



**XSTAMPP: An eXtensible STAMP
Platform As Tool Support for Safety
Engineering**

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Joint work with:
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Motivation: Why XSTAMP Platform?

◆ Problem Statement:

- ❑ The **A-STPA** (Automated STPA) tool was our first tool to implement STPA activities (**introduced at STAMP 2014**).
- ❑ A-STPA is already being used by safety analysts in different industrial domains.
- ❑ However, the current practices in using **A-STPA** face considerable obstacles:
 - **A-STPA** was developed based on the basic steps of STPA
 - The architecture of **A-STPA** is not extendable to include new requirements and further improvements.
- ❑ Consequently, these obstacles prevent **A-STPA** from supporting:
 - ❖ the application of STPA in different domains
 - ❖ The extension to support the application of CAST



◆ Research Objectives:

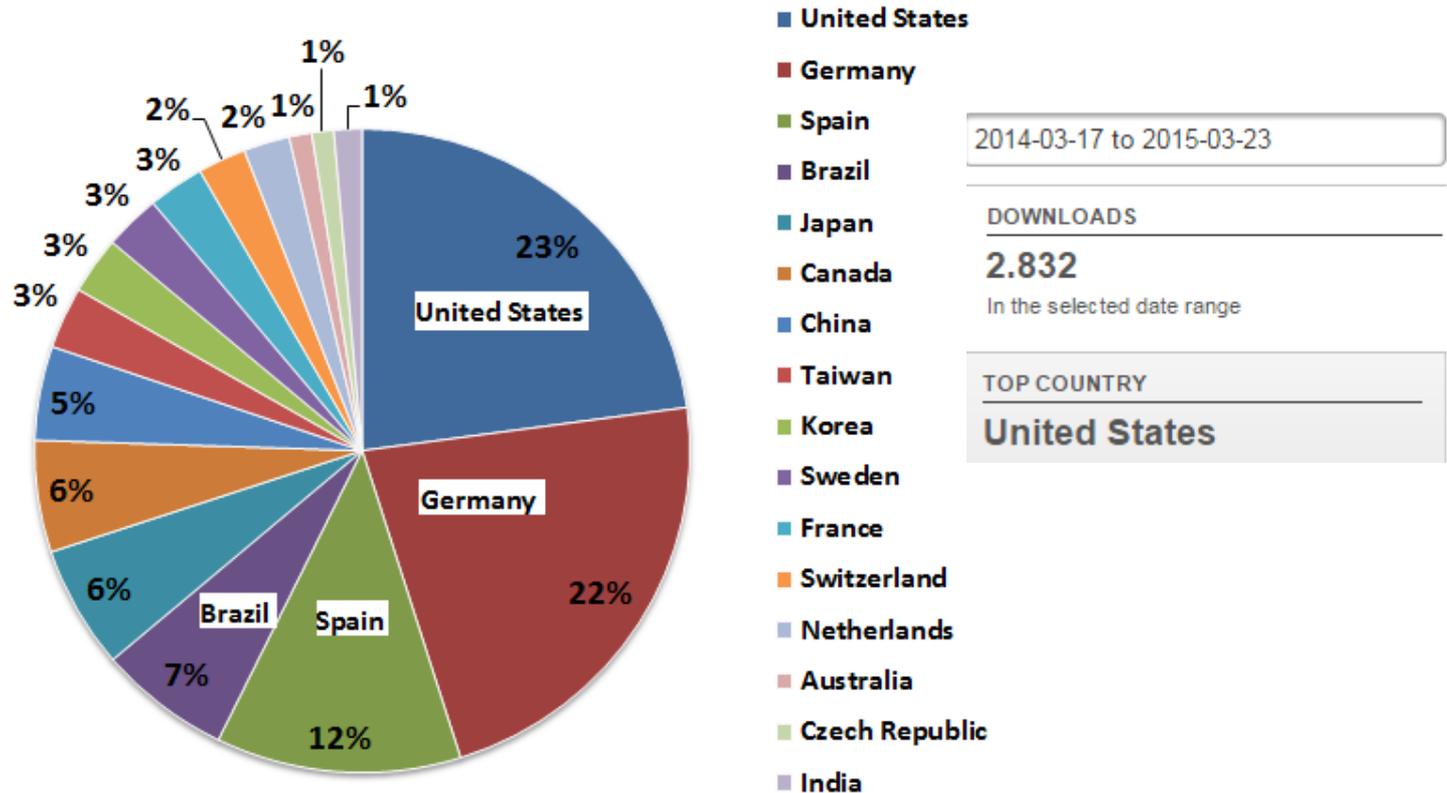
- ❑ To develop an extensible platform supporting the STAMP methodologies (STPA and CAST) to encourage the widespread adoption STAMP by safety analysts
- ❑ In particular, to develop a base platform for STPA that could be easily extended in the future to include CAST

Agenda

- ❖ Motivation
- ❖ A-STPA Overview 
- ❖ A-STPA Shortcomings
- ❖ What is XSTAMPP?
- ❖ XSTAMPP Views
- ❖ XSTAMPP Future
- ❖ Conclusion

Overview: A-STPA (Automated STPA)

- ◆ A-STPA is open-source tool to assist safety analysts in performing STPA.
- ◆ A-STPA is already being used by safety analysts in different industrial domains in **53** countries around the world (**2.832** download requests)



Greece, Iceland, Austria, Poland, Ukraine, Croatia, Estonia, Malaysia, Myanmar, Tunisia, Kenya, Slovenia, Indonesia, Belgium, Philippines, Finland, Romania, South Africa, Colombia, ...

