

SKF®



SKF Six Sigma

Development of Standards for Six Sigma

Presented to NEN TC 69 Committee

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Agenda

- SKF AB
- Six Sigma in SKF
- Design for Six Sigma
- Technical Committee 69
- Benefits

SKF – a truly global company

- Established 1907
- Sales 2014 SEK 70,975 million
- Employees 48,593
- Production sites around 165 in 29 countries
- SKF presence in over 130 countries
- Distributors/dealers 15,000 locations
- Global certificates ISO 14001
OHSAS 18001 certification
ISO 50001





SKF Group vision



**To equip the world
with SKF knowledge**

– from the customer's perspective



Industry specialist and partner to many industries

General industry

- Industrial gearboxes
- Fluid power
- Material handling
- Industrial Electrical

Heavy industry

- Metal-working
- Mining
- Pulp & Paper

Energy

- Renewable
- Traditional

Commercial transport

- Aerospace
- Railways
- Off-highway

Special industrial machinery

- Food & Beverage
- Machine tools
- Marine
- Healthcare
- Medical
- Printing
- Textile

Automotive

- Cars and light trucks
- Trucks, trailers and buses
- Two wheelers
- Vehicle aftermarket
- Home appliances & Portable power tools



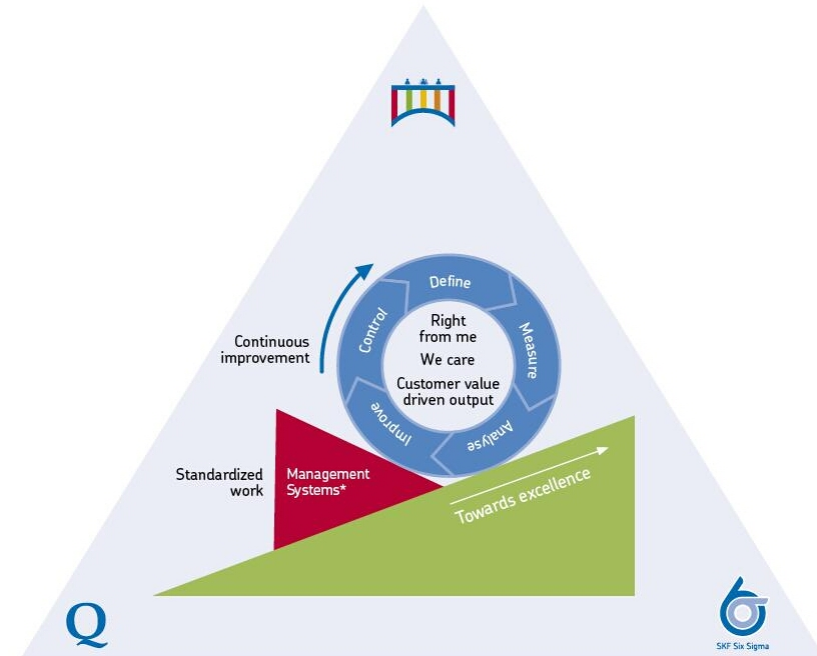
Everyone, everywhere, every day

At SKF we are committed to delivering value to our customers. This means we must continuously innovate and develop value in our products, services and solutions and improve our processes.

The triangle shows the cornerstones, which are interacting and contributing to achieve **World Class**:

- Business Excellence
- Quality
- Six Sigma

Business Excellence
Values, drivers, behaviour, principles, which guide us along the value chain



* Including Quality Management System and Environmental, Health & Safety System.

Quality
Business processes:
“What to do to sustain quality?”

Six Sigma
Process methods and tools:
“How to do to improve / sustain quality?”

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Six Sigma in SKF

Vision

SKF Six Sigma



SKF Six Sigma

Equip SKF employees with the
Six Sigma knowledge to
enable the achievement of
World Class

