Visualising the Impact of Manufacturing Variation

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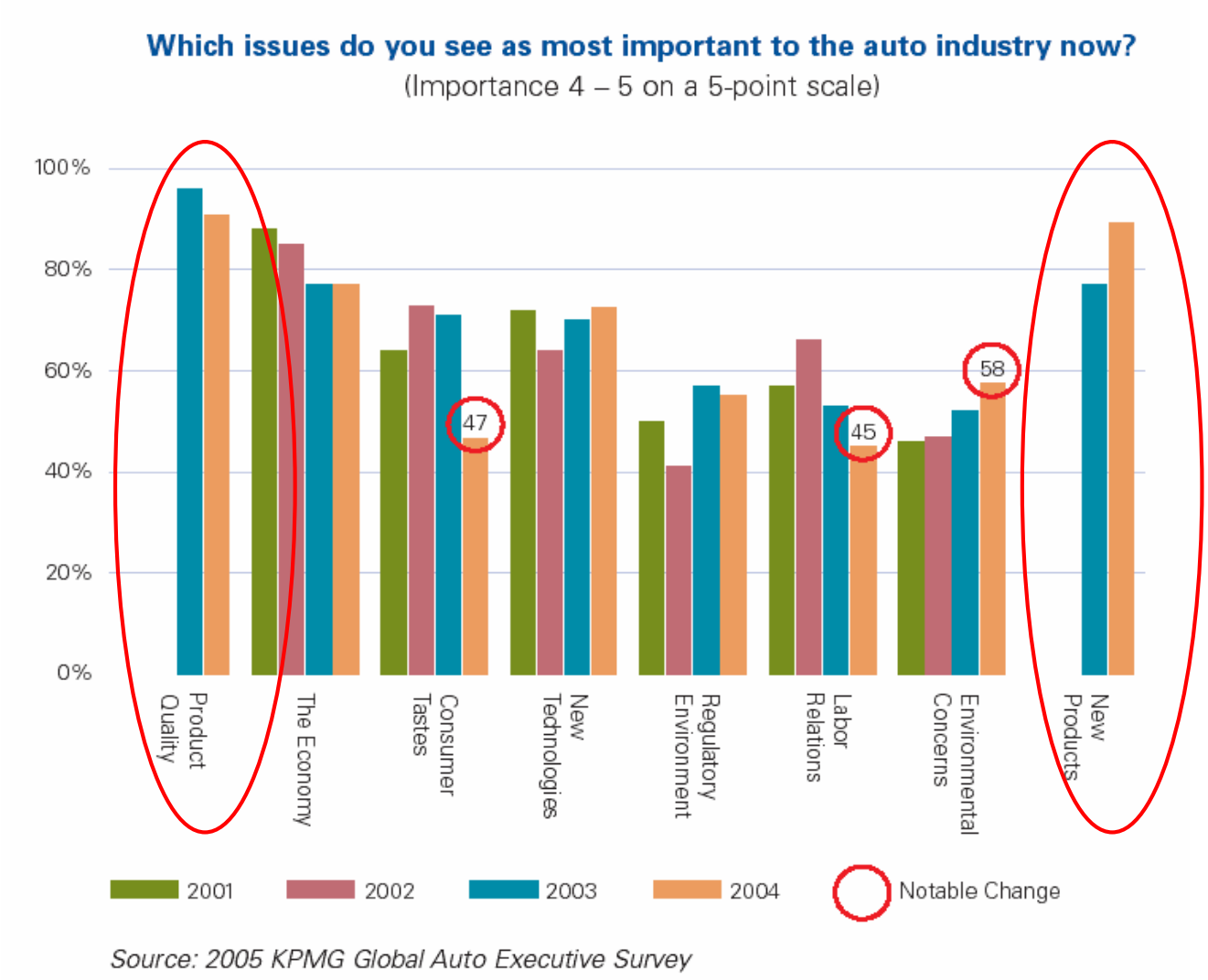
Global Auto Industry

- Increased
  - Global competition and over-capacity
  - Fragmentation and niche products
  - Consciousness in customers
  - Technological complexity
  - Differentiation through styling/aesthetics
- Reduced
  - Margins and profitability
  - Development time
  - Window of opportunity for new models

