The New ISO/CD 16355 Standard

Transfer Functions and the Effect of Ratio Scale in QFD

Thomas M. Fehlmann, Zürich
Eberhard Kranich, Duisburg
Euro Project Office AG
E: info@e-p-o.com
H: www.e-p-o.com

"Quality for Future of the World"

Budapest, Hotel Kempinsky
October 26 & 27, 2015

QFD-Institut
QFD Institut Deutschland e.V. (QFD-ID)

euro project office
Master your project.

Customer Orientation

Lean Six Sigma

Agile Processes

Project Estimations

Transfer Functions

Dr. Thomas Fehlmann

- 1981: Dr. Math. ETHZ
- 1991: Six Sigma for Software Black Belt
- 1999: Euro Project Office AG, Zürich
- 2001: Akao Price 2001 for original contributions to QFD
- 2003: SwissICT Expert for Software Metrics, ICTscope.ch
- 2004: Member of the Board QFD Institute Deutschland – QFD Architect
- 2007: CMMI for Software – Level 4 & 5
- 2011: Net Promoter® Certified Associate
- 2012: Member of the DASMA Board
- 2013: Vice-President ISBSG

Customer Orientation

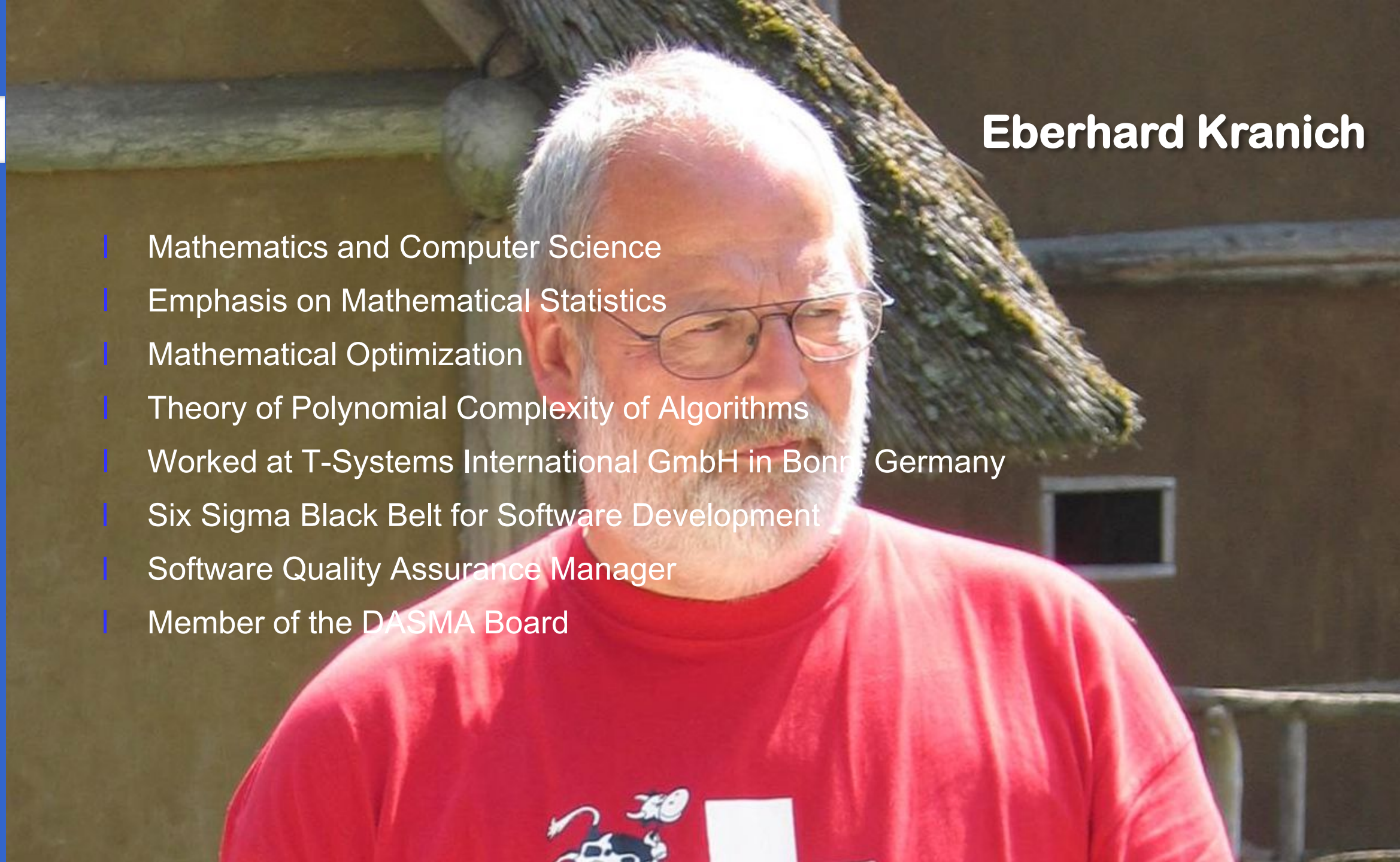
Lean Six Sigma

Agile Processes

Project Estimations

Transfer Functions

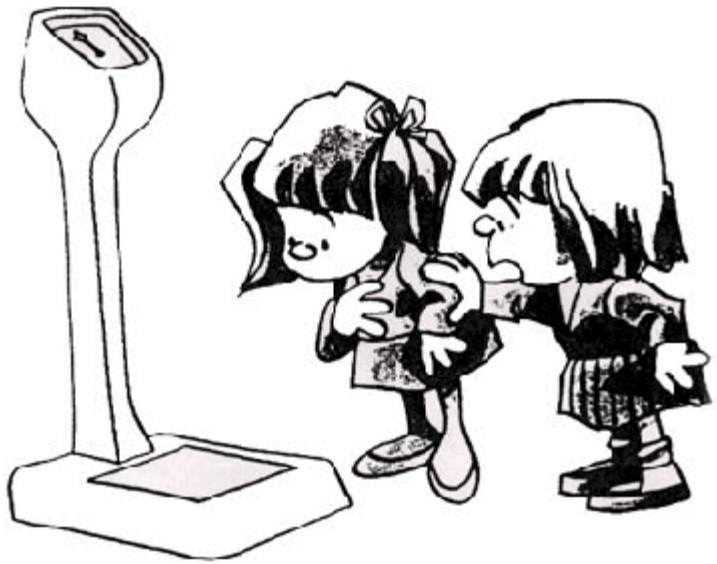
Eberhard Kranich



- Mathematics and Computer Science
- Emphasis on Mathematical Statistics
- Mathematical Optimization
- Theory of Polynomial Complexity of Algorithms
- Worked at T-Systems International GmbH in Bonn, Germany
- Six Sigma Black Belt for Software Development
- Software Quality Assurance Manager
- Member of the DASMA Board

Agenda

- Modern QFD
- The Eigenvector Method for Quality Function Deployment
- Some important Characteristics of Priority Profiles
  - Quality of a Quality Function Deployment
  - Profiles and Weights

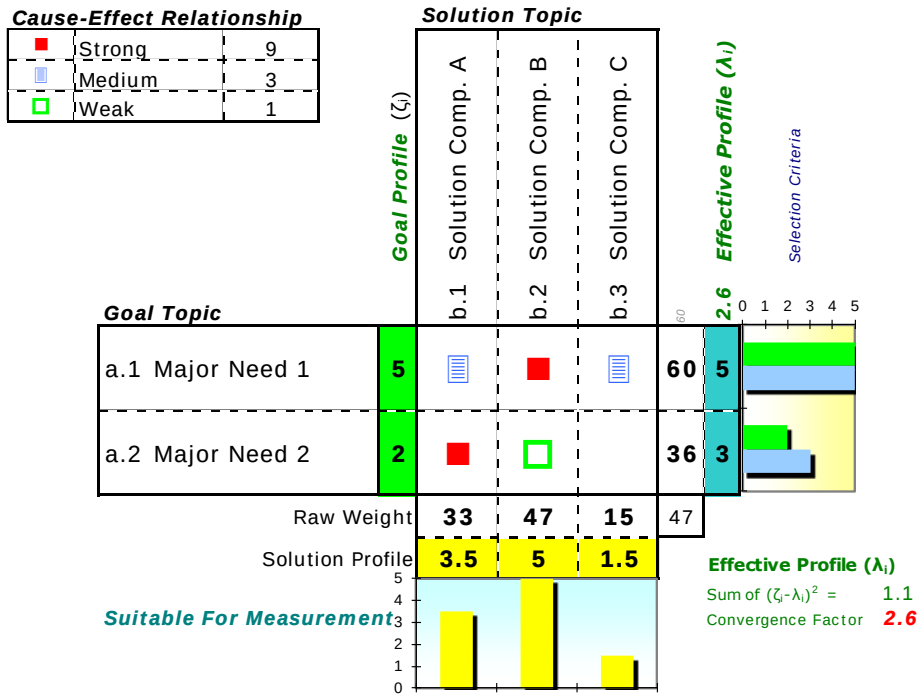


"Don't step on it . . . it makes you cry."