Mission

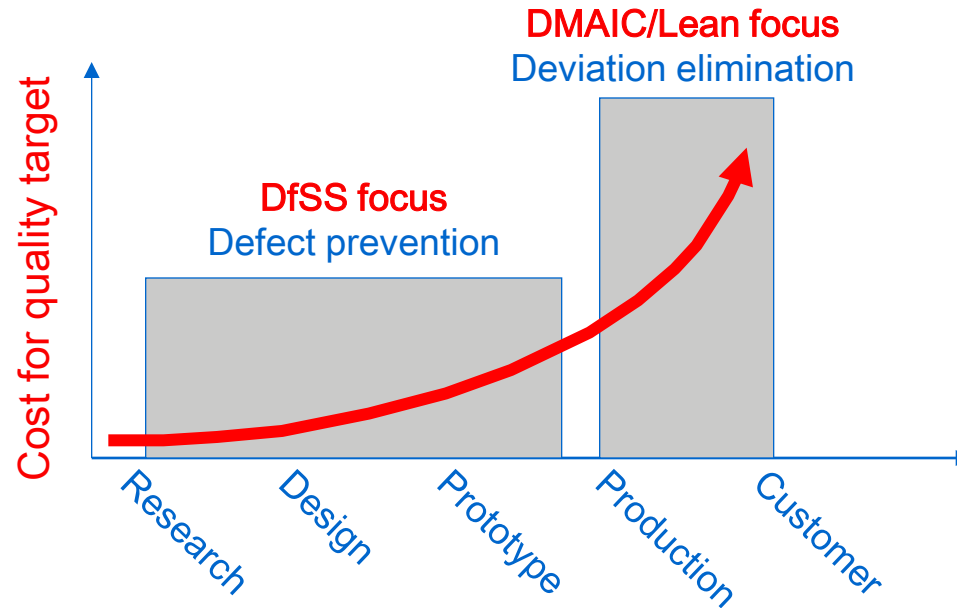
SKF Six Sigma



SKF Six Sigma

- Deploy Six Sigma with the aim of **making business with SKF easier**, attractive, reliable and faster
- Embed **risk management** and mitigation in our business decision process
- **Increase quality** and shorten time for business decisions
- Secure customer and SKF product performance through **reliable and robust** product and process design
- Create **lean, flexible and efficient** processes in the "extended enterprise"
- Provide breakthrough and **fact based** solutions and business performance improvements
- Contribute to create a culture of strategic **continuous improvement** to achieve excellence

DfSS and DMAIC – summary



DfSS – Predict to prevent

- Anticipating the Voice of Customer
- Designing robust and reliable products and processes
- Making systems insensitive to variations

DMAIC/Lean – React to correct

- Structured approach for problem solving
- Minimising output variability
- Eliminating complex deviations and reducing waste

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International Statistical Standards

ISO Technical Committee TC 69

"Application of Statistical Methods"

The scope of TC69 is:

- standardisation in the application of statistical methods, including generation, collection (planning and design), analysis, presentation and interpretation of data

Six active subcommittees

Presently, there are six active subcommittees within ISO TC 69, as follows:

Subcommittee	Topic
TC 69/SC 1	Terminology and symbols
TC 69/SC 4	Applications of statistical methods in product and process management
TC 69/SC 5	Acceptance sampling
TC 69/SC 6	Measurement methods and results
TC 69/SC 7	Applications of statistical and related techniques for the implementation of Six Sigma
TC 69/SC 8	Application of statistical and related methodology for new technology and product development

SC 4

- Statistical process control
 - Control charts
 - Process capability

SC 6

- Measurement systems analysis
 - Measurement methods/results
 - Metrology
 - Measurement systems
 - ISO/TR: Gauge r&R

SC 5

- Acceptance sampling

SC 7

- Six Sigma/DfSS
 - Design of experiments
 - ISO/TR: Full factorial experiments with four factors
 - ISO/TR: Fractional factorial screening experiments
 - ISO/TR: RSM -- Central composite design

Documents whose number starts with ISO/TR are "**technical reports**" which have useful information in the form of best practice but do not prescribe statistical methodology.

ISO/TC 69/SC 7 – Applications of statistical and related techniques for the implementation of Six Sigma

Working group 3:

- Statistical and probabilistic methods in the development of products, processes and services — Design for Six Sigma (ISO/WD 20575):
 1. DfSS Framework
 11. DfSS under specific consideration of Agile Development
 12. Specific Considerations of DfSS for service
 2. DfSS Method Overview and Information Flow
 21. Typical Graphics and Information representation in DfSS
 22. DfSS Score Cards
 23. Statistical Tolerancing

ISO/TC 69/SC4

- WG 10:
Revision of control charts standards
- WG 11:
Process capability and performance
- WG 12:
Implementation of statistical process control

ISO/TC 69/SC5

- WG 2:
Sampling procedures for inspection by attributes
- WG 3:
Sampling procedures for inspection by variables or percent nonconforming
- WG 8:
Sampling by attributes

Working groups

Technical Committee 69 (TC 69)

ISO/TC 69/SC6

- WG 1:
Accuracy of measurement methods and results
- WG 5:
Capability of detection
- WG 7:
Statistical methods to support measurement uncertainty evaluation
- WG 9:
Statistical methods for use in proficiency testing

ISO/TC 69/SC7

- WG 1:
Design of experiments
- WG 2:
Process measurement and measurement capability
- WG 3:
Six Sigma methodology
- AHG 1:
Strategic planning and working practice

Working groups

Technical Committee 69 (TC 69)

ISO/TC 69/SC8

- WG 1:
Sample survey
- WG 2:
Transformation
- WG 3:
Optimisation

ISO/TC 69/SC1

- WG 2:
Revisions of ISO 3534
- WG 5:
Terminology liaison
- WG 6:
Terminology for emerging
areas of statistical applications

Ad Hoc Group (AHG 7)

- Applications of Statistical Methods (Ad Hoc Group on Big Data)
 - Adopted the CRISP-DM methodology
(Cross Industry Standard Process for Data Mining, a European Union project led by 5 companies like SPSS, Teradata, NCR, etc.)