Global Auto Industry



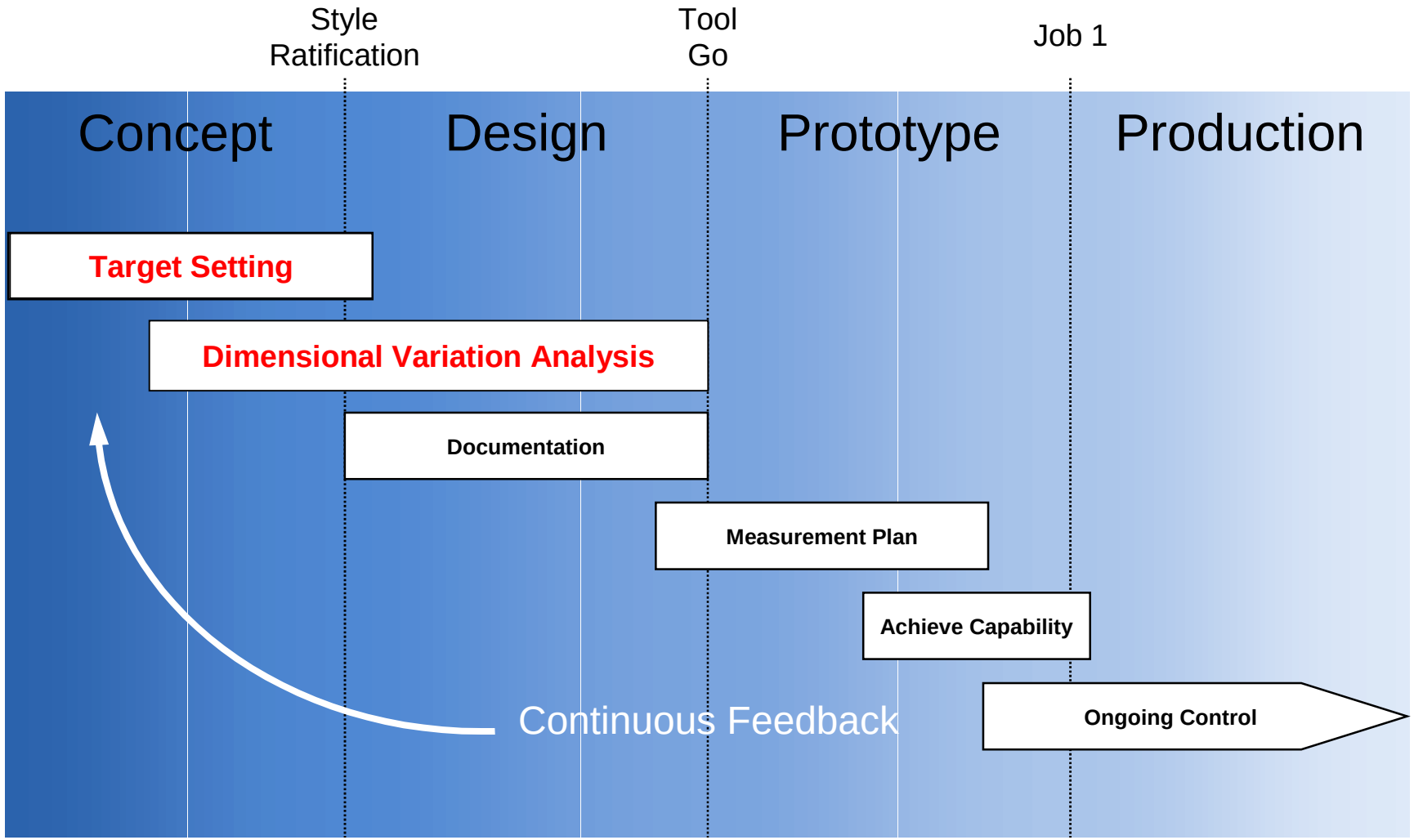
Challenges

- The challenge is to improve quality while delivering an increasing range of diverse and innovative products
- Saving time in order to meet project deadlines delivers higher returns in the long term than saving money to meet budgets (McKinsey)
- To save time companies must establish the best processes and tools for the job

