



Willkommen

welcome
bienvenue



Six Sigma in Food Production - Challenges for ,Bio'-Process Optimization

Detert Brinkmann
Institute for Animal Science
University of Bonn

Budapest, 20.06.2011



Improving the quality of pork and pork products for the consumer

Development of innovative, integrated, and sustainable food production chains for high quality pork products matching consumer demands



www.q-porkchains.org

Integrated Project **Q-PORKCHAINS**
FOOD-CT-2007- 036245
Period: 2007-2011



3

Content

- **Six Sigma – an innovative and dynamic concept**
- **Reducing costs and optimizing quality**
- **Applying Six Sigma in the food industry**
- **Summary and outlook**

4

Six Sigma

an innovative concept

- Improving the performance of companies through
 - commitment of top management
 - involvement of all stakeholders
 - training programm - BELT
 - measuring system

(Magnusson et al. 2001)

Goal: Reducing production costs through an increasing degree of conformity to customer requirements

(Conformity according to DIN EN ISO 8402)

DMAIC-Cycle

structured process improvement

TOP Management and Master Black BELT

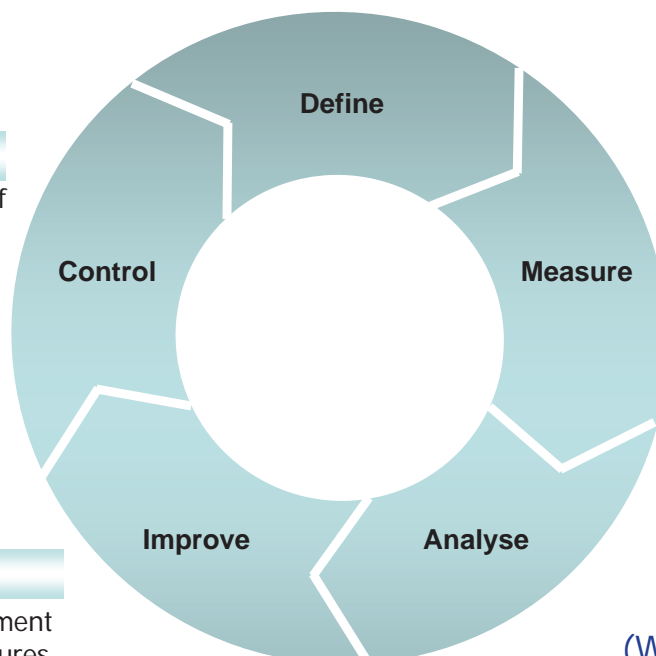
Define the problem, customer requirements, team, project scope and targets

