Empowered by Innovation NEC

Success Factors to Achieve Excellent Quality

- CMMI Level 5 Organizations Research Report -

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Business Domains and Their Chief Products and Services

IT Services

Cloud-Oriented Service Platform Solutions

MegaOak

GPRIME

PanelDirector

Platform

Super Computer

WebSAM

Server

Integrated Operation/ Management Middleware

UNIVERGE

Unified Communication

Personal Solutions

Personal Computers

Mobile Terminals

BIGLOBE

Carrier Network

Long Term Evolution Network Systems

Unity Cable Systems

WiMAX Network Systems

Compact Microwave Communications Systems

Social Infrastructure

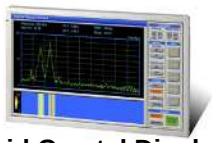
Digital Terrestrial TV Transmitters

Asteroid Explorer "HAYABUSA" (provided by Japan Aerospace Exploration Agency)

Others

Electron Devices

Lithium-ion Batteries



Liquid Crystal Displays

Previous study

Beyond CMMI level 5

- "CMMI level 5" doesn't necessarily guarantee excellent quality
- Beyond CMMI level 5 = Achieving "real" excellent quality

What's the keys to achieve "real" excellent quality?

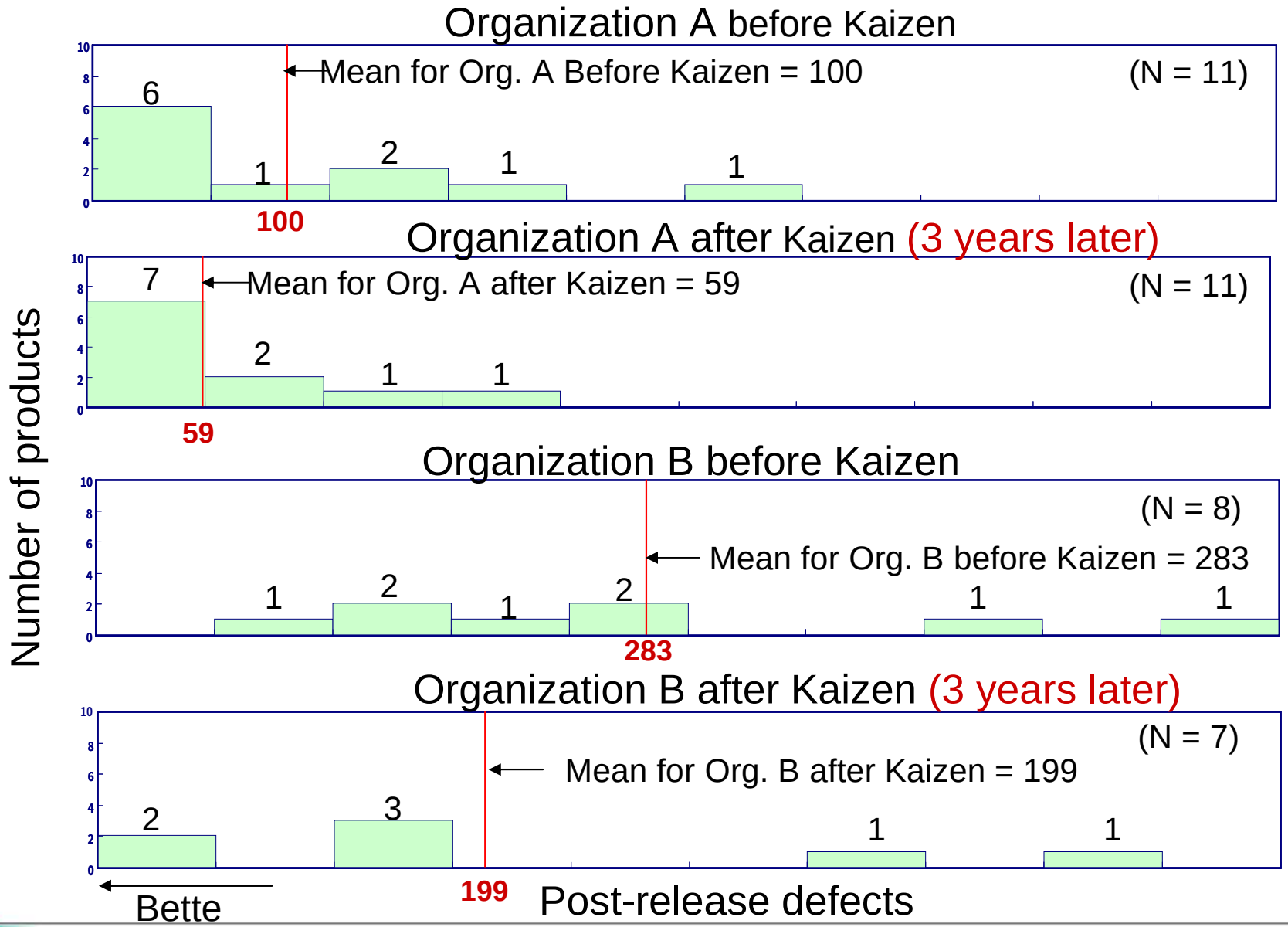
- Benchmarking using process data between CMMI level 5 organizations
- Superior abilities for defect root-cause analysis
- QCC: Quality-Centric software engineering Culture
  - The important Idea : The quality is the highest priority in the organization
  - Behaviors of the developers based on the idea