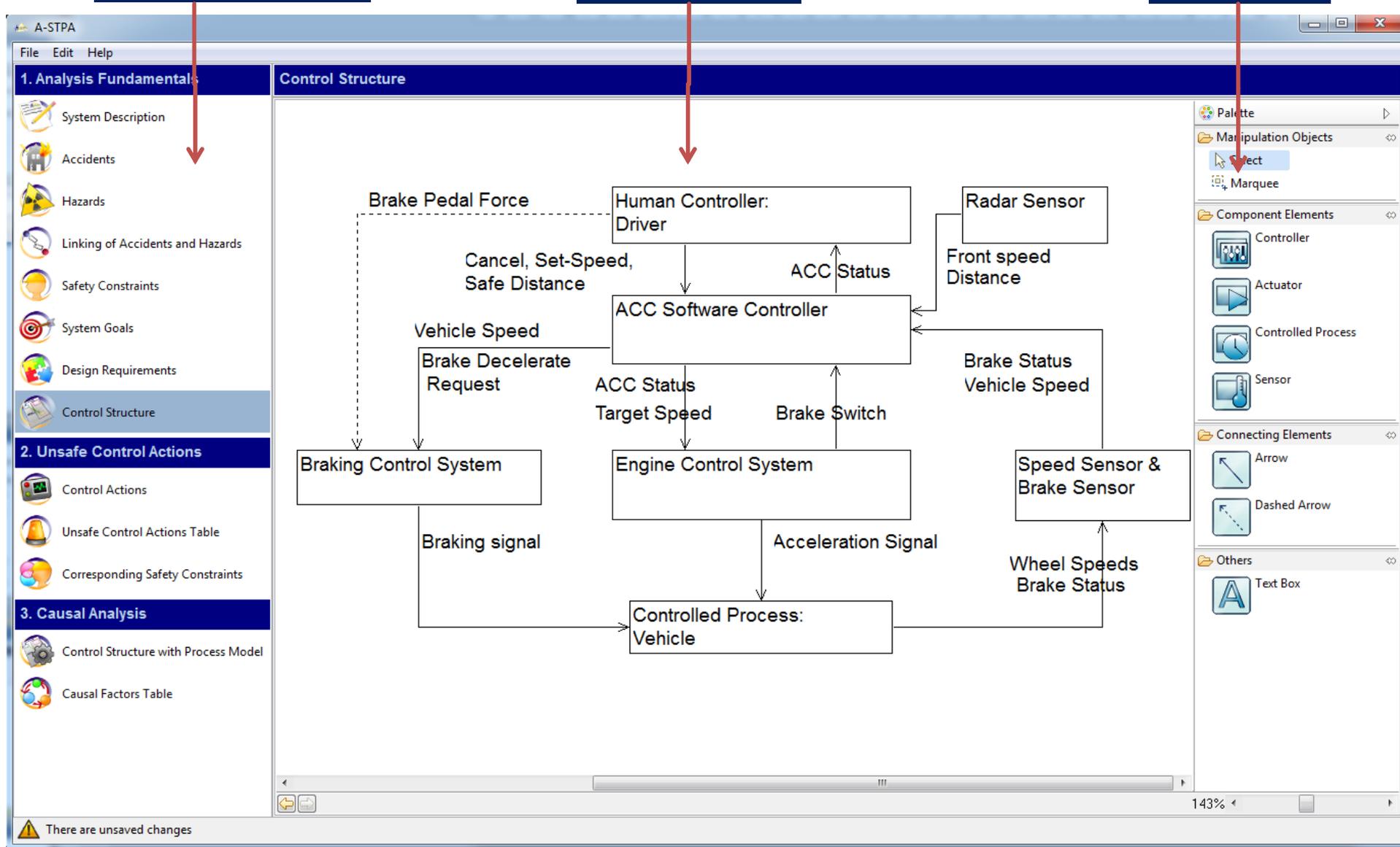
Source: <https://sourceforge.net/projects/astpa/files/stats/map?dates=2014-03-10%20to%202015-03-16>