Black BELT

Control the success of process improvement

Black BELT

Measure the process performance and compare it to customer requirements



Black BELT

Develop and implement improvement measures

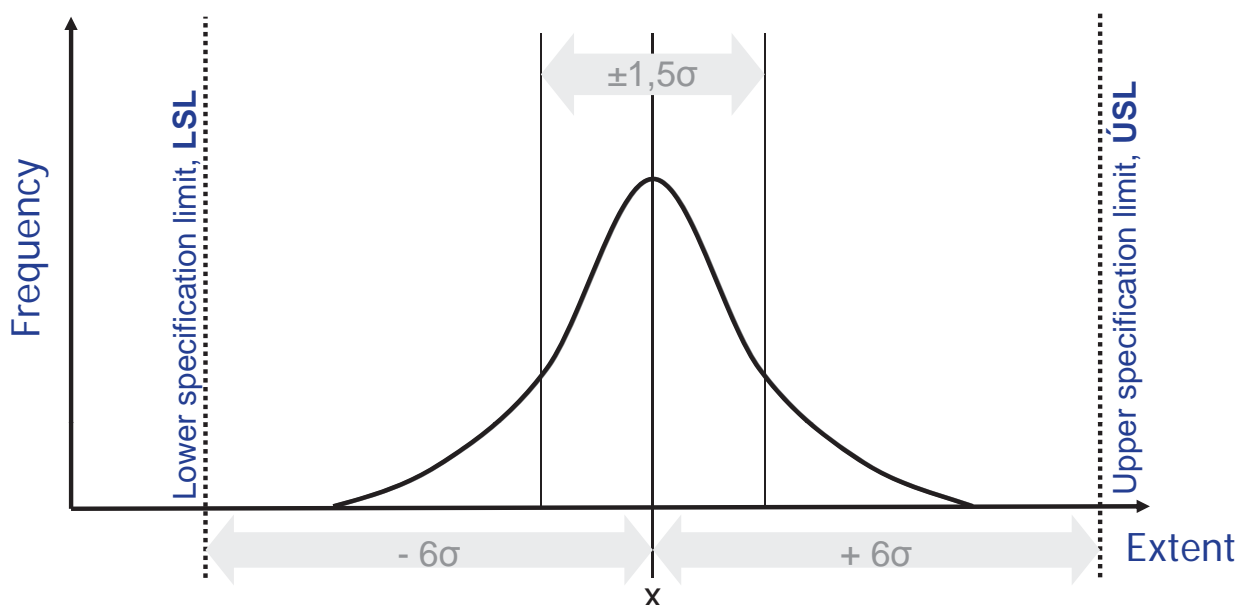
Black BELT

Analyse and determine the causes of defects

(Wappis & Young 2008)

- **Customer** tools (Kano model, VoC,...)
- **Project** tools (project charter, CTQ, ...)
- **Management** tools (decision tree, matrix diagramm, ...)
- **Lean** tools (flow charts, value chain analysis, ...)
- **Statistical** tools (DoE, Regression analysis, ...)
- **Risk** tools (Risk assessment, RPNs, ...)

7



x = target value

(Magnusson et. al 2001, modified)

8

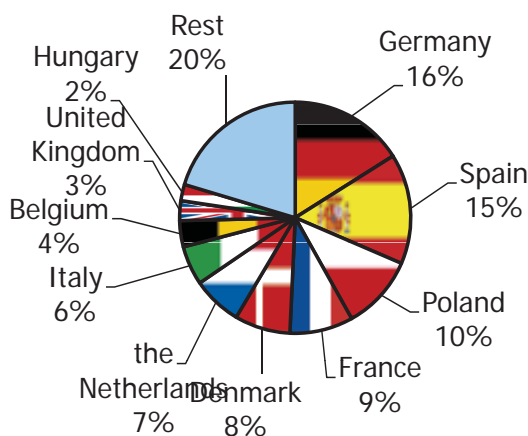
Defects per million opportunities – DPMO¹

Sigma level	DPMO	Zero-defects (in %)	Quality costs ² (in % of turnover)
1	691.462	30,85	-
2	308.537	69,15	-
3	66.807	93,32	25-40%
4	6.210	99,38	15-25%
5	233	99,98	5-15%
6	3,4	99,9997	<1%

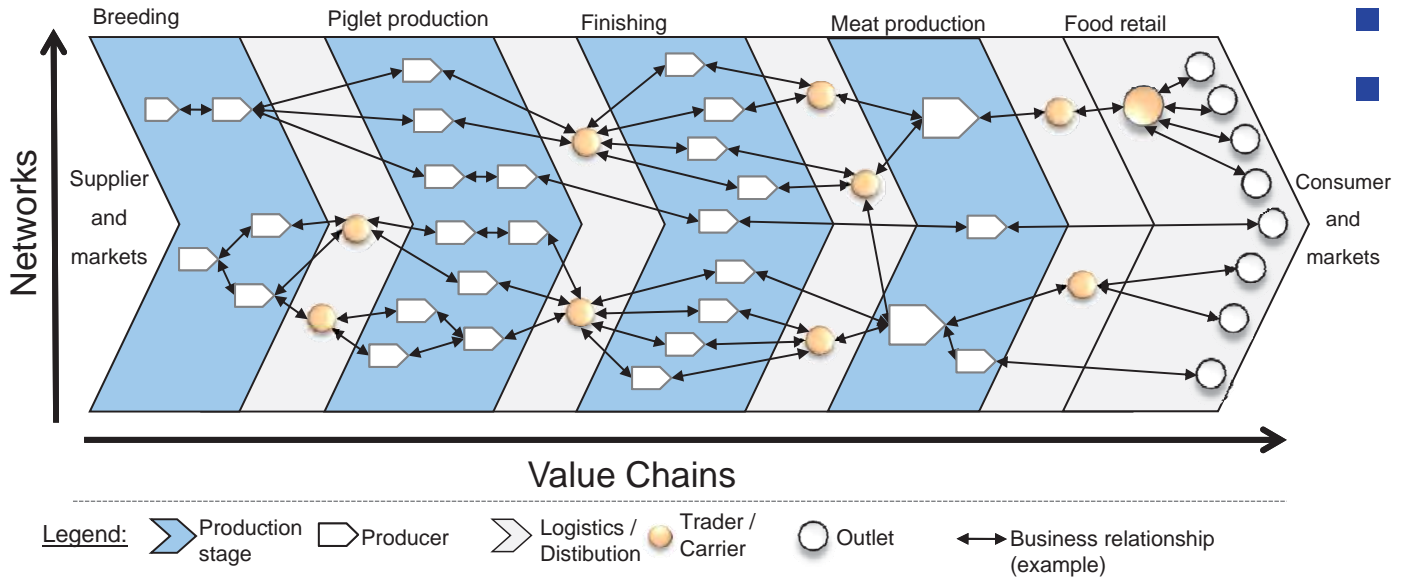
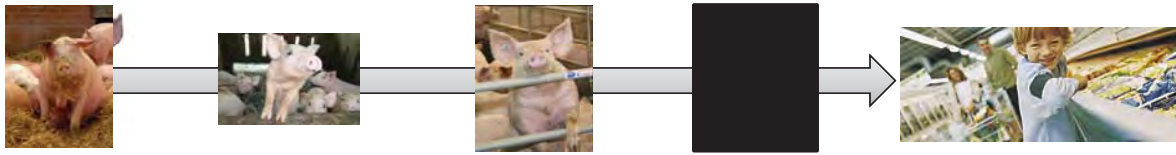
¹DGQ 2010, ²Tavasli 2007 refering to Harrington 1987

