

# See it to Believe it? The Role of Visualisation in Systems Research

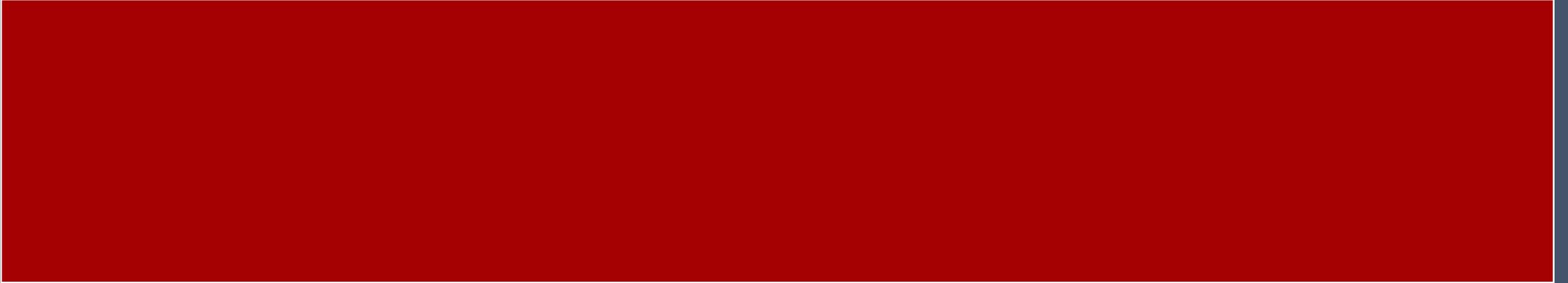
VISION PAPER

**Thomas Davidson, Max Planck Institute for Software Systems, Germany**

Jonathan Mace, Max Planck Institute for Software Systems, Germany

# The Role of Visualisation in Systems Research

The Problem



Our Solution



# The Role of Visualisation in Systems Research

## The Problem

Work wants to be adopted



## Our Solution

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Work wants to be adopted



Have to consider the end-user

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Have to consider the end-user

How well does existing work present user facing aspects?



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Visualisation

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Visualisation

Room for Improvement

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Missing

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Visualisation

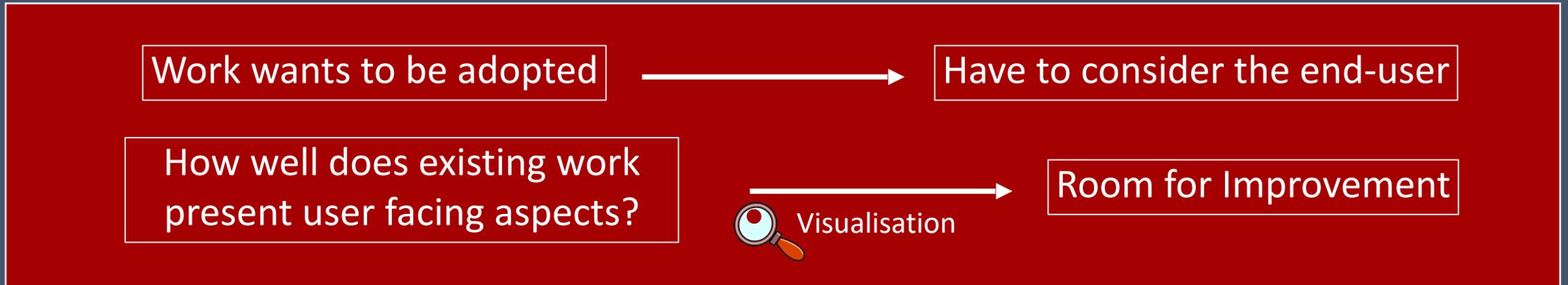
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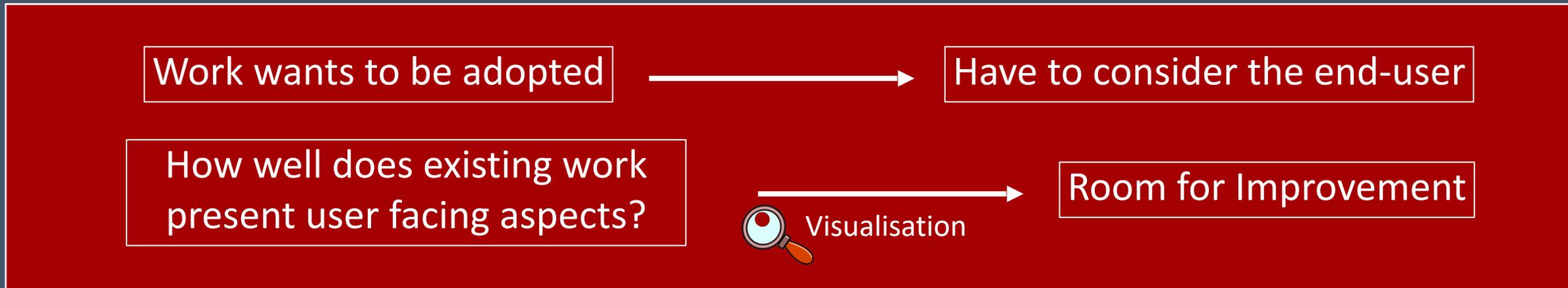
## Our Solution



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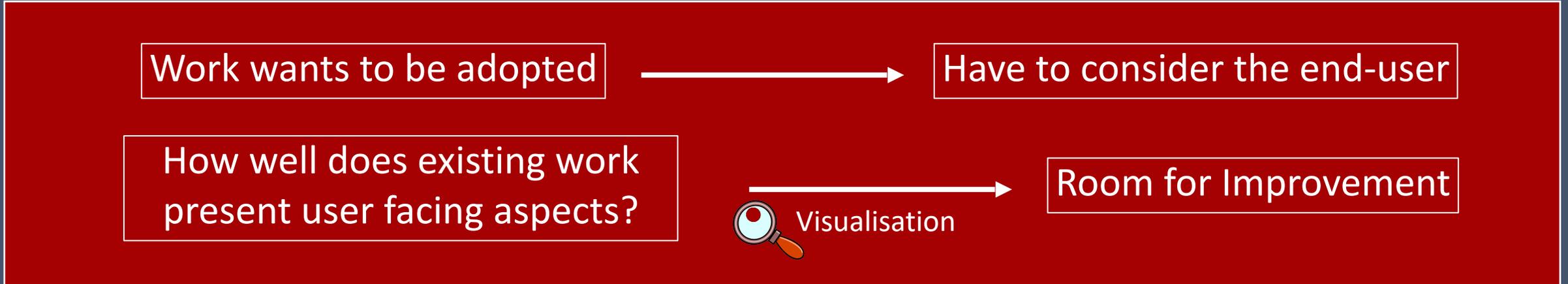
## Our Solution



