

Success is the Art of Perfection

The Strategic Research Agenda for the Forest-Based Sector

Admont, May 2nd-3rd, 2006

Herfried Lammer

**Competence Centre for Wood Composites and
Wood Chemistry**



Competence Centre Wood Kplus: Responsibilities

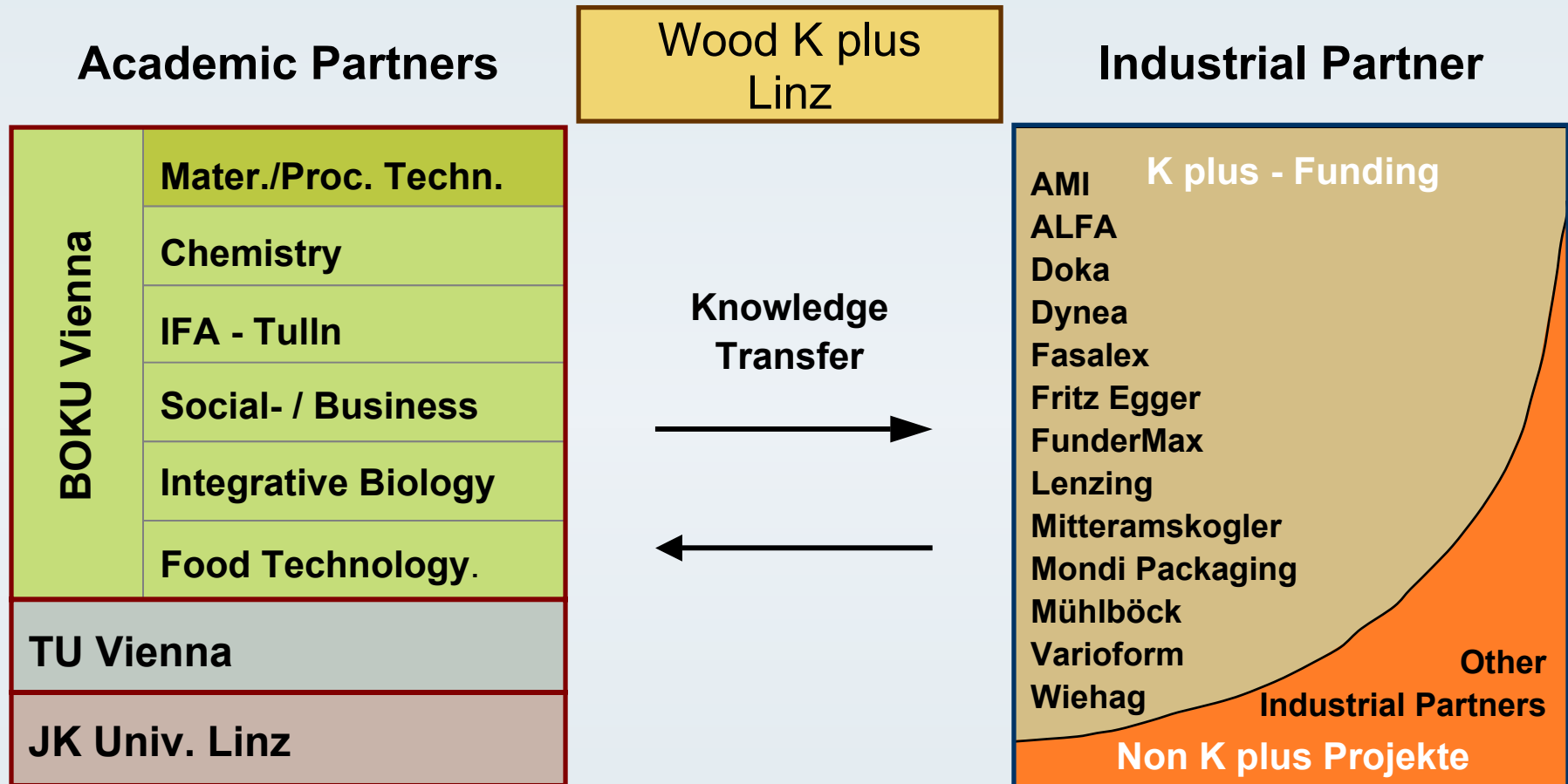


Motto:

Increase the competitiveness of our industrial partners !

- **Industrial and Scientific Partners in the field of „Wood Composites and Chemistry“**
- **Solutions for complex problems in production, development and quality**
- **Developing new and innovatives products**
- **Consulting in research and development**
- **International Network of specialists**
- **Development and Optimization of technical processes and methods**
- **Feasibility Studies**
- **Analytical Support**
- **Market Studies**
- **Long-Term and short-term technological projects**

Competence Centre Wood Kplus: Partner Firms



Long-term, strategic Cooperation

Basic Research → Pre-competitive Research → Industrial Development

Competence Centre Wood Kplus: Some Facts



Budget for 3 years (2005-2007):

12,6 Mio. EURO (without additional „Non K Plus“ projects)

Financing:

40% Partner Cooperations

35% Austrian Government (Kplus - Programm),

20% Regional Government

5% Universities

Employees:

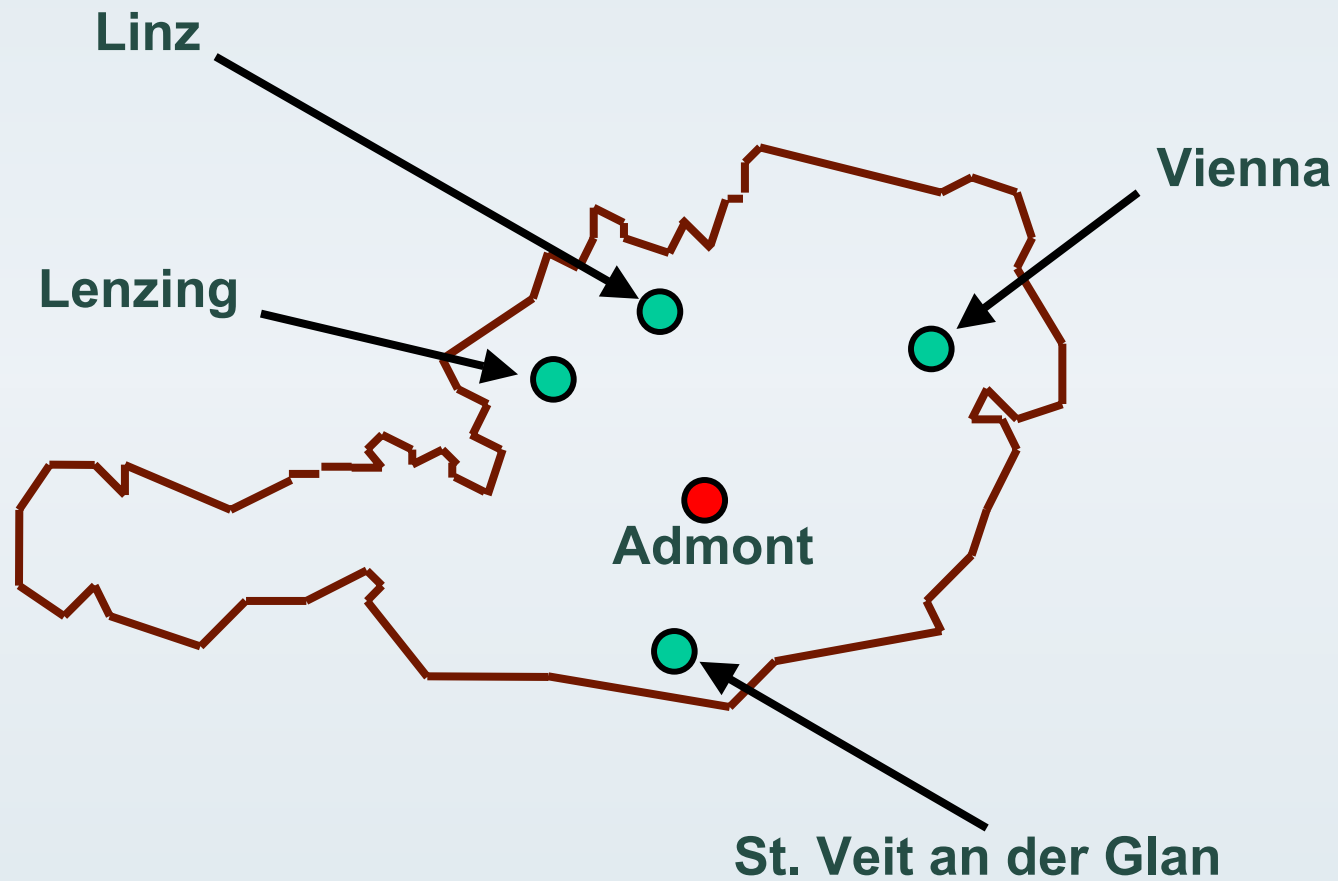
- ca. 50 direct Employees (ca. 40 % female)

- ca. 30 indirect Collaborators (associated scientists and technicians)

Project Funding:

- 3 (+4) years

Competence Centre Wood Kplus: Locations



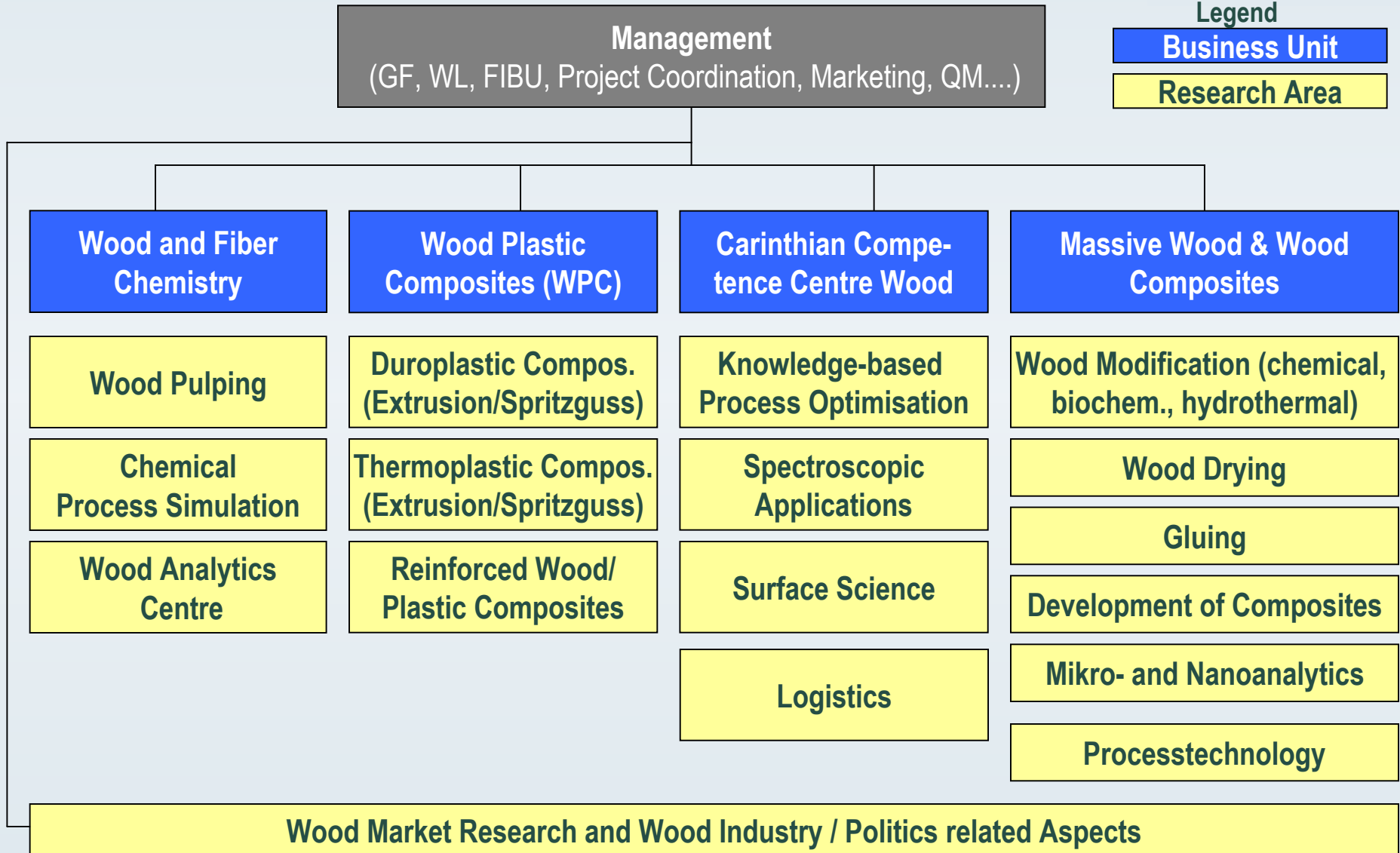
Competence Centre Wood Kplus: Organisation