Pigs in the EU-27 (2008)

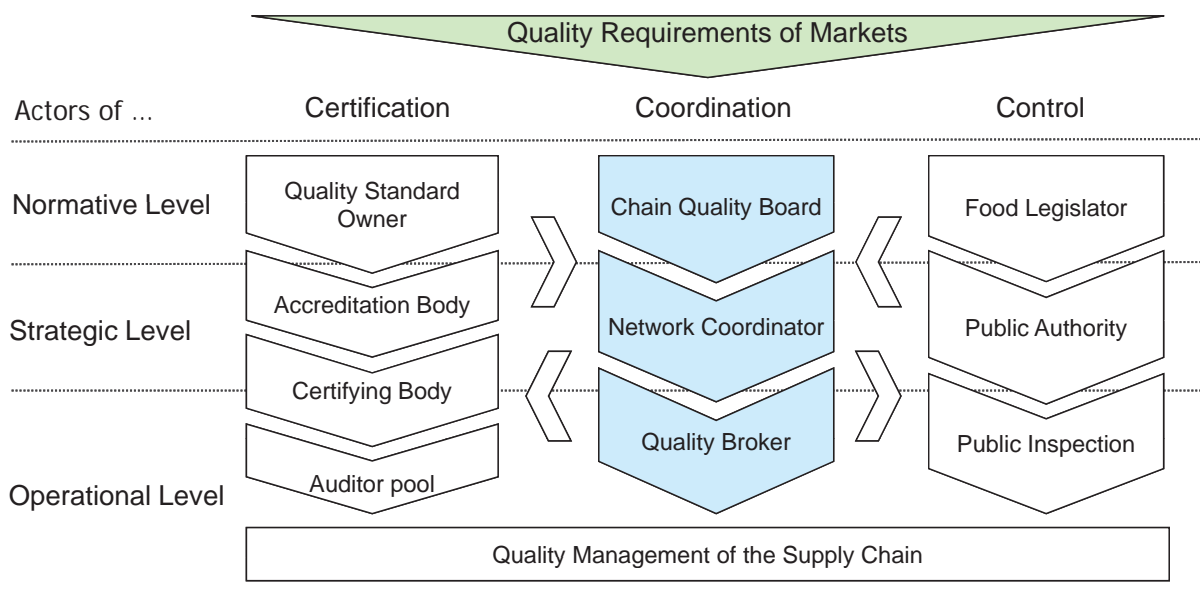
EU-27 Population: 251 mill. pigs



World Population: 1006 mill. pigs (52% in China)



