Technology Design Task

-Artefact Production-

TECHNOLOGY SUBJECTS SUPPORT SERVICE

Design Task Artefact

A number of factors can be considered in influencing the extent to which the completed artefact fully satisfies the chosen design brief specifications. These include:

- Appropriateness of materials choice
- Creativity and Design Inventiveness
- Functionality and Suitability
- Appropriateness and quality of manufacturing processes
- Appropriateness and quality of electronic and/or mechanical systems
- Appropriateness and quality of assembly methods used
- Detailed finish and overall presentation

Selection of Materials

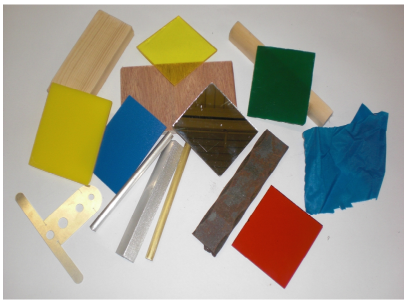
In selecting the most appropriate materials for a particular task a number of considerations need to be taken into account:

-Physical properties required: (Tensile, Shear and Compressive Strength, Hardness, Stiffness, Toughness, Malleability, Corrosion resistance, Weight

- Appearance, Colour
- Manufacturing processes involved and available
- Availability of material (to include forms and sizes)
- Economics in terms of cost and time
- Environmental considerations

Materials available

A wide range of materials are available for use in the manufacturing process.
It is important that the materials selected are suited to their respective function.



Materials in common use

- *Metals*-

- **Ferrous and non ferrous**
- **Alloys**

- Plastics-

- **Thermoplastics (Acrylic widely used)**

- *Wood*-

- **Softwood and Hardwood**
- **Processed wood**

- *Composites* –

Separate materials that are combined to produce particular properties. eg Carbon fibre, GRP, Cardboard, Kevlar, Concrete.

Materials available

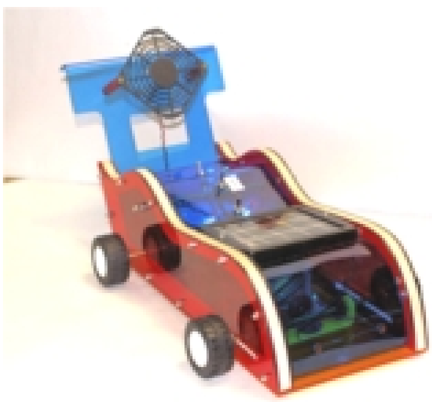
Smart Materials are now making a real impact on everyday life and so exists an opportunity for students to incorporate these materials into various design tasks.

Smart Materials

- Polymorph
- Thermocolour sheet
- Lenticular sheet
- Phosphorescent sheet
- Magnetic sheet
- Galvanised-effect card
- Anodised- effect card
- Metal paper
- QTC

Material Selection

The appropriateness of material choice is most often reflected in the finished artefact in terms of functionality, creativity, quality of manufacture, assembly, detailed finish and presentation.



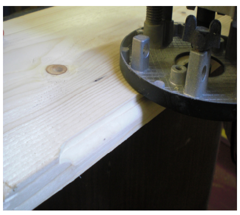
Material Selection

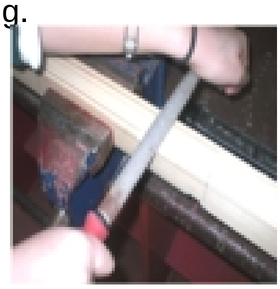
Safety considerations and proportion along with ease of access to power supplies, electro-mechanical systems etc is important.

Material finish

Good material finish is most often reflected by the overall **aesthetic** appeal and **attractiveness** an artefact has on presentation.

- Wood can be planed, routed, rasp filed, chiselled turned and sanded prior to varnishing, staining, waxing or painting.



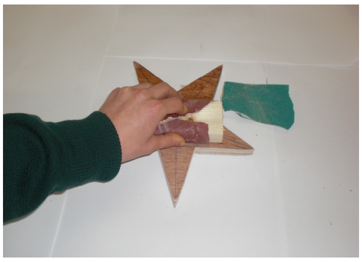


Material finish - Wood

Wood can be ***varnished*** or ***painted***

1. Apply ‘first’ coat.

2. Lightly sand when dry.



Supports

3. Apply a second coat.
4. Repeat until a good smooth finish is achieved.

Material finish

Metals and Plastics

For most metals and plastics the edges can be finished as follows:

1. 