Legend

Business Unit

Research Area

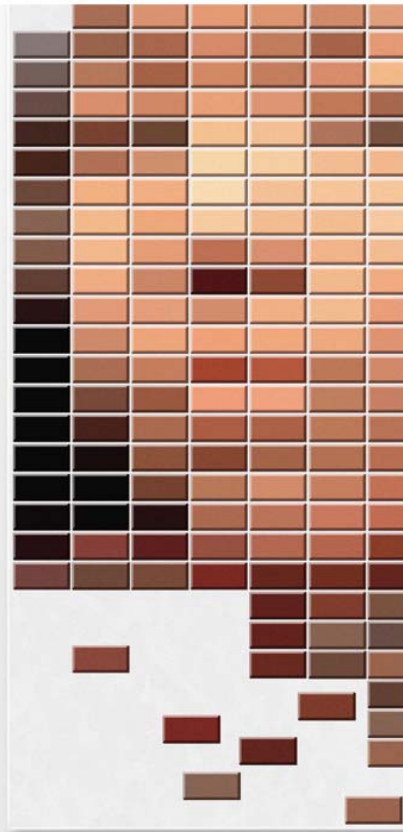


the art of
perfection.

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„Spiegelbild der Persönlichkeit“

Veranschaulichung der Wiedergeburt des Individualismus. Der Dekorverbund versteht sich als Gegenreaktion zur Monotonie in bestehenden Lebensräumen. Dekorative Platten für jeden Qualitätsanspruch fungieren dabei als Ausdrucksform der eigenen Persönlichkeit. Komposition aus Dekorspanplatte, Schichtstoffplatte, Compactplatte und Biolaser Platte.



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Unternehmen der *Conventio* INDUSTRIES GR

Partner: FunderMax GmbH

FUNDERMAX Product Range

Wood
K plus

the art of
perfection.

FUNDERMAX

„Die Mannigfaltigkeit!“
Ungewöhnliche Interpretation der flexibel einsetzbaren Beschichtungen von FUNDERMAX. Das Stillleben stellt gewohnte Formen in Frage und eröffnet neue Möglichkeiten. Zukunftsweisend. Objekt aus *Impregnated Papers* und *Schichtstoff*.

Homogen raw chipboard

Dekorspan Laminated
Chipboard

Impregnated Papers

Biofaser fibreboard panels

Exterior compact laminates

Interior compact laminates

Laminates (CPL)

Laminates (HPL)

Half finished parts

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FUNDERMAX Research Strategies

Wood
K plus

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FUNDERMAX®

„Sieg der Vielfalt über die Einfach!“
Eine Metapher für Flexibilität. Das Werk
unterstreicht die Grenzenlosigkeit der
Möglichkeiten bei Farben und Dekoren,
die der Experte bei FunderMax vorfindet.
Dekorvielfalt von Schichtstoff-
bis Dekorspanplatte.



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**Cheap raw material, fast and
save processing, etc ...**

Customers

**fast and save processing, storage
stability, perfect surface properties,
etc ...**

Kompetenzzentrum Holz GmbH

Rapid Product & Process Development

Requirement:

- Flexibility

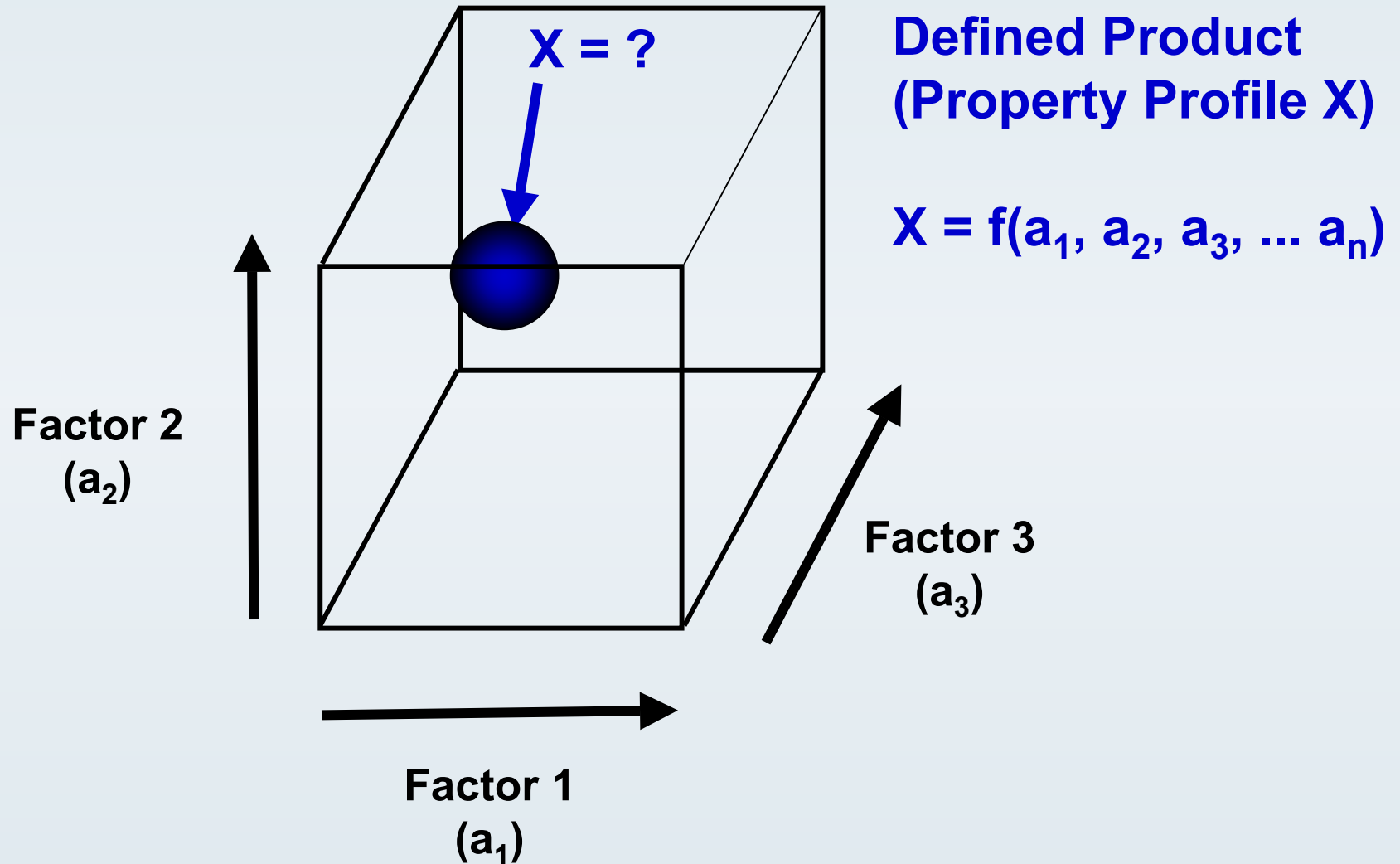
Basis:

- Knowledge Based Production

Tools:

- **Statistical Experimental Design**
- Mathematical Modelling
- Multivariate Statistics
- Technological Performance Optimisation
- Process Data Management
- Laboratory Data Management
- Process Analysis
- ...

Standard Situation in Development Lab



Find a solution and find it FAST !!! (1)

1. Never choose parameters out of production range !

- „We have to perform as few experiments as possible“
- „We´ll never produce in THAT range !“
- „We KNOW this will give bad results“
- „Don´t make absurd experiments

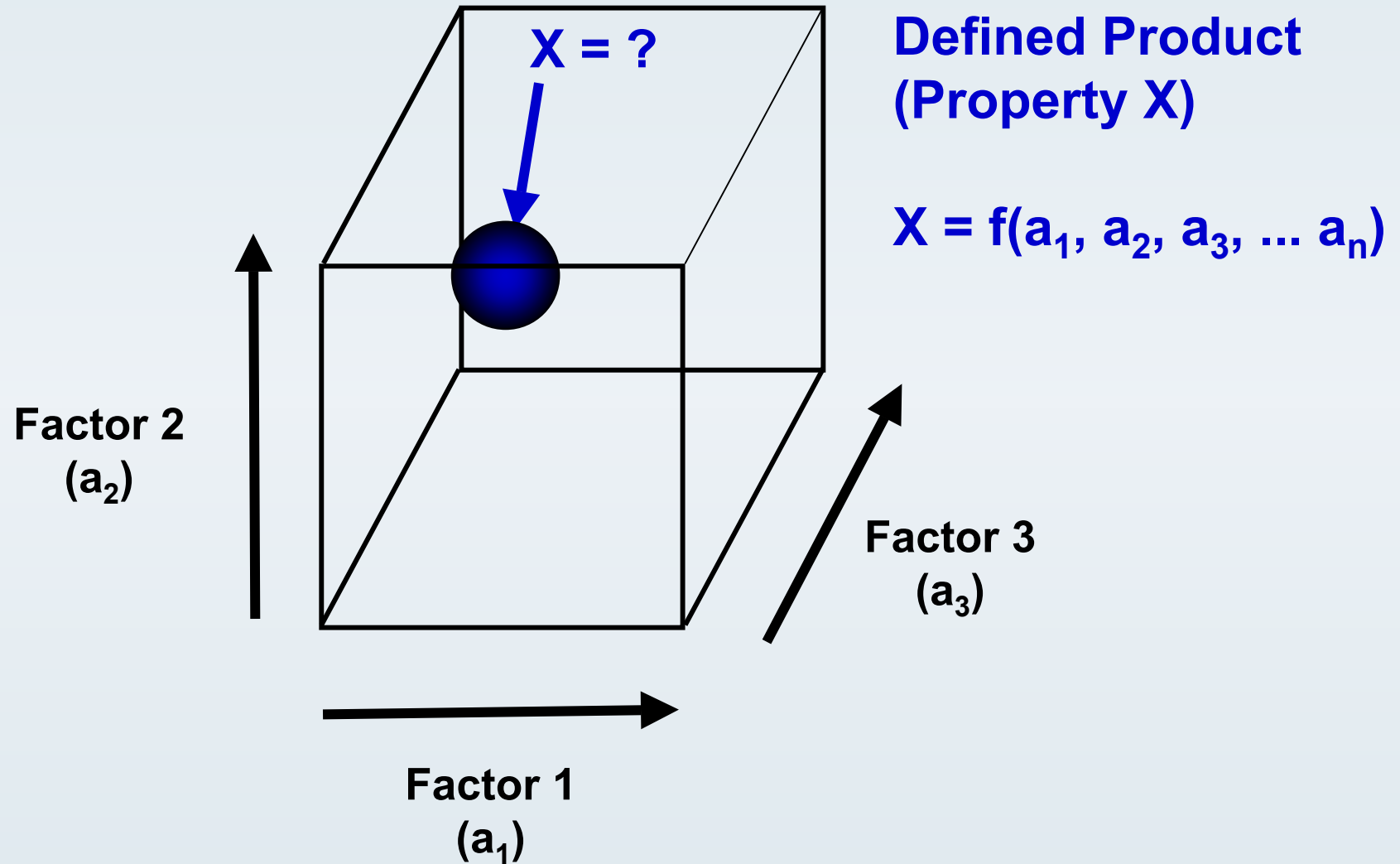
2. Choose parameter variations assumed to already best generate the desired profile!