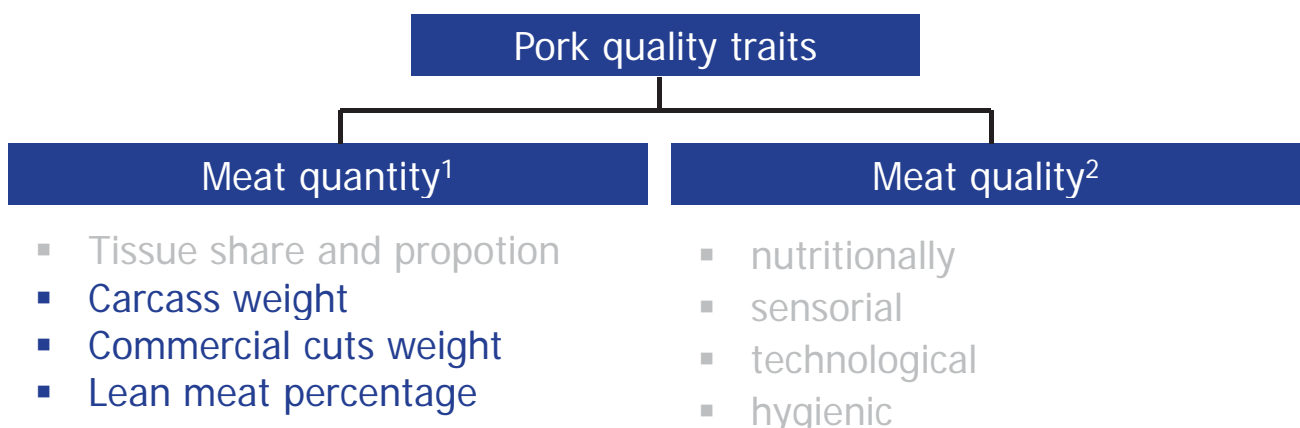
Coordination model for QM-strategies of pork supply chains



Six Sigma in food production to improve ‚bio-processes‘

13

Technical background Pork quality traits



¹including offals (which are part of carcass weight)

²iby extension (incl. quality of muscle, fat and conjunctive tissue)

Fully automatic

AUTO-FOM System



- Ultrasound
- Measurement of i.a.:
 - Lean meat percentage
 - Weight of commercial cuts

Semiautomatic (manual)

Fat-O-Meater System



- optical method (reflection)
- Measurement of:
 - Backfat and loin muscle diameter in mm
 - Lean meat percentage

15

Six Sigma study

of a pork supply chain

Initial situation:

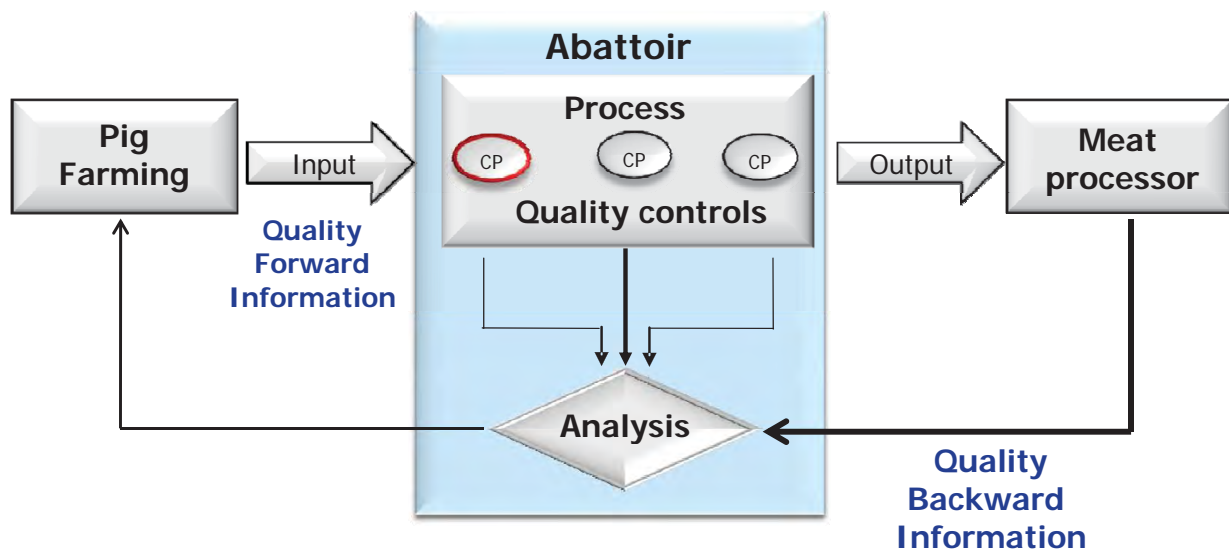
- A meat processor (customer), owned by a large German retailer (turnover 2010: 38 bill.€) is coordinating a pork supply chain
- 391 farms (supplier) delivered 292.105 pigs via an abattoir
- Quality requirements of meat processor are transferred via payment systems of the abattoir to the farmers

