



Practical experience of quantitative project management

**Luxoft Quality Center
24th October 2008**

Agenda

- 1. Typical project-related questions**
- 2. Project on-going quantitative monitoring**
- 3. Post-mortem project quantitative analysis**
- 4. Historical trends**
- 5. How it all works**



Several "How?"



- **Examples of typical questions for project managers:**
 - How to monitor testing effectiveness and product quality?
 - How to understand the product is ready for deployment?
 - How to monitor project efforts?
 - ...



On-going analysis

On-going monitoring

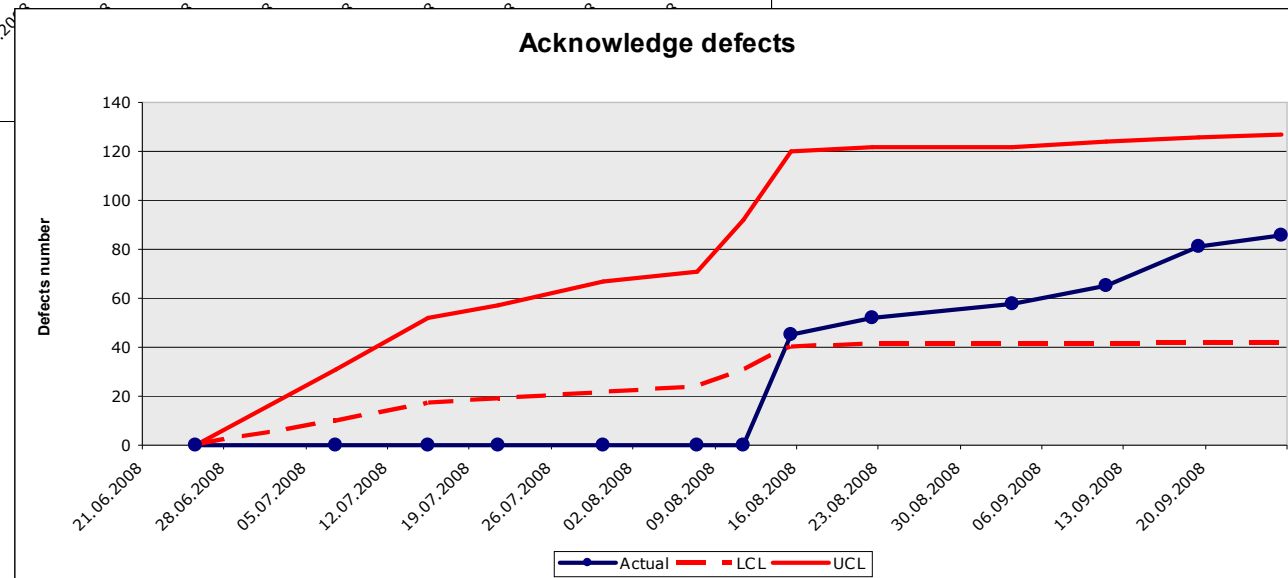
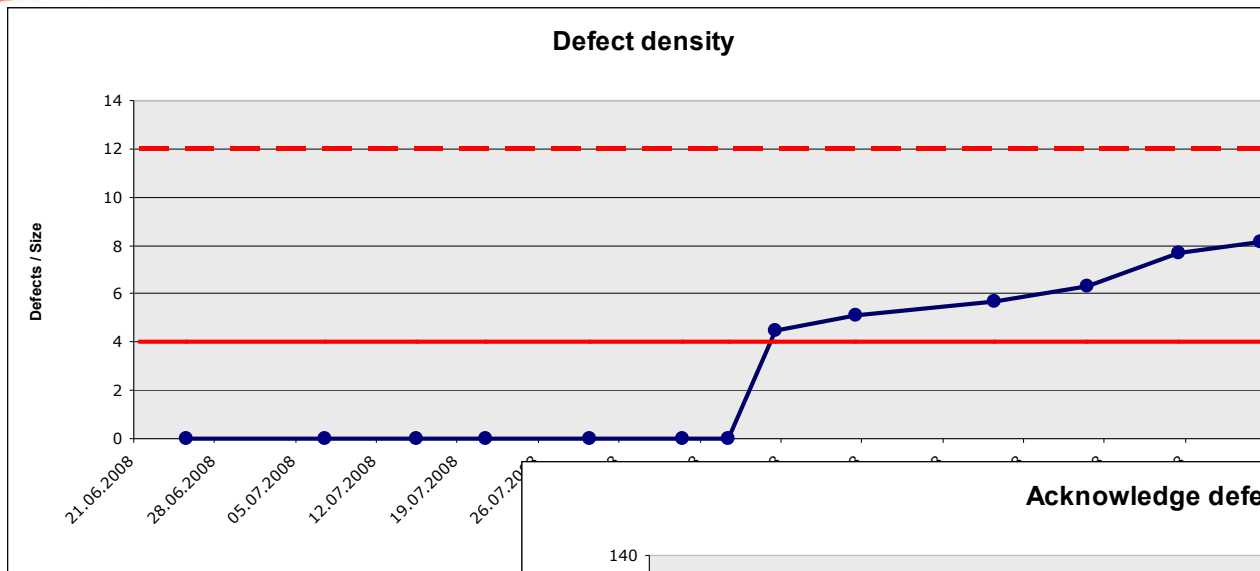


- **Product & Process Quality**
 - Defect density
 - Acknowledged defects
 - Estimation precision
 - ...

- **Efficiency**
 - Software development efficiency
 - Coding productivity
 - Defects detection timeline
 - Defects lifetime
 - ...

- **Product readiness**
 - Submitted vs Resolved defects
 - Non-closed defects
 - ...

On-going monitoring: Project/Release Quality

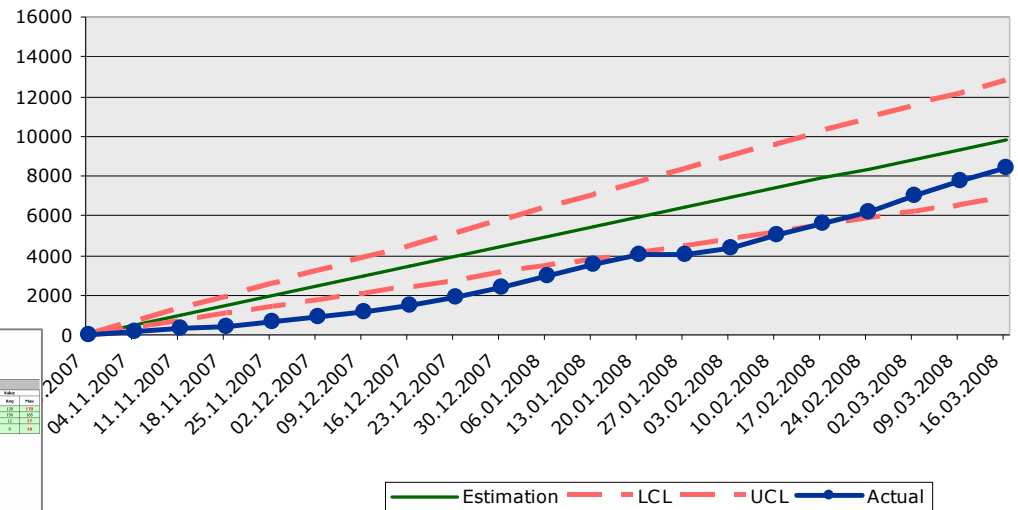


On-going monitoring: Project/Release Estimation precision

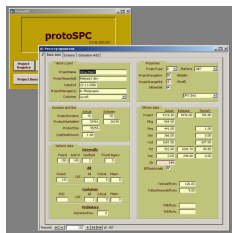


Project/Release							Metric			Metric estimation				Estimate precision (deviation)		
DC	Name	Finish date	Type	Platform	PM(s)	Estimation contacts	Name	Unit	Actual value	Min	Avg (Expected)	Max	Selected method		Alternative methods	+/- by CR
Boeing DC	REDARS_MNT Rel. 12.0 Dev	26.08.2007	Dev_R	Java	M. Oleynik, B. Gurbich	N. Bykov	Size	LSLOC	20224	14600	21600	28600	Calculation			6,4%
							Efforts	Man*hour	16322	13360	19700	26000	Expert	Calculation		17,1%
							Duration	B-day	190	140	160	180	Expert	Calculation		18,8%
Boeing DC	EAS4	09.12.2007	Dev_R	Java	A. Ulyanov	A. Ulyanov	Size	LSLOC	16476							
							Efforts	Man*hour	5941		5129		Expert			15,8%
							Duration	B-day	145		115		Expert			26,1%
Boeing DC	EAS5 Rel. 5 dev	17.03.2008	Dev_R	Java	A. Ulyanov	A. Ulyanov	Size	LSLOC	24807							
							Efforts	Man*hour	10052		12833		Expert			21,7%
							Duration	B-day	115		115		Expert			0,0%
Boeing DC	EAS5 Rel. 5.1 dev	04.07.2008	Dev_R	Java	A. Ulyanov	A. Ulyanov	Size	LSLOC	18426							
							Efforts	Man*hour								
Boeing DC	PSDS_MNT Rel.6.11 Dev	14.08.2008	Dev_R	Java	A. Ulyanov	A. Ulyanov										

Labor Efforts vs Estimation



protoSPC



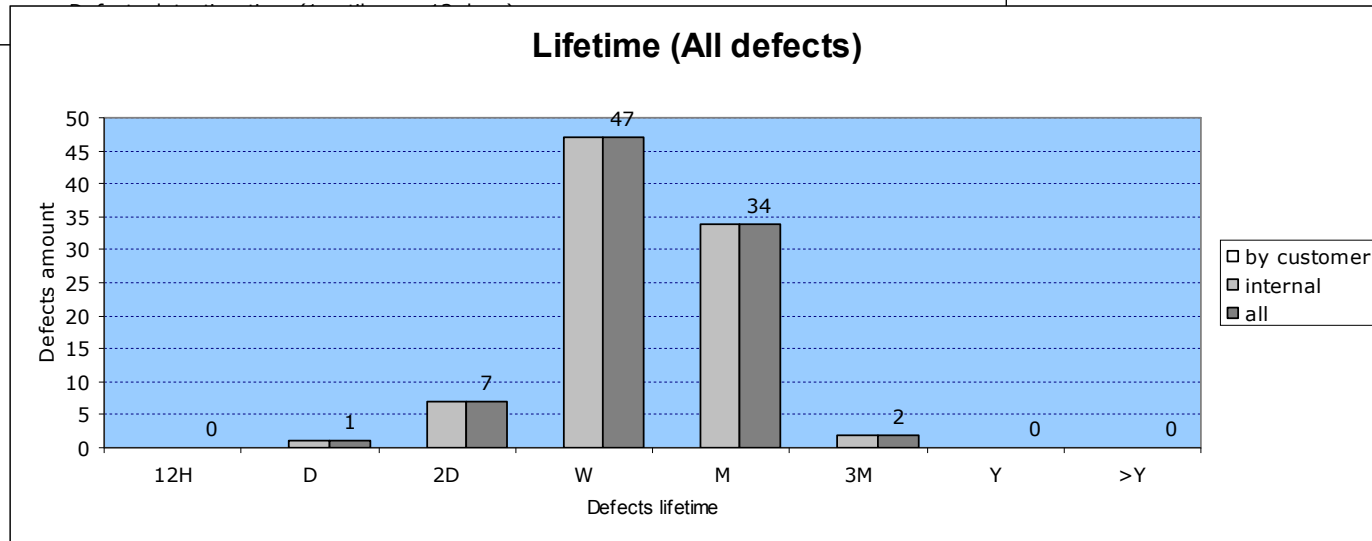
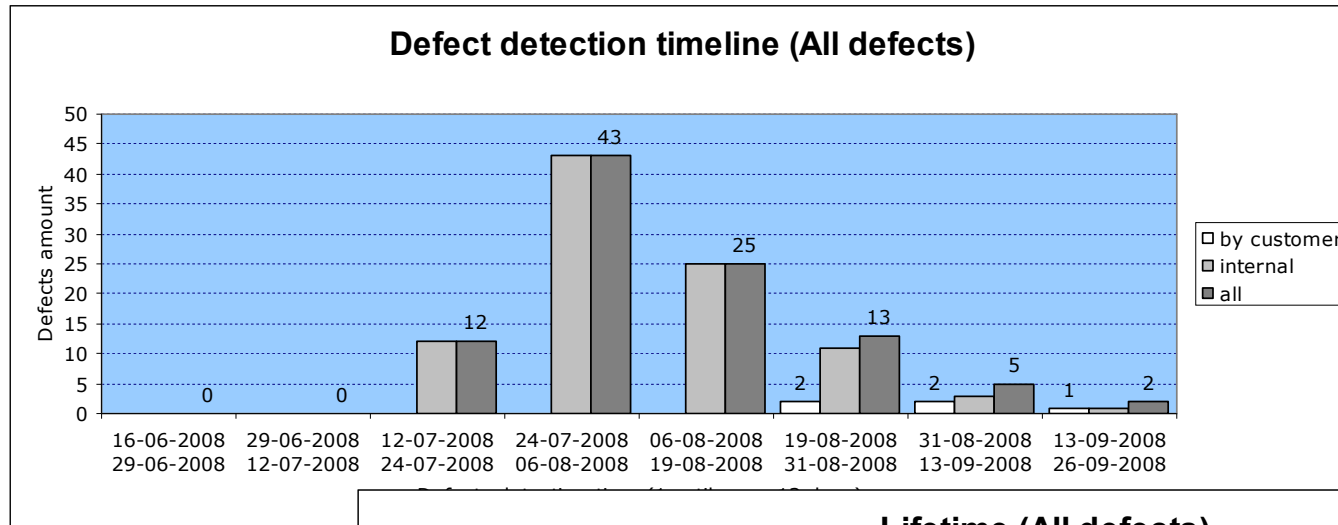
PCB form