Modern QFD

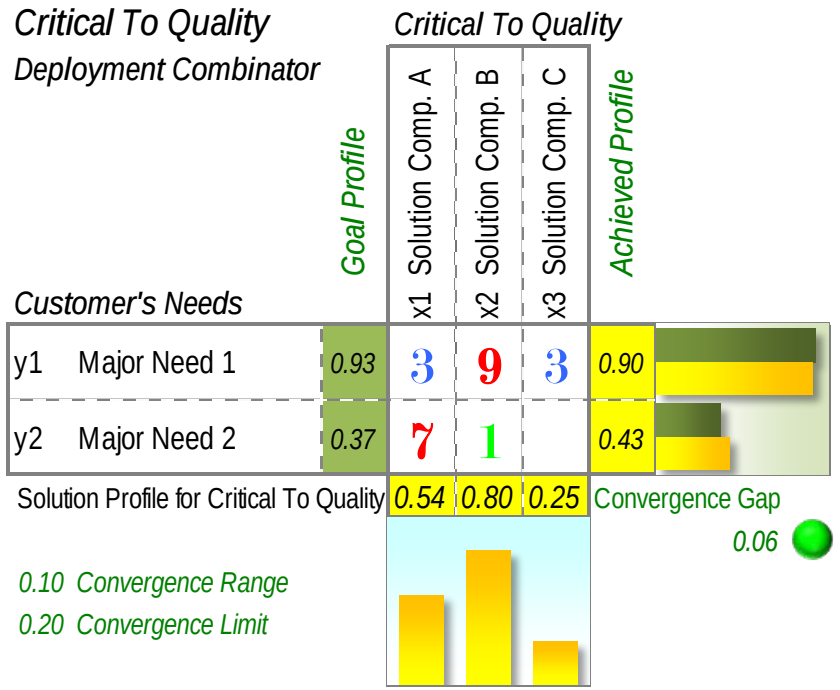
Traditional QFD

- Profiles Scale 0 to 5
- Cell Values as Symbols
- Quality Indicator not used



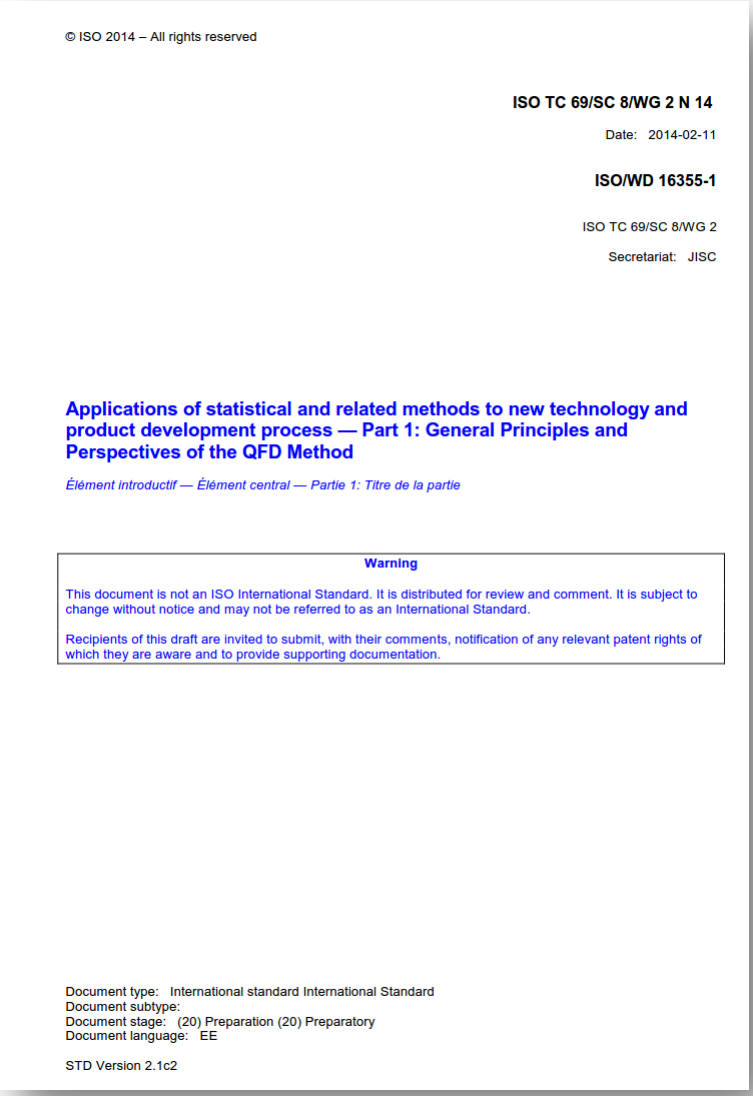
Modern QFD

- Profiles are Vectors of Length = 1
- Cells have Ratio Scale
- Teams optimize Convergence Gap



The Draft ISO/CD 16355-1 Standard

- Applications of statistical and related methods to new technology and product development process
  - Part 1: General Principles and Perspectives of the QFD Method
- Drafted by the international QFD Community
  - Spirit of QFD
  - QFD Teams
  - QFD Projects
  - Scientific foundation
  - QFD Supplier Point of View
  - QFD User Point of View



ISO TC 69/SC 8/WG 2 N 14

Date: 2014-02-11

ISO/WD 16355-1

ISO TC 69/SC 8/WG 2

Secretariat: JISC

Applications of statistical and related methods to new technology and product development process — Part 1: General Principles and Perspectives of the QFD Method

Élément introductif — Élément central — Partie 1: Titre de la partie

Warning

This document is not an ISO International Standard. It is distributed for review and comment. It is subject to change without notice and may not be referred to as an International Standard.

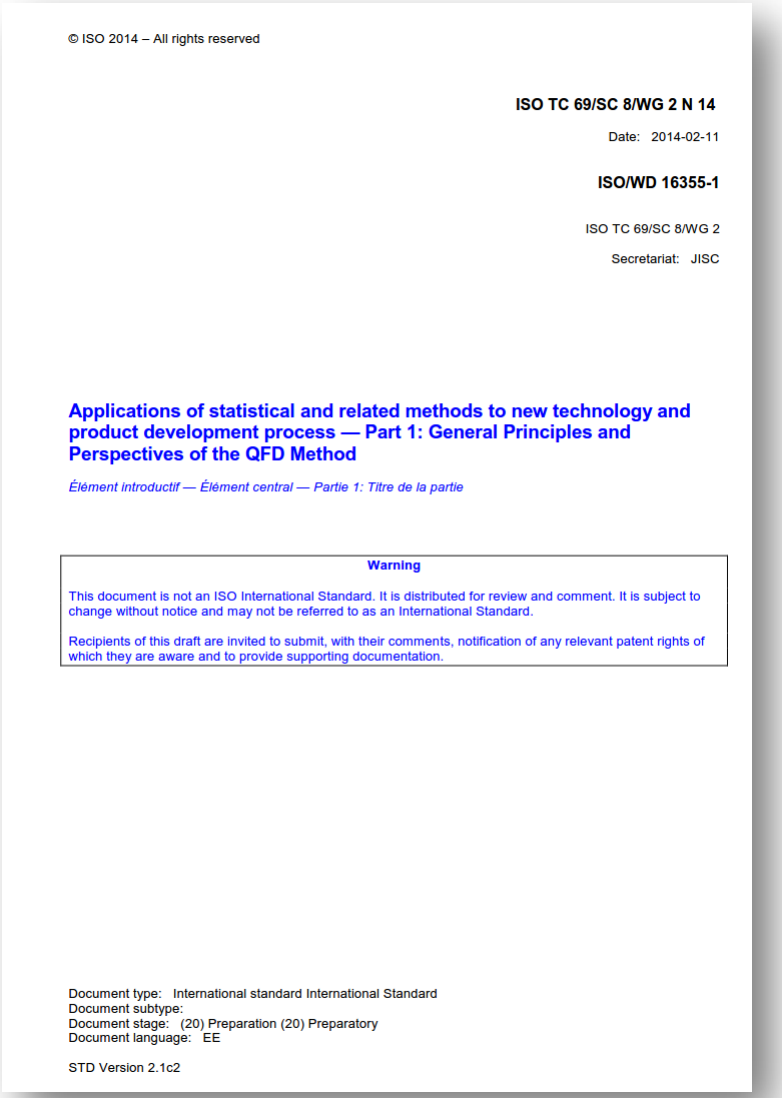
Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Document type: International standard International Standard
Document subtype:
Document stage: (20) Preparation (20) Preparatory
Document language: EE

