Managing the co-evolution of software artifacts

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synerscope
connecting the dots

LaQuSo
Laboratory for Quality Software

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Where innovation starts

LaQuSo, SynerScope

- **Laboratory for Quality Software**
  - Part of TU/e department of Mathematics and Computer Science
  - Valorization of academic knowledge for use in business and industry
  - Feeding academia with questions from industry

- **SynerScope**
  - Spin-off from TU/e's Visualization group with the creators of TraceVis
  - Invented the edge bundling techniques
  - Discovery of patterns in Big Data
  - Successful application in financial transactions for detecting fraud

Difficult questions

- **Software development is carried out under pressure**
  - "Time to Market" vs. "Costs" vs. "Quality".
- **Questions arise such as:**
  - Have we tested enough?
  - How many test do we have to redo for the new version?
- **These are difficult questions to answer, but:**
  - Every requirement should be tested with an acceptance test
  - Ideally, requirements are as thoroughly tested as their perceived risk

How to go about questions like this?

Traceability

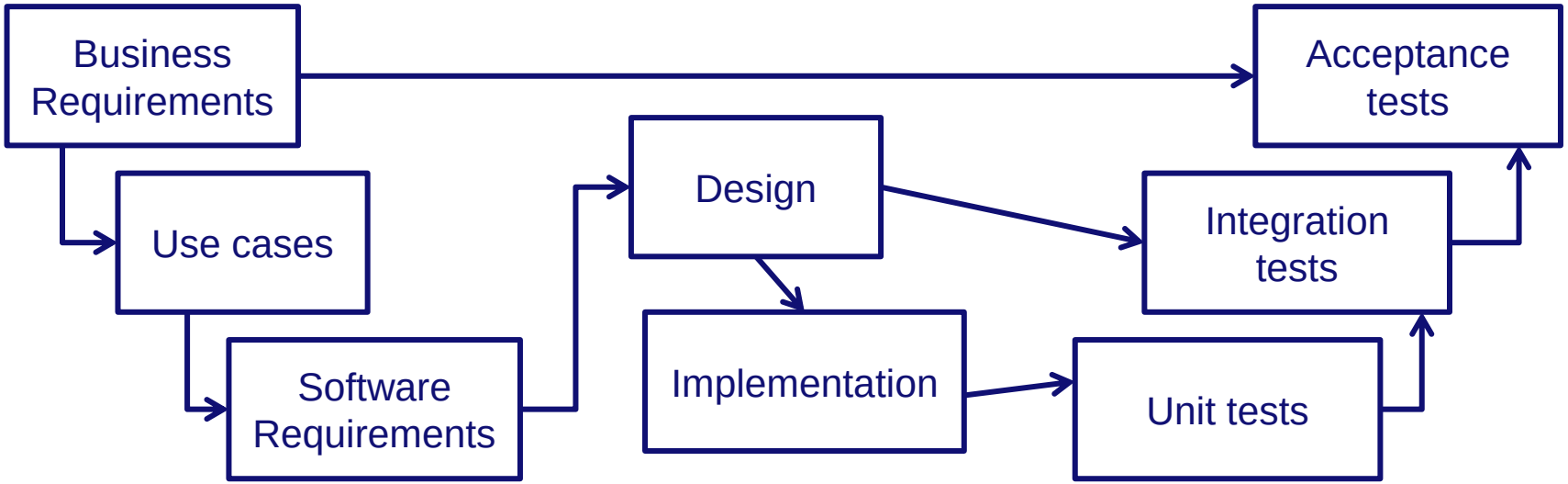
- **The usual answer is "*traceability*"**

	Req1	Req2	Req3	Req4	Req5	Req6	Req7	Req8
Test1	X							X
Test2	X							
Test3		X	X					
Test4				X				
Test5				X	X			
Test6					X			
Test7						X	X	

- **The "*traceability matrix*" *above* shows the traceability between requirements and test cases**

Traceability

- **Unfortunately, if we want full traceability across multiple software artifacts, things are more complex**

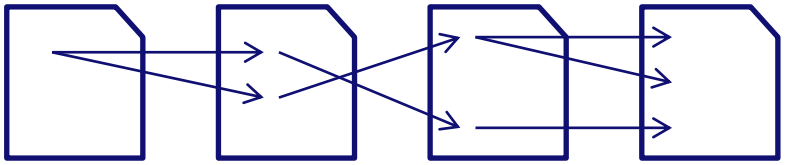


Traceability

- **There are different kinds of traceability relations:**
  1. **Direct relations between software artifacts**
     e.g. components (from design) vs. code units
  2. **Direct relations between units of a software artifact**
     e.g. business requirements vs. software requirements
  3. **Indirect (transitive) relations between software artifacts**
     e.g. business requirements vs. acceptance tests
- **To investigate the last category, we need to look at "*traceability chains*"**

