

5-day Robust Design Engineering Course

Course Description

High manufacturing costs, rework, early failures in the field and high warranty costs are often symptomatic of a sensitive design. Discovering a sensitive design in manufacture or in the hands of the customer is not good for business as options of tightening specifications, redesign or even “living with it” are all extremely expensive. Robust Engineering provides a complete methodology that can be used in the design of systems to ensure that they perform consistently in the hands of the customer. It comprises a process and tool kit that allows the designer to assess the impact of variation that the system is likely to experience in use, and if necessary, modify the design the system if it is found to be sensitive.

This 5-day Robust Engineering course is a natural follow-on from the Systems Engineering Fundamentals Course. It aims to both educate and train participants in the concepts, principles and practice of Robust Engineering. The Course will cover the theoretical basis of Robust Design established by Dr Genichi Taguchi through the concept of the *loss function* and his parameter and tolerance design approach. It will also present a pragmatic proven process for undertaking Robust Engineering together with the tools necessary to complete the steps .

Course Numbers and Who Should Attend?

The 5-day Robust Design Engineering can be delivered to up to 20 participants. The course is suitable for all personnel involved in the detailed design and optimisation of any complex system.

Benefits to the Individual and Business

During an intensive five days of teaching and practical ‘hands on’ exercises, participants will be challenged to develop the skills and mindset that can be applied to ensure a conceptual design is robust against likely sources of variation.

At the end of the course participants will:

- Have an understanding the principles of Robust Design and how it applies to the creation of a new system through the appropriate blend of people, process and tools.
- Understand the importance of Taguchi’s “loss function” and recognise where it can be applied practically.
- Be able to identify and prioritise system parameters that contribute to system sensitivity.
- Be able to perform qualitative and quantitative sensitivity assessments.
- Be able to undertake parameter and tolerance design.
- Be able to use Design of Experiments to search a system design solution space.
- Be able to specify statistical tolerances.
- Know how Robust Engineering contributes to verification and validation evidence.
- Be able to consider the impact on future business of adopting Robust Design.

Learning Approach

This course can be delivered remotely online or face-to-face on the client's site or preferred venue. The learning approach is based on the Kolb learning cycle with a significant proportion of the course set aside for exercises to reinforce the learning. Indeed, many of the small group exercises involve a case study that provides a practical focus for the course and enables the delegates to practise the methodology and tools presented. We offer a number of case studies that can be selected to reflect the client's organization.

Course Content

The block diagram below presents the high-level agenda for the 5-day course. The course follows the detailed design of a conceptual solution to a user need, introducing the Systems (Robust) Engineering processes and tool set. The focus of the course is on **doing** the Engineering. More detail on the content can be provided on request.

Course Agenda

Day 1	Day 2	Day 3	Day 4	Day 5
<ul style="list-style-type: none"> • Introductions, Aims and Agenda • Systems Engineering Reminder • The Concepts and Principles of Robust Design • Understanding Variation 	<ul style="list-style-type: none"> • Day 1 Review • Qualitative Robustness Assessment to Identify Key Parameters and Noise Using: <ul style="list-style-type: none"> ◦ The P-Diagram ◦ Design 2 Noise Matrix 	<ul style="list-style-type: none"> • Day 2 Review • Characterising the Design Space using the Design of Experiments • How to Design, Conduct and Analyse Designed Experiments 	<ul style="list-style-type: none"> • Day 3 Review • Non Linear Responses and Response Surface Methods • Handling Noise in Design of Experiments 	<ul style="list-style-type: none"> • Day 4 Review • Concepts and Principles of Monte Carlo Simulation • Surrogate Modelling • Simple Parameter Design
<ul style="list-style-type: none"> • Data and Collecting Data • Measurement Systems Analysis • Concepts and Principles of Hypothesis Testing 	<ul style="list-style-type: none"> • Qualitative Robustness Assessment Using: <ul style="list-style-type: none"> ◦ Design Failure Mode and Effects Analysis • Measuring Robustness Through Quantitative Metrics 	<ul style="list-style-type: none"> • Full and Fractional Factorial Design of Experiments • Screening Designs 	<ul style="list-style-type: none"> • Design of Experiments Consolidation Exercise: <ul style="list-style-type: none"> ◦ Screening Design ◦ Full Factorial Design ◦ Response Surface Design 	<ul style="list-style-type: none"> • Simple Parameter Design Exercise • Summary, Review and Close

Course Delivery and Costs

The 5-day Robust Engineering Course is very intensive and is delivered by two tutor-consultants.

The cost of delivering the 5-day course, excluding delivery tutor-consultant accommodation and expenses, but including all courseware, is **£16,200**. VAT will apply at the prevailing rate.

The course can be tailored to suit individual client's engineering lifecycle and review processes.



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