Requirements Visualization

Purpose

- Attempt to define overlap between SEViz and InfoViz
- Look for where opportunities lie for marriage of ideas

Two Decades of SE Visualization

- Development of visual notations and techniques for defining and communicating the understanding of a problem, its requirements and possible designs
- The demand for shared conventions has ultimately led to the UML

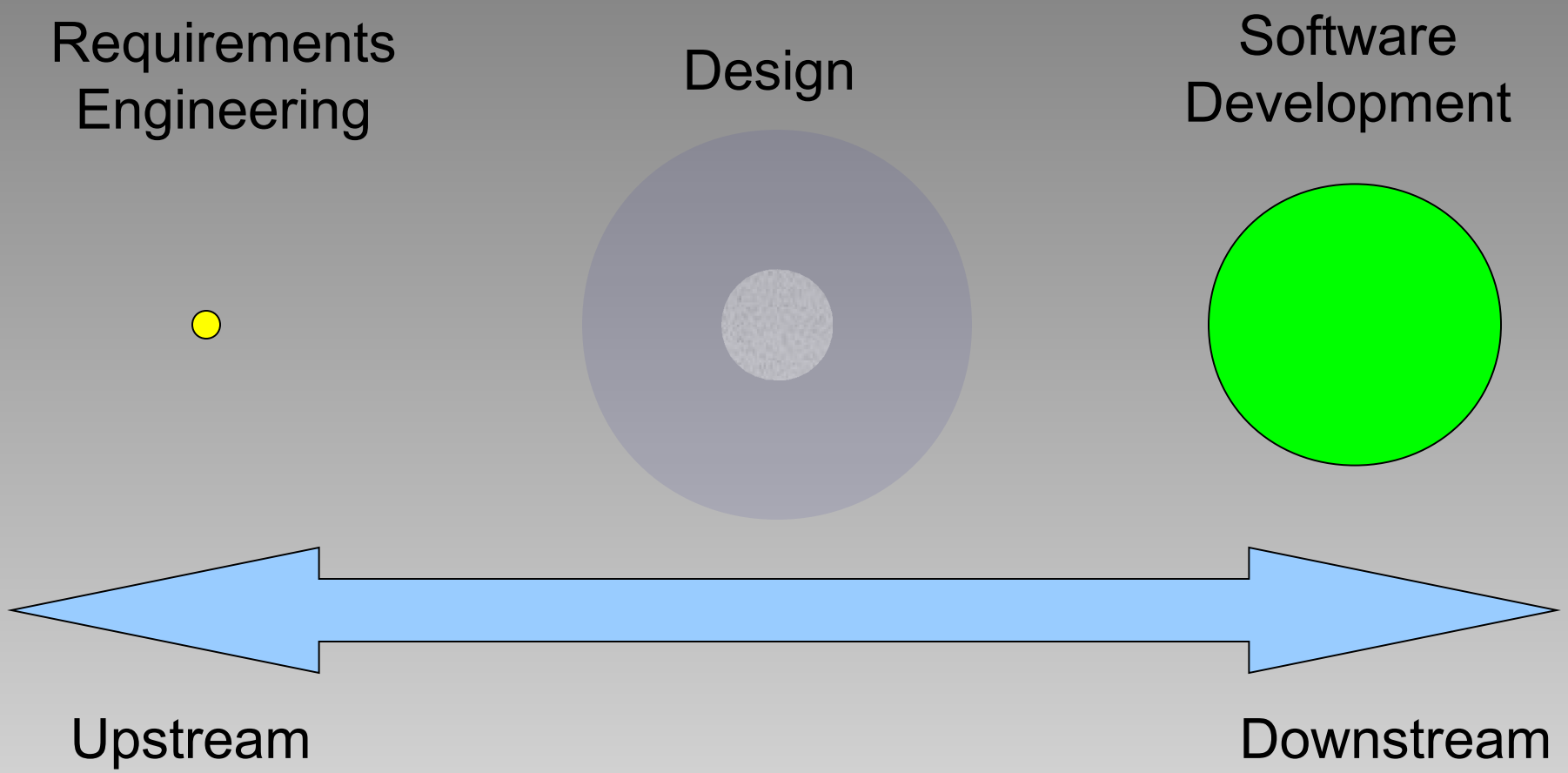
Goals of SEViz

1. Visualization **as** Artifact
   - Clearly fix and communicate structures to facilitate development.
1. Visualization **as** Activity
   - Reveal and understand hidden structures

Requirements of SEViz

1. Visualization **of** Artifacts
   - Communicate structures.
1. Visualization **of** Activity
   - Reveal states and dynamics of lifecycle processes.

Uses of Visualization



RE - Can We Go from This?

From page 157 of [1] :
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Req Type: 9 (functional requirement)
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Customer Satisfaction: 3
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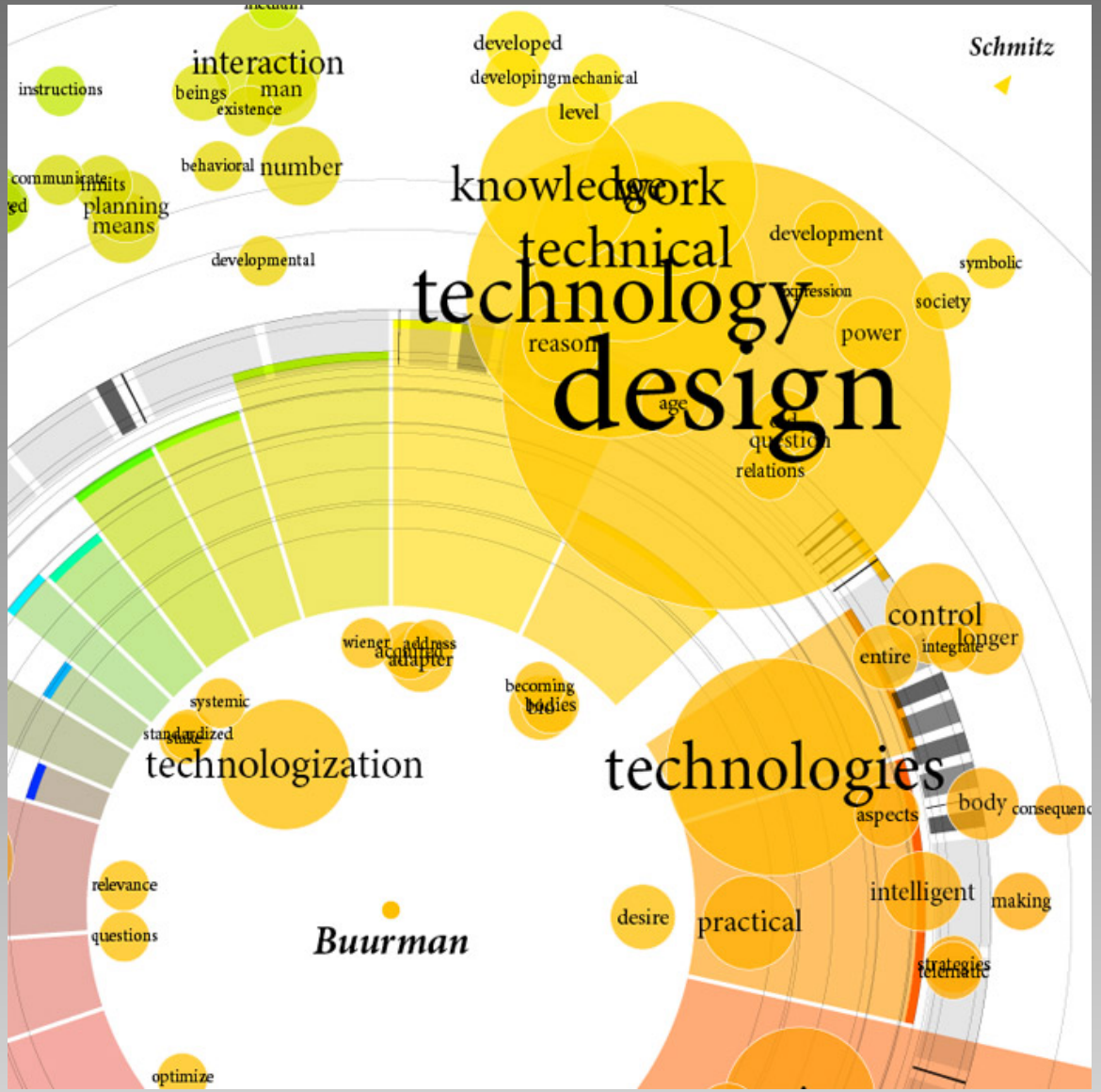
Dependencies: None
Conflicts: None
Supporting Materials: None
History: Created February 29, 2006

