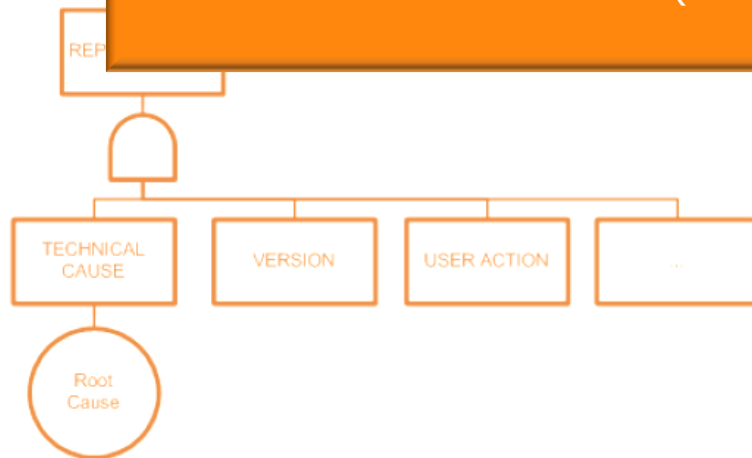


Towards A Software Failure Cost Impact Model For the Customer

Ralf Gitzel (ABB Corporate Research)

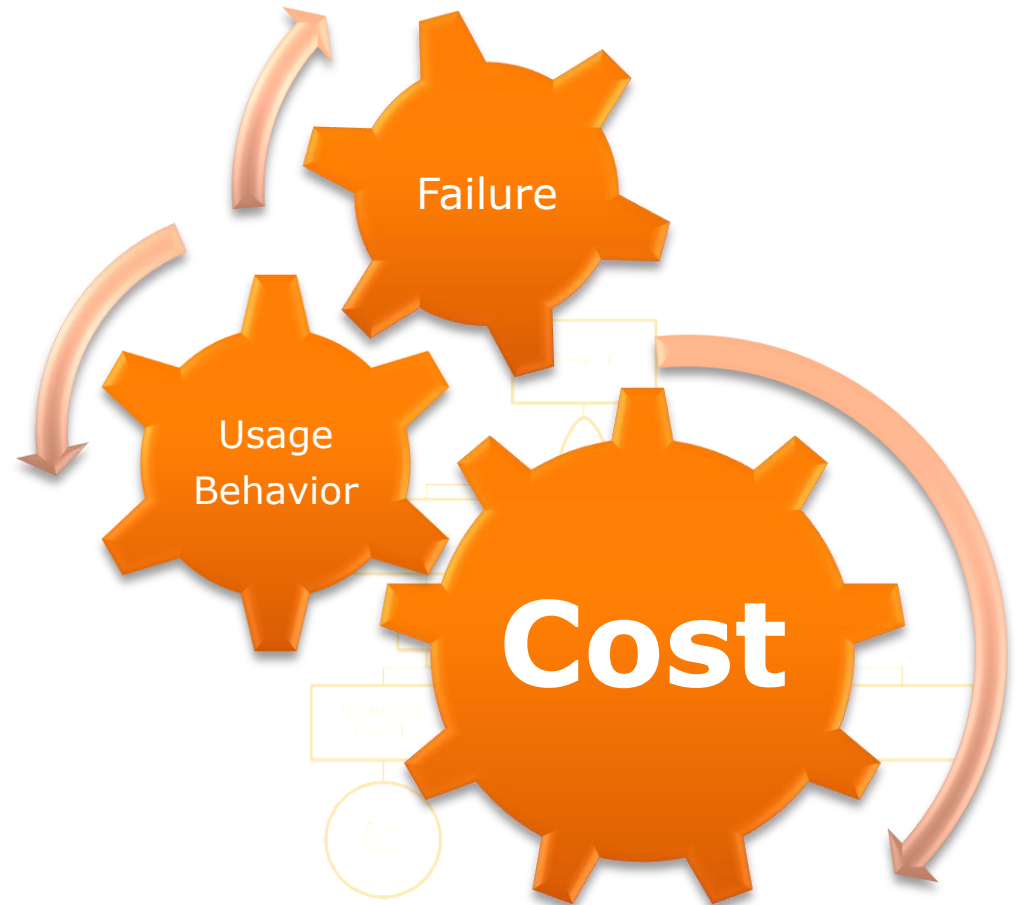
Simone Krug (University of Mannheim, Germany)

Manuel Brhel (University of Mannheim, Germany)