STD Version 2.1c2

The Draft ISO/CD 16355-1 Standard

- Major Steps forward
  - Ratio Scale for matrix coefficients
  - Identification of the QFD Matrix as a linear Transfer Function
  - Mapping technical solutions into responses as required by customer's needs



ISO TC 69/SC 8/WG 2 N 14

Date: 2014-02-11

ISO/WD 16355-1

ISO TC 69/SC 8/WG 2

Secretariat: JISC

Applications of statistical and related methods to new technology and product development process — Part 1: General Principles and Perspectives of the QFD Method

Élément introductif — Élément central — Partie 1: Titre de la partie

Warning

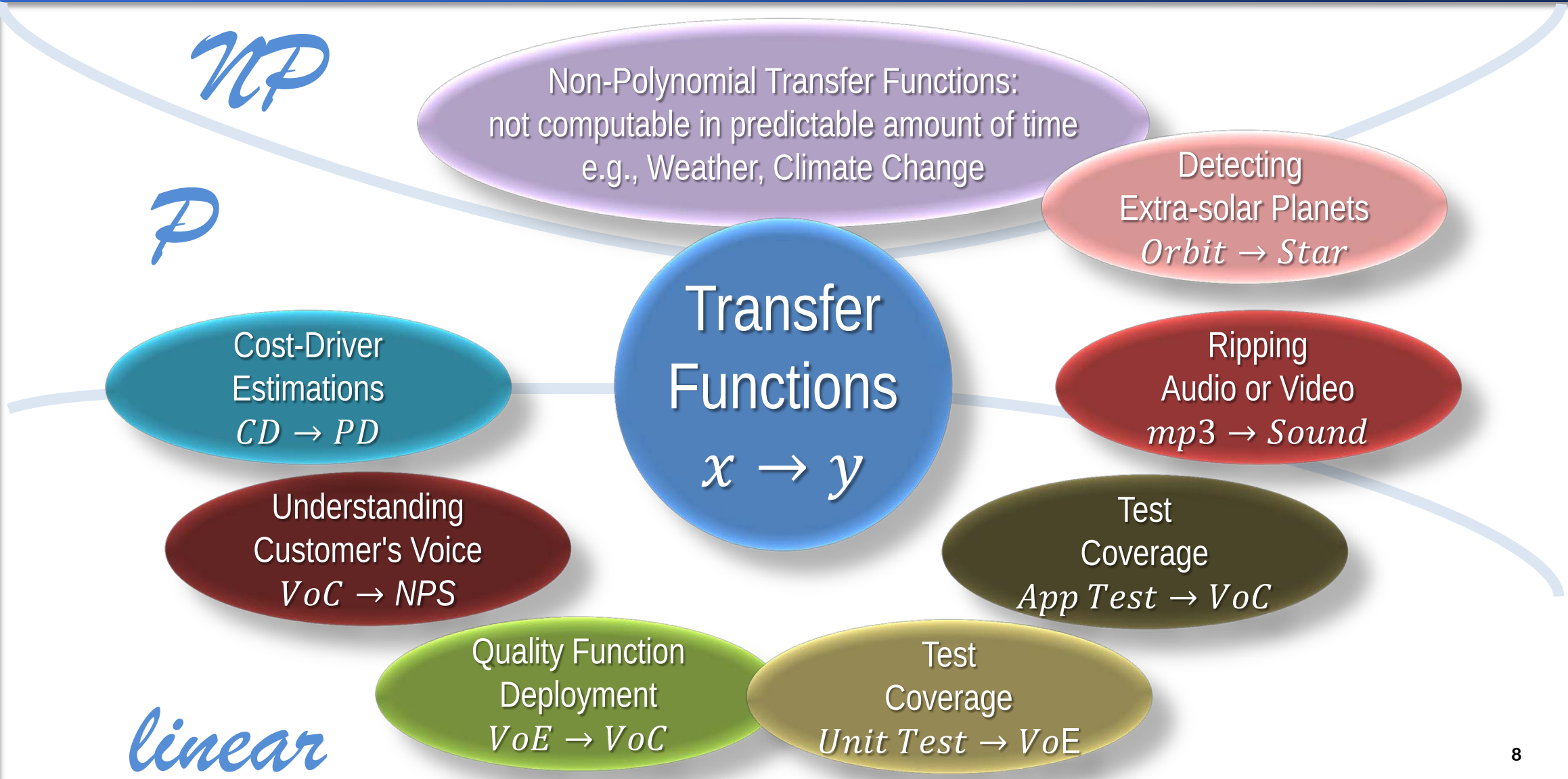
This document is not an ISO International Standard. It is distributed for review and comment. It is subject to change without notice and may not be referred to as an International Standard.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

