A sustainable software testing process for SKA

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My co-authors

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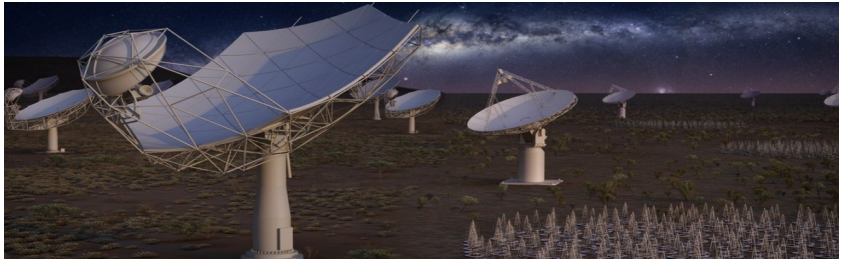
The SKA Project

(the largest radiotelescope in the world)



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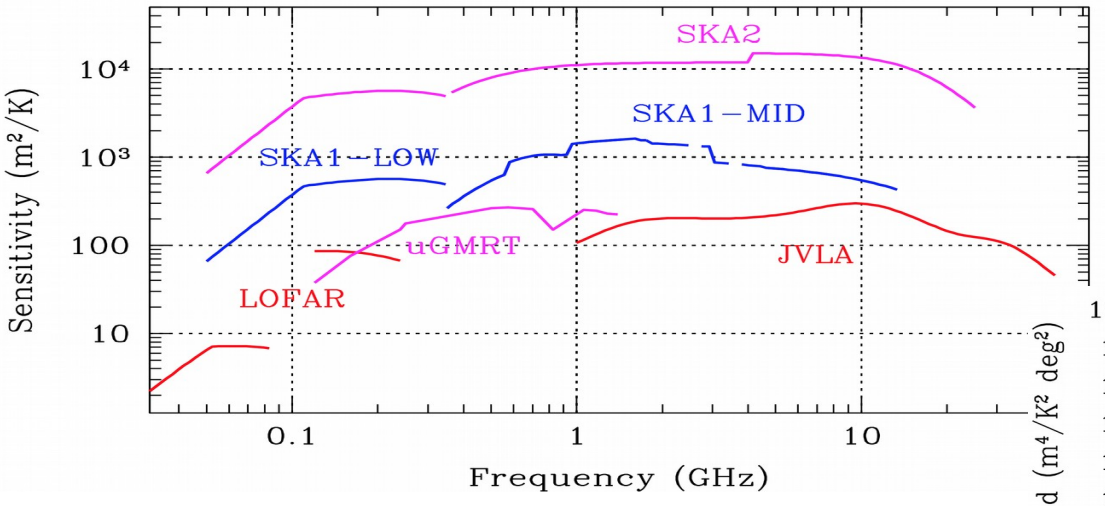
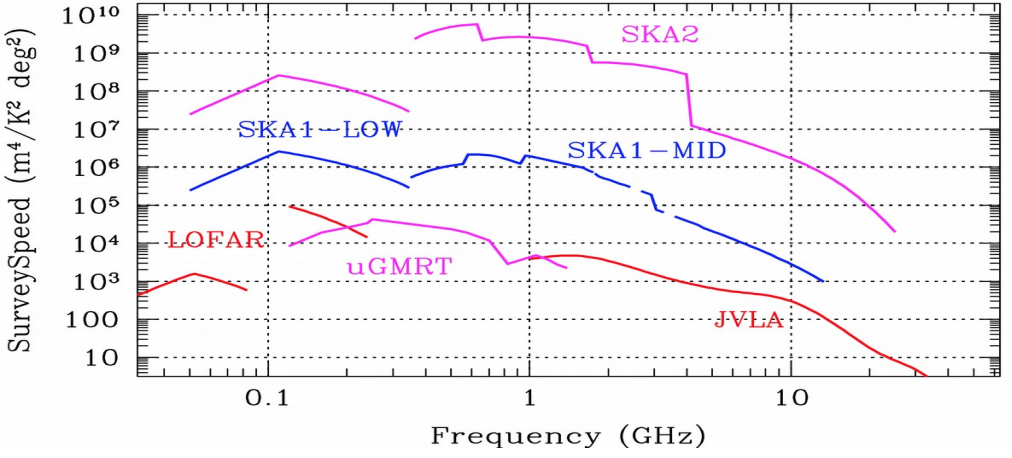
SKA 1 capabilities



Point-source sensitivity:
4 – 20 x state-of-the-art



Survey speed:
10 - 100 x state-of-the-art

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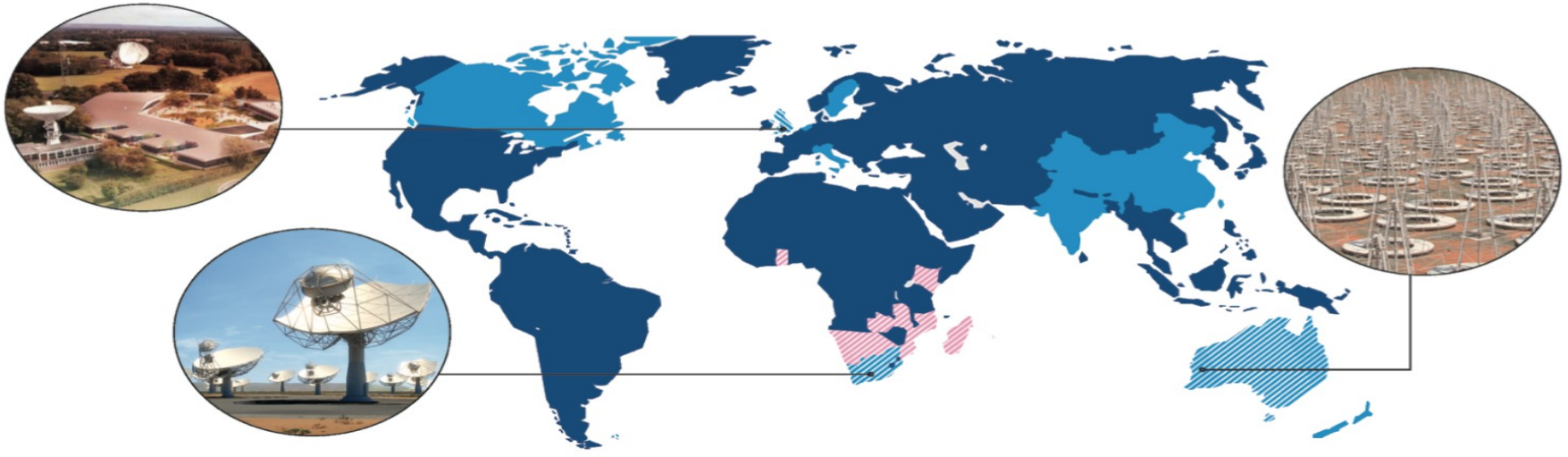
A Global Research Infrastructure



