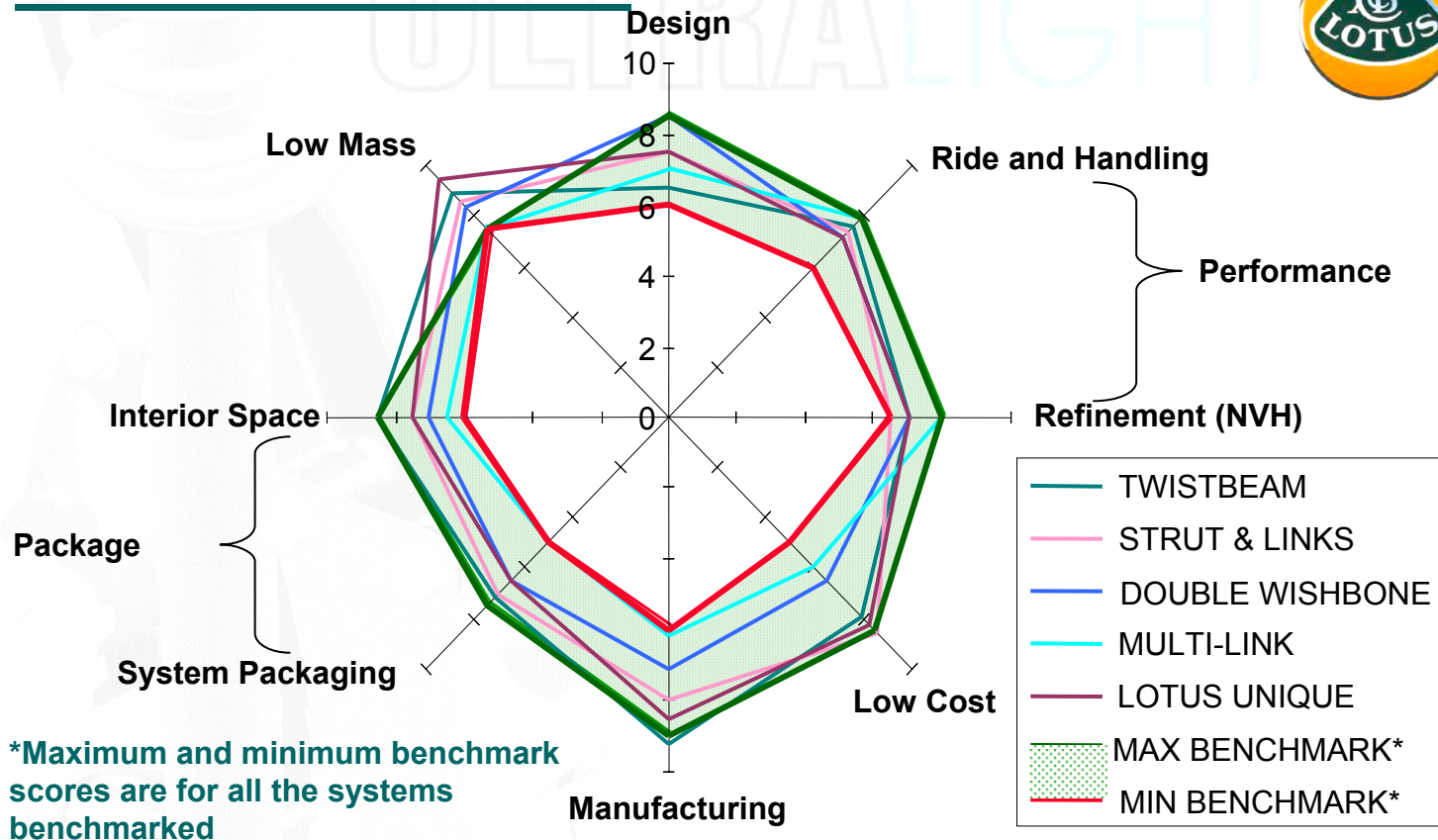


OVERALL RESULTS



The overall results for all the ULSAS systems are presented above. The ULSAS project has concentrated on promoting the areas of mass and cost, the successful results achieved in these areas are illustrated in the diagram above and further in the following pages.