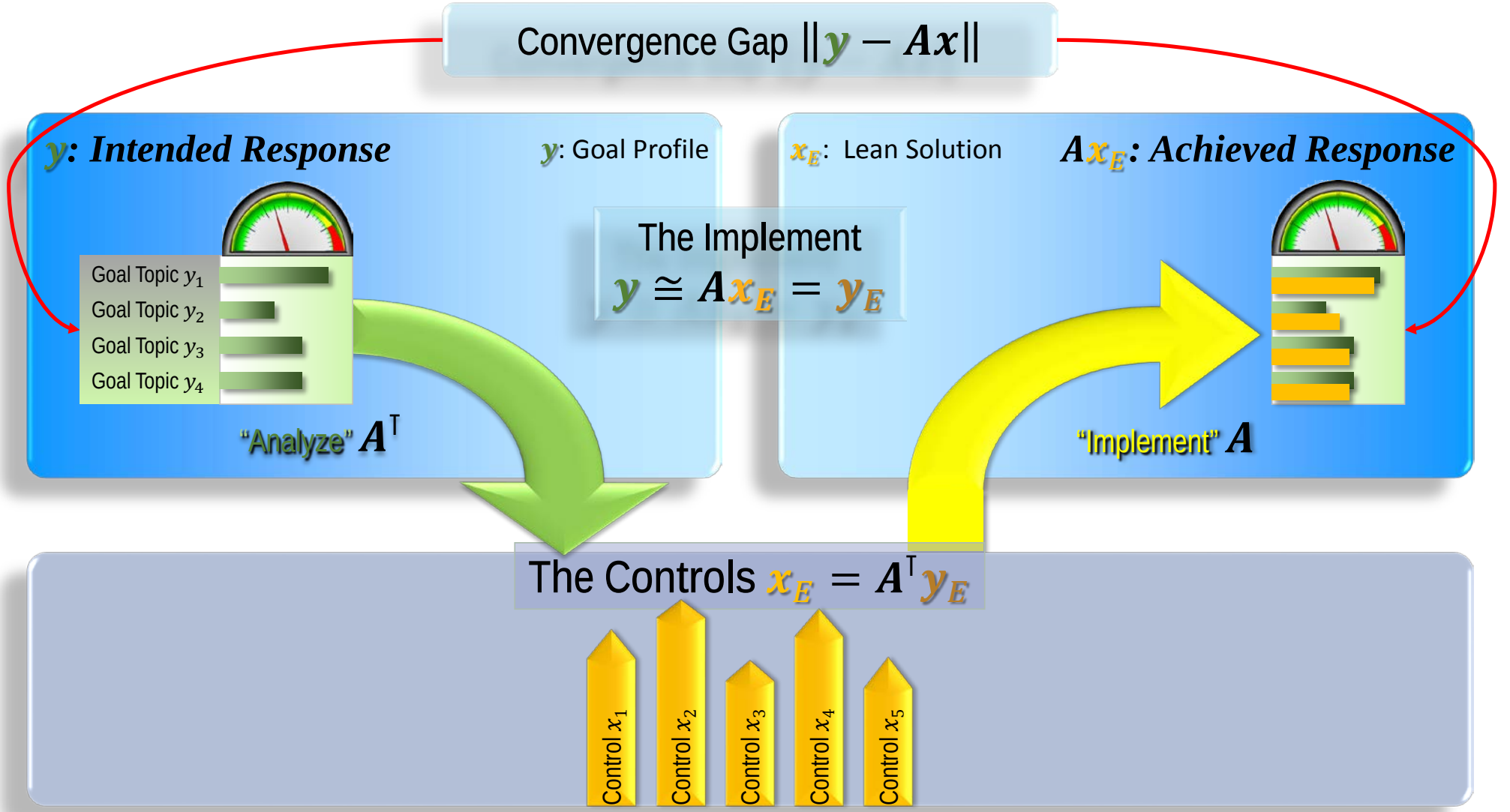
Document type: International standard International Standard
Document subtype:
Document stage: (20) Preparation (20) Preparatory
Document language: EE