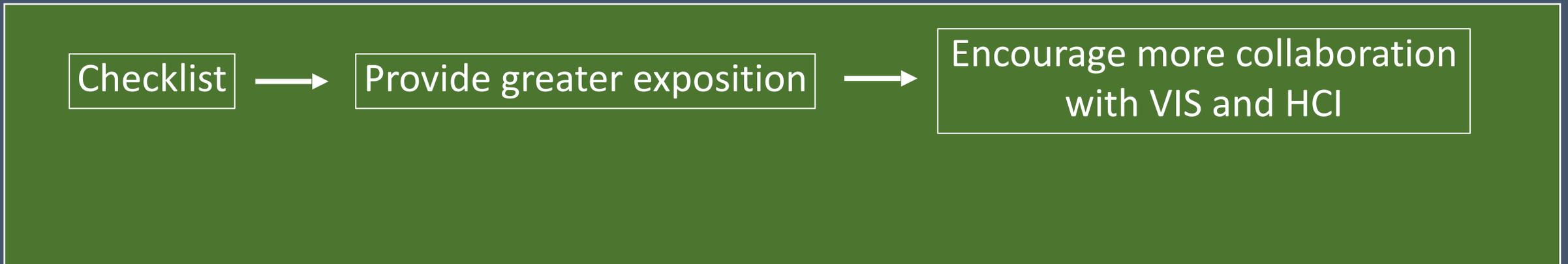
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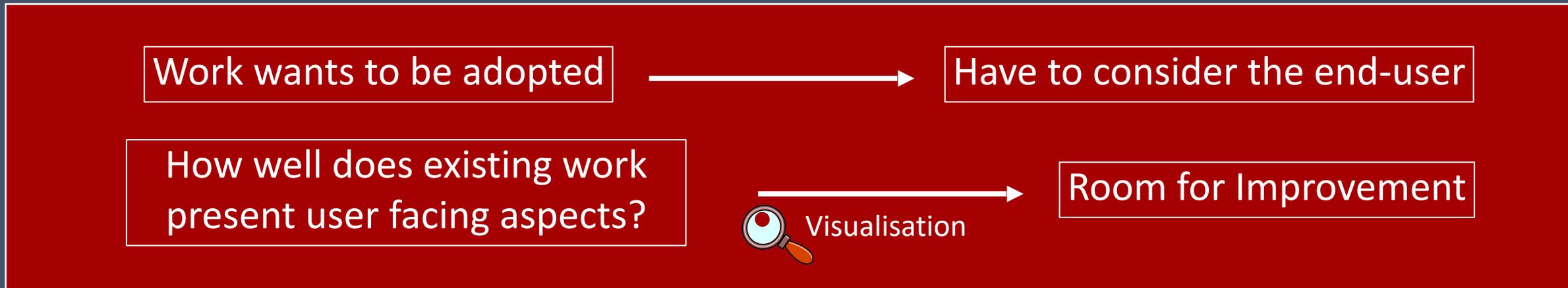
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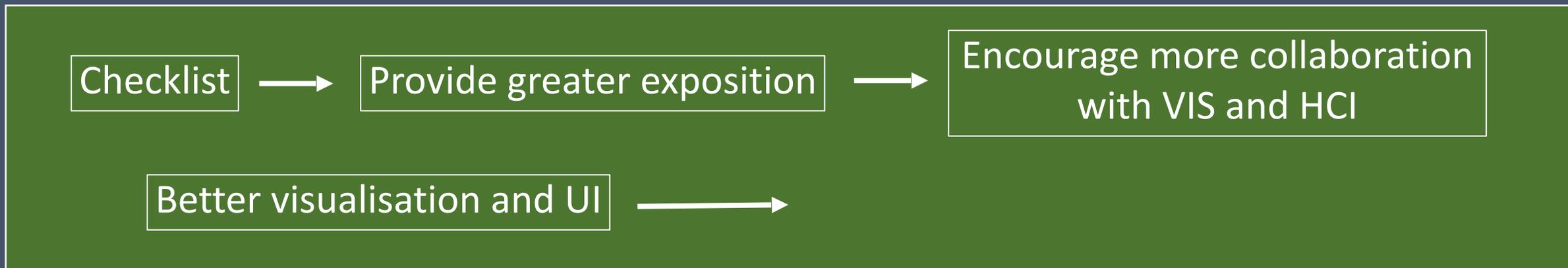
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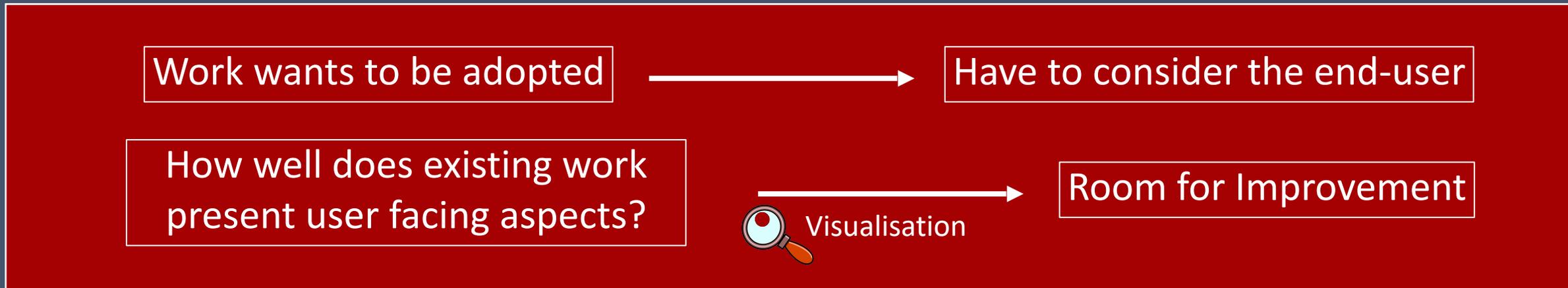
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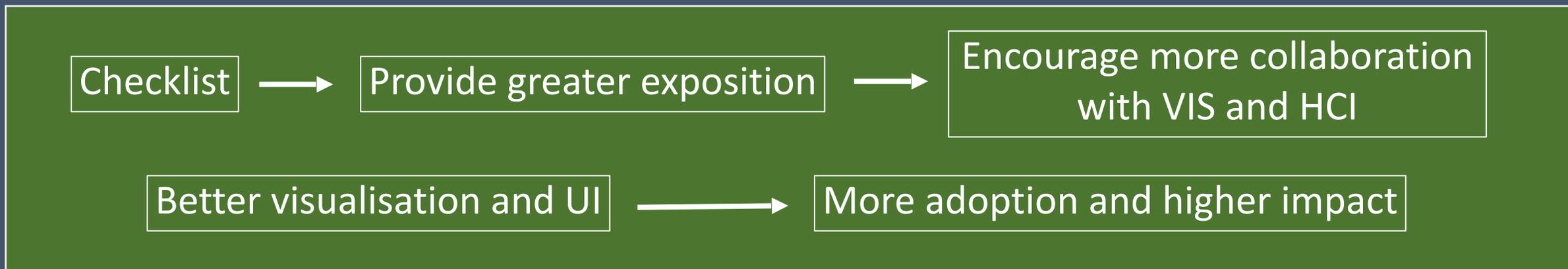
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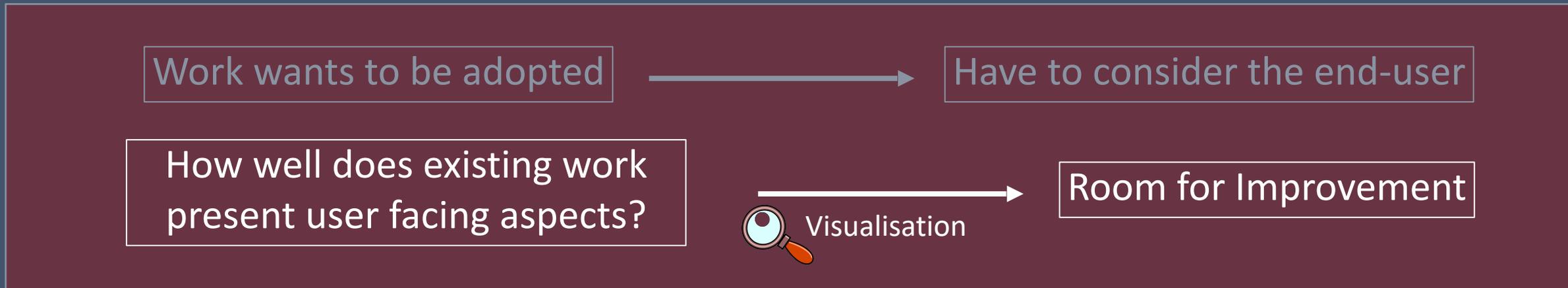
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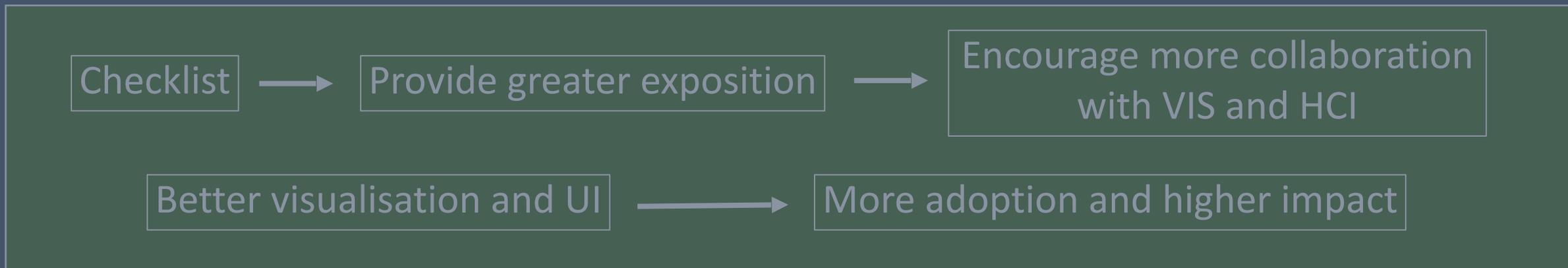
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# The Role of Visualisation in Systems Research

## The Problem



## Our Solution



Survey – What kind of work are we interested in?