- „We need to solve the specific problem – no distractions“
- „We have to focus on a single product property profile“

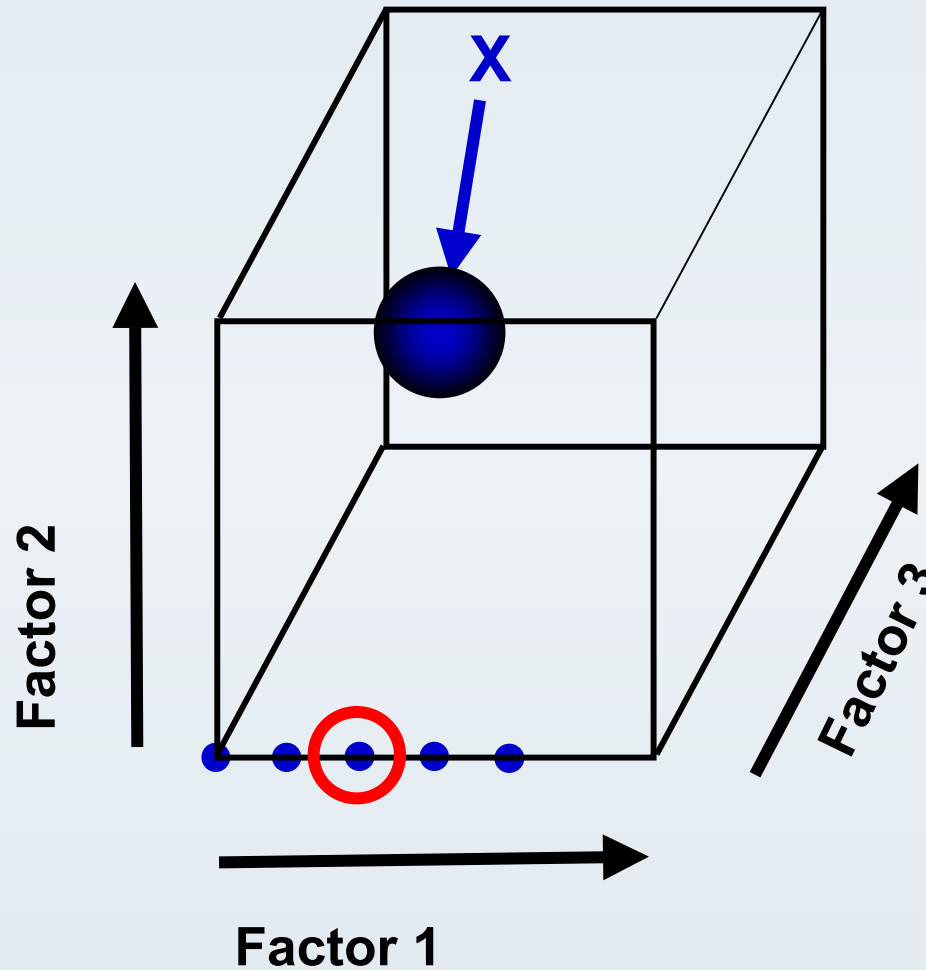
3. Choose only single parameter variations!

- „In order to understand the effect of one parameter we have to focus on this parameter and keep all the other factors constant“

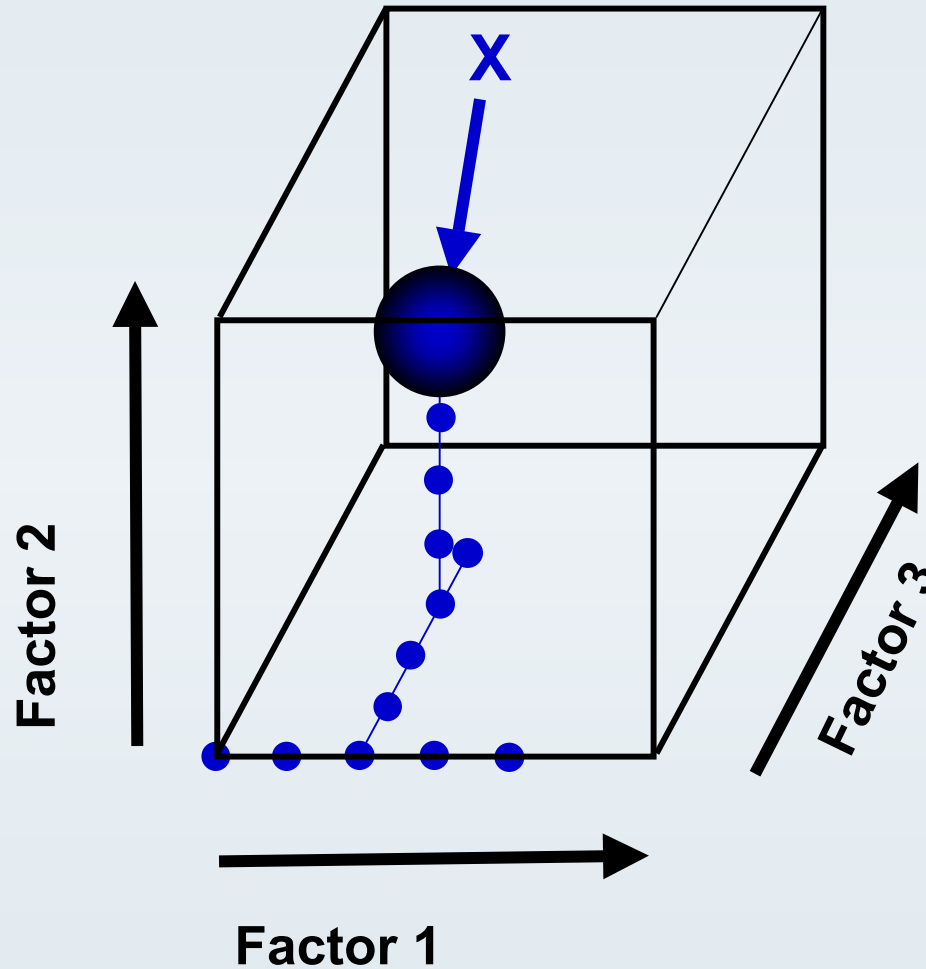
Standard Operating Procedure in Routine Lab



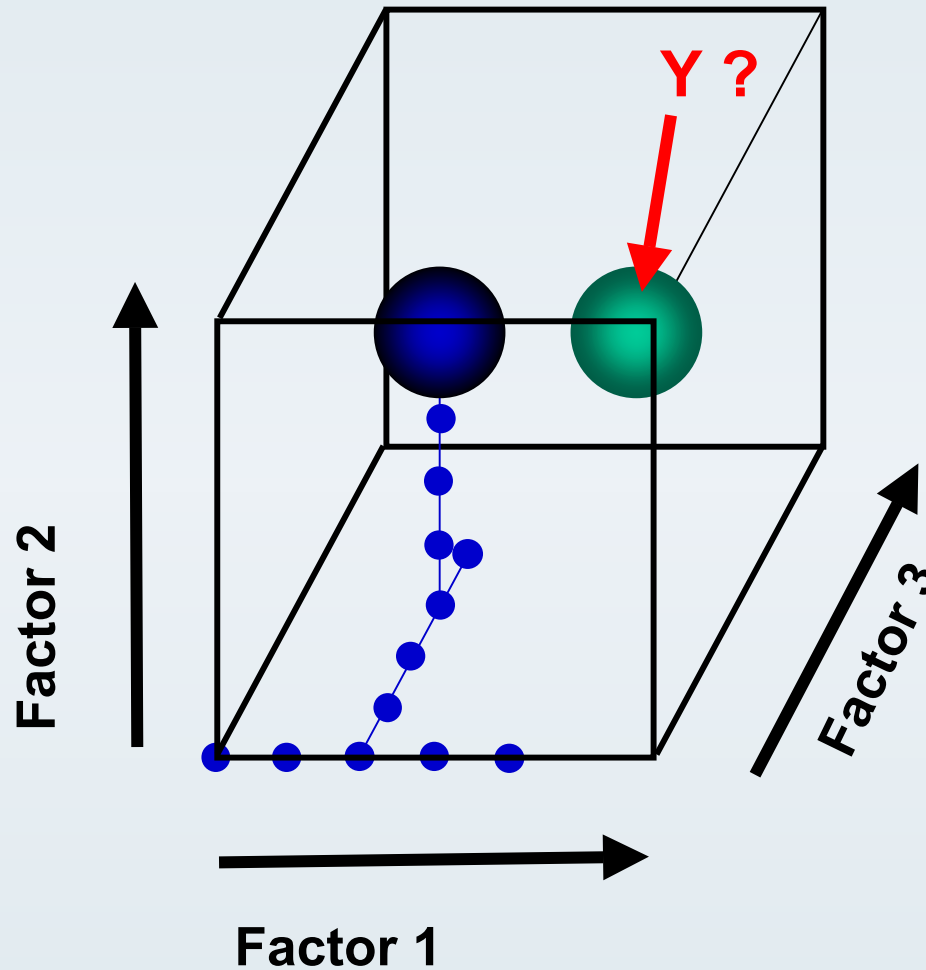
Standard Operating Procedure in Routine Lab



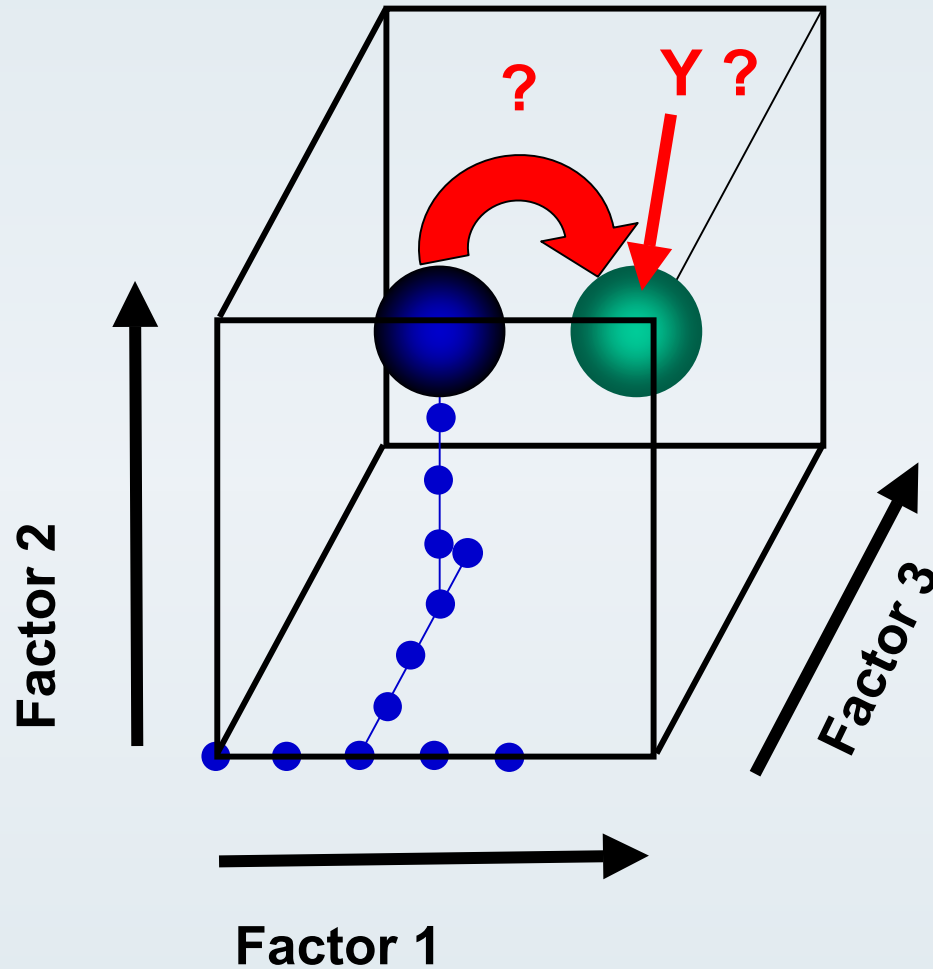
Standard Operating Procedure in Routine Lab



