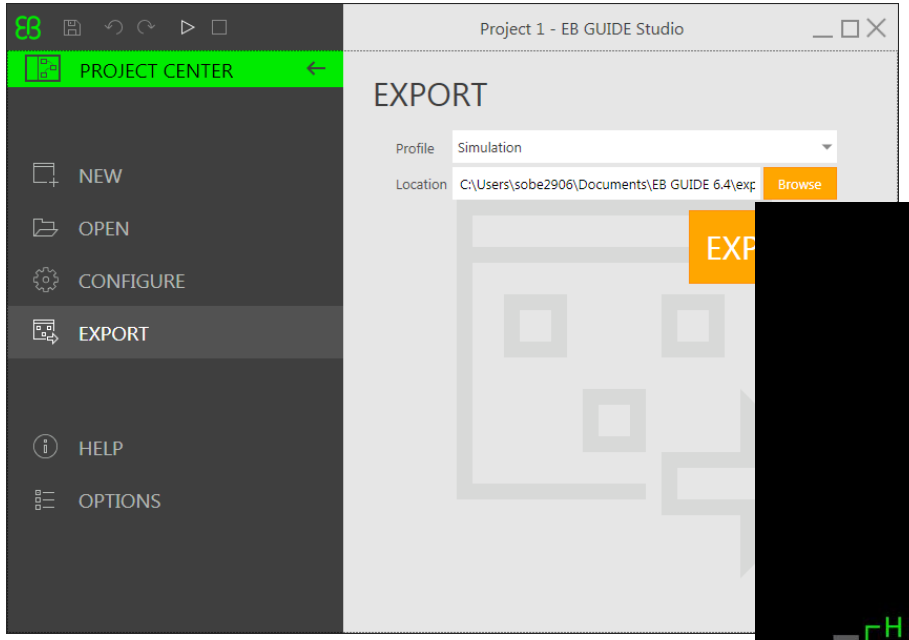
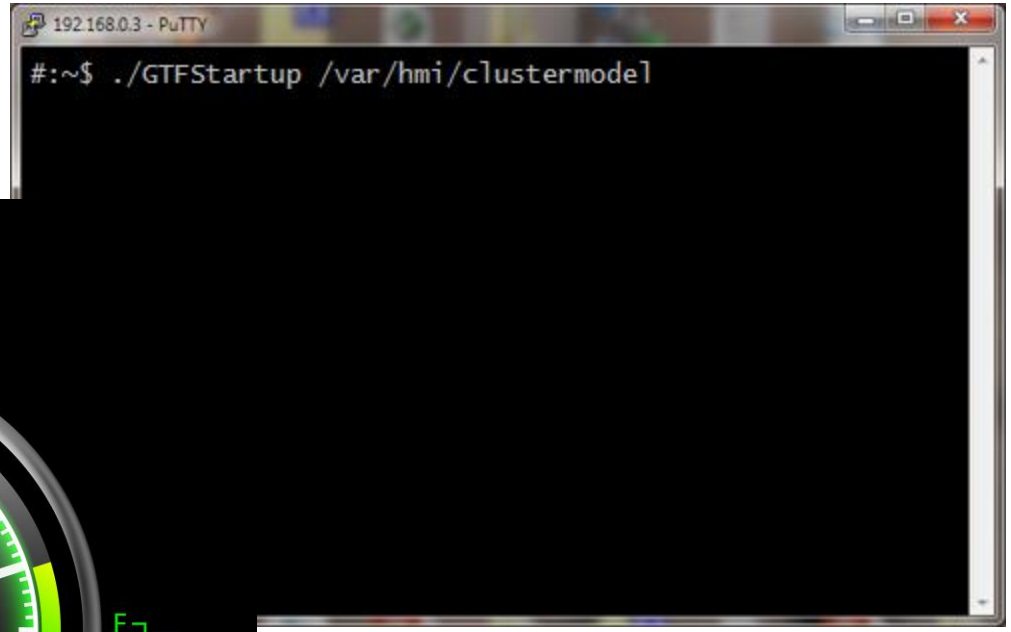
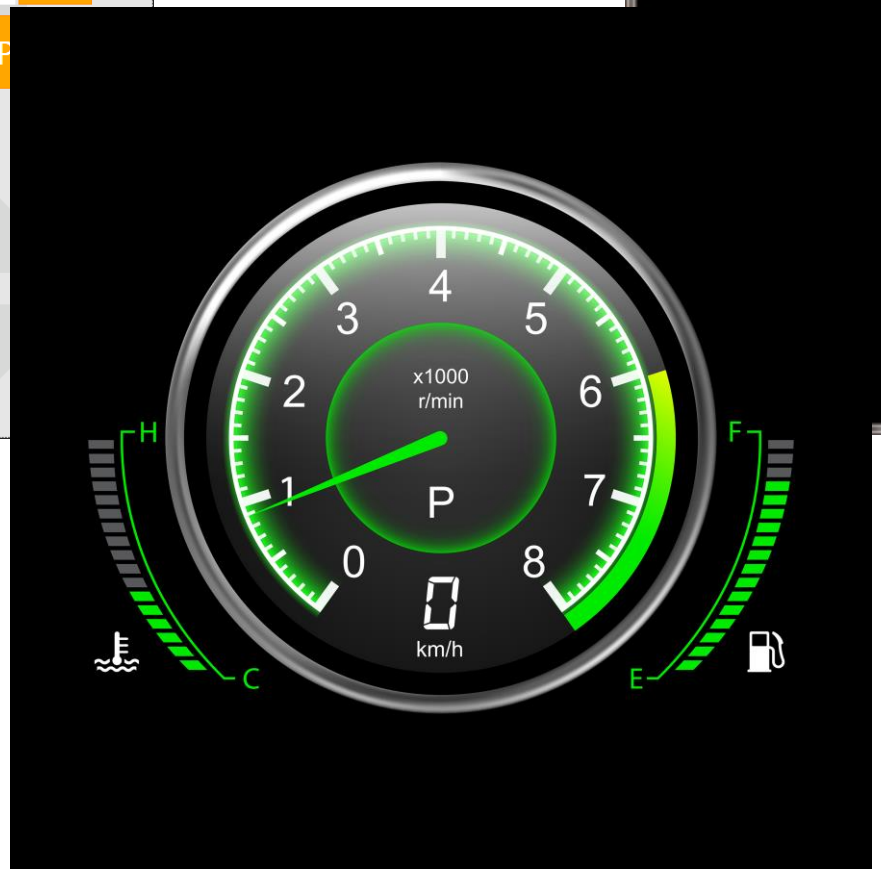
Deployment to target