A-STPA Main Workbench

A-STPA Explore Views

Workbench View

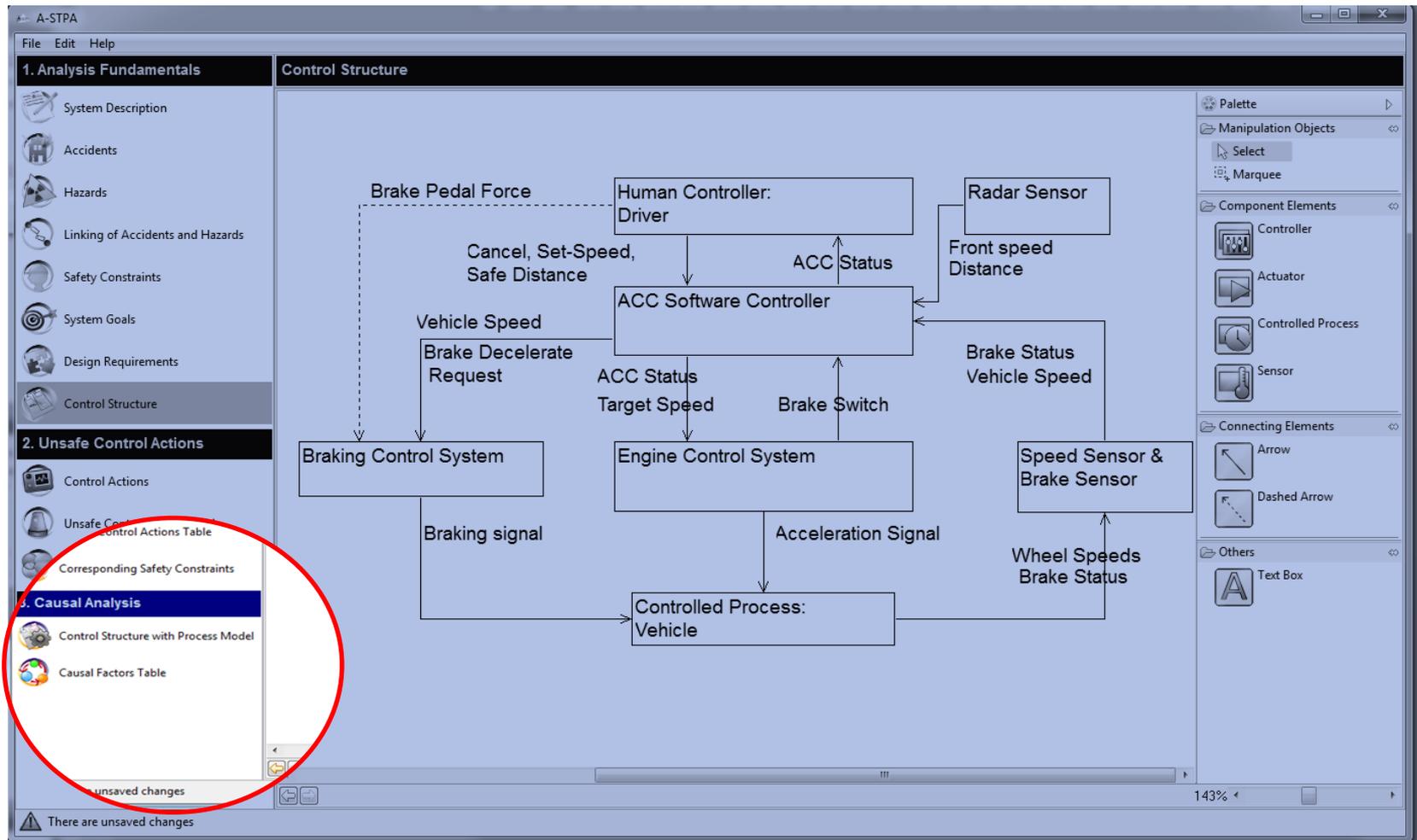
Toolbox View



A-STPA Shortcomings

◆ Extensibility Issues: (based on the online survey with 51 safety experts)

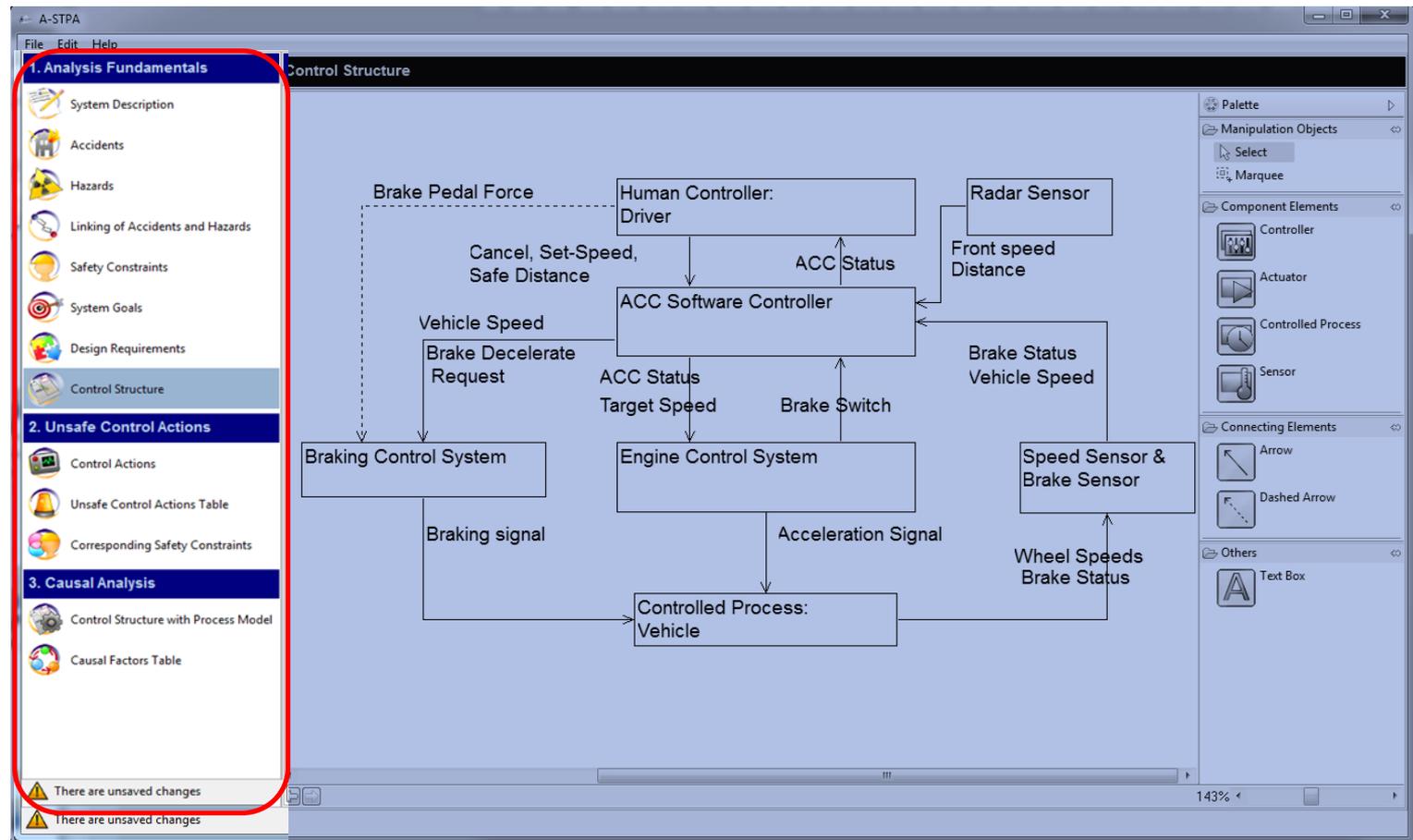
- The A-STPA navigation cannot be extended to include a new user interface editor.
- The A-STPA architecture does not support to be extended by plug-ins libraries or integrated with other existing tools.