Dimensional Management

- Understand and control manufacturing variation
- Eliminates risks earlier using simulation
- Save time and improve quality
- Better control of the product and processes
- Shorter maturation – reduce over-runs

Key DM Processes



Current Target Setting Tools

Nominal Geometry

Visualisation Software

(Alias Studio, ICEM Surf, Opticore, VisConcept)

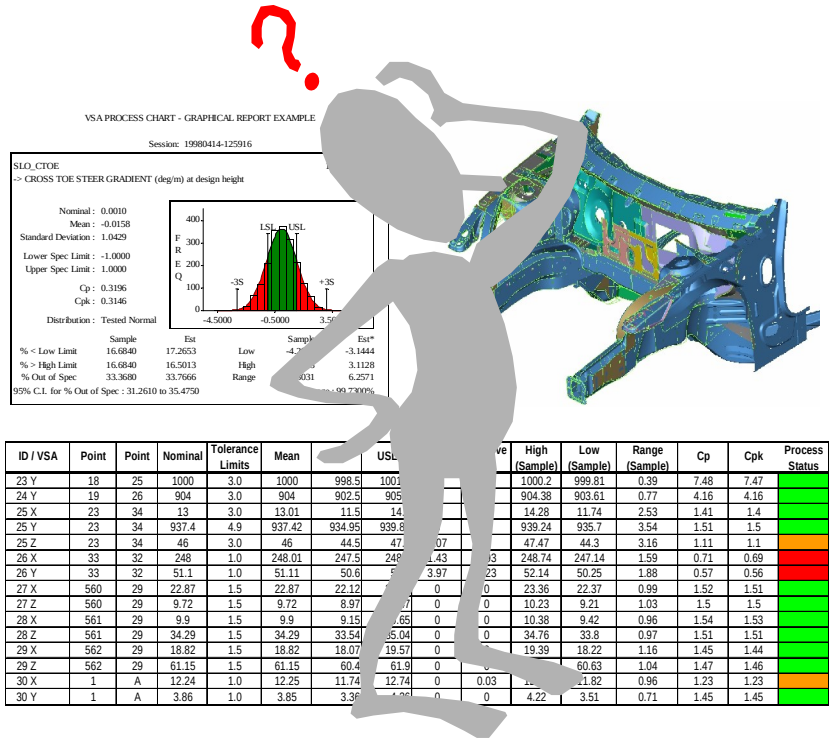
Analysis

I know what the perfect vehicle should look like…

Multi-functional target setting team

But how do I verify and show people what the actual product will actually look like?

Current DVA Tools



ID / VSA	Point	Point	Nominal	Tolerance Limits	Mean		USL			High (Sample)	Low (Sample)	Range (Sample)	Cp	Cpk	Process Status
23 Y	18	25	1000	3.0	1000	998.5	1001			1000.2	999.81	0.39	7.48	7.47	
24 Y	19	26	904	3.0	904	902.5	905			904.38	903.61	0.77	4.16	4.16	
25 X	23	34	13	3.0	13.01	11.5	14			14.28	11.74	2.53	1.41	1.4	
25 Y	23	34	937.4	4.9	937.42	934.95	939.8			939.24	935.7	3.54	1.51	1.5	
25 Z	23	34	46	3.0	46	44.5	47	07		47.47	44.3	3.16	1.11	1.1	
26 X	33	32	248	1.0	248.01	247.5	248	.43	3	248.74	247.14	1.59	0.71	0.69	
26 Y	33	32	51.1	1.0	51.11	50.6	5	3.97	23	52.14	50.25	1.88	0.57	0.56	
27 X	560	29	22.87	1.5	22.87	22.12		0	0	23.36	22.37	0.99	1.52	1.51	
27 Z	560	29	9.72	1.5	9.72	8.97		0	0	10.23	9.21	1.03	1.5	1.5	
28 X	561	29	9.9	1.5	9.9	9.15	.65	0	0	10.38	9.42	0.96	1.54	1.53	
28 Z	561	29	34.29	1.5	34.29	33.54	35.04	0	0	34.76	33.8	0.97	1.51	1.51	
29 X	562	29	18.82	1.5	18.82	18.07	19.57	0		19.39	18.22	1.16	1.45	1.44	
29 Z	562	29	61.15	1.5	61.15	60.4	61.9	0		60.63	1.04	1.47	1.46		
30 X	1	A	12.24	1.0	12.25	11.74	12.74	0	0.03	1.82	0.96	1.23	1.23		
30 Y	1	A	3.86	1.0	3.85	3.36		0	0	4.22	3.51	0.71	1.45	1.45	

Multi-functional DM team

But how do I visualise the results and show people what the final product will actually look like?

