

Sustainable Development and Management of Systems Engineering Models

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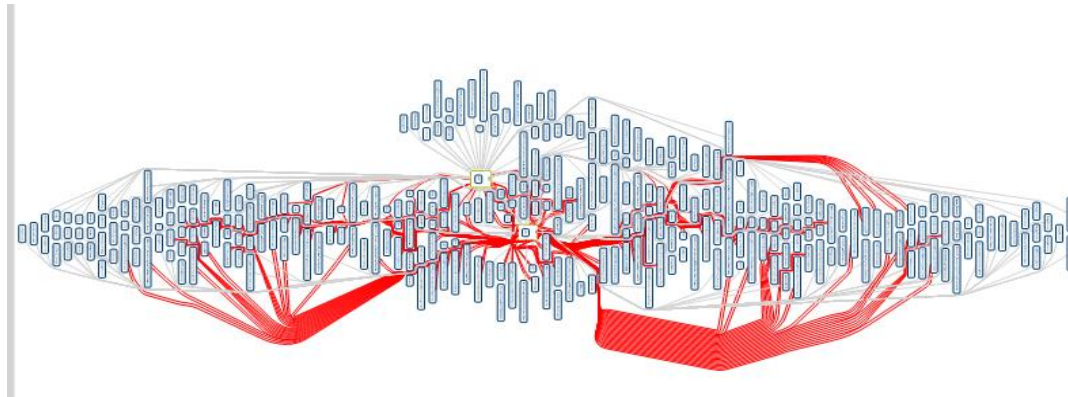
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Why we need Sustainability in System Modeling

Several decades of knowledge!

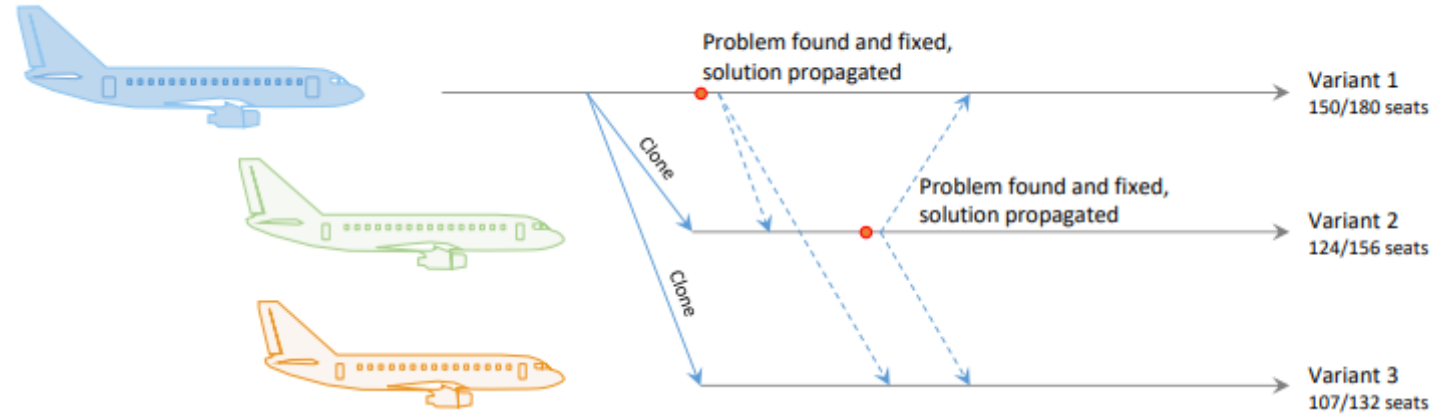
What happens if something has to be changed?



