

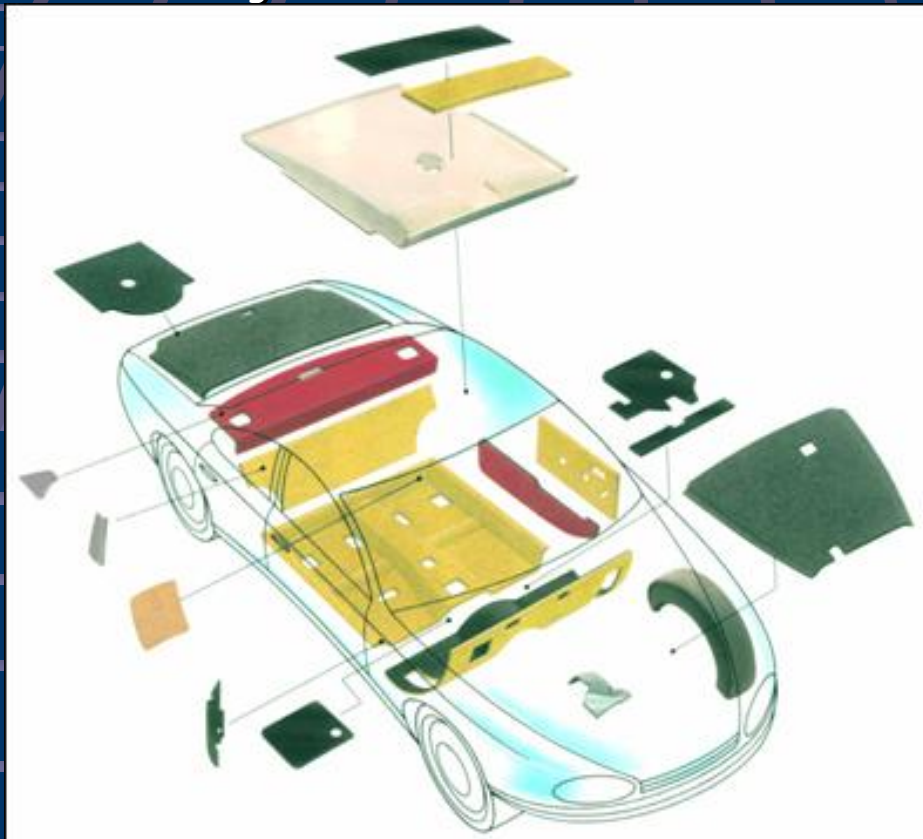
Sound Package & Vehicle Integration

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General Motors Corporation

Multiple Acoustics Parts

A List of Parts, and
A Set of Parts, and
A System of Parts!



Key influencing factors:

- Performance
- Packaging space
- Cost
- Mass
- Installation

Those Parts Are “Designed In”, not “Added On”

“Add On” – “Old days”, screening technique on prototypes

Parts were added at the late phase of the program

“Design in” - Today’s System Integration

Parts are defined at the early phase of the program
and developed and refined further along with the
program