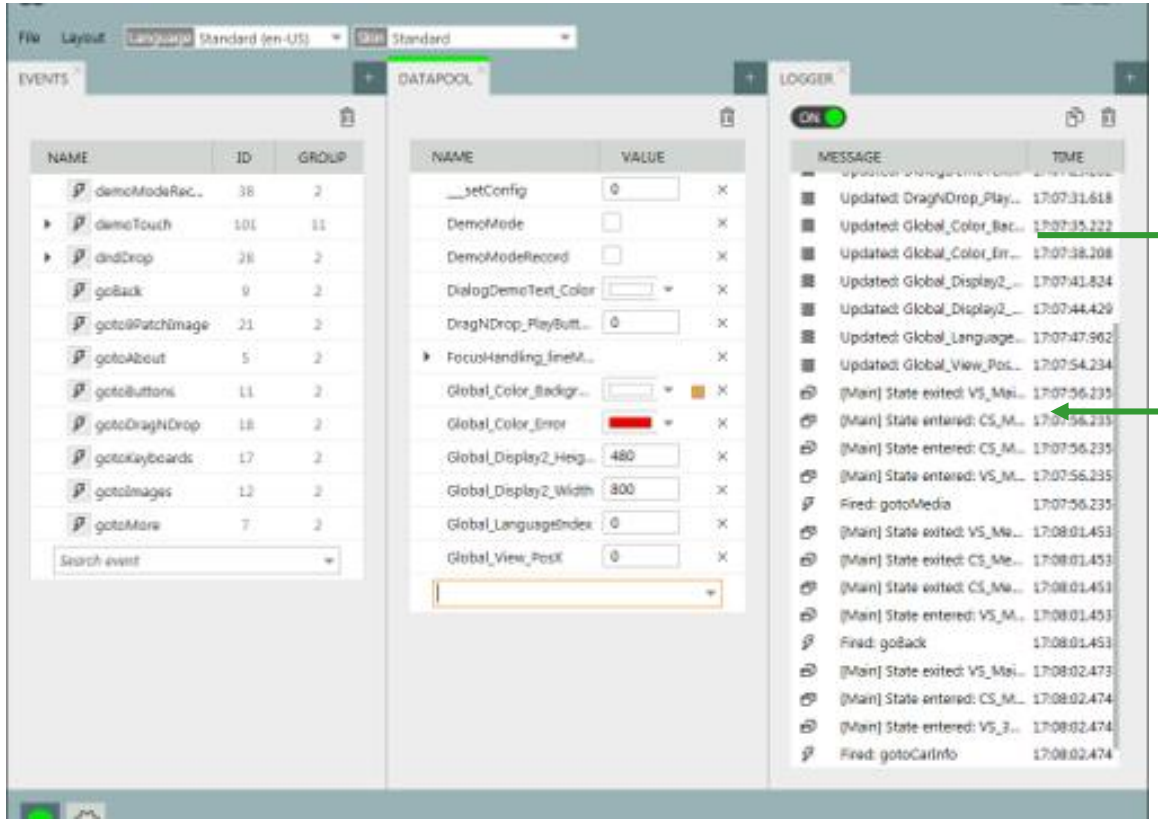






First tests on the target

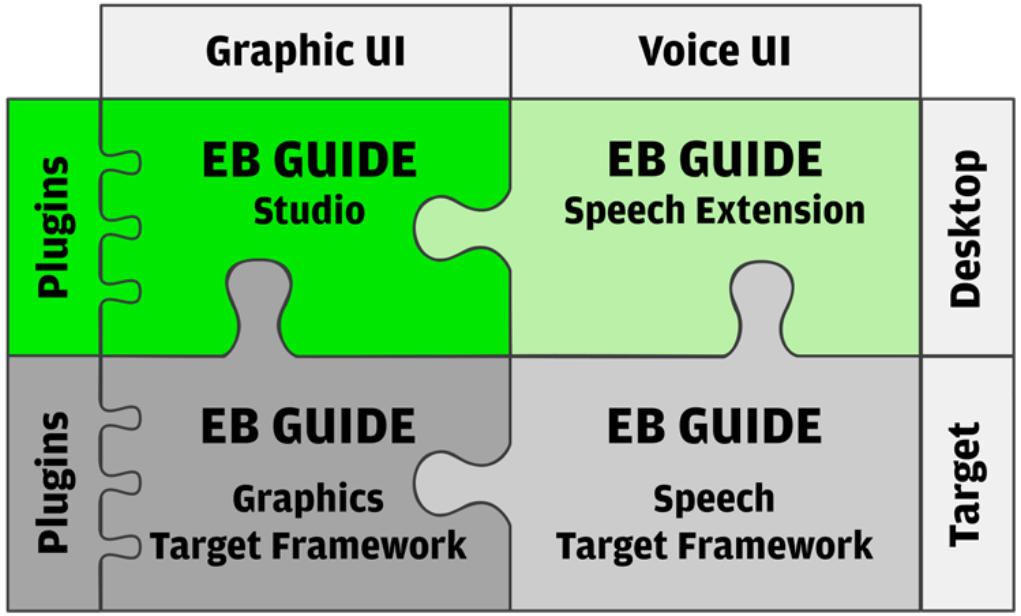
Connect EB GUIDE Monitor



Manipulate data pool, send events

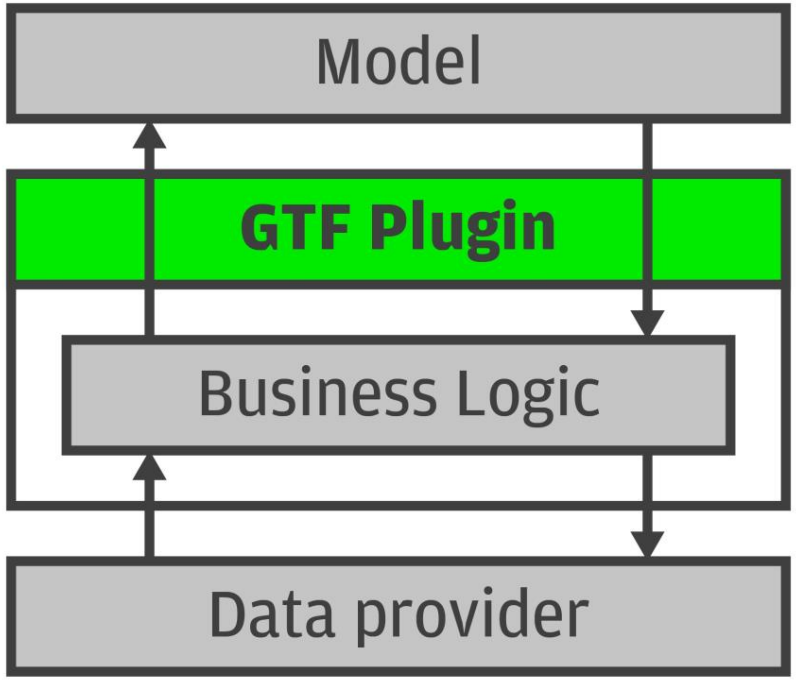
The EB GUIDE Graphics Target Framework (GTF)