Traceability

- **To investigate indirect relations using traceability matrices, we usually end up with:**
  - Multiple artifact elements in a big matrix (1-to-n relations)
  - Matrices spread over multiple artifacts



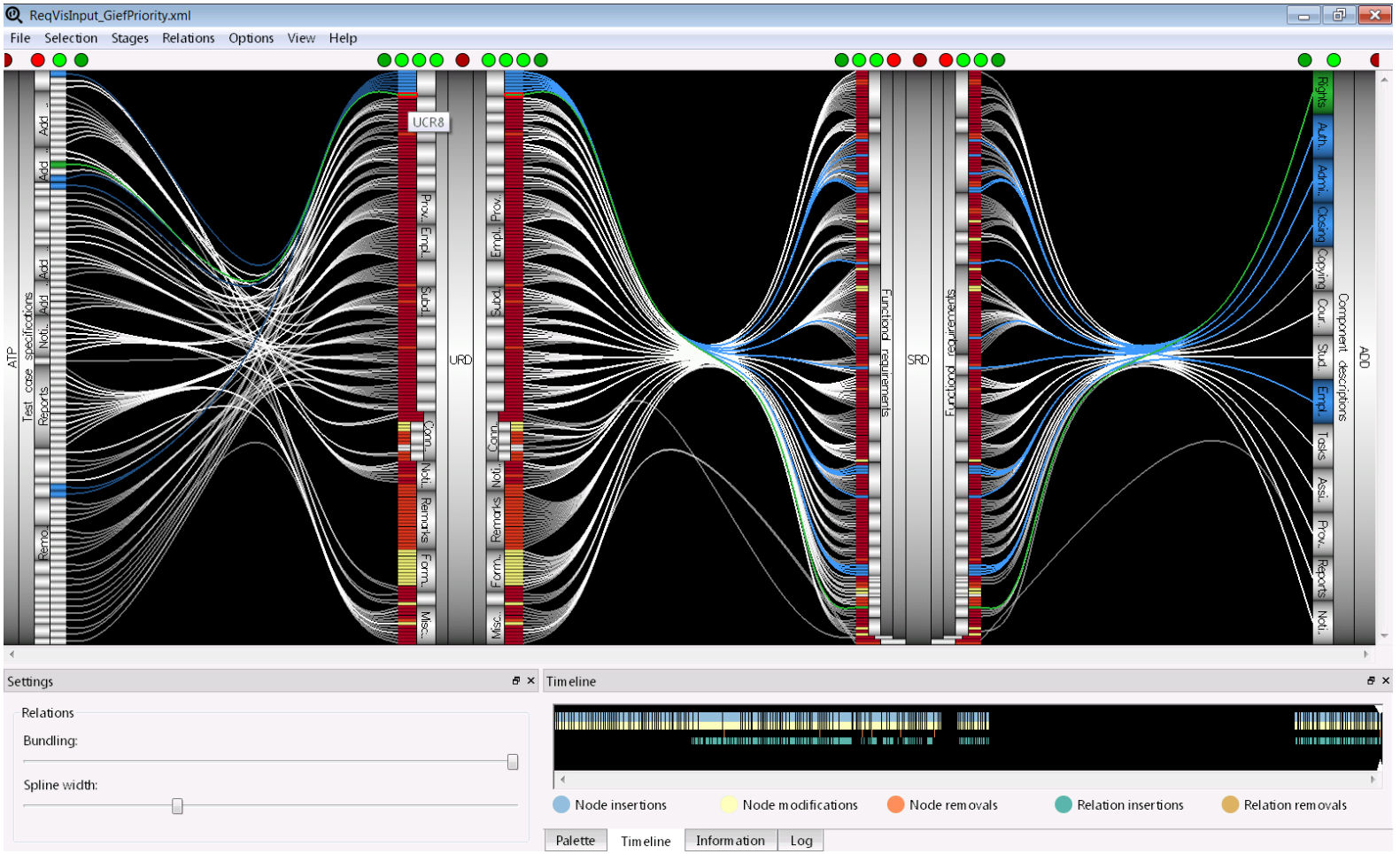
- **“Seeing things” and changing things in either of these setups can be challenging**
- **The effect of a change is difficult to assess**

