Welcome
Group 2

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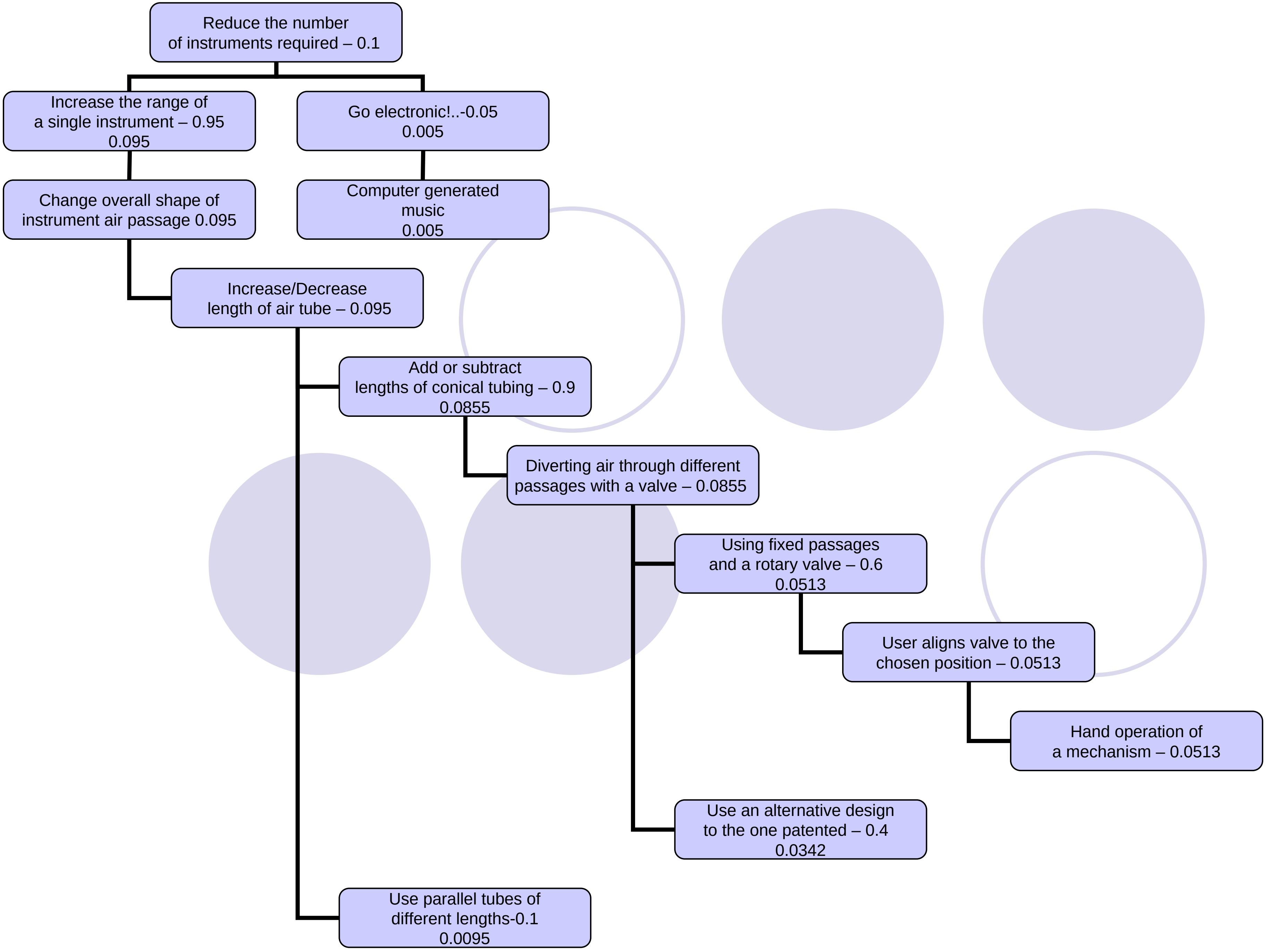
Items to be covered in this presentation are as follows:-

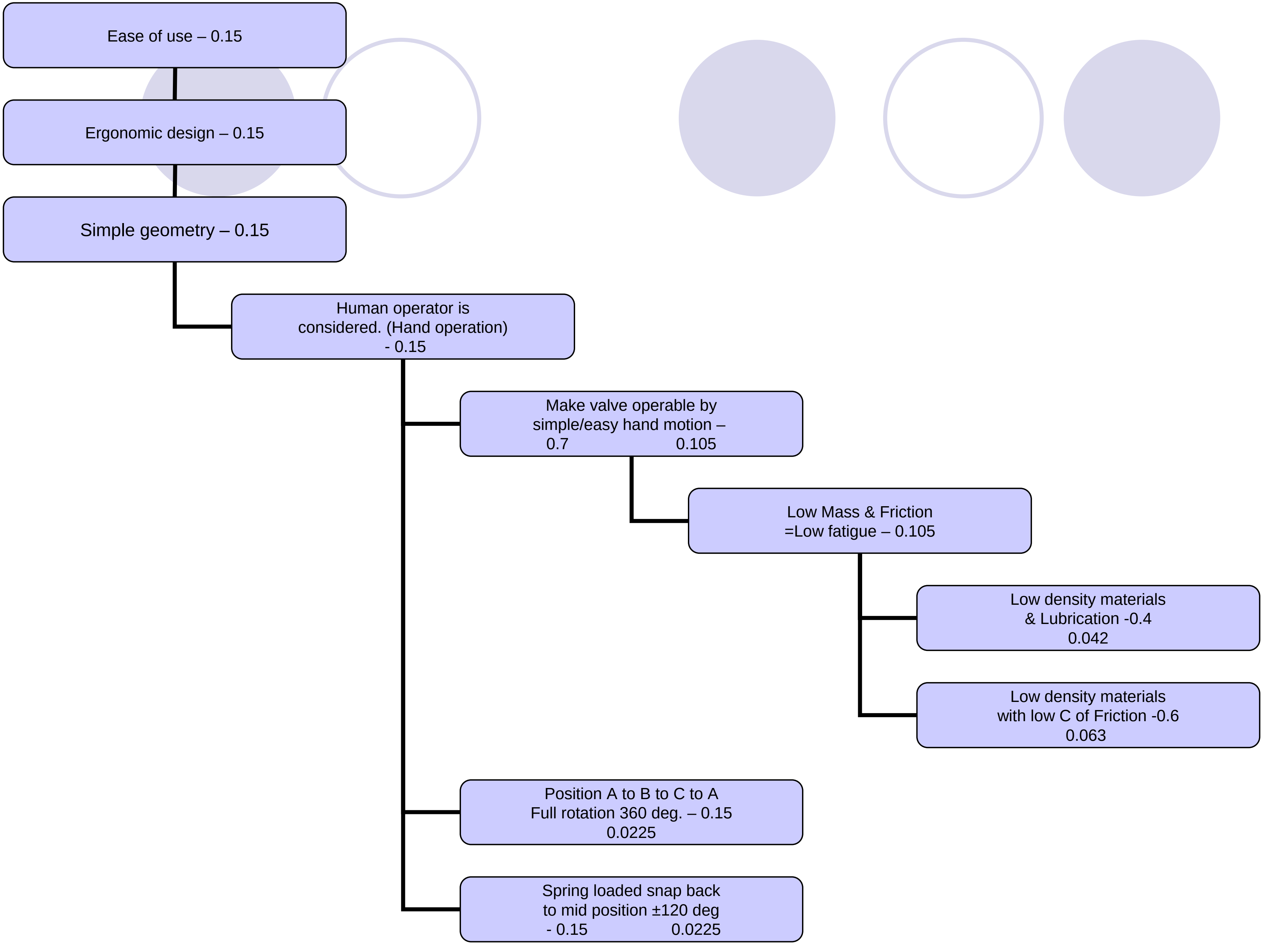
- Review of PR1
  - Objective Tree
  - Functional Model
  - Design Matrix
- Morphological Chart
- Decision Matrix
- Concepts and Designs
- Materials Selection and Properties
- Team Calendar
- Gantt Chart