- The GTF is an executable ported to the target platform.
- GTF loads exported model data on startup.
- Allows running the same model export on desktop and any target platform.
- Extendable by plugins



Processing data

- For processing data a GTF plugin is created.
- Interface to model data pool and event system is generated by EB GUIDE.
- First implementation sends events and value updates to model.
- Connection to a data provider is implemented (e.g. TCP or CAN).
- In first implementation everything is in one component.
- Connection works → Feeling of “almost done” (even if probably inappropriate).



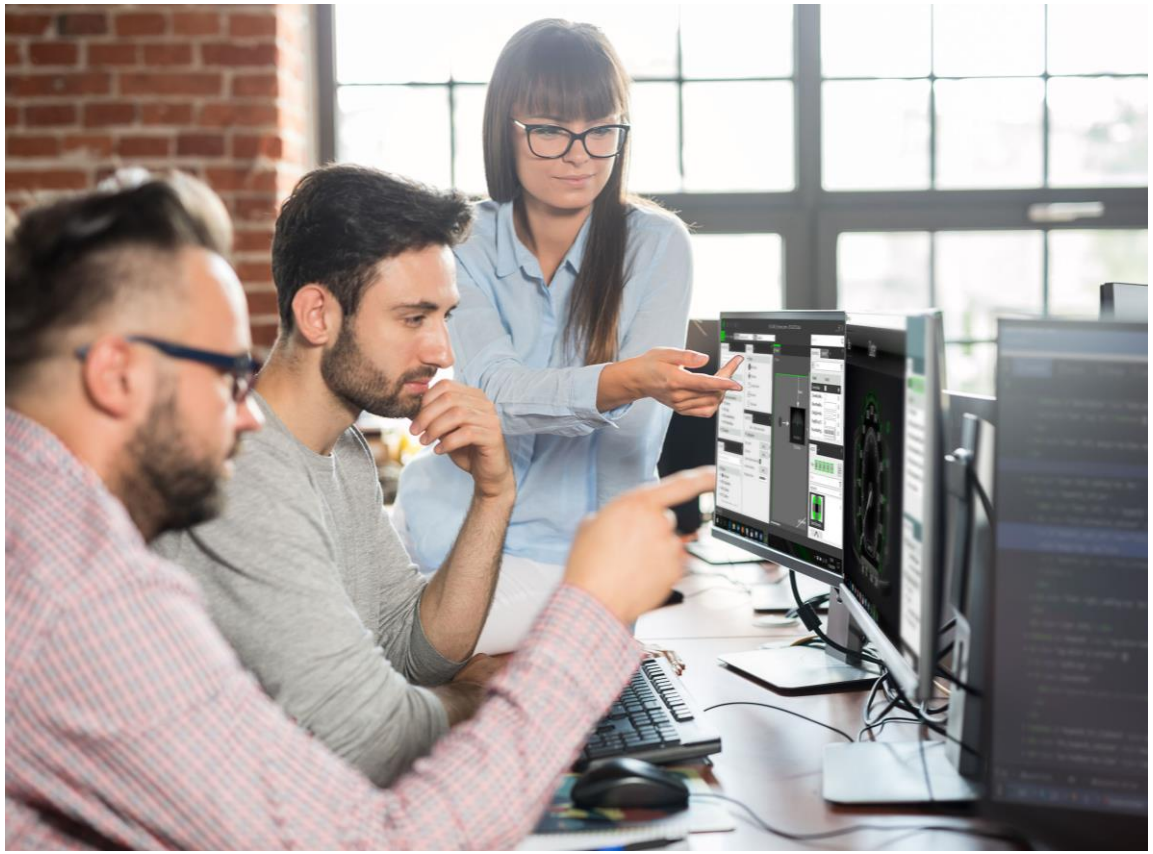
The feature set grows - so does the team

Growing team of EB GUIDE users

Multi-user support

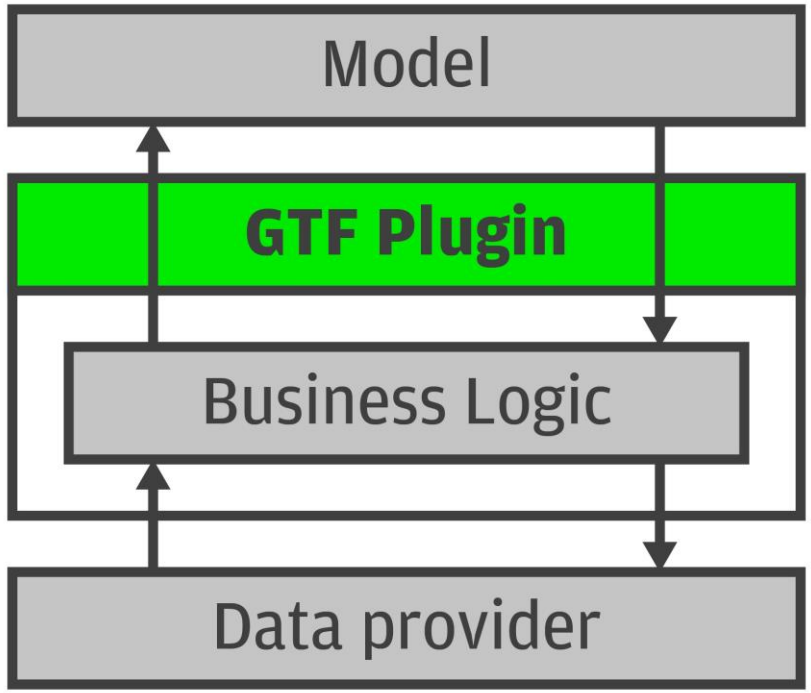
- EB GUIDE components stored in individual files.
- EB GUIDE file format is human-readable json code.