The ULSAS systems meet or exceed the benchmark minimum in all other areas. Particular areas of interest are:

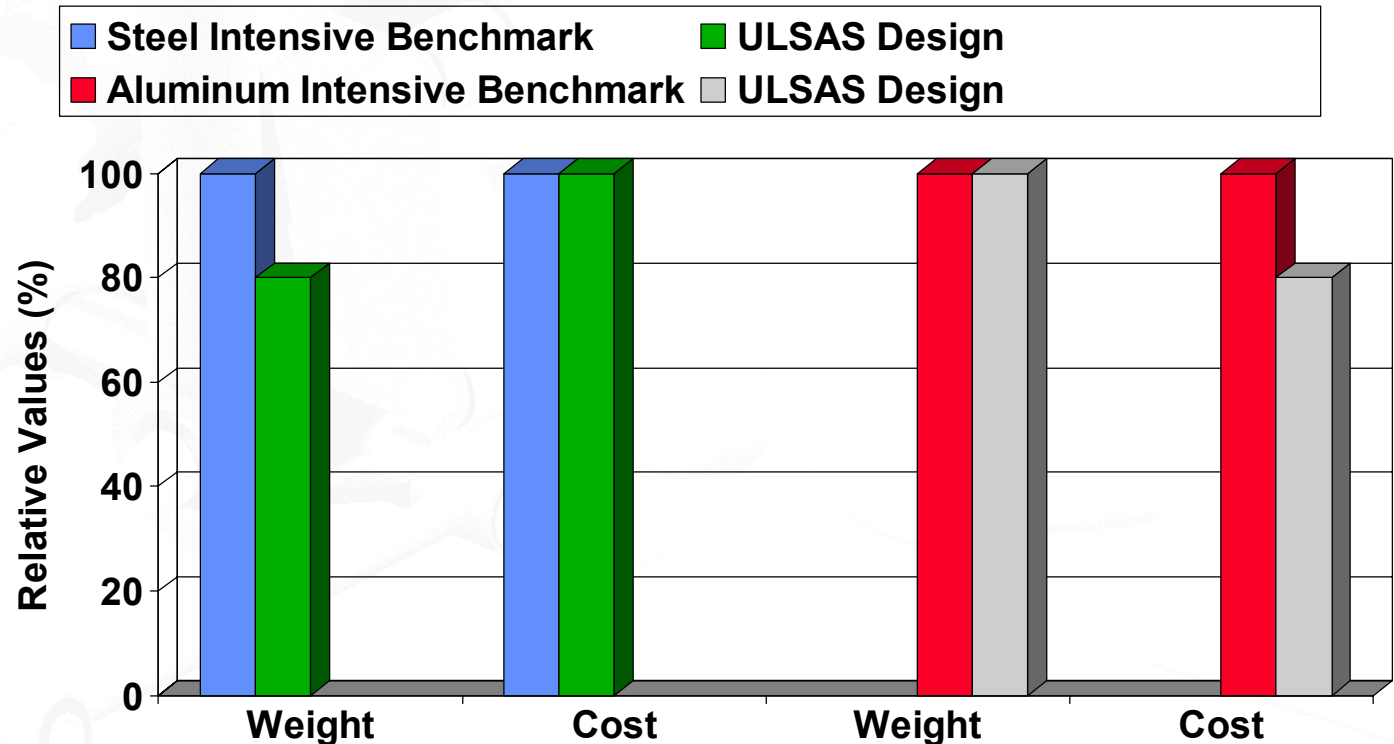
- The overall score is higher than the benchmark for ride and handling and matches that of NVH.
- The performance of the Twistbeam system which approaches that of the sophisticated Multi Link system.
- The mass of the Lotus Unique system which is the lightest ULSAS system.
- The mass of the Twistbeam system which is approximately 32% lighter than that of the benchmark.
- The cost of the Multi Link system which is 30% more economic than the aluminium intensive benchmark system.

OVERALL PROGRAMME TARGETS



The overall targets for the Design Phase of the ULSAS programme of work are as follows:

- A mass reduction target of >20% with no cost penalty with respect to the steel intensive benchmark systems.
- A cost target of 20% decrease whilst matching the mass of the aluminium intensive benchmark system.