A-STPA Shortcomings II

◆ Designing Issues:

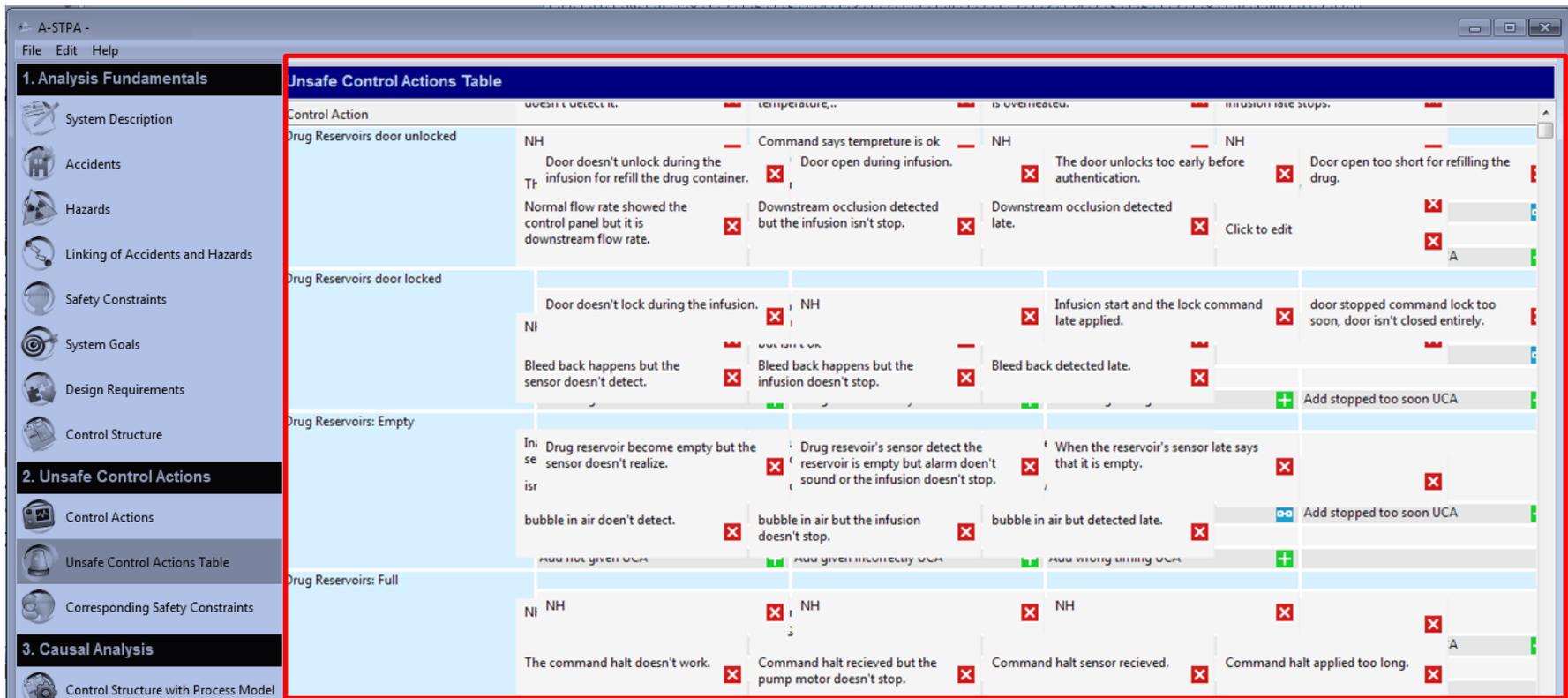
- The workbench of A-STPA is specified only to show one user interface view in the workbench UI.
- A-STPA does not have a project explorer to allow safety analysts to create or open more projects in the workbench.



