MUNICH 2020
DISCOVERY SUMMIT

JMP Pro: A valuable partner on the journey from laboratory to production

Simon Stelzig
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Abstract

- Development of the world's first UV initiated structural adhesive tape with a color change
- First products ready for sale with low no. of runs:
  - 40 run D-optimal mixture design with a necessary design augmentation
  - 15 not processible runs
  - several predicted optima's- accounting for variation in customer requirements
- Enhanced customer requirements resulted in a novel 36 run I-optimal (incl. 16 run augmentation)

Introduction

- Find optimal recipes for different applications including process steps formulation, coating and die cutting with minimal effort
- 7 mixture component, 1 continuous and 1 categorical factor problem
- 28 responses

Methods

1. Initial 40 run D-optimal custom mixture design with 7 factors and 11 responses
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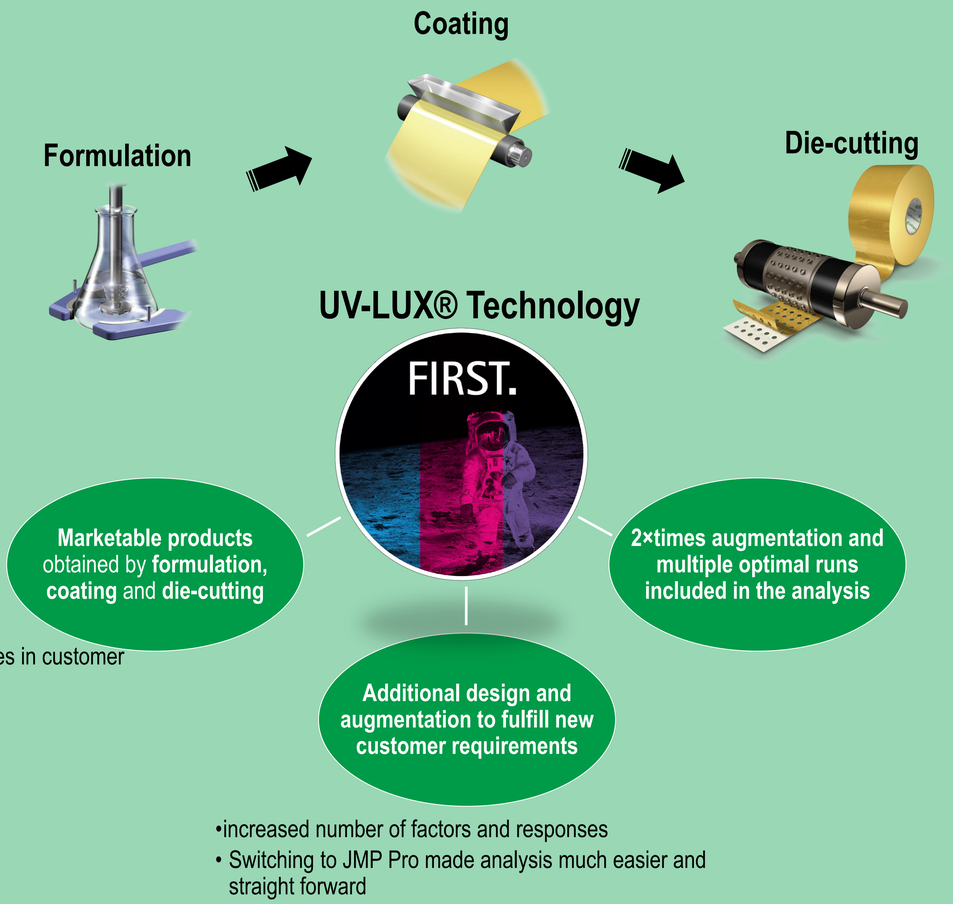
ABSTRACT



- multiple changes in customer requirements

- increased number of factors and responses
- Switching to JMP Pro made analysis much easier and straight forward

Today:

- Model selection based on autovalidation and Generalized Regression (Ramsey and Gotwalt)
- Increasing number of runs and consecutive remodeling allows fast prediction of processible solutions for customer requests

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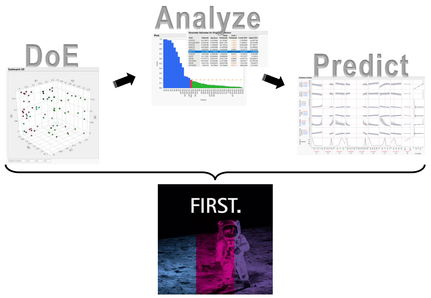
Figures & Graphs



Results

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- Valid model obtained by autovalidation and GenReg based on DoE's and predicted runs
- Model allowed prediction of products being commercialized

Conclusions

- Selection and creation of valid models is much easier using JMP Pro and GenReg/autovalidation
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INTRODUCTION