Project/Release	Platform	Estimation Unit	Indicator Value	Indicator Limit	Indicator Type
REDARS_MNT Rel. 12.0 Dev	Java	Man*hour	16322	13360	Warning
EAS4	Java	Man*hour	5941	5129	Warning
EAS5 Rel. 5 dev	Java	Man*hour	10052	12833	Warning
EAS5 Rel. 5.1 dev	Java	Man*hour			Warning
PSDS_MNT Rel.6.11 Dev	Java	Man*hour			Warning

Estimation form

Indicator	Unit	Value	Limit	Type
Project Estimation Precision	%	6,4	10	Warning
Project Duration Precision	%	18,8	20	Warning
Project Efforts Precision	%	17,1	20	Warning
Project Size Precision	%	6,4	10	Warning

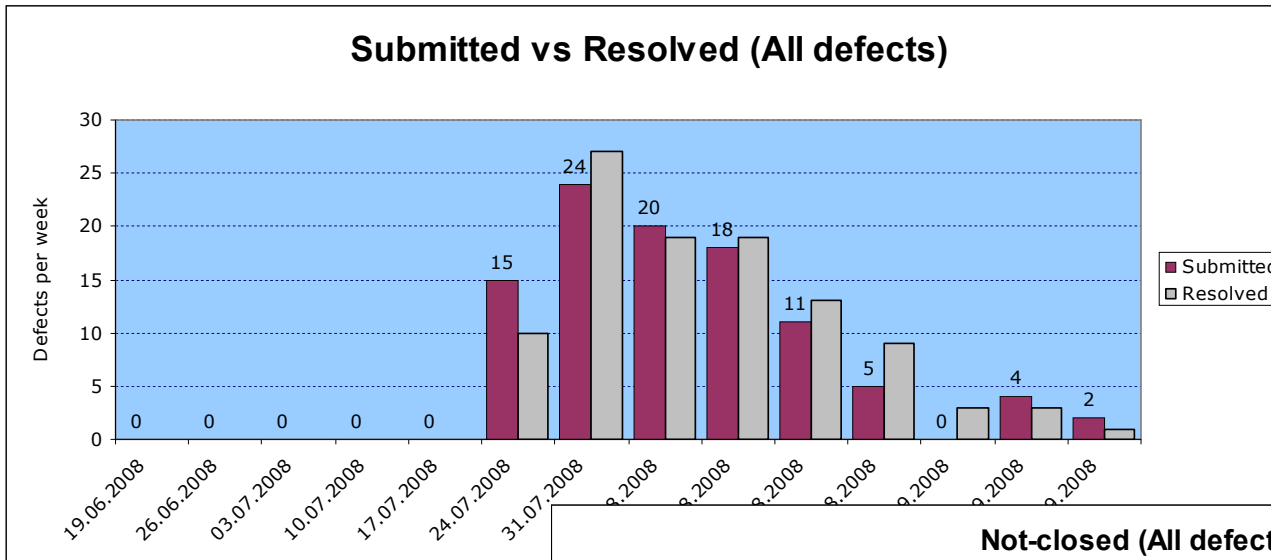
On-going monitoring: Efficiency



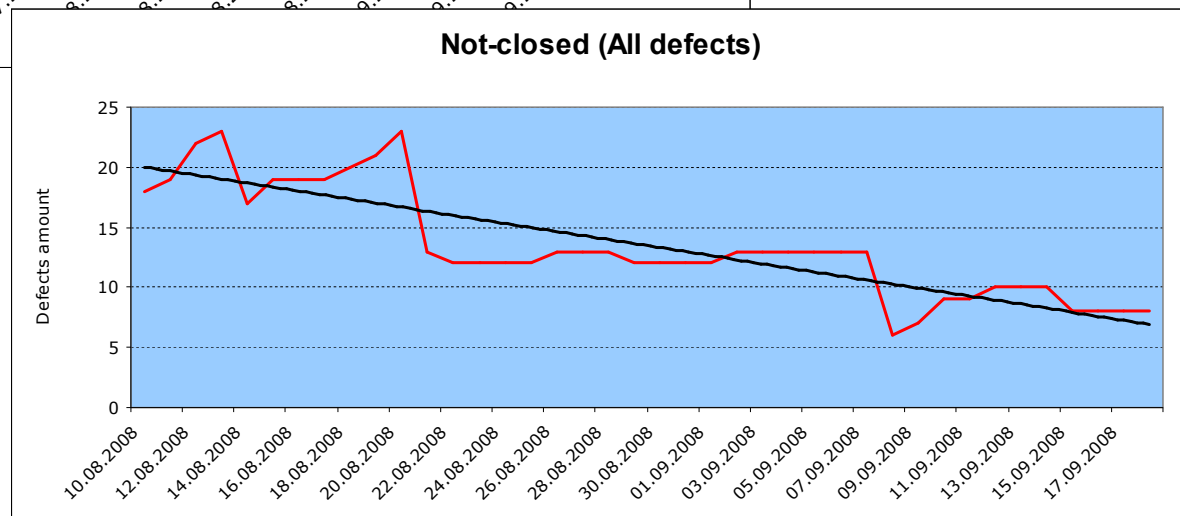
On-going monitoring: Product readiness



Submitted vs Resolved (All defects)



Not-closed (All defects)



On-going monitoring: Delivery Center/Program dashboard₁



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1															
2	Product	Project	Release	Phase	QA audits score	Quality on CAT		Quality pre-delivery		Quality post-delivery		Economics		Measurement Quality	
3						Status	Chang	Status	Chang	Status	Chang	Status	Chang	Status	Chang
4				Dead		Green	No change	Green	No change	Green	No change	Green	No change	Green	No change
5				Dead		Green	No change	Green	No change	Green	No change	Yellow	No change	Green	No change
6				Dead		Green	No change	Green	No change	Green	No change	Green	No change	Green	No change
7				Dead		Green	No change	Red	No change	Green	No change	Green	No change	Green	No change
8				Dead		Green	No change	Red	No change	Green	No change	Green	No change	Green	No change
9				Dead		Green	No change	Green	No change	Green	No change	Green	No change	Green	No change
10				Dead	4	Green	No change	Yellow	No change	Green	No change	Green	No change	Yellow	No change
11				Production		Red	No change	Green	No change	Green	No change	Red	No change	Green	No change
12				Development	4	N/A	No change	Green	Green	Green	No change	Green	Green	Green	No change
13				Development		N/A	No change	Green	No change	N/A	No change	Green	No change	Green	No change
14				Dead		Green	No change	Red	No change	Green	No change	Yellow	No change	Yellow	No change
15				Production		Yellow	No change	Green	No change	Green	No change	Green	No change	Yellow	No change
16				Development	4	N/A	No change	Green	Green	N/A	No change	Yellow	Yellow	Green	No change
17				Dead		Red	No change	Red	No change	Green	No change	Red	No change	Green	No change
18				Dead		Green	No change	Green	No change	Green	No change	Red	No change	Green	No change
19				Dead		Green	No change	Green	No change	Green	No change	Green	No change	Green	No change
20				Dead		Green	No change	Red	No change	Green	No change	Red	No change	Green	No change
21				Production	5	Green	No change	Green	No change	Green	No change	Yellow	No change	Green	No change
22				Development		N/A	No change	Green	No change	N/A	Отмена невозможна.	Red	Red	Green	No change
23				Dead		Green	No change	Green	No change	Green	No change	Green	No change	Green	No change
24				Dead		Green	No change	Green	No change	Green	No change	Yellow	No change	Green	No change
25				Dead		Green	No change	Green	No change	Green	No change	Yellow	No change	Green	No change
26				Dead		Green	No change	Green	No change	Green	No change	Green	No change	Green	No change
27				Dead		Green	No change	Green	No change	Green	No change	Green	No change	Green	No change
28				Dead		Green	No change	Green	No change	Green	No change	Red	No change	Green	No change
29				Dead		Red	No change	Green	No change	Green	No change	Red	No change	Green	No change
30				Dead		N/D	No change	Green	No change	Green	No change	Green	No change	Green	No change
31				Dead		Green	No change	Green	No change	N/A	No change	Green	No change	Green	No change
32				Dead		Green	No change	Green	No change	Green	No change	Red	No change	Green	No change
33				Production		Green	No change	Green	No change	Green	No change	Red	No change	Green	No change
34				Development		N/A	No change	Green	Green	N/A	No change	Red	Red	Green	No change

On-going monitoring: Delivery Center/Program dashboard₂



A	B	C	D	E	F	G	O	P	Q	R	S	T	U	V	W	X	Y
Product	Project	Release	Finish date	Total code size (KLSLOC)	Added or modified code size (KLSLOC)	Code changed	Defect number on CAT		Defect density on CAT (def/KLSLOC) (14+15)/5	Post delivery defects		Pre-delivery defects			Added or modified LSLOC cost (man*hrs)		
							Luxoft found	Customer found		Customer found	Density (17/4)	Total found	Customer found	Density (19/5)		Code Size	CA
	1	2	3	4	5	6	14	15	16	17	18	19	20	21	22	23	24
			21.12.2001	97,9	97,9	100%	182		1,86	N/D	N/D	839		8,6	0,352	28.02.2002	18.08.
			29.04.2002	95,0	14,3	15%	56		3,92	N/D	N/D	206		14,4	0,438	15.11.2002	18.08.
			20.12.2002	33,1	29,3	89%	38		1,30	N/D	N/D	304		10,4	0,219	09.01.2004	18.08.
			09.08.2004	269,6	105,8	39%	140	53	1,82	38	0,14	975		9,2	0,418	11.07.2005	18.08.
			22.11.2004	212,6	48,7	23%	52	30	1,68	9	0,04	461		9,5	0,895	11.07.2005	18.08.
			25.04.2005	265,3	63,9	24%	66	25	1,42	5	0,02	452	35	7,1		11.07.2005	18.08.
			03.12.2005	339,2	77,0	23%	102	15	1,52	12	0,04	843	24	10,9	0,398	24.04.2006	18.08.
			07.03.2006	366,5	18,0	5%	55	2	3,17	8	0,02	116	2	6,4		24.04.2006	18.08.
			06.10.2006	417,7	86,8	21%	40	20	0,69	N/A	N/A	1039	20	12,0	0,607	24.11.2006	01.12.
			12.11.2006	432,3	16,0	4%	2	1	0,19	8	0,02	31	1	1,9	0,436	23.03.2007	01.12.
			18.06.2007	486,9	68,6	14%	43	4	0,69	0	0,00	684	5	10,0	0,628	15.08.2007	31.10.
			30.07.2007	500,6	6,4	1%	3	0	0,47	3	0,01	66	0	10,3	0,633	30.08.2007	31.10.
			07.09.2007	503,2	2,2	0,4%	0	0	0,00	0	0,00	1	0	0,5	0,397	24.09.2007	31.10.
			07.10.2007	504,2	0,7	0,1%	N/A	N/A	N/A	0	0,00	0	0	0,0	0,469	22.10.2007	31.10.
			11.01.2008	548,0	41,1	8%	2	1	0,07	7	0,013	244	2	5,9	0,578	14.01.2008	11.01.
			24.08.2008	615,5	45,7	7%	14	3	0,37	1	0,002	668	3	14,6	0,878	01.09.2008	05.09.
			21.09.2008	619,7	0,5	0,1%	3	0	6,59	0	0,000	4	0	8,8	1,339	24.09.2008	26.09.
			Continued	631,3	10,7	2%	N/A	N/A	N/A	N/A	N/A	83	0	7,8	0,589	13.10.2008	
			Continued	695,3	6,0	0,9%	N/A	N/A	N/A	N/A	N/A	5	0	0,8	0,346	07.10.2008	
			24.08.2008	14,1	2,2	16%	0	1	0,45	0	0,000	57	2	25,9	0,878	01.09.2008	11.08.
			21.09.2008	15,5	2,0	13%	3	0	1,50	0	0,000	14	0	7,0	0,218	22.09.2008	26.09.
			Continued	17,9	1,8	10%	N/A	N/A	N/A	N/A	N/A	14	0	7,8	0,798	13.10.2008	
			28.02.2005	34,6	34,6	100%	5	13	0,52	N/D	N/D	316		9,1	0,373	27.06.2005	18.08.
			06.02.2006	96,8	1,4	1%		N/A		N/D	N/D	9		6,4	N/D	15.09.2006	N/I
			31.08.2006	96,9	0,2	0,2%		N/A		N/D	N/D	6		30,0	N/D	15.09.2006	N/I