A-STPA Shortcomings III

◆ Editing & Exporting Issues:

- It is difficult to edit a large number of unsafe control actions (more than 100) in the unsafe control action table.
- A-STPA does not allow the safety analysts to export the data in different formats.



◆ Functionality Issues:

- A-STPA does not implement the context tables based on Thomas' approach

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What is XSTAMPP Platform?

◆ XSTAMPP:

- is an open source, plug-in-based and extensible software platform
- is based on the Eclipse Rich Client Platform (RCP) and plug-in development environment which makes our platform easier to integrate independent components.
- is designed specially to serve the widespread adoption and use of STPA in different areas.
- has the potential to be extended in the future to support the application of CAST for accident analysis.

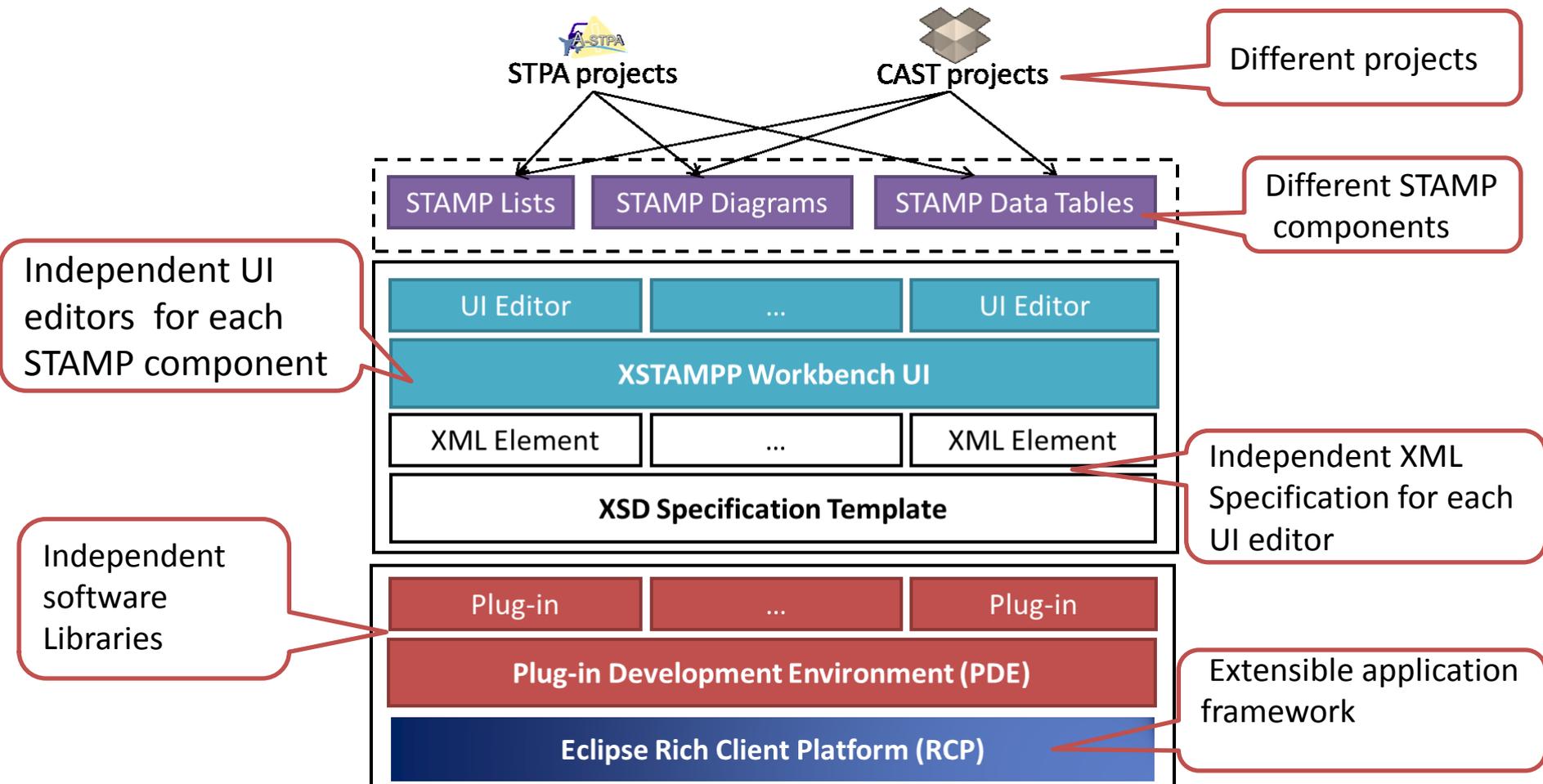


We believe that XSTAMPP is a base platform to support the application of STAMP methodologies in different domains.

XSTAMPP Architecture

◆ The XSTAMPP Architecture mainly consist of five components:

- STAMP components, STAMP UI editors, XSD specification template, plug-in development environment (PDE) and Eclipse Rich client Platform.