- **Benefits:**
  - Multiple users can work on the same model.
  - File format is compatible to any code versioning system.
  - Users can merge conflicting edits in case.
  - Change history can be traced in diffs.



Prototype reaches borders

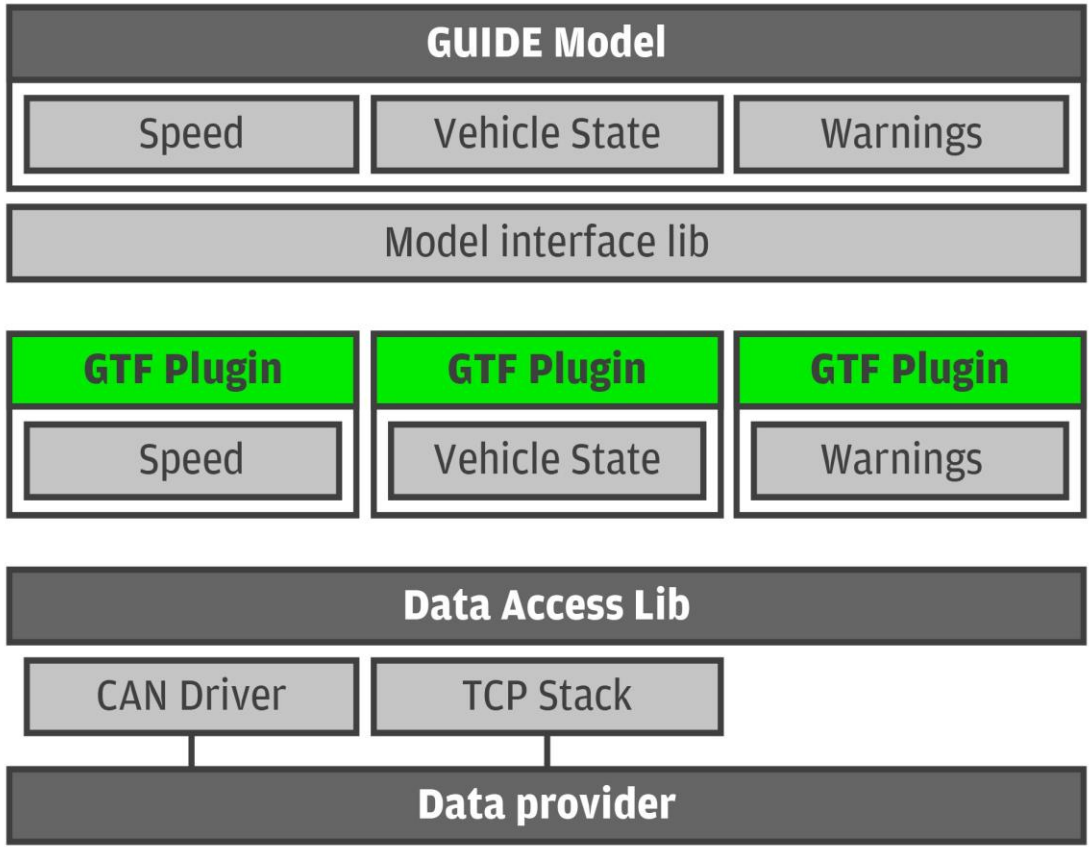
- Situation with prototype:
  - Business logic was designed for single technical scope.
  - Adding functions to business logic mixes up technical scopes.
  - Data arrives by different channels.
  - Code for updating model data is repetitive.
  - Business logic handles all type of channel and model updates.
  - A second component would have to repeat this implementation.