Organization A and Organization B

- ***Similar development conditions***
  - *Business area, Shipment volume*
  - *Development size*
  - *Number of engineers (2,000 engineers each)*
  - *Software process with CMMI level 5*
    - *V-model, V & V*
  - *Development and Management techniques*

Only organization B had troubled with Large number of post-release defects !

Comparison of the number of post-release defects



Kaizen activities

Analytical strategy	Kaizen Activities
Benchmarking using process data	**1.Reinforcing defect detection during design or code review**
	2. **Increasing the success rate of 1+n procedure**
Benchmarking Quality management system	**3. Implementation of independent QA testing**
	4. Quantitative management on a weekly basis using face to face communication

Data items

Category	No.	Data item	Unit
Effort	1	Total effort	Person-hours/KL
	2	Design and coding effort	Person-hours/KL
	3	Review effort	Person-hours/KL
	4	Testing effort	Person-hours/KL
Defect	5	Total defect	Number of defects/KL
	6	Defect during review	Number of defects/KL
	7	Defect during testing	Number of defects/KL
	8	Upstream defect detection rate	%
Testing item	9	Testing item	Number of testing items/KL
Preventive action	10	Success rate of 1+n procedure	%

Descriptive statistics on the data

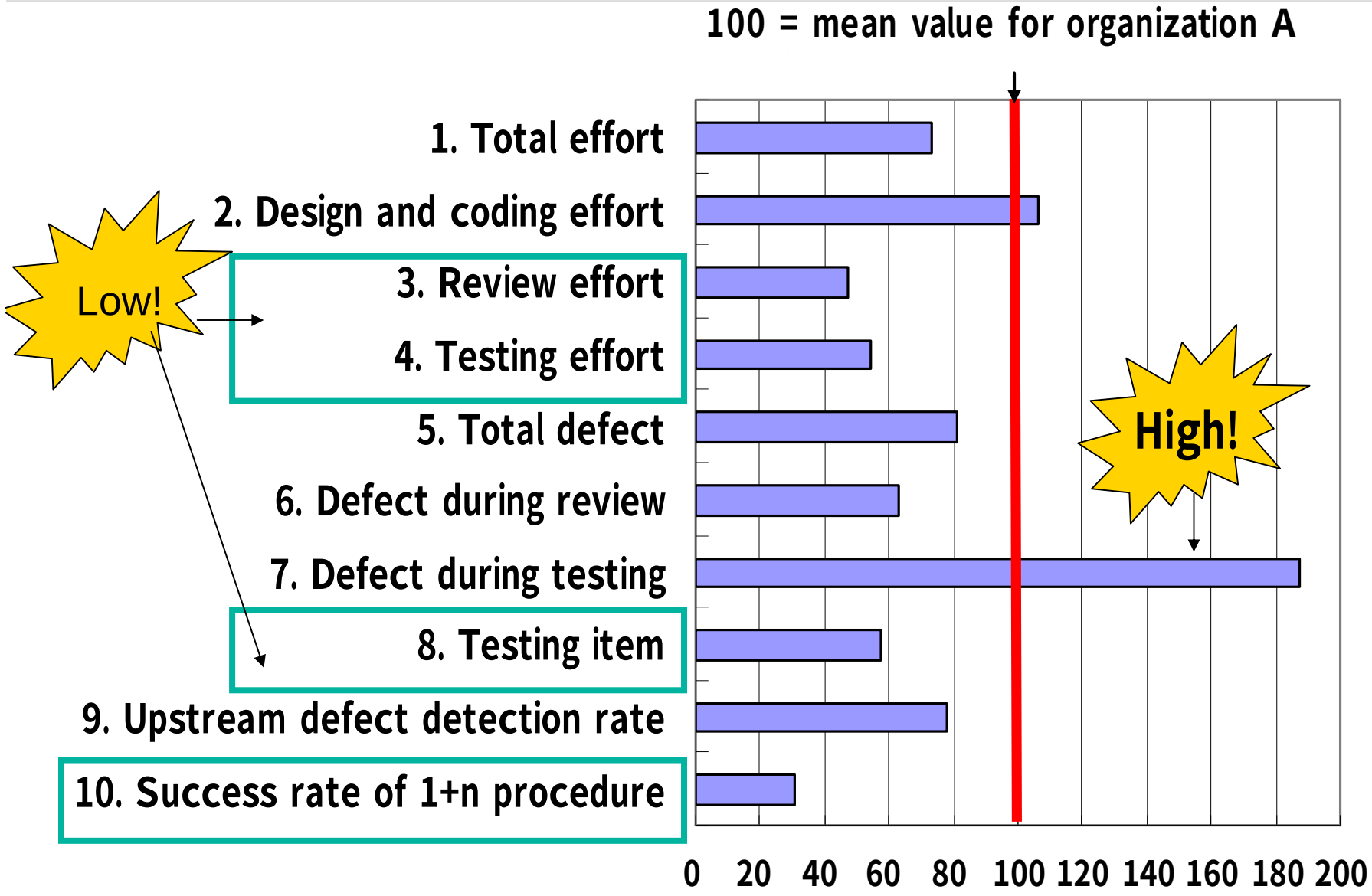
No.	Data item	Organization A						Organization B					
		Before Kaizen			After Kaizen			Before Kaizen			After Kaizen		
		N	Mean	Std. Deviation	N	Mean	Std. Deviation	N	Mean	Std. Deviation	N	Mean	Std. Deviation
1	Total effort	11	100.00	30.17	11	**113.15**	**47.36**	8	73.24	24.92	7	100.86	54.33
2	Design and coding effort	11	100.00	50.57	11	**111.43**	**38.99**	8	106.25	39.98	7	150.70	94.37
3	Review effort	11	100.00	31.22	11	**91.24**	**23.71**	8	47.56	9.17	7	81.48	22.91
4	Testing effort	11	100.00	33.79	11	**120.12**	**74.45**	8	54.69	22.57	7	67.35	39.45
5	Total defect	11	100.00	17.61	11	**96.82**	**28.55**	7	80.84	15.94	7	87.43	9.62
6	Defect during review	11	100.00	18.81	11	**95.27**	**28.77**	7	63.07	17.95	7	80.25	7.97
7	Defect during testing	11	100.00	18.31	11	**106.21**	**61.65**	7	187.77	46.48	7	130.68	34.30
8	Test item	11	100.00	34.56	11	**114.66**	**82.14**	8	57.82	22.05	7	129.75	69.64
9	Upstream defect detection	11	100.00	2.60	11	**98.95**	**7.83**	7	77.61	9.55	7	92.15	5.02
10	Success rate of 1+n procedure	11	100.00	66.77	9	**73.09**	**66.49**	8	30.49	61.23	7	81.06	53.47

Note:

1. All values are summed up for one year of each product.

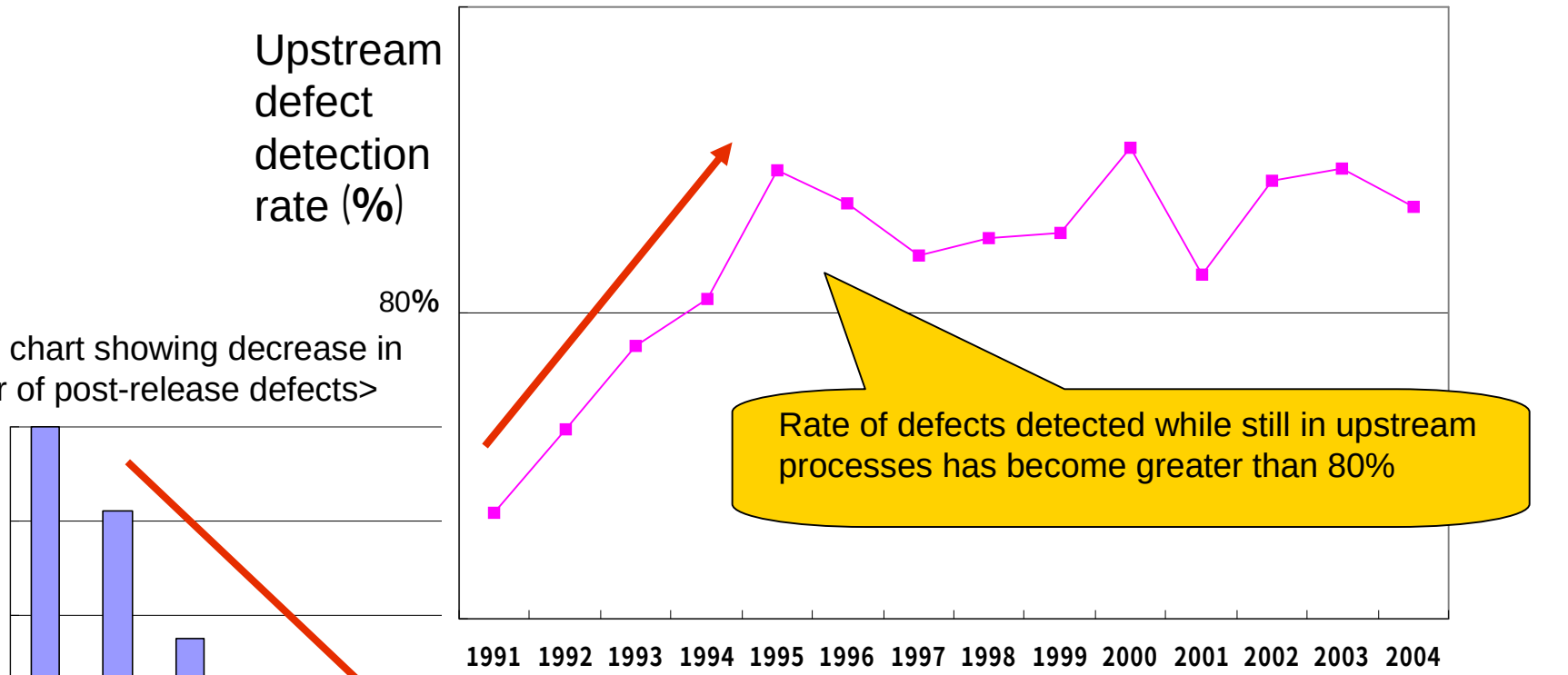
2. All values are shown using relative values, assuming the mean value for Organization A as 100.