Dimensional Variation Analysis

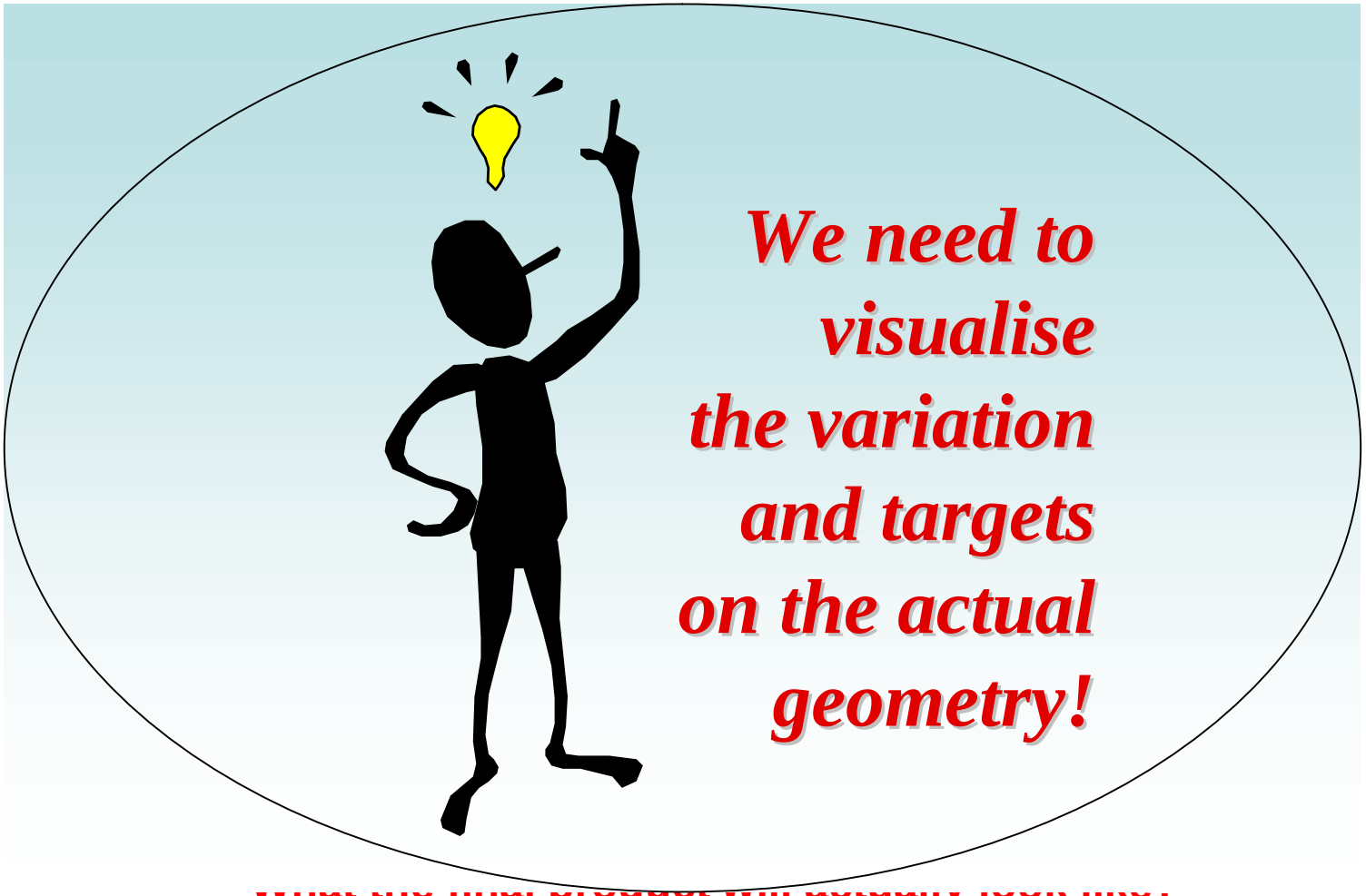
Tolerance Analysis Packages

(VisVSA, 3DCS, em-Tolmate)

Analysis

I know the build capability and sensitivities…

Current Tools



What is aesthetica™ ?