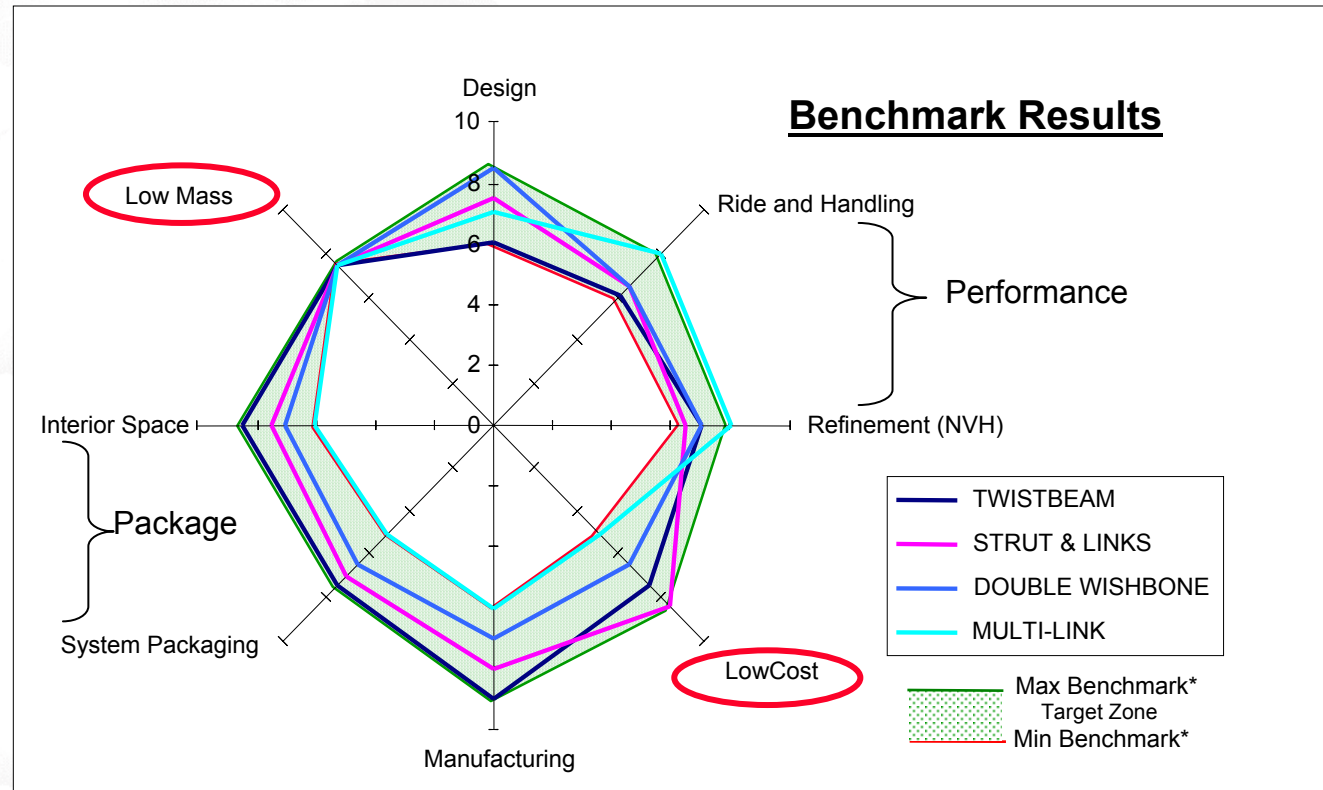


OVERALL PROGRAMME TARGETS



The performance targets for the Design Phase of the ULSAS programme of work are as follows:

- Achieve the cost and mass targets whilst not compromising any of the other criteria as shown in the spider graph.
- Therefore a target zone for ULSAS designs has been defined between the maximum and minimum benchmark scores for each individual criteria independent of the suspension system (depicted as a shaded area). For example the Multi-link suspension defines the maximum score for Refinement and Ride & Handling while the Strut & Links define the maximum score for Low Cost.