History: Raised by AG 25 Aug 99

[1] Robertson, S. AND Roberson, J. *Mastering the Requirements Process*, ACM Press, 1999 *(www.systemsguild.com/GuildSite/Robs/Template.html)*

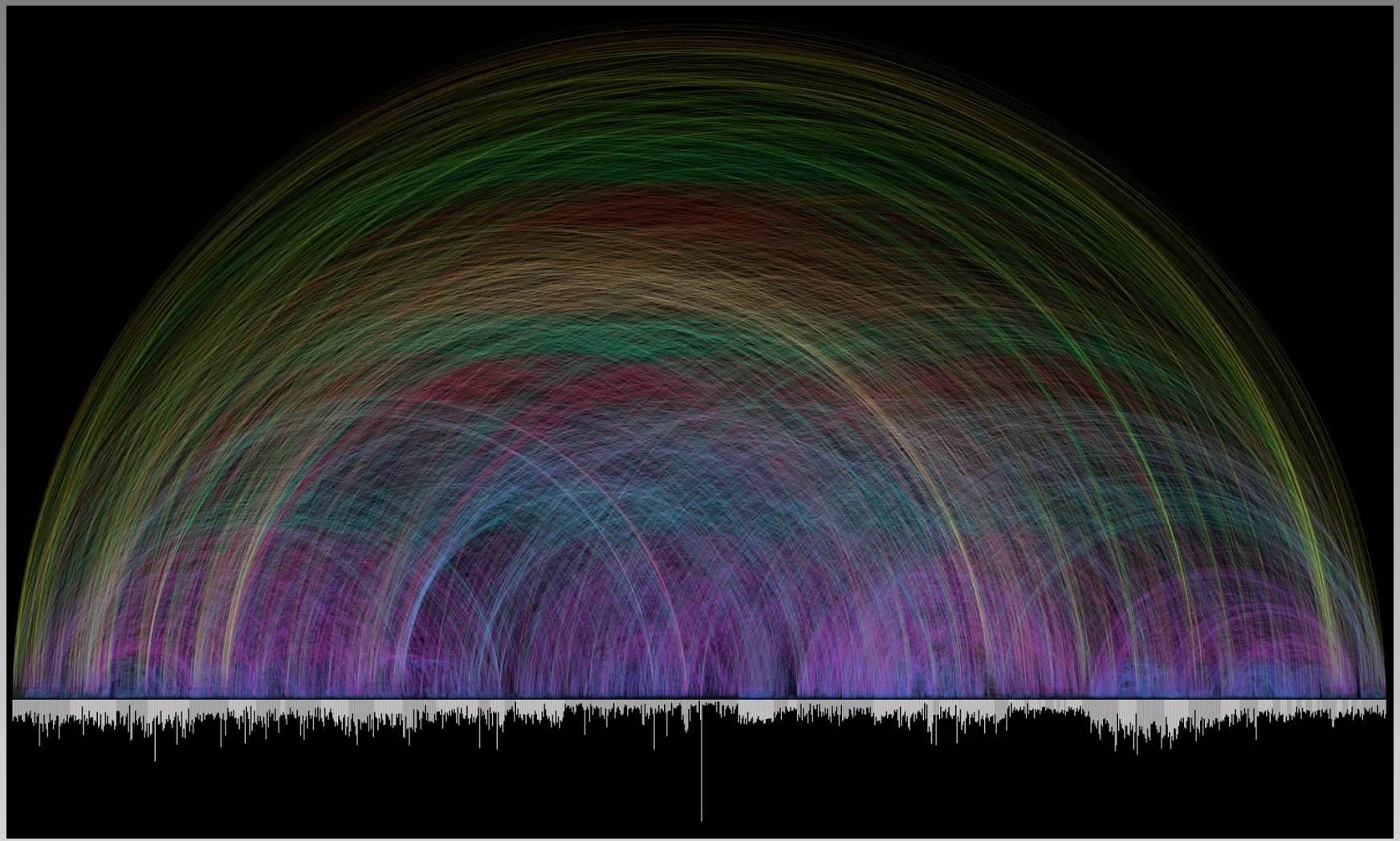
To This:



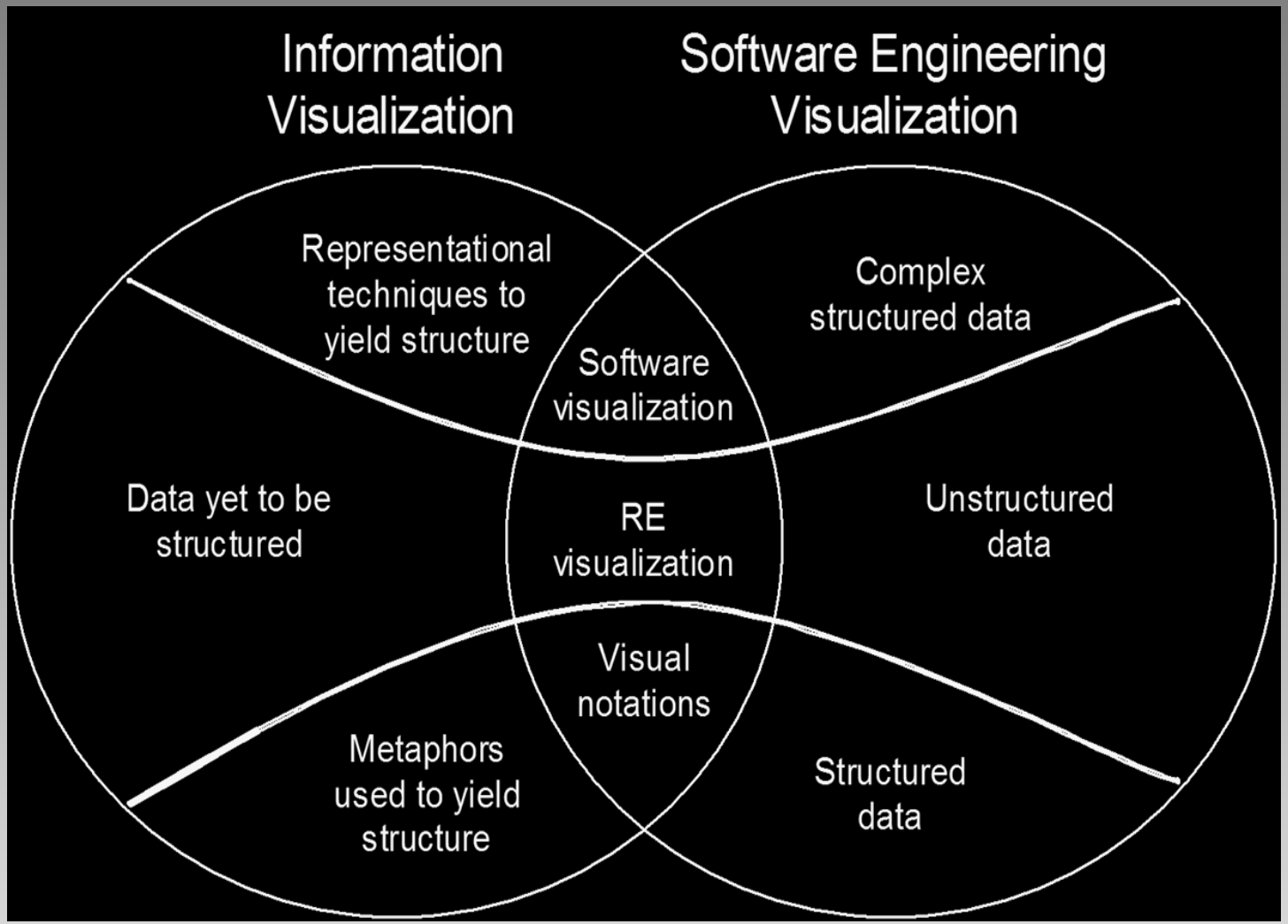
Magnus Rembold & Jürgen Späth in ***Total Interaction,*** Princeton Architectural Press, 2005,