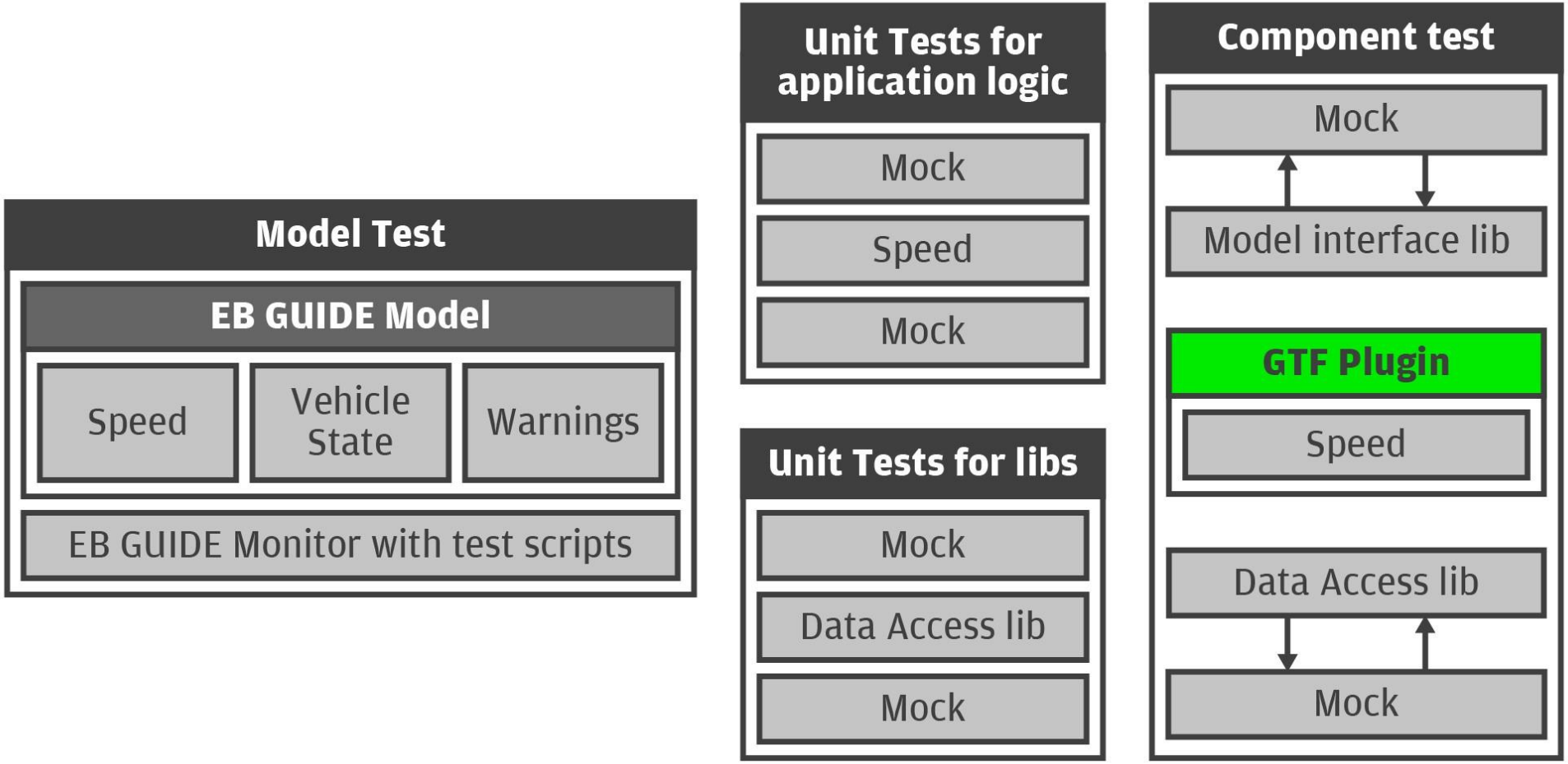
Growing team of plugin developers

- Introduce separation of concerns
  - Layer for model communication
  - Layer for data provider
  - Business logic just translates incoming data to model data and vice versa
  - Separating business logic in functional independent blocks

- Benefits:
  - Application logic is platform-agnostic (even GTF)
  - Independent testability of logic components and access libraries
  - Automated tests for model design (EB GUIDE monitor scripts)
  - Test scope can be defined layer by layer.