OVERALL RESULTS



Description	Cost (Saving)		Mass (Saving)	
	Target	Achieved	Target	Achieved
Twistbeam	0%	6%	20%	32%
Strut & Links	0%	2%	20%	25%
Double Wishbone	0%	0%	20%	17%
Multi-link (Vs Aluminium Benchmark)	20%	30%	0%	3%
Lotus Unique (Vs Double Wishbone)	0%	22%	20%	34%

MASS SUMMARY



Mass Of ULSAS Solutions Vs Benchmark Vehicles *					
Description	B	C	D	E	P
VW Golf Audi A6		33.40		45.35	
ULSAS Twistbeam (Kg)	25.12	27.30	30.97	30.63	26.31
System Mass Savings (%)		18%		32%	
Ford Mondeo Taurus			39.70	42.10	
ULSAS Strut & Links (Kg)	27.77	28.37	29.87		27.97
System Mass Savings (%)			25%		
Honda Accord			39.84		
ULSAS Double Wishbone (Kg)			32.88		31.29
System Mass Savings (%)			17%		
BMW 5 Series				48.00	
ULSAS Multi-link (Kg)			46.34	46.67	45.34
System Mass Savings (%)				3%	
Honda			39.84		
ULSAS Lotus Unique (Kg)			26.49		23.53
System Mass Savings (%)			34%		

* Masses are for the Suspension Structure only; in case of the Multi-link the subframe is included

COST SUMMARY



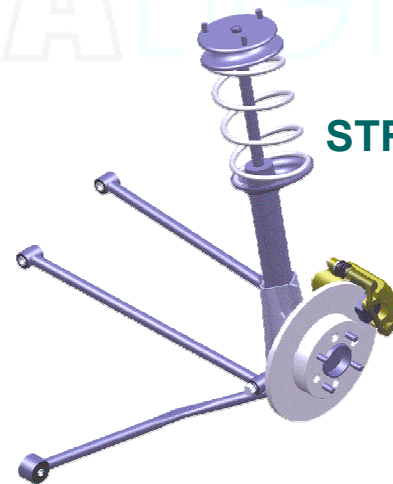
Cost of ULSAS Solutions Vs Benchmark Vehicles									
(US\$)	Twistbeam		Struts & Links		Double Wishbone		Multi- Link		Lotus
	Benchmark E Class	ULSAS E Class	Benchmark E Class	ULSAS P Class	Benchmark D Class	ULSAS D Class	Benchmark E Class	ULSAS E Class	ULSAS D Class
PIECE COST	\$178.3	\$169.9	\$144.5	\$145.1	\$200.7	\$202.5	\$470.8	\$334.4	\$159.4
TOTAL TOOLING COST (\$,000)	\$5,611	\$2,965	\$2,180	\$2,283	\$4,192	\$4,340	\$12,211	\$5,855	\$2,907
5 YEAR Volume (Assumptions)	2,000,000	2,000,000	2,000,000	2,000,000	2,075,000	2,000,000	1,075,000	1,000,000	2,000,000
TOOLING COST	\$2.8	\$1.5	\$1.1	\$1.1	\$2.0	\$2.2	\$11.4	\$5.9	\$1.5
TOTAL SYSTEM COST	\$181.1	\$171.4	\$145.6	\$146.2	\$202.7	\$204.7	\$482.2	\$340.2	\$160.9
SYSTEM ASSY									
Labour Rate (US\$/min on \$44/Hr)	\$0.73	\$0.73	\$0.73	\$0.73	\$0.73	\$0.73	\$0.73	\$0.73	\$0.73
Assembly Mins	3.86	2.42	6.17	1.92	6.59	2.87	9.93	5.03	1.58
SYSTEM ASSEMBLY COST	\$2.83	\$1.77	\$4.52	\$1.41	\$4.83	\$2.10	\$7.28	\$3.69	\$1.16
VEHICLE FITTING									
Labour Rate (US\$/min on \$44/Hr)	\$0.73	\$0.73	\$0.73	\$0.73	\$0.73	\$0.73	\$0.73	\$0.73	\$0.73
Fitting Mins	1.21	0.93	2.93	1.33	1.83	1.76	1.35	0.64	1.01
VEHICLE FITTING COST	\$0.89	\$0.68	\$2.15	\$0.98	\$1.34	\$1.29	\$0.99	\$0.47	\$0.74
Total Cost (\$)	\$184.8	\$173.9	\$152.3	\$148.6	\$208.9	\$208.1	\$490.5	\$344.4	\$162.8
Cost Saving(\$)		\$11.0		\$3.7		\$0.8		\$146.1	\$46.1
Cost Saving %		6%		2%		0%		30%	22% *