Desired State of Early Development

Program Definition

Preliminary
definition

Feasibility
Study

Formal Development & Preparation For
Production

Time

Balanced Solutions
Available

Noise Performance
Requirement

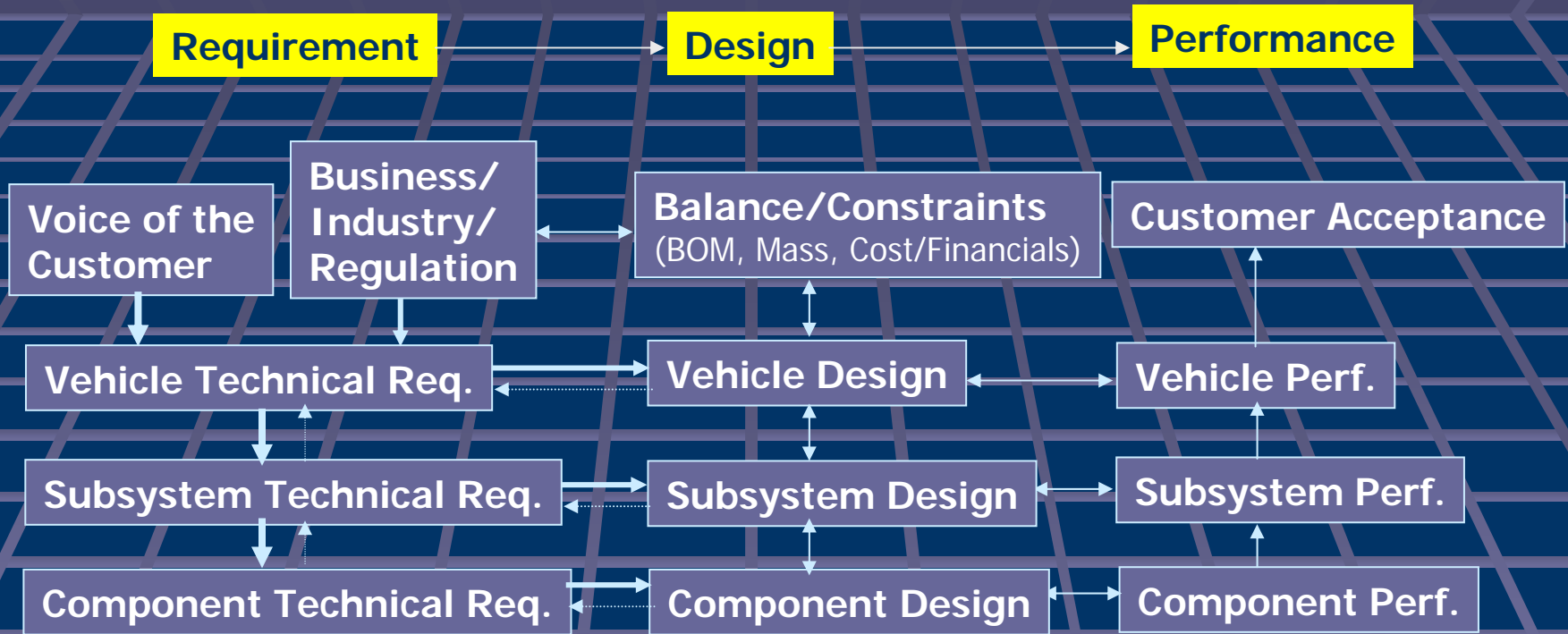
Packaging
Space

Mass

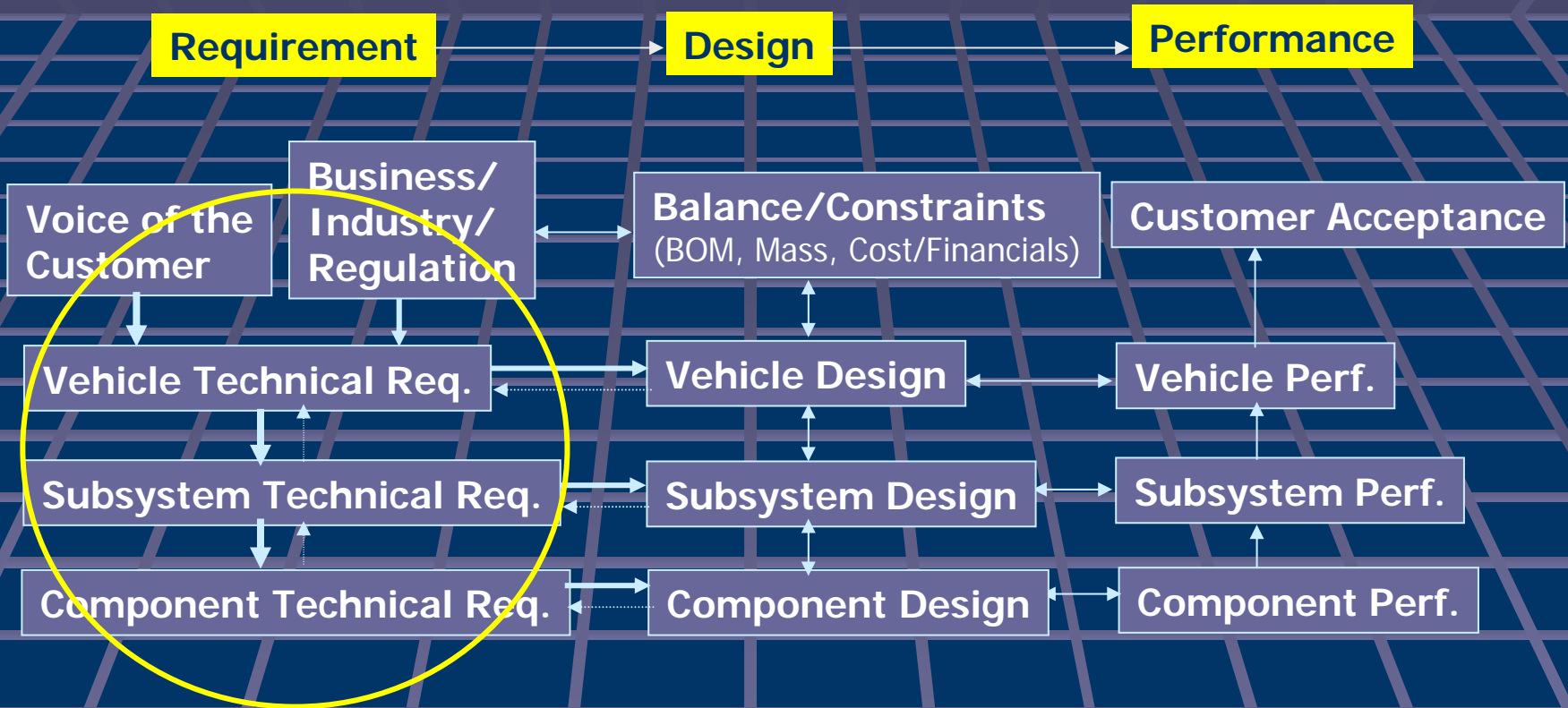
Cost

* Other constraints
not shown

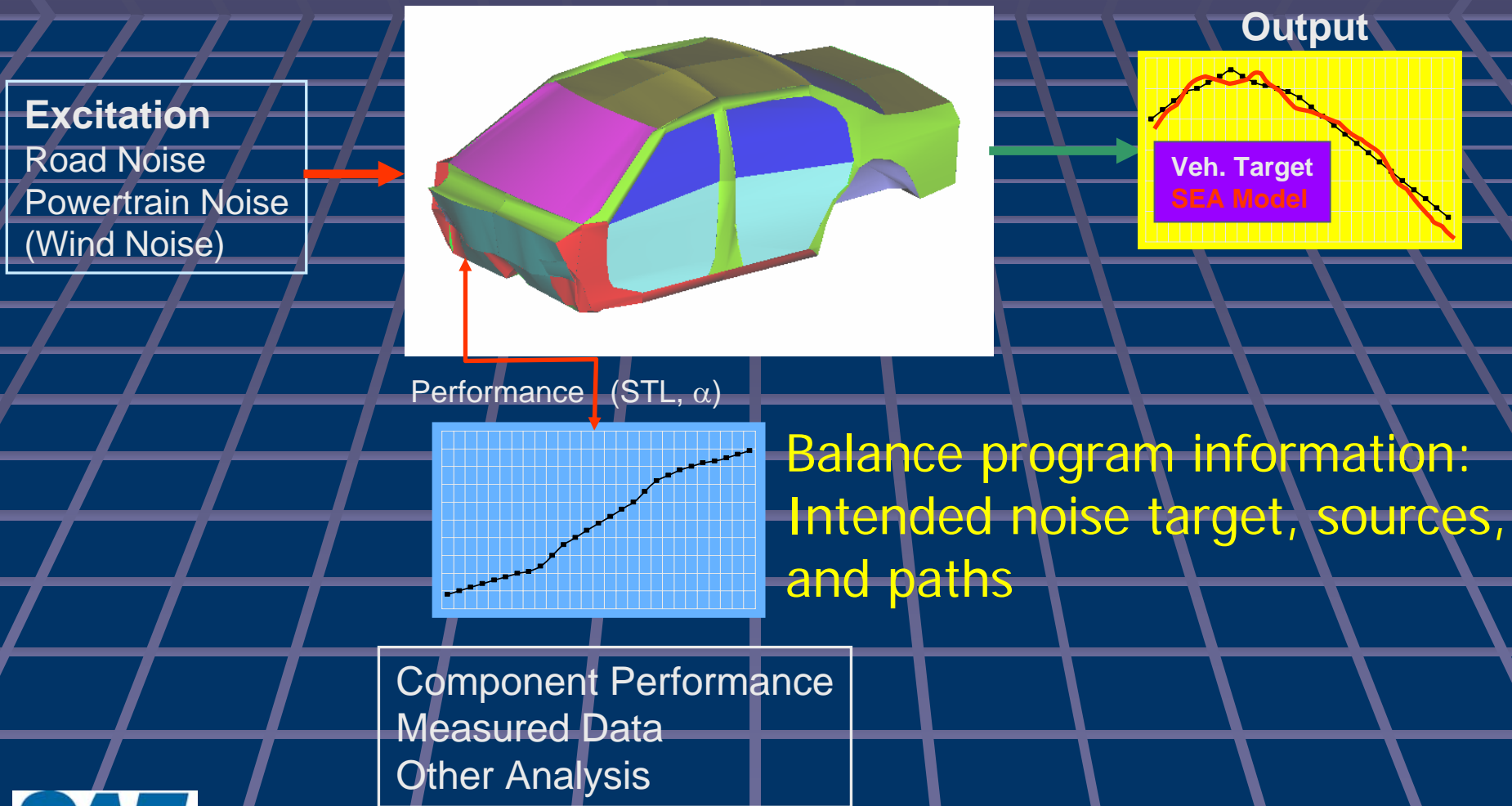