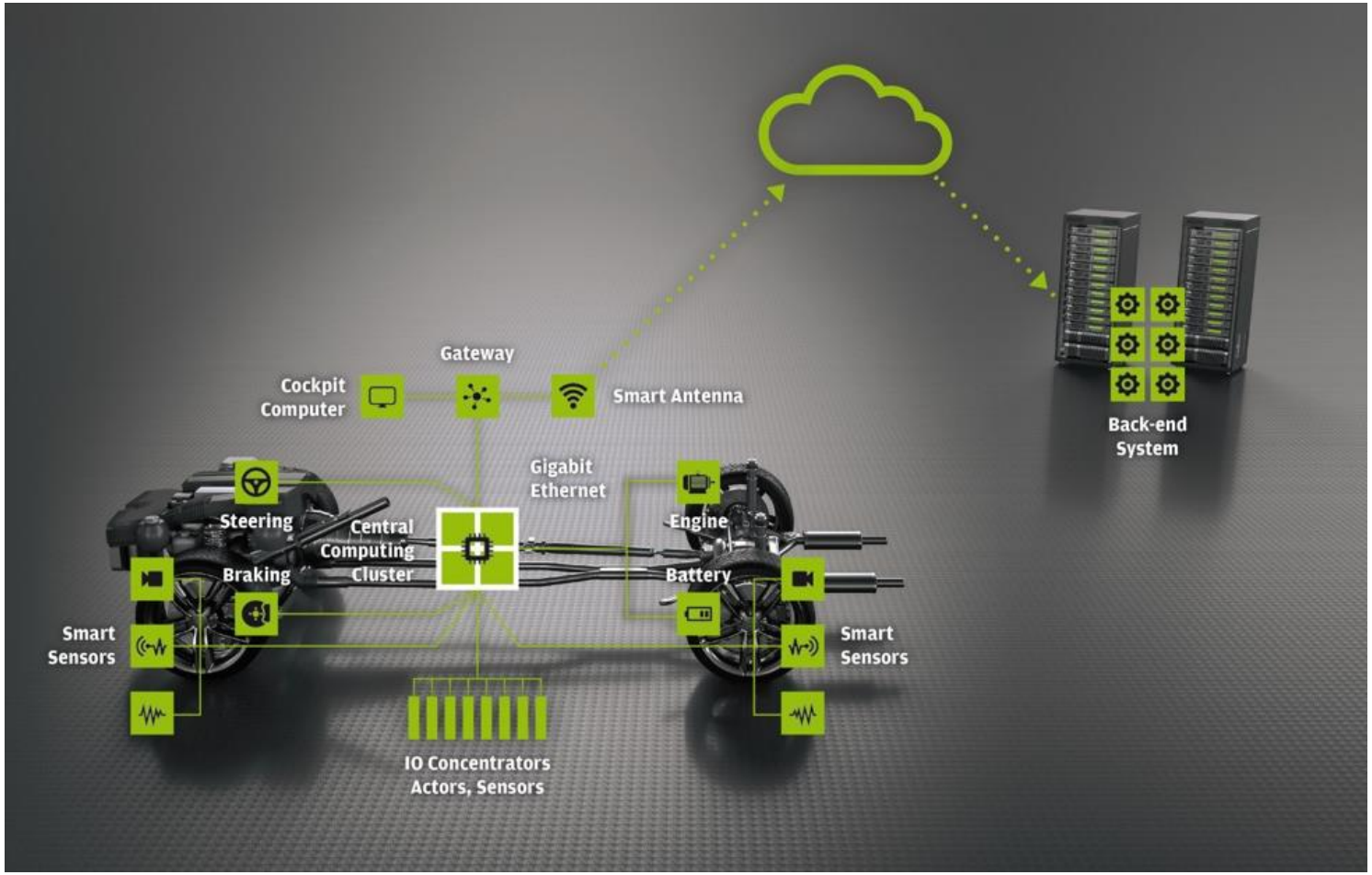


Testing setups



Reality check

System integration test



System integration test

System failure

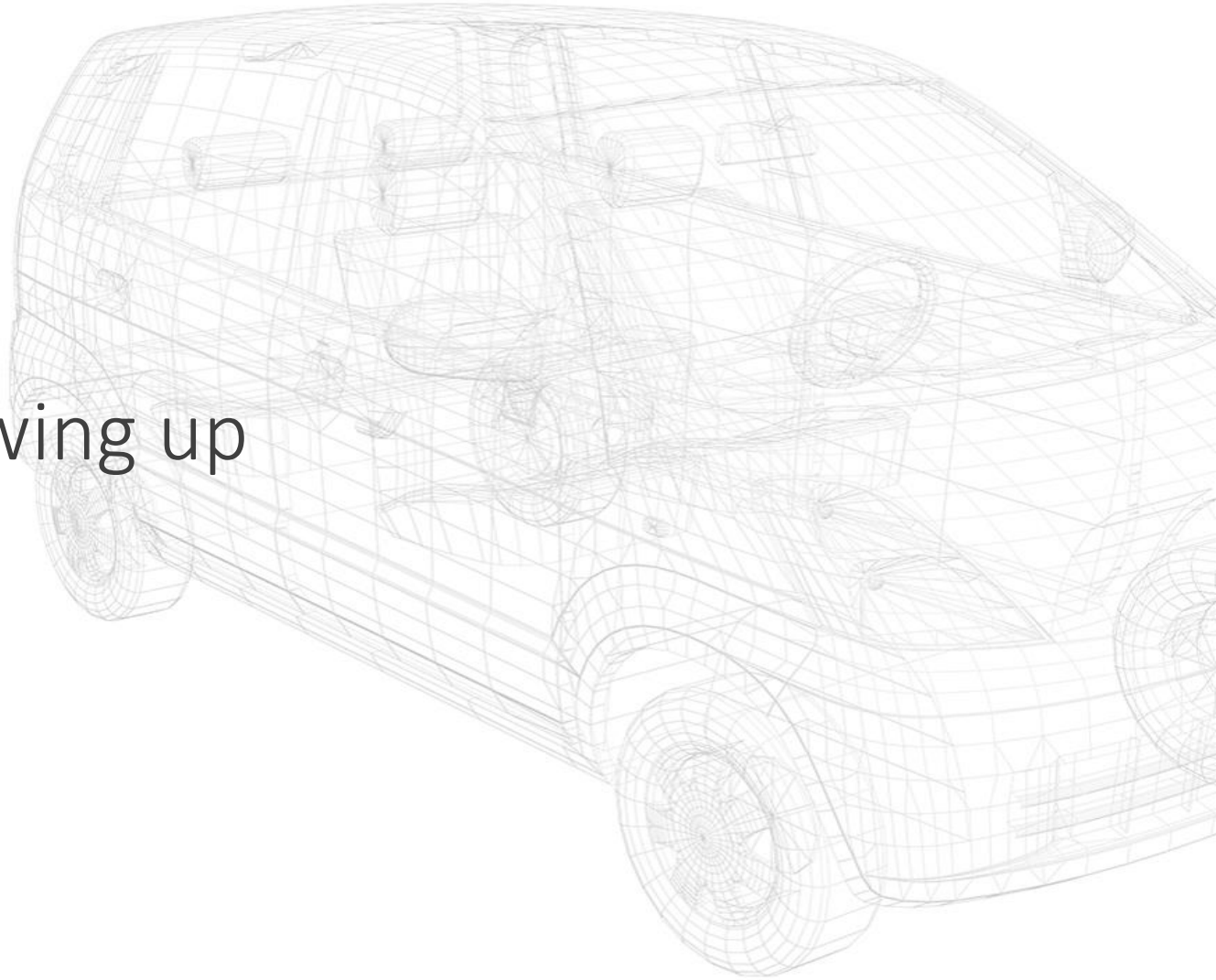
- Some ECUs deliver the expected data.
- Some don’t or do sporadically.
- Some interpreted spec differently than the HMI team.
- A crash of the HMI occurred.
- Performance of HMI is unsatisfying.

System integration test

Fast system recovery

- Issues can be analyzed and fixed quickly during the workshop:
  - Developers bring their complete toolchain to the workshop.
  - Components allow isolation of issues .
  - Separation of concern allows safe application of fixes.
  - Short build and deploy times allow direct testing of patches.
- The overall integration test is considered a success:
  - The HMI was delivered in time.
  - The HMI was started and the user experience was presented.
  - Critical issues could be addressed and solved directly during the integration test phase due to fast roundtrip times.
- Follow-up
  - Further analysis of remaining issues later
  - EB Experts help on reviewing model and source code
  - EB port team optimizes GTF to given hardware

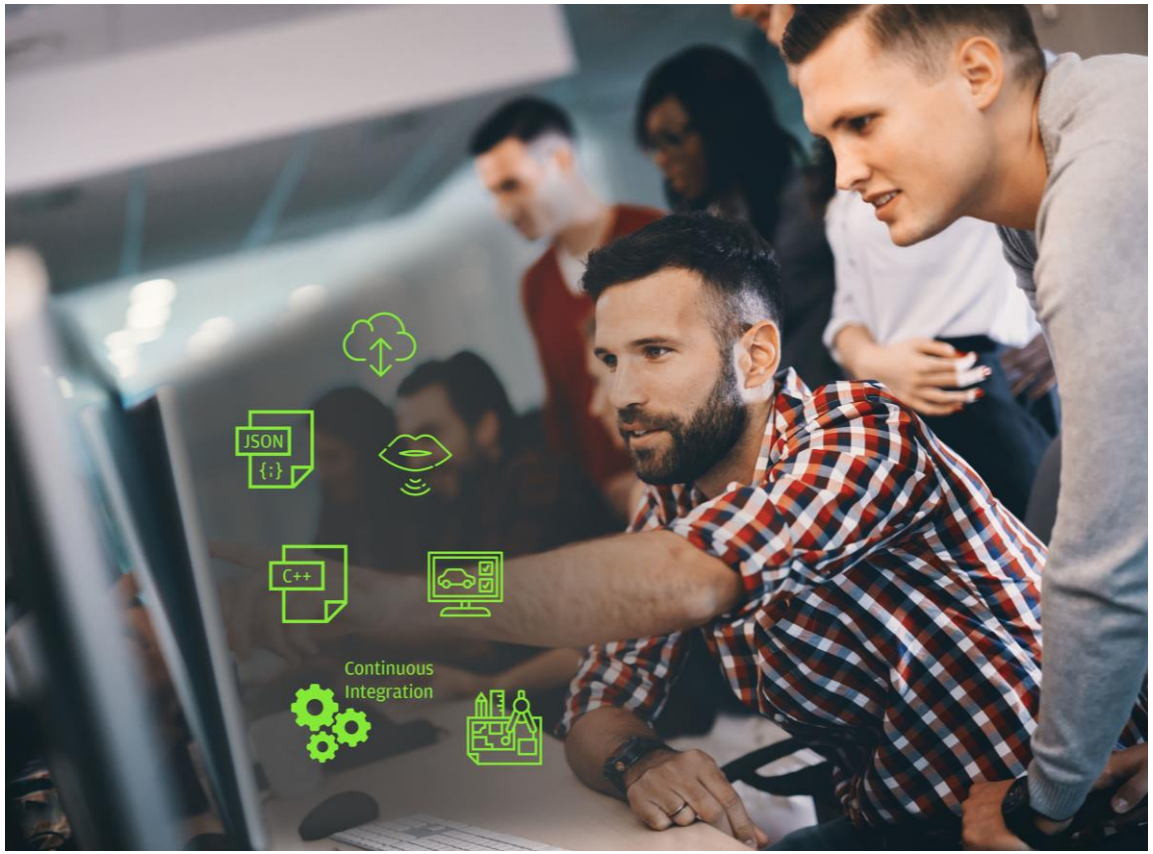
Growing up



Development has to match standard processes

- Organization has established processes for
  - Integration
  - Configuration management (git/svn)
  - Delivery

- Project structure supports these processes:
  - Libs for abstraction layers and components can be maintained separately.
  - Nightly builds can integrate all components.
  - Automated tests on different scopes can be run.
  - Model is json format (code) and plays well in the established processes.
  - Headless EB GUIDE supports continuous integration.