Process data of organization B (before Kaizen)

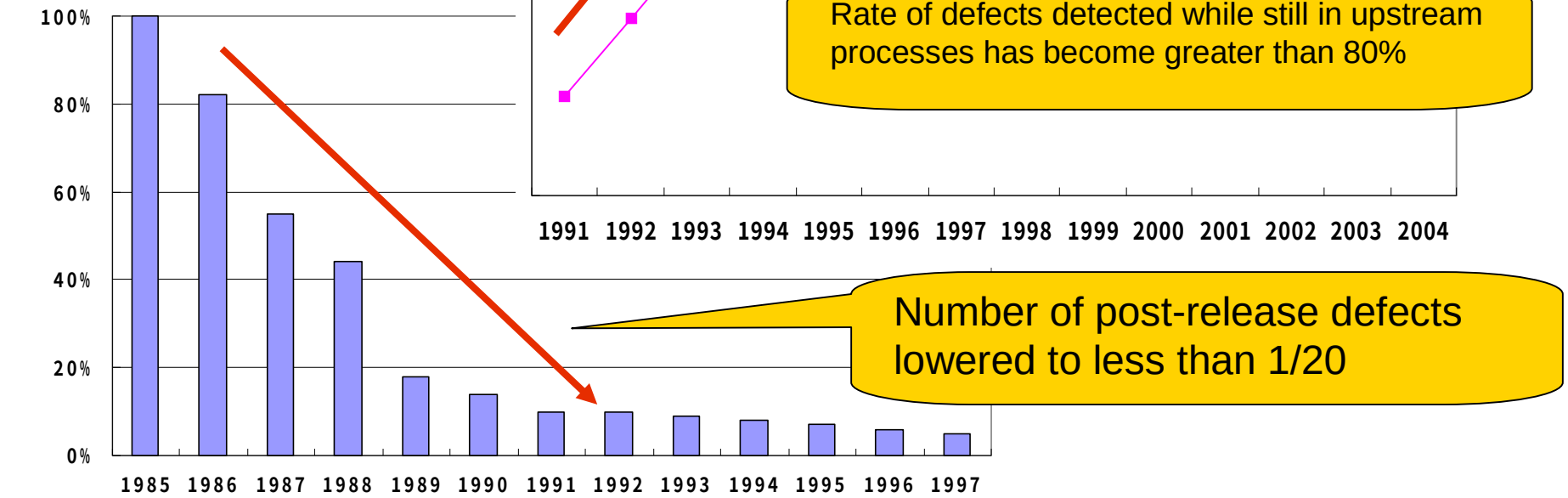


Experiences in organization A

<Trend chart showing the change of upstream defect detection rate>

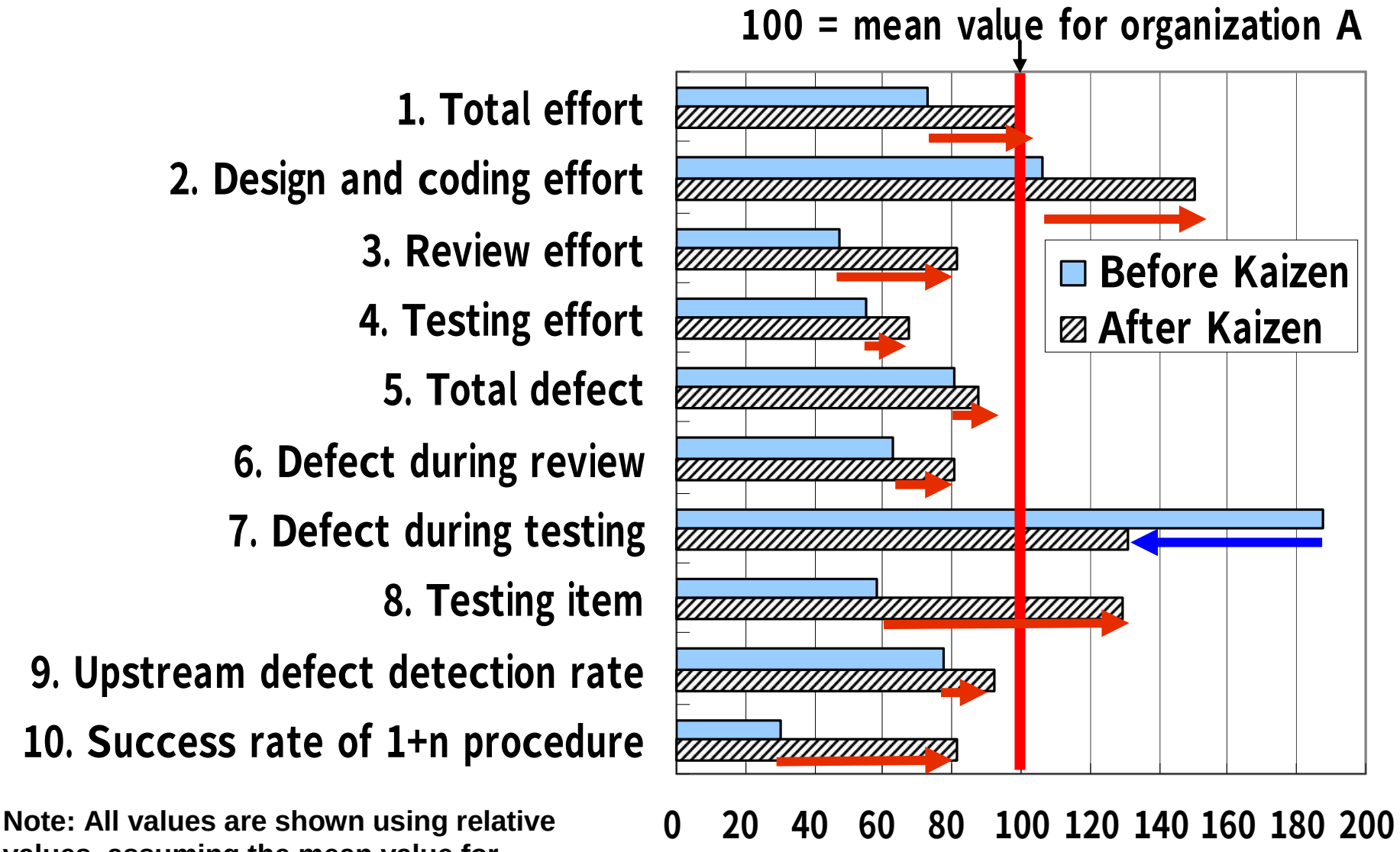


<Trend chart showing decrease in number of post-release defects>



※This chart shows relative ratio against the number of post-release defects of 1985

Process data of organization B (after Kaizen)