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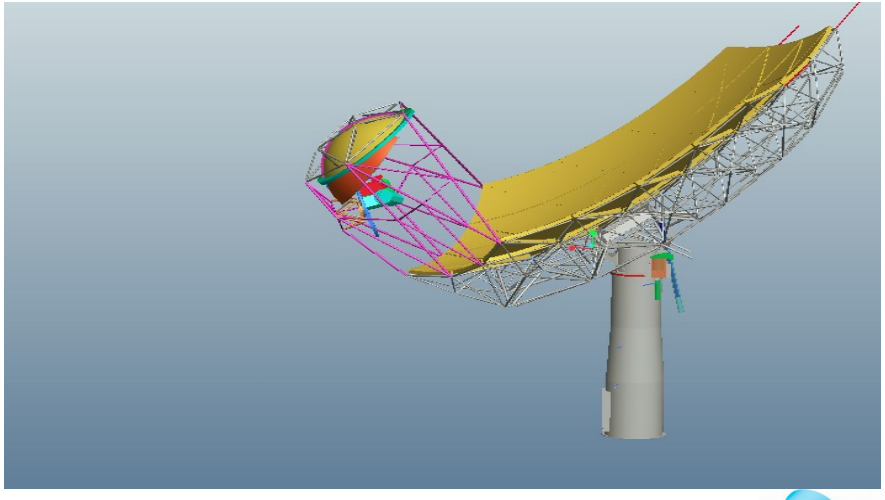
Many sub-systems

SKA Mid

- 133 new antennas
- Integrated with 64 existing antennas
- 5 frequency bands



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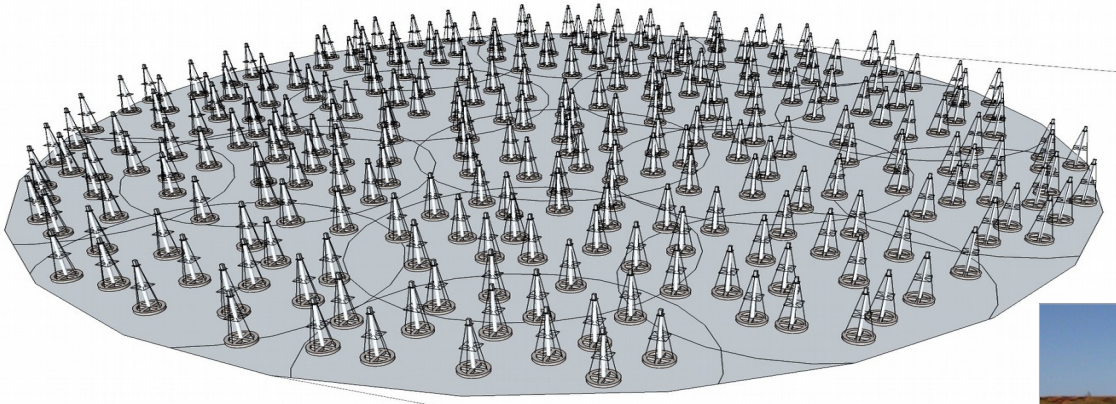
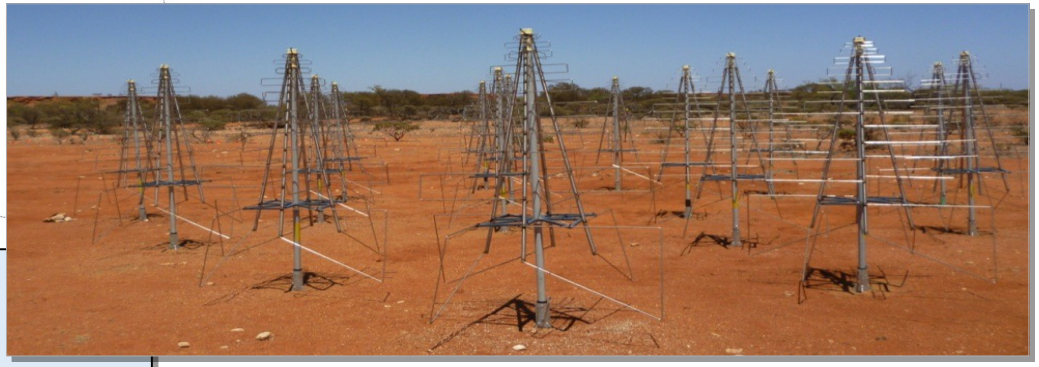
SKA Low





Antenna: Log Periodic

No. of ant.: 131,072 (2^{17})

Ant. Spacing, min: 1.5m (av. ~1.9m)

Station size: 256 antennas
~40m dia.

No. of stations: 512

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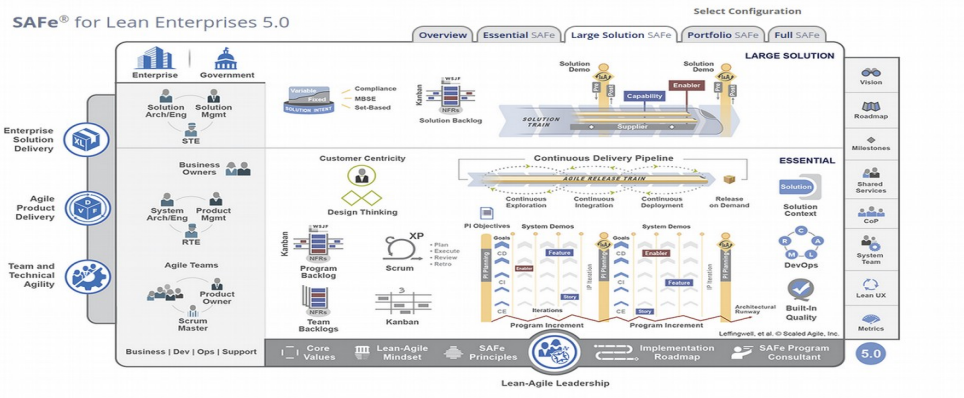
Computing requirements

- ~25 PetaFLOPS/sec total sustained
- ~200 PetaByte/s aggregate BW to fast working memory
- ~50-100 PetaByte fast working storage
- ~1 TeraByte/s sustained write to storage
- ~10 TeraByte/s sustained read from storage
- ~10000 FLOPS/byte read from storage
- Current power cap proposed is ~5MW per site.

SAFe

(Scaled Agile Framework)