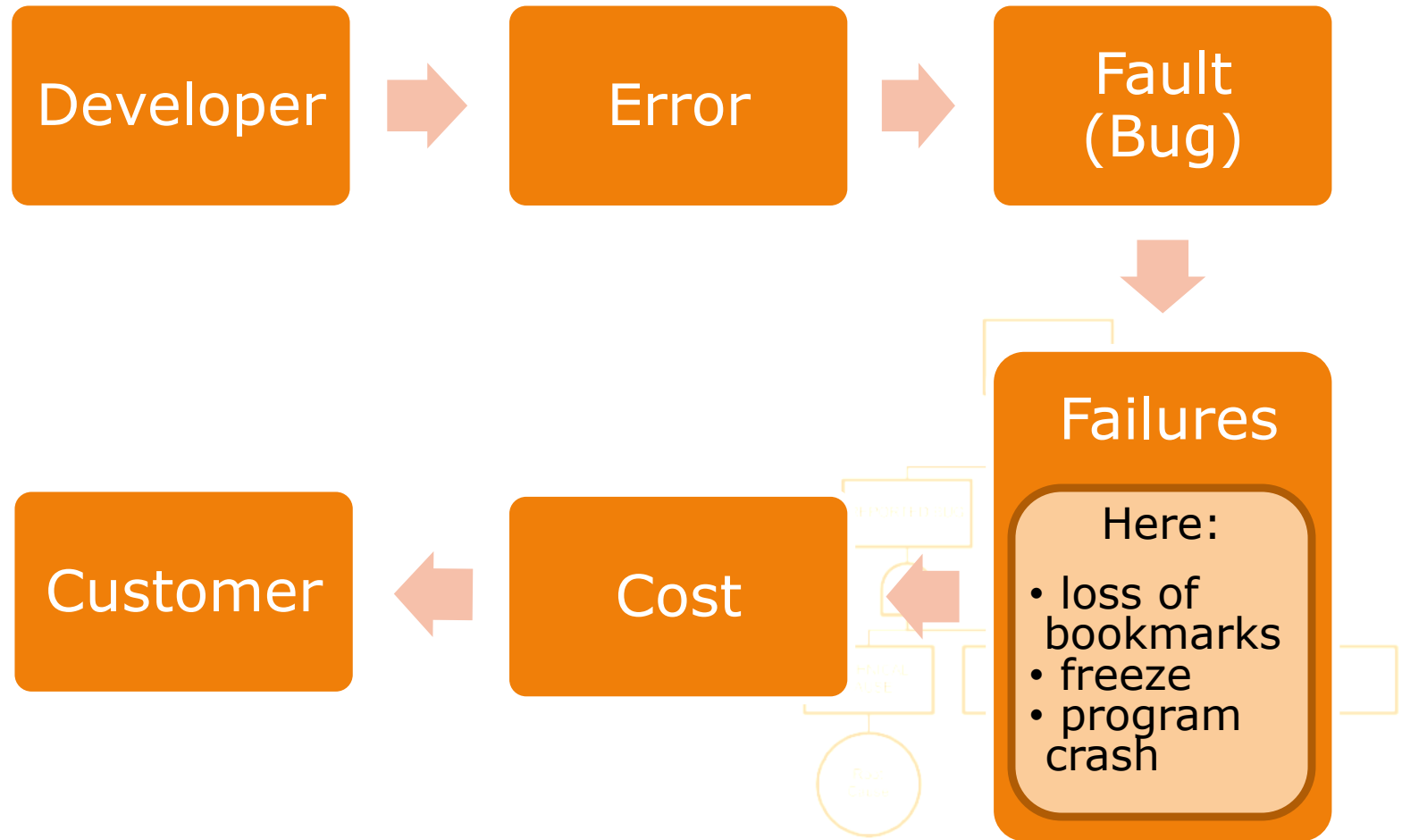


Research Question

What is the cost impact of software failures on the **customer**?