Systems Engineering



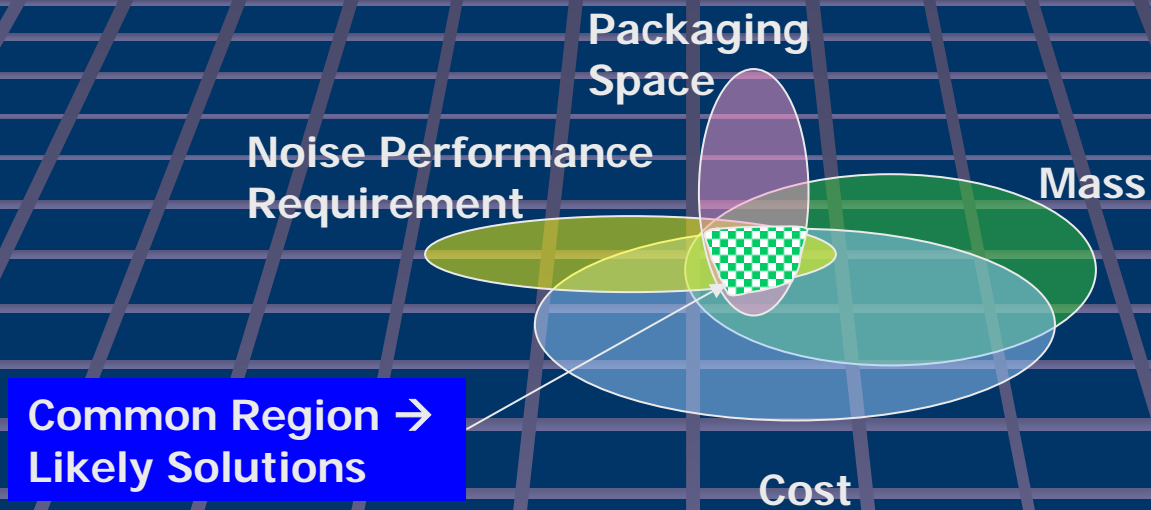
Systems Engineering



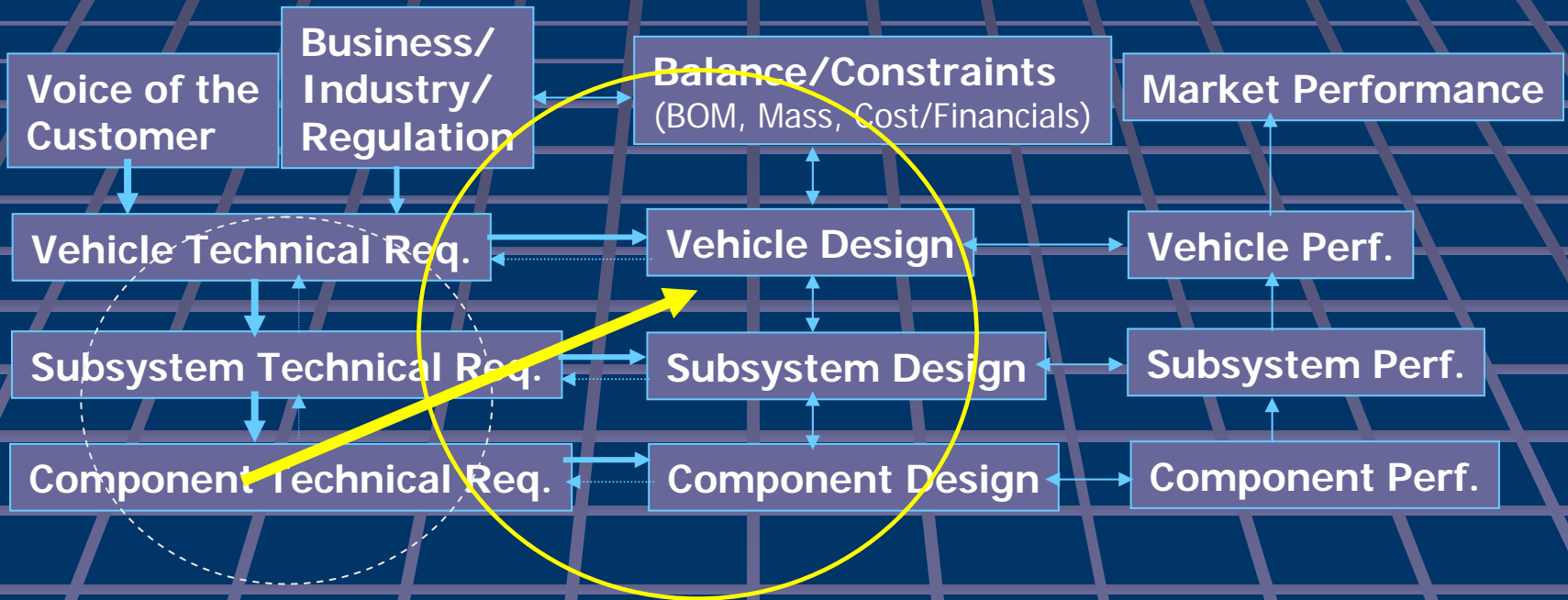
SEA Model For Requirement Balance



Desired State Reached?