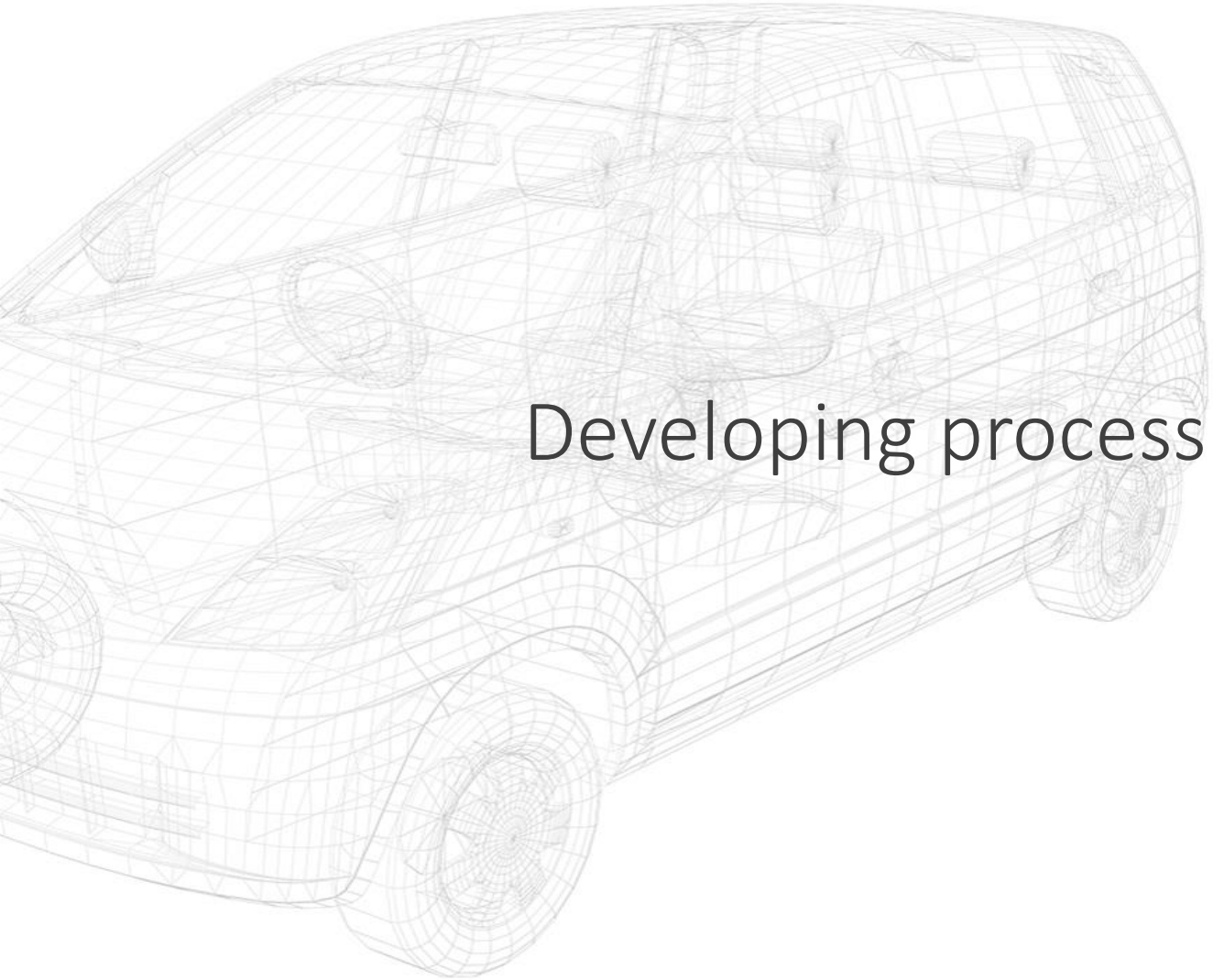


Design updates are incoming

- Design team provides frequently updates.
- Functional scope is extended, design grows, many views, views get more and more elements.
- Animations are defined.
- Integrating the design updates manually is repetitive.
- Is there a way to automate this?
  - Designers and developers agree on technical exchange format and process (e.g. psd).
  - Developers create EB GUIDE C# plugin for importing design information

Internationalization is required

- All texts have to be translated into different languages.
- Organization has a division with given processes.
- Developer team creates EB GUIDE plugin to match these processes.
  - EB GUIDE provides basic in and export tool for texts.
  - Based on the source code the tool is adapted to processes of organization.
  - EB GUIDE plugin has access to all elements of the model and can annotate texts with meta information helping the translation team to find fitting translations.