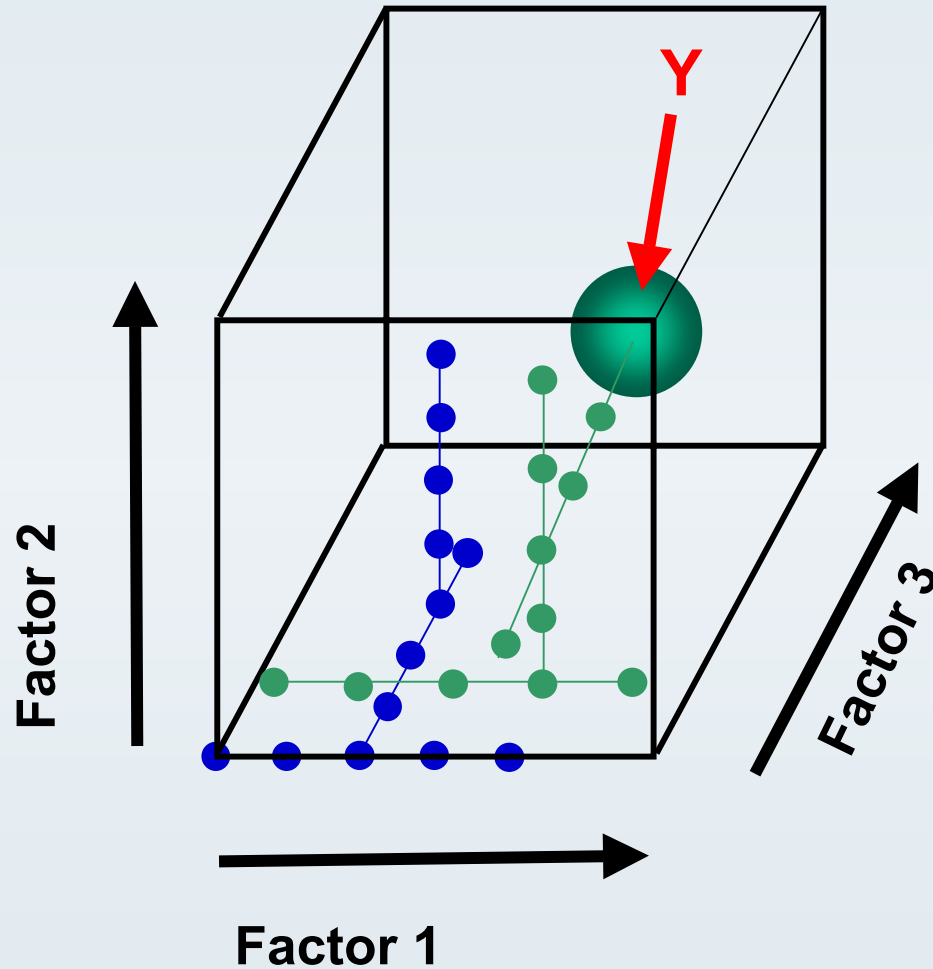
Standard Operating Procedure in Routine Lab



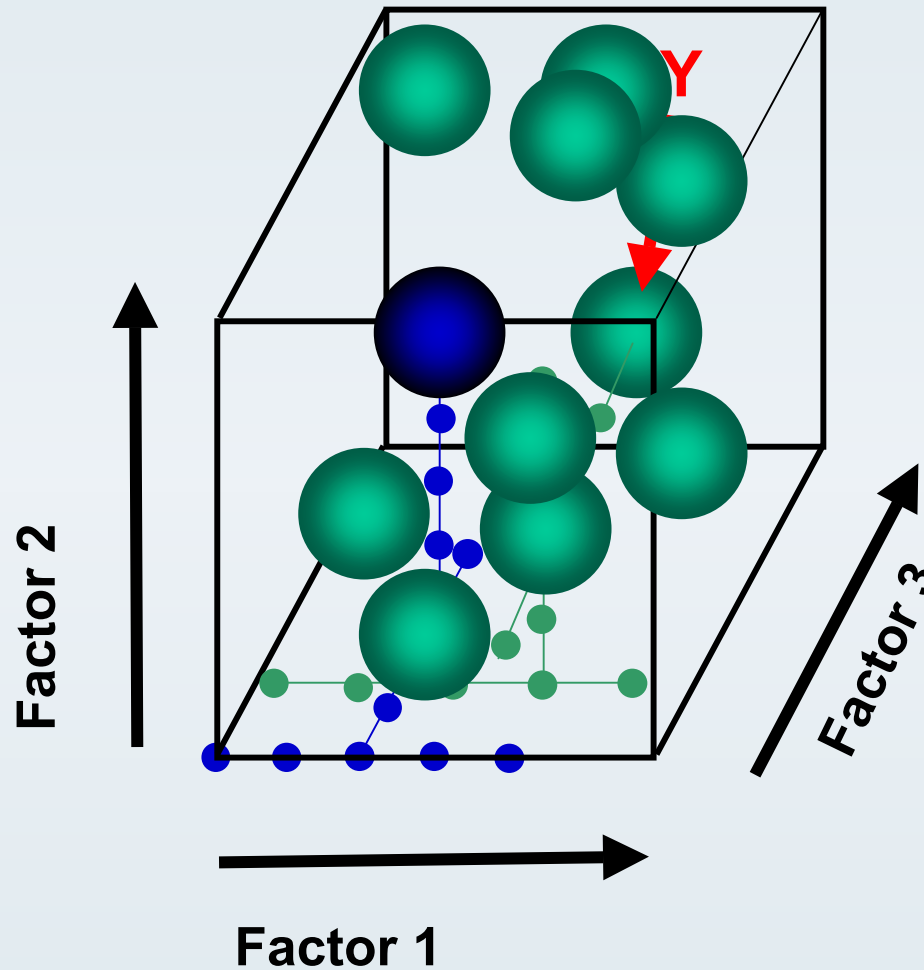
Standard Operating Procedure in Routine Lab



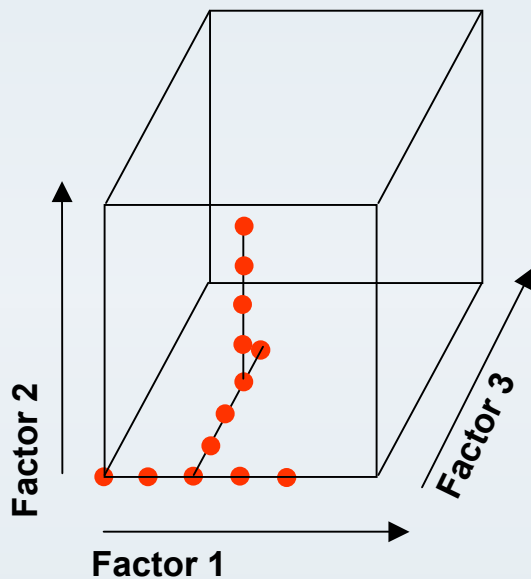
Standard Operating Procedure in Routine Lab