* Savings compared to Double Wishbone Benchmark

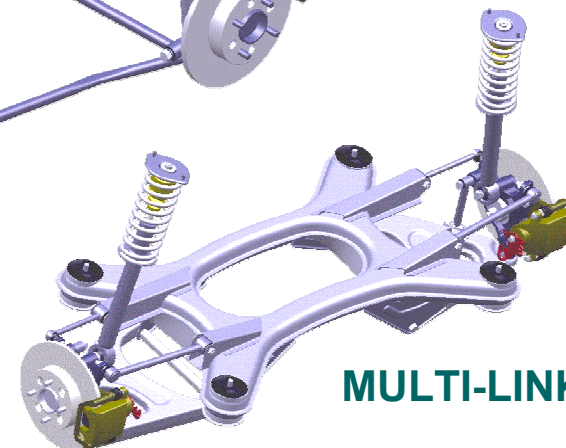
The ULSAS Programme has demonstrated lightweight suspension systems that are manufacturable, affordable and meet customer expectations.

Suspension system solutions have been identified that are up to 34% lighter than benchmarked systems whilst remaining cost effective.

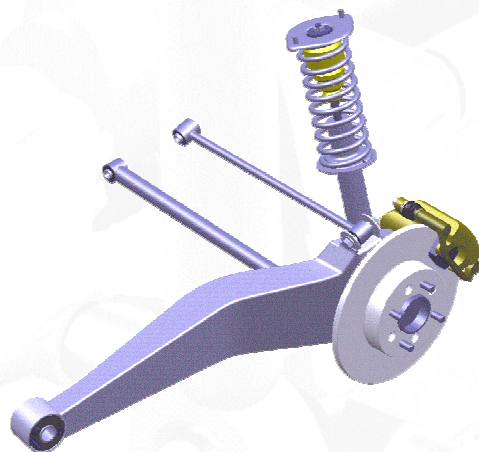
Other solutions have been identified that closely match the mass of Aluminium systems whilst achieving 30% cost savings.



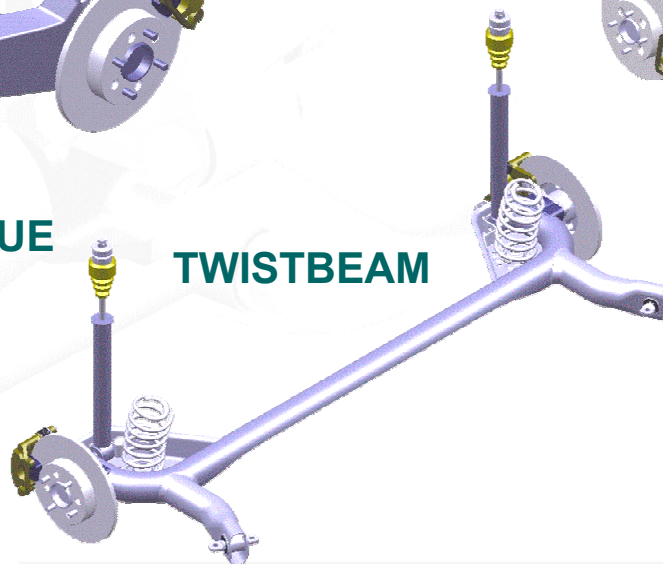
STRUT & LINKS



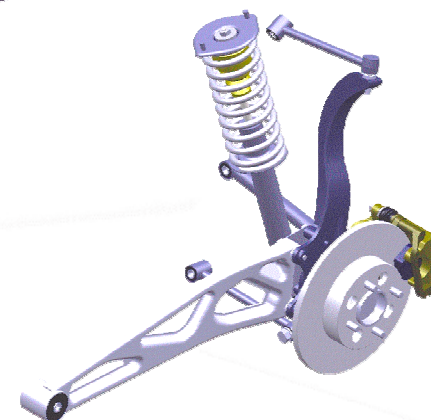
MULTI-LINK



LOTUS UNIQUE



TWISTBEAM



DOUBLE WISHBONE

STEEL AUTO SUSPENSION