Software Failure Impact



Our Data Source

- Bugzilla : Firefox bug repository

Closed Source

Open Source

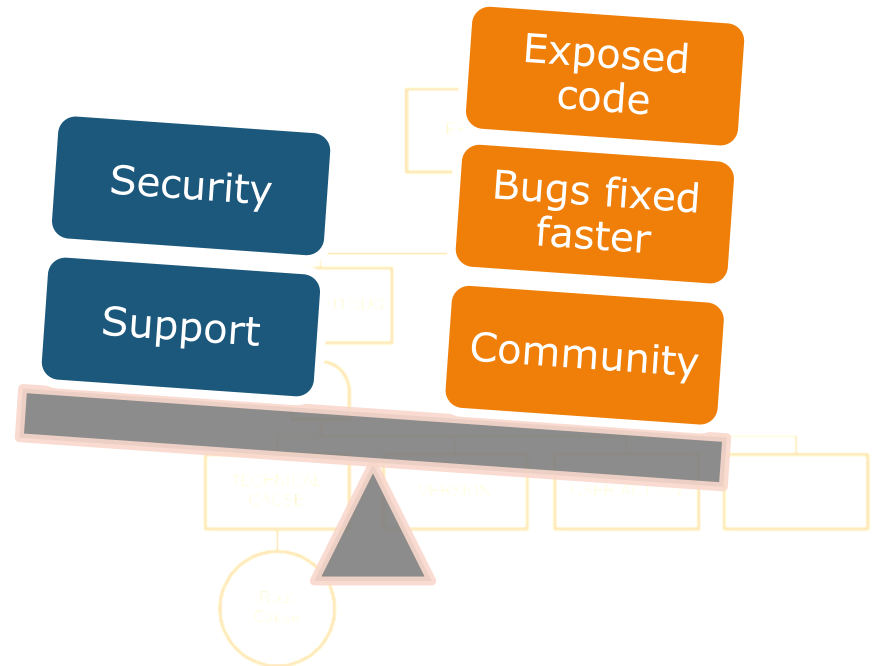
Security

Support

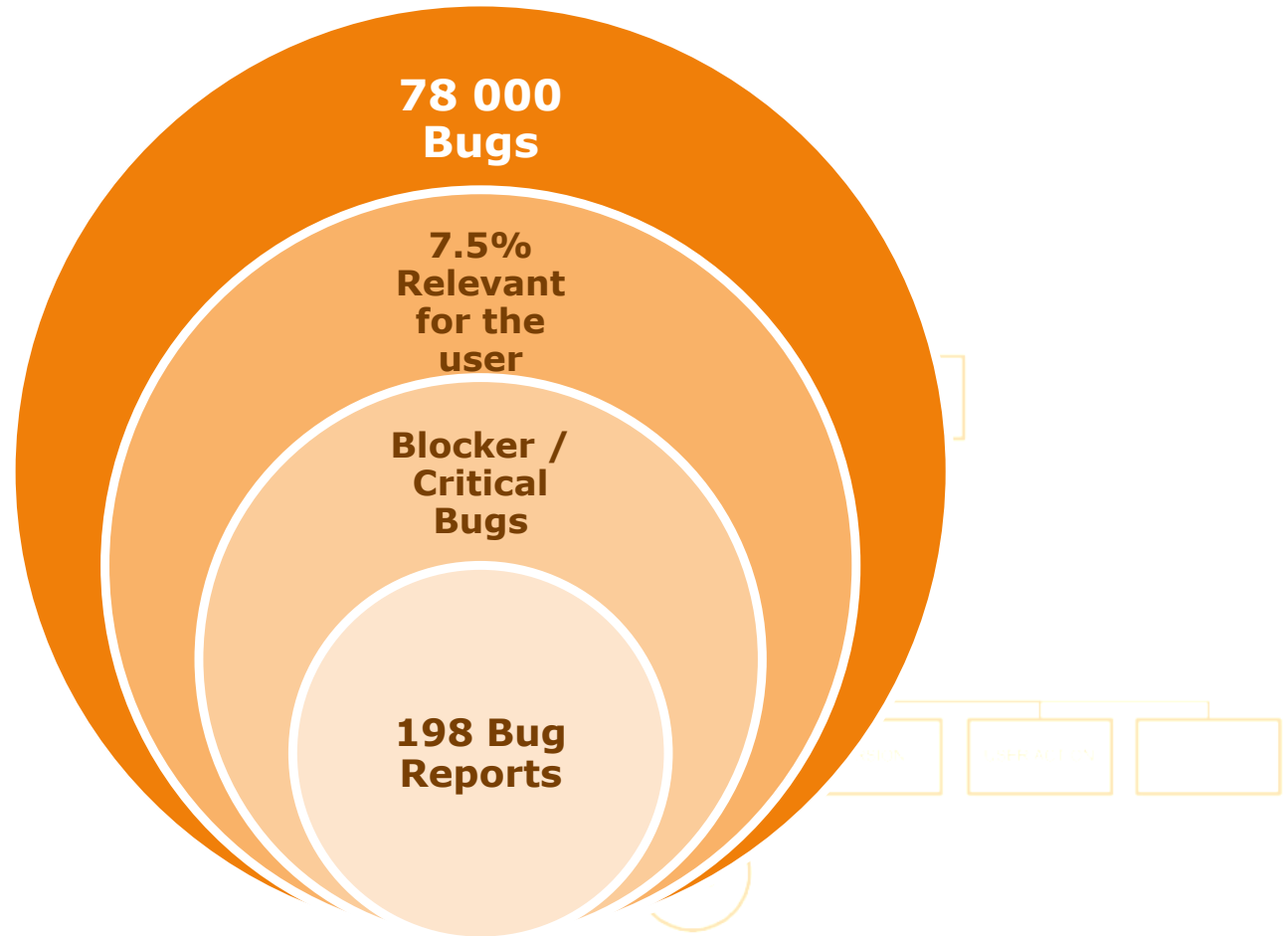
Exposed code

Bugs fixed faster

Community

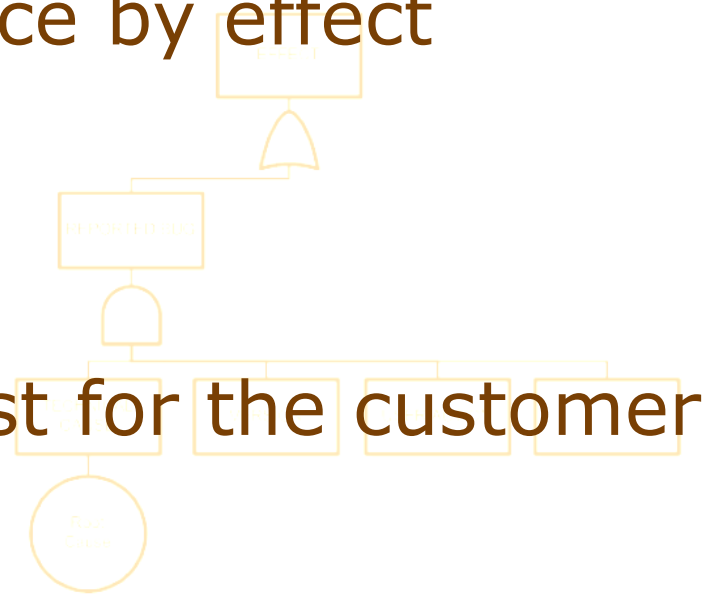