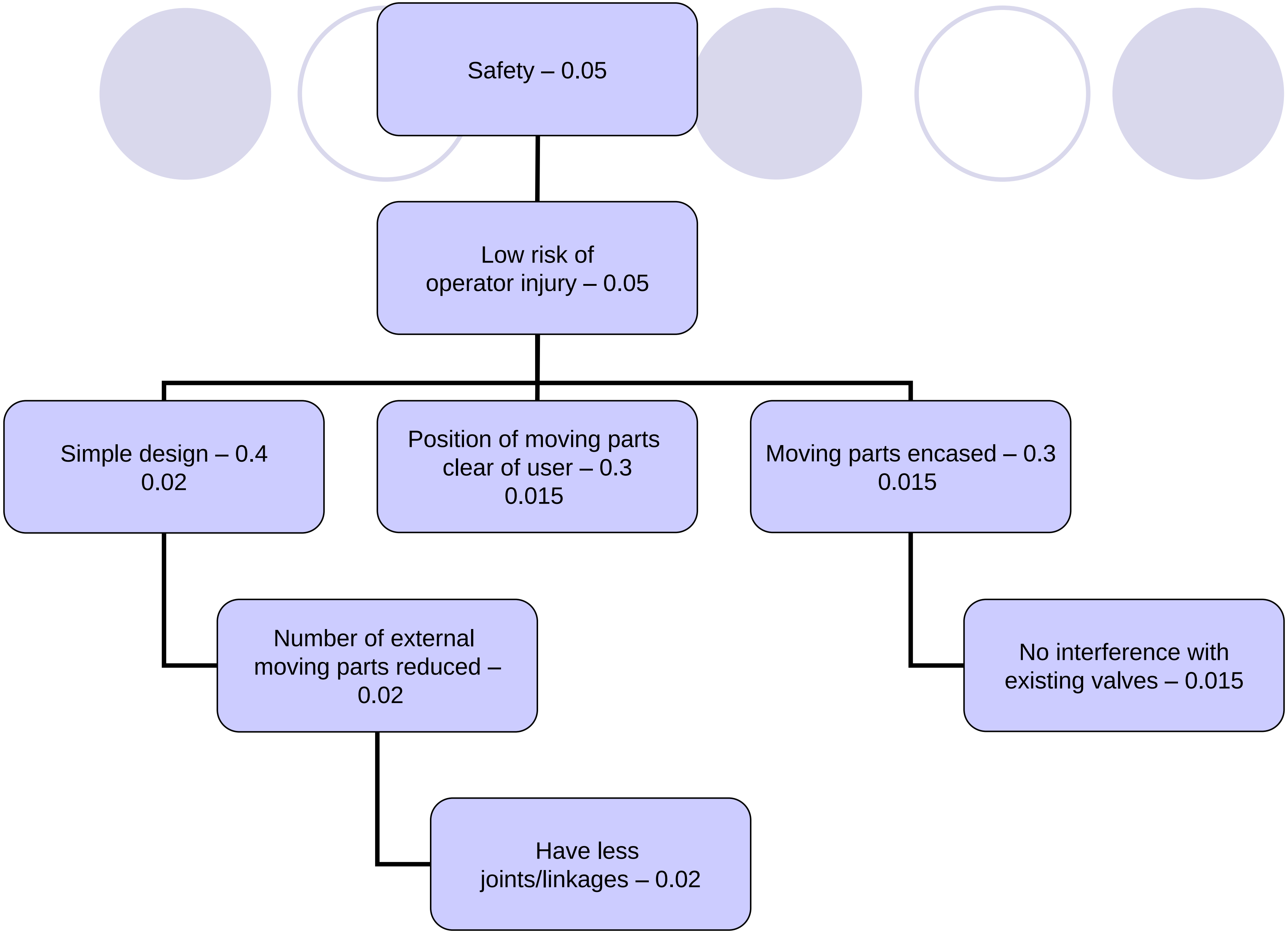
Objective tree

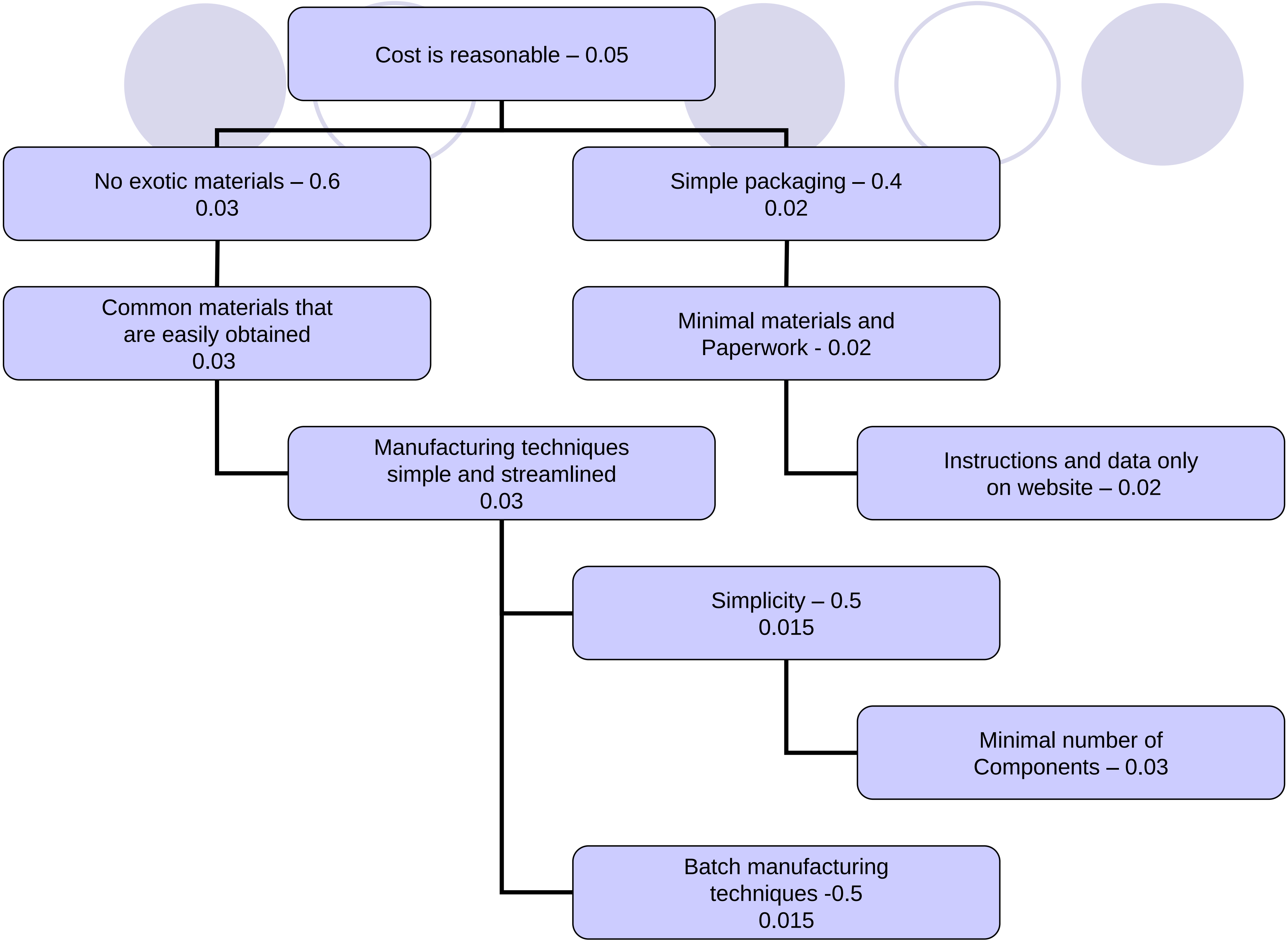
Valve design

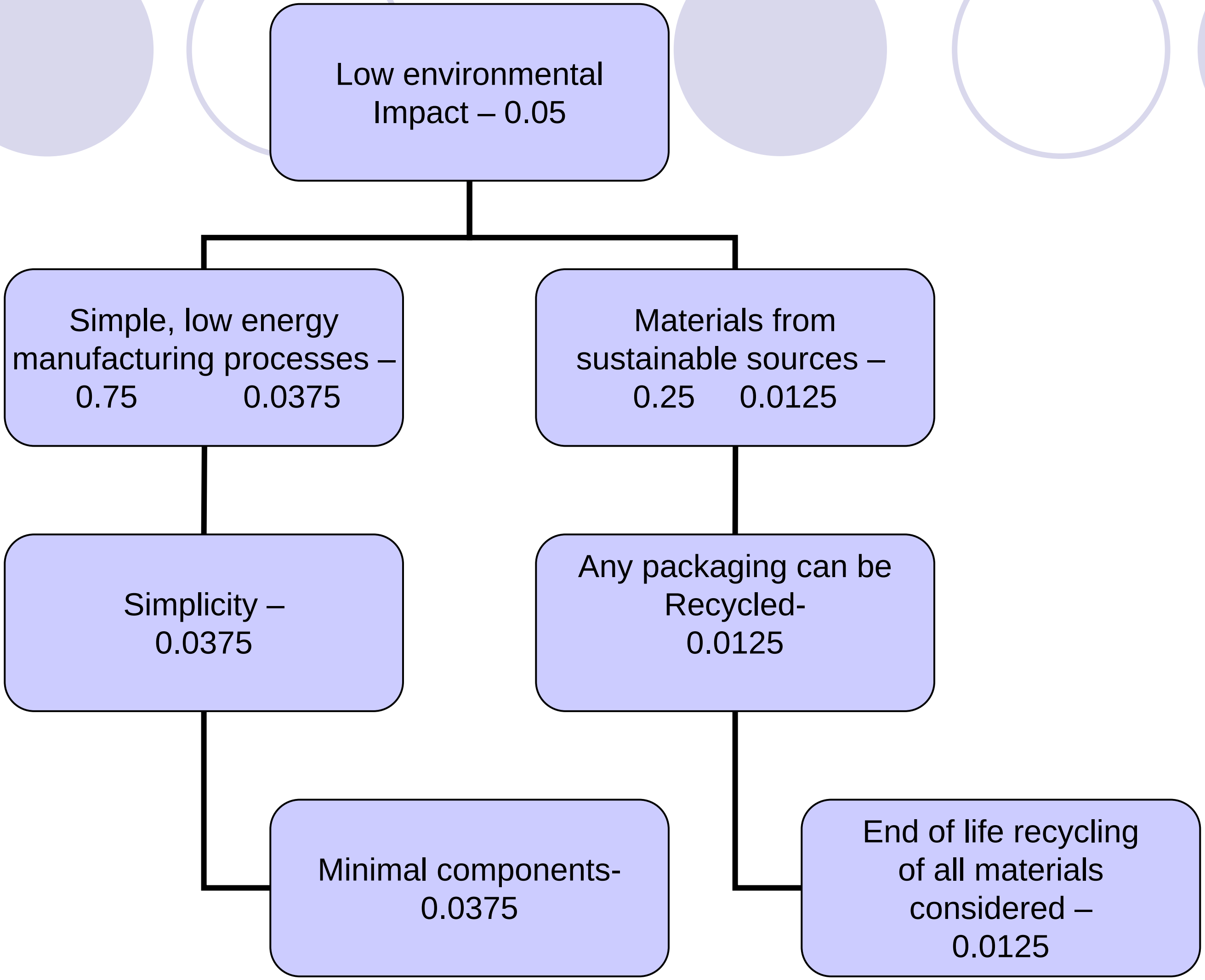
- 1. Reduce the number of instruments required - 10%
- 2. Ease of use – 15%
- 3. Safety – 5%
- 4. Reasonable Cost – 5%
- 5. Low Environmental Impact – 5%
- 6. Aesthetics – 20%
- 7. Easily installed on instrument – 10%
- 8. Beneficial to the instrument – 15%
- 9. Good Life Cycle – 15%

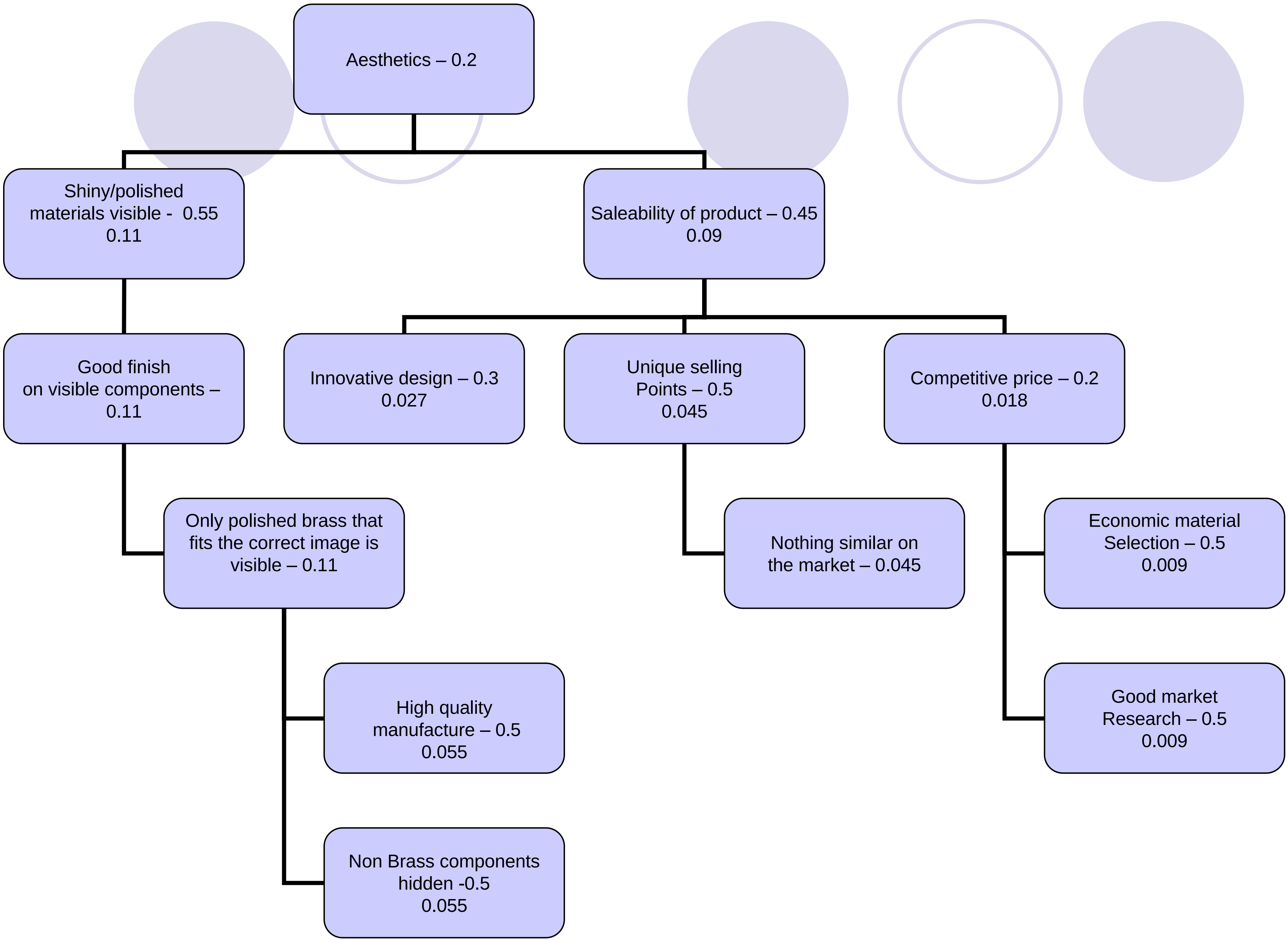

Reduce the number of instruments required – 0.1
Increase the range of a single instrument – 0.95 0.095
Go electronic!..-0.05 0.005
Change overall shape of instrument air passage 0.095
Computer generated music 0.005
Increase/Decrease length of air tube – 0.095
Add or subtract lengths of conical tubing – 0.9 0.0855
Diverting air through different passages with a valve – 0.0855
Using fixed passages and a rotary valve – 0.6 0.0513
User aligns valve to the chosen position – 0.0513
Hand operation of a mechanism – 0.0513
Use an alternative design to the one patented – 0.4 0.0342
Use parallel tubes of different lengths-0.1 0.0095


Ease of use – 0.15
Ergonomic design – 0.15
Simple geometry – 0.15
Human operator is considered. (Hand operation) - 0.15
Make valve operable by simple/easy hand motion – 0.7 0.105
Low Mass & Friction =Low fatigue – 0.105
Low density materials & Lubrication -0.4 0.042
Low density materials with low C of Friction -0.6 0.063
Position A to B to C to A Full rotation 360 deg. – 0.15 0.0225
Spring loaded snap back to mid position ±120 deg - 0.15 0.0225

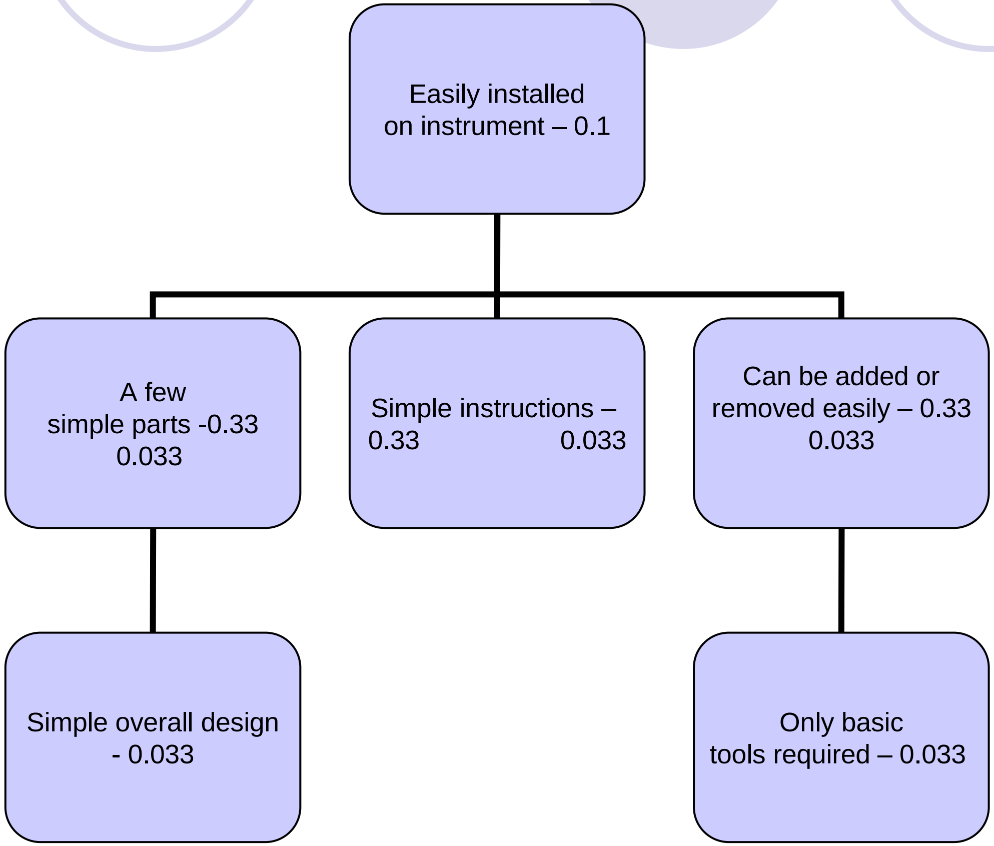

Safety – 0.05
Low risk of operator injury – 0.05
Simple design – 0.4 0.02
Position of moving parts clear of user – 0.3 0.015
Moving parts encased – 0.3 0.015
Number of external moving parts reduced – 0.02
No interference with existing valves – 0.015
Have less joints/linkages – 0.02