Post-mortem project analysis



PQA Form. Variance evaluation and discussion



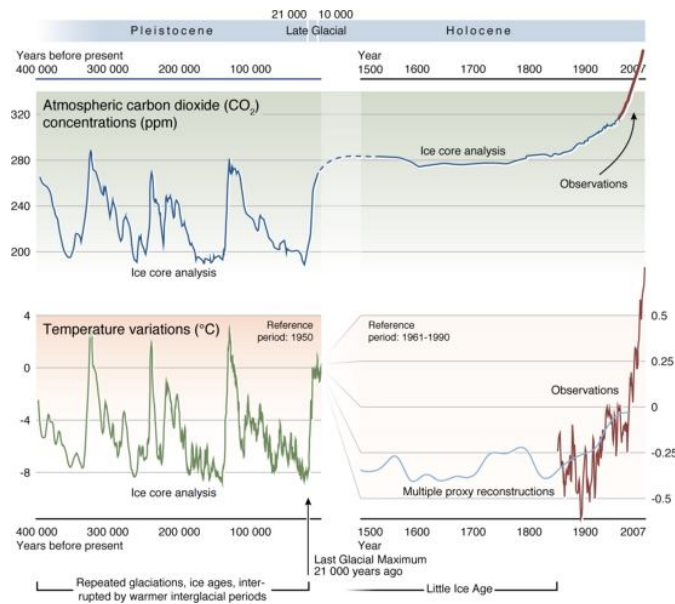
	A	B	C	D	E	F	G	H	I	
1	Project			Type	Range	Platform				
2	PM			Dev	Middle	Java				
3										
4	Project feature			DC	Job opening	Job completion				
5					08.01.2007	13.01.2008				
6										
7	Area	Indicators	Result performance (see also IndicatorsSummary and other sheets)	Actual value	vs BeyondPCB DC benchmarking	QS	SPCM and QAE comment	PM and TM resume		
8				Dev						
20	Product Quality	CAT Defect Density (all)	CAT Defect Density (all) is better than lower boundary of beyondPCB. Sigma*3 criteria is not violated	0,07	↓	5	[SPCM] Excellent result!!! How it was achieved?	TM> 1. All defects submitted during CAT were defects found by Boeing. There were no defects found by Luxoft as a) all planned testing have been completed by the CAT beginning b) there were no extra CAT Build deliveries. 2. Good code quality		
21		CAT Defect Density (severe)	CAT Defect Density (severe) is better than lower boundary of beyondPCB. Sigma*3 criteria is not violated	0,05	↓	5		TM> Good code quality because of 1) Enough time was planned for very detailed testing 2) No newcomers in developer's team, all developers worked with well known parts of the System. The most parts of the System were covered by Unit testing. 3) Very detailed test design with good quality. Only 1 defect was discovered during CAT as a result of defect in test design.		
22		CAT Defect Density (critical)	CAT Defect Density (critical) is within the normal range	0,02	↓	4				
23	Quality	Declined Defects Ratio	Declined Defects Ratio is within the normal range	6,5%	↓	4				
24		Code Size Rework	Code Size Rework is better than lower boundary of beyondPCB. Sigma*3 criteria is not violated	1,04	↓	5	[SPCM] Indicator value reflects code development during Sep,2007 - Jan,2008 only because there were some incorrect actions with DB patches.			
25		Project Efforts Estimate Precision	Indicator is not analysed as estimation is not prepared				2	[SPCM] Boeing DC process should be improved. Lack of these indicators misrepresent		

PM & TM comments (causal analysis)

PQA Form. Evaluation & Decisions

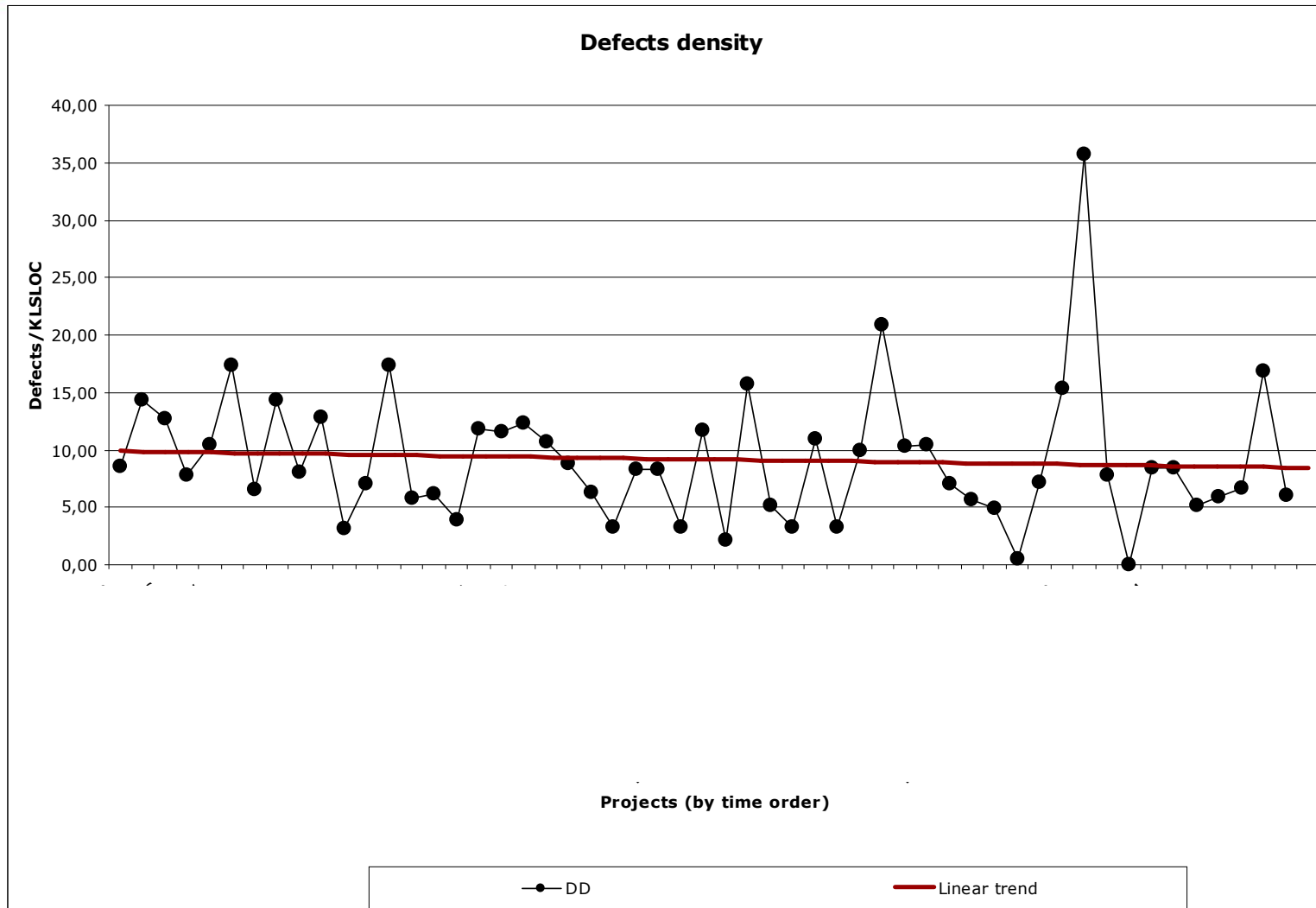


A	B	C	D	E	F	G	H	I
Project			Type	Range	Platform			
PM			Dev	Middle	Java			
Project feature			DC	Job opening	Job completion			
				08.01.2007	13.01.2008			
Area	Indicators	Result performance (see also IndicatorsSummary and other sheets)	Actual value	vs BeyondPCB DC benchmarking	QS	SPCM and QAE comment	PM and TM resume	
Dev								
Conclusions								
<p>1. Project improvement areas</p> <p>a) <u>Project estimations</u>: overall release estimation was not done (please see rows 25-29)</p> <p>b) <u>Code measurements</u>: DB patches implementation leads to difficulties with the code measurements and decrease measurements reliability</p> <p>2. Achievements</p> <p>a) <u>product quality</u>: excelent product quality (please see rows 19-22)</p> <p>b) <u>project process in general</u>: trend for project process improvement</p> <p>3. In general (please see "IndicatorsSummary" spreadsheet), quantity indicators are on the good level. Integrated mark of project quality, defined based on listed above quantity indicators, is 3.8 (1 is bad/ low level, 5 is excellent / high mark). Estimation process has to be improved.</p>								
Decisions								
<p>1. Boeing DC process engineer should describe and document an instruction for Estimation process, which will take into account Boeing DC development features.</p> <p>2. CM engineers and QAE should improve technology of DB patches measurements.</p>								
QS Legend								
Background								
	Critical bad							
	Unsatisfactorily							
	Satisfactorily							
	Excellent high							
Value (score)								
<nobody>	Not relevant or not fixed							
-1	Process violation							
<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> </div> <div style="text-align: center;"> </div> <div style="text-align: center;"> </div> </div> <p><u>Arrows legend</u></p> <p><u>Background:</u> green - O.K. or positive trend yellow - negative trend red - critical negative trend</p> <p><u>Direction:</u></p>								