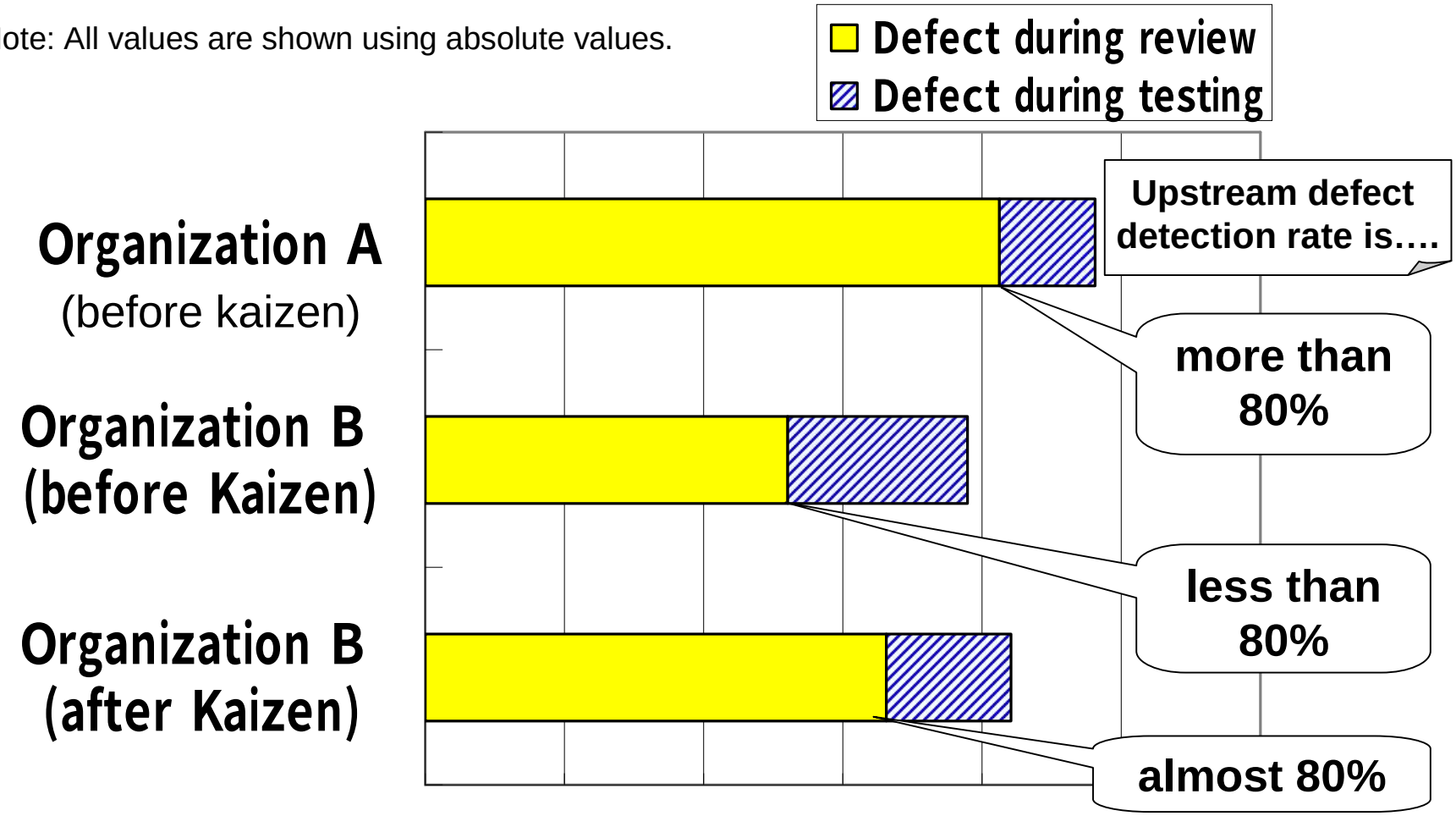


Note: All values are shown using relative values, assuming the mean value for Organization A as 100.

Result of defects during review and testing

<Comparing of defects during review and testing>

Note: All values are shown using absolute values.



Early detection more than 80% of defect during design or code review is a key to achieve excellent quality

Lessons Learned 1

Success factors to achieve excellent quality

- **Early detection more than 80% of defect during design or code review**
- **Superior abilities for defect root-cause analysis**

Kaizen activities

Analytical strategy	Kaizen Activities
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Comparison of Quality management system

Item		Organization A	Organization B
Software process		▌V model ▌V & V etc.	▌V model ▌V & V etc.
Quality checking through develop-ment	Based on deliverables	▌Independent QA testing for final products	▌Not applicable
	Based on process data	▌Weekly basis ▌Discussing on weekly Project management meeting	▌On completion of each process ▌Confirmation in writing

Effects and Lessons learned

Kaizen Activity	Effects	Lessons learned
Implementation of independent QA testing	4% of total defects were detected Shipment of defective software products were reasonably postponed	Quality assurance from both process quality and product quality has a good effect on reduction of post-release defects.
Quantitative management on a weekly basis using face to face communication	Problems were timely figure out through development <Example> Checking whether actual value of the review effort reaches the target value	Quantitative management with hands-on approach has a good effect on reduction of post-release defects.

Hands-on approach (Triple Actualities)

Actual spot

- Visiting the location of the trouble

Actual object

- looking at the actual objects there

Actual phenomenon

- Observing what is really happening

Instead of sitting at one's desk theorizing!

Behavioral changes in organization B

	Before Kaizen	After Kaizen
Participants in Quality meeting	Very few words	Lively discussion
Address of the Top management in the year beginning	No words about quality procedure	Explaining the importance of product quality Declaration about the quality target Holding of Quality enhancement event

Quality-centric software engineering culture is being built up now!

Conclusion

Success factors to achieve excellent quality

1. Early detection more than 80% of defect during design or code review
2. Superior abilities for defect root-cause analysis
3. Quality assurance from both side of process quality and product quality
4. Quantitative management with hands-on approach
5. Quality-centric software engineering culture

NEC Group Vision 2017

To be a leading global company leveraging the power of innovation to realize an information society friendly to humans and the earth

Established in 2008

Empowered by Innovation