Identifying Relevant Entries

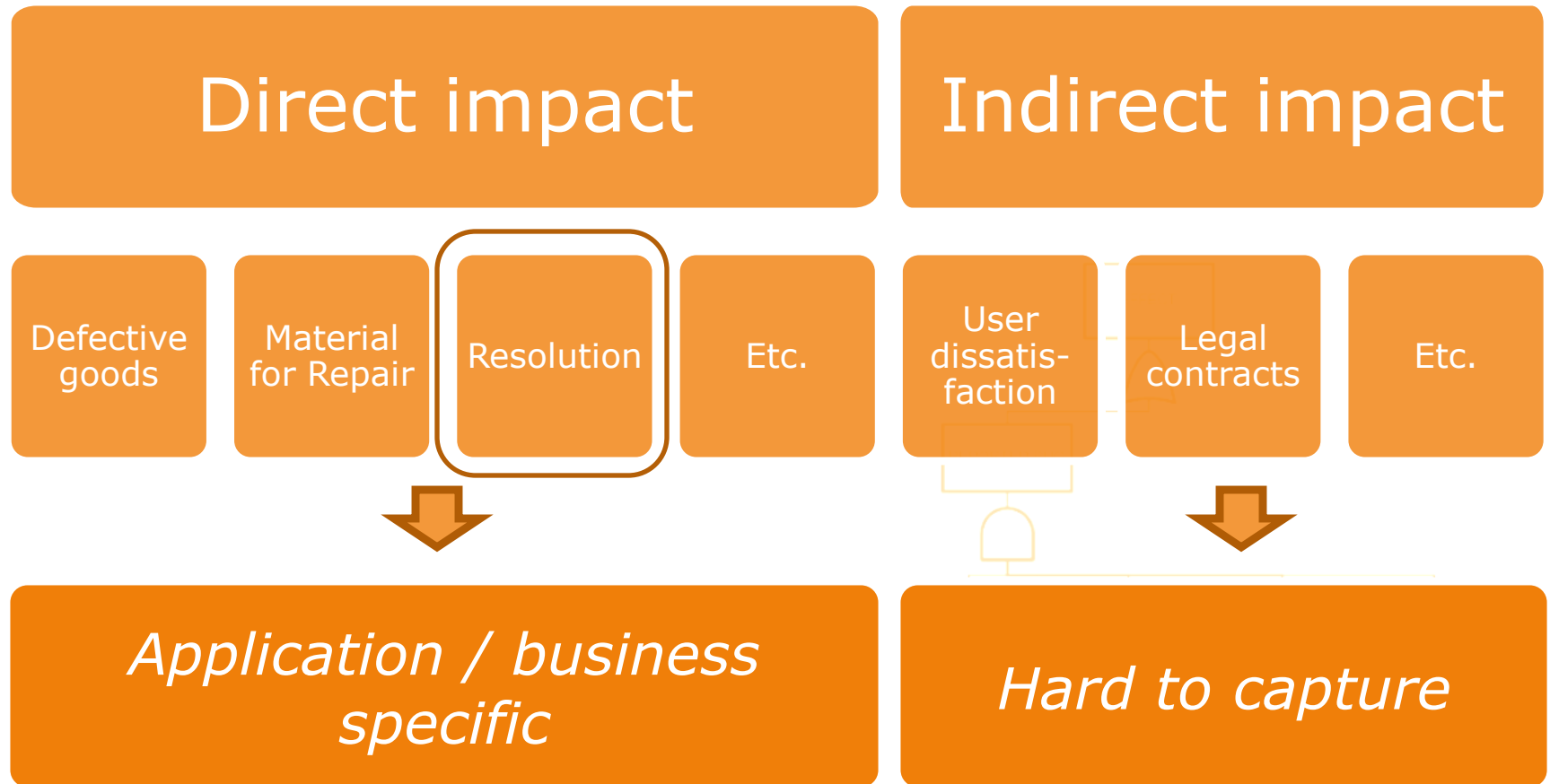


Modeling Customers' Failure Cost

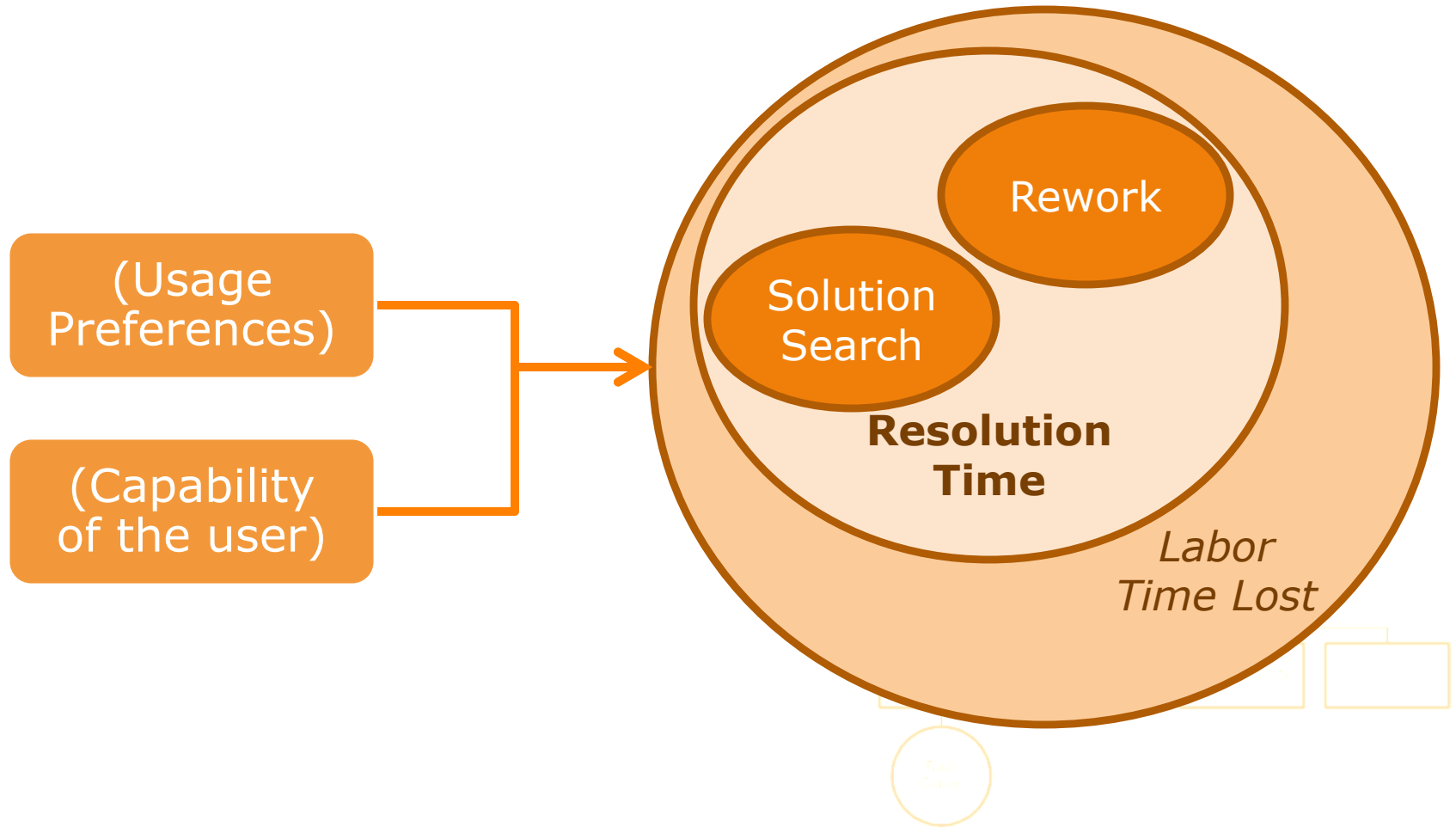
1. Identify cost drivers
2. Model failure occurrence by effect
3. Model user behavior
4. Calculate expected cost for the customer