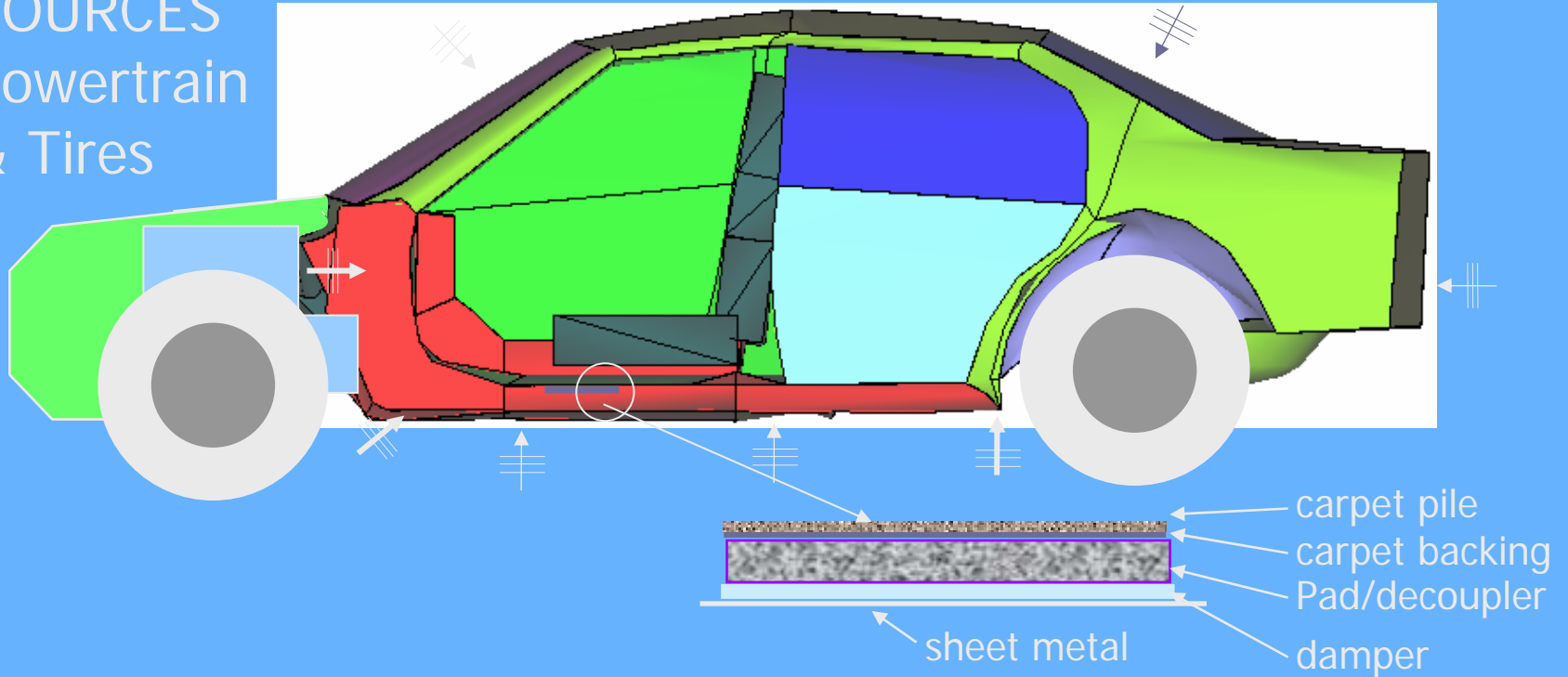
Early Development & Early Designs