XSTAMPP Main Workbench

Create different projects in the workbench

Open different UI views in the workbench

Draw components with different colours

The screenshot displays the XSTAMPP Main Workbench interface. On the left is the Project Explorer showing a tree view of projects and components. The main workspace shows a control structure diagram with components: Driver (blue), Cruise control software (controller) (blue), Throttle actuator (yellow), Vehicle (purple), and Sensors (green). Data flows are labeled: 'UI commands' from Driver to Controller; 'Accel. Pedal, Brake Pedal' from Controller to Driver; 'desired speed' from Controller to Throttle actuator; 'Increase / reduce a X rate the position value of throttle' from Throttle actuator to Controller; 'adjust position of throttle' from Throttle actuator to Vehicle; 'Disturbance or load step' to Vehicle; 'Vehicle status data' from Vehicle to Sensors; 'estimated speed & condition' from Sensors to Controller; and 'brake status, engine status, current speed' from Sensors to Controller. On the right is the Palette with categories: Manipulation Objects (Select, Marquee), Component Elements (Controller, Actuator, Controlled Process, Sensor, Control Action), Connecting Elements (Arrow, Dashed Arrow), and Others (Text Box). At the bottom, there are buttons for 'Decoration is ON' and 'Preferences'. Three red callout boxes point to specific features: 'Create different projects in the workbench' points to the Project Explorer; 'Open different UI views in the workbench' points to the tabs at the top; 'Draw components with different colours' points to the colored boxes in the diagram; 'Decorations button' points to the 'Decoration is ON' button; and 'Preferences to change the font and color' points to the 'Preferences' button.

Decorations button

Preferences to change the font and color

XSTAMPP vs. A-STPA

◆ XSTAMPP:

- includes A-STPA as plug-in.
- has the same major functions of A-STPA.
- allows to create and open more than one project in the project explorer.
- allows to arrange different user interface views in the workbench.
- integrates, combines and updates easily by additional plug-in libraries.
- allows to draw the control structure diagram components with different colours.
- exports the whole project data as a PDF file and each individual user interface view as an Excel sheet or various image formats.



A-STPA stand alone version
(current version 1.0.5)



A-STPA is plug-in in XSTAMPP

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XSTAMPP Views I

The screenshot displays the XSTAMPP software interface. The top-left pane shows a project tree with the following structure:

- PCA Pump
 - Establish Fundamentals
 - System Description
 - Accidents
 - Hazards
 - Linking of Accidents and Hazards
 - Safety Constraints
 - System Goals
 - Design Requirements
 - Control Structure
 - 1 Unsafe Control Actions
 - 2 Causal Analysis
- AVANDIA_Asim_updated
 - Establish Fundamentals
 - 1 Unsafe Control Actions
 - 2 Causal Analysis
- ACC STPA
- Cruise speed software
 - Establish Fundamentals
 - System Description
 - Accidents
 - Hazards
 - Linking of Accidents and Hazards
 - Safety Constraints
 - System Goals
 - Design Requirements
 - Control Structure
 - 1 Unsafe Control Actions
 - Control Actions
 - UnsafeControlActions Table
 - Corresponding Safety Constraints
 - 2 Causal Analysis
- test
- ACC
- Avandia_Asim

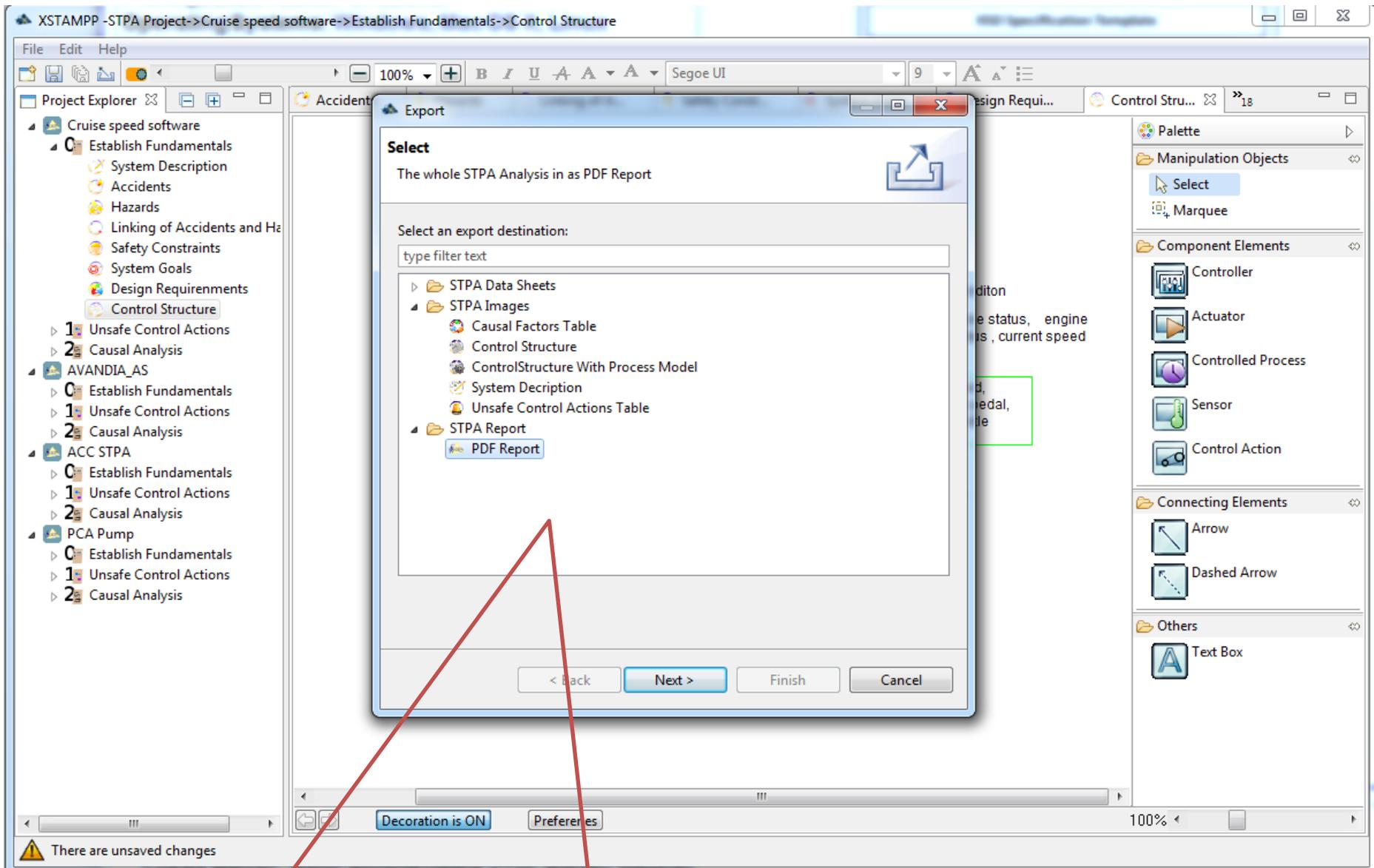
The main workbench area is divided into two views:

- Control Structure:** A block diagram showing the interaction between a Driver, Cruise control software (controller), Throttle actuator, and Sensors. The Driver sends UI commands (Accel. Pedal, Brake Pedal) to the controller and receives Notifications. The controller sends desired speed to the actuator, which adjusts the throttle position. The controller also receives estimated speed & condition from the sensors, which monitor speed, engine, brake pedal, gear, axle, and throttle.
- Unsafe Control Actions Table:** A table listing control actions and their associated hazards.

Control Action	Not providing causes hazard	Providing causes hazard	Wrong timing or...causes hazard	Stopped too soo...plied too lon
Provides throttle position command (out)	throttle position command provided but does not receive by the throttle actuator when the cruise control is engaged (on). [H-1]	The throttle position commanded while the cruise control is disengage (off). [H-1]	Late: the command provided too late [H-1]	Vehicle does not complete change the throttle position [H-1]
		The throttle position commanded with incorrect X throttle position value	early: The command provided too early	The vehicle does not achieve the target speed
Add not given UCA		[H-1]	Not Hazardous	[H-1]

XSTAMPP supports to open different views in the main workbench

XSTAMPP Views II



XSTAMPP supports to export different formats Excel sheets, images and PDF

XSTAMPP Views III

The screenshot displays the XSTAMPP software interface for a project titled "XSTAMPP -STPA Project->Cruise speed software->Establish Fundamentals->Control Structure". The main window shows a control structure diagram with the following components and interactions:

- Driver** (blue box): Provides "UI commands" (Accel. Pedal, Brake Pedal) to the **Cruise control software (controller)** and receives "Notifications" from it.
- Cruise control software (controller)** (blue box): Receives "desired speed" and sends "Increase" or "reduce a X rate the position value of throttle" commands to the **Throttle actuator**. It also receives "estimated speed & condition" from the **Sensors** and sends "brake status, engine status, current speed" back to the **Driver**.
- Throttle actuator** (yellow box): Receives "adjust position of throttle" commands from the **Vehicle** and sends "desired speed" to the **Cruise control software (controller)**.
- Vehicle** (purple box): Receives "Disturbance or load step" and sends "Vehicle status data" to the **Sensors**.
- Sensors: speed, engine, brake pedal, gear, Axel, throttle** (green box): Receives "Vehicle status data" and provides "estimated speed & condition" to the **Cruise control software (controller)**.

The interface includes a Project Explorer on the left, a Help pane on the right, and a status bar at the bottom. A red arrow points from the bottom of the diagram area to a text box at the bottom of the slide.