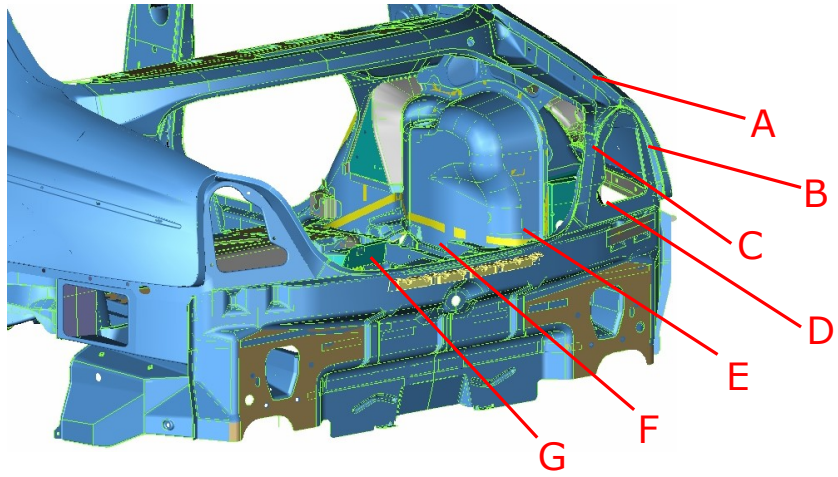
An innovative product for quickly visualising the impact of variation on the aesthetic quality of products early in the product development process

Company Background

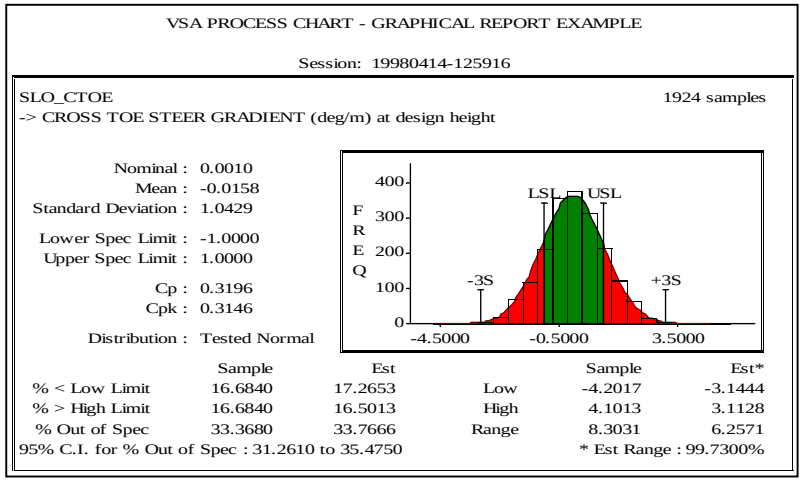
- University of Leeds VITAL research project from 1996 to 2002 (**V**isualising the **I**mpact of **T**olerance **AL**location)
- Research partners included Rover, BMW, JLR and SGI
- Icona Solutions Ltd formed in Feb 2003 to develop, market and sell commercial products based on VITAL technology
- First product, aesthetica™, launched in March 2004
- Majenta Solutions signed as exclusive UK resellers - Apr 2004
- Final stages of establishing international reseller network
- Customers include Nissan, MG Rover, Case New Holland and Warwick Manufacturing Group