Goals of the study:

- to adopt the approach of Six Sigma to food production
- to assess the Process Sigma
- to discover weak points in the value chain

16

Define



Legend:

- Product flow
- Information flow
- CP=Control point

Define

Supplier = Finishing farms via abattoir
 Customer = Meat processor

Using the CTQ-Matrix tool (Critical to Quality)

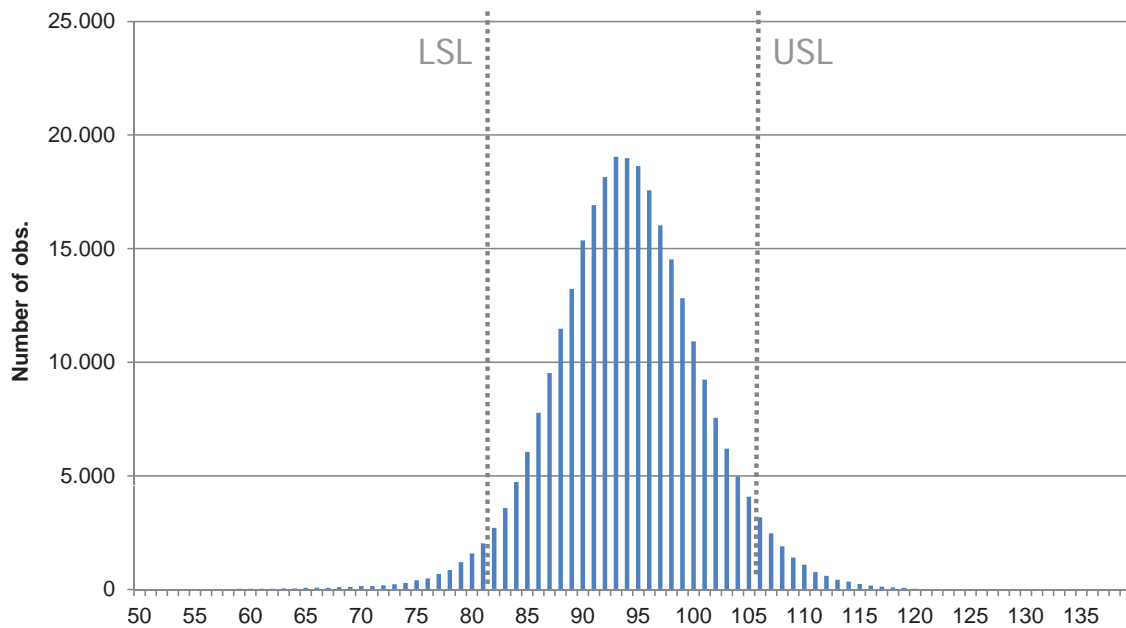
- VoC: Pork should fulfill specific quality requirements in the field of meat quantity (1) and meat-fat-ratio (2)
- Core topic: Improvement of the product conformity
- CTQ: 60% percent conformity of delivered products

Specifications of selected pork quality traits

Quality trait	Unit	LSL	Average	USL
Carcass weight	kg	82	93,5	105
Lean meat percentage	%	52	55,5	60

(L/USL=lower/upper specification limit)