STD Version 2.1c2

Transfer Functions

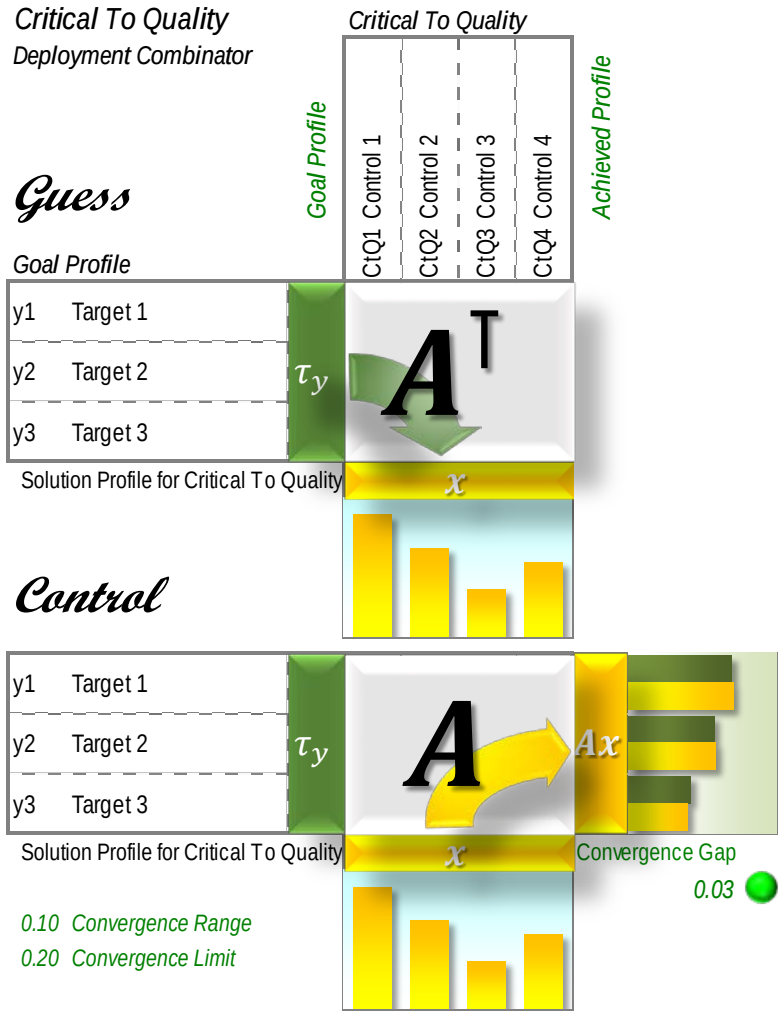


Measurement Principle with Transfer Functions

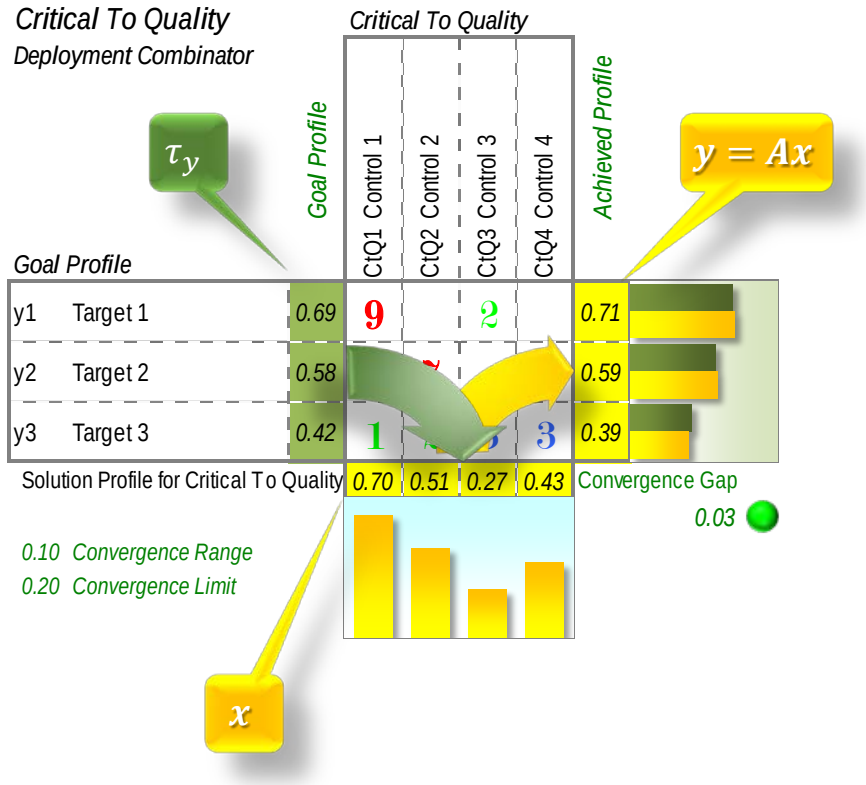


Solving a QFD Matrix $y = Ax$

Theory



Practice



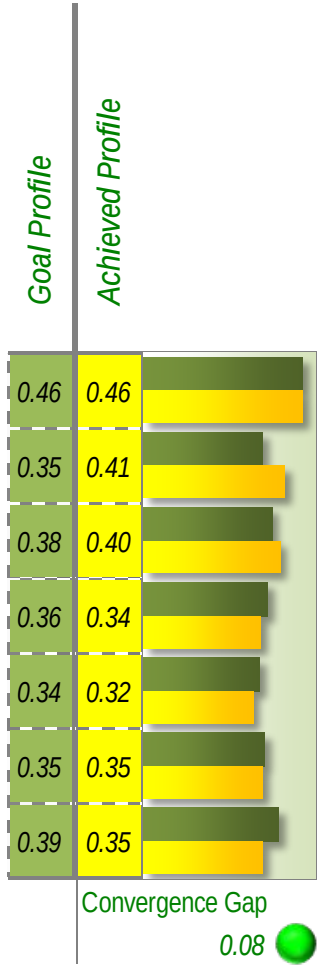
A Measure for Quality – the Convergence Gap