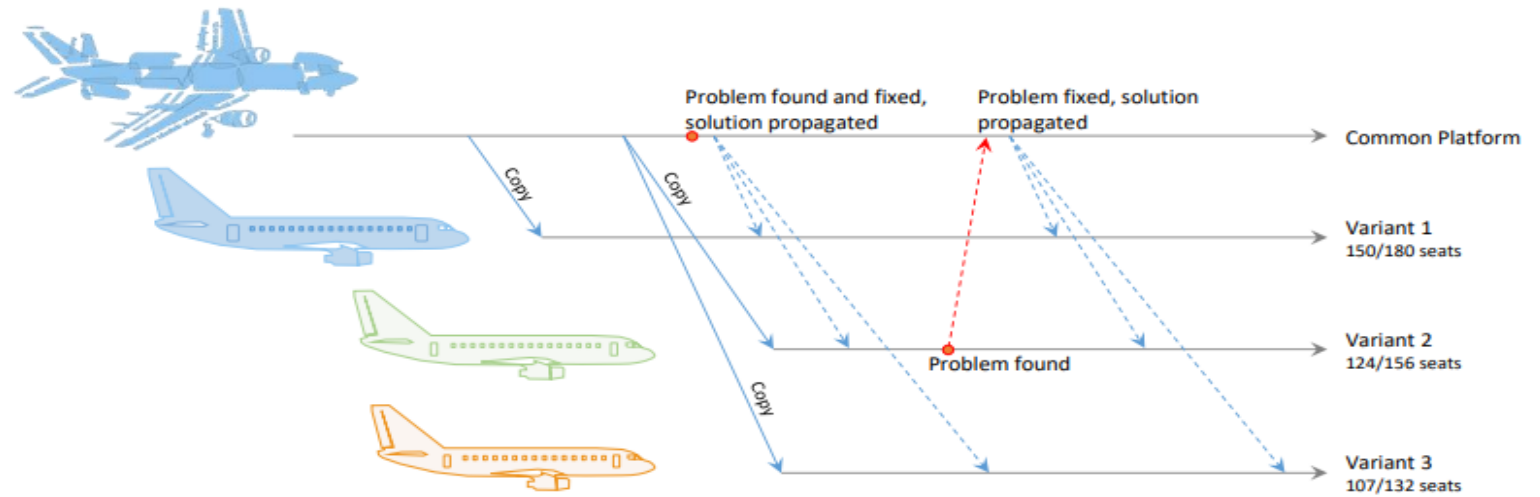
Metric	Value
# Elements	139.045
# Connections	79.059
# Attributes	49.534
# Packages	8.809

An Example

Clone & Own



Platform



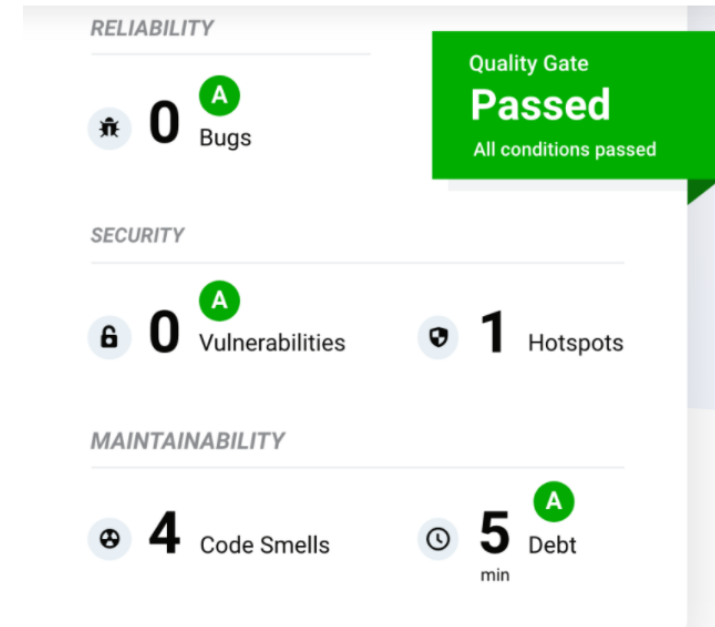
Managing Sustainability in System Models

Limitations of current Visualization approaches

- Work well for software code
- But what about system models?
- How to measure sustainability in system models?
- What are measures to improve sustainability?

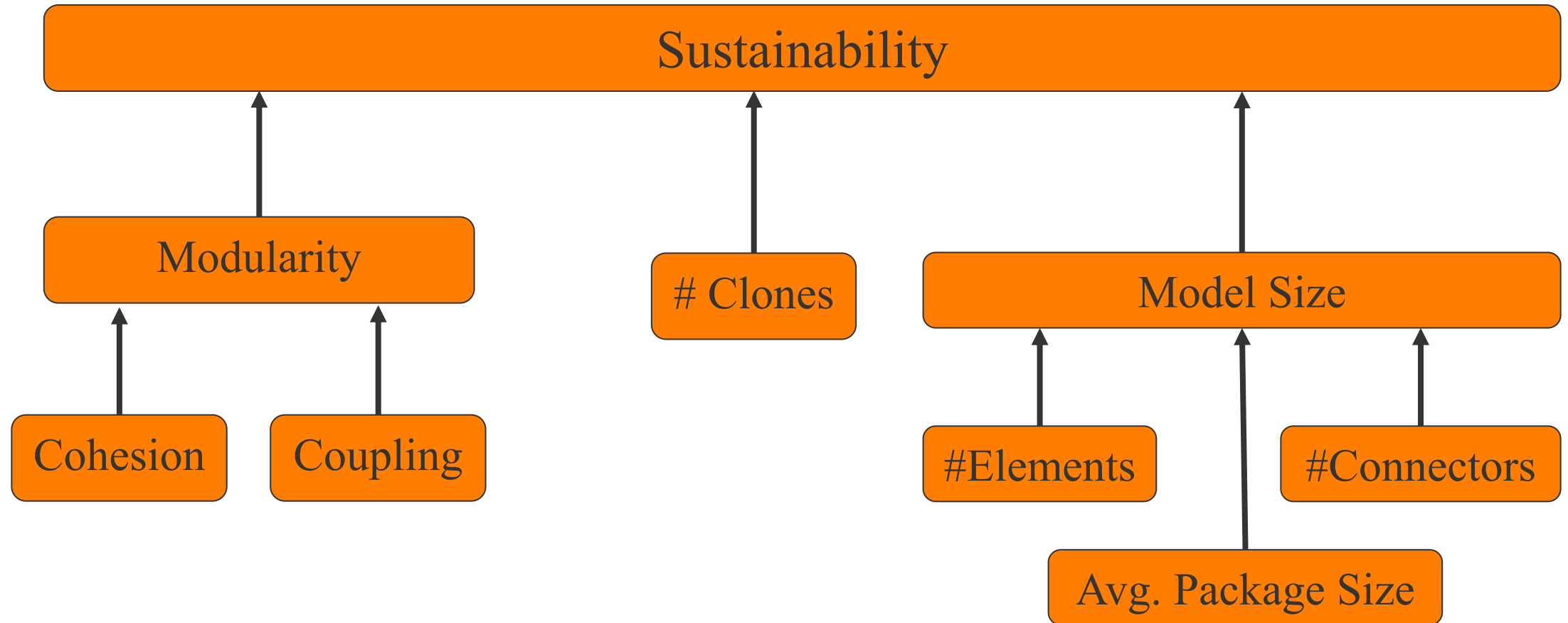
Solution: System Model Monitoring Dashboard