Standard Operating Procedure in Routine Lab

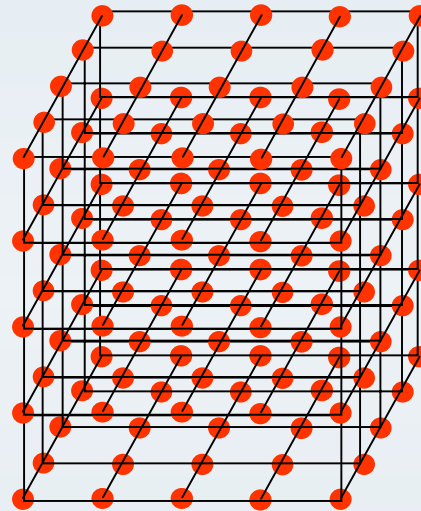


Minimum amount of experiments – Maximum information



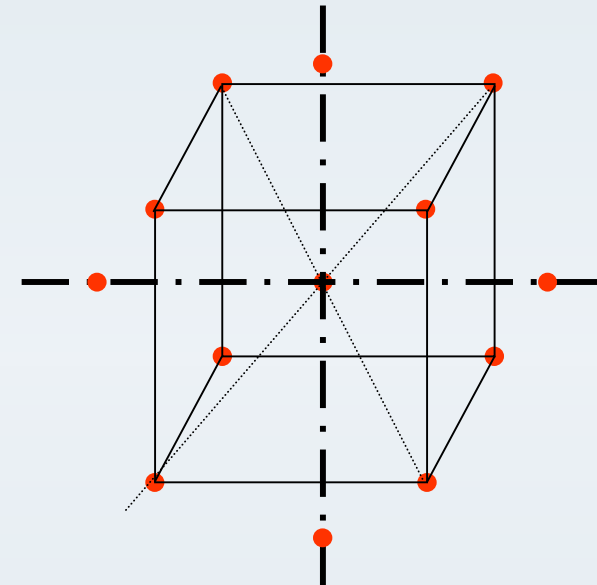
Classical Proceeding

10-20 Exp



Factorial Plan

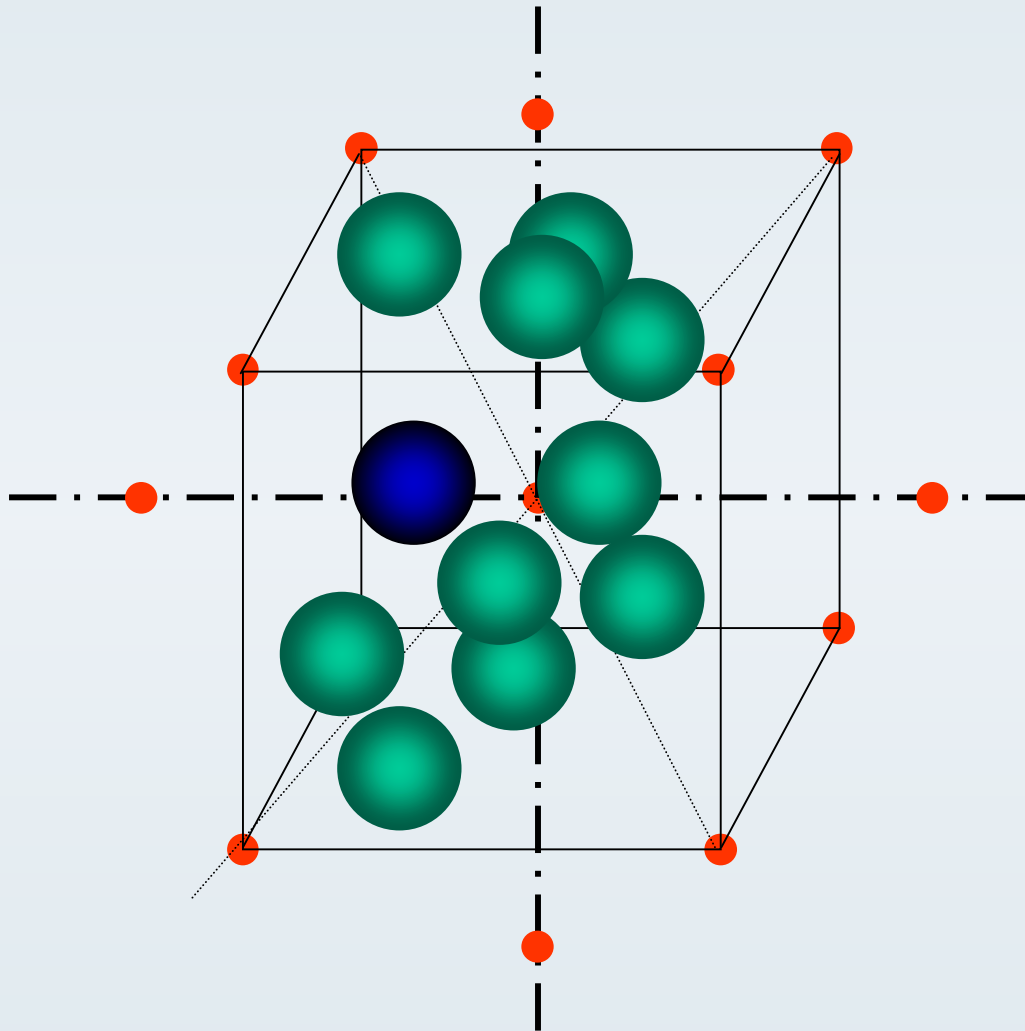
∞ Exp



**Statistical Design
Mathematical Modelling**

10-20 Exp

Use past data for future information!



Systematic Variation
Simultaneous Variation
Symmetry in Design

Reproducibility
Validation

Understanding of a complex system

Focus on one parameter at a time

„How can you be sure that everything else **WAS** kept constant, if you don't measure it?“

„How can you be sure to check the right parameter?“

„How can you be sure that there are no interdependencies with other parameter?“



Focus on ALL parameters at the same time

- Raw material data
- Process data management
- On-Line measurement of material properties

Find a solution and find it FAST !!! (2)

~~1. Never choose parameters out of production range!~~

1. Choose extreme parameters in order to visualize effects !

~~2. Choose parameter variations assumed to already best generate the desired profile!~~

2. Choose parameter variations that best cover the complete production space

~~3. Choose only single parameter variations!~~

3. Choose multiple parameter variations!

Some Advantages of Statistical Design

Knowledge Basis

System oriented, Holistic

Flexibility

Speed

Reliability

Confidence

Formalized

Quantitative

Easy to communicate

Long term efficient

Cost efficient

Multiple Problem Solving

Elimination of recurring problems

Etc.

Define Problem !

„What exactly do we (not) need?“

Define Influential Parameters !

„Screening Design?“

Define System !

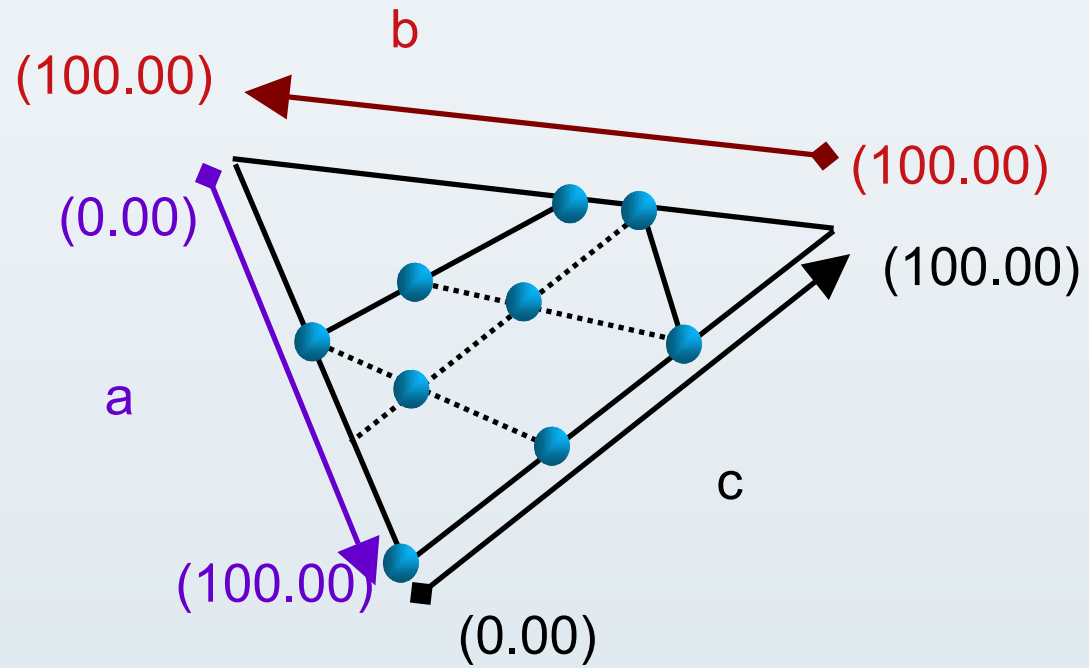
„Space of Production, Limits“

Define Important Responses !

Discuss compromises and assumptions !

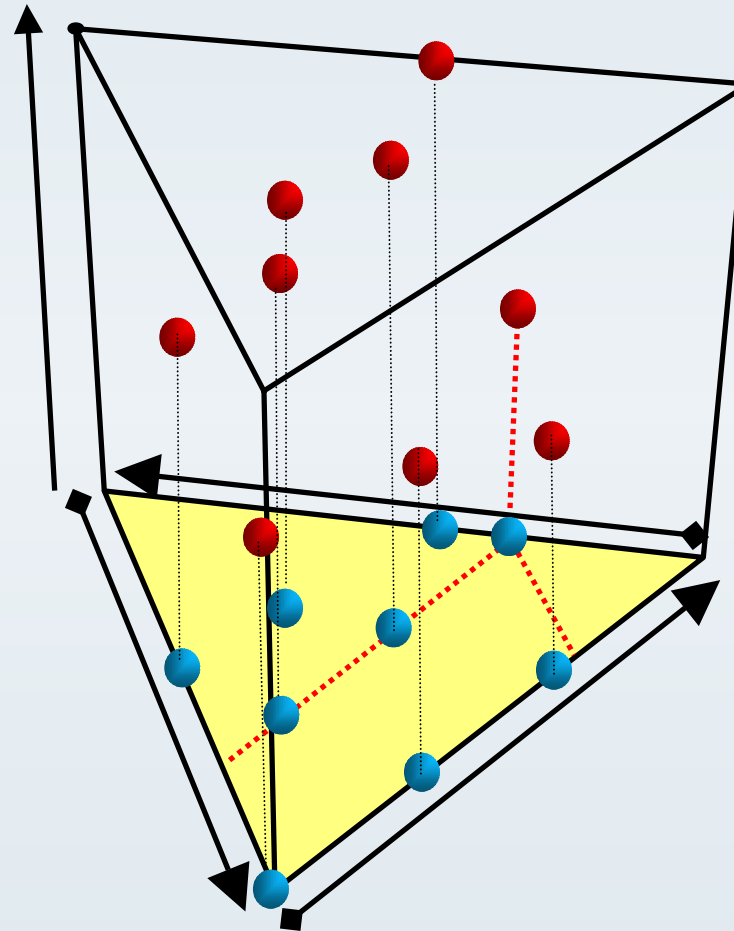
Experimental Design and Mathematical Modelling