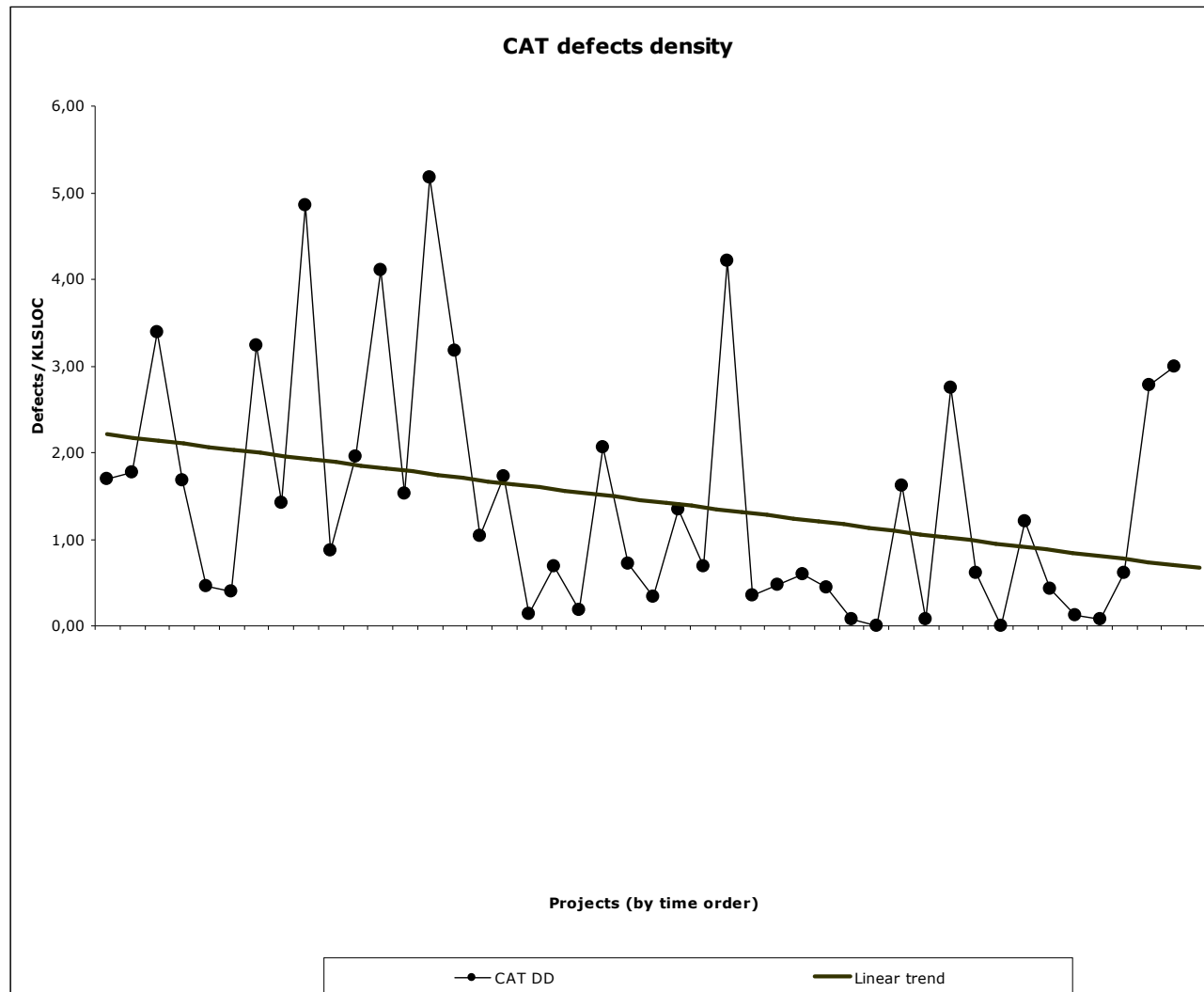


Historical trends

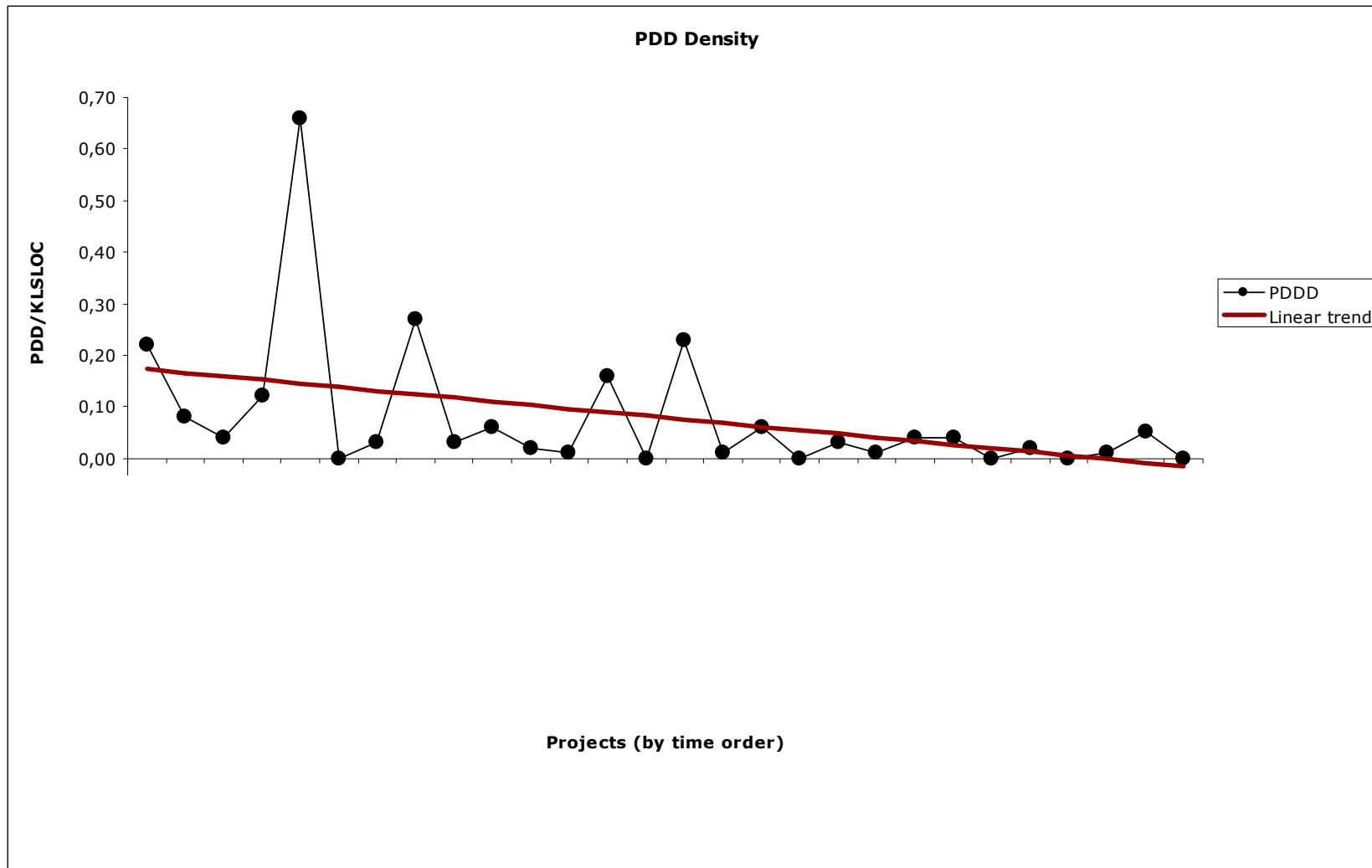
Defect density trend (2001 – 2008)



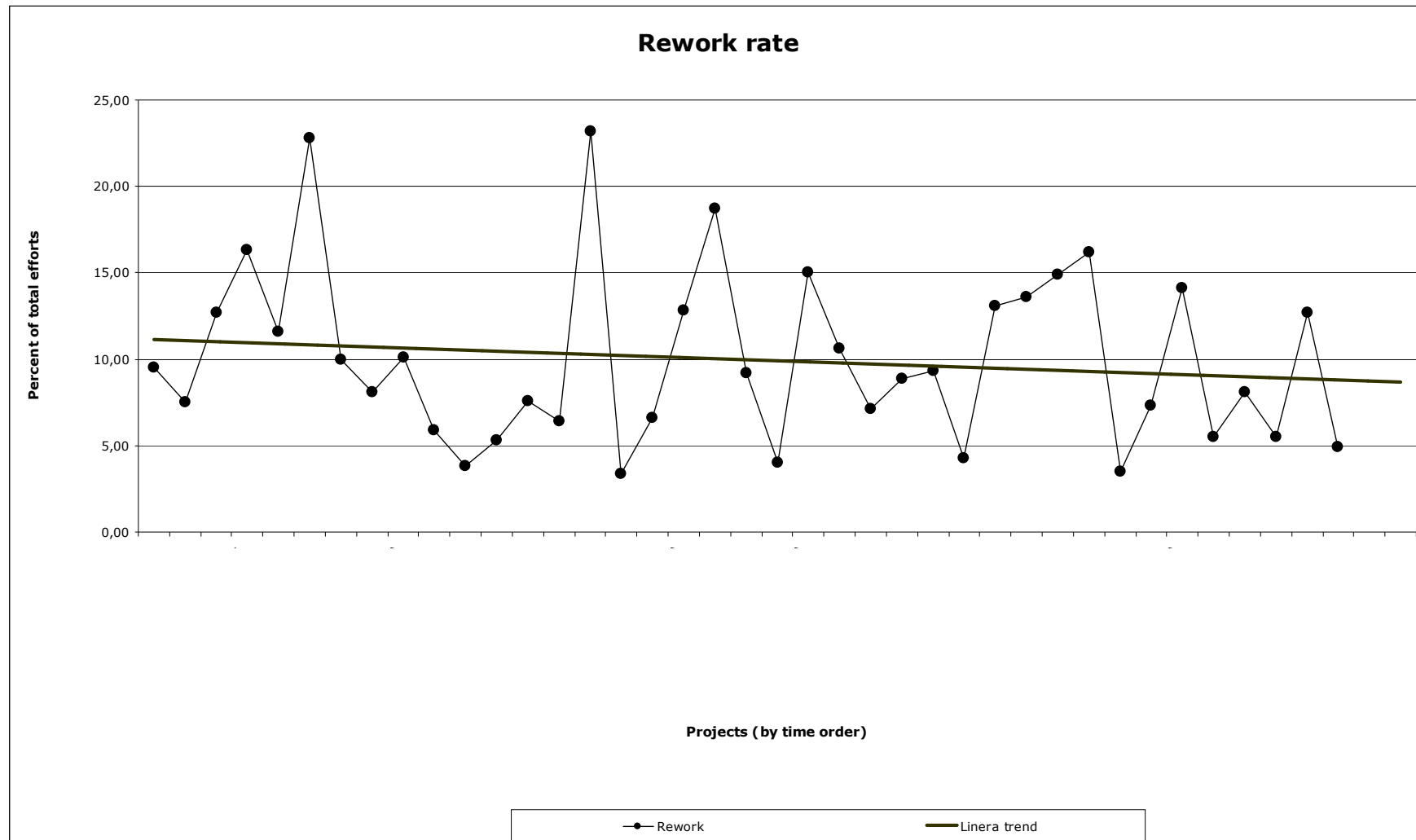
CAT defect density trend (2003 – 2008)

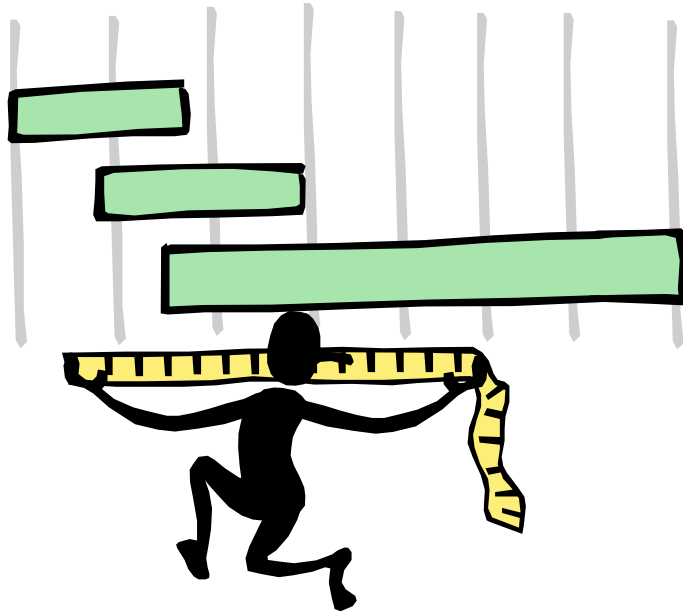


PDD density trend (2004 – 2008)