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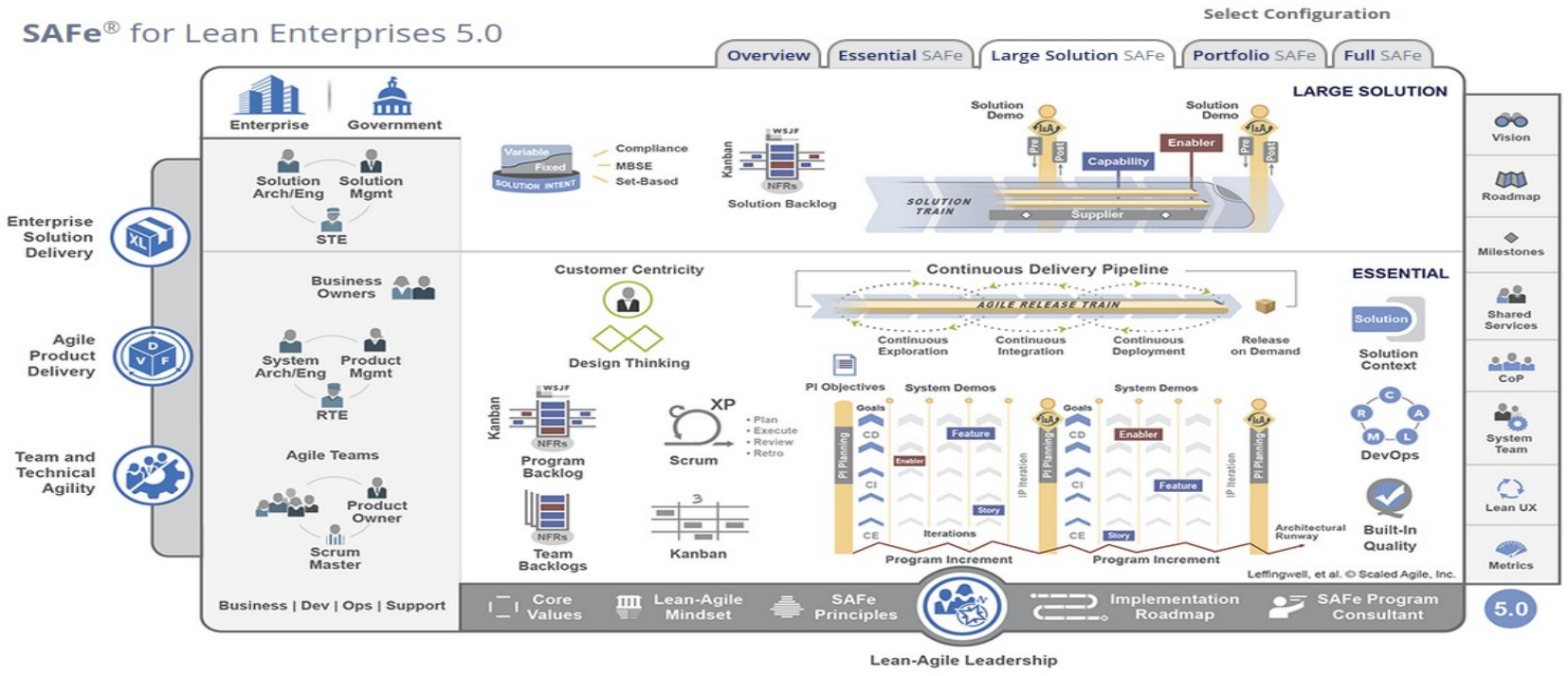
SAFe



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SAFe (as implemented by SKA)

- Developers belong to SCRUM teams (grouped in Agile Release Trains)
  - they develop User Stories → Features → System Capabilities
- Product & Process Management
  - consists of Product Owners, Product Managers, Architects
  - SCRUM Masters, RT engineers, Solution Train engineer
- Cadence is shared:
  - **Sprints** (2w) – with usual SCRUM cerimonies
  - **Program Increments** (5 sprints) – with **system demos**, with **PI planning** week, **SOS meetings**, **PO Sync** meetings
- Common **Definition of Done**
- There are **Communities of Practice**

Current status

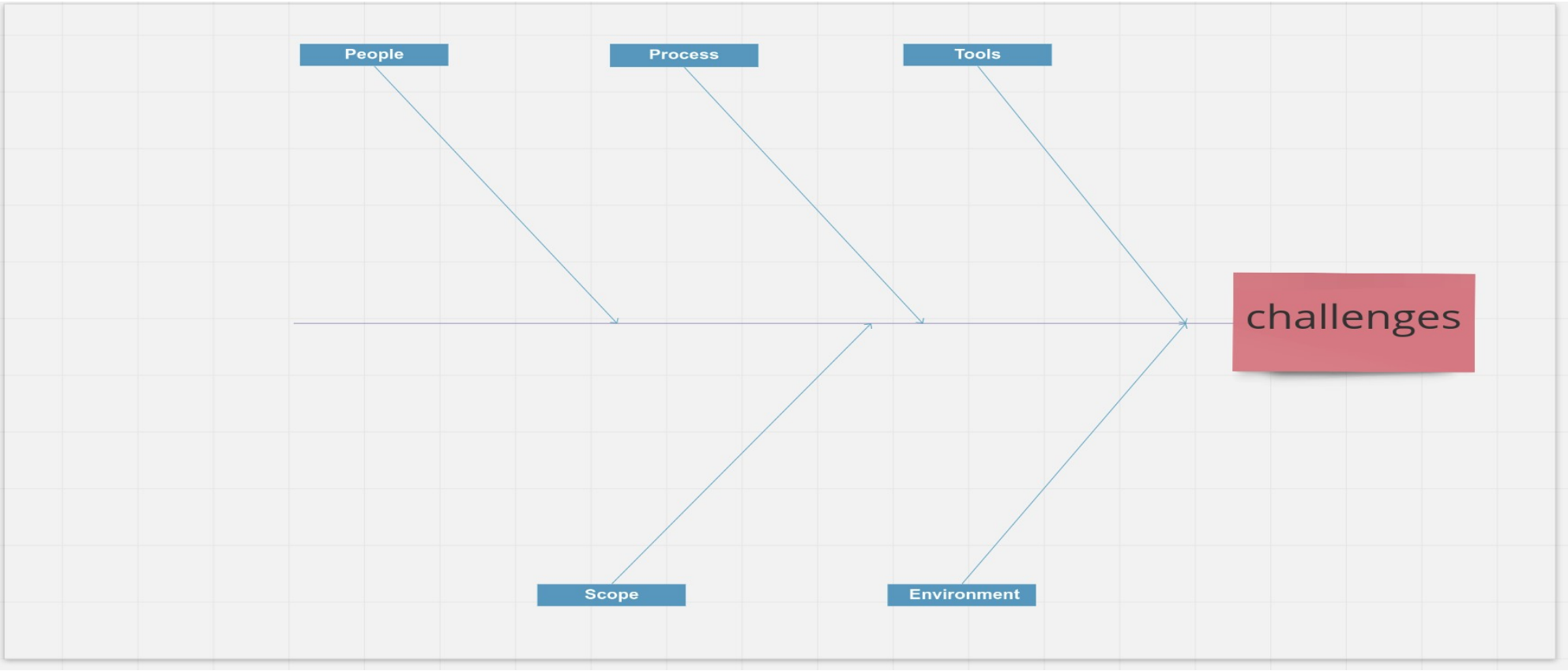
- 16 Agile Teams in 2 Trains
- ~105 FTEs
- ~160 people involved → ~60% average time commitment

- we are now in PI#7 – 19 months from the start of development
- in the Bridging phase
- Construction will begin in June 2021

The problem

(pain points for test managers)