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- Human-in-the-Loop Tools

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Visualisation-in-the-Loop Tools  
(VL-Tools)

# Survey - Conferences

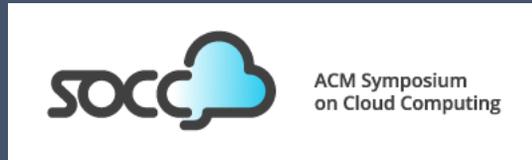


nsdi



2017 - 2021

OSDI



=



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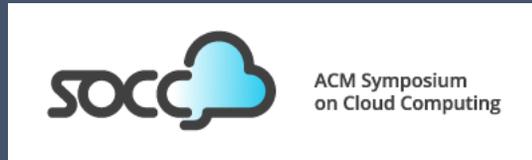


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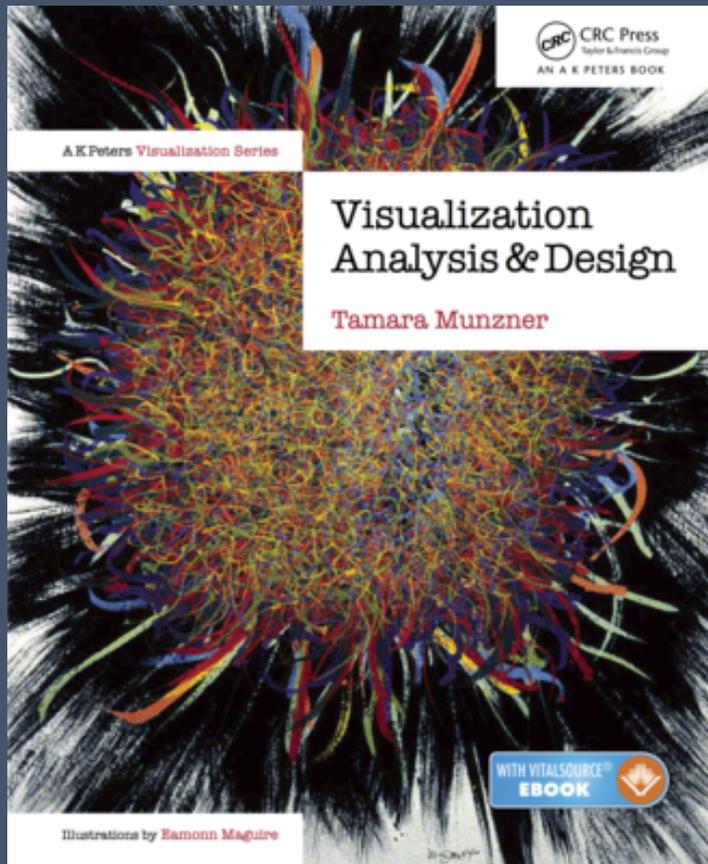


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1,274 Full Papers

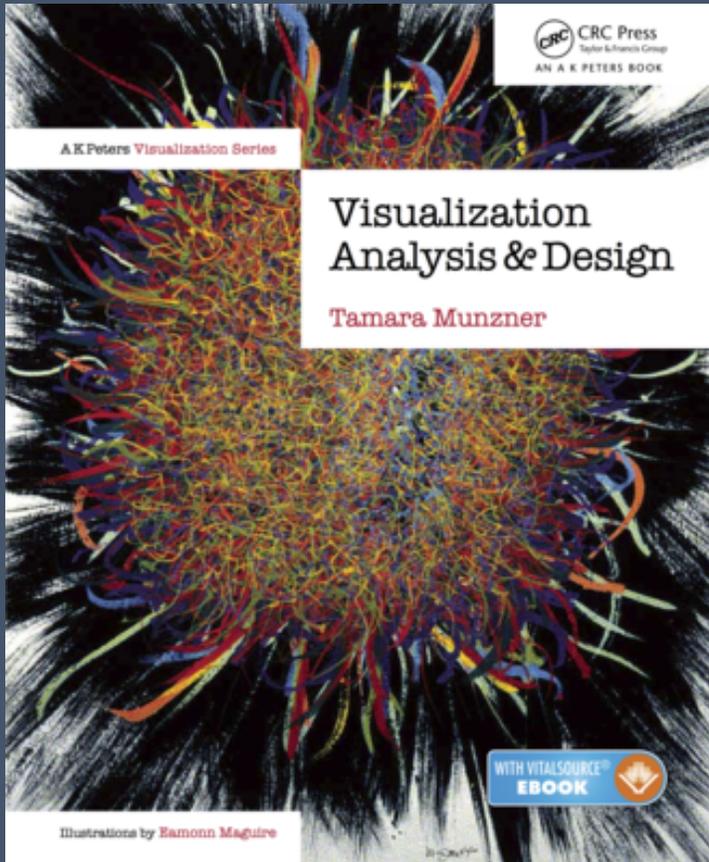


# Survey - Design



Munzner, Tamara. *Visualization analysis and design*. CRC press, 2014.

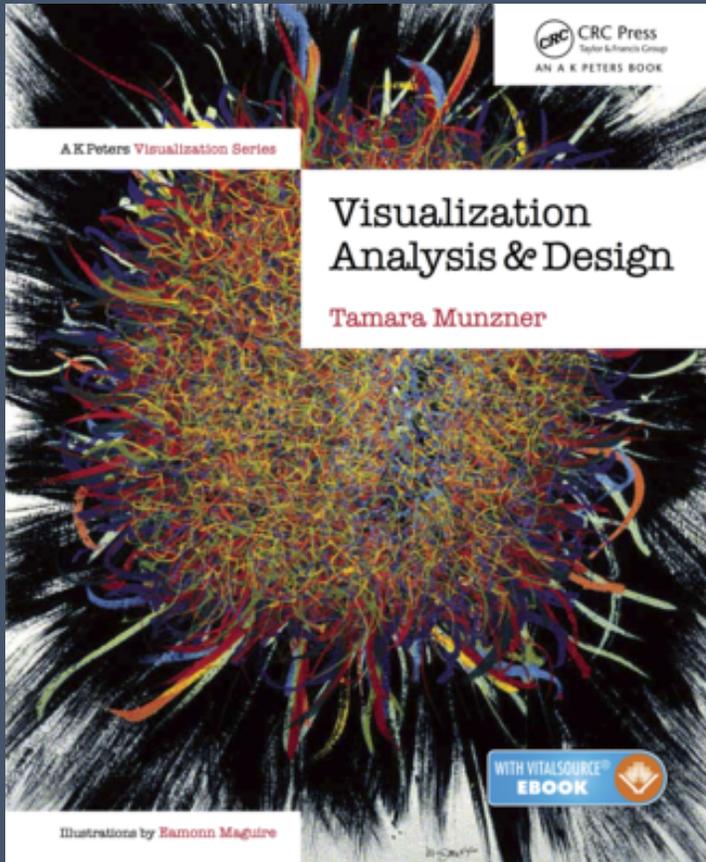
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The What Why How Idiom

# Survey - Design



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## The What Why How Idiom

“*What* data the user sees, *why* the user intends to use a vis tool, and *how* the visual encoding and interaction idioms are constructed in terms of design choices”

# Survey - Questions

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What Why How?

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- Q1: Does the paper present a VL-Tool?

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# Survey - Execution

Q1: Does the paper present a VL-Tool?