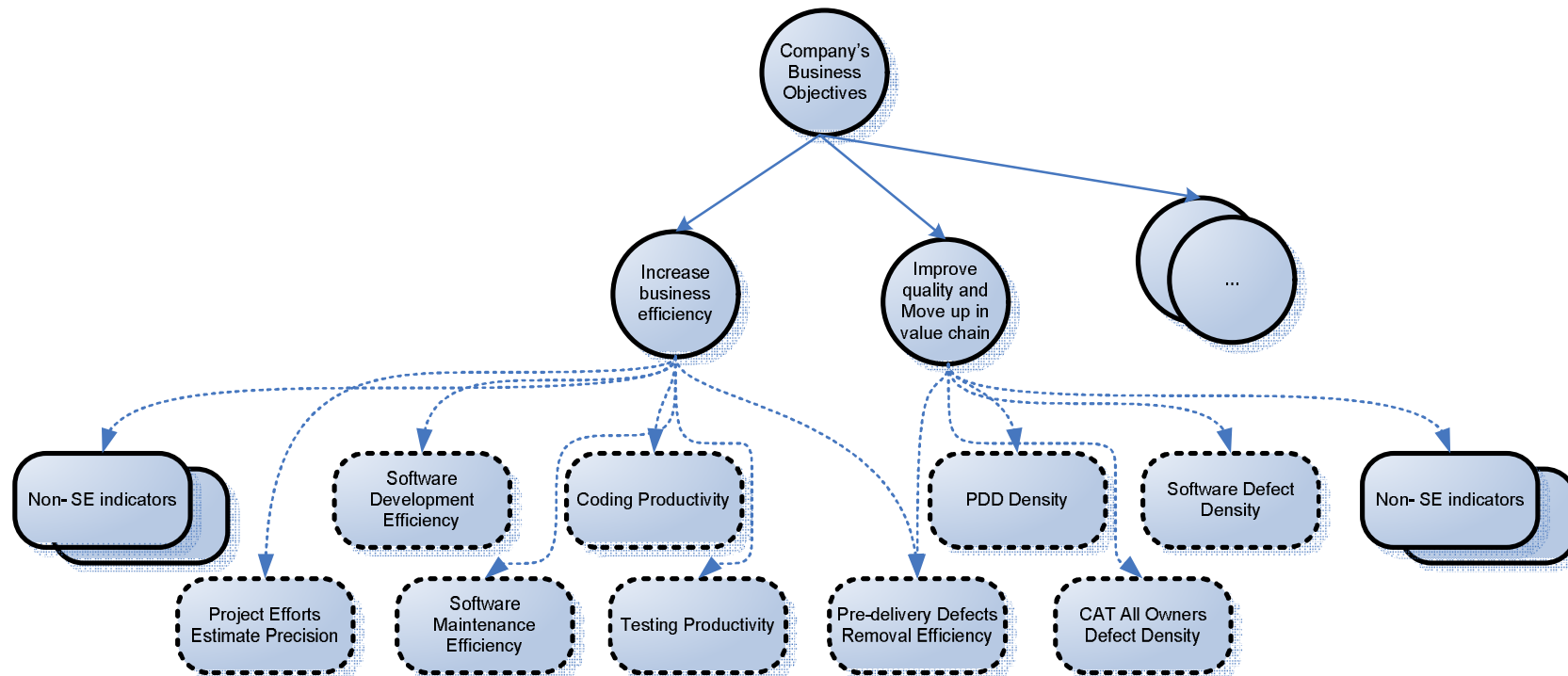
Rework rate trend (2004 – 2008)



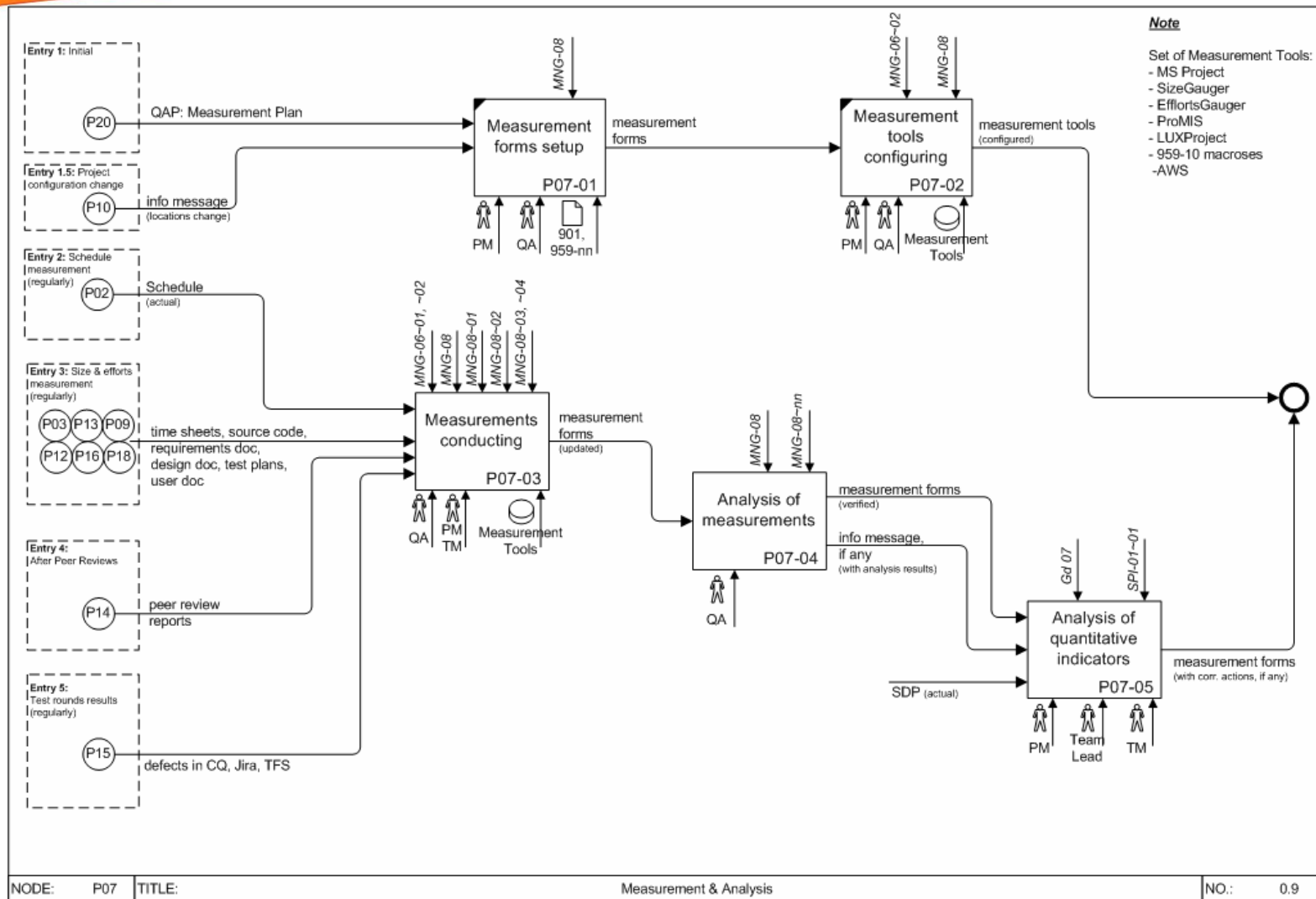


How it works

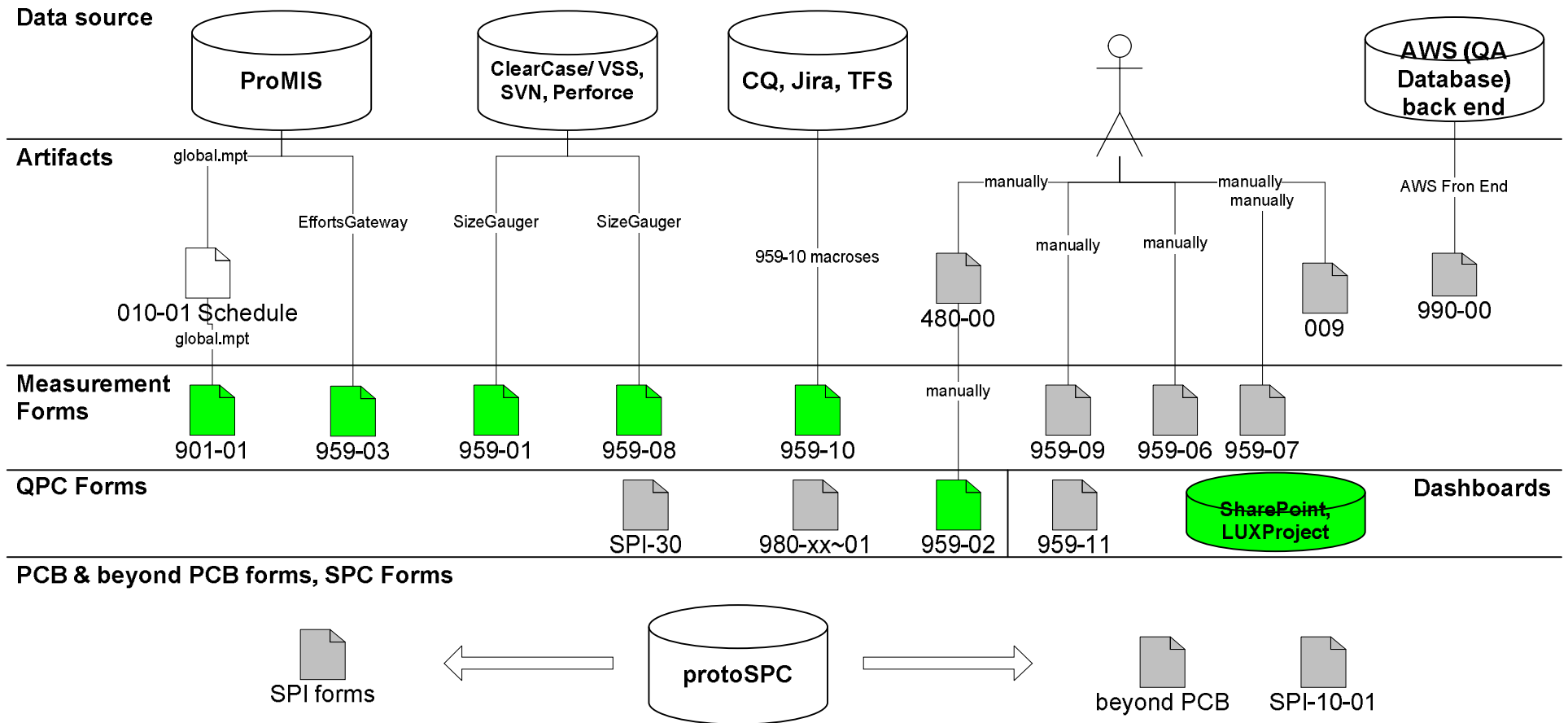
Business Objectives & SE indicators



Luxoft Measurement and Analysis Process



Metrics gathering & analysis

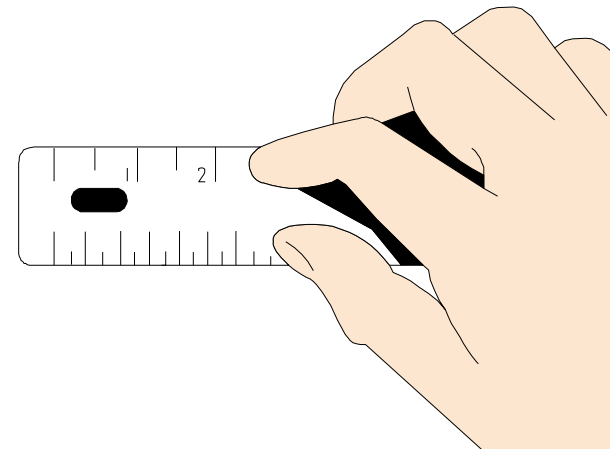
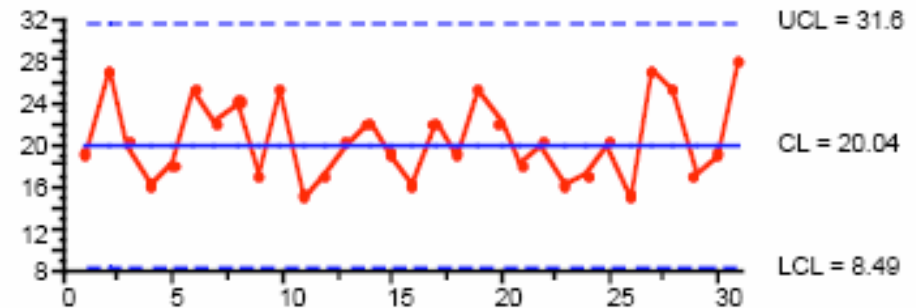