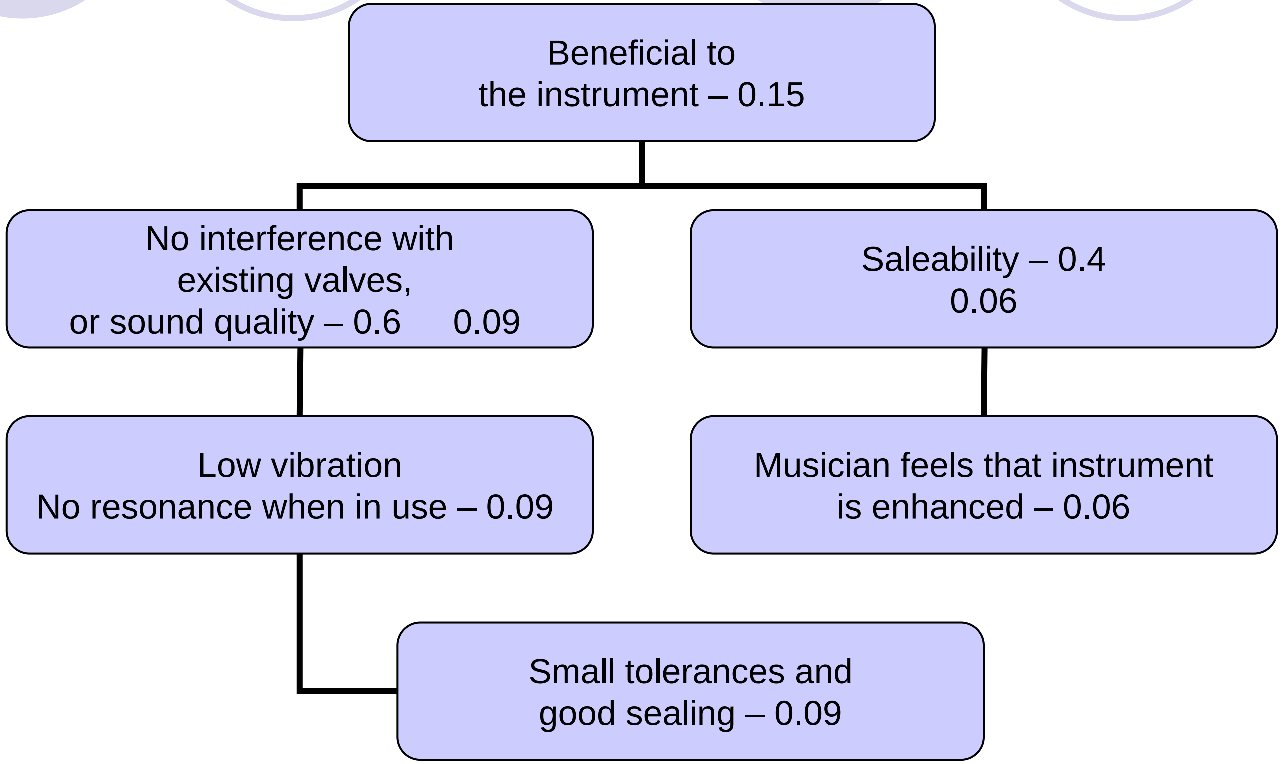

Cost is reasonable – 0.05
No exotic materials – 0.6
0.03
Simple packaging – 0.4
0.02
Common materials that
are easily obtained
0.03
Minimal materials and
Paperwork - 0.02
Manufacturing techniques
simple and streamlined
0.03
Instructions and data only
on website – 0.02
Simplicity – 0.5
0.015
Minimal number of
Components – 0.03
Batch manufacturing
techniques -0.5
0.015

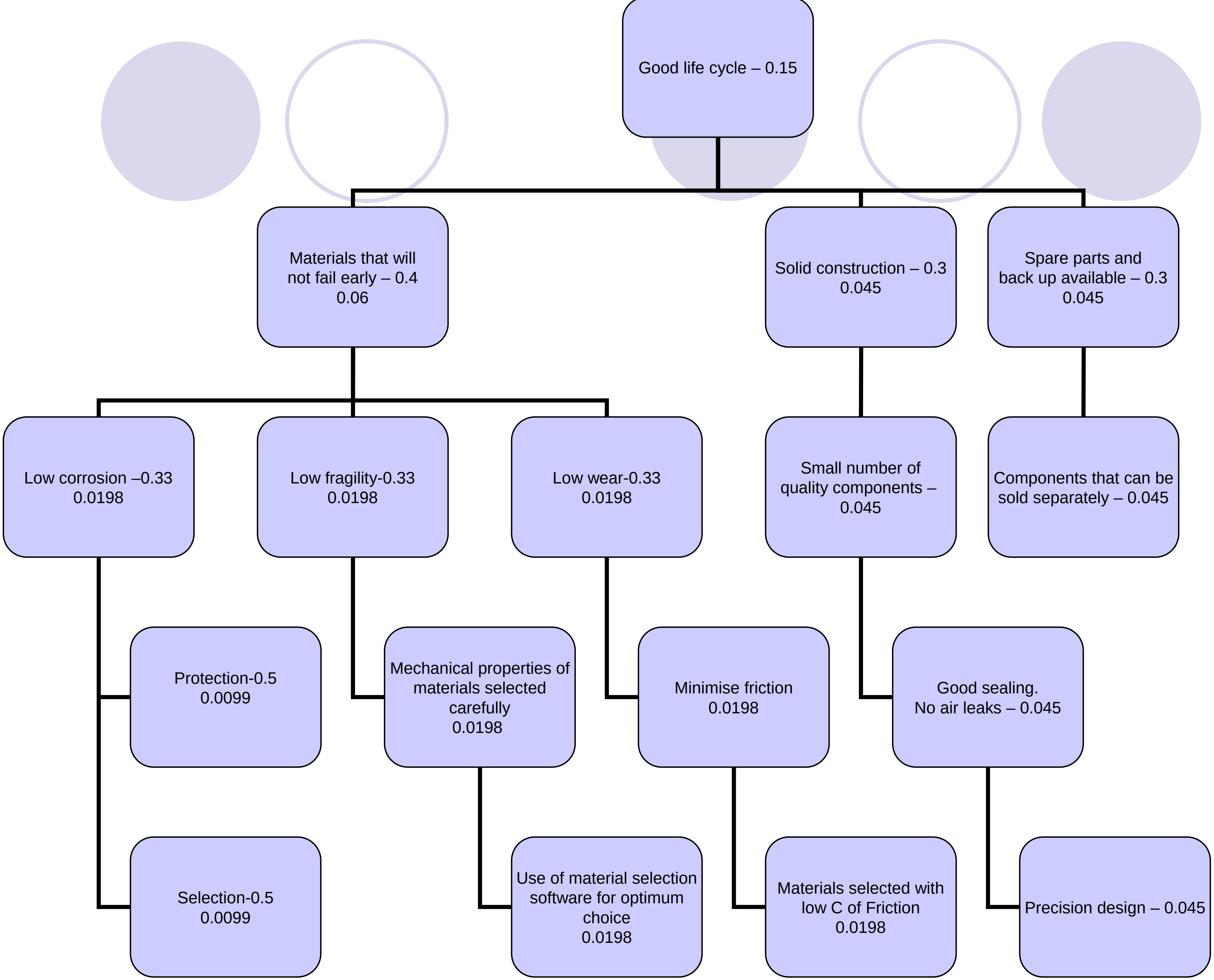

Low environmental Impact – 0.05
Simple, low energy manufacturing processes – 0.75 0.0375
Materials from sustainable sources – 0.25 0.0125
Simplicity – 0.0375
Any packaging can be Recycled- 0.0125
Minimal components- 0.0375
End of life recycling of all materials considered – 0.0125



Aesthetics – 0.2
Shiny/polished materials visible - 0.55 0.11
Saleability of product – 0.45 0.09
Good finish on visible components – 0.11
Innovative design – 0.3 0.027
Unique selling Points – 0.5 0.045
Competitive price – 0.2 0.018
Only polished brass that fits the correct image is visible – 0.11
Nothing similar on the market – 0.045
Economic material Selection – 0.5 0.009
High quality manufacture – 0.5 0.055
Good market Research – 0.5 0.009
Non Brass components hidden -0.5 0.055

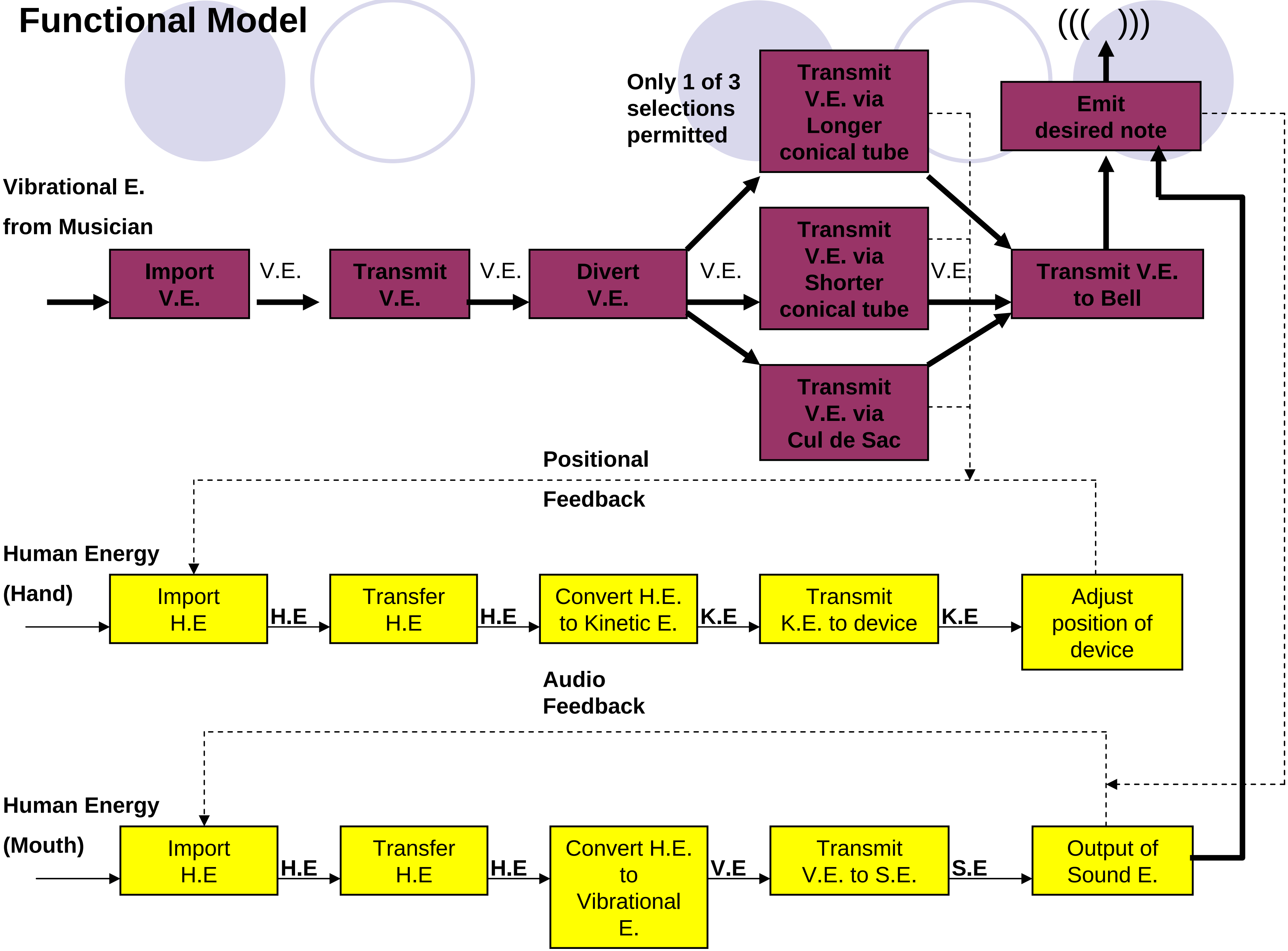

Easily installed
on instrument – 0.1
A few
simple parts -0.33
0.033
Simple instructions –
0.33 0.033
Can be added or
removed easily – 0.33
0.033
Simple overall design
- 0.033
Only basic
tools required – 0.033


Beneficial to
the instrument – 0.15
No interference with
existing valves,
or sound quality – 0.6 0.09
Saleability – 0.4
0.06
Low vibration
No resonance when in use – 0.09
Musician feels that instrument
is enhanced – 0.06
Small tolerances and
good sealing – 0.09

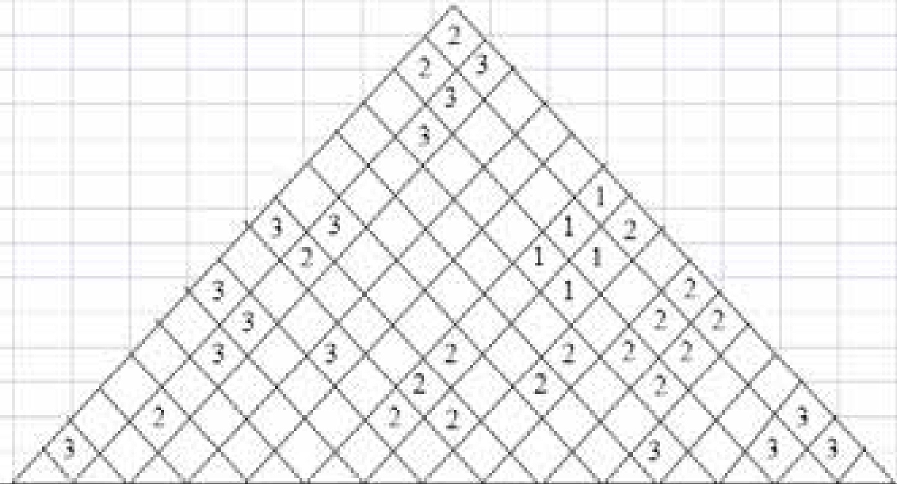


Good life cycle – 0.15
Materials that will not fail early – 0.4 0.06
Solid construction – 0.3 0.045
Spare parts and back up available – 0.3 0.045
Low corrosion –0.33 0.0198
Low fragility-0.33 0.0198
Low wear-0.33 0.0198
Small number of quality components – 0.045
Components that can be sold separately – 0.045
Protection-0.5 0.0099
Mechanical properties of materials selected carefully 0.0198
Minimise friction 0.0198
Good sealing. No air leaks – 0.045
Selection-0.5 0.0099
Use of material selection software for optimum choice 0.0198
Materials selected with low C of Friction 0.0198
Precision design – 0.045

Functional Model



Design Matrix



KEY	
Strong link	3
Medium link	2
Weak link	1

CA Importance	Engineering Characteristics	Mass	Overall dimensions	Biostatic	No resonance	Corrosive properties	Friction	Low Inertia	Acoustic properties	Low Torque	Tolerance	Voltage	Current	Strain	Stress	Bending Moment
Reduce number of instruments	10								0.3		0.3	0.3	0.3			
Ease of Use	15	0.45	0.45	0.3	0.15	0.3	0.45	0.45		0.45	0.3	0.45	0.45	0.45	0.45	0.3
Safety	5	0.1	0.1	0.15		0.15	0.05	0.15	0.05	0.15	0.05	0.1	0.1	0.15	0.15	
Manoeuvrability	5	0.15	0.15				0.3	0.15		0.1	0.05			0.15	0.15	0.1
Low environmental impact	5	0.05				0.1					0.1					
Aesthetics	20		0.4	0.6		0.6					0.2					
Easily installed	10	0.2	0.2					0.1			0.1					
Beneficial to instrument	15	0.45	0.45		0.45	0.3	0.3	0.15	0.3	0.3	0.3			0.3	0.3	
Good life cycle	15			0.45	0.15	0.45	0.45			0.3				0.3	0.3	0.45

