Shifting left - using Statistical Process Control & Metrication

An experience report of using SPC and test analytics

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Agenda

- Introductions
- 5 challenges faced by testing
- Statistical Process Control – an explanation!
- Specific application of SPC to help solve challenges
- 3 examples of departmental and cross divisional change
  - Problem statement analysis
- Building trust and credibility with data
- Additional benefits
Delivering software to regulated environments

IDBS is a global provider of innovative enterprise data management, analytics and modelling solutions

- Used by more than 200 pharmaceutical companies, major healthcare providers, global leaders in academic study, and high tech companies
- Our products enable increased efficiency, reduced costs and improved productivity of industrial R&D and clinical research
- Our platforms are enabling translational medicine – personalised medicine (right drug, right patient, right time)

Our customers work in highly regulated environments

- GxP (GLP, GCP, GMP etc...) FDA regulated, 21 CFR Part 11, EU Annexe 11

Our Test Department operates as a centre of excellence

- Repeatable processes and supporting toolsets, consistently applied
The seeds of change

- Value of testing not understood – perceived by some stakeholders as a cost centre / overhead
- Testing perceived as a bottleneck – impacting time to market
- More people required than budget would accommodate – impact on operating costs
- Ensure SDLC improvements were supporting business goals
  - Testing process improvement driven by practitioners, but not necessarily aligned to business objectives
- Unassociated targets across product delivery – meant it was hard to drive holistic improvements in SDLC
Statistical Process Control (SPC)

- Methodology focused on quality control and process improvement involving statistical data analysis

- SPC is based on the following principles:
  - Define the process requiring control
  - Measuring the process
  - Analyse, Identify and eliminate unusual variation from the process
  - Improving the process to its best target value
  - Monitor and control the process performance over time
Common Cause vs Special Cause Variation

- **Common Cause Variation:**
  - Naturally present within the process
  - Usually insignificant and predictable

- **Special Cause Variation:**
  - Assignable to a root cause
  - Usually significant and unpredictable
Process & Variation

- An activity which transforms inputs into outputs; \((F(x) = Y)\)

\[
\text{INPUT} \xrightarrow{\text{ACTIVITY}} \text{OUTPUT}
\]

\[X \xrightarrow{f(X)} Y\]

Example: *making a cup of tea, baking a cake, getting to work, etc.*

- Any process will have a certain degree of variation; some variation will be inherent to the process, some will not.

- Variation in a Process = **Common Cause** Variation + **Special Cause** variation
### Statistical Process Control – day to day example

<table>
<thead>
<tr>
<th>Days</th>
<th>Journey Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>45 minutes</td>
</tr>
<tr>
<td>Tuesday</td>
<td>50 minutes</td>
</tr>
<tr>
<td>Wednesday</td>
<td>47 minutes</td>
</tr>
<tr>
<td>Thursday</td>
<td><strong>120 minutes</strong></td>
</tr>
<tr>
<td>Friday</td>
<td>49 minutes</td>
</tr>
</tbody>
</table>

Special Cause Variation
Control Charts

- Statistical tool used to monitor the stability of a process over time

- Key features:
  - UCL (Upper Control Limit) = mean + 3*sigma
  - LCL (Lower Control Limit) = mean – 3*sigma
  - central line (mean of data set)

- A process is said to be in control when data points fall within limits of variation (i.e.: between Upper and Lower Control Limits)
Statistical Process Control - Benefits

a) Continuous Process Improvement

b) Process Baselines

c) Early visibility and reaction

d) Quantitative Management Decision Making

e) Economical Value
So, why SPC?

- IDBS is not formally following a maturity model
- Previous CMMi experience (level 2 – level 5) & Six Sigma
- Understanding of TMMi
- “Self assessment” of IDBS maturity levels (akin to a readiness review)
  - Level 3 supporting processes in place to include SPC
- Scientists and data analysis – cultural alignment!
Demonstrate and gain recognition of the value of testing

- No measure of the protection / assurance testing provided to the business – inevitably raises a question of value
  - Why do you do so much?
  - Can you reduce scope?
  - Are you testing the right things?

- Limited existing measures; time in test per project, and defect data raised by projects.

- Introduction of Test Effectiveness Metric (aka Defect Leakage, DDP)

- Test Effectiveness = defects found in test as percentage of defects found by test and customers

- Demonstrate per product line the Test Effectiveness, with improvement over time
Test Effectiveness Control Chart

- ProjectA: 100%
- ProjectB: 30%
- ProjectC: 80%
- ProjectD: 70%
- ProjectE: 50%
- ProjectF: 90%
- ProjectG: 80%
- ProjectH: 70%
- ProjectI: 60%
- ProjectJ: 50%
- ProjectK: 40%

- 2010: 35%
- 2011: 80%
- 2012: 70%
- 2013: 60%
- 2014: 50%
Testing – Optimised for business value

Test Effectiveness Control Chart

Leakage:
- Service Releases
- Patch releases
- Customer Satisfaction

Level of Exposure

Level of Protection
Changing the perception of test (and improve time to market...)