Possible answers: Yes, Unclear, No

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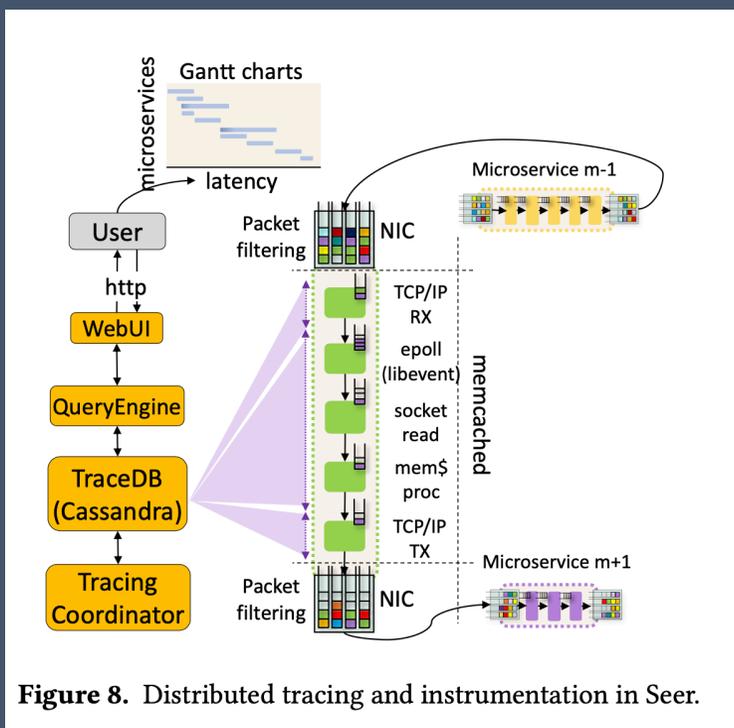
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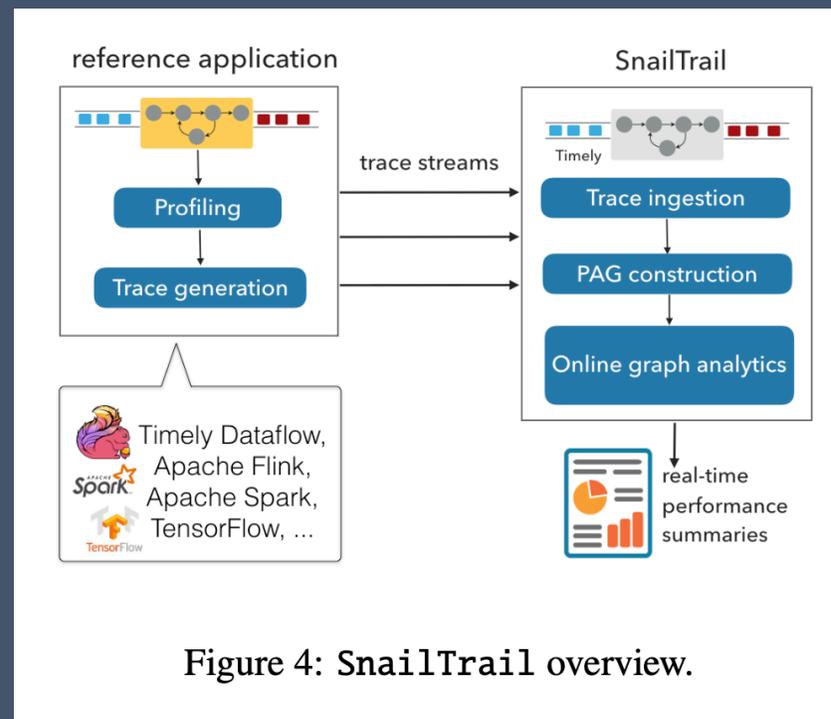
# Survey - Execution

Q2: Does the paper show a screenshot or a mock-up of the tool?

Possible answers: Yes, Partial, No



Partial

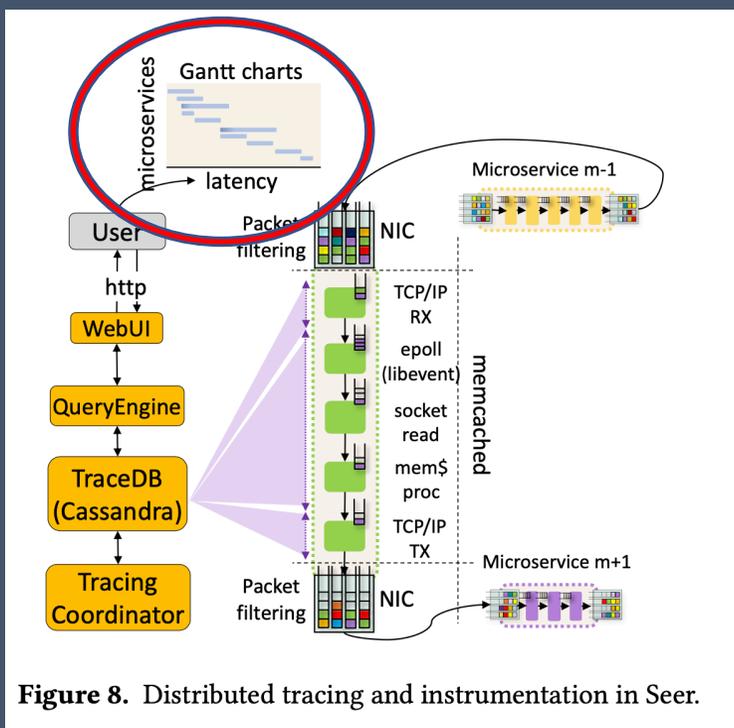


No

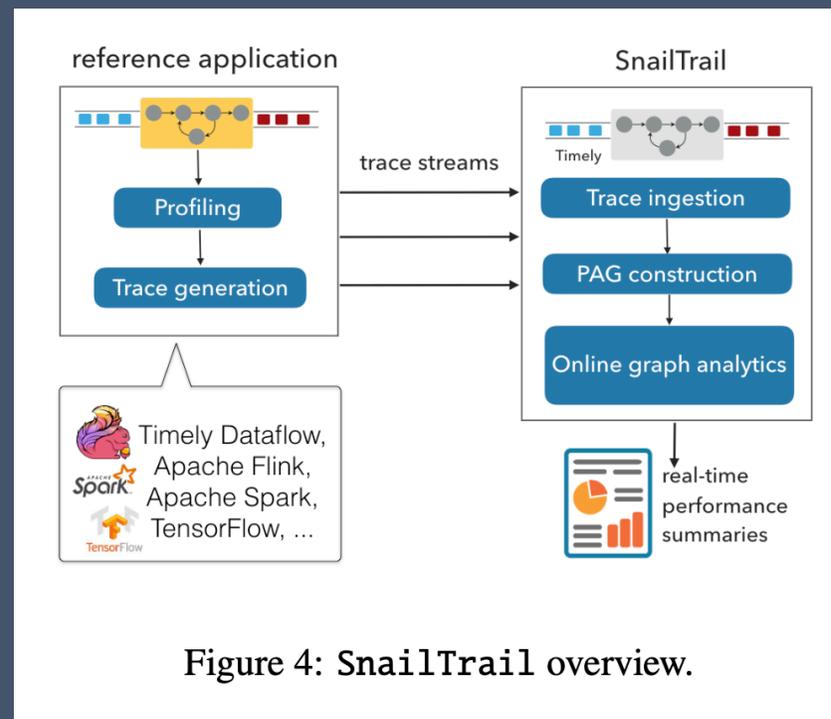
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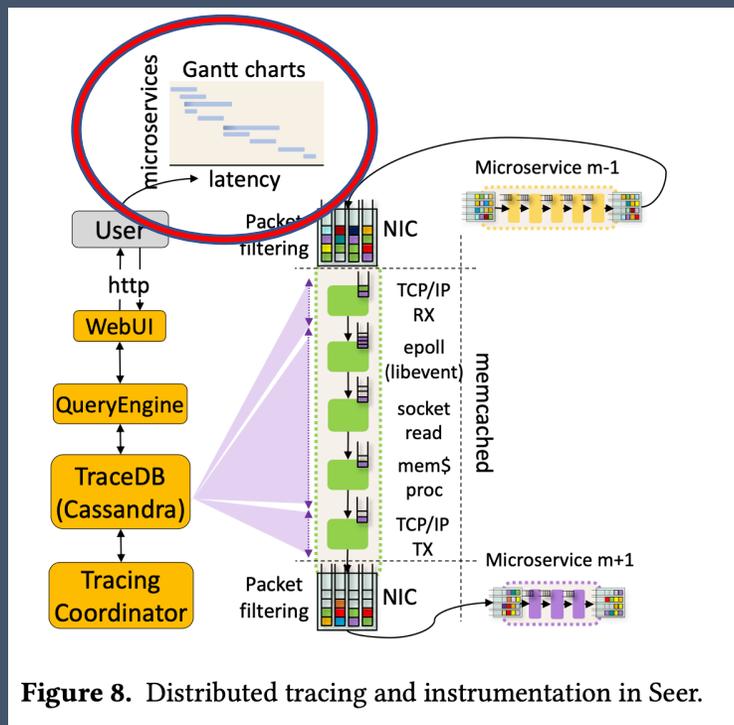