Challenges



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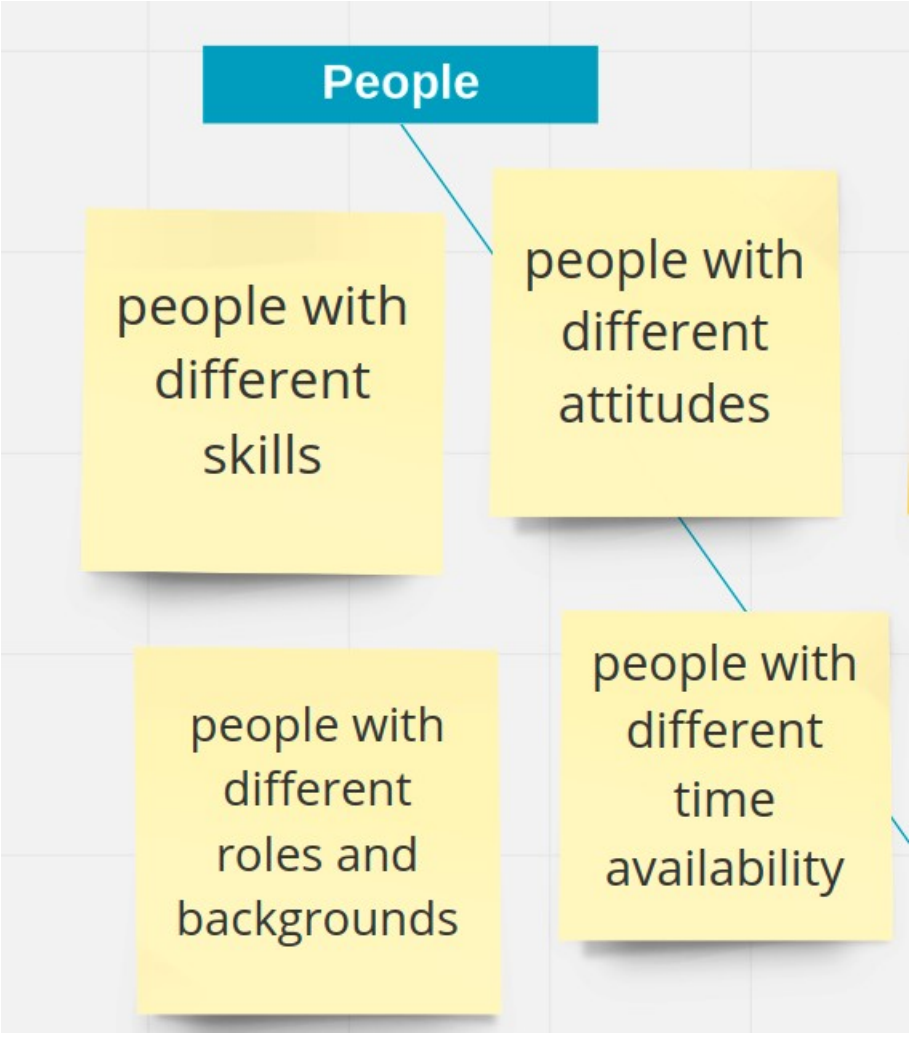
Challenges



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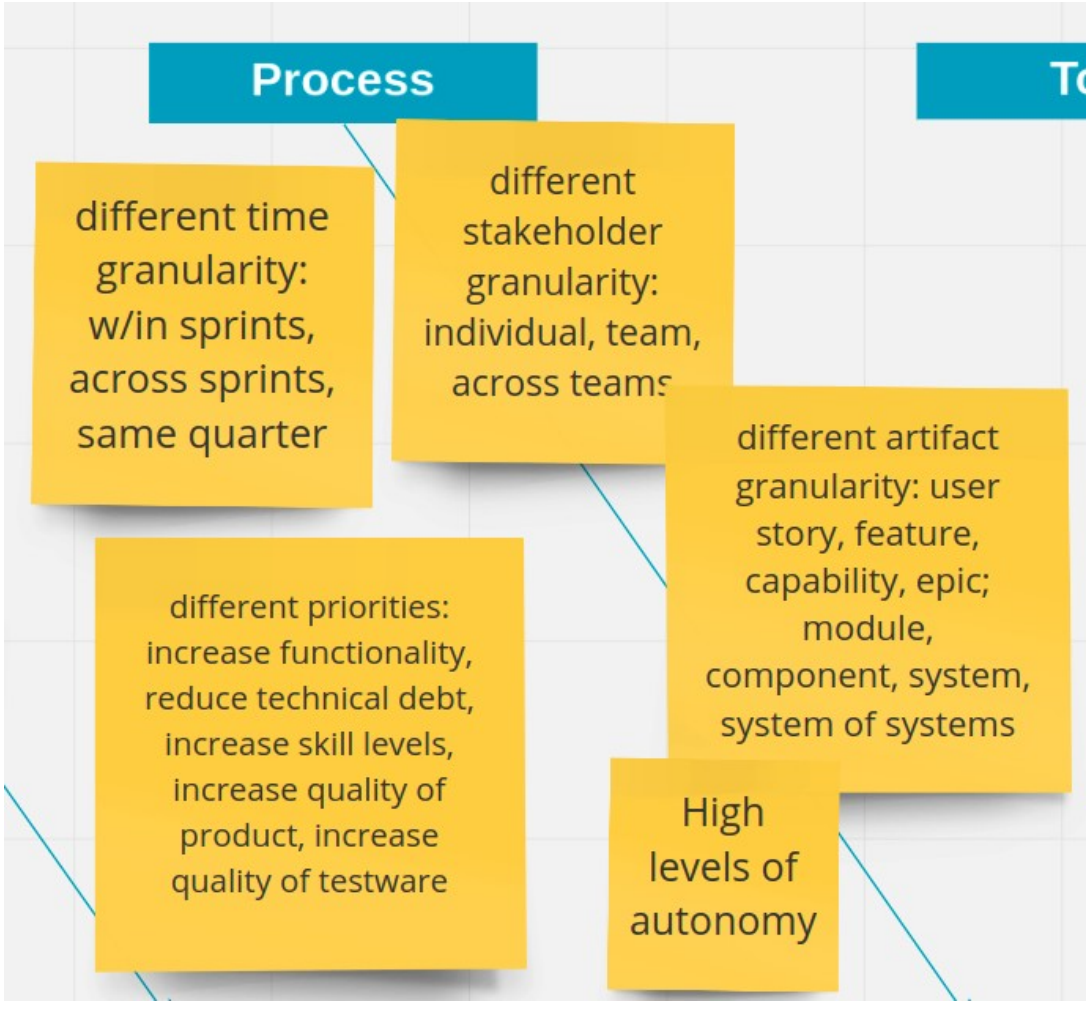
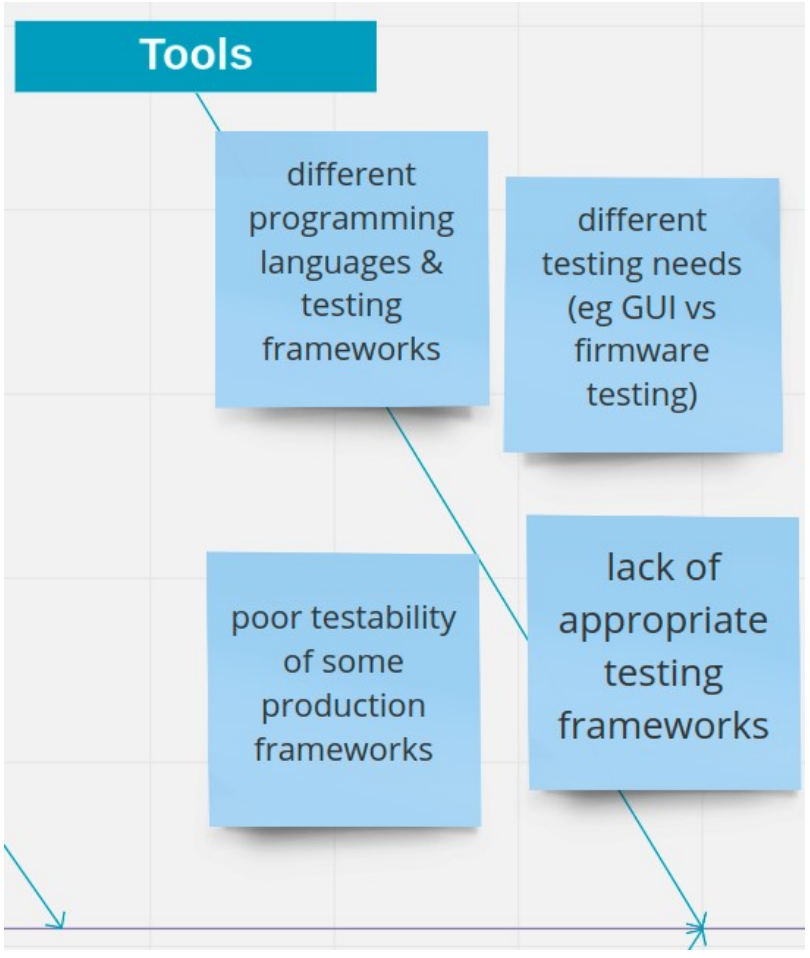
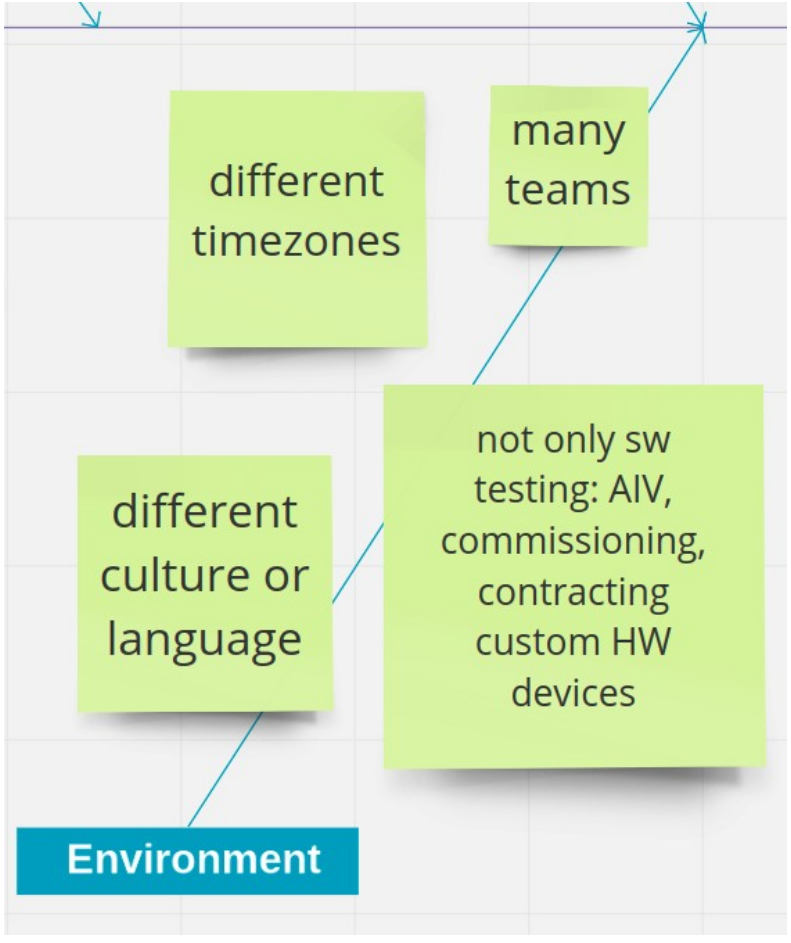
Challenges


