SUBSYSTEMS

DEFINITION

"A system is a construct or collection of different elements that together produce results not obtainable by the elements alone. The elements, or parts, can include people, hardware, software, facilities, policies, and documents; that is, all things required to produce system-level results." (*NASA Systems Engineering handbook 2007 edition)*

TYPES OF SUBSYSTEMS

Subsystems are found in business, science and technology fields and elsewhere. The automotive industry is well known for the use of subsystems. Subsystems used in automotive construction include:

Powertrain	Power
Exhaust	Intake
Fuel	Starting & charging
Train	Steering
Engine electrical	Electrical
Differential	Cooling
Universal and CV joints	Wheel/axle suspension
Brakes	Body
Suspension	Transmission

When a vehicle is constructed all of these systems must be considered simultaneously and made to work as one - efficiently and effectively.

Constructing subsystems allows parts to be constructed separately. There are often subsystems inside subsystems. Subsystems can be tested before placing onto the final system. The Systems Engineering Process is not sequential, the functions are performed in a parallel and iterative manner.

SYSTEMS ENGINEERING

The systems engineer focuses on the whole system leading and working with many diverse technical team members, following the systems engineering development cycle, conducting studies of alternatives, and managing the system interfaces.

Systems engineering is primarily concerned with

- Evaluating the problem and finding the most appropriate solution
- guiding the engineering development and design,
- defining and managing interfaces,
- developing test plans, and
- determining how discrepancies in system performance uncovered during test and evaluation should best be rectified.

The main bulk of the engineering effort is carried out during this stage.

The Systems Engineering Process is usually comprised of seven tasks.

S	**S**tate the problem
I	**I**nvestigate alternatives
M	**M**odel the system
I	**I**ntegrate
L	**L**aunch the system
A	**A**ssess performance
R	**R**e-evaluate

MODEL/KIT SUBSYSTEMS

Model vehicles construction can also be broken down into subsystems The completed subsystems are assembled to form the complete model. The complexity of the project determines the subsystems required. Examples of subsystems you may find are:

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Subsystem	Components
Power / Electrical	Battery, chargers, wires & connectors, motor, gearboxes
Steering	Steering linkages, front axle
Powertrain	Components of Electrical system, back wheels, back axle
Chassis	Frame of vehicle
Control	Transmitter, Receiver, Infra-Red

Many Scorpio Technology kits use subsystems e.g. gearboxes. We have nine different gearboxes. These allow the student to investigate and experiment with gear ratios and torque. They can then choose the best gearbox for their project. Many kits also have PCBs for control. The PCBs often have their own subsystems (H-bridge, Schmitt trigger etc.). All except the smallest electronic systems are built up from subsystems. These are built from electronic components such as resistors, transistors, and switches.

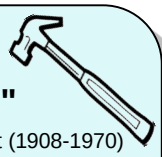
The Radio Control vehicle uses a front wheel and steering linkage subsystem. The front wheel & steering linkage is also available separately so that it can be used in other projects.

The Windup clockwork mechanism is a subsystem most often used in toys. A key winds up the mechanism. The *Jumping Bug* project is a simple project using this mechanism.

FURTHER INVESTIGATION:

- Investigate types of subsystems. Draw a simple diagram showing the components used to make a subsystem.
- Choose a kit or project. Decide if it would be beneficial to divide it into subsystems. What subsystems would you choose.
- How do subsystems interact?

"To a man with a hammer everything looks like a nail."



Abraham Maslow, psychologist (1908-1970)

We teach students how to use a tool. Then they use that tool for everything. We should teach them to study each problem and then select the best tool for that problem.

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Inspirational projects for teaching Design, Creativity & Technology

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