Or This?

Arc Diagram of 63,000 Bible Cross-References,
Chris Harrison (CMU) and Christoph Römhild



Overlapping Concerns



Questions

- What are we looking for?
- What are the challenges?
- Where are the opportunities?
- How can we jumpstart research?

The Problem

- A meta-problem?
- Where is visualization used in RE?
- What for?
- Who for?
- With what results?

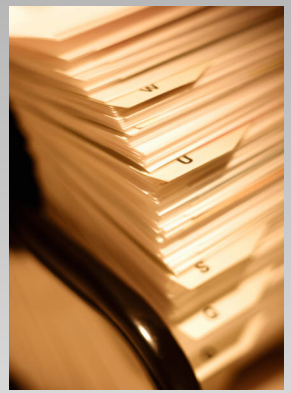
VISUALIZATION: *"the act of forming a mental vision, image, or picture of (something not visible or present to the sight, or of an abstraction); to make visible to the mind or imagination."* [OED]

A Problem

- Do we SEE requirements?
- Can we render requirements visible?
- Can we gain some quick or new insight?
  - How do we know if our requirements are any good?
  - Are our requirements healthy? Credible?
- Visualizing the multi-dimensional nature of requirements:
  - Individual requirements
  - Sets of requirements

What's Been Created?

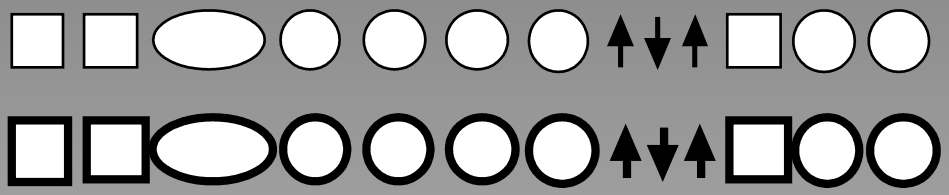
- 3 ideas:
  - Individual requirement's footprint
  - Snapshot of health (requirements set) focusing on possible concerns associated with a few important properties
  - Overall big picture (requirements set) focusing on stability / volatility

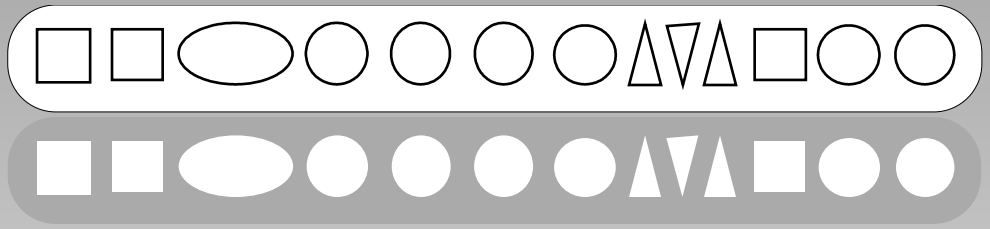


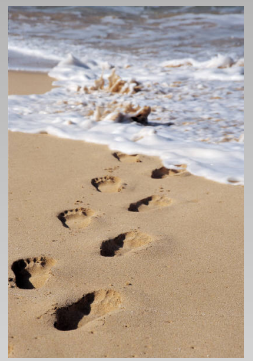
Requirement's Footprint

#	attribute name	[type]	(content)	{symbol}
1	requirement no	[number]	(000)	{square}
2	requirement type	[number]	(00)	{square}
3	events/use cases list	[references]	(000)-(000)-(000)-...	{linked ovals}
4	description [text]	(abc...)	{expanding circle}	
5	rationale	[text]	(abc...)	{expanding circle}
6	originator	[reference or text]	(000)/(abc...)	{square}/{expanding circle}
7	fit criterion/tests	[text]	(abc...)	{expanding circle}
8	customer satisfaction	[range]	(1,2,3,4,5)	{upward vertical arrow}
9	customer dissatisfaction	[range]	(1,2,3,4,5)	{downward vertical arrow}
10	priority	[range]	(?)	{upward vertical arrow}
11	conflicts list	[references]	(000)-(000)-(000)-...	{linked squares}
12	supporting materials	[references]	(000)-(000)-(000)-...	{linked circles}
13	history	[text or list or references]	(abc...)/(000)-(000)-(000)-...	{expanding circle}/{linked circles}

Empty Requirement







Visual Mapping (i)

From page 159 of [1]:
Req #: 110
Req Type: 11 (non-functional requirement - usability)
Event/Use Case #: 6, 7, 8, 9, 10
Description: The product shall be easy for the road engineers to use.
Rationale: It should not be necessary for the engineers to attend training classes in order to be able to use the product.
Source: Sonia Henning, Road Engineering Supervisor
Fit Criterion: A road engineer shall be able to use the product to successfully carry out the cited use cases within 1 hour of first encountering the product.
Customer Satisfaction: 3
Customer Dissatisfaction: 5
Dependencies: None
Conflicts: None
Supporting Materials:

History: Raised by AG 25 Aug 99

Crude to automate; plan to make more of semantics

1 requirement no (110)

2 requirement type (11)

3 events/use cases list (006)-(007)-(008)-(009)-(010)

4 description (11 words)

5 rationale (21 words)

6 source (5 words)

7 fit criterion/tests (26 words)

8 customer satisfaction (3)

9 customer dissatisfaction (5)

10 priority (? not given)

11 conflicts list (000)

12 supporting materials (void)

13 history (6 words)

NB 'Dependencies: None' does not fit shell

Visual Mapping (ii)

1 requirement no (110)

2 requirement type (11)

3 events/use cases list (006)-(007)-(008)-(009)-(010)

4 description (11 words)

5 rationale (21 words)

6 source (5 words)

7 fit criterion/tests (26 words)