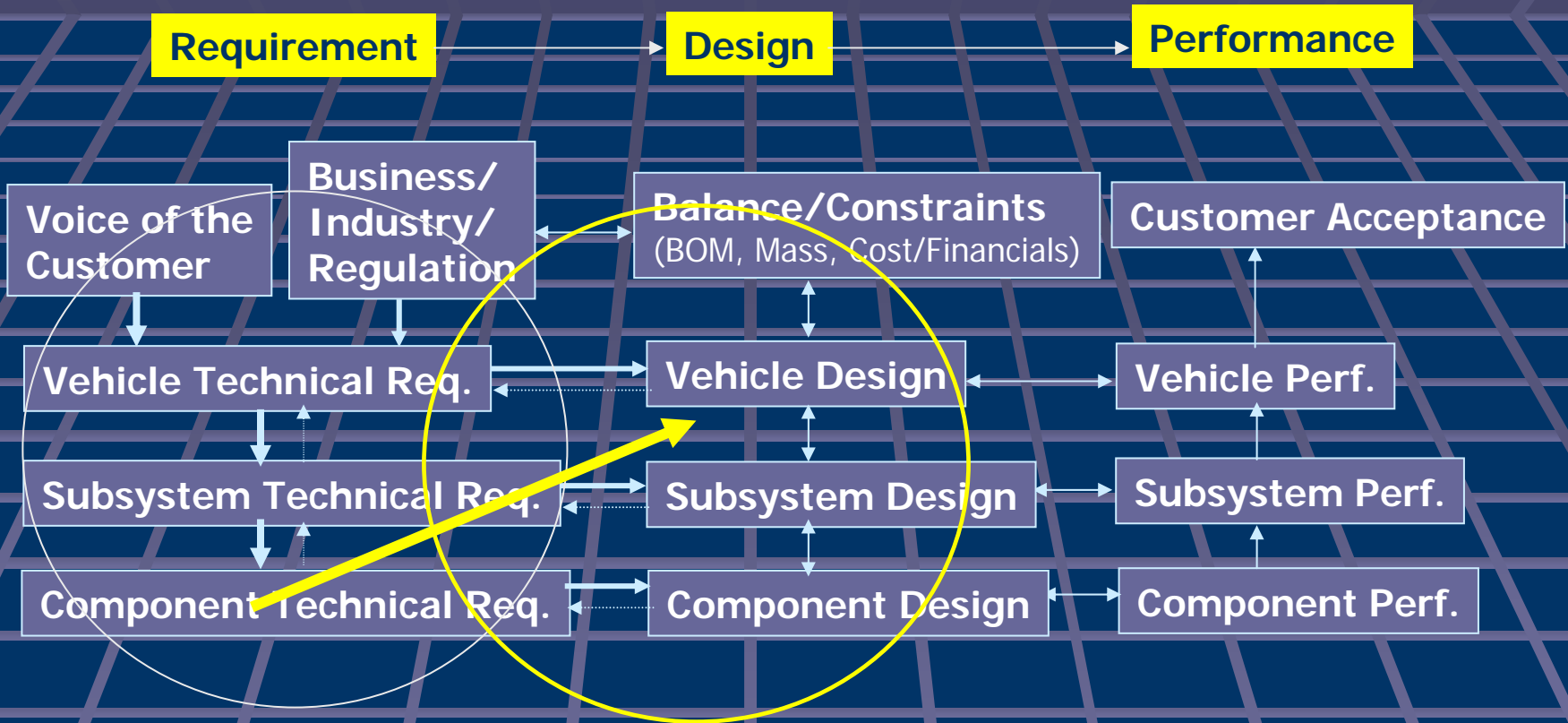
Early Design Can Be Detailed

Packaging scenario 1
Packaging scenario 2
...