Process
different time granularity: w/in sprints, across sprints, same quarter
different stakeholder granularity: individual, team, across teams
different artifact granularity: user story, feature, capability, epic; module, component, system, system of systems
different priorities: increase functionality, reduce technical debt, increase skill levels, increase quality of product, increase quality of testware
High levels of autonomy

Challenges


Tools
different programming languages & testing frameworks
different testing needs (eg GUI vs firmware testing)
poor testability of some production frameworks
lack of appropriate testing frameworks

Challenges



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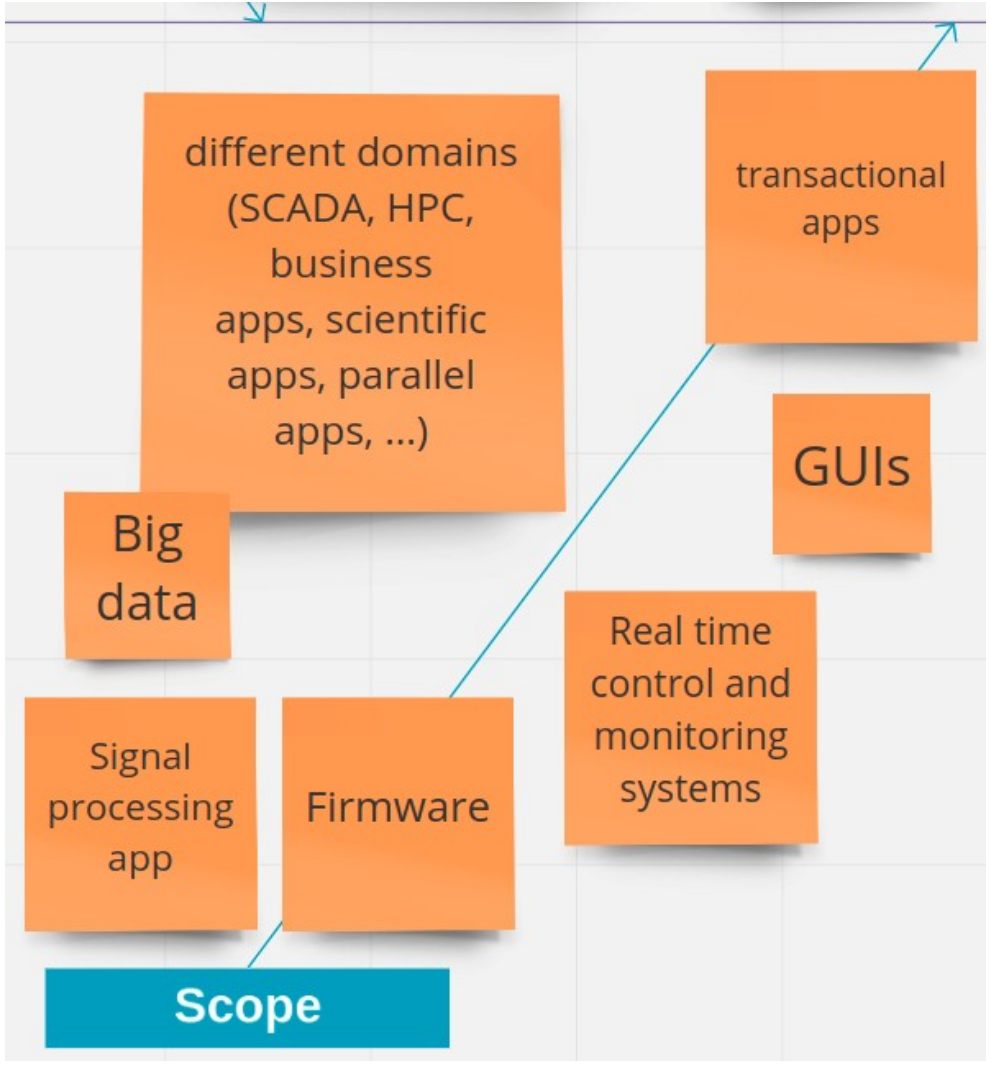
Challenges