Initially 2 different applications

DoE

Predict optimal formulations

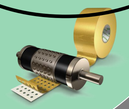
Create valid model

Final product will have at least 3 process steps

Formulation
7-9 components

Coating
Response to account for coatability

Die-cutting
Response to account for die-cuttability



Find optimal formulations
for initial applications

Enhance experiments to cover future applications

Analyze DoE's

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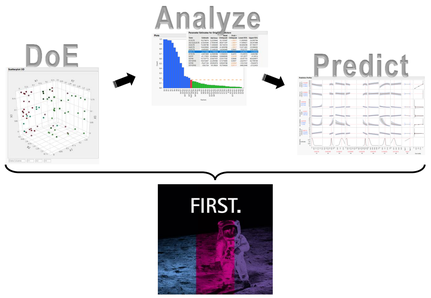

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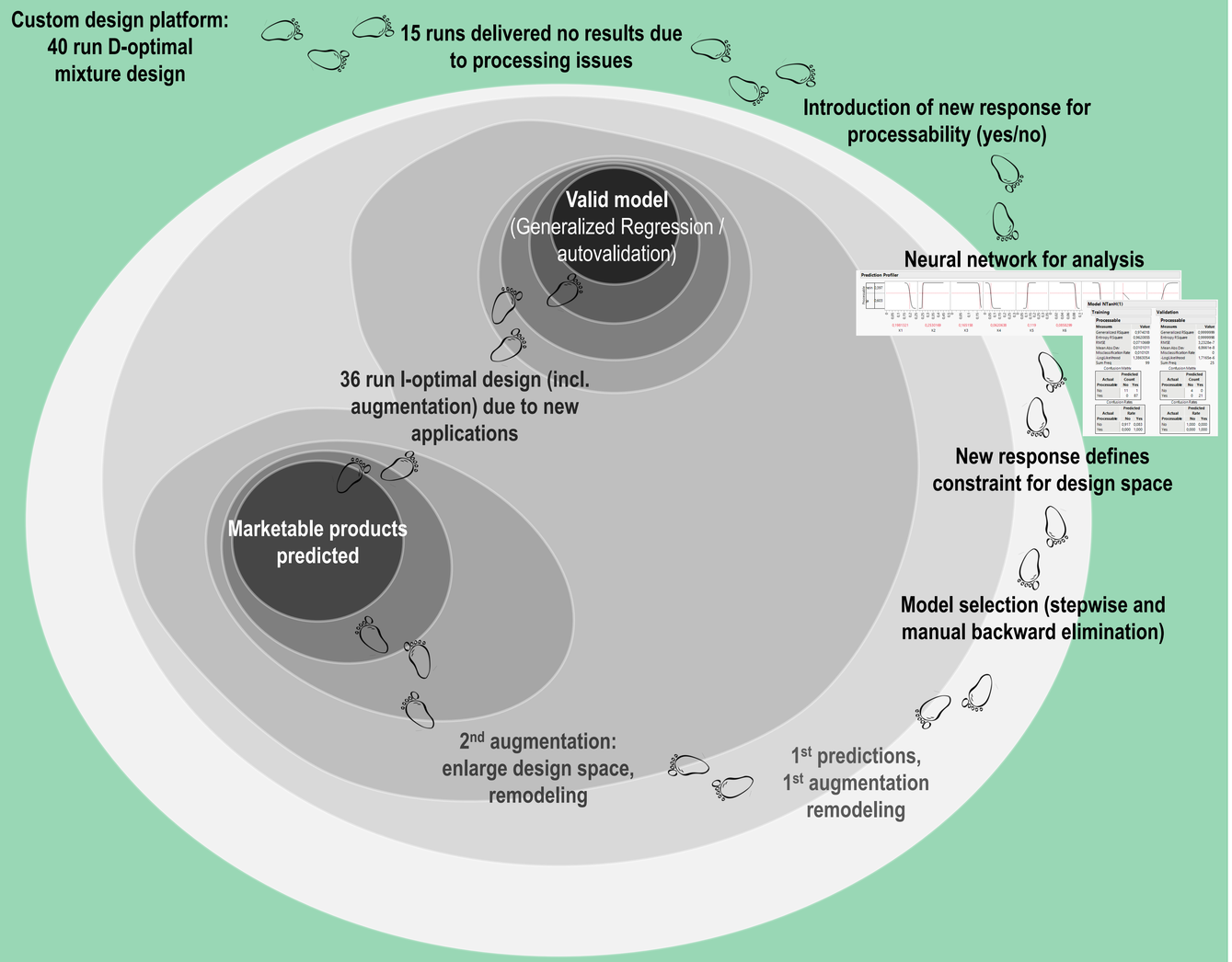