1. Identify Cost Drivers



Main Cost Drivers

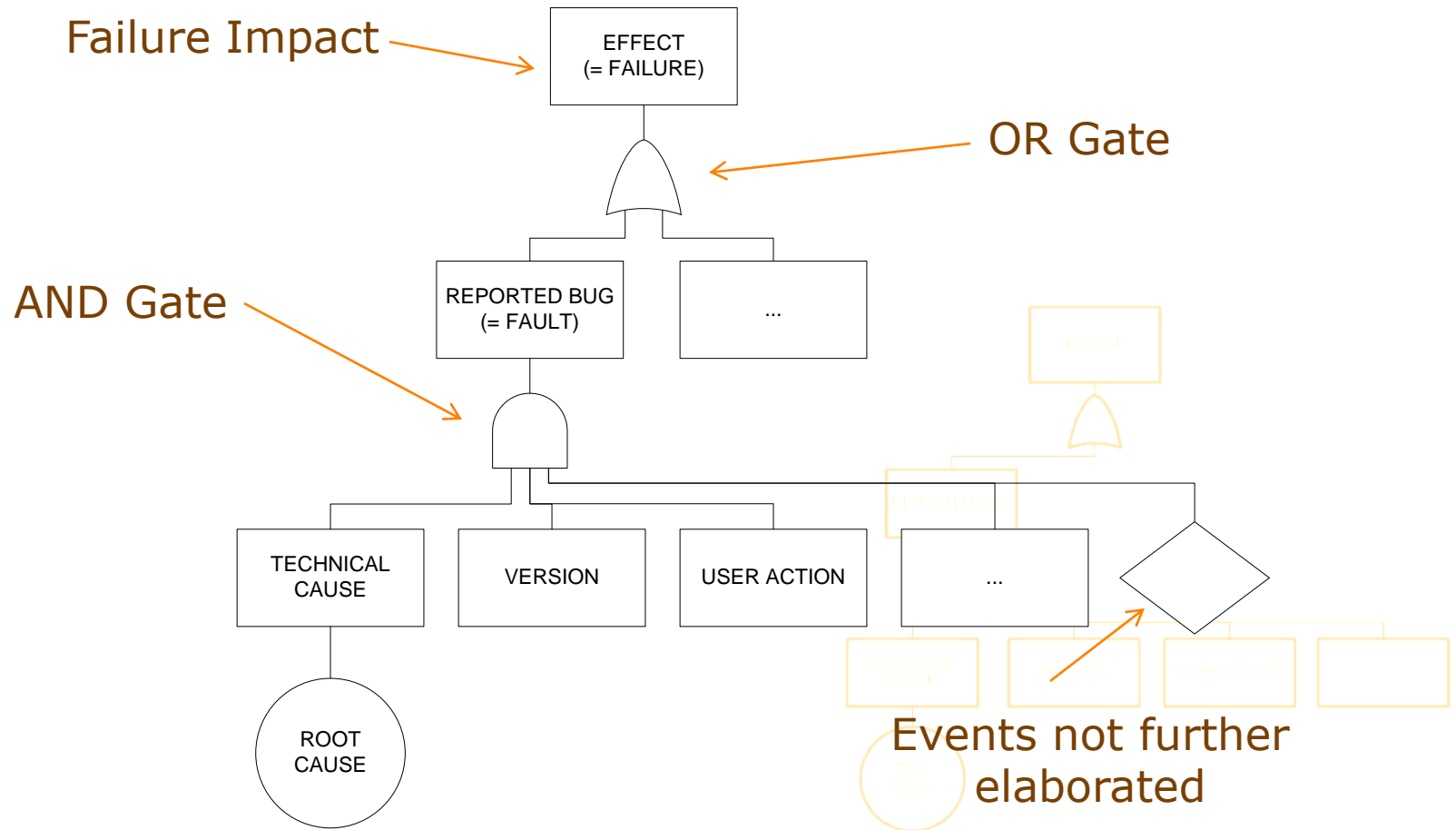


2. Model failure occurrence by effect

Table 1: Relevant Firefox Errors.