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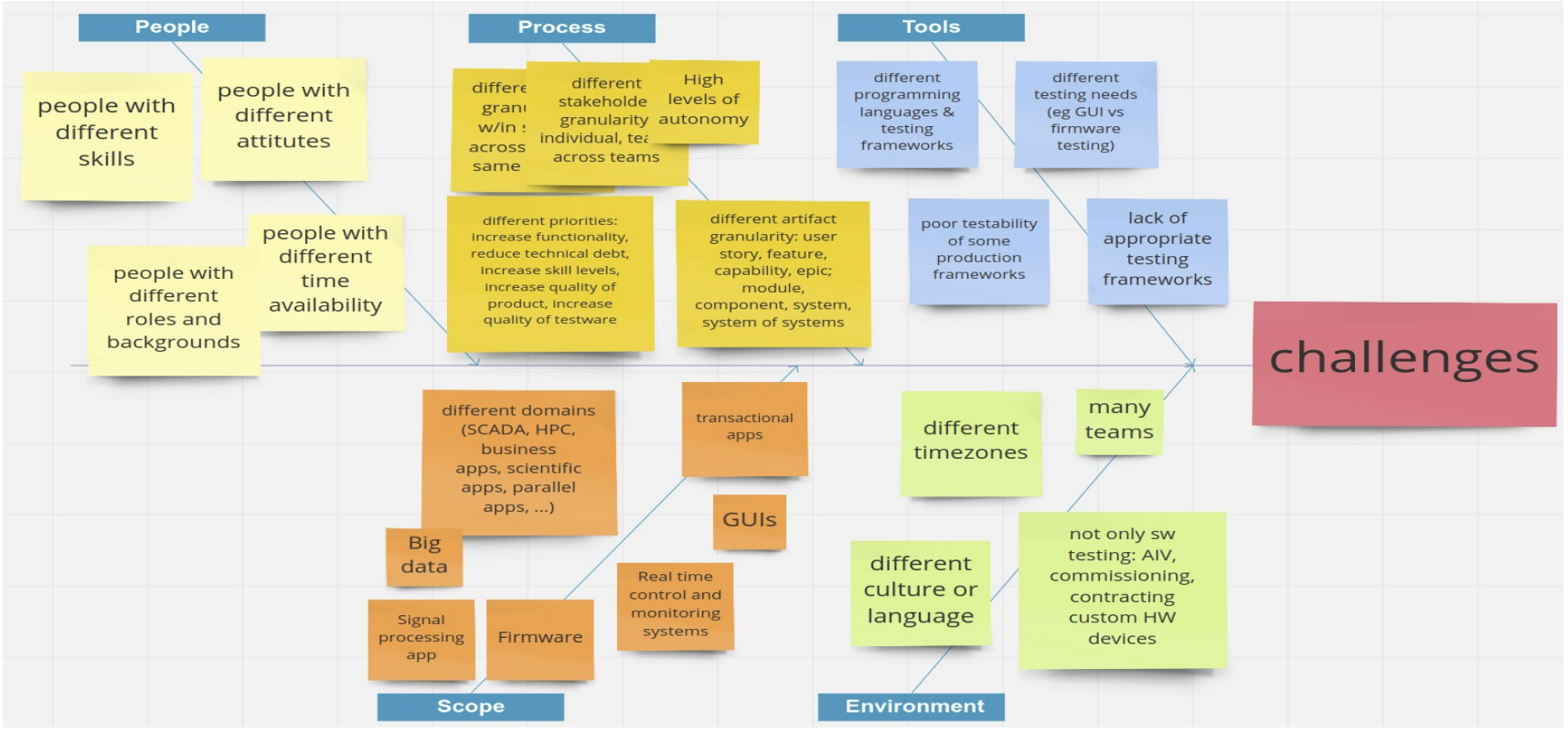
Challenges: the result?



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Examples of actual pain points

POs/FOs need to be trained so that they focus more on acceptance criteria (and then tests)

train testers to design better tests and to implement good test approaches

Inconsistent Testing Environments

Inconsistent behaviour | Testing | Quality | SKAMPI

Observe Inconsistent behavior of SKAMPI on local development environment

Inconsistent behaviour | Quality | SKAMPI

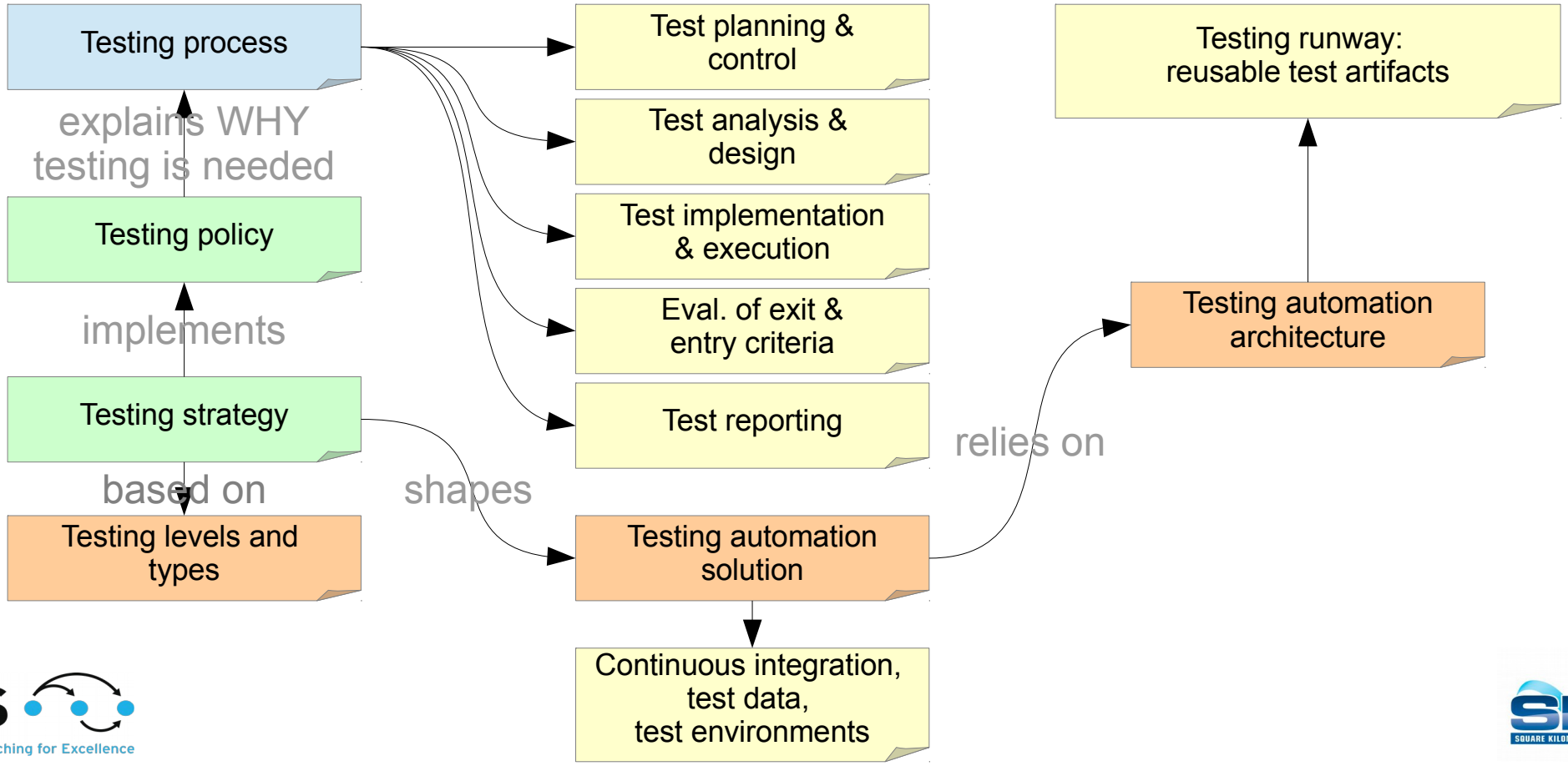
Having a good way to reset the MVP to a clean state quicky - for instance for BDD Tests.