- Visualizing Sustainability
- Recommendations for Action
- Continuous Improvement



<https://www.sonarqube.org/>

Measuring Sustainability (1/2)



Measuring Sustainability (2/2)

Example Calculation

- $\#elems = Sum(model.getElements())$
- $modelSize = \#elems * ElemWeight + \#cons * connectionWeight + avgPckgSize * pckgSizeWeight$

Open Challenges

1. How to access model information?
 - For different versions of the same model?
2. What is the practical relevance of the metrics?
3. What is the weight of individual metrics in practice?
4. How to derive actions from metric results?

Visualizing Sustainability

Project 1 optimized

Elemente 30 A	Klone 5 B	Verknüpfungen 20 C	durchschnittliche Paketgröße 50 D
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[Details](#)

Project 2 semi

Elemente 35 B	Klone 10 C	Verknüpfungen 20 C	durchschnittliche Paketgröße 40 C
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[Details](#)

Project 3 unoptimized

Elemente 65 D	Klone 15 D	Verknüpfungen 15 C	durchschnittliche Paketgröße 50 D
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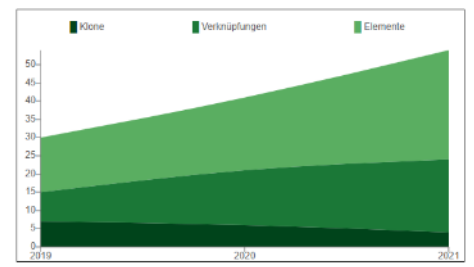
[Details](#)

[30](#) Elemente

[5](#) Klone

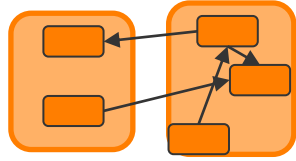
[20](#) Verknüpfungen

[50](#) durchschnittliche Paketgröße

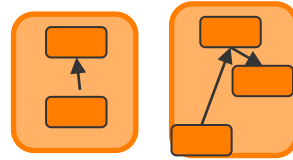


Potentials of AI

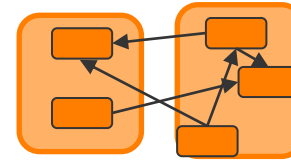
- Heuristic Search for Metric Optimization



Baseline Model:
Sust. = 50 %

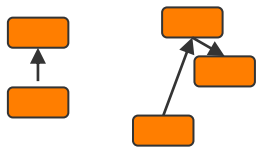


Model Variant 1:
Sust. = 70 %

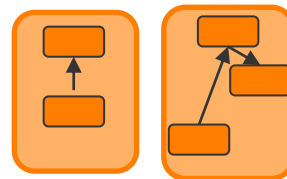


Model Variant 2:
Sust. = 40 %

- Unsupervised Learning for (Re-)Modularization



Baseline Model



Packaged Model

- Reinforcement Learning for Improvement over time
 - Improvement of metric combination
 - Improvement of refactoring techniques

Conclusion

- System Models developed over many years
- Sustainability currently neglected
 - What happens after a change?
- Model Monitoring Dashboard for Sustainability Management
- Potentials of AI for Improving Sustainability



Recommendations for Action