Process Capability Baseline



- **PCB Goals**
 - History of measurements
 - Capability of the process
 - Confidence in that capability
 - Basis for capability predictions

- **Luxoft PCB**
 - Based on business goals
 - Updated yearly
 - Stratified by:
 - Process Type (Delivery Center)
 - Project Type (Dev, Mnt)
 - Project Size
 - Technology (coding language)



Standard PCB form



	Indicator_Name	ProjectType	ProjectRange	PL_Platform	ProcessOrMethod	Indicator_Unit	Indicator_Mean	Indicator_Low	Indicator_High
2									
3	Economics								
4	Software Development Efficiency	Blend	Blend			Man*hrs/KSLOC			
38	Software Maintenance Efficiency	Mnt	Blend			Man*hrs/KSLOC/ b-day			
46	Project Rework Efforts Rate	Blend	Blend			Percent			
75	Coding Rework Efforts Rate	Blend	Blend			Percent			
101	Design Rework Efforts Rate	Blend	Blend			Percent			
125	Documentation Rework Efforts Rate	Blend	Blend			Percent			
150	Requirements Rework Efforts Rate	Blend	Blend			Percent			
176	Test Design Rework	Blend	Blend			Percent			
204	Software Efforts Distribution Rate								
415	Efficiency (productivity)								
416	Coding Productivity	Blend	Blend			SLOC/man*day			
450	Testing Productivity	Blend	Blend			Defects/man*hrs			
482	Software Defect Remove Productivity	Blend	Blend			Defects/man*hrs			
509	Product Quality								
510	Software Defect Density	Blend	Blend			Defects/KSLOC			
545	CAT All Owners Defect Density								
569	PDD Density	Mnt	Blend			PDD/KSLOC			
570		Mnt	Blend			PDD/KSLOC			
571	Project types that contributed to the average (Mean)	Mnt	Blend	.NET		PDD/KSLOC			
572		Mnt	Blend	Java		PDD/KSLOC			
573		Mnt	Large			PDD/KSLOC			
574		Mnt	Large	Java		PDD/KSLOC			
575		Mnt	Middle			PDD/KSLOC			
576		Mnt	Small			PDD/KSLOC			

+/- 1 sigma

Project types that contributed to the average (Mean)

PCB tool – protoSPC



SixSigma

protoSPC is a MS Access based application for collecting, analyzing and reporting quantitative project metrics and indicators. It's integrated with Excel-based measurement forms used in projects to:

- ✓ collect data
- ✓ analyze causes of variation
- ✓ test stability
- ✓ report on all levels and
- ✓ maintain statistical baselines

The screenshots illustrate the protoSPC application's interface, including data entry forms, statistical analysis tools, and reporting dashboards. Key elements include:

- Indicator Configuration:** A window for setting up indicators like 'Coding Productivity' with project area, type, and range parameters.
- Data Table:** A table listing projects such as ADAPSR, ETCMS, COMLIB/2/3, ESCAL_DEV, ICAT2 (dev), ENCYC (Dev), CEKRS_S03 (Rel. 1. Dev), ENCYC_SUS30 (dev 3.1), BRIDGE, REPARS_MNT (Rel. 8.0), CAISE (whole), REPARS_MNT (Rel. 9.0), and ENCYC_2005.
- Statistical Analysis:** A window showing UCL: 23.94, LCL: 155.90, Sigma: 29.95, and UCLr: 110.41 for the Coding Productivity indicator.
- Reporting:** A window titled 'Software Development Efficiency' with a bar chart and a table of project performance metrics.
- Summary Dashboard:** A window showing various project metrics and a table with columns for Product, Project, Release, and various performance indicators.

protoSPC. Project registry



Identity data

Add stratified data and primitive metrics

Stratified data

Primitive metrics

protoSPC
(C) NB 2005-2007

Регистр проектов

Basic data | Domens | Estimation Add

History point

ProjectName: ORGCHART
ProjectNameAdd: Release1 dev
DateEnd: 22-11-2006
ProjectManager(s): А. Мокрушин
Customer: Luxoft

Properties

ProjectType: D Platform: .NET
ProjectRangeDev: M (Middle)
ProjectRangeMnt: S (Small)
InBaseSet:
DPS (Int):

Duration and Size

	Actual	Estimate
ProjectDuration	76	70
ProductSizeAdded	33416	26190
ProductSize	35256	
CodeSizeRework	1.08	

Efforts data

	Actual	Estimate	Rework
Project	4119.30	4976.00	704.80
Mng	564.00		
Req	441.00		1.00
Dsn	366.00		0.00
Cod	1681.50		607.00
Tst	922.80	1094.70	96.80
Doc	0.00	248.80	0.00
SA	144		
EffDistrIsValid	<input checked="" type="checkbox"/>		
TstDsnEfforts	126.00		
TstDsnReworkEfforts	9.00		
TMEfforts			
TDEfforts			

Defects data

Internally

Found	Ack'n'd	Declined	Found legacy
150	145	2	0

All

Closed	CAT:	All	Critical	Major
142		3	0	0

Customer

PDD	CAT:	All	Critical	Major
		1	0	0

Prehistory

AcknInterPrev: 0

Record: 102 of 157

protoSPC. Statistic analysis



Expertise in Software Services

Indicator: Coding Productivity

Project area

Project Type: Development Maintenance Blended

Project Range: Small Middle Large Blended

Platform:

Solution:

Industry:

DC: Boeing DC

Coding Productivity

Sample size: 37

Closing	Project	Indicator	Move Range	Type	Range	PL-platform
21-12-2001	ADAD5R	58.7		D	L	Java
29-04-2002	ADAD52E (New Version)	53.1	5.6	D	M	Java
28-10-2002	ETOMS	146.6	93.5	D	L	Other
19-12-2002	COMLIB/2/3	45.7	100.9	D	M	Other
24-12-2002	ESCM_DEV	92.7	47	D	M	Java
03-10-2003	ICAT2 (dev)	66.2	26.5	D	M	.NET
01-11-2004	ENCYC (Dev)	82.2	16	D	M	Java
17-12-2004	CEDRS_SDG (Rel. 1. Dev)	50.6	31.6	D	S	Java
07-02-2005	ENCYC_SUS30 (dev 3.1)	88.5	37.9	D	M	Java
28-02-2005	BRIDGE	66.7	21.8	D	M	Other
30-03-2005	REDARS_MNT (Rel. 8.0)	19.4	47.3	D	M	Java
31-05-2005	CAISE (whole)	70.9	51.5	D	L	Java
02-08-2005	REDARS_MNT (Rel. 9.0)	18.8	52.1	D	M	Java
25-09-2005	ENCYC_2005	68.8	50	D	M	Java

Indicator Unit: SLOC/man*day

LCLx: -23.84

UCLx: 155.90

Sigma: 29.95

UCLr: 110.41

Bounds:

Low Bound: 36.08

Average: 66.03

Upper Bound: 95.98

Warning indication!!!

Problem detected

View problem cause

No problem!

Values over UCLx exist!

Values over UCLr exist!

Sigma-tests

Test 1 (Sigma*3)

Test 2 (Sigma*2)

Test 3 (Sigma*1)

Test 4 (Average)

Move rang test

Test UCLr

Data distribution by Sigma-deviation

95% 68% 99.7%

Save in beyondPCB

Domain AVG

Delete record

Delete max * min

Base set only

Save in PCB

Histogram

Export (Excel)

Exit

Selected indicator

Selected strata

Avg-3Sigma

Avg+3Sigma

PCB candidates

Statistic distribution chart

protoSPC. Project benchmarking



The screenshot displays the protoSPC software interface with several windows open:

- Project Benchmarking:** Shows project details for "REDARS_MNT Rel. 12.0 Dev" and a list of benchmarks including "Company Wide beyondPCB Boeing DC".
- beyondPCB Boeing DC -> Indicators:** A list of indicators with color-coded status bars: Economics (red), Efficiency (yellow), Quality.Prod (green), Quality.Proces (yellow), and Documentation Rework Efforts Rate (red).
- beyondPCB Boeing DC: Economics:** A list of metrics with checkboxes: Software Development Efficiency (checked), Software Maintenance Efficiency (unchecked), Project Rework Efforts Rate (checked), Requirements Rework Efforts Rate (checked), Design Rework Efforts Rate (unchecked), Coding Rework Efforts Rate (checked), Test Design Rework (unchecked), and Documentation Rework Efforts Rate (checked).
- Documentation Rework Efforts Rate:** A detailed view showing a project indicator value of 18.57, a percentage bar, and statistical markers (+3Sigma, Avg, -3Sigma).
- Best Indicators Value (demand fetching):** A table of best practices for similar projects.

Best Indicators Value (demand fetching) Table:

Indicator	Value	Project Name	Strata
SDE	102.96	HERMES Maintain Flight Pt	D, M, Java
SME	0.03	CAISE9 Rel. 9.3 Dev	D, L, Java
PRER	3.39	REDARS_MNT Rel. 11.1.1 D	D, M, Java
RRER	0	LATTE	D, M, Java
DRER	0	ENCYC_2005	D, M, Java
CRER	4.8	LATTE	D, M, Java
TDR	0	ENCYC_2005	D, M, Java
DR	0	ADADS2E New Version	D, M, Java
TMTDRR	No defined		

Red arrows indicate data flow from the benchmarking and indicators windows to the detailed view and the best practices table. A red dashed arrow points from the "Documentation Rework Efforts Rate" indicator to the "Best Indicators Value" table, where a red text annotation reads: "Company best practices (for similar projects)".

Thank you!



- Discussion?
- Questions?

- Contact Us

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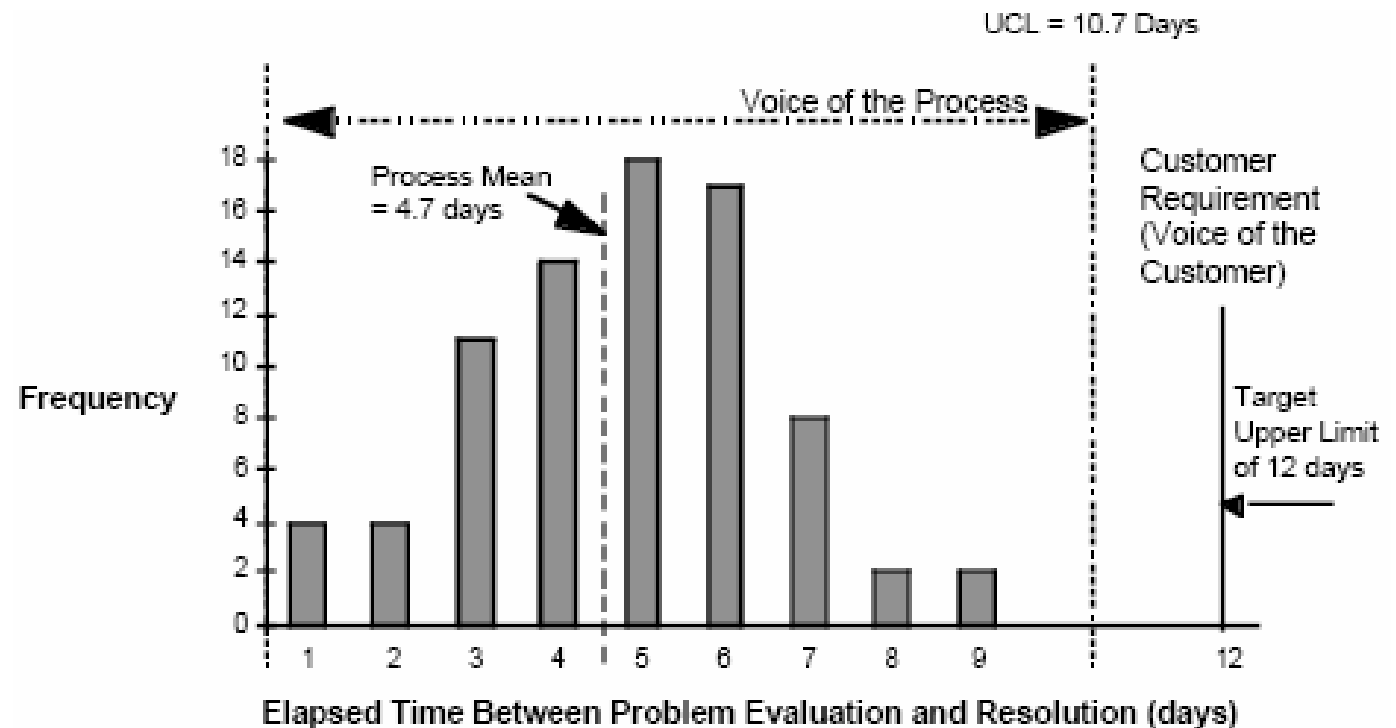
Back-up slides - Statistic basics



