

Software Reliability and Safety

CSE 8317 — Spring 2015

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SRE.1: SRE Basics

- SRE Overview and Approaches
 - see Slides for SQE Chapter 22.
- SRE Activities and Context
- Analyses beyond reliability modeling
- General problems/issues

SRE Activities

- Main reference: Lyu/HSRE Ch.6

- Analysis/modeling activities:
 - ▷ Predicting (prescriptive) reliability:
 - based on prod./proc. characteristics
 - Musa's work at AT&T
 - ▷ Estimating (descriptive) reliability:
 - s/w reliability growth models (SRGMs)
 - other models and applications
 - all based on testing/defect/etc. data
 - ▷ SRE practice: mostly latter

- Modeling sub-activities:
 - ▷ Observing/measuring
 - ▷ Choosing models for goal/data
 - ▷ Evaluating modeling result
 - ▷ Applying results in process/decisions
 - ▷ Followup and improvement

SRE Activities

- In-process activities:
 - ▷ OP construction:
 - start:requirement — end:testing
 - ▷ Prepare/execute OP-guided testing
 - ▷ Process management & improvement
 - manage by reliability goals
 - ▷ Techniques for above: in 7314
 - ▷ Design for reliability:
 - some additional research

- In-field activities:
 - ▷ Measurement and data gathering
 - ▷ Focus: availability management

$$\text{Availability} = \frac{MTTF}{MTTF + MTTR}$$

increase MTTF and decrease MTTR

SRE and System Reliability

- Hardware reliability
 - ▷ Different characteristics
aging, wear, etc. \Rightarrow reliability decay
 - ▷ Different models (and distribution functions)
 - ▷ Extensive existing work
analysis, composition (block-diagram),
etc.

- Systems engineering
 - ▷ System composition/trade-offs
 - ▷ Maximize *system* reliability

- Lyu-book: Chapter 2 (s/w vs sys.)

SRE and Quality/Dependability

- Quality attributes beyond reliability and safety:
 - ▷ Usability
 - ▷ Security
 - ▷ Many others in ISO 9126 etc.
 - ▷ Share some common analysis techniques

- Dependability
 - ▷ Usually for (software-intensive) systems
 - e.g., SOA, Cloud, Net-Centric
 - ▷ High-assurance systems (HISS):
 - security as one major area
 - reliability, safety
 - availability, fault tolerance, etc.
 - ▷ SRE/SSE as important part of HISS techniques

SRE and Other Analysis

- Quantitative analysis
 - ▷ Defect analysis, risk analysis, etc,
 - ▷ Measurement and data collection
 - ▷ Analysis: assessment/prediction/control
 - in SRE, SSE, HISS
 - ▷ Statistical and AI-based

- Qualitative analysis
 - ▷ Defect classification, root-cause, etc.
 - ▷ Measurement level: nominal or ordinal
 - ▷ Subjective judgment and process

- Example of recent usability work at SMU

SRE Issues: What and How

- Usage and effectiveness
 - ▷ Good assessment vehicle
 - ▷ Prediction varies w/ OP quality
 - ▷ Limited control capability
 - ▷ Dependency on data/environment

- Models and development
 - ▷ SRGMs: overall picture
 - ▷ Combinatorial: snapshots, focus
 - ▷ Integrated(TBRMs etc): promising
 - ▷ Data/tools/experience
 - ▷ Integration with other initiatives

SRE Issues: Where and When

- Products and environments
 - ▷ Medium reliable software: SRE
 - ▷ Safety critical: SSE
 - ▷ Mass market: focus on usability, etc.
 - ▷ Spectrum: (-ilities)...(SRE)...(safety)
 - ▷ Tailoring/adaptation/adoption

- When it is useful
 - ▷ OP-based random testing
 - ▷ Late in development cycle
 - ▷ Too late? What to do? (SRE.2)
 - ▷ Learn from hardware RE.

SRE Issues: Process & QA

- Direct link to testing
 - ▷ Testing techniques affect reliability
 - ▷ Testing measurements in SRE modeling
 - sampling: Nelson model & other IDRMs
 - reliability growth over time: SRGMs
 - fault seeding (& models), etc.

- Other in-process measurement/analysis
 - ▷ Requirements/specs to OP/UBST
 - ▷ Design and code measurement to defect analysis and predictive modeling
 - ▷ Data from other QA activities
 - ▷ Early remedial/preventive actions

SRE Issues: Improvement

- Improvement potential
 - ▷ Risk identification
 - ▷ Remedial actions
 - ▷ Prevention: design for reliability
 - ▷ Learn from experience

- More data and analyses
 - ▷ Defect: Classification/distribution
 - ▷ Internal measurement
 - ▷ Linkage: predictive analysis/modeling
 - ▷ Analysis techniques
 - statistical: regression, NN, TBM etc.
 - analytical: trace, causing, FT etc.
 - ▷ Linkage to subsequent topics