Testing

Our solution

(ad hoc)

Introduce a common language



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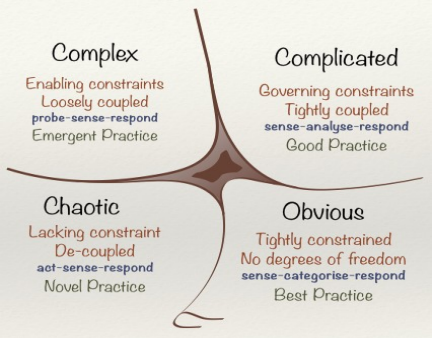
Sustainable process?

- it has to support the **business goals** for which the software product is being developed
- it has to support the **development teams**
- testing can be performed **quickly** and **frequently**
- **it has to be** economically feasible

Background principles

- Evolutionary approach (PI by PI)
- Use Cynefin:
  - establish hard constraints
  - seed ideas
  - nurture them
  - use “social coercion”
- **Awareness → Desirability → Knowledge → Applicability → Reinforcement**
- Lean documentation



Example

Introduction of Given-When-Then tests

- show examples to stakeholders
- give a seminar
- do a pilot spike
- assemble a group of people that can carry out that work
- motivate Management
- establish it as a standard in the Testing Strategy
- suggest ideas like “Virtual team of testers”
- monitor its adoption & its quality

Example

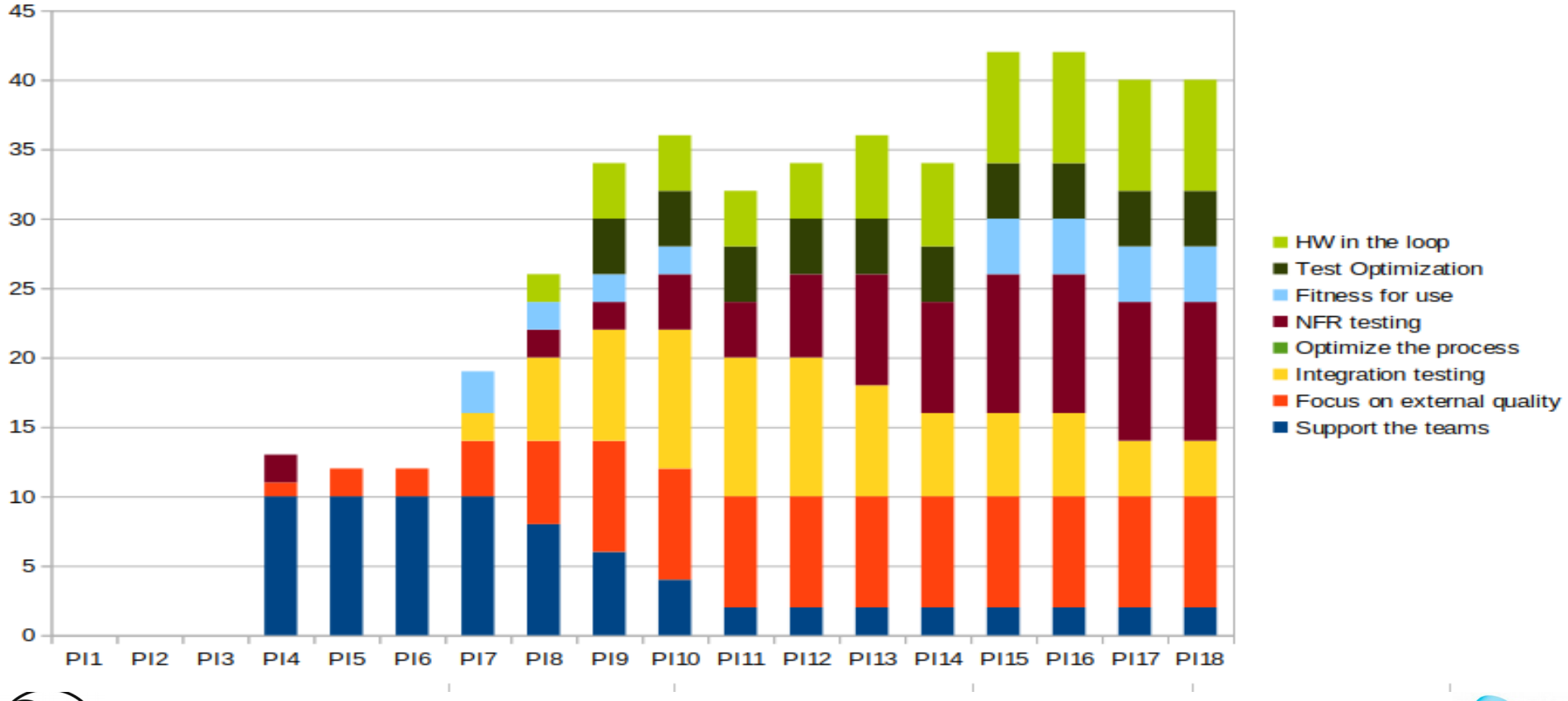
Introduction of *Test-First approach* for acceptance testing

- show examples to developers
- give seminars and workshops
- pick a willing and capable team to make sure that it makes sense
- motivate Management
- establish it as a standard in the Testing Strategy
- suggest the idea of Test-Driven Demos
- coach other teams
- monitor its adoption and its quality