1. Set Up Experiment:

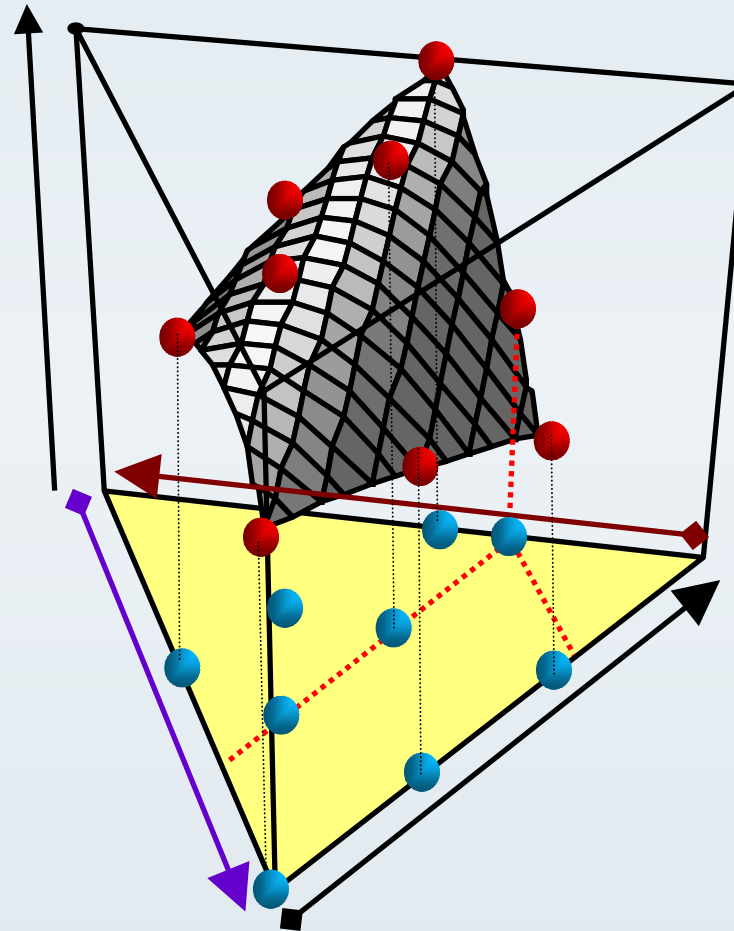


1. Set Up Experiment
2. Measure Response at Design points

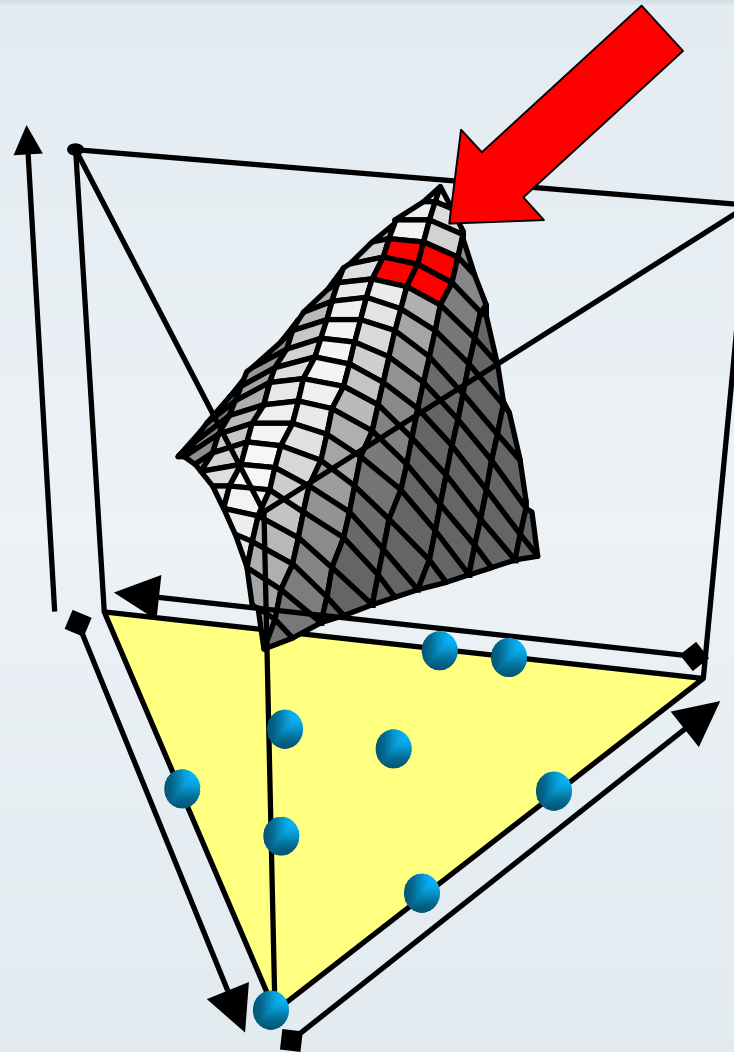
Response 1: Viscosity



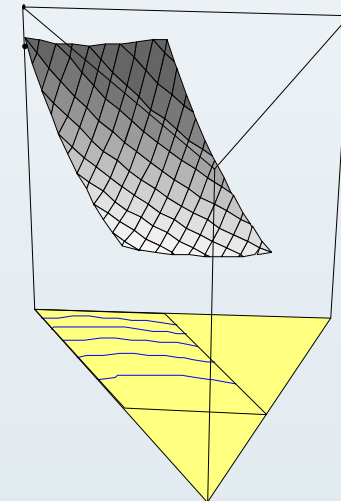
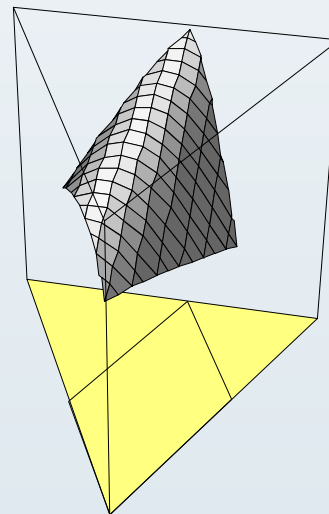
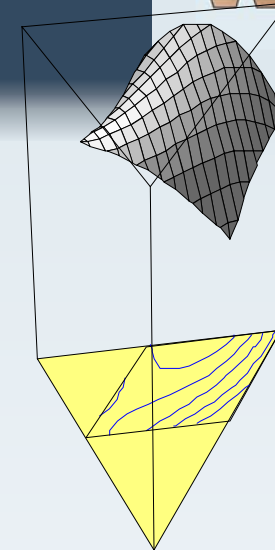
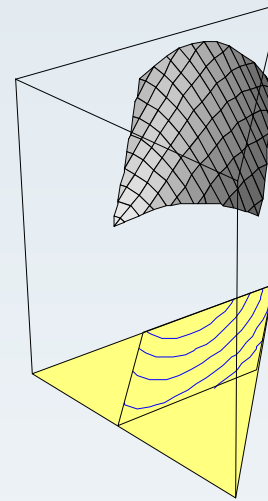
1. Set Up Experiment
2. Measure Response at Design points
3. **Calculate Response Surface**



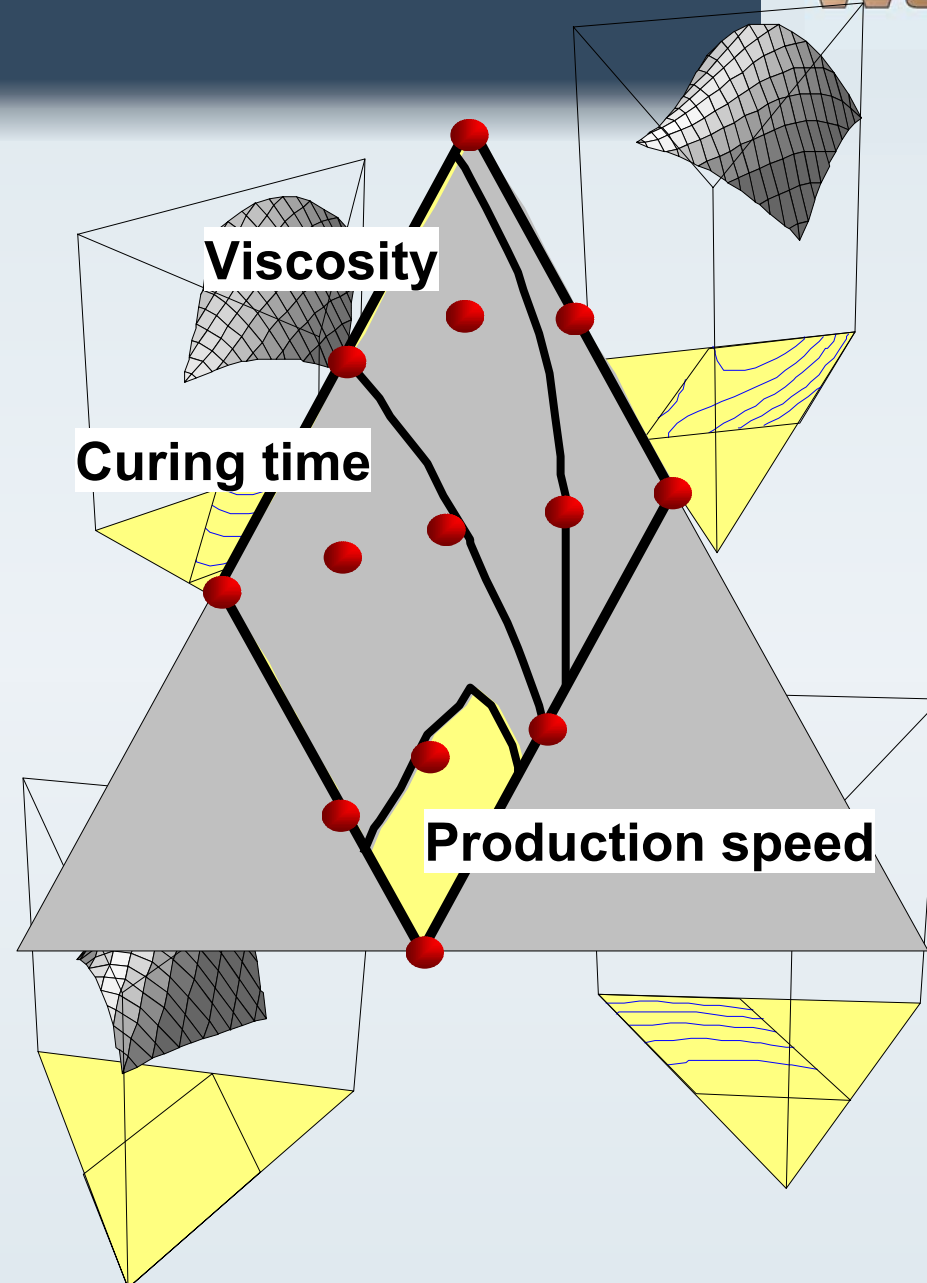
1. Set Up Experiment
2. Measure Response at Design points
3. Calculate Response Surface
4. Check Accuracy and Plausibility
5. **Calculate Optimum for Response**



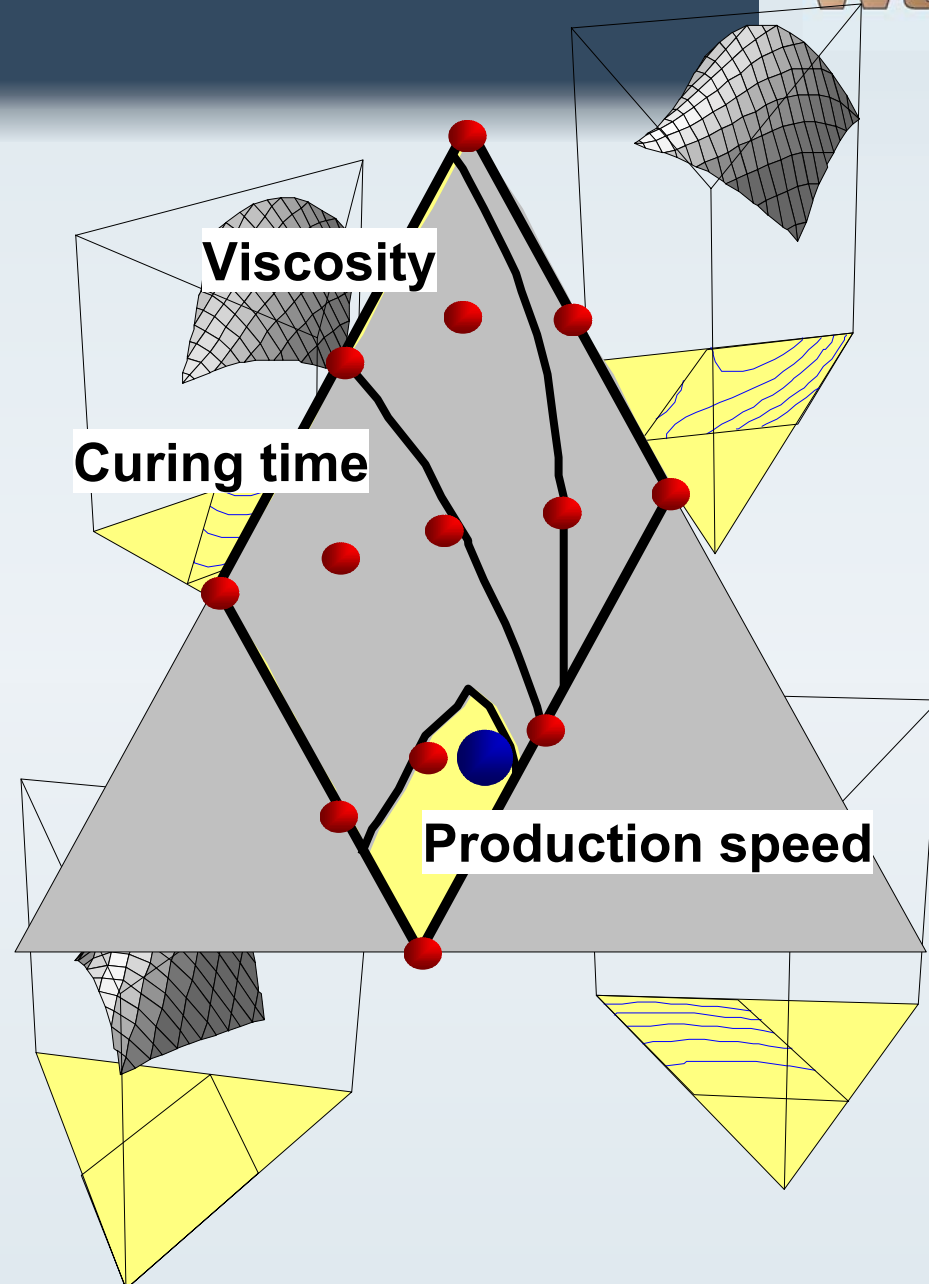
1. Set Up Experiment
2. Measure Response at Design points
3. Calculate Response Surface
4. Check Accuracy and Plausibility
5. Calculate Optimum for Response
6. **Compare all different Responses**



1. Set Up Experiment
2. Measure Response at Design points
3. Calculate Response Surface
4. Check Accuracy and Plausibility
5. Calculate Optimum for Response
6. Compare all different Responses
7. **Calculate overall optimum by mathematical correlation**