Developing process becomes routine

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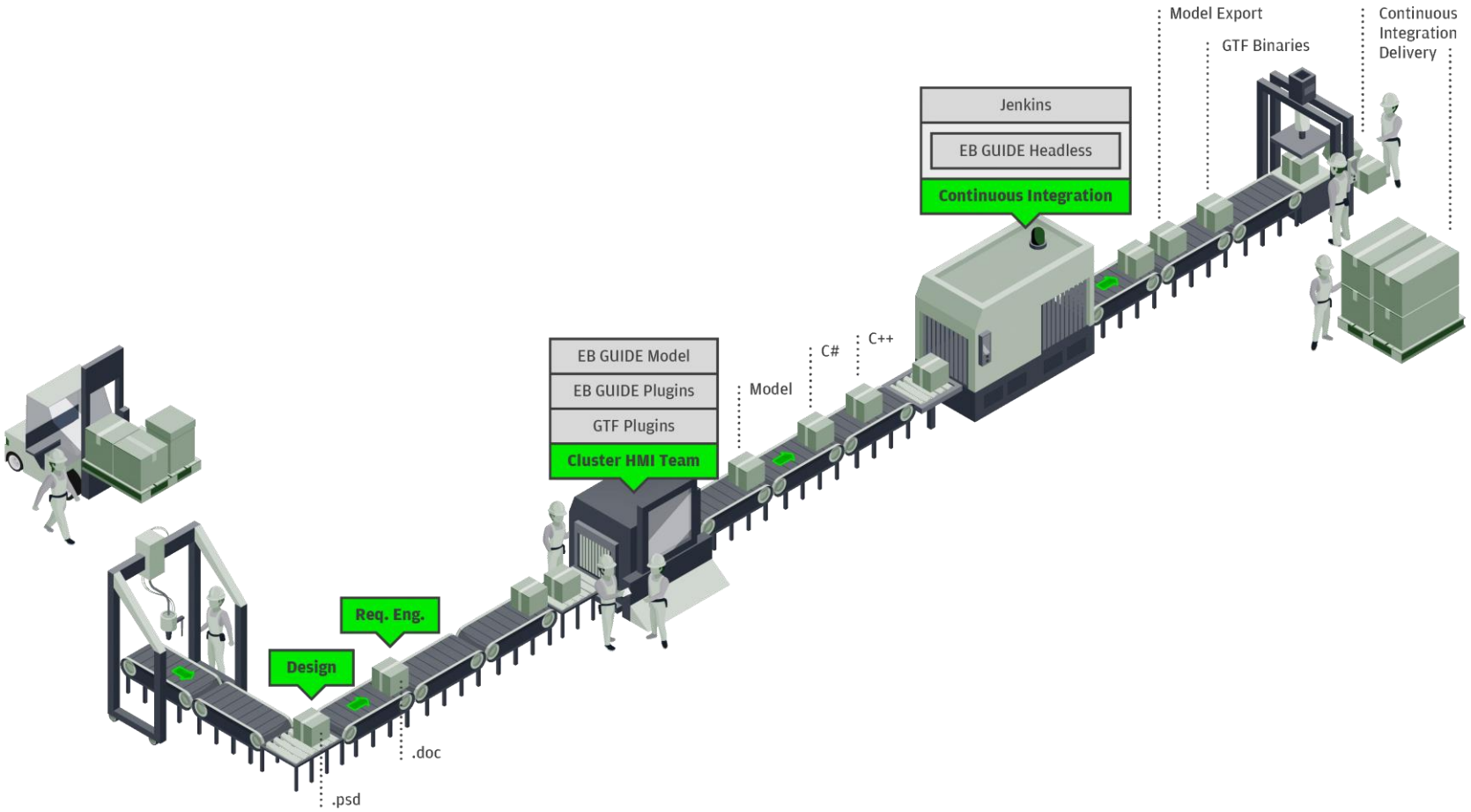
EB GUIDE becomes integral part of the process workflow



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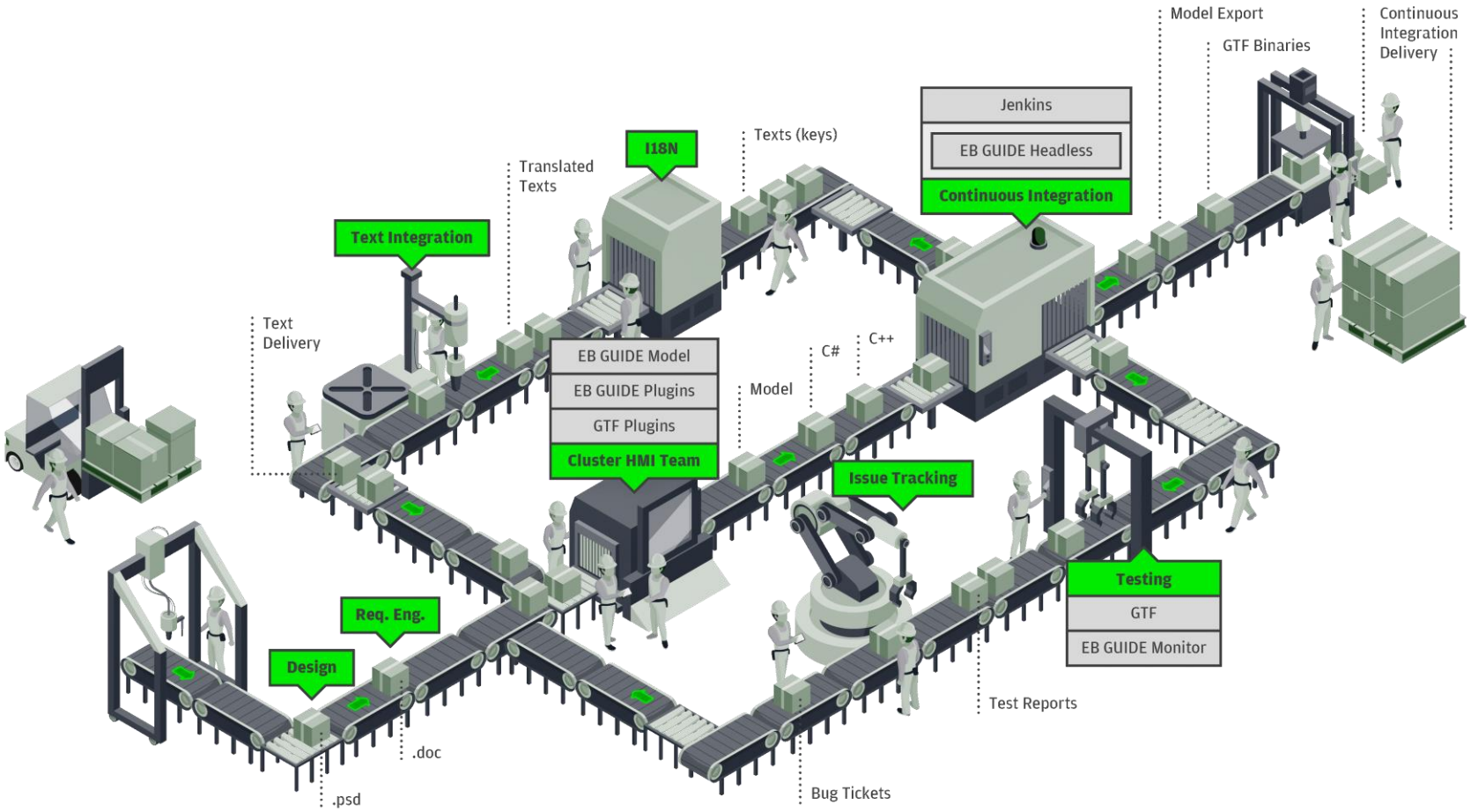

Get in touch!

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