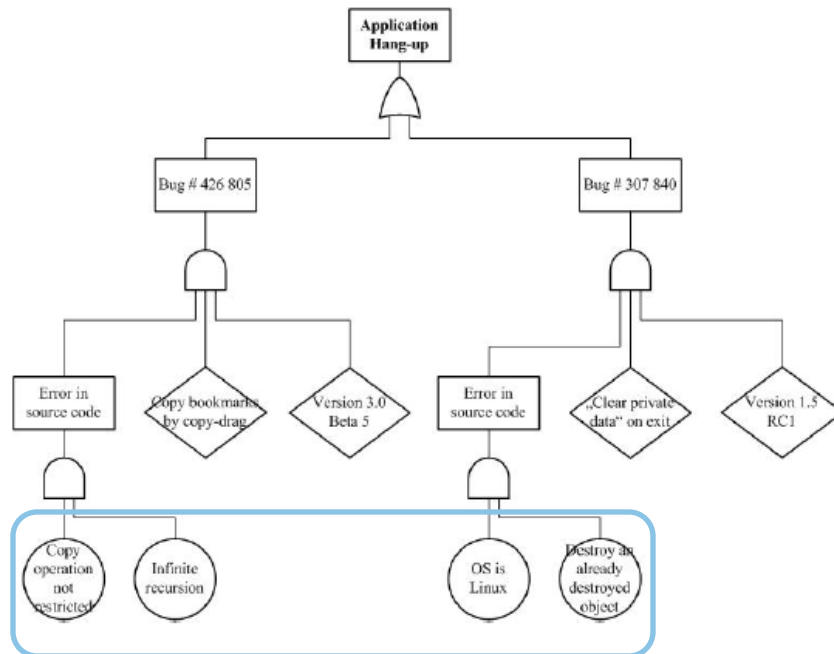
| Category | Bugs in Category (Bugzilla IDs) |
|---|--|
| Crash | 455283, 423226, 400744 |
| Halt | 426805, 307840 |
| Security risk | 339377, 341829 |
| Loss of bookmarks | 477739, 478258, 478258, 477739 |
| Cannot save files | 263956 |
| Crash during installation | 369221, 364710, 285283, 261734 |
| Unable to bookmark URL | 264031 |
| Temporarily unable to access bookmarks | 452469, 414715 |
| Waste of disk space | 271883 |
| No live bookmark functionality | 398398 |
| Limited bookmark information loss | 473120, 377500 |
| Unable to search bookmarks | 336488 |
| Unable to access all tabs | 475031 |
| Focus of URL bar must be gained by click | 333651 |
| News search does not work | 402508 |
| Search engines do not work in the toolbar | 342540, 341908 |
| Limited bookmark usability | 434749, 330929 |
| Completely trivial bugs | 342110, 308743, 423226, 340167, 268144, 475030, 474964 333651, 266983, 360572, 337625, 317060, 258088 |

Fault Trees

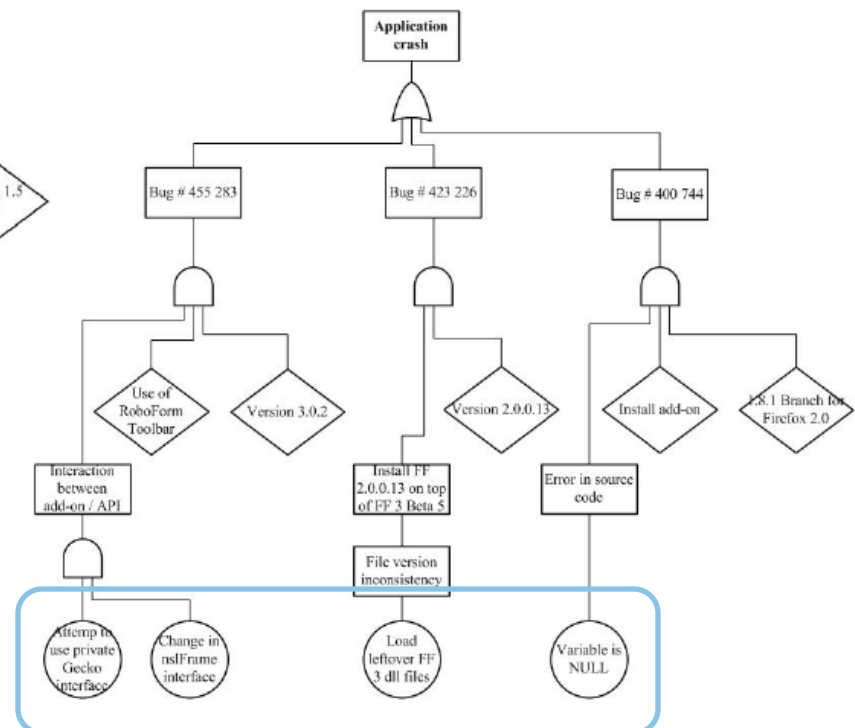


Firefox Failure Analysis

Freeze (Halt)



Crash



3. Model User Behavior

- A User Profile contains:
 - Features of a system and their purpose
 - Frequency of execution
- Each User Profile corresponds to a job specification