Cross file

2. 

Draw file

3. 

Use wet/dry paper

4. 

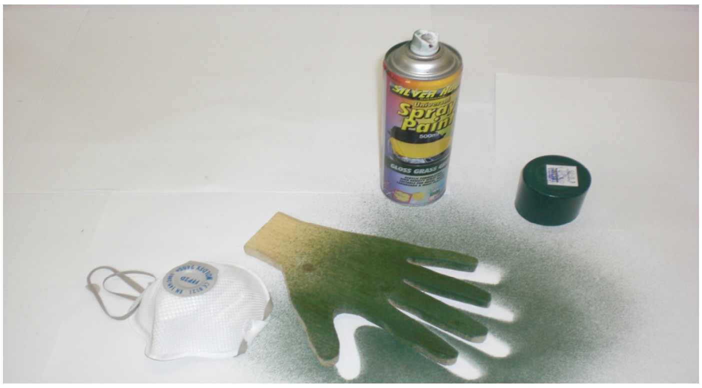
Use steel wool and oil

5. 

Polish

Material finish – Spray Painting

Wood (along with metals and plastics) can also be spray painted.



To avoid 'overrun' spray should be applied lightly in consistent even passes.

Integration

Functionality, reliability, quality, detailed finish and presentation can be further enhanced by the appropriate **integration** of components and subsystems to include electrical, electronic and electro-mechanical control systems.

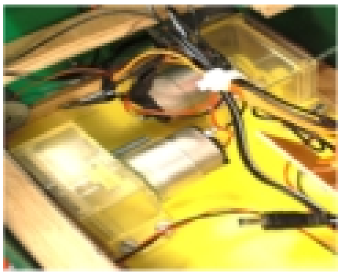
Motor mounting

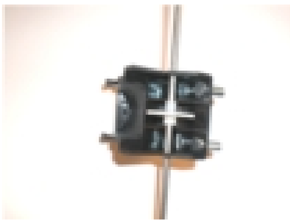
Motors can be mounted and fixed in placed using a number of different options:

A range of commercially available motor mounts can be used and fixed in place with bolts, screws or an adhesive pad.

Integration

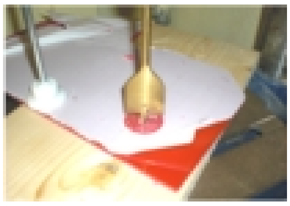
Motor mounts are also available which incorporate the motor and/or gear system and can be attached using bolts or screws.





Integration

Depending on the task at hand motors can also be mounted directly to the body of the artefact by drilling a hole to match the motor diameter.

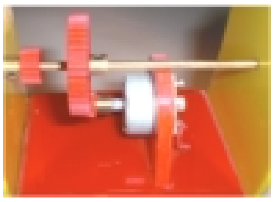


or

Flat bit

Hole saw

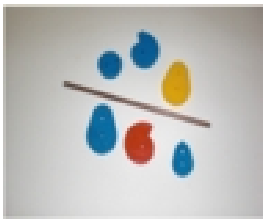
- Ensure that the workpiece is **clamped** whilst drilling -



Integration–Motion transmission

Once the motor has been mounted motion can then be transmitted using a variety of mechanical systems dependant on the output required. These systems can include:

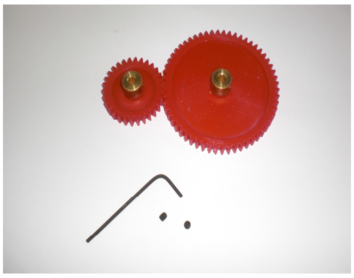
Cam and Follower

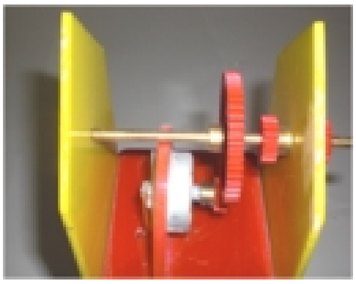


Integration-Motion Transmission

Gear systems – Gear systems commonly used include :

Simple and Compound gear trains



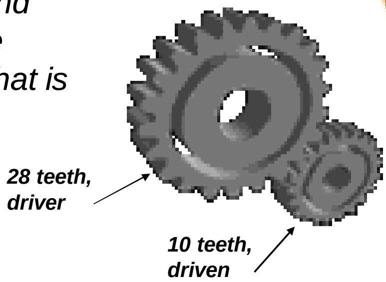


Can be used to increase or decrease the output speed (rpm) of the driven gear based on the input speed of the motor.