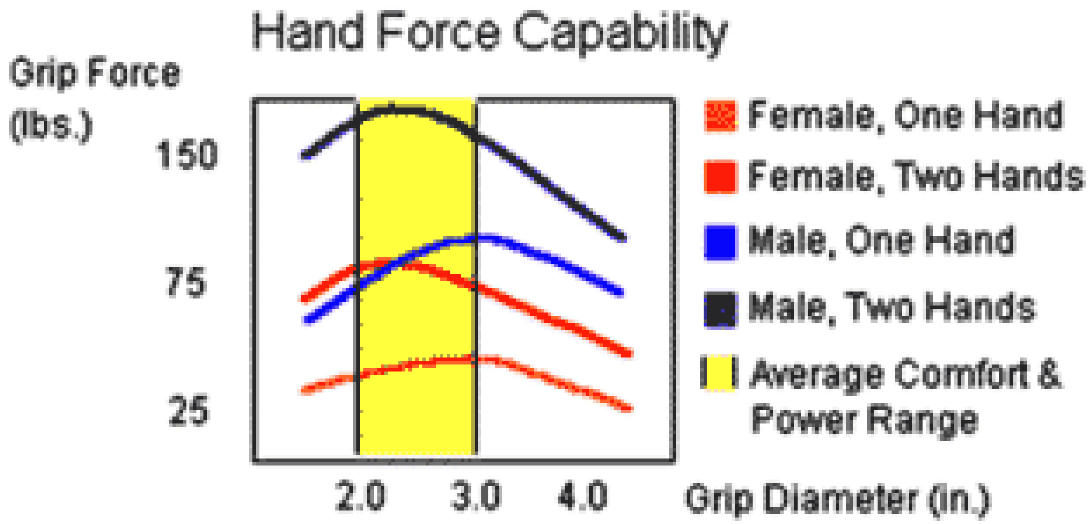
	Mass	Overall dimensions	Biostatic	No resonance	Corrosive properties	Friction	Low Inertia	Acoustic properties	Low Torque	Tolerance	Voltage	Current	Strain	Stress	Bending Moment
EC importance	1.4	1.75	1.5	0.75	1.9	1.55	1	0.65	1.3	1.4	0.85	0.85	1.35	1.35	0.85
Units	kg	m				N	$kg.m^2$		N.m	m	V	A		Pa	N.m
Targets															

Competitors				
1	2	3	4	5

Ergonomics – Brass Instruments

ERGONOMICS – "tool/work should fit person" ; not the other way round!

Brief history of brass instrument-related injuries – CTS symptoms



Men can exert much greater force than women, and both perform crimping operations better double-handed rather than single handed.

Capability of human hands/arms – differences in gender

Coverage of population required

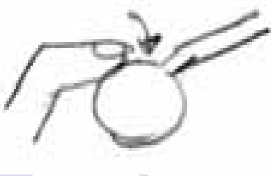
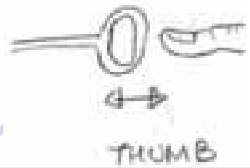
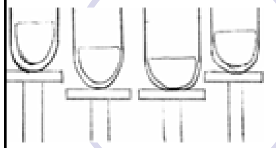
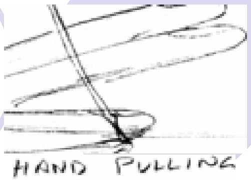
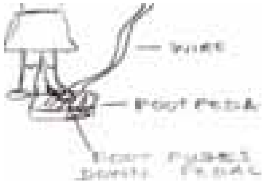
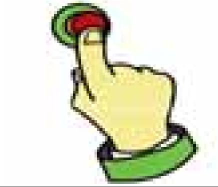
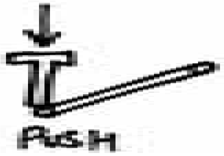
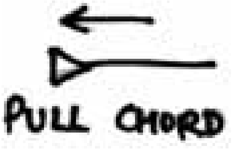
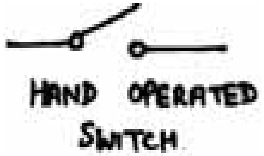
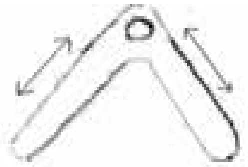
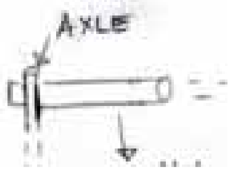
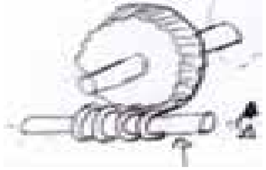
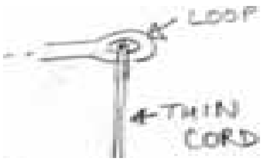
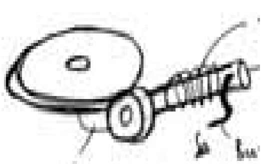
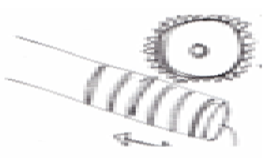
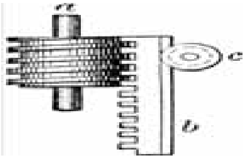
Ergonomics – Brass Instruments

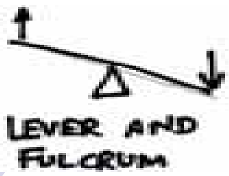
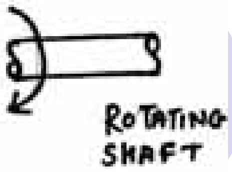
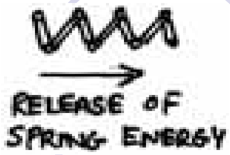
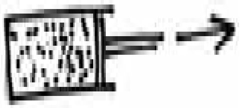
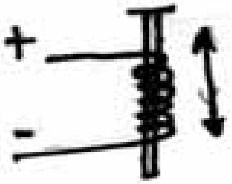
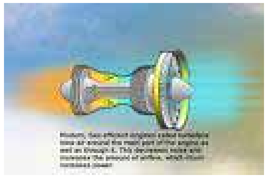
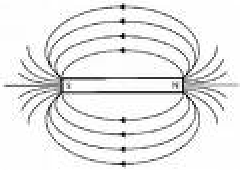
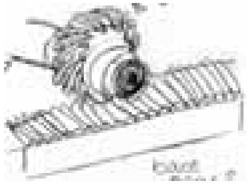
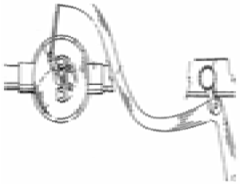
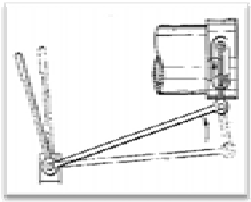
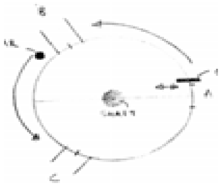
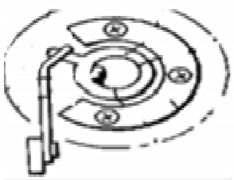
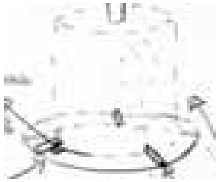
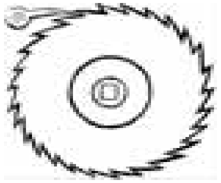
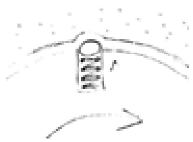
Some examples of ergonomic instruments – viola, clarinet

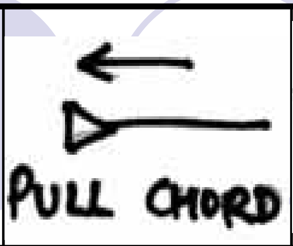
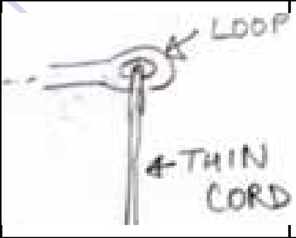
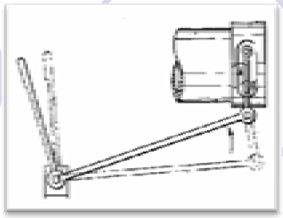
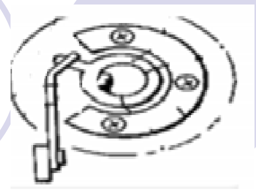
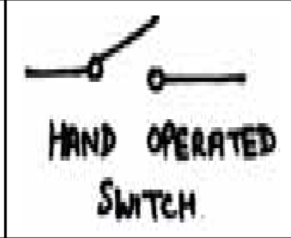
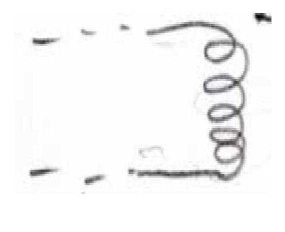
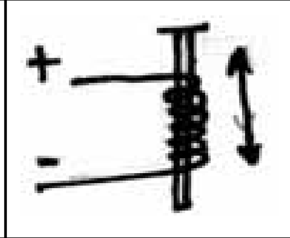
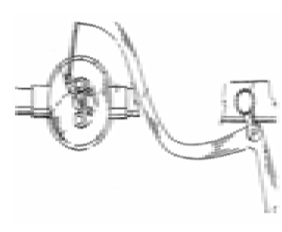
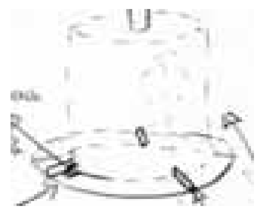
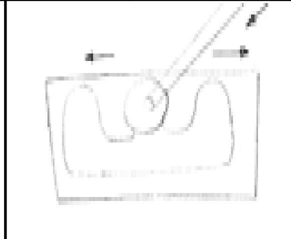
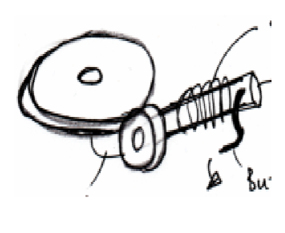
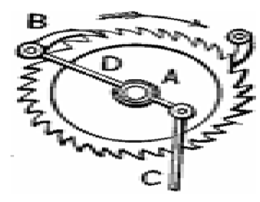
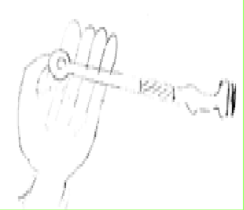
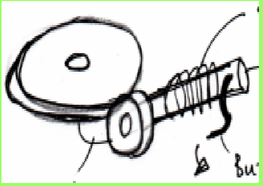
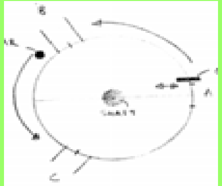
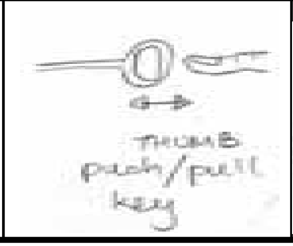
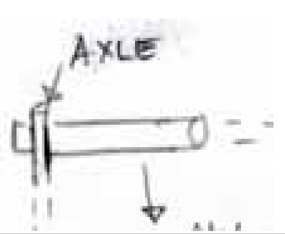
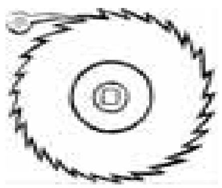
Posture – holding a brass instrument

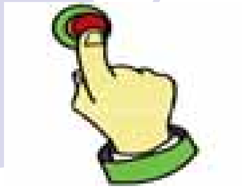
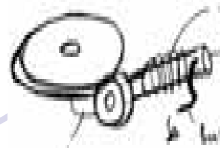
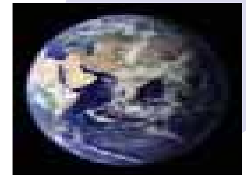
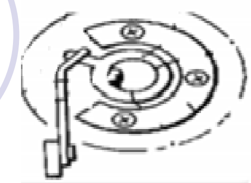
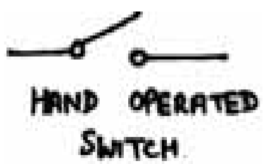
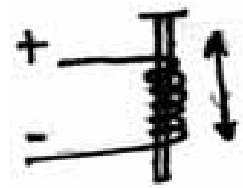
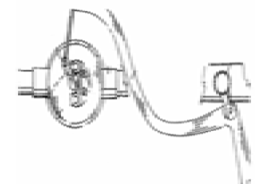
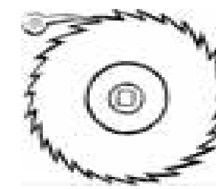
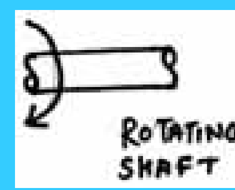
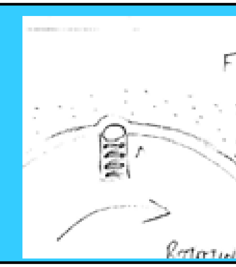
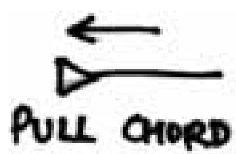
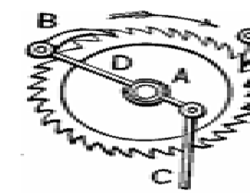
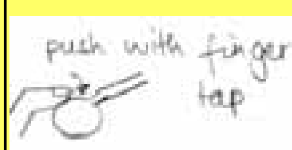
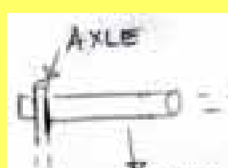
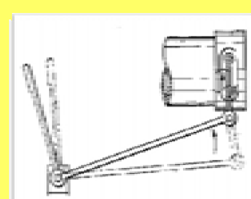
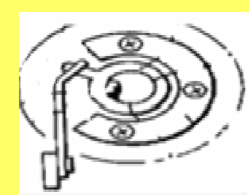
Poor sods – Bless them!