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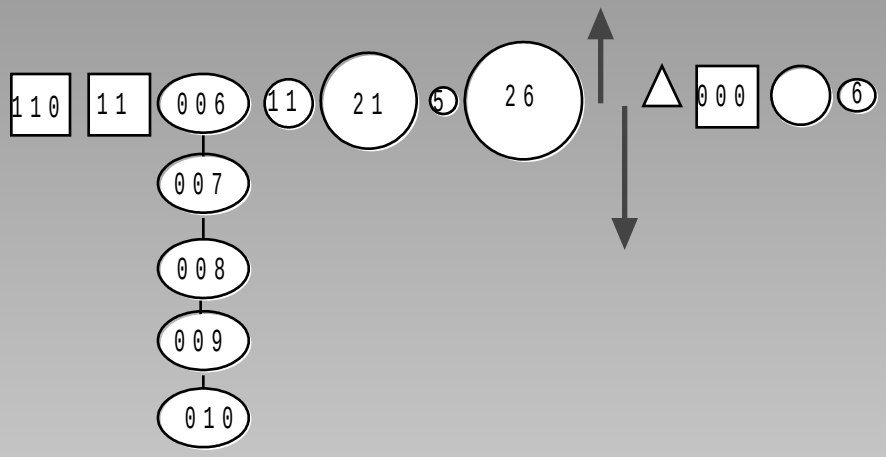
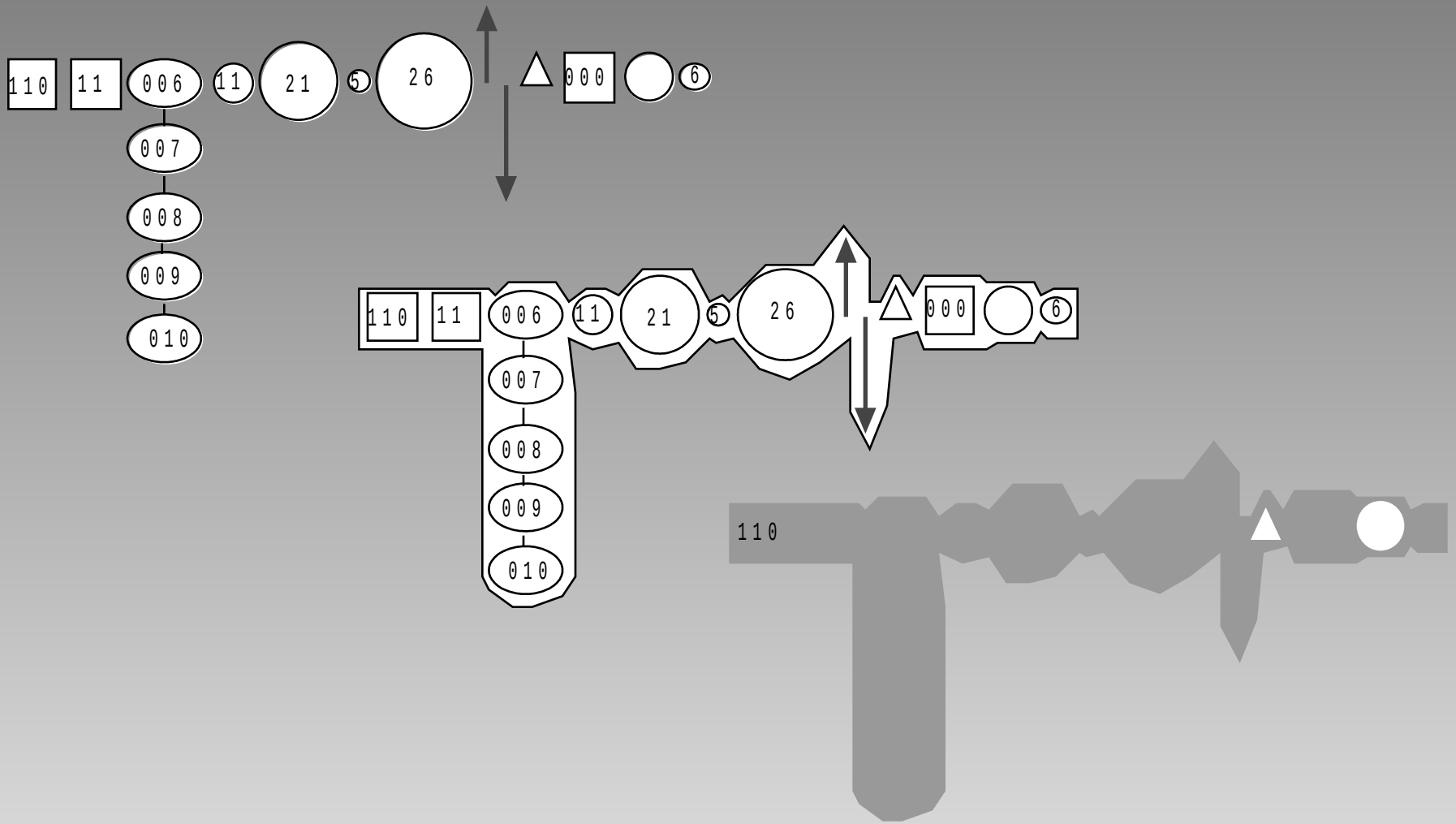
NB 'Dependencies: None' does not fit shell



Resulting Visualization



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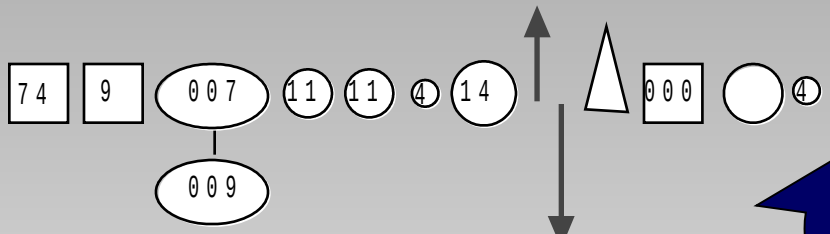
Fit Criterion: The recorded treated and untreated roads shall agree with the drivers' road treatment logs.
Customer Satisfaction: 3
Customer Dissatisfaction: 5
Dependencies: None
Conflicts: None
Supporting Materials: None
History: Created February 29, 2006

Another Mapping



1 requirement no (74)

2 requirement type (9)

3 events/use cases list (007)-(009)

4 description (11 words)

5 rationale (11 words)

6 source (4 words)

7 fit criterion/tests (14 words)

8 customer satisfaction (3)

9 customer dissatisfaction (5)

10 priority (void)

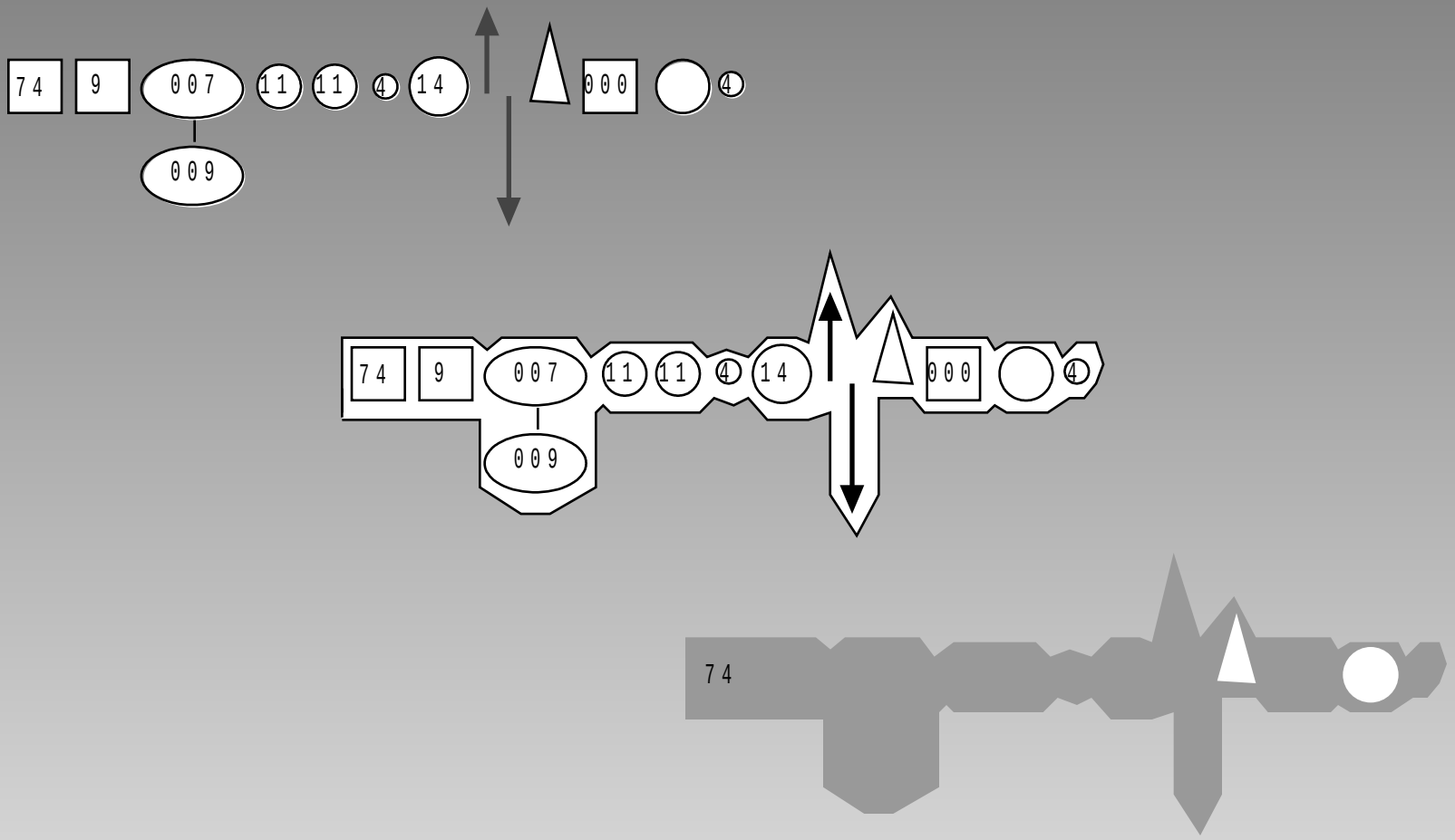
11 conflicts list (000)