- The **Convergence Gap**

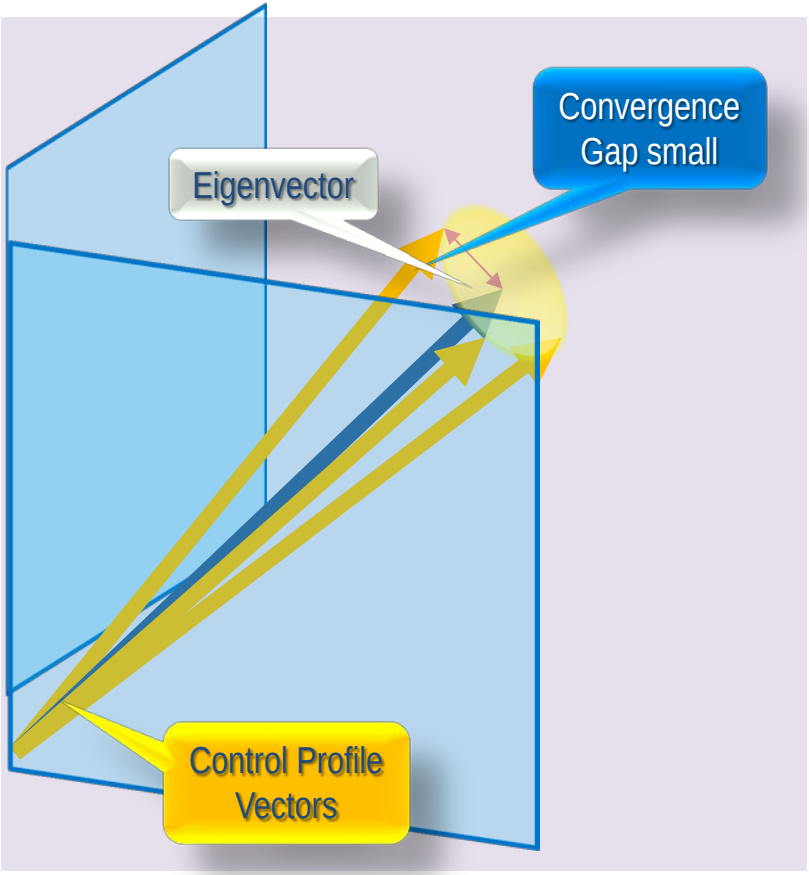
$$\|y - \tau_y\| = \sqrt{\sum_{i=1}^{m} (y - \tau_y)_i^{\,2}}$$

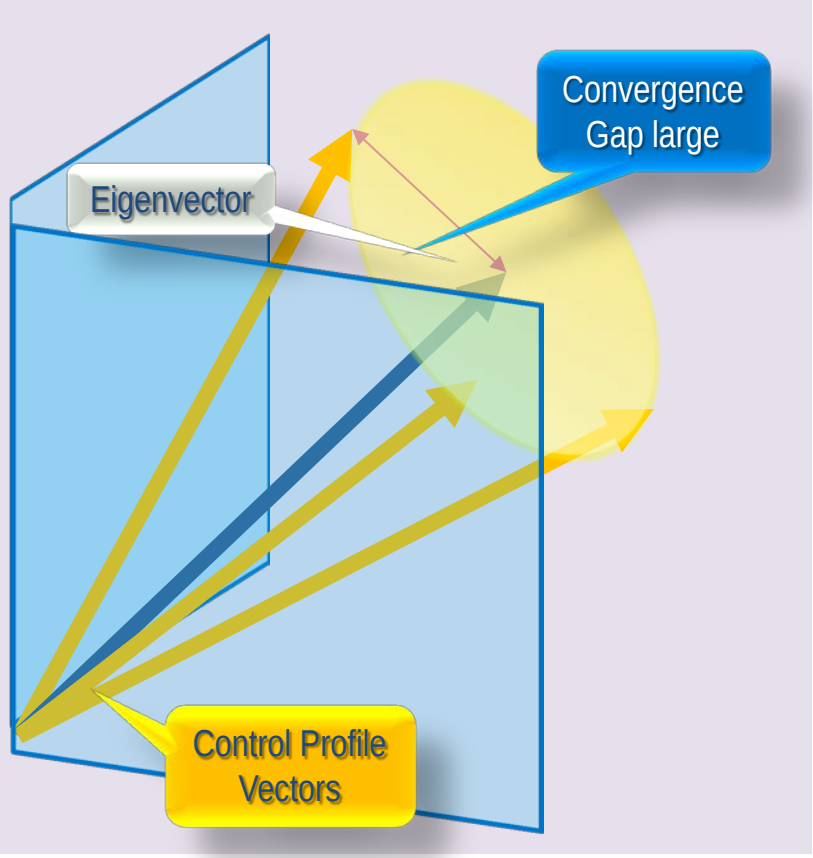
reveals the quality of the goal profile's approximation by the achieved solution profile

- This is the Euclidean Norm
  - Distance between vectors y and τ_y



Comparing Vectors





See Schurr, 2011

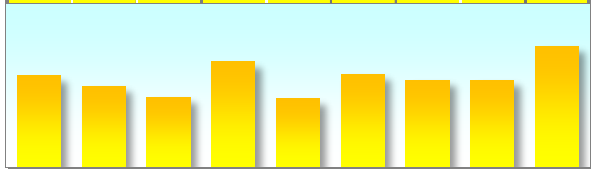
Traditional Solution Profile and Modern Solution Profile

- Eigensolution level Inconsistencies out
  - Similar to Saaty's AHP Calculation

Critical To Quality
Deployment Combinator

Critical To Quality

Customer's Needs		*Goal Profile*	x1 Browser Style GUI	x2 Keep to XSQL Standard	x3 Open Interfaces	x4 Agile Programming	x5 Reusable classes	x6 Custom Extensions	x7 Portfolio Management	x8 Reliable Functionality	x9 Moderated Forum	*Achieved Profile*
y1	Competency to answer inquiries	*0.46*	9	9	9	3		3	3	9	3	*0.46*
y2	Confidentiality	*0.35*		9	3		9	9	3		9	*0.41*
y3	Suitability for business needs	*0.38*	3		3	9	3	3	9	9	1	*0.40*
y4	Short Development Cycles	*0.36*		3	3	3	3	3	9		9	*0.34*
y5	Functionality where you need it	*0.34*	9			9	1	3		9		*0.32*
y6	Social competency	*0.35*				9	3	9	1		9	*0.35*
y7	Communication	*0.39*	9	3	3	3	3		3		9	*0.35*
	Solution Profile for Critical To Quality		*0.34*	*0.30*	*0.26*	*0.39*	*0.25*	*0.34*	*0.32*	*0.32*	*0.44*	Convergence Gap
												0.08