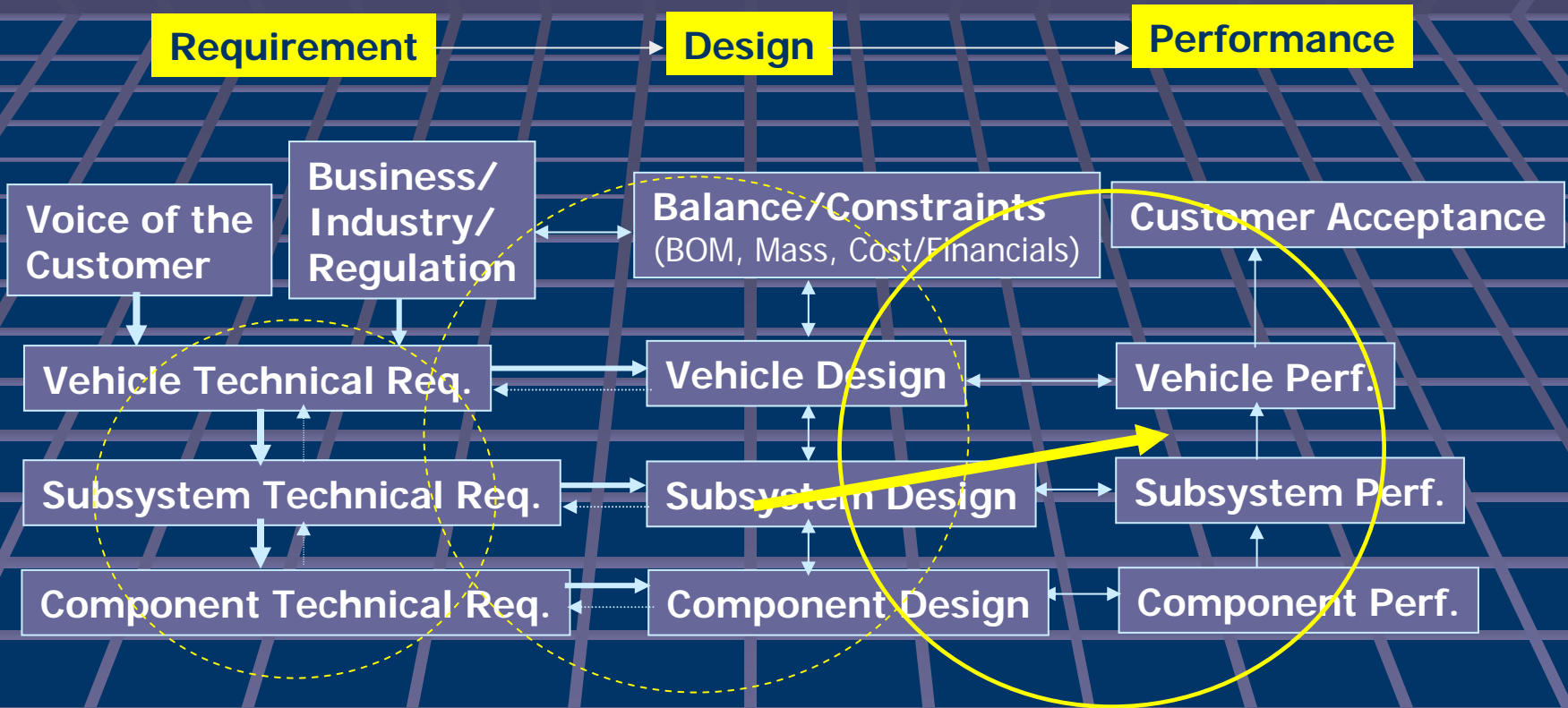
SOURCES
Powertrain
& Tires



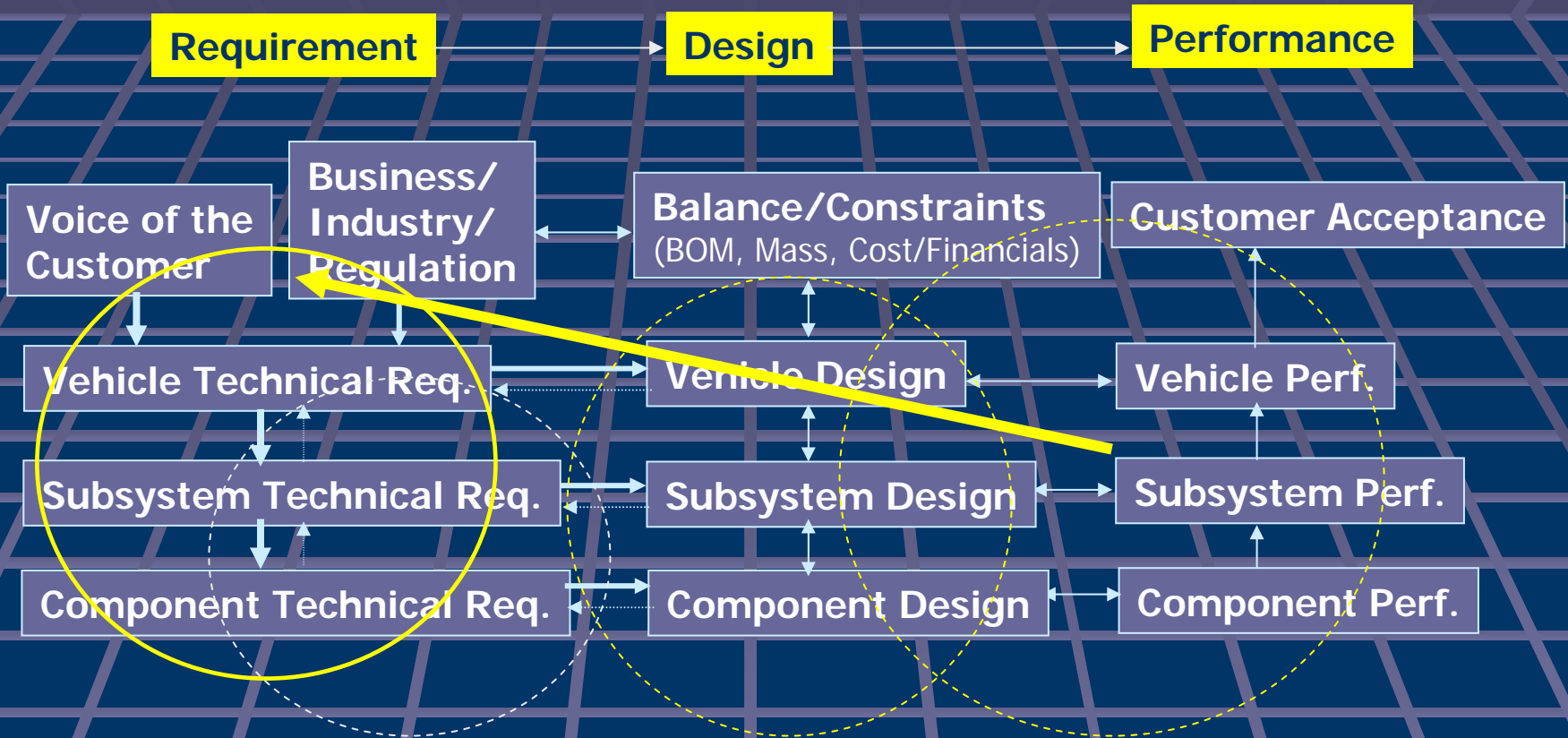
Systems Engineering



Systems Engineering



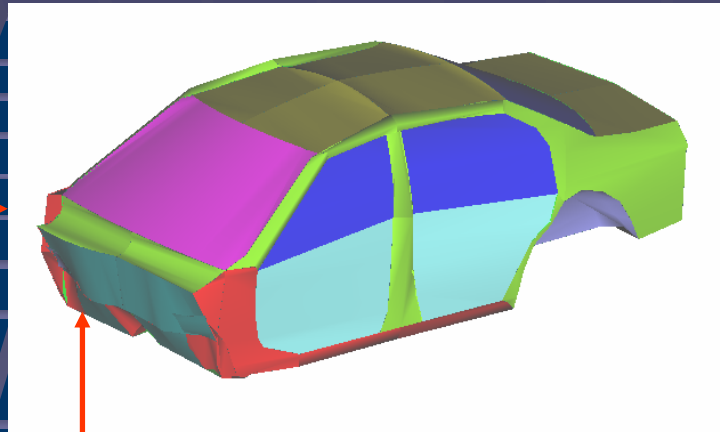
Systems Engineering



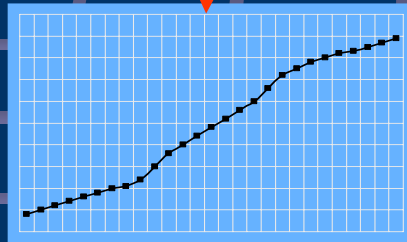
Further Requirement Balance

Excitation

Road Noise
Powertrain Noise
(Wind Noise)

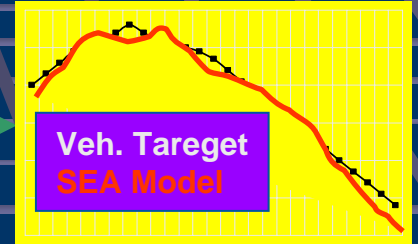


Performance (STL, α)



Component Performance based
on updated design

Output



Repeated process

- fast
- approximation OK
- optimization possible

Conclusions

Parts are “designed in” through system engineering

Performance requirement interactive with early design

“Balance” is an iterative process, optimization is possible