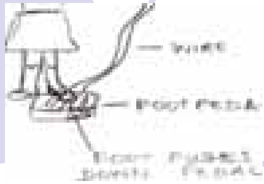
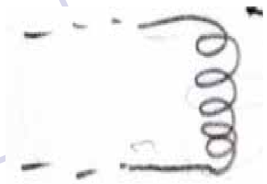
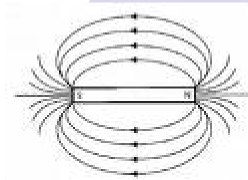
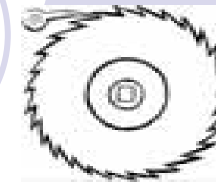
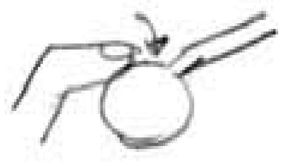
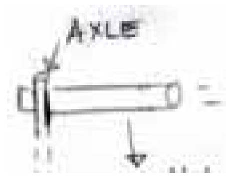
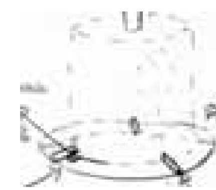
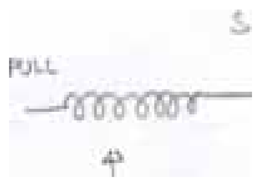
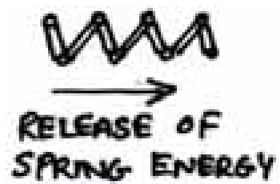
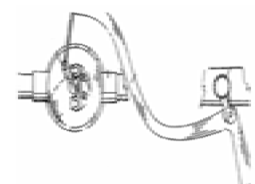
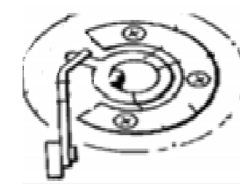
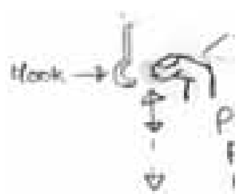
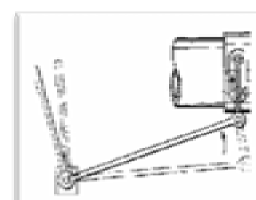
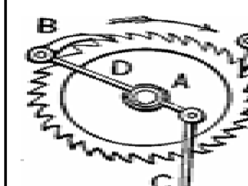
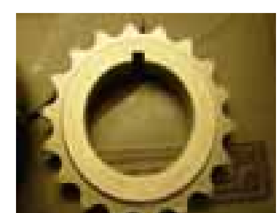
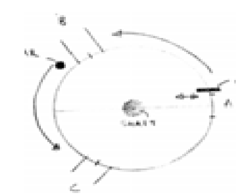
Morphological Chart

Import HE					
					
					
					
Transfer HE to System					
					

Transmit HE to System					
					
					
Rotate Device					
Set Positions					

Concept 1					
Concept 2					
Concept 3					
Concept 4					
Concept 5					

Concept 6					
Concept 7					
Concept 8					
Concept 9					
Concept 10					

Concept 11					
Concept 12					
Concept 13					
Concept 14					
Concept 15					

Import Human Energy

		Hand Key	Slider mechanism	Push rods	Thumb Slider	Direct hand rotation
Reduce no. of Inst.	0.1	0	0	0	0	0
Ease of use	0.15	2 0.3	4 0.6	4 0.6	4 0.6	3 0.45
Safety	0.05	4 0.2	3 0.15	3 0.15	3 0.15	2 0.1
Cost	0.05	4 0.2	3 0.15	2 0.1	3 0.15	3 0.15
Environmental Impact	0.05	0	0	0	0	0
Aesthetics	0.2	3 0.6	2 0.4	1 0.2	2 0.4	3 0.6
Easy Installation	0.1	4 0.4	3 0.3	2 0.2	3 0.3	3 0.3
Beneficial	0.15	4 0.6	4 0.6	3 0.6	4 0.6	3 0.6
Life cycle	0.15	2 0.3	2 0.3	2 0.3	2 0.3	2 0.3
Total		2.7	2.5	2.15	2.5	2.5

Transfer HE to System

		Slider mechanism	Rack and Pinion	Drive shaft	Electric circuit	Meshing gears
Reduce no. of Inst.	0.1	0	0	0	0	0
Ease of use	0.15	3 0.45	1 0.15	4 0.6	4 0.6	3 0.45
Safety	0.05	3 0.15	3 0.15	3 0.15	2 0.1	3 0.15
Cost	0.05	3 0.15	4 0.2	3 0.15	3 0.15	3 0.15
Environmental Impact	0.05	0	0	0	0	0
Aesthetics	0.2	4 0.8	3 0.6	3 0.6	1 0.2	4 0.8
Easy Installation	0.1	3 0.3	3 0.3	3 0.3	2 0.2	4 0.4
Beneficial	0.15	3 0.45	3 0.45	3 0.45	1 0.15	4 0.6
Life cycle	0.15	4 0.6	3 0.45	4 0.6	2 0.3	3 0.45
Total		2.9	2.3	2.85	1.7	3.0

Transmit HE to System

		Rotating Shaft	Releasing spring energy	Lever & fulcrum	Expanding gas	Gravit y
Reduce no. of Inst.	0.1	0	0	0	0	0
Ease of use	0.15	3 0.45	3 0.45	4 0.6	2 0.3	3 0.45
Safety	0.05	3 0.15	3 0.45	2 0.1	1 0.05	3 0.15
Cost	0.05	3 0.15	4 0.2	3 0.15	1 0.05	3 0.15
Environmental Impact	0.05	0	0	0	0	0
Aesthetics	0.2	3 0.6	2 0.4	3 0.6	2 0.4	3 0.6
Easy Installation	0.1	3 0.3	4 0.4	2 0.2	2 0.2	3 0.3
Beneficial	0.15	3 0.45	2 0.3	3 0.45	0	2 0.3
Life cycle	0.15	2 0.3	3 0.45	3 0.45	1 0.15	2 0.3
Total		2.4	2.65	2.55	1.15	2.25

Rotate Device

		Elbow Device	Lever Arm Device	Rotating Shaft	Gear Wheel with key-way	Splined Shaft
Reduce no. of Inst.	0.1	0	0	0	0	0
Ease of use	0.15	2 0.3	3 0.45	4 0.6	3 0.45	4 0.6
Safety	0.05	2 0.1	3 0.15	4 0.2	2 0.1	4 0.2
Cost	0.05	3 0.15	3 0.15	3 0.15	3 0.15	2 0.1
Environmental Impact	0.05	0	0	0	0	0
Aesthetics	0.2	3 0.6	3 0.6	3 0.6	3 0.6	3 0.6
Easy Installation	0.1	2 0.2	3 0.3	3 0.3	3 0.3	2 0.2
Beneficial	0.15	2 0.3	2 0.3	4 0.6	2 0.3	2 0.3
Life cycle	0.15	2 0.3	2 0.3	3 0.45	3 0.45	3 0.45
Total		1.95	2.25	2.9	2.35	2.45

Set Position

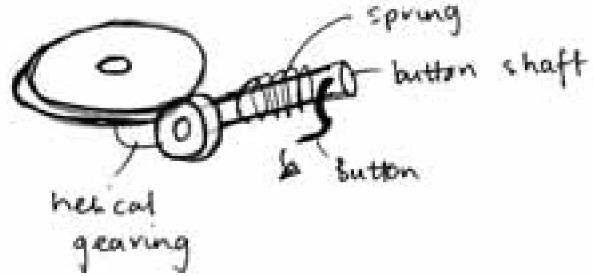
		Pillar & Catch	Locking Pin	Hand-pin	Pawl & ratchet	Spring ball bearing
Reduce no. of Inst.	0.1	0	0	0	0	0
Ease of use	0.15	3 0.45	3 0.45	4 0.6	2 0.3	3 0.45
Safety	0.05	3 0.15	3 0.15	4 0.2	2 0.1	4 0.2
Cost	0.05	3 0.15	2 0.1	3 0.15	3 0.15	3 0.15
Environmental Impact	0.05	0	0	0	0	0
Aesthetics	0.2	3 0.6	3 0.6	3 0.6	2 0.4	4 0.8
Easy Installation	0.1	3 0.3	3 0.3	3 0.3	2 0.2	3 0.3
Beneficial	0.15	2 0.3	3 0.45	3 0.45	2 0.3	4 0.6
Life cycle	0.15	3 0.45	3 0.45	3 0.45	3 0.45	3 0.45
Total		2.4	2.5	2.75	1.9	2.95

Final Decision Matrix

		Concept 4		Concept 8		Concept 10	
		hand pull, with driven gears and rotating shaft with locking pins		**slider mechanism with drive shaft**		**Finger push Lever with Fulcrum and pins**	
Reduce no. of Inst.	0.1	3	0.3	3	0.3	3	0.3
Ease of use	0.15	2	0.3	3	0.45	3	0.45
Safety	0.05	2	0.1	2	0.1	2	0.1
Cost	0.05	2	0.1	3	0.15	1	0.05
Environmental Impact	0.05	2	0.1	3	0.15	3	0.15
Aesthetics	0.2	3	0.6	3	0.6	3	0.6
Easy Installation	0.1	2	0.2	3	0.3	1	0.1
Beneficial	0.15	3	0.45	3	0.45	3	0.45
Life cycle	0.15	3	0.45	3	0.45	3	0.45
Total		**2.6**		**2.95**		**2.65**	

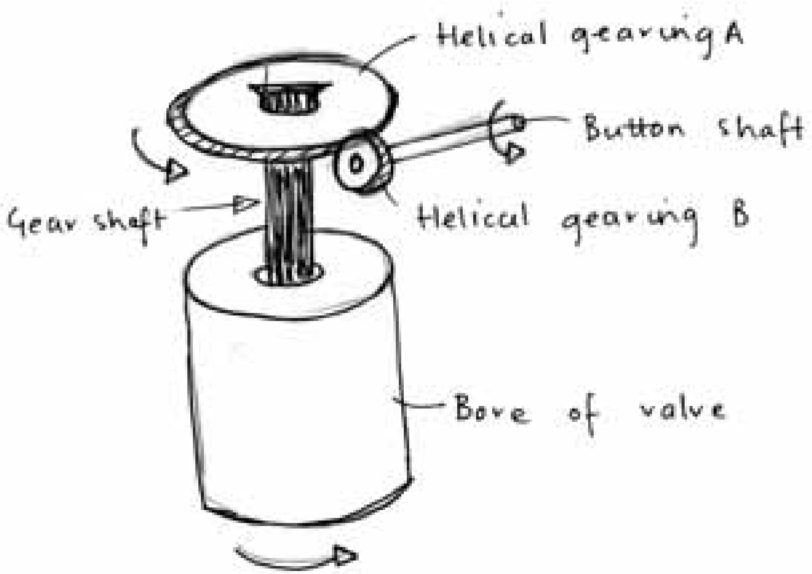
Concepts and Designs

Concept 4



90° helical gearing for 240° movement of gear / big gear.

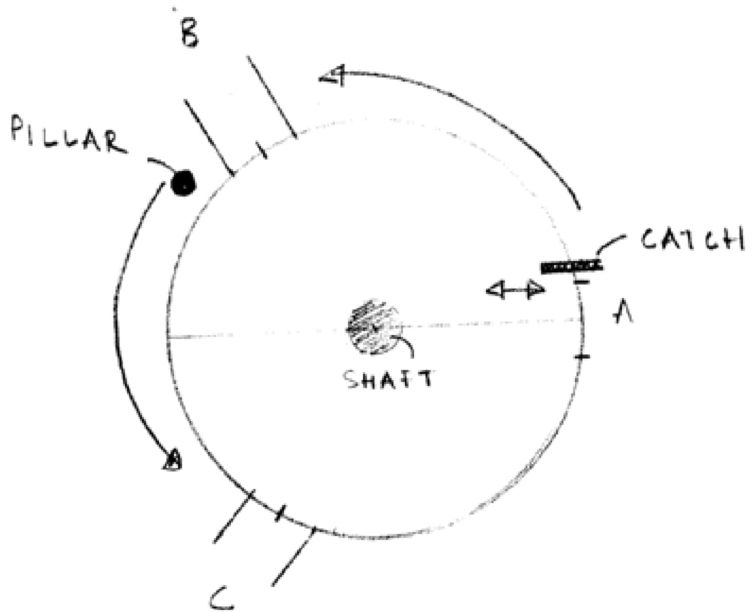
Stopped at 120° by a catch in the bore of valve. Catch released by pressing another button.



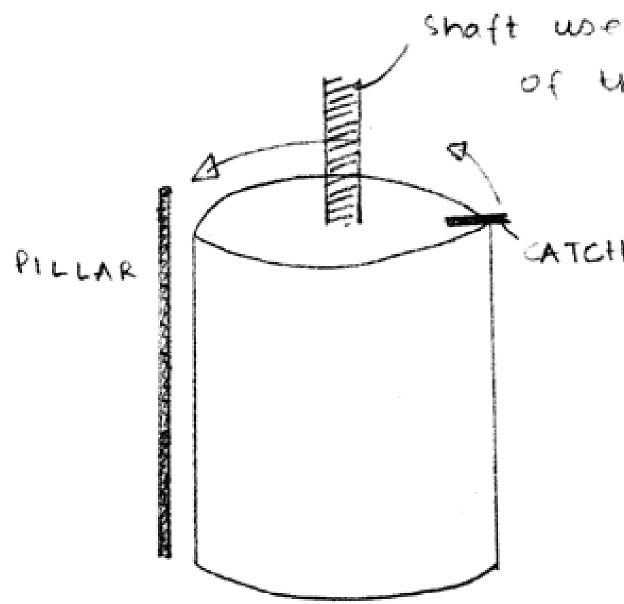
CAN BE USED FOR 180° MOTION

Concept 4

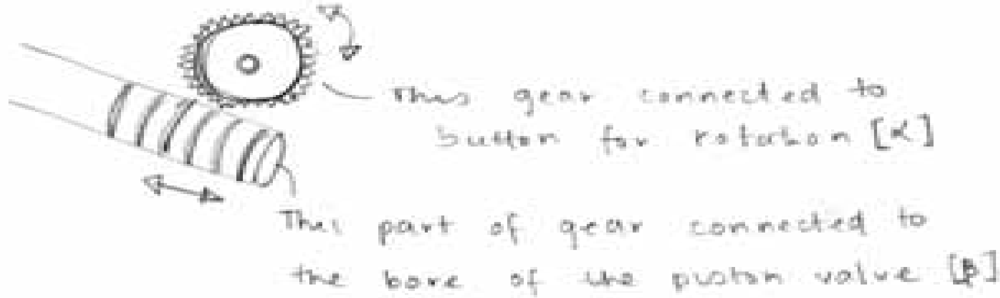
THE SHAFT WILL BE CONNECTED TO GEARS TO MAKE IT ROTATE 240° ONLY. SO THE VALVE CAN ONLY ROTATE IN ONE DIRECTION EITHER CLOCKWISE OR ANTI-CLOCKWISE