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Member of Technical Advisory Group

Member contribution

TC 69 / SC / WG

Standardisation process:

- Proposal stage NWIP – New Work Item Proposal
- Consult in Working Group WD – Working Draft
- Committee stage CD – Committee Draft
- Enquiry stage DIS – Draft International Standard
- Approval stage FDIS – Final Draft International Standard

Participate in a specific Working Group (WG):

- Contribute to develop a new standard or review an existing standard

Participate in a specific Subcommittee (SC):

- Contribute as proof-reader

Annual TC 69 meetings

Year	Location
2004	Stockholm, Sweden
2005	Paris, France
2006	Sun City, South Africa
2007	Helsingor, Denmark
2008	Beijing, China
2009	Kuala Lumpur, Malaysia
2010	Paris, France
2011	Berlin, Germany
2012	Tokyo, Japan
2013	Milwaukee, USA
2014	Vienna, Austria
2015	Dalian, China
2016	London, UK

June 6-10, 2016

Quality Techniques:

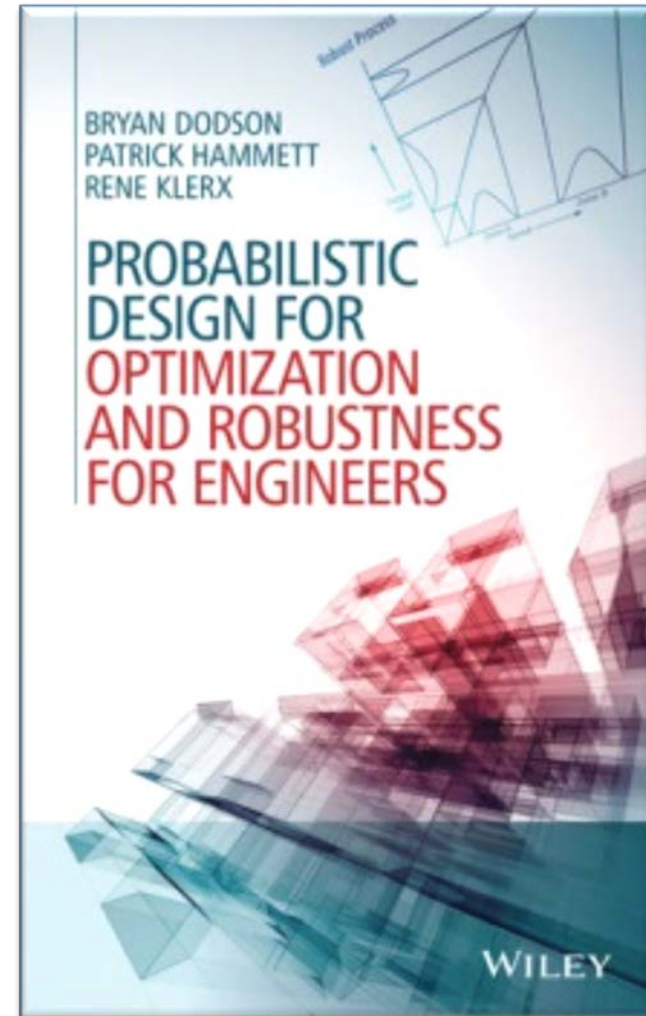
- **QT 1 – Process capability studies**
- QT 2 – Statistical process control
- **QT 4 – Failure mode and effects analysis**
- **QT 5 – Measurement systems analysis**
- QT 6 – Measurement uncertainty budgeting
- **QT 9 – Design and analysis of experiments**
- **QT 20 – Systematic innovation event**
- QT 22 – Robust design
- QT 24 – Test strategies and risk analysis (reliability)

Probabilistic Design for Optimization and Robustness for Engineers

Description

- Presents the theory of modeling with variation using physical models and methods for practical applications on designs more insensitive to variation.
- Provides a comprehensive guide to optimization and robustness for probabilistic design.
- Features examples, case studies and exercises throughout.

The methods presented can be applied to a wide range of disciplines such as mechanics, electrics, chemistry, aerospace, industry and engineering. This text is supported by an accompanying website featuring videos, interactive animations to aid the readers understanding.



The book is available via Wiley, see:
<http://eu.wiley.com/WileyCDA/WileyTitle/productCd-1118796195.html>