

# Practical Approaches to Statistical Design of Experiments (DoE) for Chemical Process Research & Development and Manufacturing

23-24 MAY 2017



**Boston, USA**  
Boston Metro  
Meeting Center

A 2 day course presented by  
**Dr Andrei Zlota -**  
**The ZLOTA Company LLC**  
In conjunction with Scientific Update

"Course provided a broad  
selection of examples of DoE,  
and context of DoE choices  
that will make it easier for  
me to apply in my own work  
experiences."

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# Practical Approaches to Statistical Design of Experiments (DoE) for Chemical Process Research & Development and Manufacturing

A 2 day course given by Dr Andrei Zlota,  
The ZLOTA Company LLC

23-24 May 2017 Boston Metro Meeting Center, USA

Multiple attendees discounts  
**UP TO 15%** available

## INTRODUCTION

**The synergy between fundamental science and statistical design of experiments (DoE) has been demonstrated to create more significant process understanding than that achieved by the same number of one-variable-at-a-time (OVAT) experiments.**

This course takes a balanced approach presenting basic DoE theory as well as numerous examples of DoE use in the pharmaceutical industry. The course will discuss statistical and practical significance, assumptions and limitations of DoE methodology, together with practical approaches for the process scientist to be in control of the DoE investigation (and not the computer).

Precedent and experience compel many chemists to use OVAT experimentation in spite of its incomplete nature, and in spite of its inability to detect factor interactions, e.g., cases when the impact of one factor depends on the level of another factor. When such interactions occur between scale dependent and scale independent factors, ignoring such factor interactions can lead to high risk process scale-up and technology transfer.

Participants will learn how to design effective screening experiments, how to use response surface methods for reaction and analytical method development, how to design robust processes, and how to quantify the risk associated with the implementation of the processes developed. Several commercial DoE software platforms will be reviewed.

For the benefit of process scientists, engineers, formulators\*, analytical chemists and manufacturing personnel, this course includes highly interactive, hands-on workshops.

## COURSE OUTLINE

### Introduction

- > Why DoE?
- > Statistics for chemical process R&D: friend not foe
- > Synergy between statistical, kinetic and engineering models
- > Univariate experimentation limitations
- > Design of experiments (DoE), a multivariate method to investigate multivariate processes

### Statistical Design of Experiments (DoE)

- > Requirements for a successful DoE
- > Responses
- > Scale independent and scale dependent factors
- > Meaningful use of categorical factors
- > Factor ranking; factors to be fixed, factors to be varied
- > Ranges, number of levels
- > Randomization, replication, centerpoints, blocking

### Screening the Experimental Space

- > DoE commercial software platforms
- > Full factorial designs
- > Fractional factorial designs: advantages and challenges
- > Plackett-Burman designs
- > Design efficiency, design resolution, statistical power of a design
- > Chemical reaction, and workup: together or separate?
- > Design augmentation; practical strategies for cost-effective screening
- > Using DoE to set raw material specifications

### Analyzing DoE

#### screening investigations

- > Objectives
- > Key statistical concepts
- > The value of redundancy, the power of visualization tools
- > Practical vs. Statistical significance
- > Case studies: chemical reactions, API crystallizations

#### Response Surface Methodology (RSM)

- > Types of "optimization"
- > RSM design options
- > Analysis of RSM designs, model manipulation
- > Model verification experiments
- > Case studies: chemical reactions, API crystallizations

#### DoE and Quality by Design (QbD)

- > The concept of design space; risk calculations using the DoE model
- > Critical Quality Attributes and Critical Process Parameters
- > DoE for process robustness assessment, and for process validation; process capability indices

#### "Advanced Topics" (time permitting)

- > DoE and Principal Component Analysis (PCA)
- > DoE for process troubleshooting
- > DoE investigating scale-dependent and scale-independent factors
- > Mixture designs

**A DoE course dedicated to drug product development is also available; if interested, please inquire.**

## VENUE

The Metro Meeting Centers  
101 Federal Street, 4th Floor  
Boston  
MA 02110  
USA  
(617) 737 1200

[www.metromeetingcenters.com](http://www.metromeetingcenters.com)

## TRANSPORT

Metro Meeting Centers is 10 minutes from Boston's Logan International Airport and within a short distance to public transportation.

A list of nearby hotels will be sent to you when you register.

## Course Fee: \$1,850

## COURSE TUTOR

**Dr Andrei Zlota**  
The ZLOTA Company  
LLC



Andrei obtained an M.Sc. in Chemical Engineering from the Bucharest Polytechnic Institute (Organic Chemical Technology, 1980). After working in the industry for several years, he obtained an M.Sc. in Chemistry from the Technion (Organic Chemistry, 1986).

Subsequently he obtained a Ph.D. in Chemistry from the Weizmann Institute of Science (Organometallic Chemistry, 1991). He has been a regular contributor to the Organic Process R&D Journal (OPRD) Highlights from the Literature section since 2003, and he also participates in the review of papers submitted for publication in OPRD. In 2006 Andrei founded his

consulting firm, The Zlota Co., LLC, specializing in Quality by Design (QbD) implementation, including practical statistical design of experiments, accelerated process scale-up, and meaningful Process Analytical Technology practice.

Andrei provided QbD training to more than 1500 scientists from 180 companies in the US, Europe and Asia. Thirty five companies obtained, and continue to obtain project support from The Zlota Co. with their successful implementation of various elements of QbD methodology.

Note: A full version of Andrei's biographical note is available on our website.

### Upon completion of the course participants will be able to:

- > Meaningfully include numerical continuous, numerical discreet, and categorical variables in DoE matrixes
- > Know when to separate and when to combine scale dependent and scale-independent parameters in a DoE investigation
- > Design effective DoE screening matrixes, suitable for the objectives at stake
- > Design robust processes, capable of tolerating variability in raw materials and process parameters
- > Quantify process risk
- > Use the DoE generated process understanding for Quality by Design (QbD) implementation

## REGISTRATION

You can either use our fast online booking system or mail or fax the attached registration form to:

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