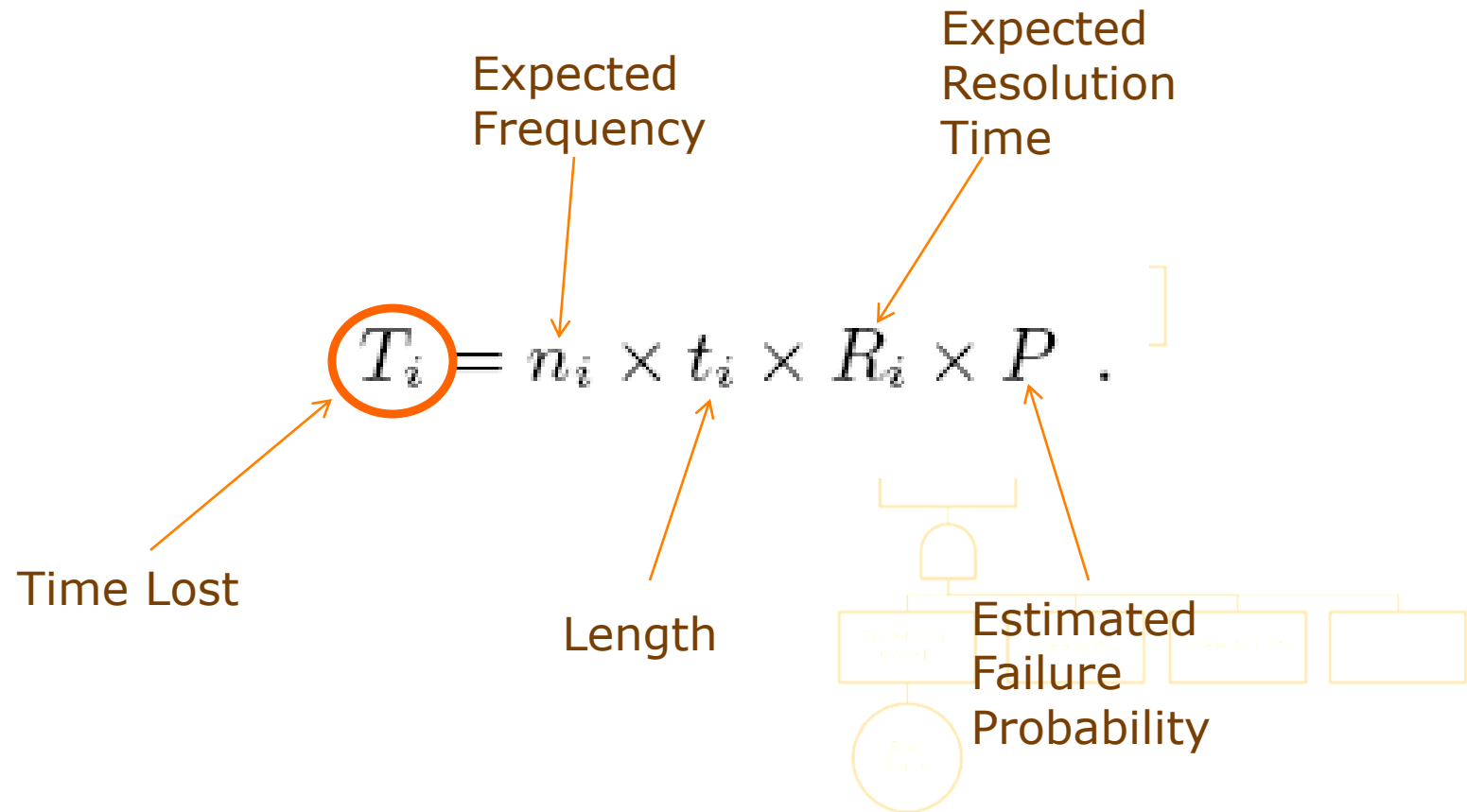


User Behavior Example

Table 2: Example User Profiles

| Activity | Frequency (per week) | Length (min.) | Recovery Time (min.) |
|--|-------------------------|------------------|-------------------------|
| <i>User: Procurement Worker</i> | | | |
| Research offers online (e.g. compare prices) | 10 | 30 | 5 |
| Visit online shops | 20 | 15 | 5 |
| Order online | 1 | 15 | 15 |
| Use online auctions | 5 | 15 | 5 |
| <i>User: Secretary</i> | | | |
| Search for information online | 10 | 30 | 5 |
| Online banking | 2 | 15 | 15 |
| Use online dictionary | 10 | 3 | 3 |
| Online booking | 2 | 15 | 15 |
| <i>User: Marketing</i> | | | |
| Search online (e.g. competitor's pricing) | 10 | 30 | 5 |
| Create online polls | 1 | 30 | 30 |
| Update website information | 2 | 15 | 15 |