Measure



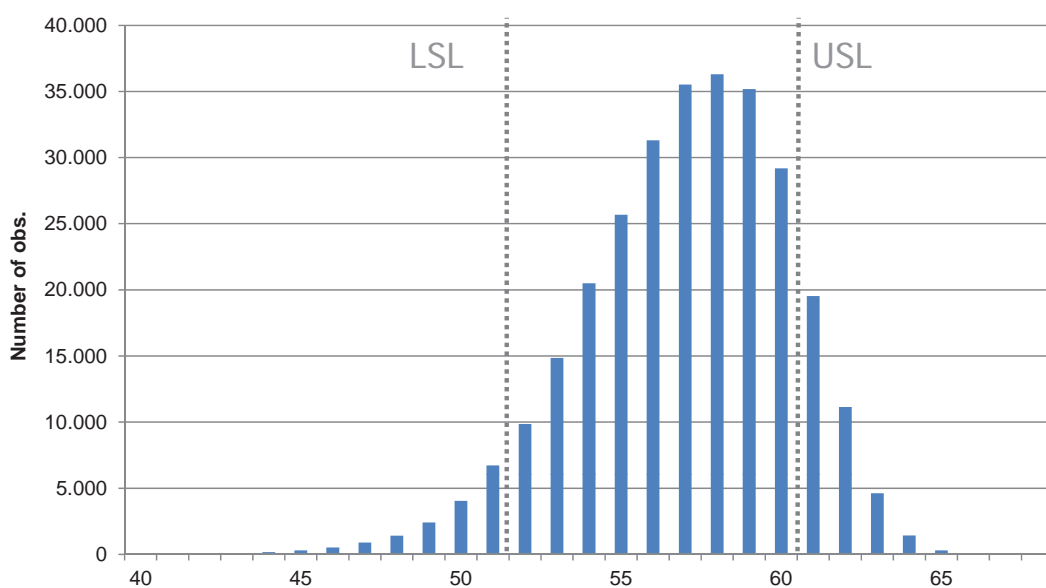
Descriptive statistics

Carcass weight (kg)

Quality trait	Unit	x	s	CV (%)	min	max	r
Carcass weight	kg	94,4	6,8	7,2	50,0	141,8	91,8

19

Measure



Descriptive statistics

Lean meat percentage (kg)

Quality trait	Unit	x	s	CV(%)	min	max	r
Lean meat percentage	kg	57,4	3,2	5,6	37,3	68,2	30,9

20

Analyse

Defects matrix (n=292.105 products)

		Lean meat percentage		
		OK	<52%	>60%
Carcass weight	OK	140.414	37.083	89.390
	<82 kg	4.511	901	3.597
	>106 kg	8.429	3.375	4.405
Total defects			151.691	