Typical DVA Review

Results from a typical Dimensional Variation Analysis (DVA) Process



ID	Nominal	Tolerance Limits	% below LSL	% above USL	High (Sample)	Low (Sample)	Range (Sample)	Cp	Cpk	Process Status
A	115	0.5	19.77	19.6	115.99	114.11	1.88	0.29	0.29	
B	151	0.5	14.8	14.17	151.8	150.28	1.52	0.36	0.36	
C	160	0.5	0.87	0.9	160.38	159.63	0.76	0.77	0.77	
D	44	0.5	20.53	21.3	44.96	43.02	1.93	0.28	0.27	
E	0.02	1.0	3.07	2.6	0.95	-0.81	1.77	0.64	0.63	
F	0.02	1.0	1.9	2.7	0.95	-0.85	1.8	0.65	0.64	
G	-0.05	1.5	1.1	0.37	0.89	-1.11	2	0.83	0.76	
H	3.24	1.5	1.17	0.47	4.29	2.11	2.19	0.83	0.77	
I	6.64	1.5	1.17	0.33	7.6	5.59	2.01	0.83	0.76	
J	9.53	1.5	1.17	0.23	10.42	8.32	2.09	0.83	0.76	
K	19.03	2.0	0.07	0	19.91	17.83	2.08	1.09	1.03	
L	-8.65	2.0	0	0	-7.88	-9.39	1.52	1.47	1.47	



Typical DVA Review

Useful analysis, but it doesn't answer the fundamental questions:

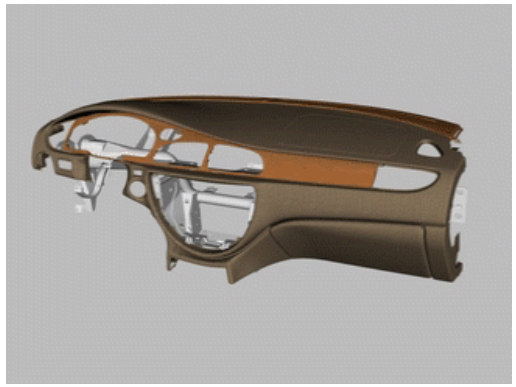
What will the assembly look like in the red light areas?

What is happening between the measurements?

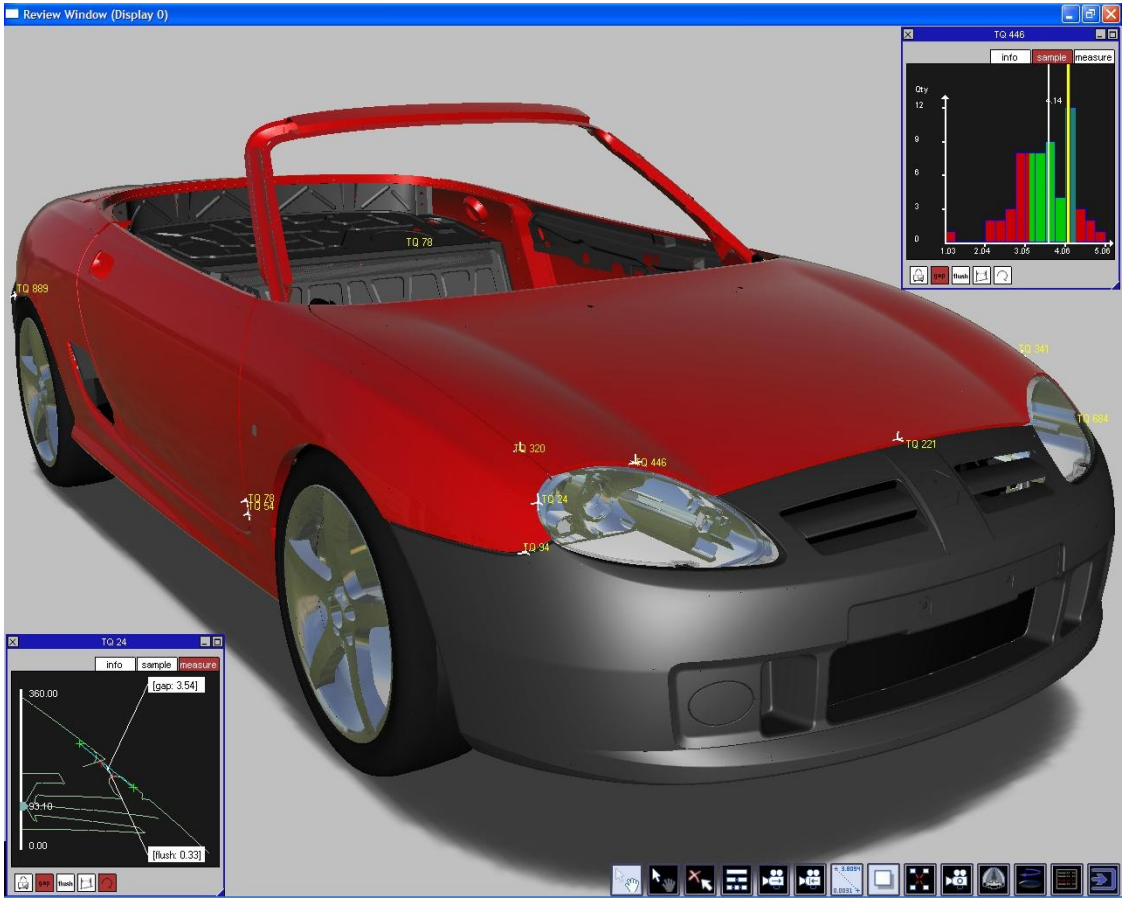
What will final product actually look like to a customer?