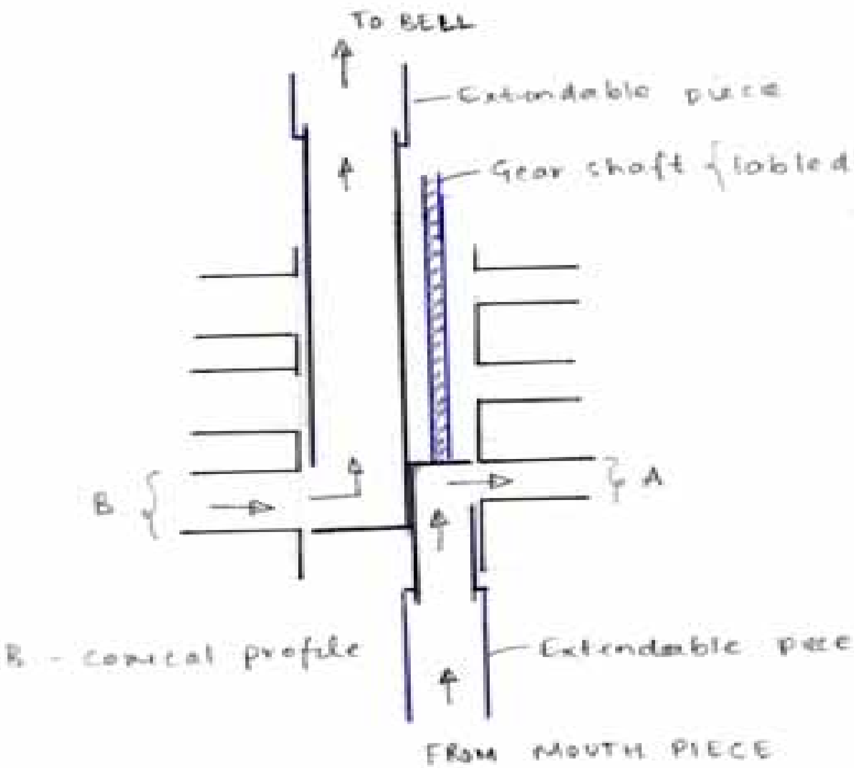


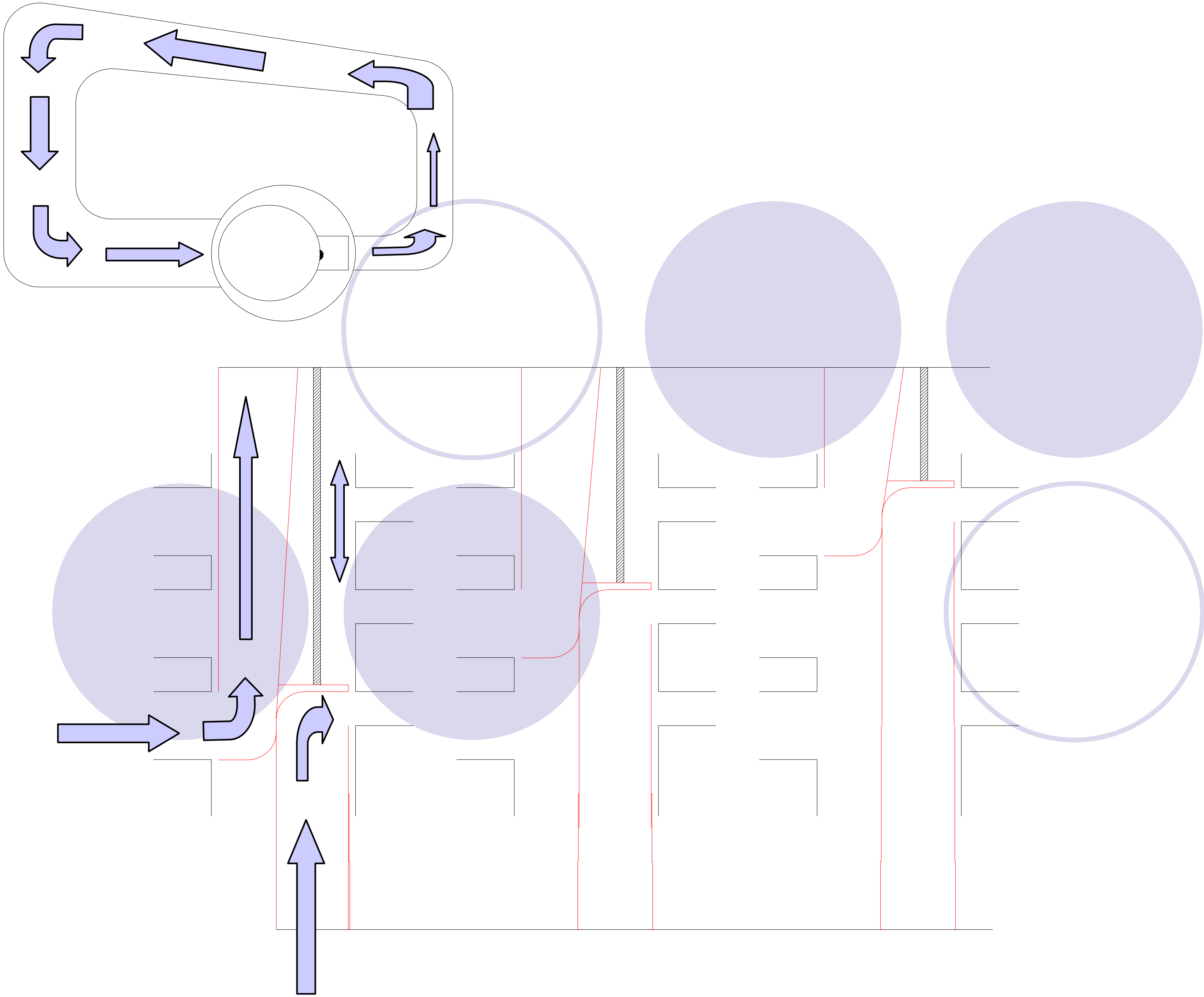
THE CATCH CAN MOVE IN THE DIRECTION SHOWN ABOVE. THE SNAP BACK POSITION WILL BE "OUT". ANOTHER BUTTON (BY THE THUMB) WILL NEED TO BE DEPRESSED TO "RELEASE" THE CATCH

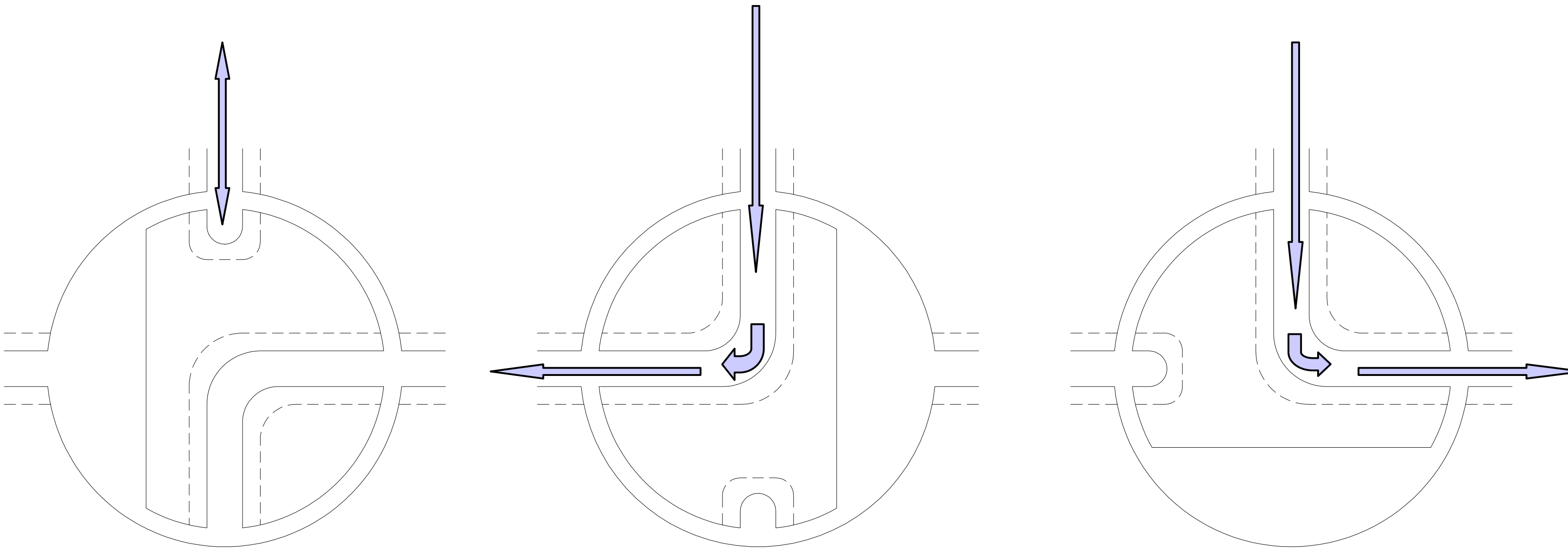


When the valve rotates, the catch will be "caught" by the pillar, ie valve wont be able to rotate a full 120°. Only when this catch released, the valve rotates the 240°

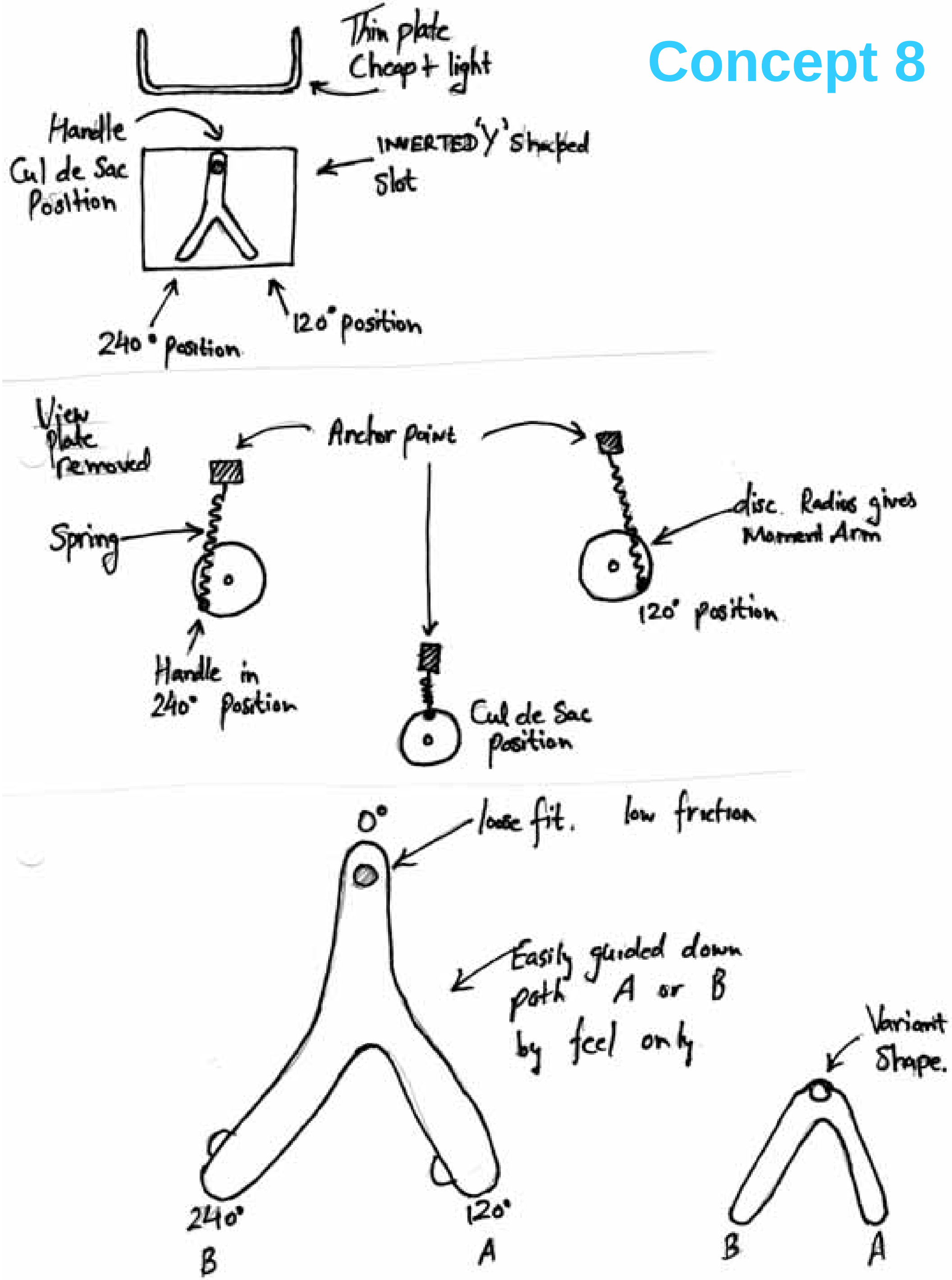

This gear connected to button for rotation [α]
This part of gear connected to the bore of the piston valve [β]


TO BELL
Extendable piece
Gear shaft {labled [β] above.}
A
B
B - conical profile
Extendable piece
FROM MOUTH PIECE