12 supporting materials (void)

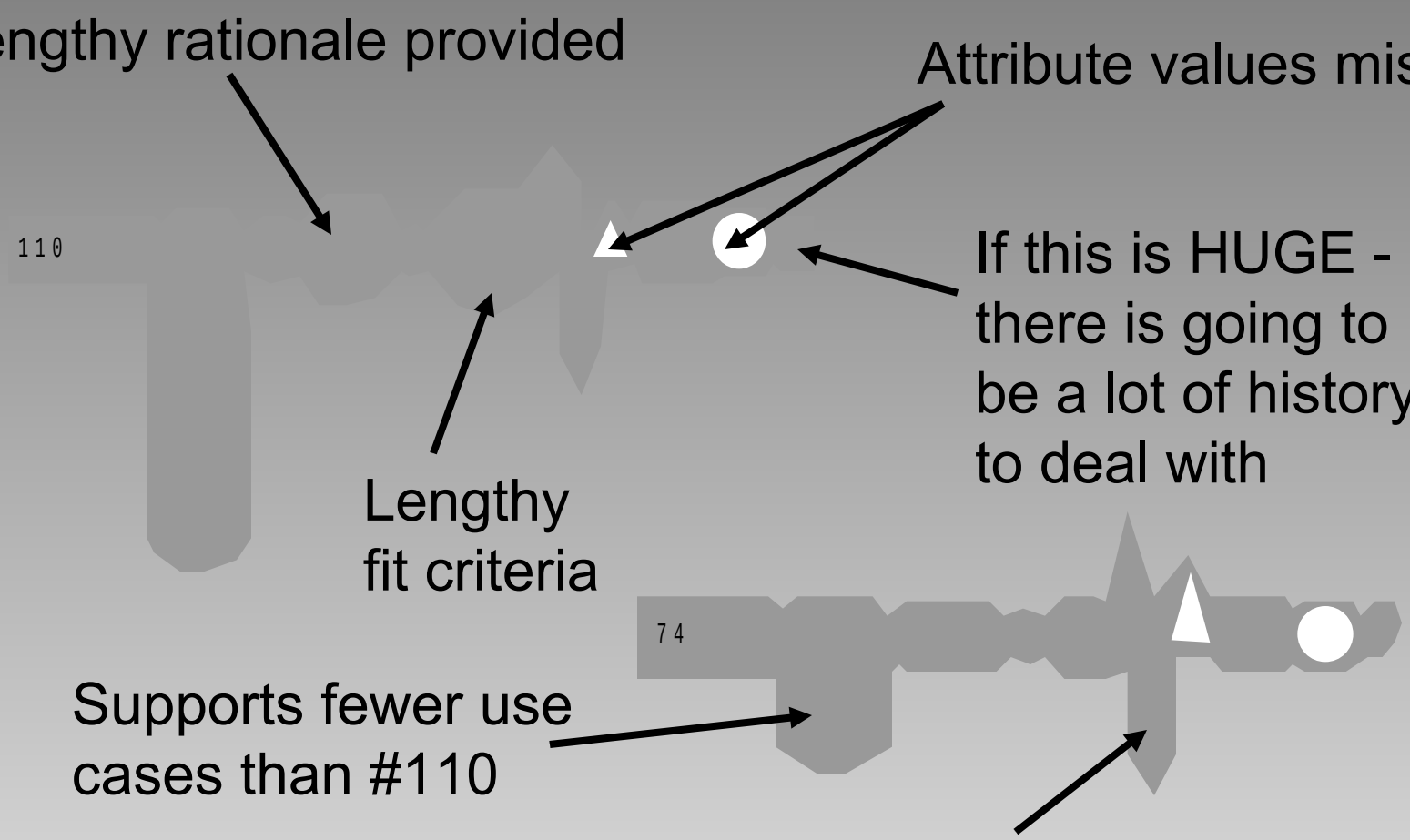
13 history (4 words)

NB 'requirement no' changed to avoid conflict with another example

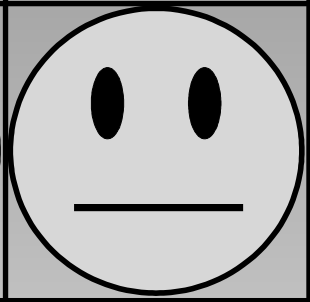
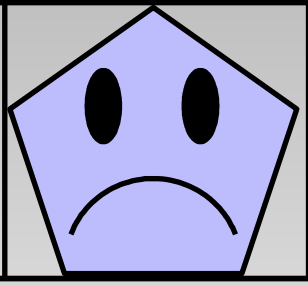
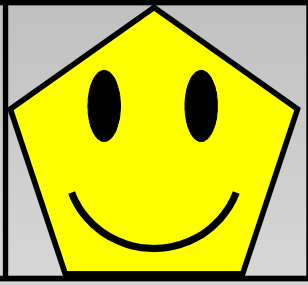
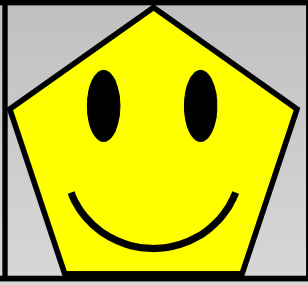
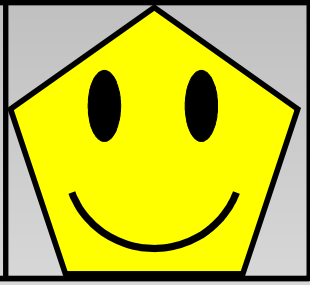
Resulting Visualization