Integration - Simple Gears

Gear Speed - Calculations

A motor gear has 28 teeth and revolves at 100 rev/min. The driven gear has 10 teeth. What is its rotational speed?



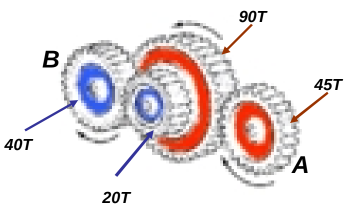
Speed of driven gear = $\frac{\text{Number of teeth on driver gear}}{\text{Number of teeth on driven gear}}$ x 100

Speed of driven gear = $\frac{28}{10}$ x $\frac{100}{1}$ = 280 rev/min

Integration – Compound Gears

Gears

Calculate the speed of gear B if the speed of the driving gear A is 100 rev/min.



Calculation:

45/90 = 1/2
20/40 = 1/2
1/2 x 1/2 = 1/4
Ratio = 1:4
Speed A = 100 rev
Speed B = 25 rev

**** Alternatively***

Output speed = $\frac{\text{Driver}}{\text{Driven}}$ x $\frac{\text{Driver}}{\text{Driven}}$ x Input speed

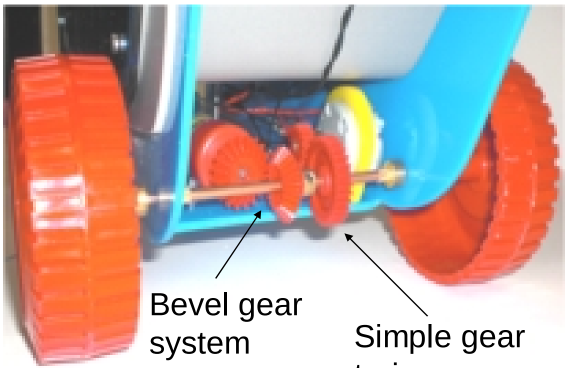
= $\frac{45}{90}$ x $\frac{20}{40}$ x $\frac{100}{1}$

= 25 rpm

Integration-Motion Transmission

Bevel Gear System

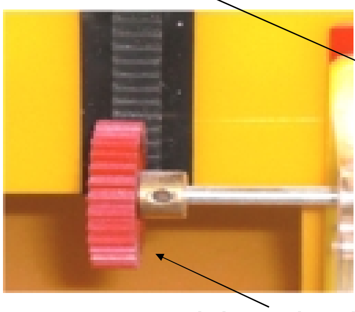
This system allows for motion to be transmitted through a right angle relative to position of the motor.

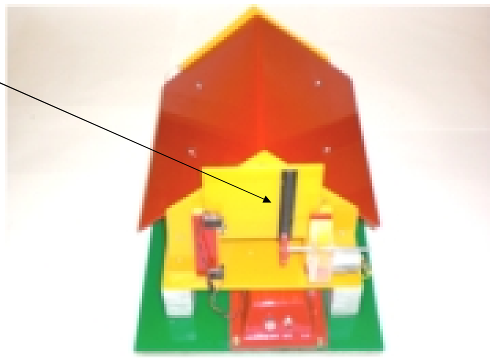


Integration-Motion Transmission

Rack and Pinion system

This system changes rotary motion into linear motion and vice versa.





The rack moves one tooth for every tooth of the pinion.