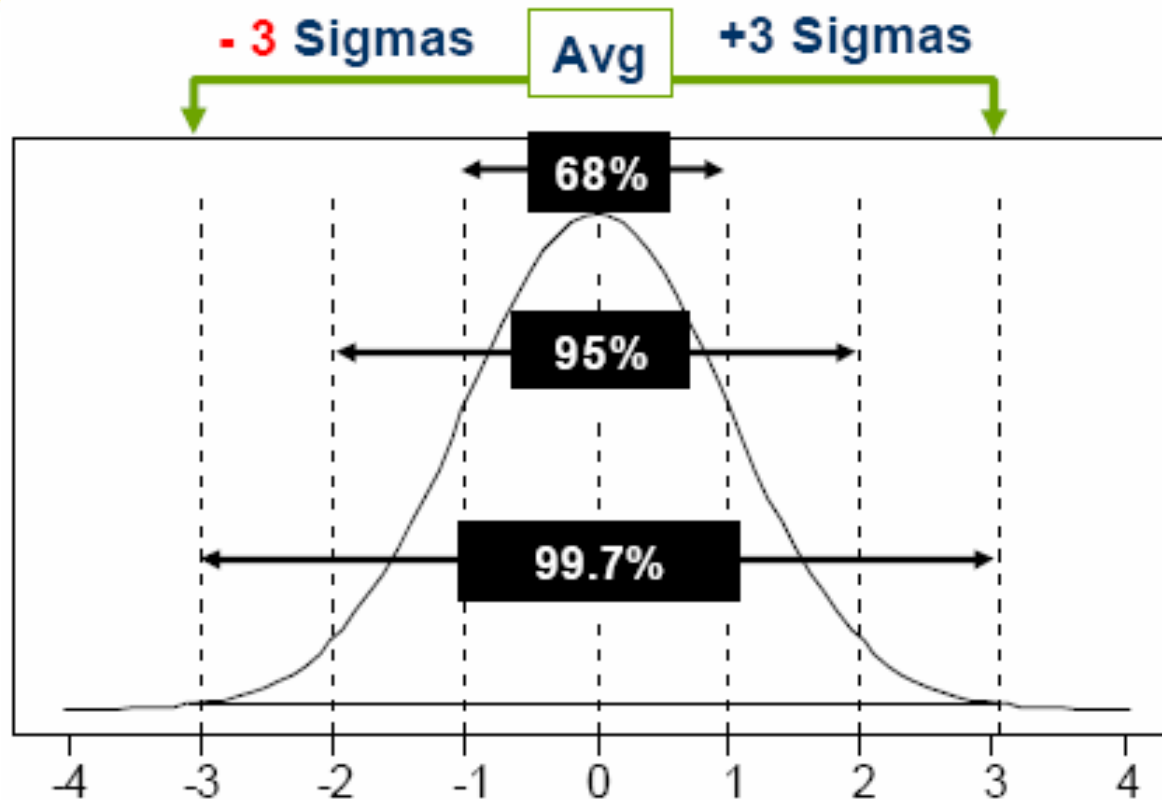
Statistics – Normal Distribution

Stable defined process yields various results but those results are distributed “normally”, according to the law of probability.

- Most of the results are grouped around “Mean”.
- Other results are grouped “normally” in form of a bell-shaped curve.
- Percentage of the results obey the “Sigma” law.



Normal Distribution Law



997 of 1000 instances of the controlled process will be within +/- 3 Sigma range

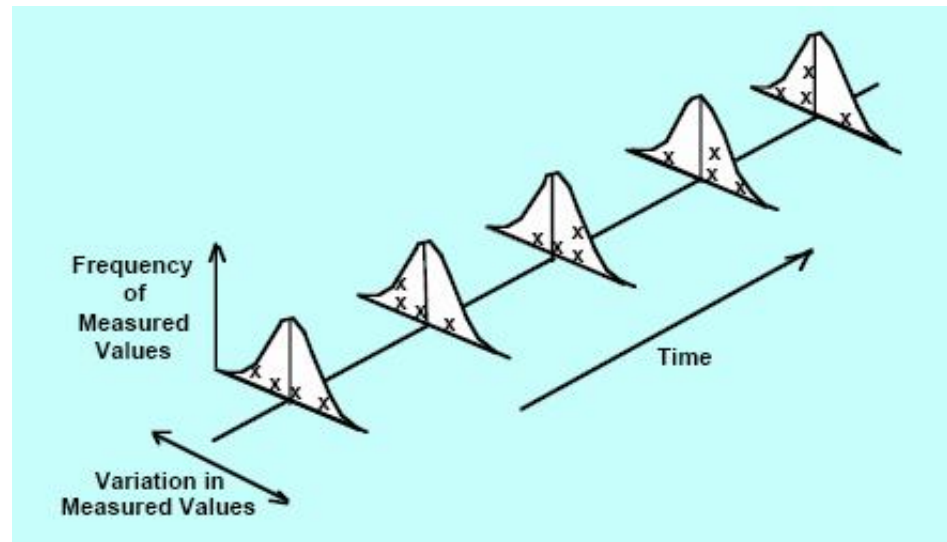
68 of 100 instances of the controlled process will be within +/- 1 Sigma range

Sigma = root-mean-square deviation (rms deviation)

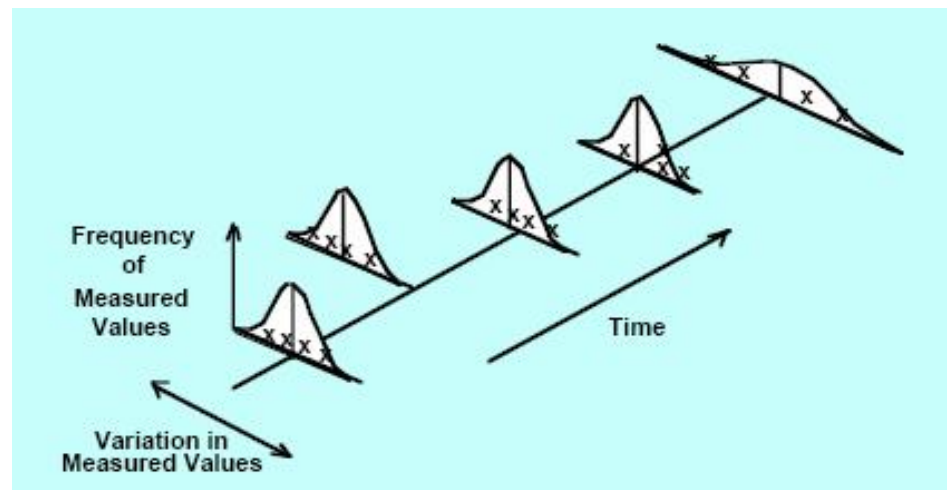
Statistics – Process Variation

Controlled Variation Normal distribution, just “noise” of the process

Note: The histogram of a controlled process can be *Bell-shaped, Poisson, Skewed, Pareto,...* (not the subject of the present training)



Uncontrolled Variation Variation due to assignable cause(s)

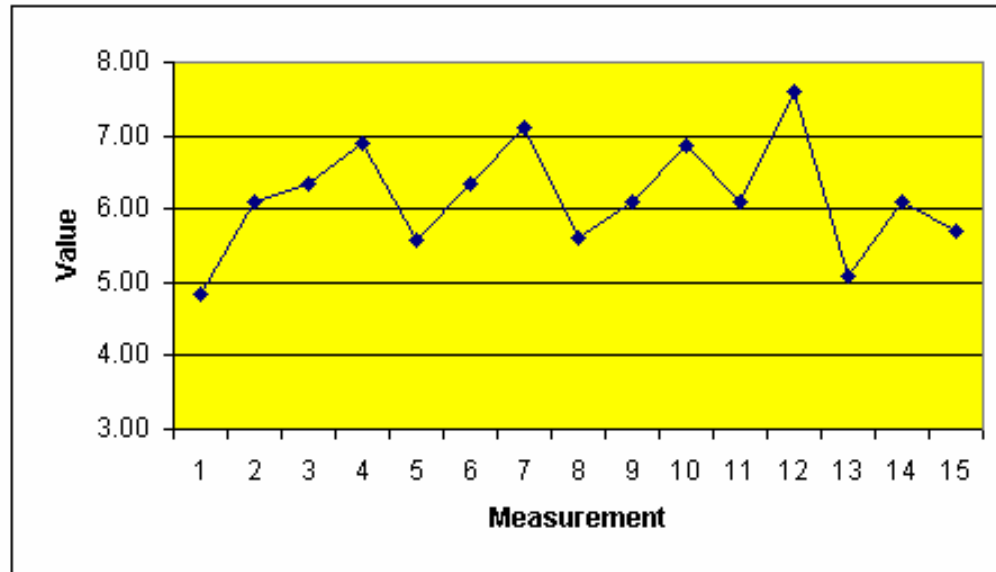


Process Under Statistical Control



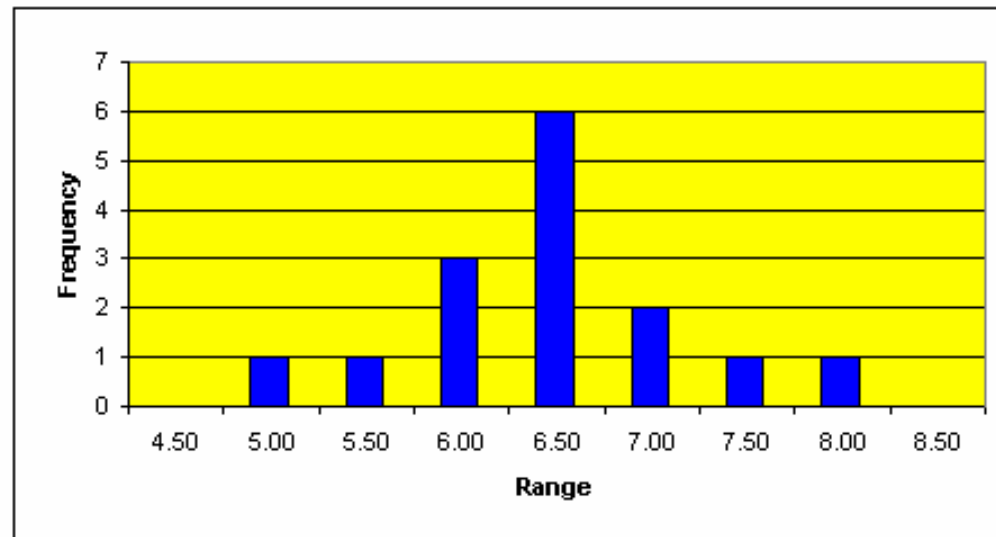
Release	Date	Defects/KSLOC
---------	------	---------------

1	1/16/2007	4.85
2	2/1/2007	6.10
3	2/4/2007	6.35
4	2/28/2007	6.90
5	3/16/2007	5.57
6	5/5/2007	6.35
7	5/12/2007	7.10
8	5/31/2007	5.60
9	6/7/2007	6.10
10	6/13/2007	6.85
11	7/7/2007	6.10
12	7/8/2007	7.60
13	7/31/2007	5.10
14	8/14/2007	6.10
15	8/22/2007	5.71