Testing goals

- **Support the teams**:
  - unit & module, TDD, code coverage, clean code, clean architecture
- **Focus on external quality**:
  - system-level tests, suitable test environments, BDD tests
- **Integration testing**:
  - consumer driven contract based testing, mocking Tango servers, tests as living doc, bottom up integration testing
- **Optimize the process**:
  - continuous testing, risk-based testing, master plan for a PI
- **NFR**:
  - performance, security, reliability
- **Fitness for use**:
  - exploratory testing, usability testing
- **Test optimization**:
  - domain partitioning, boundary value analysis, combinatorial testing, coverage in terms of finite state automata, mutation testing
- **HW in the loop**:
  - intake tests,
    compliance of sw wrt AIV

Intensity of goals



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Means to achieve this

- Definition of Done
  - should be shared & normative
- Testing Policy and Strategy
- Testing Community of Practice
- Problem Solving Workshops
- Tooling

Testing CoP

Mission:

"*We aim **to support** testers, developers and managers on everything that deals with testing and to **provide guidance** and support to help them proceed along a **test maturity path**. Within the community there should be **conversation** about the testing process, the testing techniques, any testing issues, testing resources. We should try to **anticipate and remove impediments,** and encourage simultaneous **focus on practices and principles**.*"

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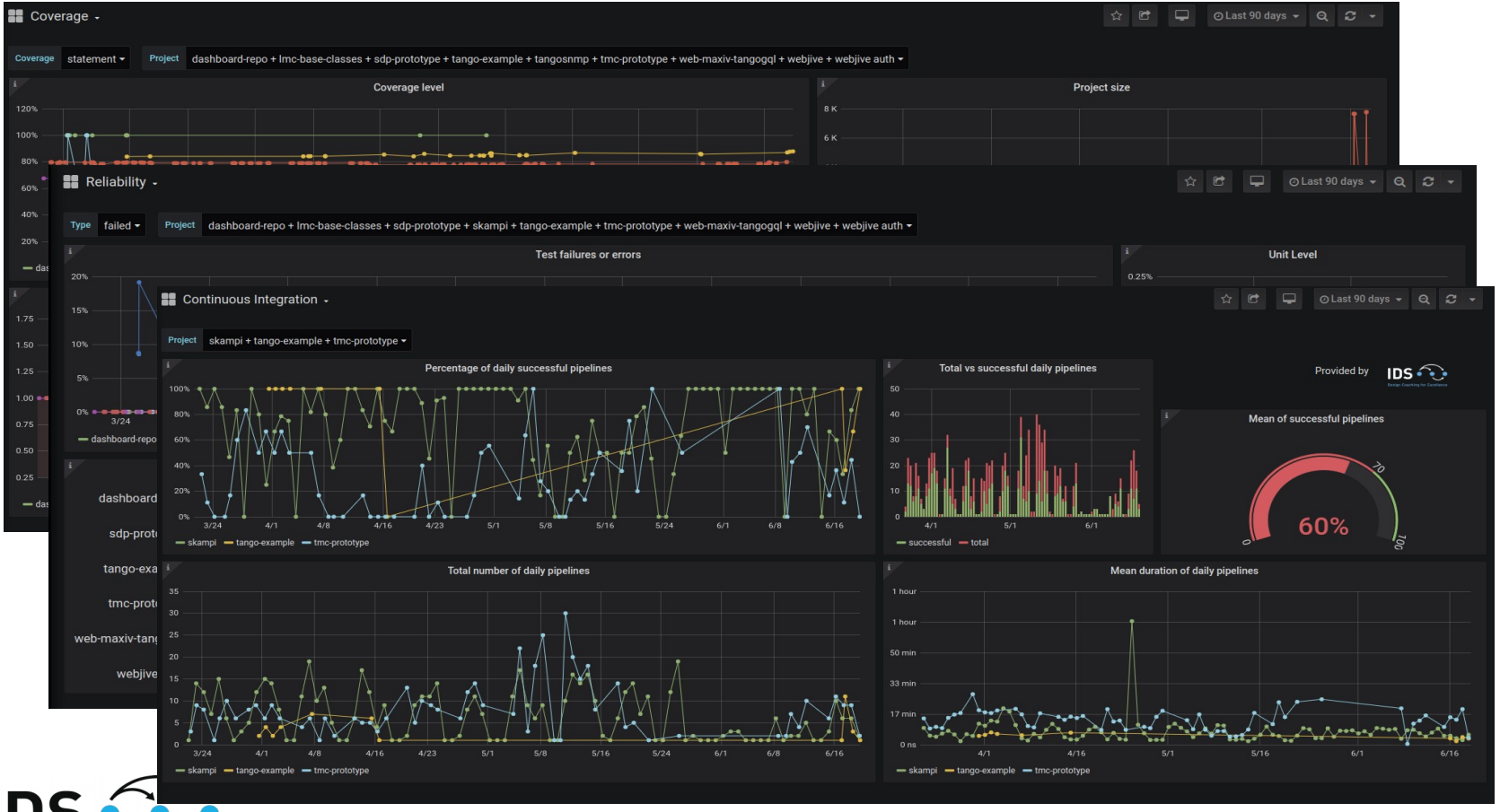
Example of tools

- Atlassian's Jira, Confluence, X-Ray
- Zoom and Slack
- IDS' Argos, perhaps Daedalus & Chronos

Argos: testing dashboards (by IDS)



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Daedalus: web IDE for living doc (by IDS)

```
project-name: homeBank
area: Transfer
import-steps: transfer_steps.tai
scenarios:
- scenario: Transfer - The system allows you to make a
            transfer with an amount greater than 5000
            filling in the city field
  steps:
  - given: integration
  - when: logging in w
  - and: you select the
  - when: you pick the
  - and: you insert an
  - and: you insert the
  - and: you insert tra
  - then: city field is
  - and: you continue
  - then: the summary
  data:
  - user:
      userAccount:"00
```

```
Feature: Transfer
  Scenario Outline: Transfer - The system allows you to make a transfer with an
  amount greater than 5000 filling in the city field
    Given integration environment is loaded
    When logging in with user code "<userAccount>"
    And you select the voice menu "Payments" and "Transfer"
    When you pick the debit account of "MR. TESTING"
    When you insert an amount of "5.001,00"
    And  you insert the payee of the transaction "IDS TESTER" with city "UDINE"
    And you insert transaction causal
    Then city field is required
    And you continue the transaction with valid data
    Then the summary of the transfer is complete and consistent
    Examples:
      | userAccount |
      | 00000 |
```

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Where are we now?

- 12 months after initial work on the testing process
- full speed on first 2 goals: supporting teams and system tests
- pushing
  - test first approach
  - testing runway and architecture
  - API testing

Leading indicators

- there is a change in vocabulary
- much more buy-in of “testing” by everybody
- emerging solutions:
  - mocking tools and examples
  - FSA testing
- testing needs felt by teams and by management
- variety of stakeholders
  that are involved with testing

Conclusion

- develop a custom solution
- introduce the basics of testing
- roll out a series of goals to be achieved, and ways to measure them
- put constraints, seed ideas, nurture them
- get buy-in by teams and management – and manage it
- relentless attention on quality of testware
- promote testing education and growth
  across all the teams

Contact

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