1. Set Up Experiment
2. Measure Response at Design points
3. Calculate Response Surface
4. Check Accuracy and Plausibility
5. Calculate Optimum for Response
6. Compare all different Responses
7. Calculate overall optimum by mathematical correlation
8. **Validate your Model**



Example: Impregnation Resin

Significant Factors of Influence

- Curing Agent Type
- Curing Agent Amount
- Resin Type
- Pressing Time
- etc

Technological Responses

- Gloss
- Flexibility
- Curing Time
- Curing Degree
- Operating Window
- etc

Cost, Time etc. can also be integrated

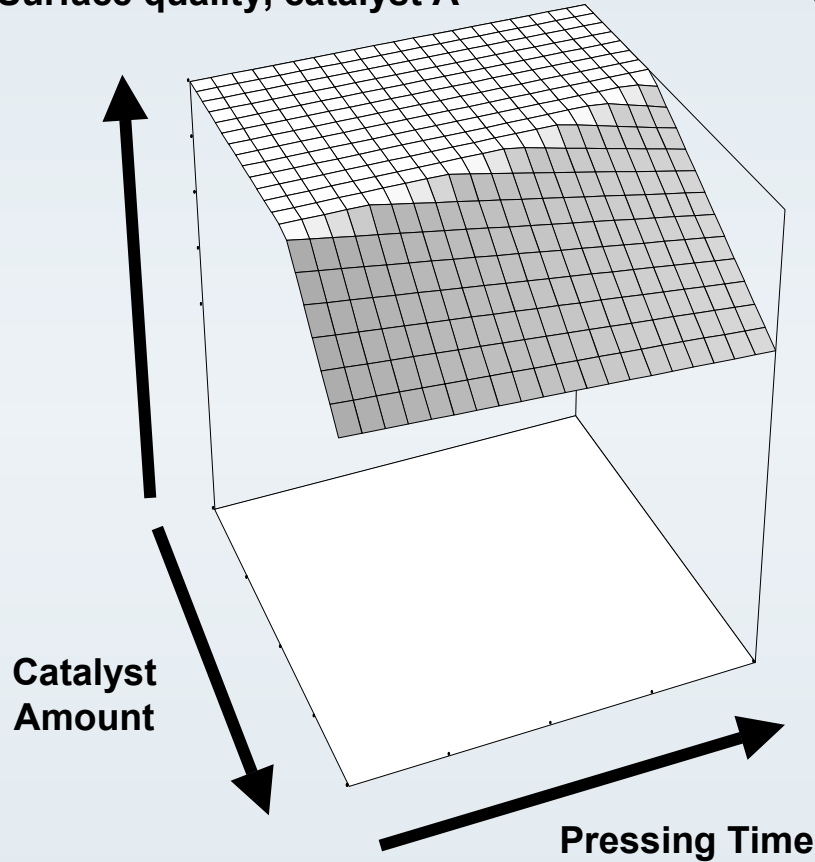


- Notes for Schlussdaten.dx6
- Design
 - Status
 - Evaluation
- Analysis
 - Säure(Analyzed)
 - Porosität(Analyzed)
 - Glanzgrad(Analyzed)
 - Fluß(Analyzed)
 - Endgewicht(Analyzed)
 - Darrwert(Analyzed)
 - Max Cure Rate(Analyze)
 - Cure Time(Analyzed)
 - Cure Rate(Analyzed)
 - Fließzeit(Analyzed)
 - Flexibilität(Analyzed)
- Optimization
 - Numerical
 - Graphical
 - Point Prediction

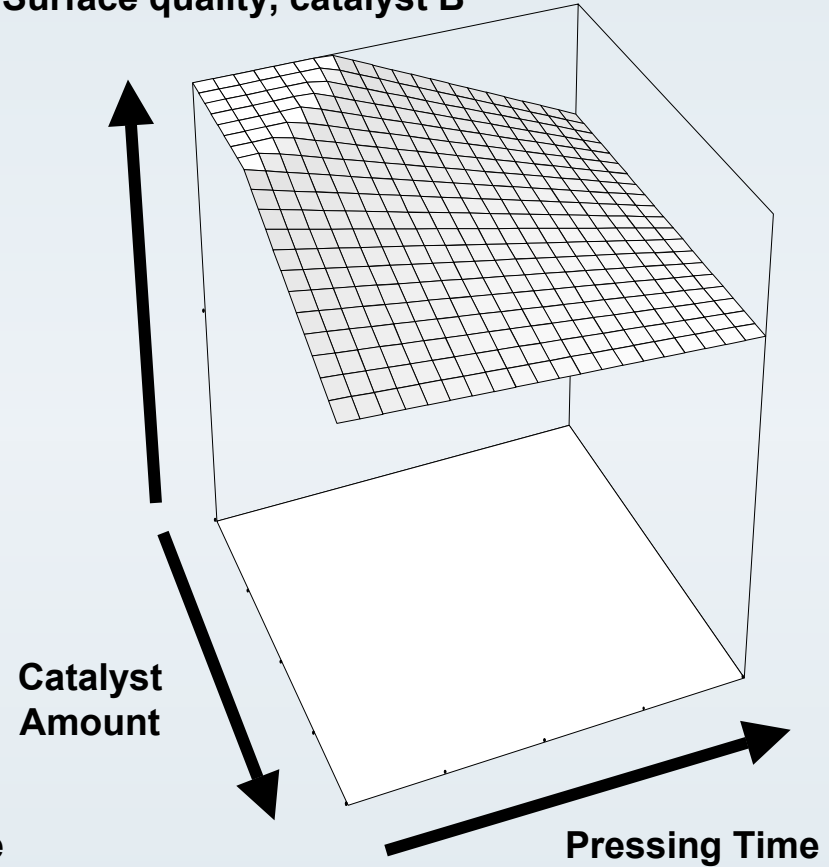
	Std	Run	Block	Factor 1 A:Rohlemerge	Factor 2 B:Presszeit	Factor 3 C:Pressampe	Factor 4 D:Rohrertyp	Factor 5 E:Harzsaure	Response 1 Porosität	Response 2 Glanzgrad	Response 3 Fluß	Response 4 Endgewicht	Response 5 Darrwert	Response 6 Max Cure Rate	Response 7 Cure Time	Response 8 Cure Rate	Response 9 Fließzeit	Response 10 Flexibilität	
	114	1	Block 1	0.10	16.00	140.00	BASF 528	170	2	4.5	38	9.13333	173	7.4	4.29997	4.5	1.6563	142	88.9997
	20	2	Block 1	0.30	16.00	170.00	FHM 510	170	1.5	4.5	9	6.99997	174.333	7.63333	4.09997	4.43333	1.4813	114	92.9997
	563	3	Block 1	0.50	16.00	140.00	FHM 510	160	1.5	3	103	0.0833333	164.333	5.5	0.7	1.63333	3.7088	18	88.9997
	562	4	Block 1	0.40	8.00	170.00	FHO 530	160	1.5	2.5	14	0	165.333	5.63333	0.5	1.43333	4.15223	12	82
	597	5	Block 1	0.50	12.00	170.00	FHO 530	160	1.5	2	13	0	165	5.99997	0.499997	1.23333	4.62523	12	80
	396	6	Block 1	0.40	8.00	140.00	FHO 530	170	2	3	61	4.13333	177.667	6.89997	2.6	4.13333	1.30023	66	93.9997
	133	7	Block 1	0.20	14.00	170.00	BASF 528	170	2.5	4.5	9	8.9	176	7.23333	4.3	4.43333	1.4619	111	90.3333
	644	8	Block 1	0.30	14.00	170.00	BASF 528	160	1.5	3.5	13	0.133333	164.333	5.49997	0.9	2.03333	3.089	24	94
	564	9	Block 1	0.40	8.00	140.00	FHO 530	160	1.5	3.5	97	0	165.333	5.63333	0.5	1.43333	4.15223	12	82
	107	10	Block 1	0.10	14.00	140.00	BASF 528	170	2.5	4	40	9.13333	173	7.4	4.29997	4.5	1.6563	142	88.9997
	104	11	Block 1	0.10	14.00	170.00	BASF 528	170	2.5	4.5	9	9.13333	173	7.4	4.29997	4.5	1.6563	142	88.9997
	886	12	Block 1	0.10	14.00	140.00	FHO 530	160	1.5	3	61	0.399997	166	5.9	1	2.93333	2.21567	27	93.3333
	565	13	Block 1	0.50	14.00	170.00	FHM 510	160	1.5	2.5	14	0.0833333	164.333	5.5	0.7	1.63333	3.7088	18	88.9997
	922	14	Block 1	0.20	16.00	140.00	FHO 530	160	1.5	2	96	0.1	164.667	5.53333	0.8	2.13333	2.98917	21	91.3333
	776	15	Block 1	0.20	20.00	170.00	BASF 528	160	1.5	3	13	0.2	168	5.8	0.833333	1.99997	3.12947	21	92.9997
	448	16	Block 1	0.10	20.00	140.00	FHM 510	160	2.5	4	99	0.533333	173.667	5.53333	1.29997	3.4	1.78253	36	92.3333
	305	17	Block 1	0.50	8.00	140.00	BASF 528	170	1.5	3	68	1.63333	174	7	2	3.93333	1.391	54	93.9997
	790	18	Block 1	0.30	12.00	140.00	BASF 528	160	1.5	4	96	0.1	166.333	5.6	0.699997	1.53333	3.52763	17	89.9997
	1015	19	Block 1	0.50	20.00	170.00	FHO 530	160	1.5	3	13	0	165	5.99997	0.499997	1.23333	4.62523	12	80
	841	20	Block 1	0.50	8.00	170.00	BASF 528	160	1.5	3	13	0	166.667	5.63333	0.5	1.13333	5.06543	12	86
	422	21	Block 1	0.10	8.00	170.00	FHM 510	160	3.5	5	10	0.533333	173.667	5.53333	1.29997	3.4	1.78253	36	92.3333
	509	22	Block 1	0.30	12.00	170.00	FHO 530	160	1.5	2.5	13	0	166	5.49997	0.6	1.79997	3.4182	15	85
	158	23	Block 1	0.30	12.00	170.00	BASF 528	170	2	5	10	4.19997	173.667	6.53333	3.6	4.4	1.30017	89	92
	136	24	Block 1	0.20	14.00	170.00	BASF 528	170	3	5	10	8.9	176	7.23333	4.3	4.43333	1.4619	111	90.3333
	705	25	Block 1	0.50	14.00	170.00	BASF 528	160	1.5	2.5	13	0	166.333	5.89997	0.7	1.43333	4.15667	17	91.3333
	821	26	Block 1	0.40	12.00	140.00	BASF 528	160	1.5	3.5	100	0	166.667	5.8	0.599997	1.2	4.63113	15	85.9997
	205	27	Block 1	0.40	20.00	170.00	BASF 528	170	1.5	4	10	2.29997	173.667	6.3	2.79997	4.29997	1.24593	77	91.9997
	530	28	Block 1	0.40	16.00	170.00	FHM 510	160	1.5	4	13	0.1	164.667	5.73333	0.8	1.8	3.32497	22	91
	596	29	Block 1	0.50	20.00	170.00	FHM 510	160	1.5	3.5	13	0.0833333	164.333	5.5	0.7	1.63333	3.7088	18	88.9997
	680	30	Block 1	0.40	16.00	170.00	BASF 528	160	1.5	2	13	0	167	5.6	0.733333	1.99997	3.64077	18	90.9997
	6	31	Block 1	0.30	8.00	140.00	FHM 510	170	3	5	31	6.99997	174.333	7.63333	4.09997	4.43333	1.4813	114	92.9997
	220	32	Block 1	0.50	12.00	140.00	BASF 528	170	1.5	4	51	1.89997	175	6.6	2.73333	4.2	1.25437	70.3333	93.9997
	387	33	Block 1	0.40	20.00	170.00	FHO 530	170	1.5	3	12	4.13333	177.667	6.89997	2.6	4.13333	1.30023	66	93.9997
	273	34	Block 1	0.40	8.00	170.00	BASF 528	170	1.5	3	12	1.1	172.333	8.6	2.73333	4.2	1.29997	66	94
	772	35	Block 1	0.20	16.00	140.00	BASF 528	160	1.5	3	92	0.2	168	5.8	0.833333	1.99997	3.12947	21	92.9997
	87	36	Block 1	0.50	20.00	170.00	FHM 510	170	1.5	4	10	4.7	178.667	7	3	4.33333	1.3007	87	92.9997
	71	37	Block 1	0.50	12.00	140.00	FHM 510	170	1.5	4	40	4.7	178.667	7	3	4.33333	1.3007	87	92.9997
	451	38	Block 1	0.20	8.00	170.00	FHM 510	160	2	5	13	0.5	167.667	5.8	1.13333	2.79997	2.22833	36	92.3333