0.10 Convergence Range
0.20 Convergence Limit

Profiles and Weights

- In the columns, two priority profiles are summed up yielding the sum of profiles in the third row, and normalized again in the fourth row
- Left are the corresponding weight vectors
- Summing up the weight vectors and transform them back to profiles yields different results than the sum of profiles
- Summing up the corresponding weight vectors is bad mathematics
  - Good mathematics is with profiles only
  - When calculating with weights, large vector components leave a bias

	Weights	→	Profiles	→	Weights	
Topic 1	5%	0.00	0.06	0.06	5%	
Topic 2	85%	0.72	0.99	0.99	85%	
Topic 3	10%	0.01	0.12	0.12	10%	
	100%	0.86	1.00	1.17	100%	Weight & Profile 1
	plus ↓	→	plus ↓	→	Weights	
Topic 1	33%	0.11	0.57	0.57	33%	
Topic 2	34%	0.12	0.59	0.59	34%	
Topic 3	33%	0.11	0.57	0.57	33%	
	100%	0.58	1.00	1.73	100%	Weight & Profile 2
	sum ↓		sum ↓	→	Weights	
Topic 1	0.38		0.63	0.34	21.7%	
Topic 2	1.19		1.58	0.86	54.5%	
Topic 3	0.43		0.69	0.37	23.7%	
	2.00		1.84	1.58	100%	Sum of Profiles 1+2
	norm ↓	→	Profiles	→	Weights	≠
Topic 1	19%	0.04	0.22	0.22	19.0%	
Topic 2	60%	0.35	0.69	0.69	59.5%	
Topic 3	22%	0.05	0.25	0.25	21.5%	
	100%	0.66	0.77	1.17	100%	Sum of Weights 1+2
				0.24		Convergence Gap

Conclusion

- The ISO/CD 16355 proposed standard projects QFD into the 21st century
- QFD is thanks to good mathematics implementable in quality processes
  - At least one QFD user has implement New Lanchester Theory into its New Feature Prioritization concept
  - Impact of QFD on agile software development is on the horizon now
- QFD will always depend on the teams using it
  - Because it record and documents the reasons for taking some decision
- QFD will go mainstream

Questions?

Solving Multilinear Transfer Functions $y = Ax$

y A

$x_E = A^T y_E$

Theory

A_T

y_E AA^T

y_E

Eigenvectors:

0.71	-0.69	-0.17
0.59	0.71	-0.39
0.39	0.17	0.90

y

9	0	2	0
0	7	0	5
1	2	3	3

$x_E = A^T y_E$

Theory

9	0	1
0	7	2
2	0	3
0	5	3

y_E

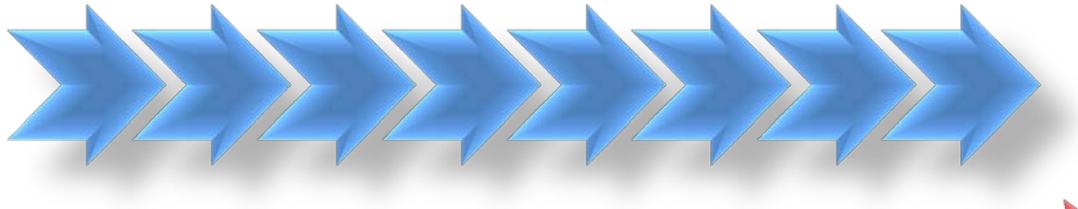
85	0	15
0	74	29
15	29	23

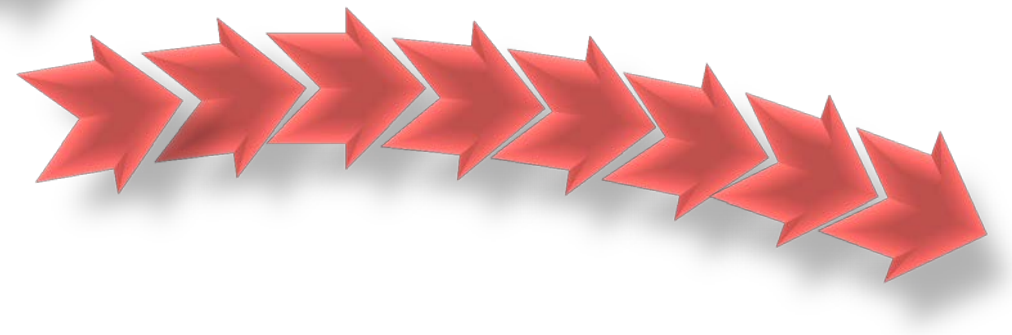
y_E

Advantages of Eigensolution Method

- Eigensolutions are stable
  - When repeatedly applying the process represented by the transfer function $\boldsymbol{A}$, the response $\boldsymbol{y}$ remains always the same
  - $\boldsymbol{y} = \boldsymbol{A}\boldsymbol{A}^{\mathsf{T}}\boldsymbol{y} = \boldsymbol{A}\boldsymbol{A}^{\mathsf{T}}(\boldsymbol{A}\boldsymbol{A}^{\mathsf{T}}\boldsymbol{y}) = \boldsymbol{A}\boldsymbol{A}^{\mathsf{T}}\big(\boldsymbol{A}\boldsymbol{A}^{\mathsf{T}}(\boldsymbol{A}\boldsymbol{A}^{\mathsf{T}}\boldsymbol{y})\big) = \cdots$

- Other solutions might also yield good – even better – convergence gaps but when repeated the process diverges





- Eigensolutions level out inconsistencies