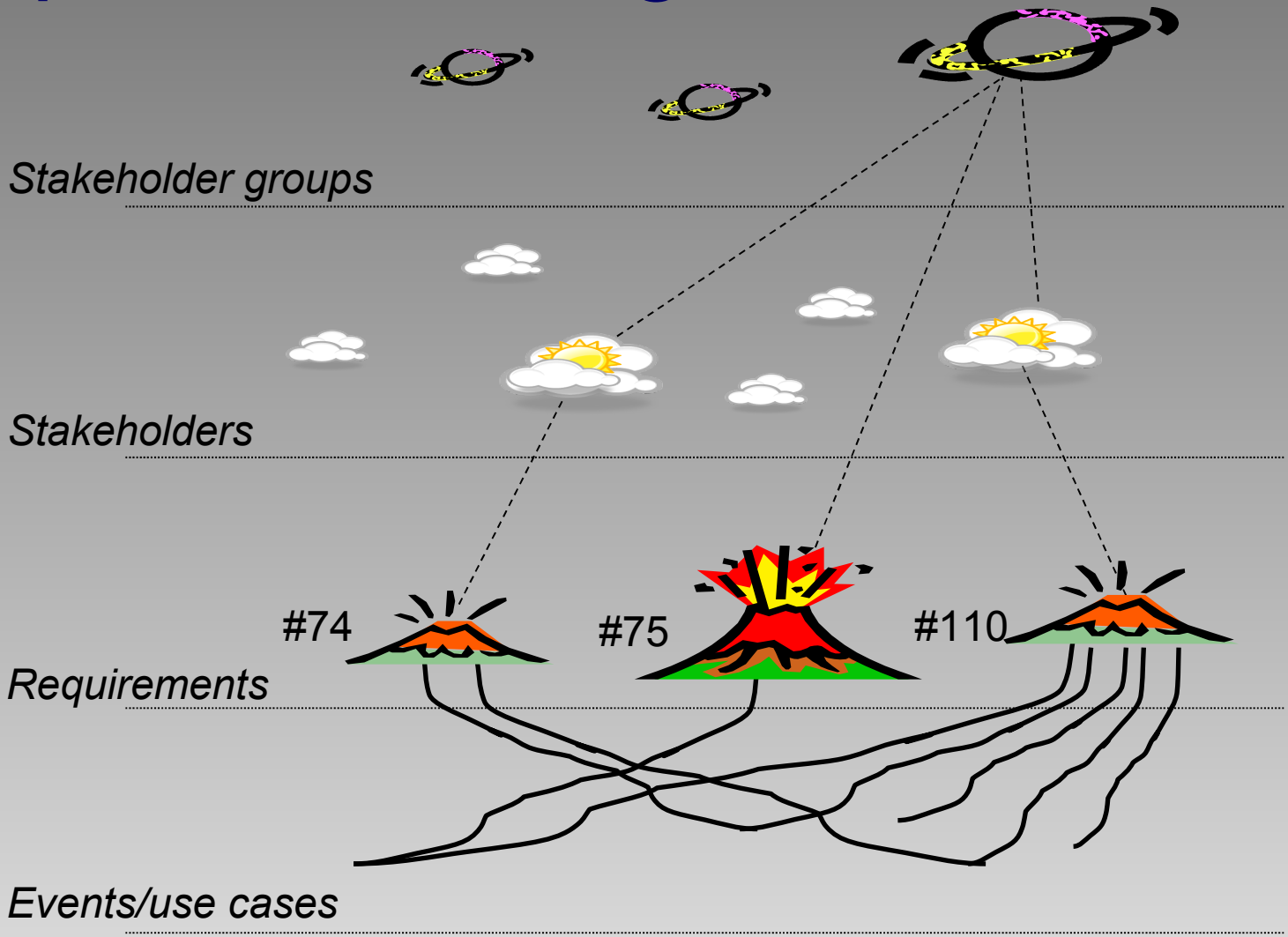
How Does it Work?



Requirements Health Check

REQ	Value	Source	Rationale	Fit
# 74				
# 75				
# 110				

Requirements Big Picture



Validation, Critique, Next Steps?

- These are **visions** of visualization possibilities in RE … there is a lot to do!
- Currently: simple - can be automatically generated and support a small set of questions / tasks
- Future: a collection of visual renderings to support multiple tasks, more use of semantics, user consultation

Scouting Requirements Quality Using Visual Representations

Francis T. Marchese & Orlena C.Z. Gotel
Pace University, New York, USA

ogotel@pace.edu, fmarchese@pace.edu

How to assess quality of this.

From page 157 of [1] :
Req #: 75
Req Type: 9 (functional requirement)
Event/Use Case #: 6
Description: The product shall issue a
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Rationale: Failure to transmit reading
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Source: Road Engineers
Fit Criterion: For each weather statio
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[1] Robertson, S. AND Roberson, J. *Mastering the Requirements Process*, ACM Press, 1999 *(www.systemsguild.com/GuildSite/Robs/Template.html)*

Requirements Quality Questions

- If you could name the intended software system, what would you call it?
- Who are the main stakeholders for the system?
- What are the main functional requirements of the system?
- What categories of non-functional requirement are important to the system.?
- What techniques are used to describe the requirements?
- What are the *general contents* of the requirements document?
- What *requirements* are specified in the requirements document?

Scouting Software Requirements

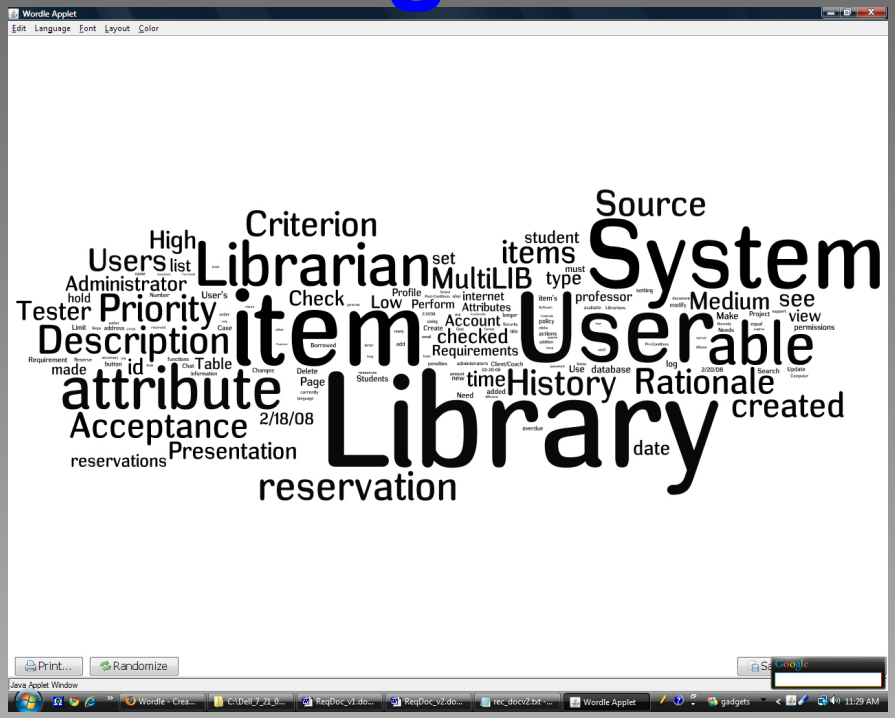
- A preliminary activity to highlight when and where a more careful inspection of requirements documents, is needed.

- An interactive and collaborative activity centered on a single visual representation of the requirements.