No

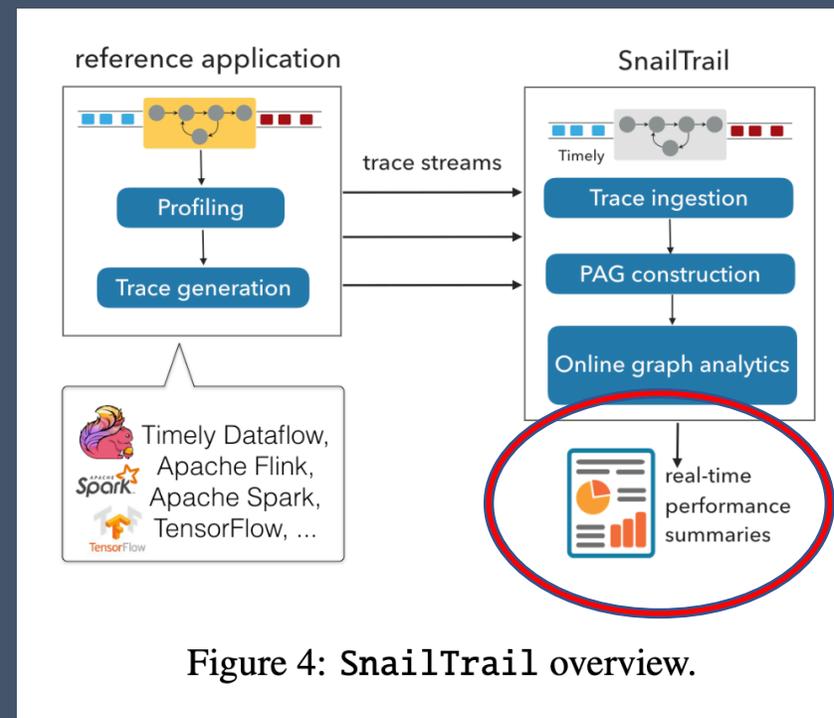
# Survey - Execution

Q2: Does the paper show a screenshot or a mock-up of the tool?

Possible answers: Yes, Partial, No



Partial



No

# Survey - Execution

- Q3: Does the paper explain the user-facing output?
- Q4: Does the paper motivate the user-facing output?
- Q5: Does the paper design user-facing components?

Possible answers: Yes, No

# Survey - Results

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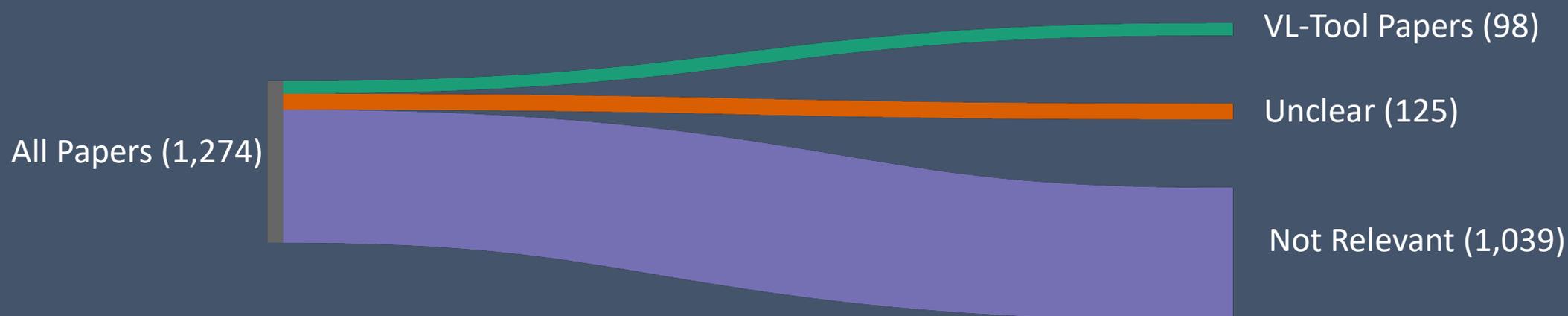
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(%)	7.7	9.8	81.5	28.6	12.2	59.2	37.8	62.2	17.4	82.6	12.2	87.8

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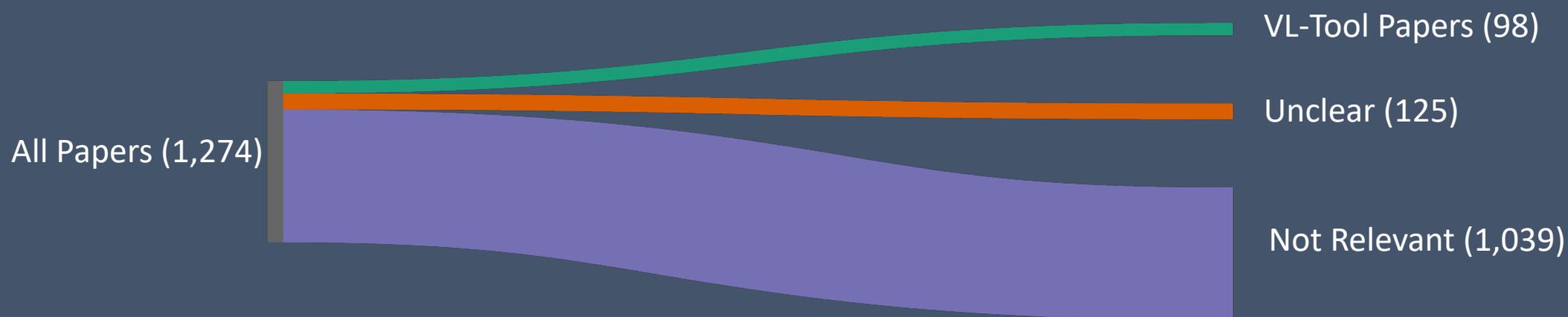
# Survey - Results

VL- Tools are a sizeable minority

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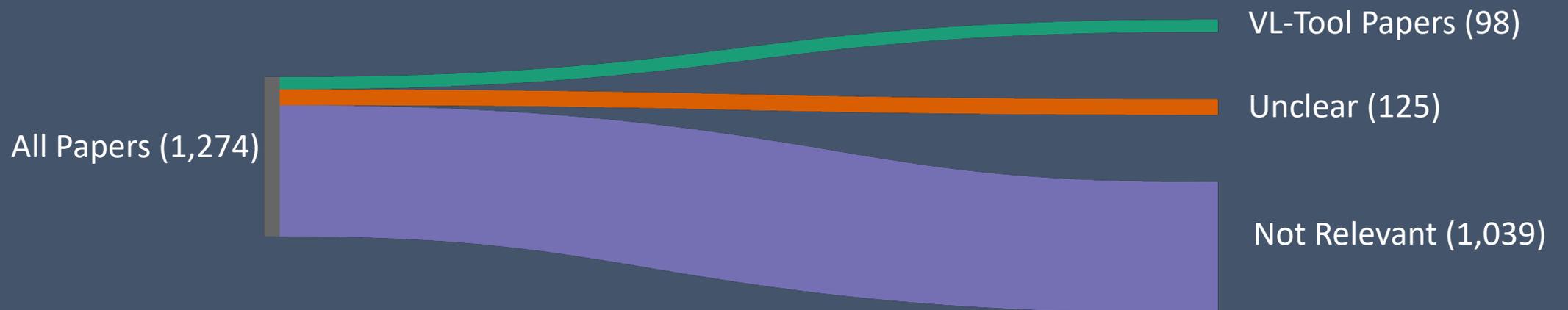
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Lots of work is ambiguous