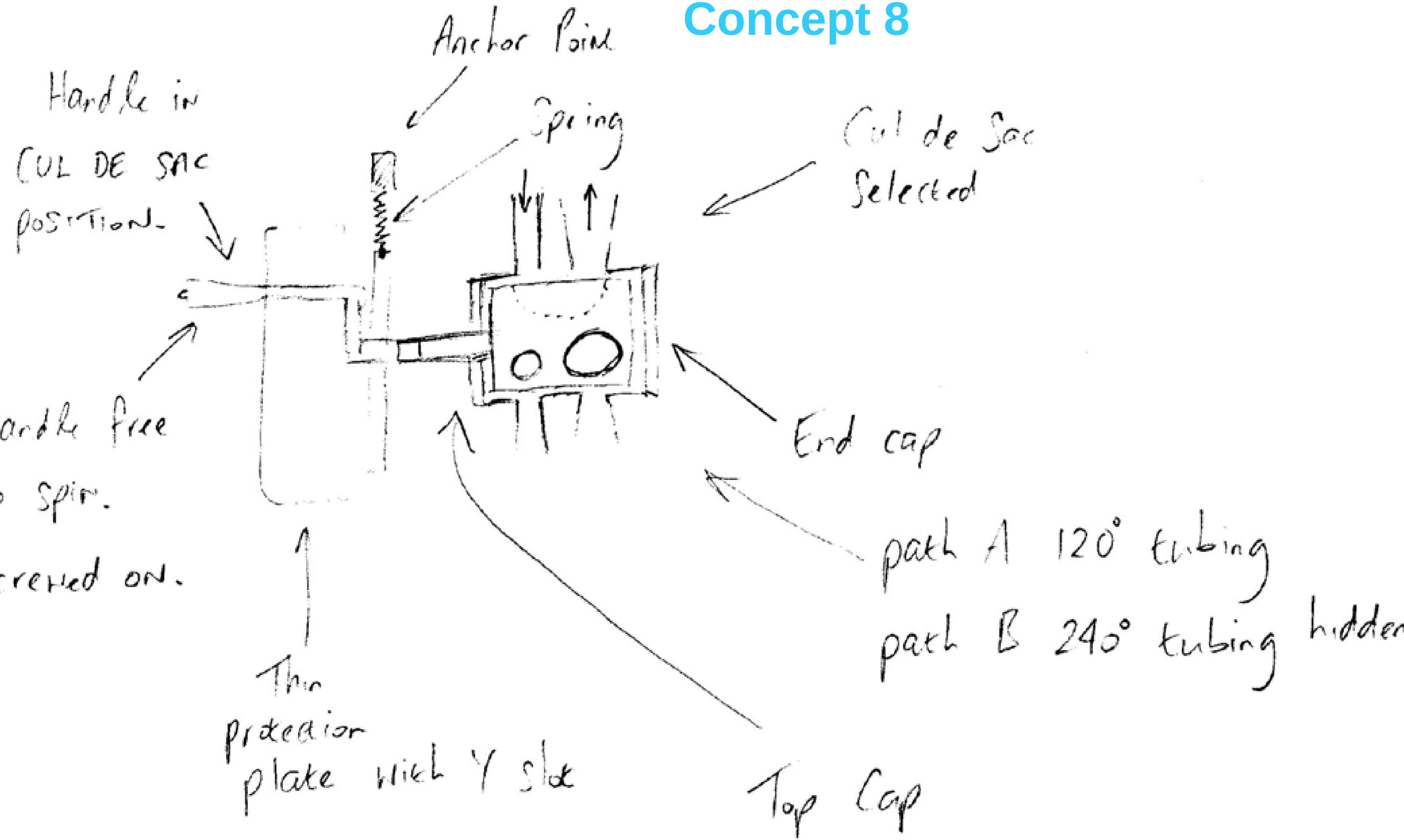


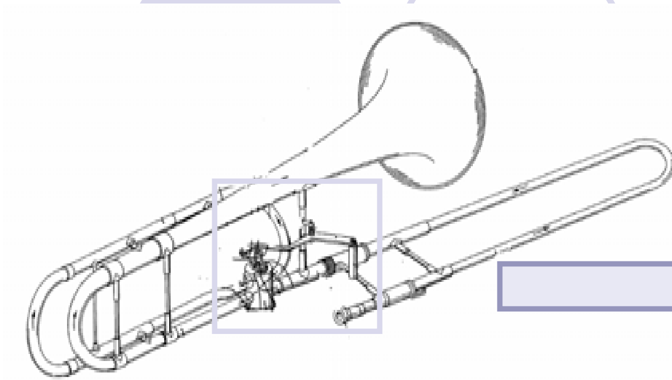
Concept 8

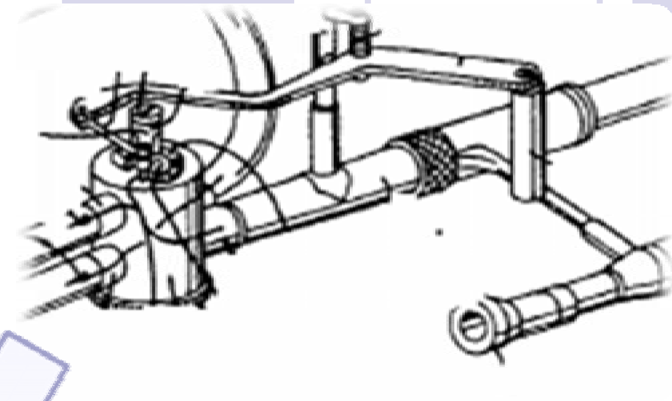


Thin plate
Cheap + light
Handle
Cul de Sac
Position
INVERTED 'Y' Shaped
Slot
240° position
120° position
View
plate
removed
Anchor point
Spring
disc. Radius gives
Moment Arm
120° position
Handle in
240° position
Cul de Sac
position
0°
loose fit. low friction
Easily guided down
path A or B
by feel only
Variant
Shape.
240°
B
120°
A
B
A

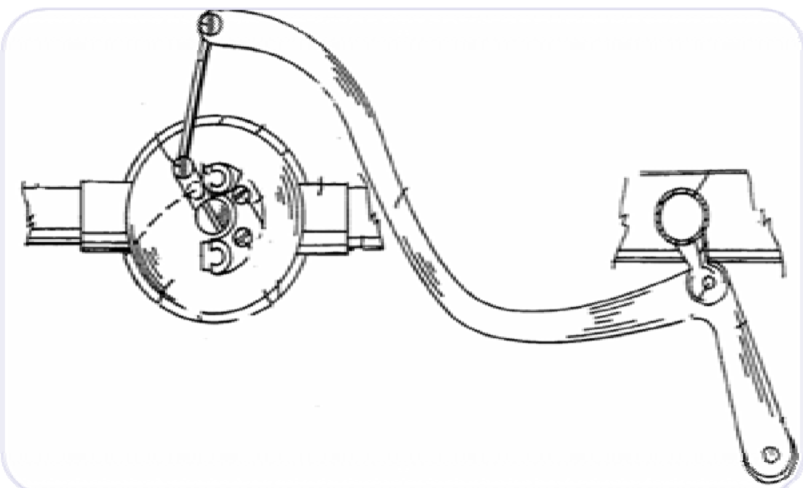
Concept 8


Anchor Point
Handle in CUL DE SAC position.
Spring
Cul de Sac Selected
andle free
spin.
crewed on.
End cap
path A 120° tubing
path B 240° tubing hidden
Thin protection plate with Y slot
Top Cap

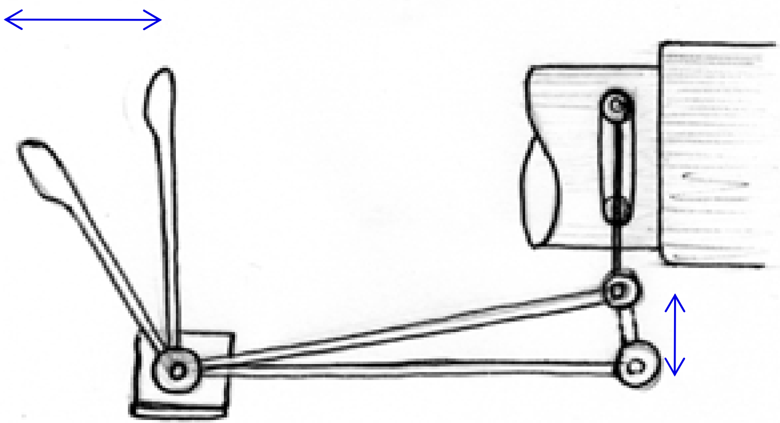




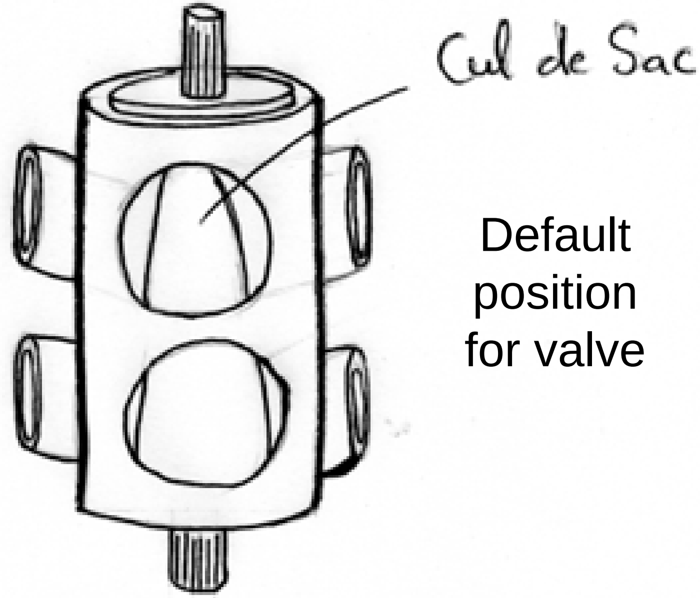
Current rotary valves could only rotate to maximum of 180 deg.



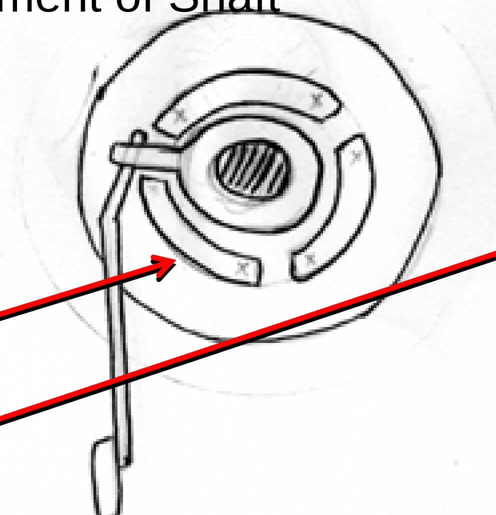
Concept 10

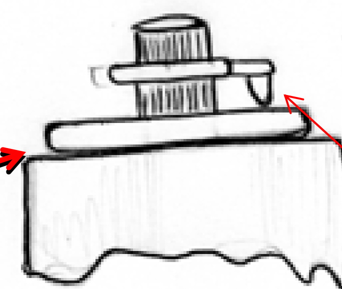


Simple push or pull on the rod will generate rotational movement of Shaft



Default position for valve



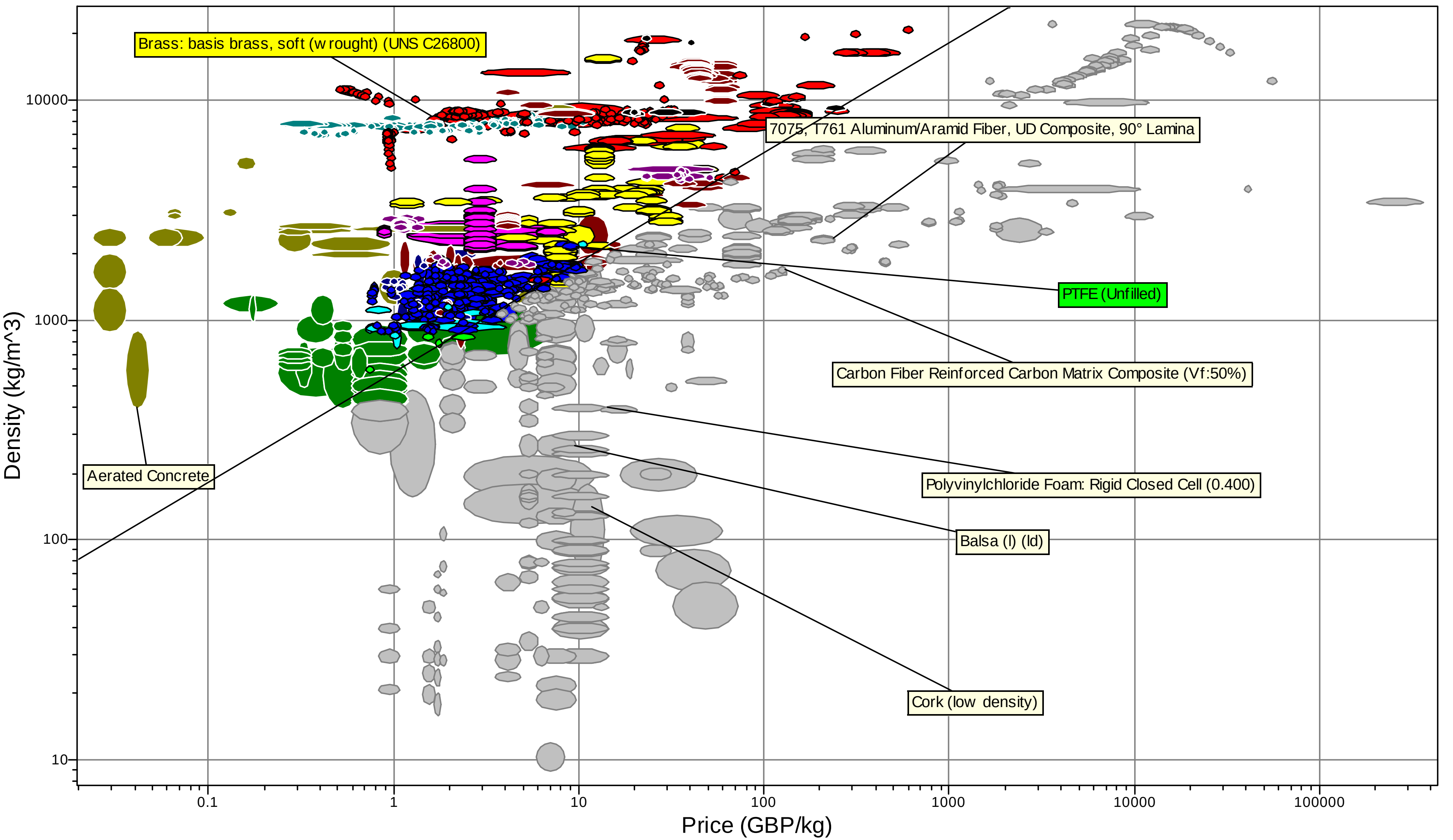


Disc with three cut out holes attached on top of casing.