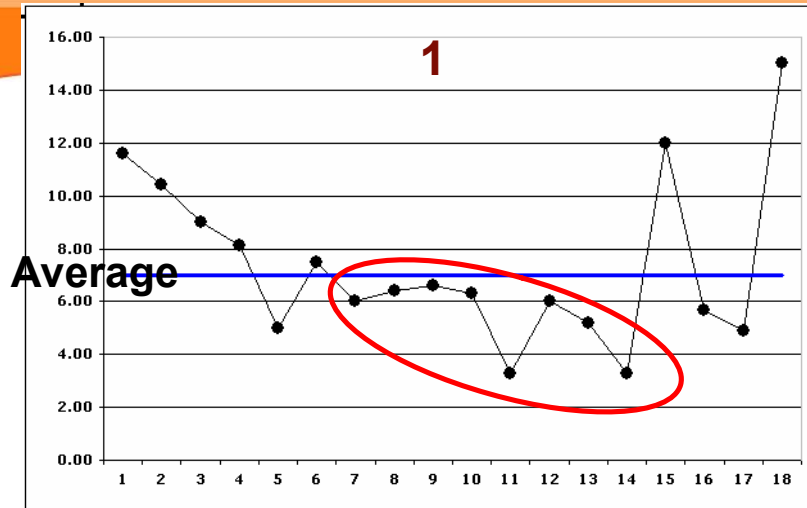


Range []	# of Values
-----------	-------------

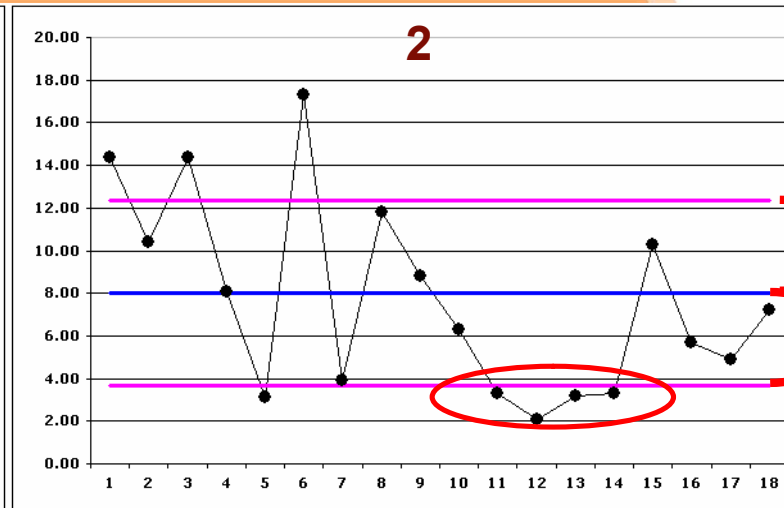
4.00	4.50	0
4.50	5.00	1
5.00	5.50	1
5.50	6.00	3
6.00	6.50	6
6.50	7.00	2
7.00	7.50	1
7.50	8.00	1
8.00	8.50	0



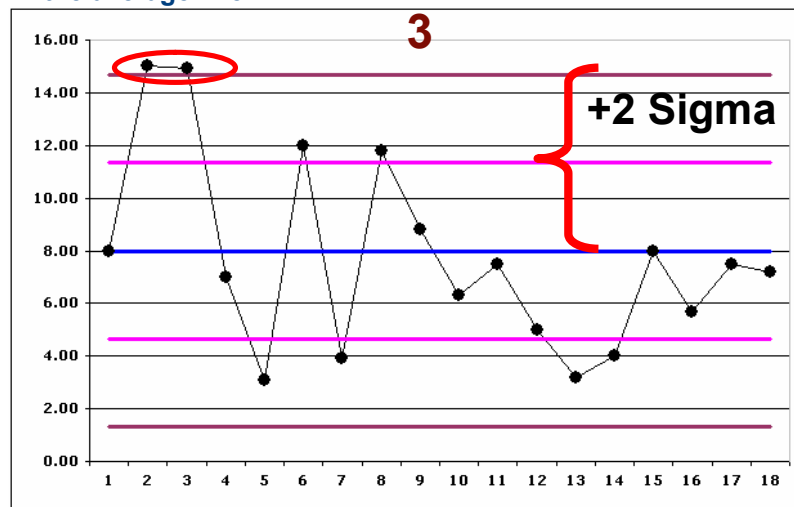
Uncontrolled Processes



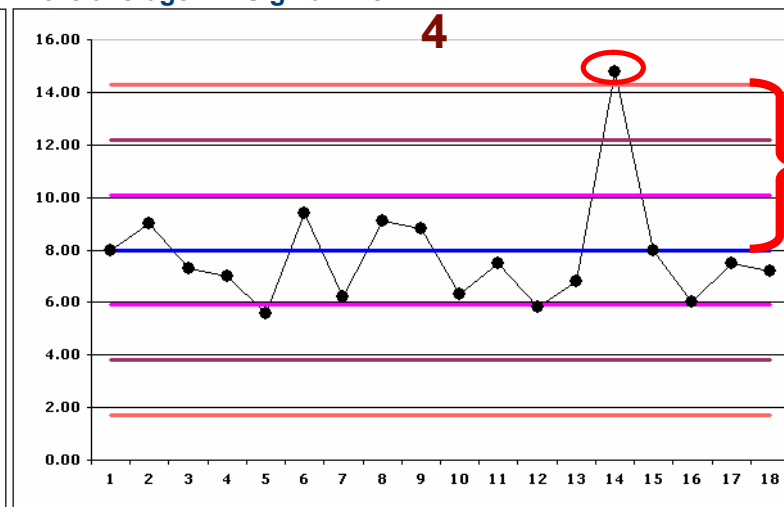
Too many (≥ 8) subsequent values on the same side of the average line



Too many (≥ 4) subsequent values on the same side of the average ± 1 Sigma line



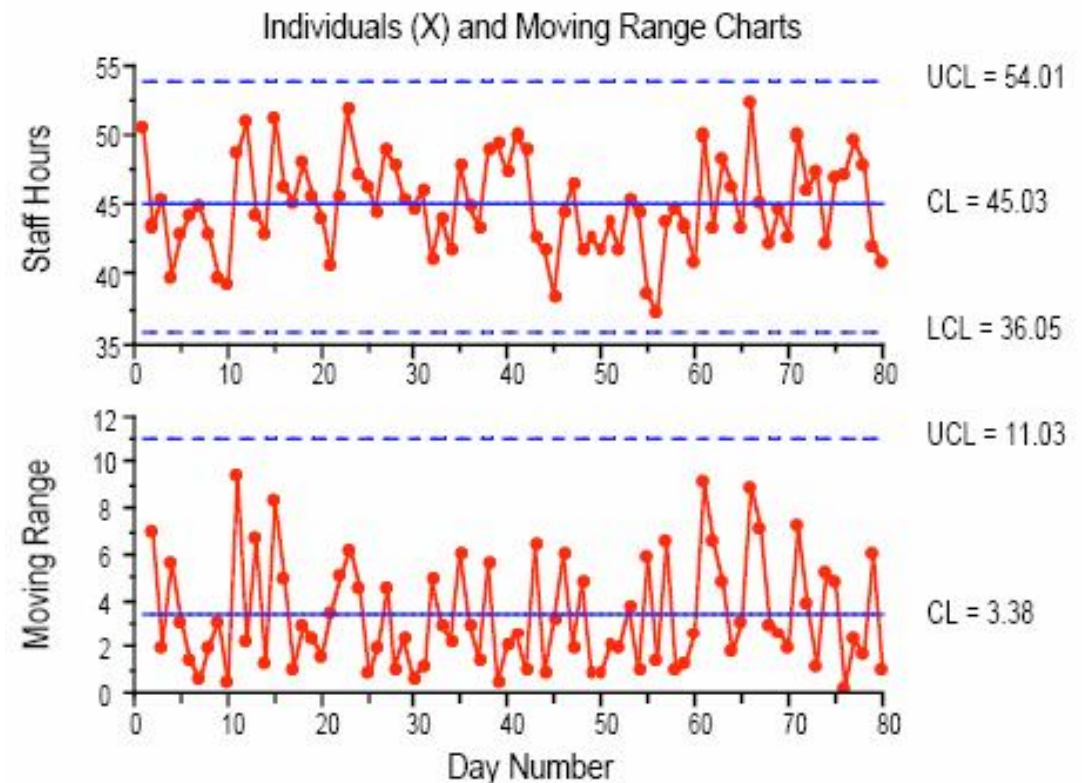
Too many (≥ 2) subsequent values on the same side of the average ± 2 Sigma line



Values upper the average + 3Sigma line or lower the average - 3Sigma

Statistics – XmR Charts

- In ever changing software industry, it's hard to have a solid basis for continuous statistics (a large organization like Luxoft can hardly measure more than 10 projects of the same type following the same process)
- When subgroups can easily include non-random components, XmR charts minimize the influence that non-random effects have upon estimates for sigma (by keeping the subgroups as small as possible). The smallest possible subgroup size is 1. There is no way to estimate sigma from a single measurement, so we do the next best thing—we attribute the changes that occur between successive values to the inherent variability in the process. The absolute values of these changes are called two-point moving ranges.

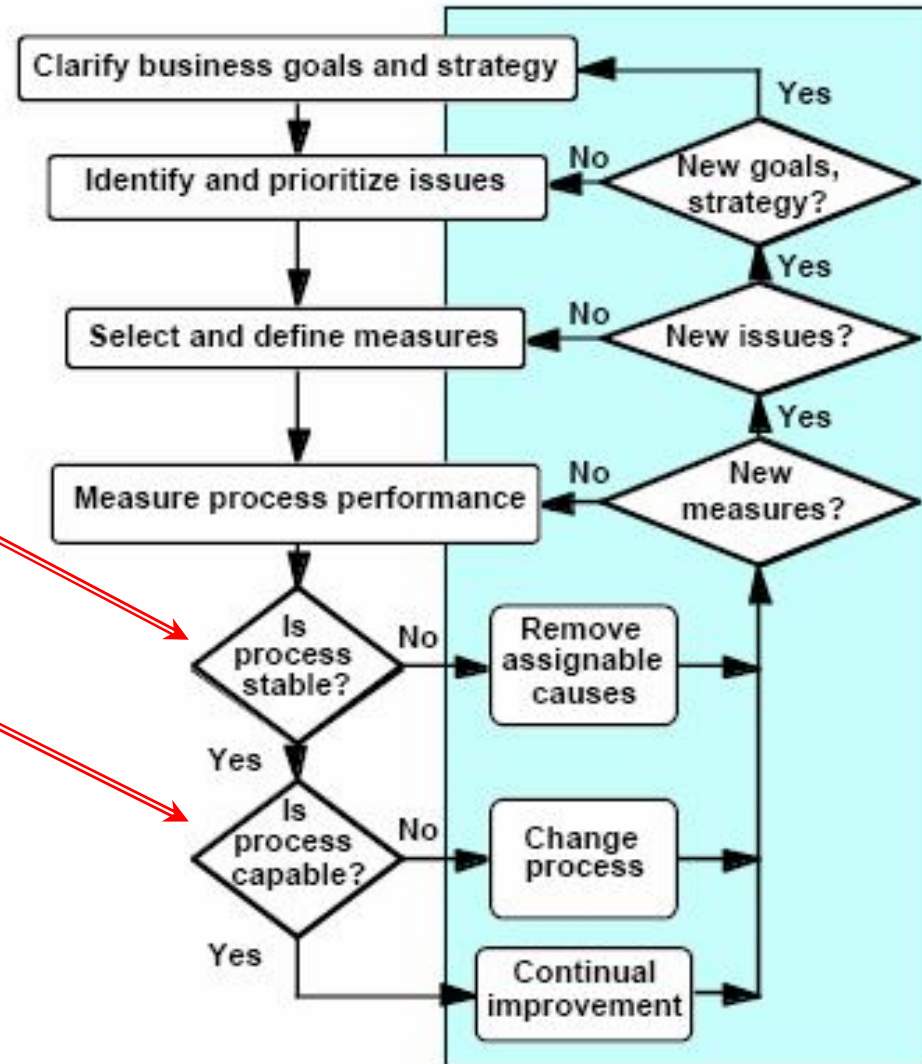


Statistics – Process Control

Evaluation of the process performance:

First – stability
Then – any process improvements

- CMMI Level 4 requires an organization to stabilize (get under the statistical control) the most critical processes.
- CMMI Level 5 requires an organization to continuously improve the process to satisfy their business goals.



Process Improvement

Three ways to improve process capability:

1. Reduce variability while keeping the average the same.

2. Retarget the process by shifting the average.

3. Revise the specification so that more of the results fall within the specification limits (a negotiation issue rather than true process improvement).