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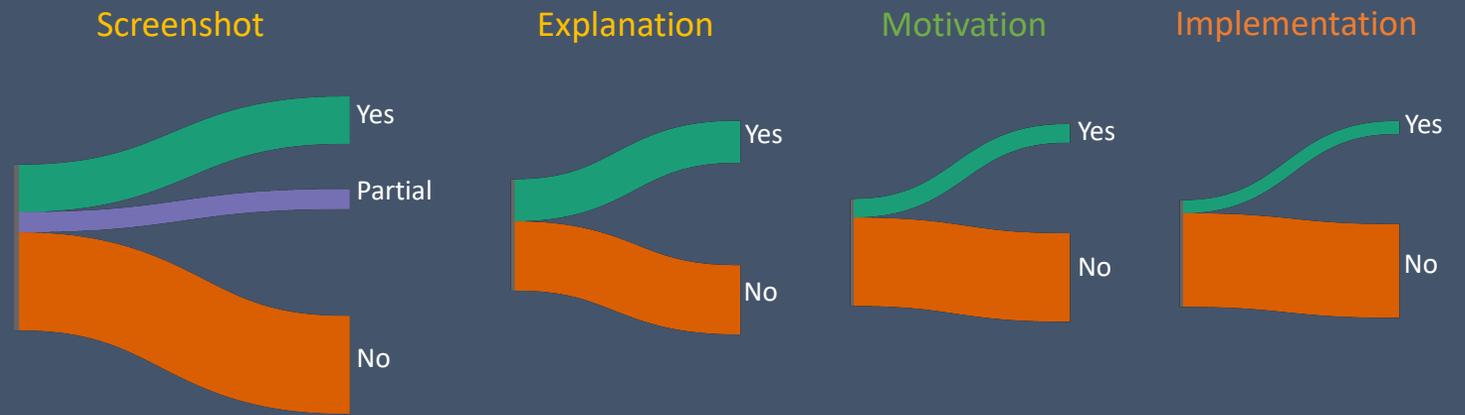
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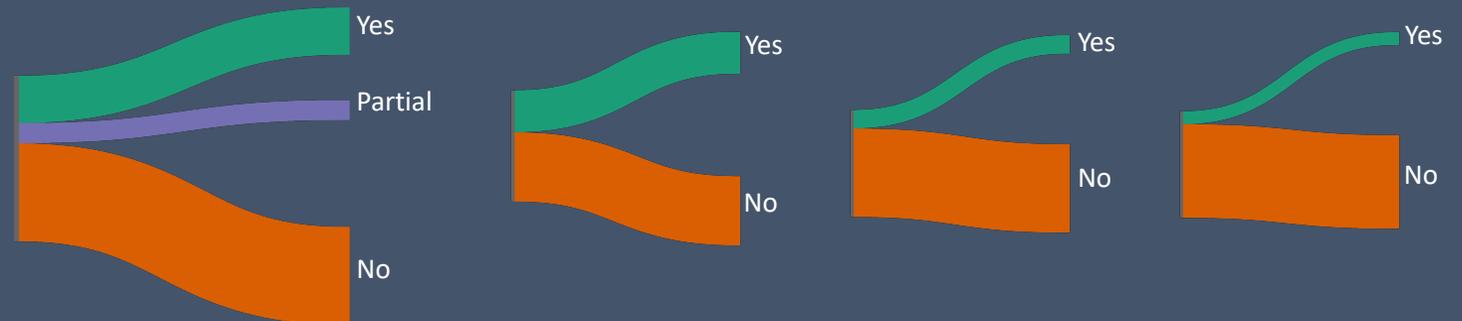
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Screenshot

Explanation

Motivation

Implementation



In general, visualisation and user-facing aspects are underrepresented

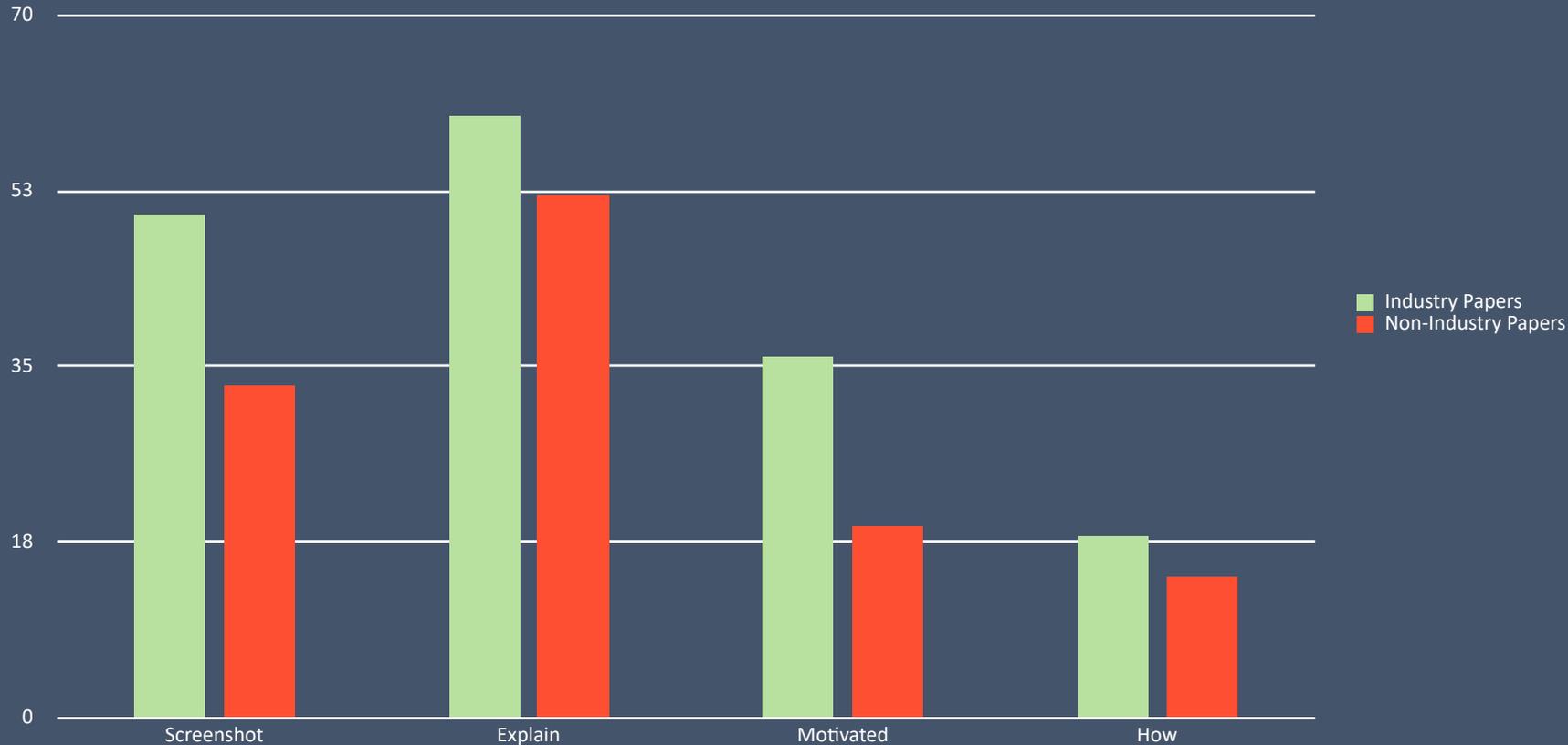
# Survey – Results (Industry)

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Percentage of Papers Satisfying Each Question