- Once the opportunity cost (less projects being tested) was understood by Executive, testing no longer seen as a bottleneck, but the problem was a development issue requiring resolution.

- Headcount / resourcing discussions reduced.

- Only measure was time in test, and defect numbers raised by projects.

- Time captured to demonstrate how much effort was being applied to rework (or, WASTE!)

- Introduction of Initial Build Quality (IBQ) (% of tests that pass FIRST time they are run.

- IBQ = 50 tests executed, 25 pass, 25 fail = 50% IBQ – measure of development quality process.
Ensure SDLC improvements were supporting business goals

- Root Cause Analysis of control limit breaches drives change to process to reach departmental targets.
Problem statement: Late defect detection

- IBQ & Test Effectiveness outliers
  - Demonstrated quality problems, however defects often found late in projects, often deferred...
  - Testing manual, CI tests lacked depth / breadth

- Solution
  - Introduction of automation architects to increase test coverage and early detection using Robot framework
  - Automation on the desktop of >65% test group
  - Automation tests shifted into nightly builds
  - Robot buddies: Testers coaching development in improving automation coverage in unit tests and continuous integration
Problem statement: project prioritisation

- IBQ outliers
  - Developers frequently switched between projects; inadequate time to become familiar with code and requirements
  - This was because the priority of work was not understood and frequently changed.

- Solution
  - Introduction of a Portfolio Management Office – corporate service to align IT and Professional Services in delivering optimal business value
  - Improved business planning & prioritisation of projects to maximise ROI of IT development
  - Improved alignment of Sales, Product Management & Product Delivery

Business Benefit
- New License Revenue
- Customer Satisfaction
- Maintenance Protection
- Cost Savings
Problem statement: understanding edge cases

- IBQ outliers, Test Effectiveness and customer raised issues
  - Developers, Testers and Product Management had different understanding of requirements
  - This was because our customer base was using our software in increasingly diverse ways...our understanding of use cases was behind the curve

- Solution
  - Introduction of Business Analysis as a vertical function in IDBS, it was previously shared between experts. Tester transitioned to Lead BA
  - Assisted in product quality by renewing our understanding of use cases (functional and non functional)
  - Analytics from software logs – increased visibility on usage patterns, operational profiles
  - Enabling more agile teams by having correct customer representation to define the backlog.
Implementation

- **AWARENESS**: Internal Quality & Testing Conference (March 2012)
  - High Level Processes Under SPC
    - Unit Test Coverage & IBQ, Overall Quality (Development Process Measures)
    - Test Effectiveness (Test Process Measure)
    - Support metrics – (support team SLA achievement)
    - Root Cause Analysis (process improvements measures)
  - **Stakeholders**: Product Delivery, Sales, Marketing, Product Management, Project Management, Development, Support

- **CONTROL**: Quarterly Governance Board
  - Continuous engagement with stakeholders
  - Once Performance baselines were understood trends towards targets monitored
Building Trust - Credibility of Metrics

- Metrics provided by SPC needed credibility

- Governance board were shown the following:
  - Approach taken in capturing data, including the source of data
  - Historic data, (up to 4 years old) that not only provided the baseline but showed outliers (events) in the corporate memory they recognised, so future outliers would be trusted.
  - The data was available in Quality Centre & Support works – it was simply a case of extracting it and presenting the information.
Positive Outcomes

- Development & Testing leadership combined into one role
  - Holistic approach to improving software quality

- Decreased focus in supplier audits due to
  - Demonstrable closed loop quality improvements
  - Auditors love it 😊, it helps retain ISO 9001 certification and sell to new customers

- Test Group now positioned as the ‘trusted advisor’ to executive team

- Overall improvement initiatives in place to
  - Increase predictability of project outcomes
  - Improve quality of software into test
  - Move towards defect prevention culture – still on the journey

- Investment in performance, security, business analysis to improve usability and quality improvements to products.
Success Factors

- Standardised Testing Methodology, and tools, consistently applied
- Access to a mathematician 😊 if you don’t have “an Ilca” - tools like Minitab for SPC
- Ensure sponsorship – work out what is important to your sponsor and how this would help them achieve their goals.
- Keep it simple – Senior Exec’s don’t have the time for detail, or necessarily understand the detail...
- Stress metrics are used for process improvement – not individual performance management. You will fail otherwise...