Requirements for Visualization

- Must capture the essence of the system
- Act as a trigger for stakeholder discussion
- Provide an alternative mode of communication
- *Be easy to use!*

Text/Tag Clouds



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Wordle – Top 150 words

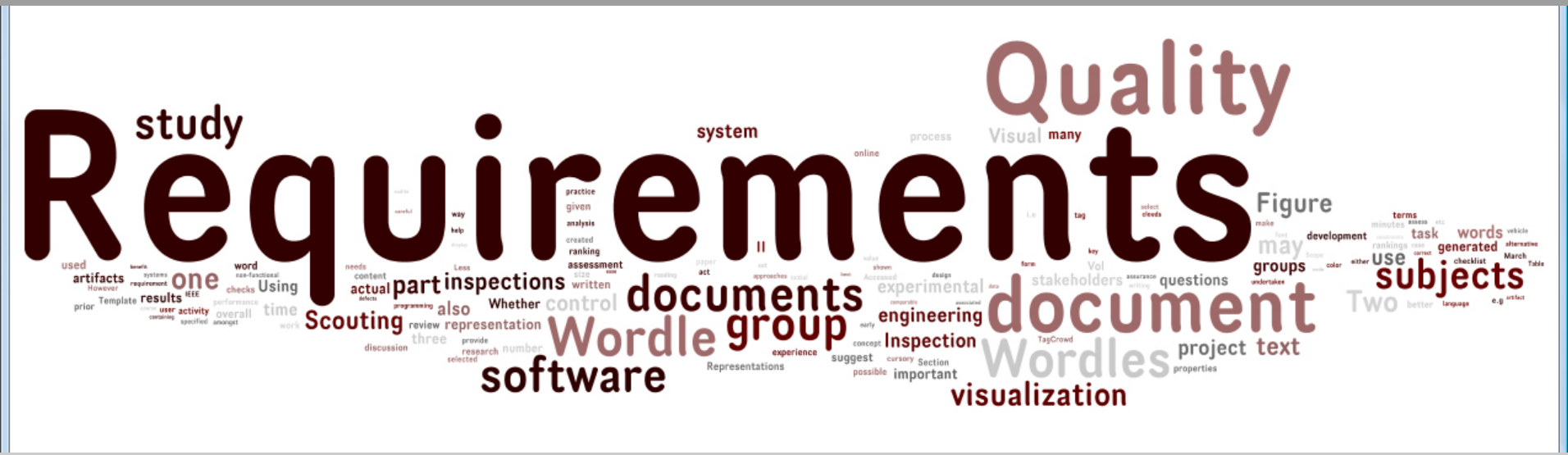
All words that appear 5 times or more

TagCrowd - Top 50 words

able acceptance account added administrator attribute borrowed case changes check client created criterion database date delete description functions history hold id information internet item librarian library limit list log medium multilib page perform presentation priority professor profile project rationale requirements reservation search source student system table tester type user view

Wordle

- Created by Jonathan Feinberg
- http://www.wordle.net
- Cut-and-Paste Visualization



Wordle of this paper from the IV'09 Proceedings

Hypothesis

A Wordle of a requirements document provides an effective visualization to help ascertain the quality of a requirements document at a cursory level.

It should:

- *Highlight prominent terms*
- *Emphasize the problem that is being tackled*
- *Make clear whether the document is written in the language of the domain or populated with design constraints*
- *Yield a first impression on quality that is comparable with scouting the text of the requirements document itself*

Experiment

Part 1: (All 34 Subjects)

A task to assess whether it is possible to differentiate Wordles generated out of requirements documents from those generated out of requirements document templates.

Actual Requirements Document

Requirements Document Template

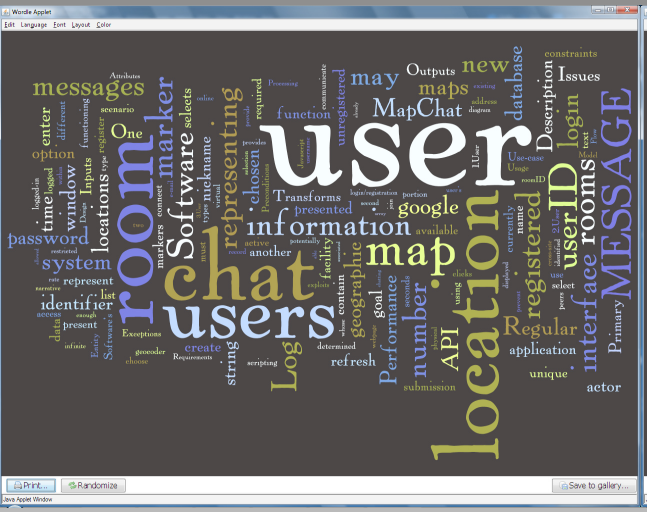
Experiment

Part 2:

Task to assess the results from scouting a Wordle representation of a requirements document for quality.

***Control group**: Read original requirements documents*

***Experiment group**: Viewed Wordles*



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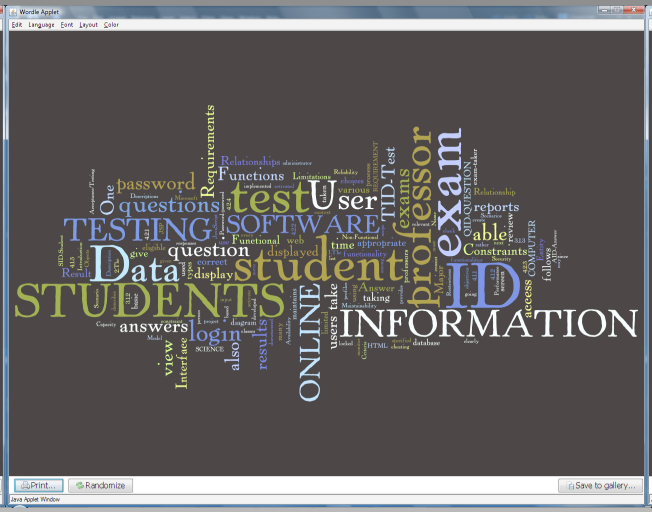

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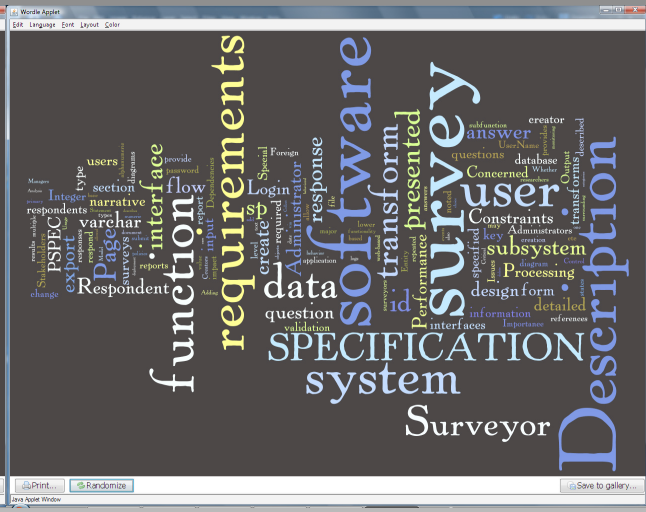


c

Three sample requirements documents randomly selected from documents created during a graduate software engineering course