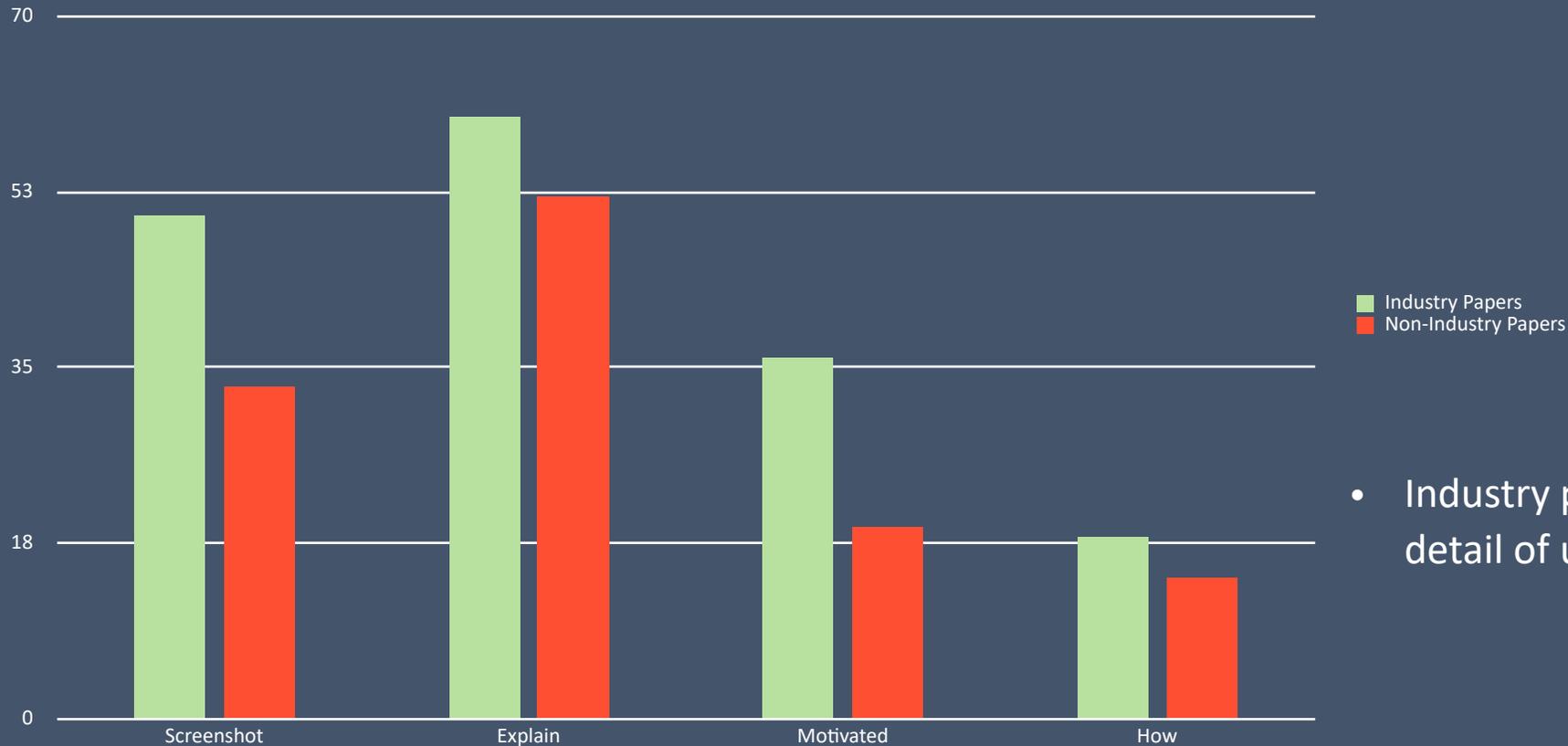


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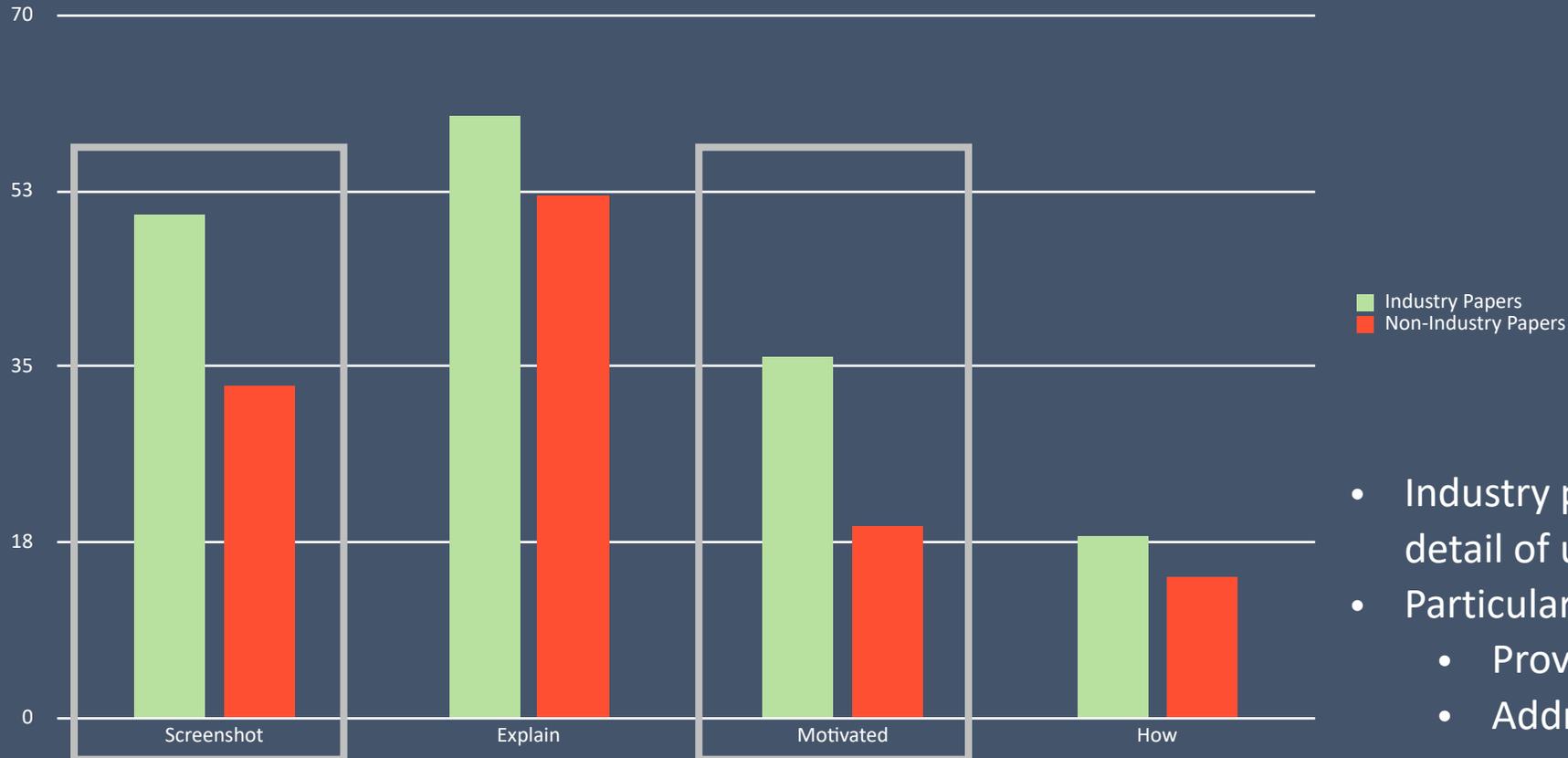
- Industry papers consistently give more detail of user-facing aspects

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Percentage of Papers Satisfying Each Question



- Industry papers consistently give more detail of user-facing aspects
- Particularly
  - Providing screenshots
  - Addressing user needs

# Survey - Consequences



# Survey - Consequences



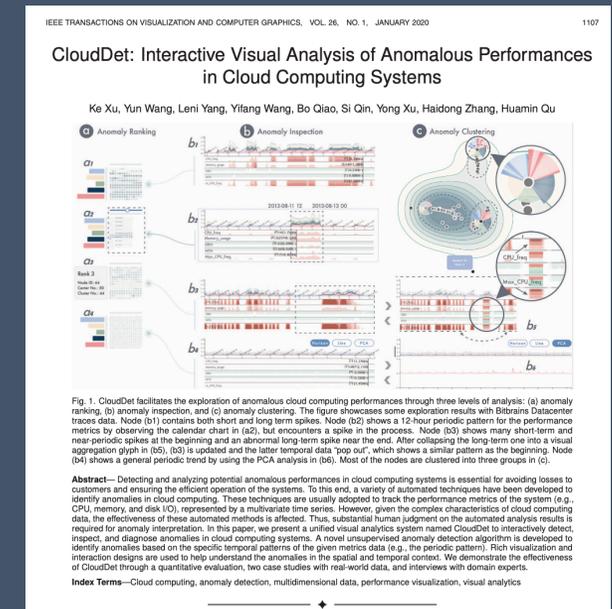
1,000 Papers



# Survey - Consequences



Just 1 VL-Tool Paper



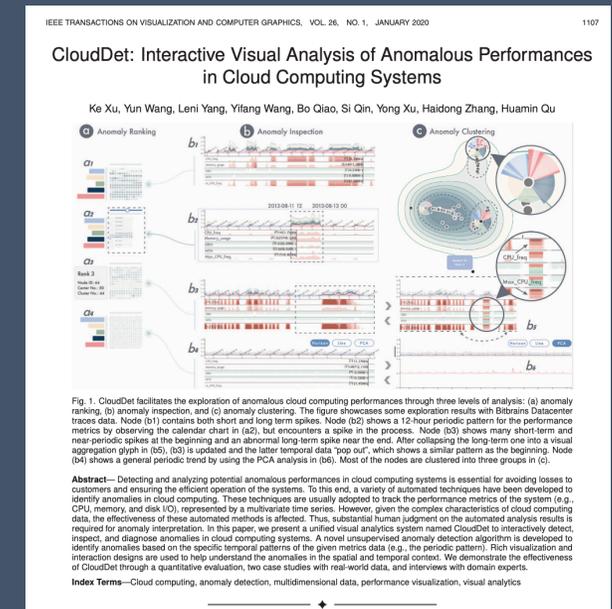
Xu, Ke, et al. "Clouddet: Interactive visual analysis of anomalous performances in cloud computing systems." *IEEE transactions on visualization and computer graphics* 26.1 (2019): 1107-1117.