Traceability with TraceVis

- **In 2011, Wiljan van Ravensteijn started TraceVis as part of his Masters Project at the TU/e**

- **The goal was to create a visual analytics tool to:**
  - Visualize traceability relations with hierarchies
  - Allow interactive manipulation of the view
  - Show the co-evolution of traceability across artifacts

TraceVis



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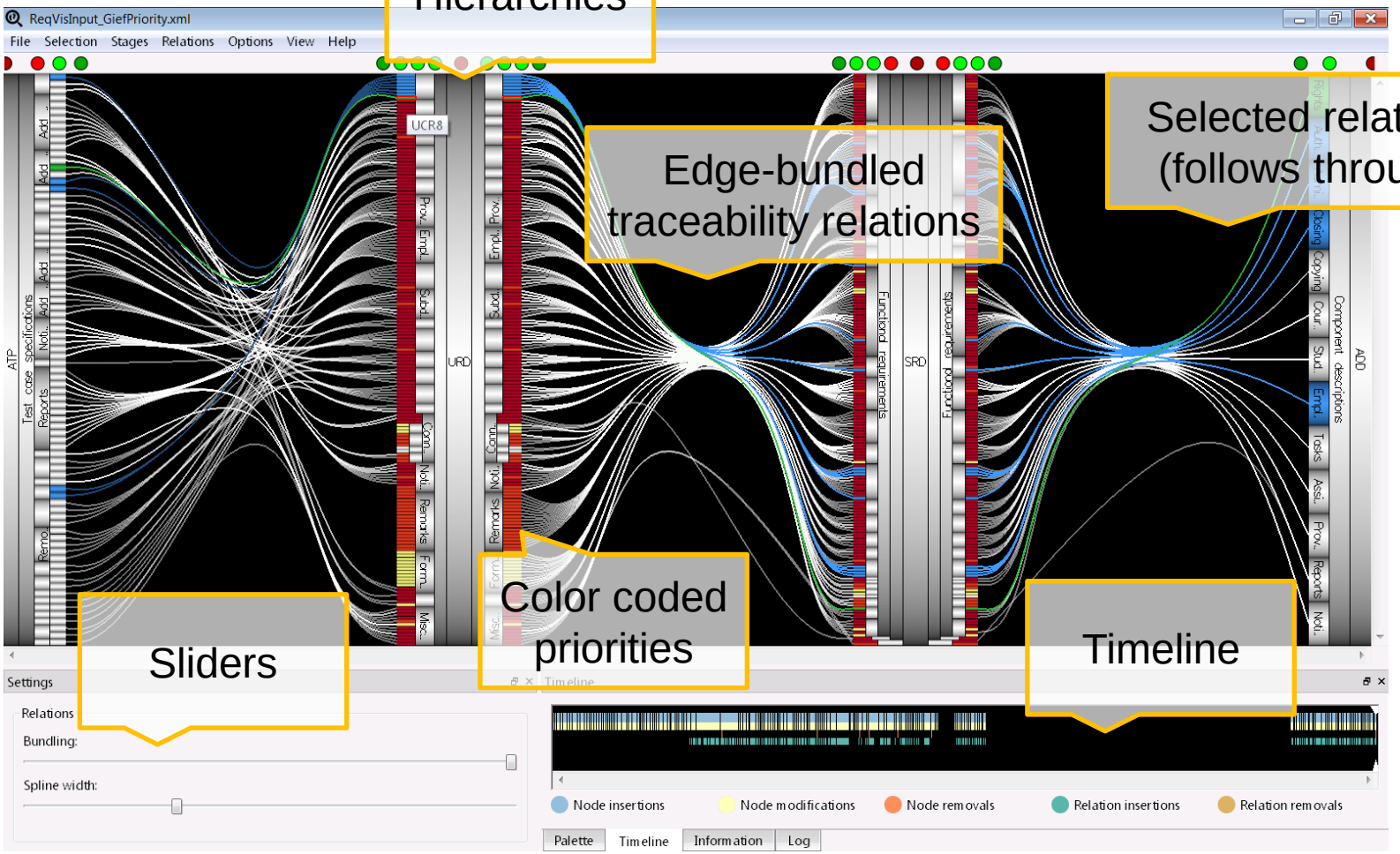
TraceVis - Overview