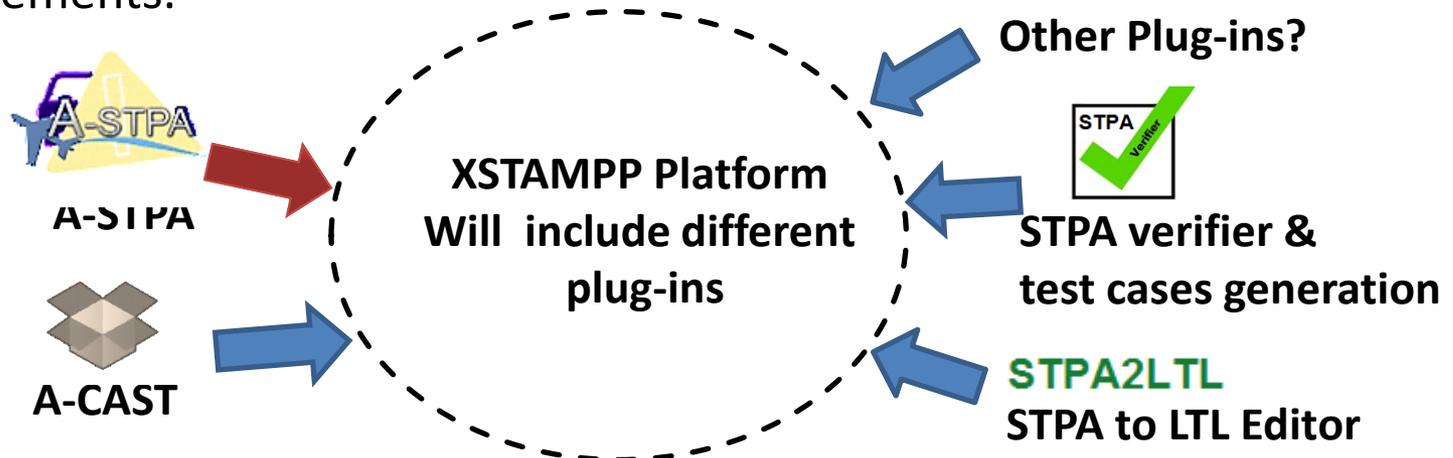
XSTAMPP provides a help wizard to get instructions for each STPA step

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XSTAMP Future?

- ◆ We aim to benefit from the new architecture:
 - to implement the CAST steps and provide them in the upcoming version of the platform ( **A-CAST plug-in**)
 - to integrate support for safety analyst to transform the STPA safety requirements automatically to formal specifications such **Linear Temporal Logic** (LTL) ( **STPA2LTL plug-in**)
 - to support the safety analysts to verify design models of the system against the STPA safety requirements with model checking as well as software code. ( **STPA verifier**)
 - To support the safety analysts to generate test cases from STPA safety requirements.



Challenges and Problems

◆ A big challenge is:

- ❑ reusing the A-STPA code and adapting all A-STPA functions which implement all necessary functions of STPA.
- ❑ This challenge is addressed in the first version of XSTAMPP

◆ Finding bugs

- ❑ Many bugs arose during reusing the A-STPA code which should be removed from XSTAMPP code.

◆ Testing XSTAMPP with real project in industry

- ❑ Many safety analysts are interested in using XSTAMPP, but we do not know whether they used it in their real projects in industry and what are their problems and feedback.



Your feedback is highly appreciated and will help us to improve XSTAMPP

How to get XSTAMPP?

- ◆ XSTAMPP website:

<http://www.iste.uni-stuttgart.de/se/werkzeuge/xstampp.html>

- ◆ Download XSTAMPP and its source code:

<http://sourceforge.net/projects/stampp/files/>

- ◆ Online Feedback of using XSTAMPP:

<http://a-stpa.limequery.org/index.php/survey/index/sid/791994/newtest/Y/lang/en>

- ◆ Get in Touch with us:

- Fill out the form on XSTAMPP website:

- Email : Asim.Abdulkhaleq@informatik.uni-stuttgart.de

- ◆ XSTAMPP Vision:

XSTAMPP is free and open-source software and you are cordially invited to join us !

Thanks

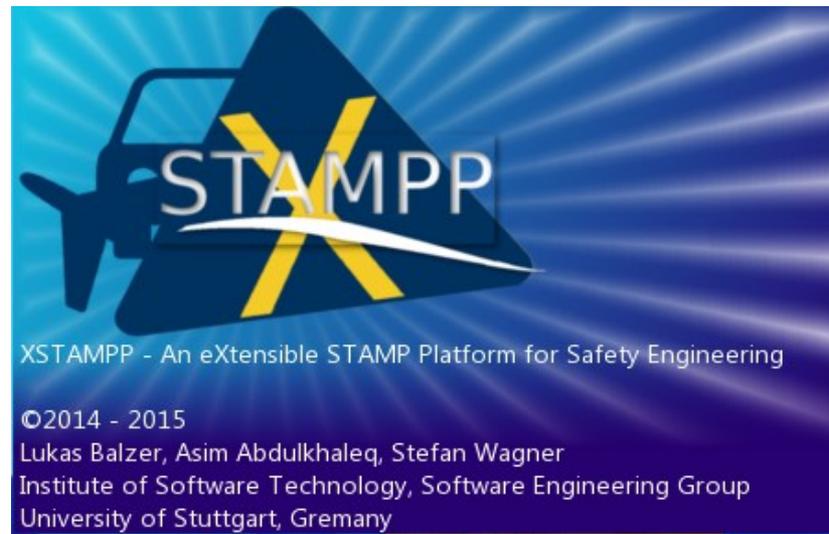
- ◆ We would like to thank A-STPA team:

Aliaksei Babkovich, Lukas Balzer, Adam Grahovac, Jarkko Heidenwag, Benedikt Markt, Jaqueline Patzek, Sebastian Sieber, Fabian Toth and Patrick Wickenhaeuser

- ◆ We would like to thank **Mr. Lukas Balzer** who worked with us to improve and build XSTAMPP.
- ◆ We would like also to thank the safety experts who provided us their valuable feedback and evaluation of using A-STPA.

The End...

Thank You for your attention. Questions?



Tool Demo will be presented during Buffet Dinner and Poster Session