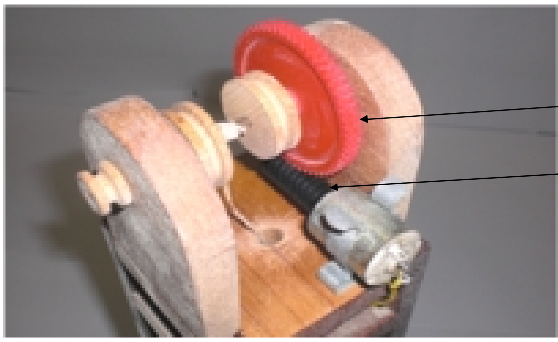
Integration-Motion Transmission

Worm and Wheel system

This system results in a ***large speed reduction***.

The wheel cannot drive the worm gear and so no ***slippage*** can occur.

The shafts are at ***right angles*** to each other.



Output speed = 1/no. of teeth on wheel x input speed

Integration-Motion Transmission

Pulley Systems

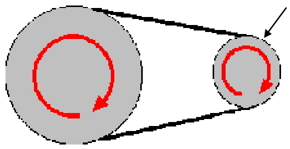
As an alternative to gear systems pulley systems are also used in the transmission of motion. The same principles apply in terms of speed output in that the pulley wheel diameters used determine the output velocity. Increased/decreased speed is based on which wheel is the ***driver*** and which wheel is the ***driven.***

Output speed = $\frac{\text{Driver dia.}}{\text{Driven dia.}}$ X input speed

Integration – Pulley Drives

Pulley drive calculations:

Driven 70 mm Dia.
Output speed ?



Driver 40 mm Dia.
280 rev/min

Driven will rotate slower than the driver.

Calculation;

Speed ratio $= \dfrac{\text{Diameter of Driver pulley}}{\text{Diameter of Driven pulley}} = \dfrac{40}{70}$

Speed of Driven pulley $= \dfrac{40}{70} \times 180$

$= 160$ rpm

**** How could you change the direction of rotation of the driven pulley ?***

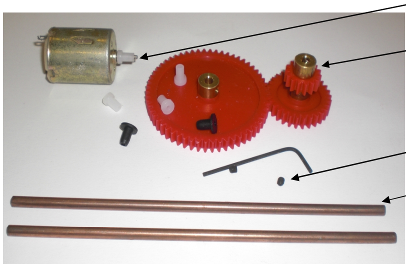
Integration – Mechanical systems

To ensure that any *mechanical system* involving *motor* and *shaft* rotation operates efficiently the following considerations are important:

- Motor mounting appropriate and stable
- Gear / Pulley wheel / Cam is securely and tightly fixed to the motor.

Plastic 4mm dia. reducer

Brass hub



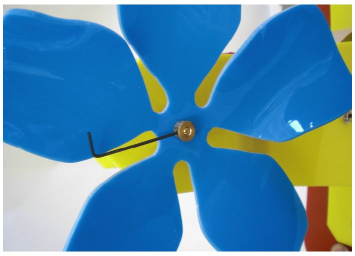
Grub screw

4mm dia. shaft

A brass hub can be fixed to the centre hole so as to accommodate a shaft or motor spindle with / without the use of a plastic reducer.

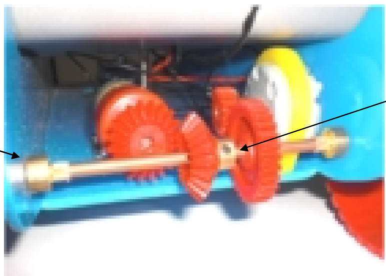
Integration-Mechanical systems

Brass hubs can be used for mounting other fixtures to a shaft such as a propeller.



A hub can also be used as a ***bush*** *and* as a ***retainer*** *to prevent linear slippage of the shaft*

Brass hub retainer

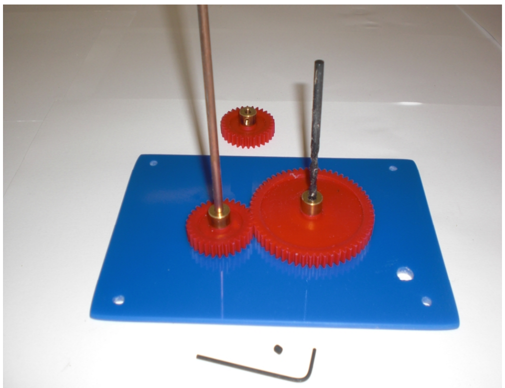


Gear mounting

Integration – Gear systems

To ensure that gears mesh effectively and so run smoothly the mounting holes for each shaft must be positioned accurately.