Influence on Quality of Surface (Acid-Value)

Surface quality, catalyst A

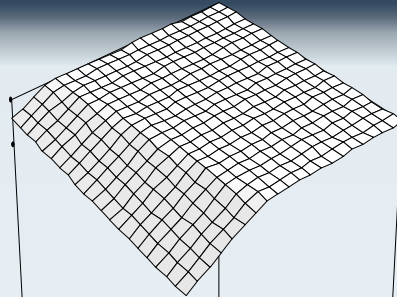


Surface quality, catalyst B

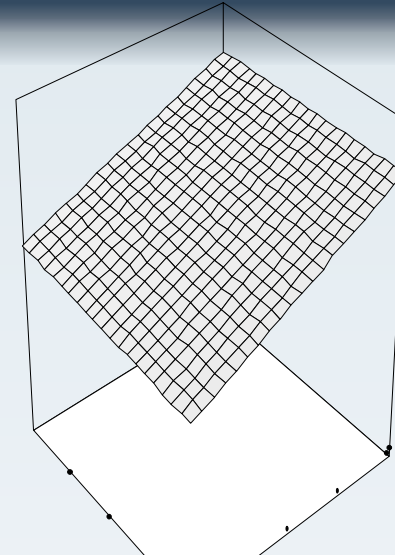


Influence on Gloss of Surface

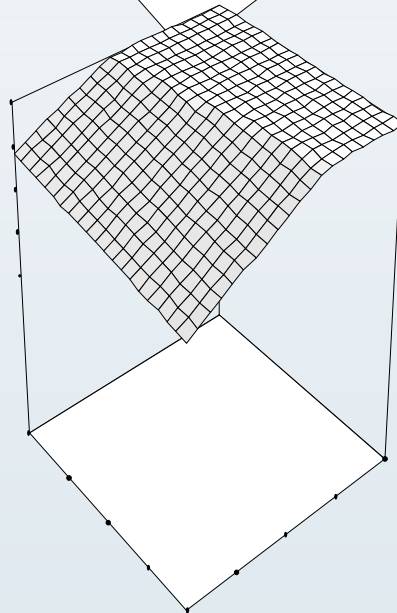
Pure MF Resin
Curing Agent 2



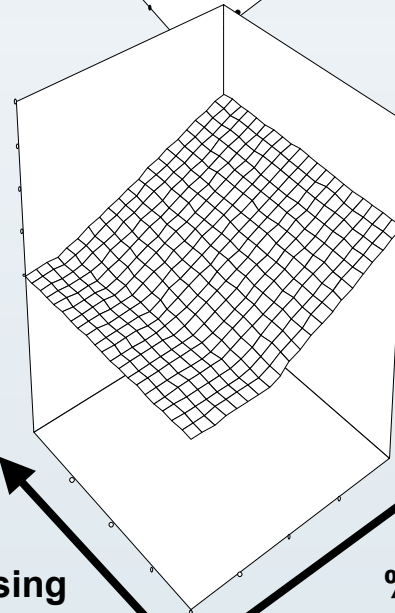
Mixture MF / UF Resin
Curing Agent 2



Pure MF Resin
Curing Agent 1



Mixture MF / UF Resin
Curing Agent 1

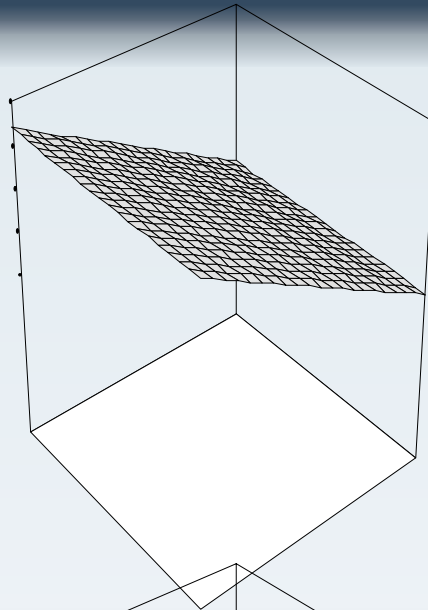


Pressing
Time

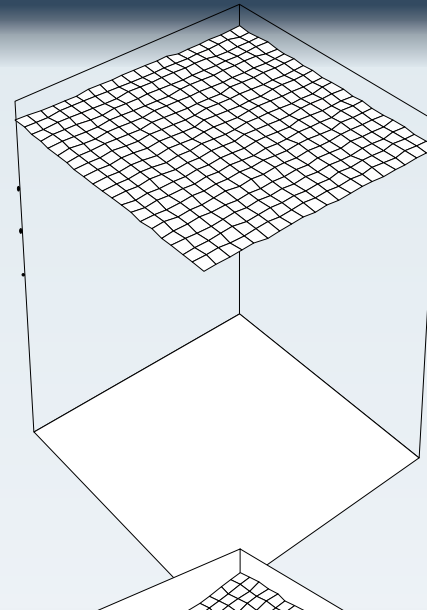
% Curing
Agent

Influence on Flexibility of Impreg. Paper

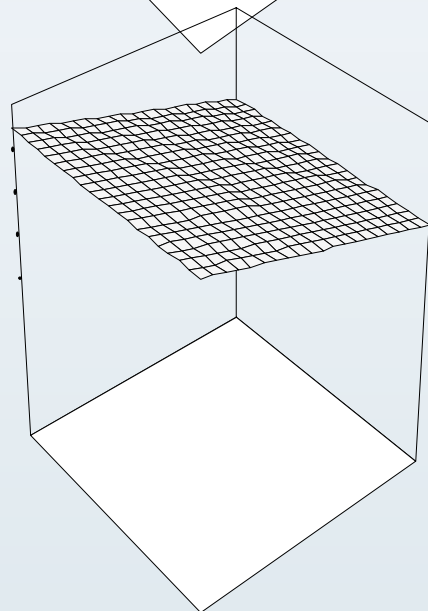
Pure MF Resin
Curing Agent 2



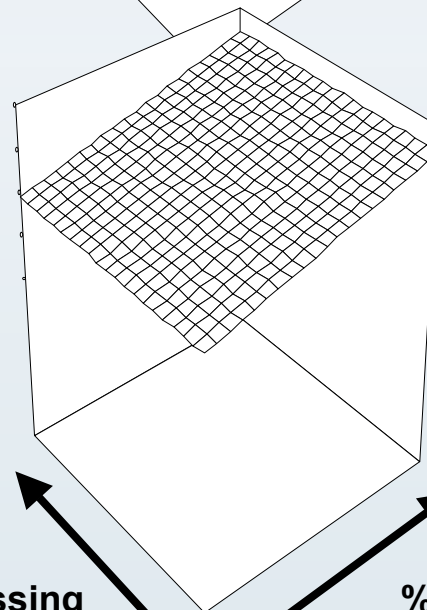
Mixture MF / UF Resin
Curing Agent 2



Pure MF Resin
Curing Agent 1



Mixture MF / UF Resin
Curing Agent 1

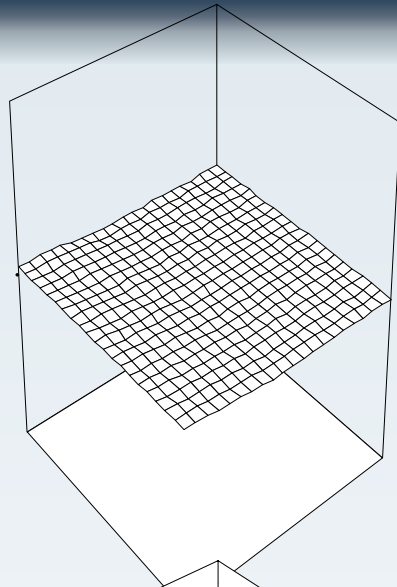


Pressing
Time

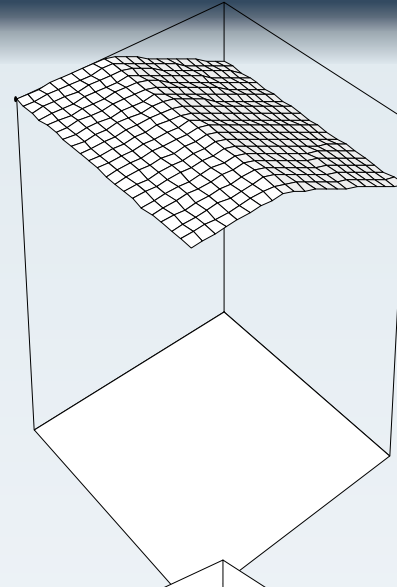
% Curing
Agent

Influence on operation window (Flow)

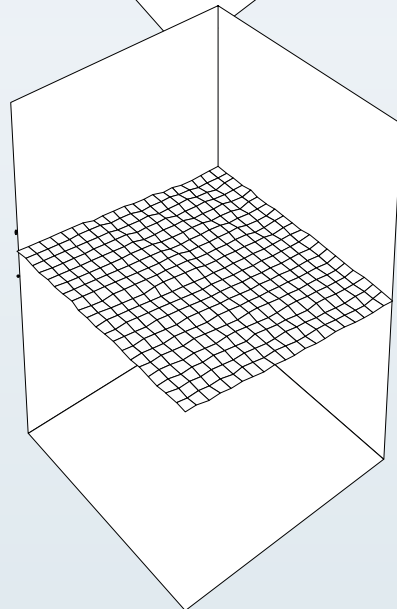
Pure MF Resin
Curing Agent 2



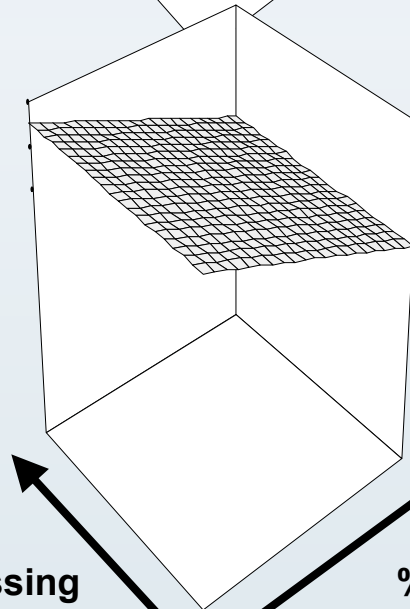
Mixture MF / UF Resin
Curing Agent 2



Pure MF Resin
Curing Agent 1



Mixture MF / UF Resin
Curing Agent 1



Pressing
Time

% Curing
Agent

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