Time Lost Per Week

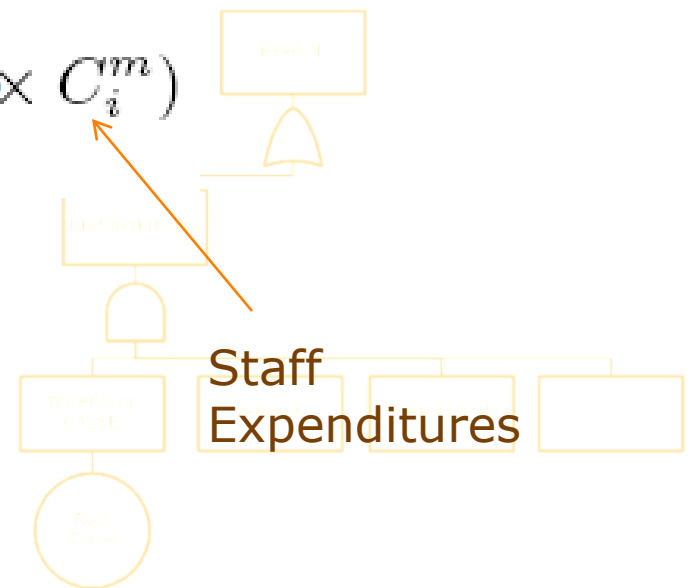


Expected Cost for the Customer

Expected
Cost for the
Customer

$$C = C^r + \sum_{i=1}^N (T_i \times C_i^m)$$

Repair Cost



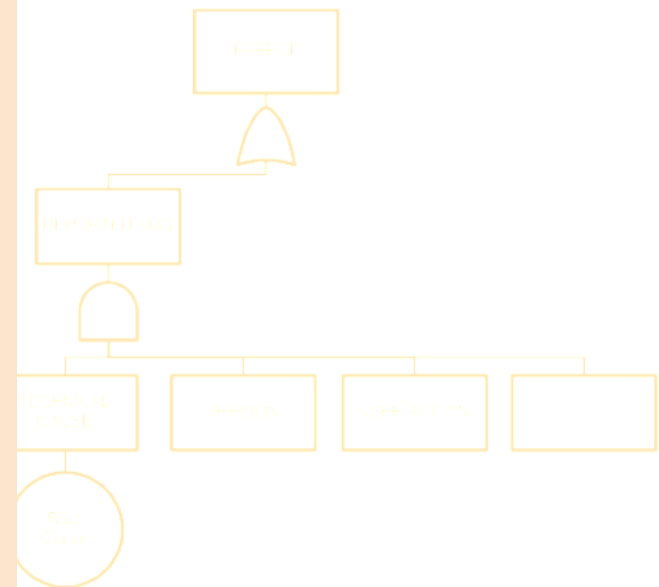
4. Calculate expected cost for the customer

- $P = \frac{1}{300}$ per hour

| User | T |
|--------------------|---------|
| Procurement Worker | 12 min |
| Secretary | 8.3 min |
| Marketing | 9.5 min |

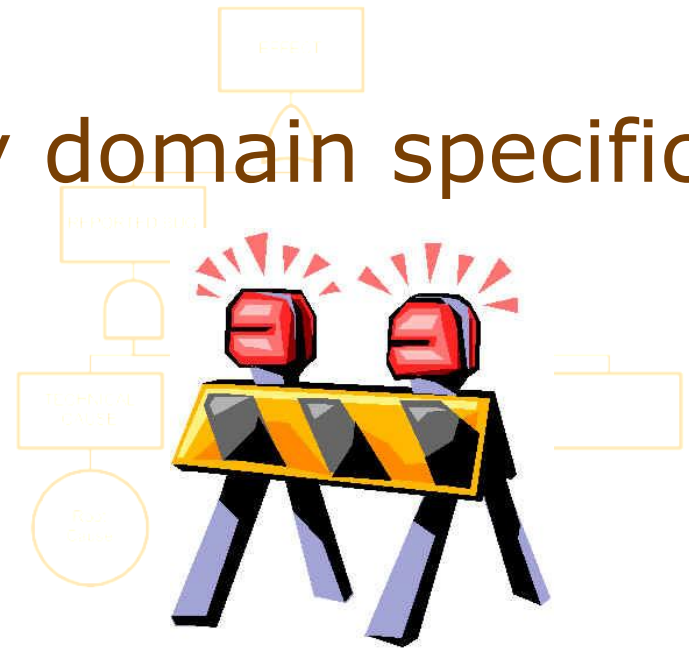
- $C^r = 0 \$$ $C^m = 100 \$$

$$\Rightarrow C = 49.67 \$$$



Assumptions and Limitations

- Producer-Consumer gap leads to limited empirical data on failure-induced cost
- Cost drivers are very domain specific
- Legal implications



Lessons Learned and Future Work

Most high impact bugs are eliminated prior to release

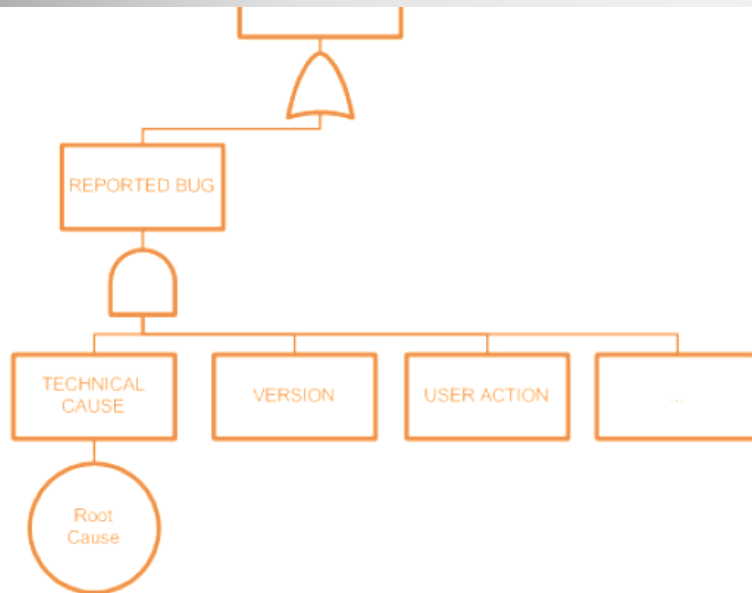
However, minor failure effects accumulate over time!

Include software defect prediction techniques

Industrial case study



Thank you for your attention!



Questions / Comments?