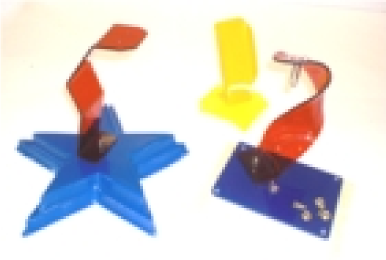
This can be achieved by first *meshing* the gear wheels involved and then marking or drilling through the centre hole mounting of each wheel.



The brass hub acts as a guide to ensure that the holes are accurately marked / drilled.

Material –Plastic forming

Plastics can be formed using a variety of techniques to include Strip heating, Vacuum forming, Blow moulding and Press moulding.



Intricate moulding of plastics such as acrylic is also possible using an oven once the heating temperature is closely monitored.

Material presentation – Joining / fixings

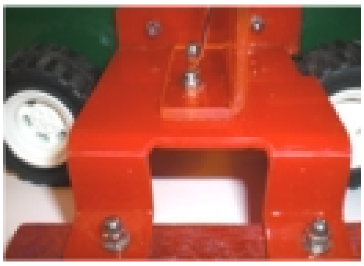
Materials can be joined using a variety of different methods :

Wood: adhesives, joints, nails, screws, nut and bolt.

Metals: nut and bolt, self tapping screws, rivets, soldering, welding, brazing, folding.

Plastics: adhesives, nut and bolt, plastic rivet, plastic welding.

Examples:



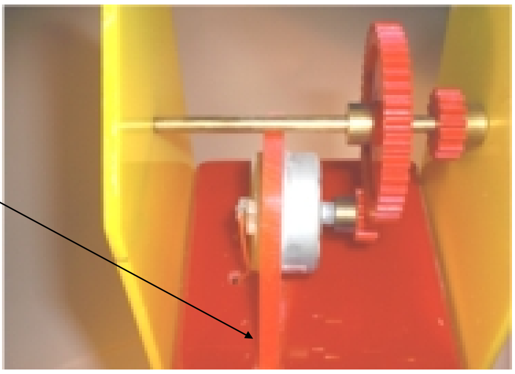
Bolt and Cap nut

Screw and cup washer

Material presentation - Joining

In order that '***edge to surface'*** joining is successful it is essential that the **mating** edge is finished **flat**.

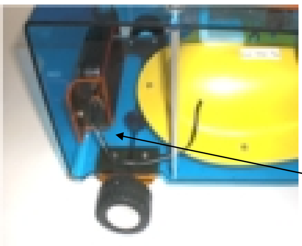
Mating surfaces
- flat edge-

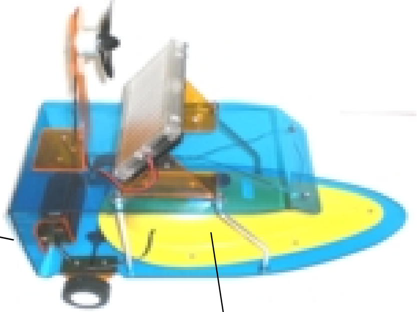


An appropriate adhesive should be used and the part supported until the adhesive has dried.

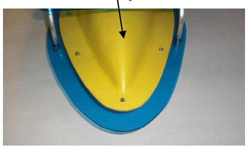
Material presentation - Joining

An alternative method of joining is to allow for ***'over lap'*** between two surfaces.



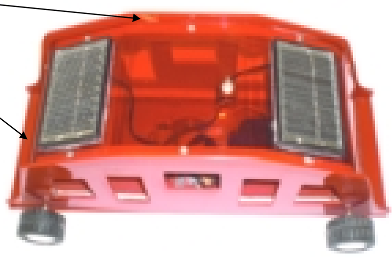


Over lap allows for two material parts to be joined as an alternative to a **'*butted edge*'** joint.



Material presentation - Joining

<u>Over run</u> is another useful joining technique in which two material parts are ***butted*** together without the need for ***edge <u>on</u> edge*** contact but rather ***edge <u>to</u> surface*** contact.



A timber frame attached to the inside acts as a support and allows the top section to be screwed / bolted in place.