# Survey - Consequences



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(7 Tangential Papers)

# Survey - Opportunities

## VL-Tools

- Multi-dimensional data
- Highly structured data
- Complex data

# Survey - Opportunities

VL-Tools

- Multi-dimensional data
- Highly structured data
- Complex data

Medical Sciences

Bioinformatics

# Survey - Opportunities

## VL-Tools

- Multi-dimensional data
- Highly structured data
- Complex data

Medical Sciences



The screenshot shows the website for VIS2020 VIRTUAL. The main navigation bar includes links for Schedule, All Events, Papers, Posters, Speakers, Awards, Help, and Register. The current page is titled 'VIS Full Papers / Health & Disease'. The main content area features the session title 'VIS Full Papers: Health & Disease', the session chair 'David Gotz', and the date and time 'Friday, Oct 30th, 2020 @ 15:00 - 16:30 GMT+02:00'. There are also links for 'Jump to event listing', 'Jump to Fast Forwards', and 'Add to Calendar'.

Bioinformatics

# Survey - Opportunities

## VL-Tools

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- Highly structured data
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Medical Sciences



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Bioinformatics



# Survey - Opportunities

## VL-Tools

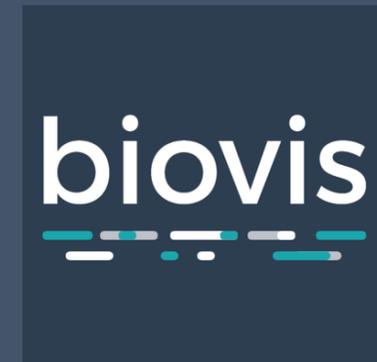
- Multi-dimensional data
- Highly structured data
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Medical Sciences



Bioinformatics

No such avenues currently for  
systems research



# So What Now? – The Checklist

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1. Explain the user's role

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*“Metis helps network operators to design, debug, deploy, and ad-hoc adjust DL-based networking systems”*

Interpreting Deep Learning-Based Networking Systems – SIGCOMM 2020

# So What Now? – The Checklist

1. Explain the user's role

# So What Now? – The Checklist

2. Include a Screenshot

1. Explain the user's role



# So What Now? – The Checklist

1. Explain the user's role
2. Include a screenshot

# So What Now? – The Checklist

3. Describe the data output and visualisation

1. Explain the user's role
2. Include a screenshot

# So What Now? – The Checklist

## 3. Describe the data output and visualisation

1. Explain the user's role
2. Include a screenshot

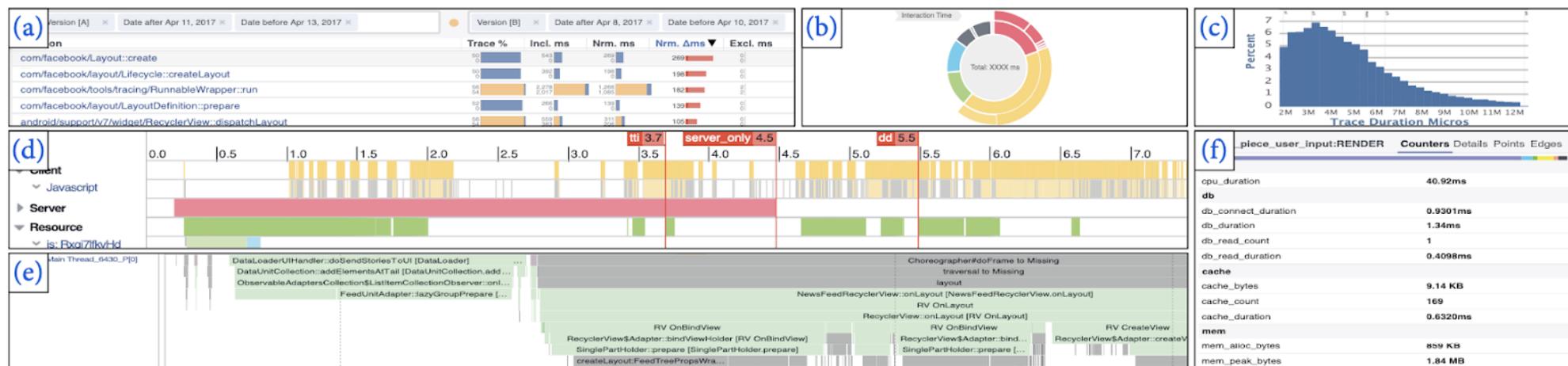


Figure 9: Engineers can use aggregate visualizations (a-c) to explore features. They can continue to drill down to individual traces (d-e) or elements within the trace (f). All visualizations support customizations to focus on relevant data for that view (cf. §4.5)

# So What Now? – The Checklist

1. Explain the user's role
2. Include a screenshot
3. Describe the data output and visualisation

# So What Now? – The Checklist

4. Motivate the visualisation from the users' perspective

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# So What Now? – The Checklist

4. Motivate the visualisation from the users' perspective

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*“This section describes what developers and users need to do to use Smart-Conf library and configurations...”*

# So What Now? – The Checklist

4. Motivate the visualisation from the users' perspective

1. Explain the user's role
2. Include a screenshot
3. Describe the data output and visualisation

*“This section describes what developers and users need to do to use Smart-Conf library and configurations...”*

*“With the above changes, users are completely relieved of directly setting performance-sensitive configurations.”*

Wang, Shu, et al. "Understanding and auto-adjusting performance-sensitive configurations." ACM SIGPLAN Notices 53.2 (2018): 154-168.

# So What Now? – The Checklist

1. Explain the user's role
2. Include a screenshot
3. Describe the data output and visualisation
4. Motivate the visualisation from the users' perspective

# So What Now? – The Checklist

5. Explain how you built it

1. Explain the user's role
2. Include a screenshot
3. Describe the data output and visualisation
4. Motivate the visualisation from the users' perspective

# So What Now? – The Checklist

5. Explain how you built it

1. Explain the user's role
2. Include a screenshot
3. Describe the data output and visualisation
4. Motivate the visualisation from the users' perspective

*“We are publicly releasing our analysis scripts and the underlying datasets via an interactive visualization interface and query API to encourage reproducibility of our results.”*

Dhamdhere, Amogh, et al. "Inferring persistent interdomain congestion." *Proceedings of the 2018 Conference of the ACM Special Interest Group on Data Communication*. 2018.

# So What Now? – The Checklist

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# So What Now? – Broader Changes

Short Term

Mid Term

Long Term

# So What Now? – Broader Changes

Short Term

- More Exposition

Mid Term

Long Term

# So What Now? – Broader Changes

## Short Term

- More Exposition

## Mid Term

- Specific Topic Areas
- More Collaboration

## Long Term

# So What Now? – Broader Changes

## Short Term

- More Exposition

## Mid Term

- Specific Topic Areas
- More Collaboration

## Long Term

- Increased Focus on VL and HL – Tools
  - Better design
  - Evaluation

# Summary

The Problem

Today's talk

The paper

# Summary

## The Problem

- A significant minority of systems research presents VL - Tools
- Visualisation lacks exposition
- Reduced impact and accessibility

## Today's talk

## The paper

# Summary

## The Problem

- A significant minority of systems research presents VL - Tools
- Visualisation lacks exposition
- Reduced impact and accessibility

## Today's talk

- Checklist for improving exposition

## The paper

# Summary

## The Problem

- A significant minority of systems research presents VL - Tools
- Visualisation lacks exposition
- Reduced impact and accessibility

## Today's talk

- Checklist for improving exposition

## The paper

- Future avenues and going beyond just exposition

Any Questions?

# See it to Believe it? The Role of Visualisation in Systems Research

VISION PAPER

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<https://gitlab.mpi-sws.org/cld/sysviz>