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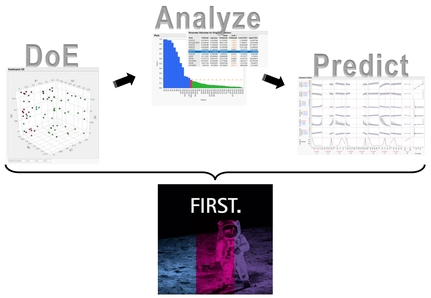

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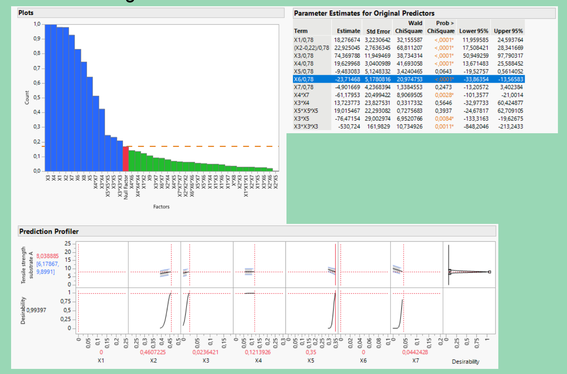
RESULTS

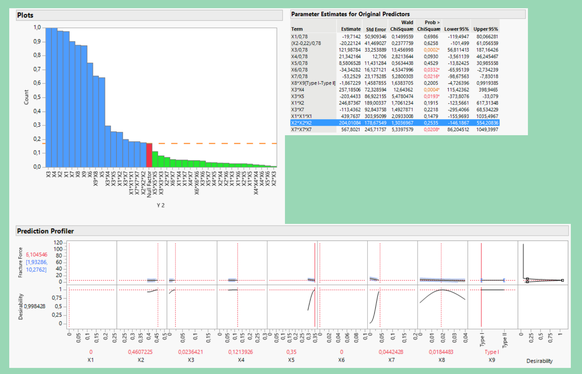
Analysis / Model selection

- Analysis for each response using autovalidation and (Pruned) Forward Selection in Generalized Regression

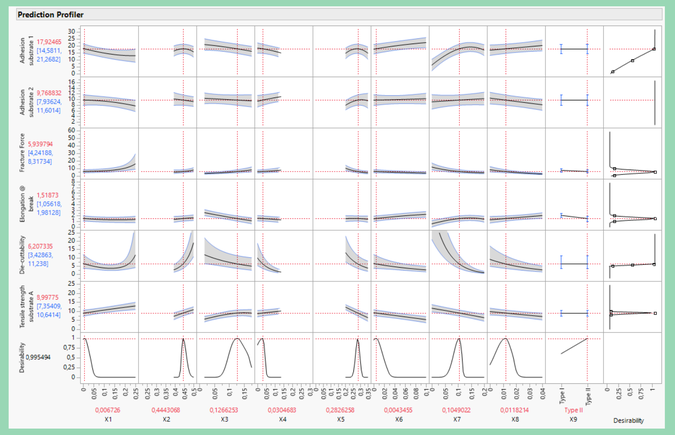
Tensile strength:



Fracture Force:



Profiler (final model) for selected responses



Final recipe for 1st application

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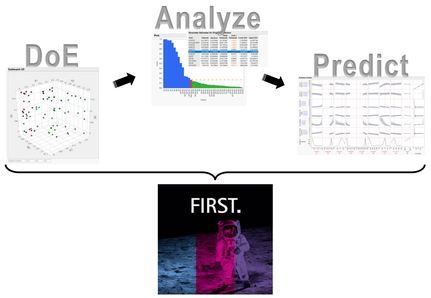

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CONCLUSIONS

Development of marketable products:

- **Custom design platform to create mixture DoE with numerous constraints**
- **Augmentation based on functional constraint (model for one response)**
- **Model selection with JMP is difficult and error-prone**
- **JMP Pro's generalized regression platform in combination with autovalidation to select valid model is more reliable and easier**
- **Model reevaluation after experimental verification of predicted formulations / augmentation resulted in precise and valid model**
- **Prediction of optimal formulation for application in the vicinity of the formulation possible with JMP's Optimization platform**
- **Valid model and prediction enables fast customer response**

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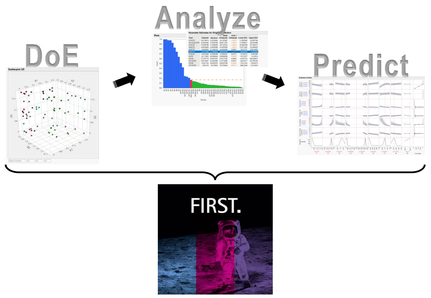

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