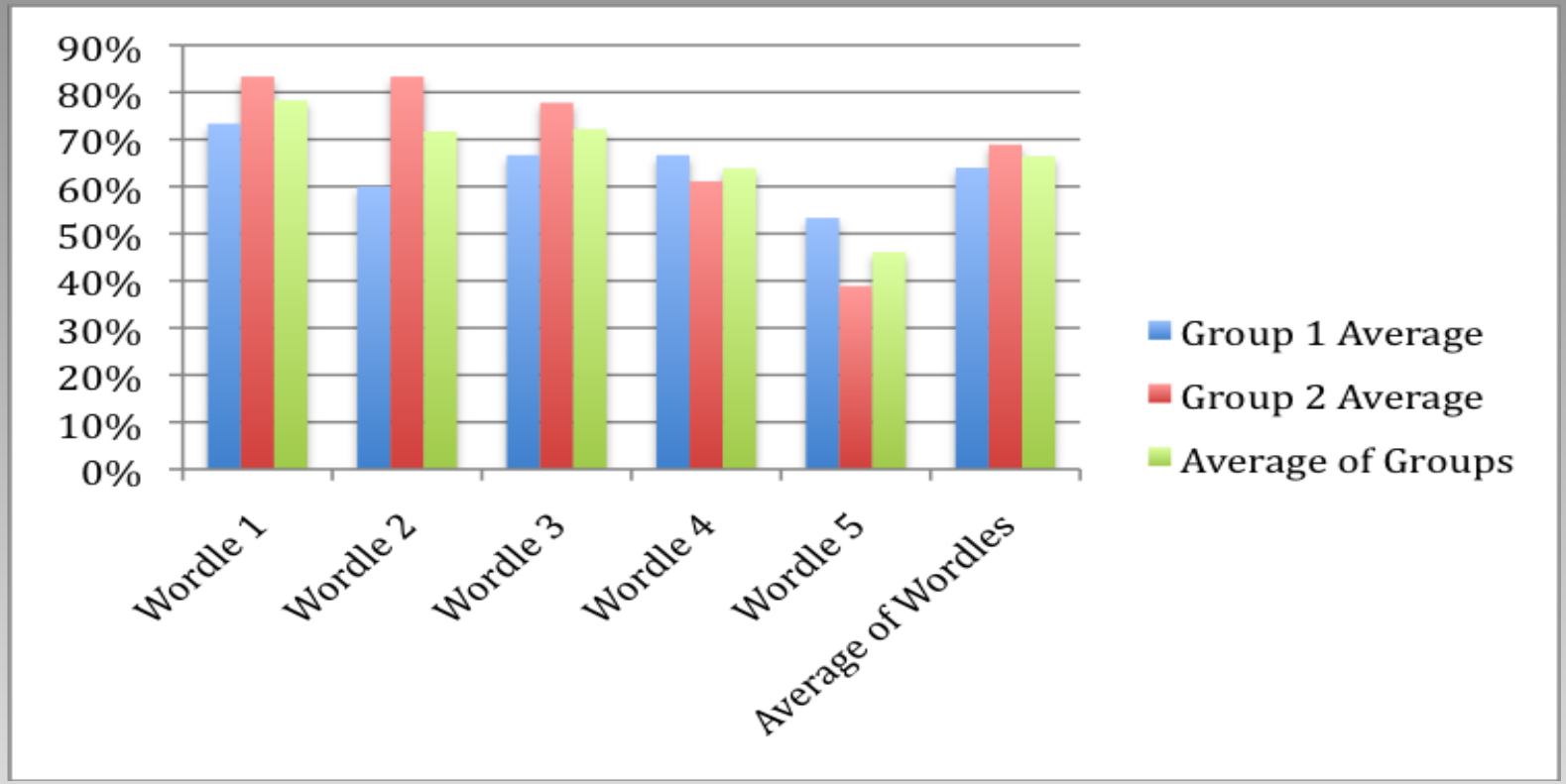
Each document rated according to 10 Quality Questions

Results: Part1

Could subjects differentiate requirements documents Wordles from requirements document template Wordles ?

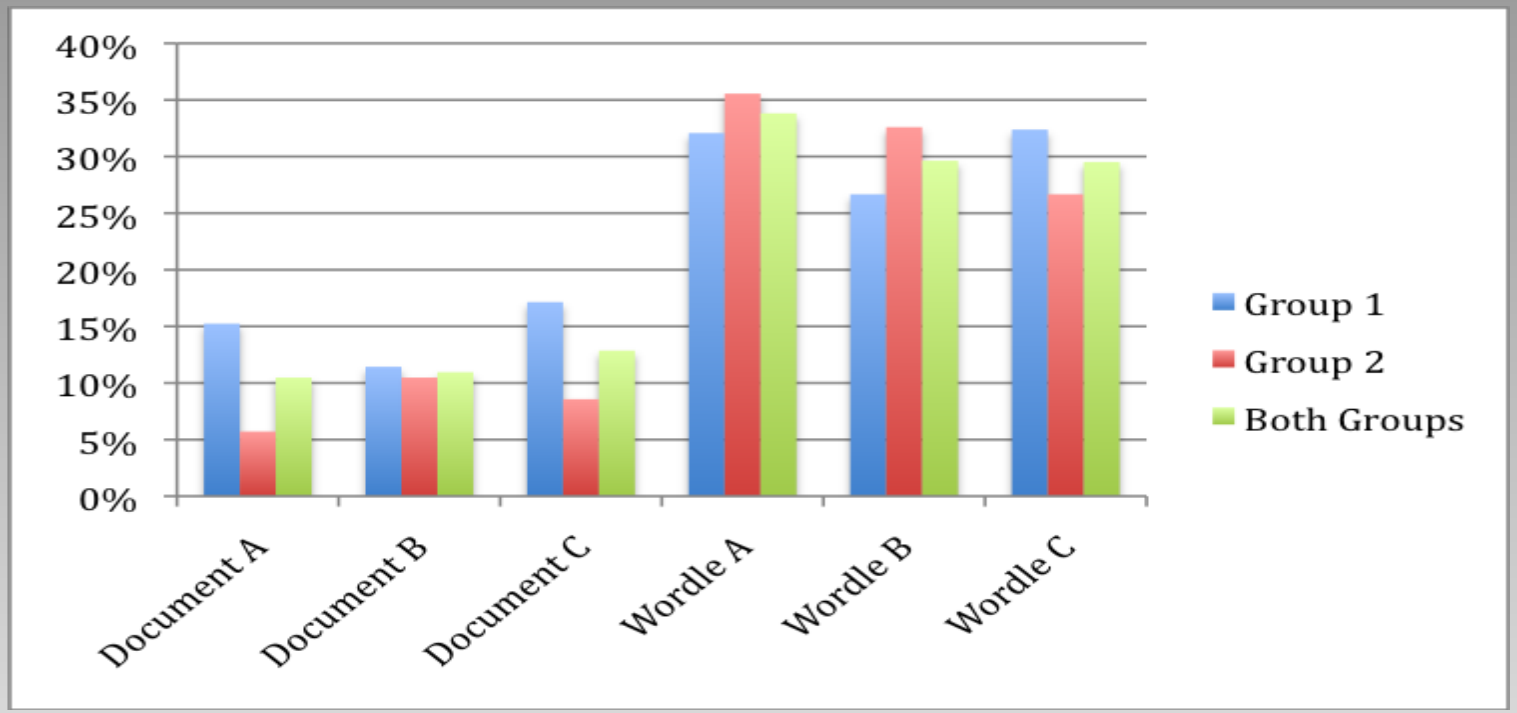
Study Group 1: 15 graduate computer science students in a 2nd project-based course in software engineering

Study Group 2: 18 graduate software design and engineering students



Part 2: *Scouting Performance*

- The inexperienced group completed the scouting task 25% faster than the experienced group.
- Wordles users completed scouting from 12 to 20% faster than the control groups (inexper. vs. exper.).
- Group 1 performed better with Wordles when ranking quality accurately than Group 2 by 56% to 41%.
- Uncertainty about requirements document exhibiting quality properties



Limitations

- *Wordles used to represent documents in their first instance*
- *Finding ‘ideal’ visual representation beyond the scope of our study*
- *Experimental studies limited in size and availability of artifacts.*
- *Font style and color scheme unoptimized*

Conclusions and Future Work

- Wordles hold promise for scouting*:*
  - *as the size of a requirements document increases*
  - *for inclusion of stakeholders who have little prior exposure to writing or reviewing requirements*
- Wordles can concurrently act as a shared communicative artifact for conducting a directed requirements quality discussion
- Wordles cannot support all software development tasks - alternative visualizations are being explored.
- Ultimate goal is a dashboard of visual representations that act as triggers for discussions among parties.