What is unique about aesthetica™?

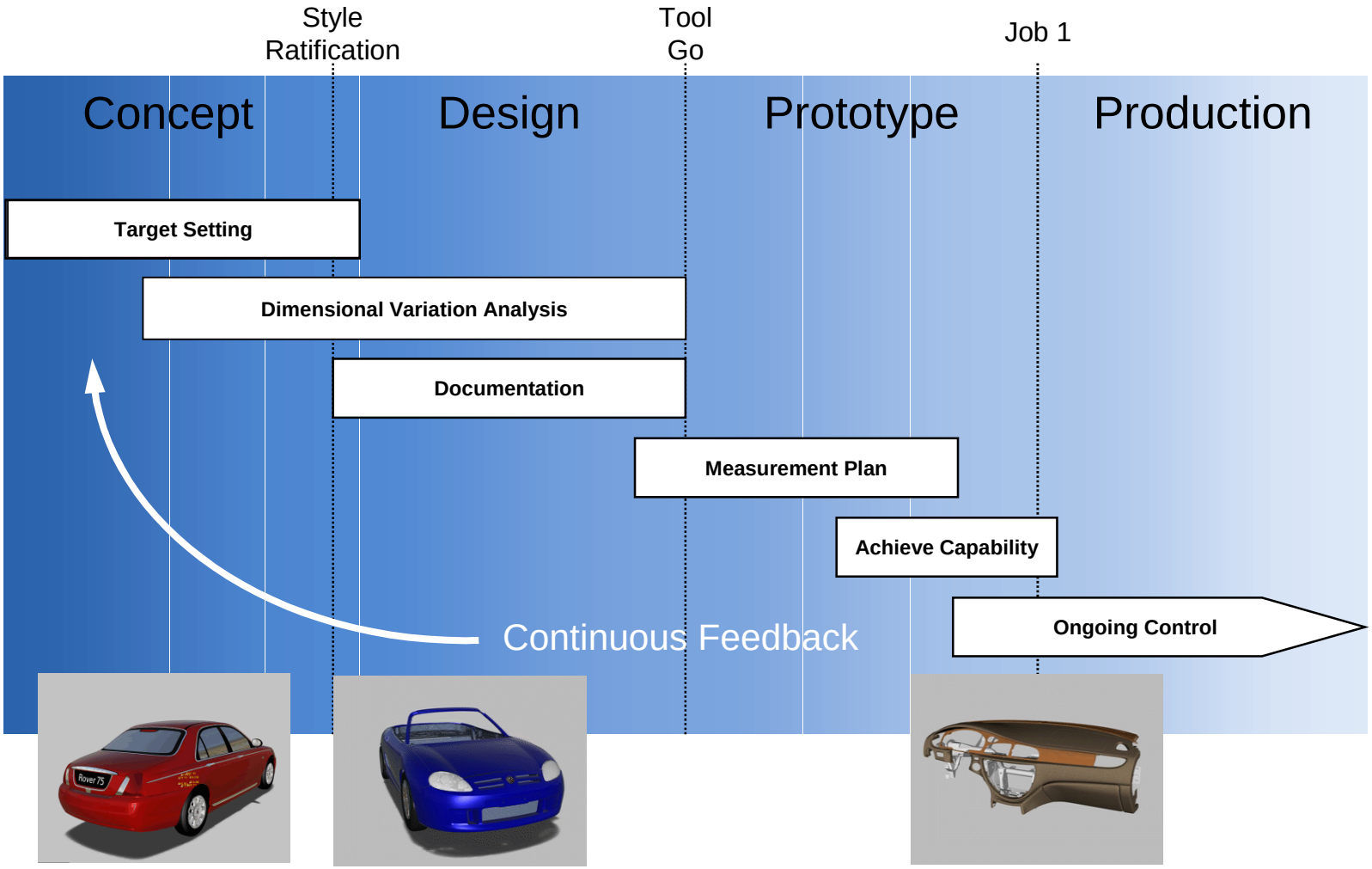
- aesthetica™ is unique because it applies variation directly to component geometry
- This enables you to see what the manufactured product will look like using a virtual model
- Reducing the need for physical models and other forms of one-off prototype