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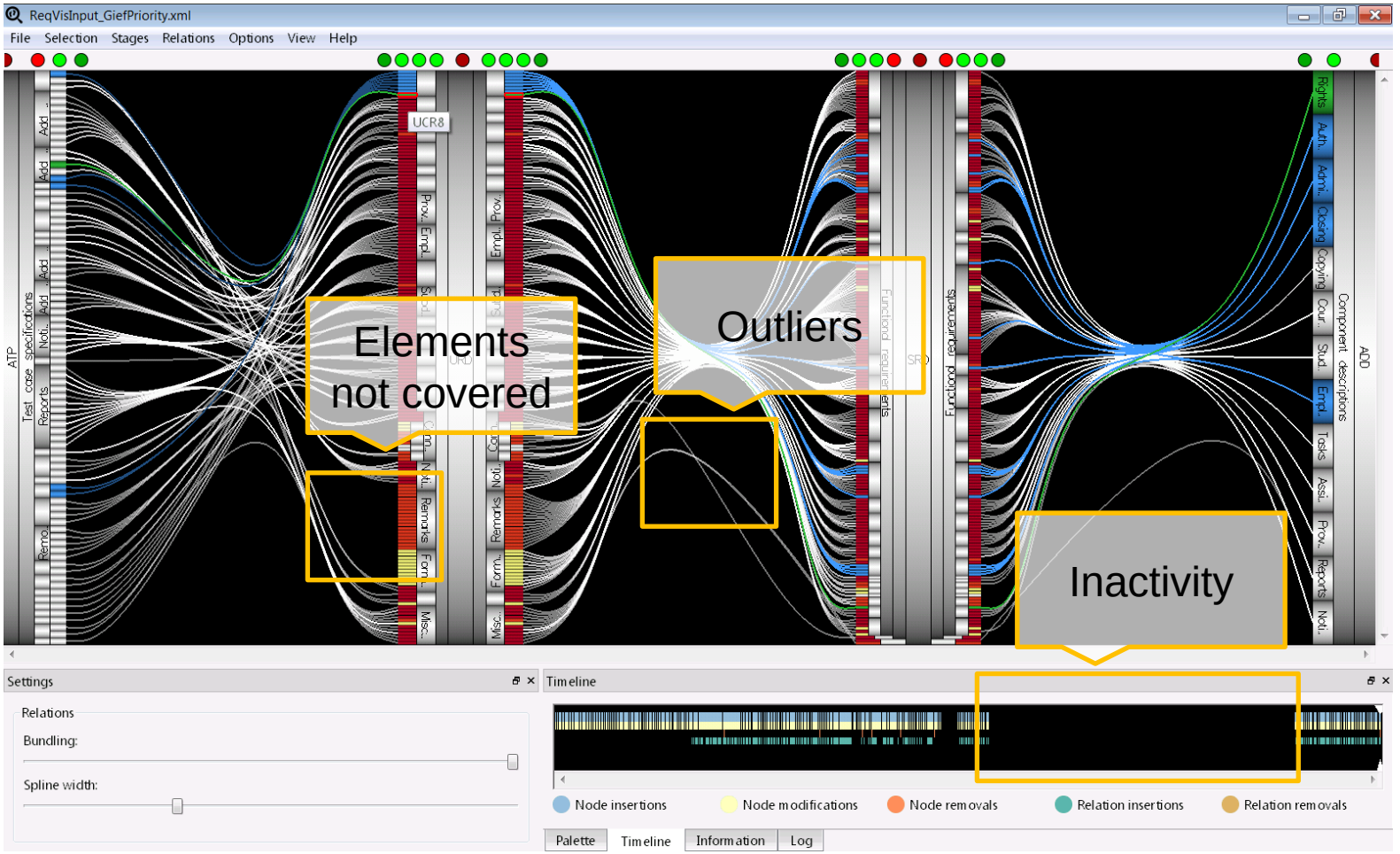
TraceVis - Patterns



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Short Demo

Conclusions

- **With TraceVis, we can:**
  - Interactively visualize traceability relations at different levels
  - Spot anomalies such as outliers, empty spaces, inactivity, etc. without knowing in advance what they look like
  - Browse through the timeline and see how things evolve
- **We can get insight into:**
  - Coverage (or the lack thereof) between artifacts
  - Distribution of traceability relations between artifacts
  - The co-evolution of artifacts
  - The completeness of traceability chains

Future research

- **Often, the traceability information is (partly) missing:**
  - Investigate to what extent we can reconstruct traceability information from artifacts
    - Extract an *architecture proposal* from code
    - Extract unit test vs. code traceability from code
- **We want to optimally steer development / test effort:**
  - Investigate problems with traceability in practice
    - Visualizing industrial datasets
  - Extend TraceVis with additional analysis features

Thank you!

Questions / Feedback / Ideas?