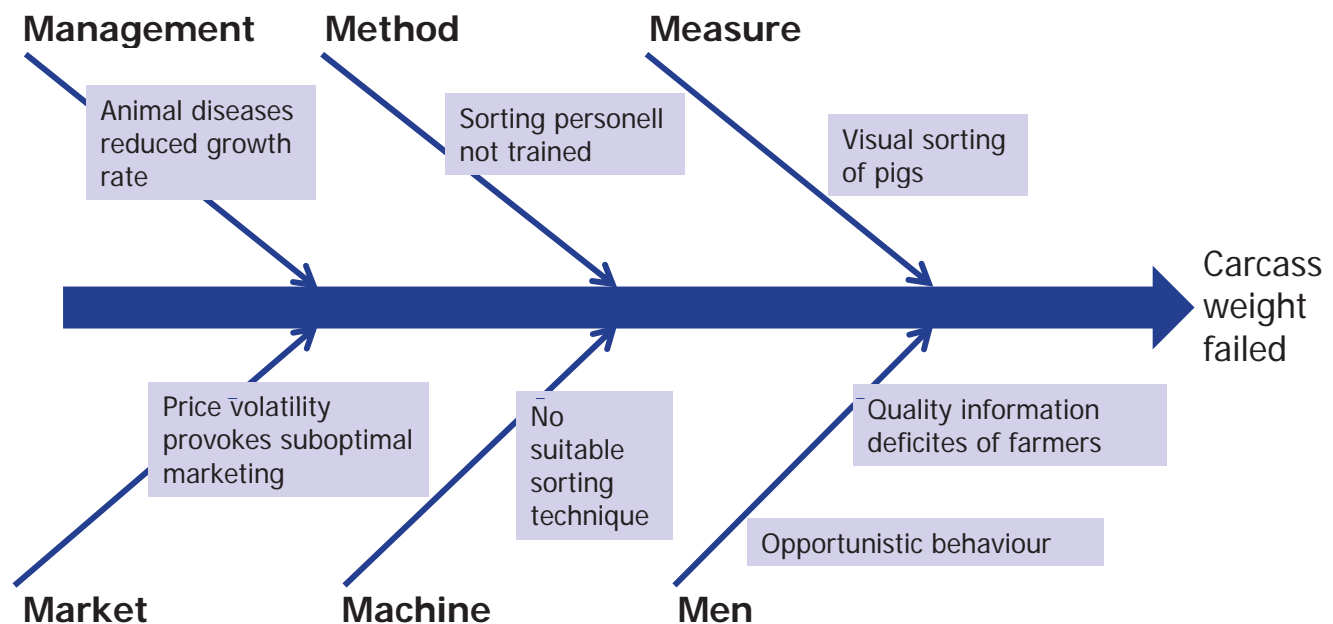
CTQ (60%) = 48%

DPMO = 259.651

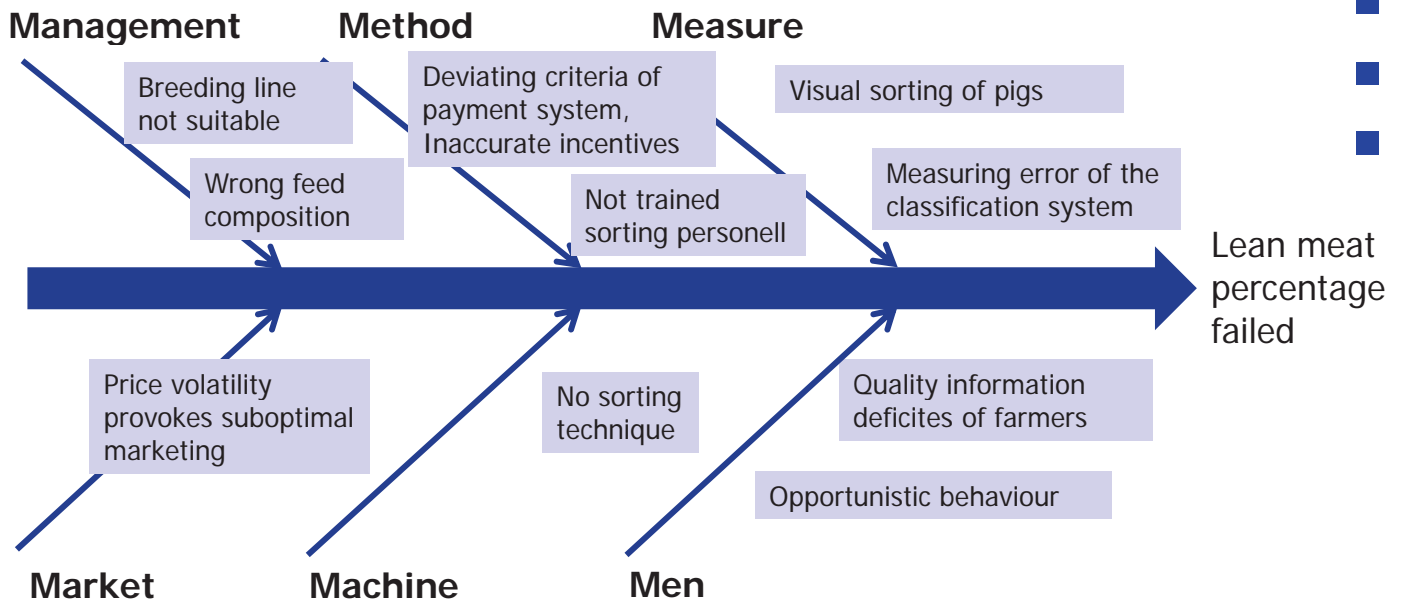
Process Sigma = 2,2 (short term) and 0,7 (long term)

Weak points Ishikawa-Diagramm („6M“)

Analyse



Weak points Ishikawa-Diagramm („6M“)



23

Summary and Outlook

- Quality traits were identified that are suitable for applying Six Sigma
- Process Sigma (2,2) reveals optimization potential
- Several weak points were identified in the value chain:
 - Inaccurate incentives of the abattoirs pricing system for the quality trait lean meat percentage
 - Incorrect sorting of pigs before marketing
 - Animal diseases

Outlook: the Six Sigma concept shall be extended to further quality traits of the chain

24



Thank you!



www.itw.uni-bonn.de



Acknowledgement

The authors gratefully acknowledge from the European Community financial participation under the Sixth Framework Programme for Research, Technological Development and Demonstration Activities, for the Integrated Project **Q-PORKCHAINS** FOOD-CT-2007- 036245.

Disclaimer

The views expressed in this publication are the sole responsibility of the author(s) and do not necessarily reflect the views of the European Commission. Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use, which might be made of the information. The information in this document is provided as is and no guarantee or warranty is given that the information is fit for any particular purpose. The user thereof uses the information at its sole risk and liability.