Demonstration

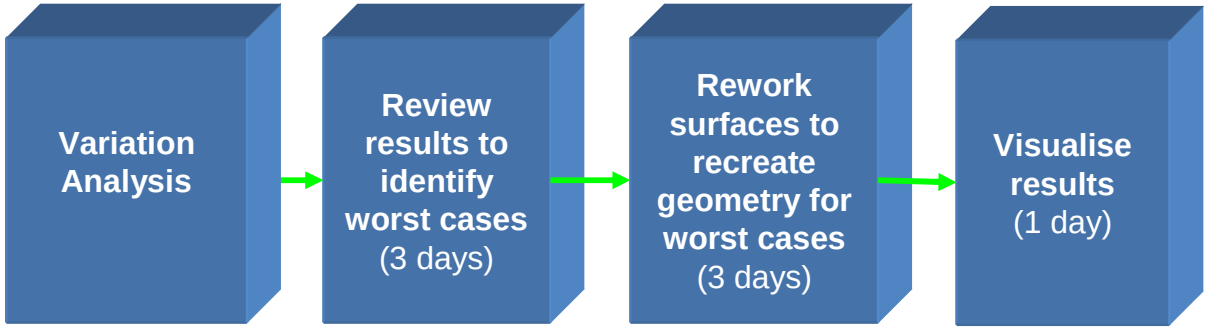


aesthetica™ in the DM Process



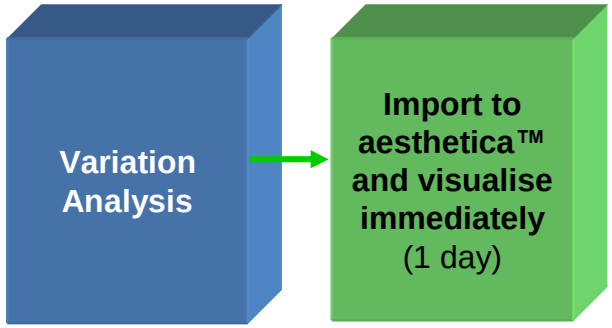
Benefits – Time Compression

Current Process for Visualising DVA Results



7 Days

Using aesthetica™…



1 Day

Repeated for:

- Body side and Fenders
- Hood top and Decklid
- Front & Rear Bumper
- Front & Rear Lamps
- Front Grille & Mouldings
- Doors and Glazing

aesthetica™ delivers significant time savings for DM processes

Summary

- The Dimensional Management (DM) process delivers significant time and cost savings
- The DM process already benefits from engineering tools for tolerance analysis and design tools for visualisation
- aesthetica™ bridges the gap between these areas enabling full visualisation of the aesthetic impact of manufacturing variation
- Enables multi-functional DM teams of designer AND engineers to quickly and efficiently share problems and negotiation solutions
- … leading to significant time and cost savings

Thank you

Icona

Visualizing Aesthetic Quality

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