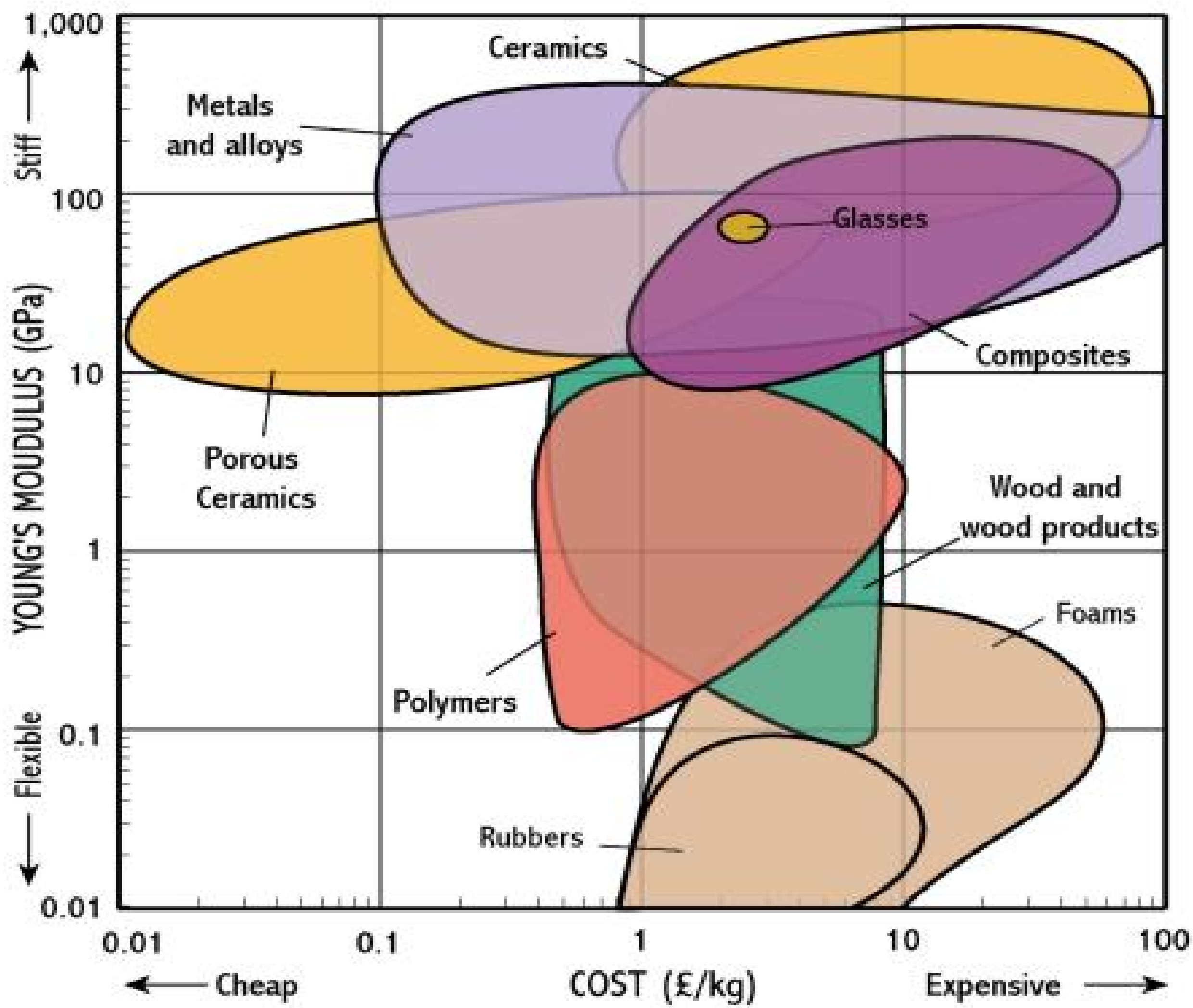
Pin would lock into the three slots on disc below.

Materials Selection and Properties For Rotary Valve

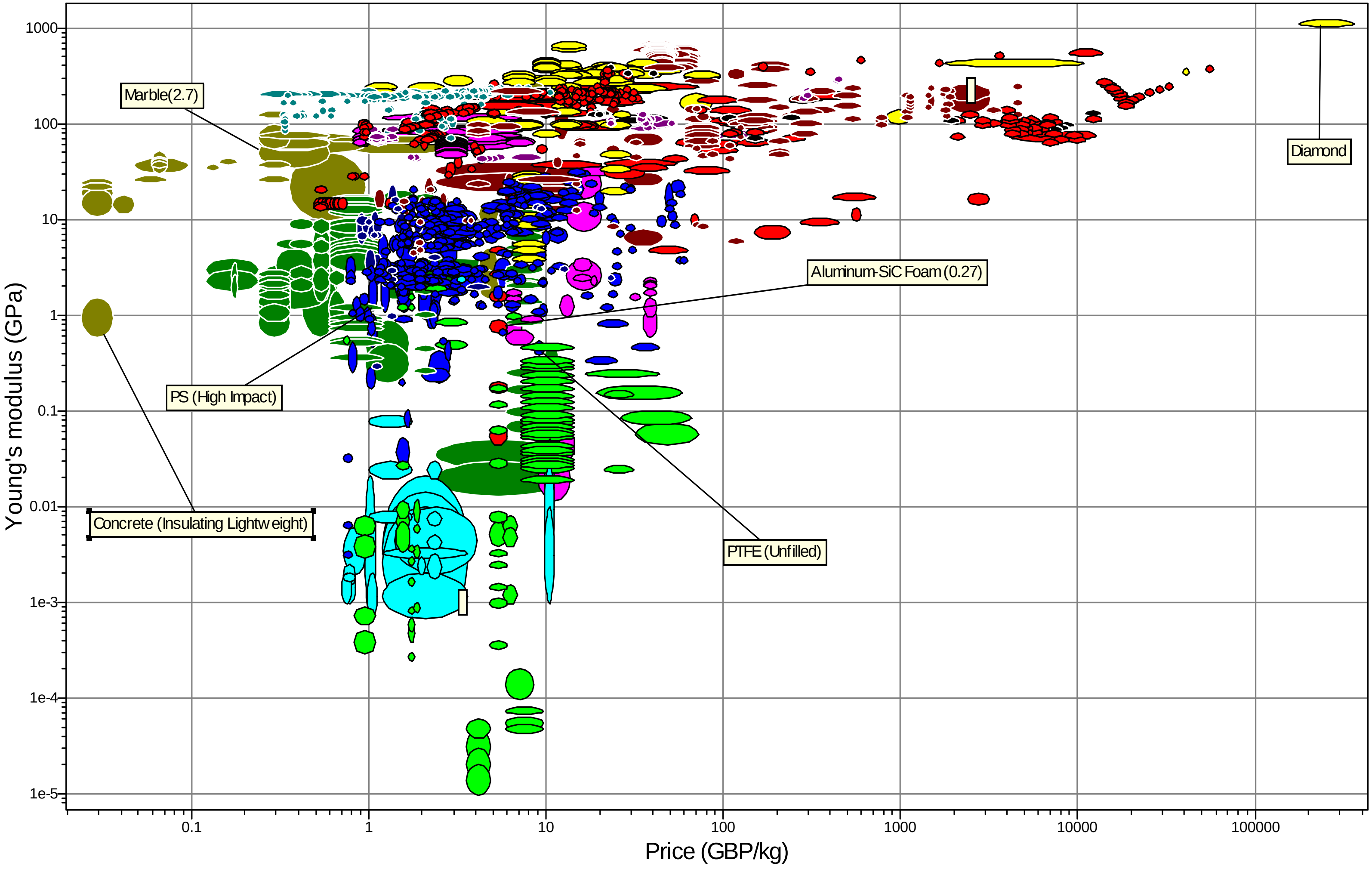
The Selection of Materials for the valve body.
Important features: Low mass, Cost kept down.



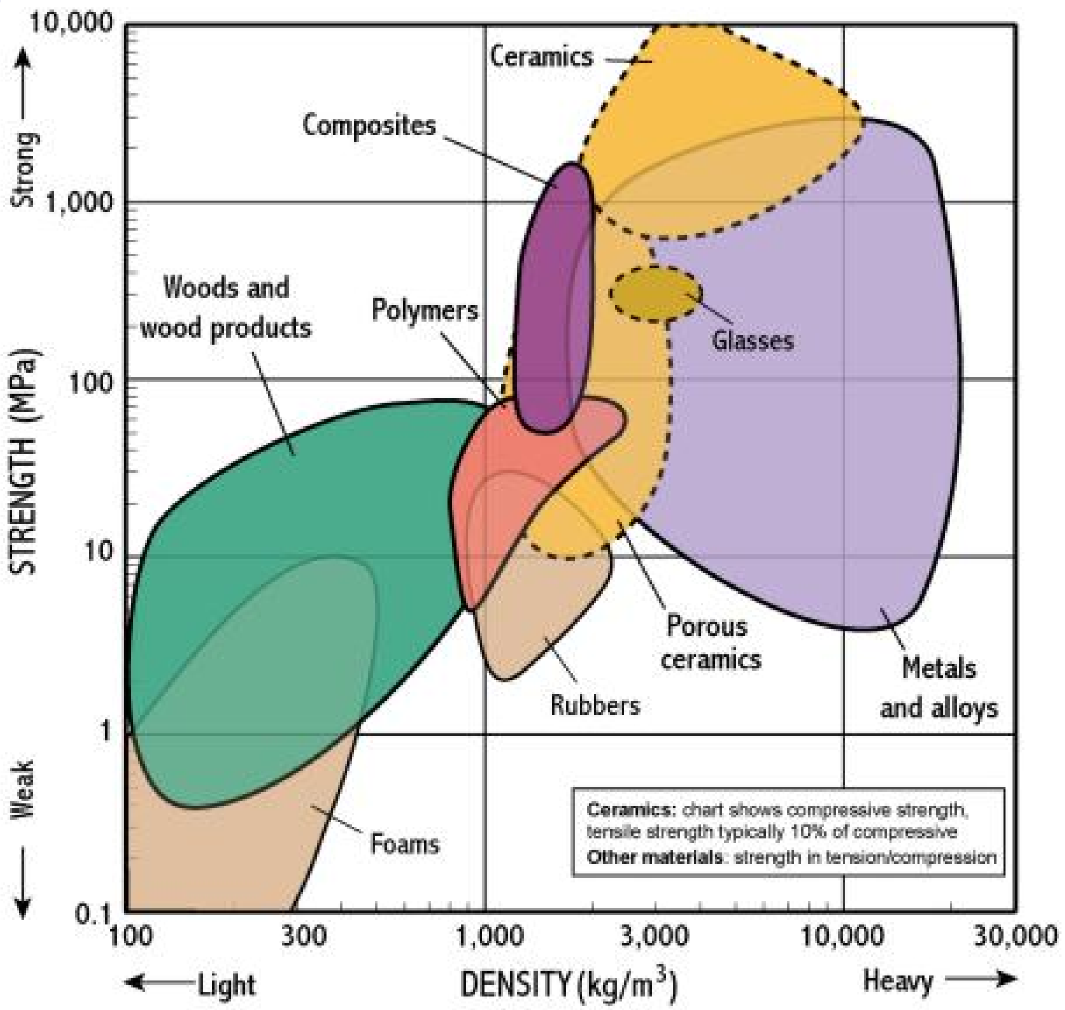
The positions of various materials on a Young's Modulus Vs Cost plot:



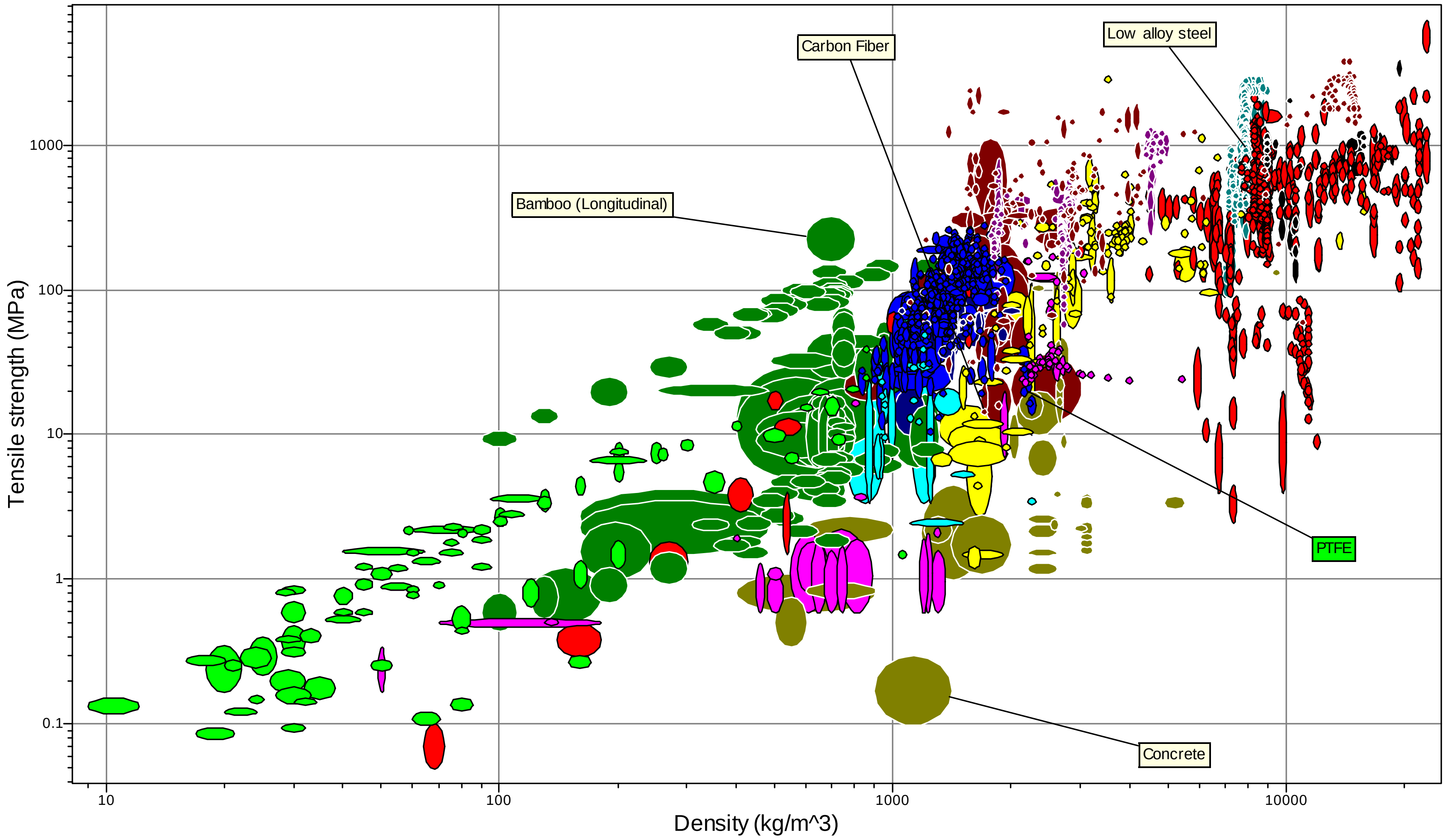
Important features: **Acceptable value for Youngs Modulus while keeping Costs down.**



The positions of various materials on a Strength Vs Density plot:



Important features: **Adequate Tensile Strength, while balancing that with the Low Density requirements**



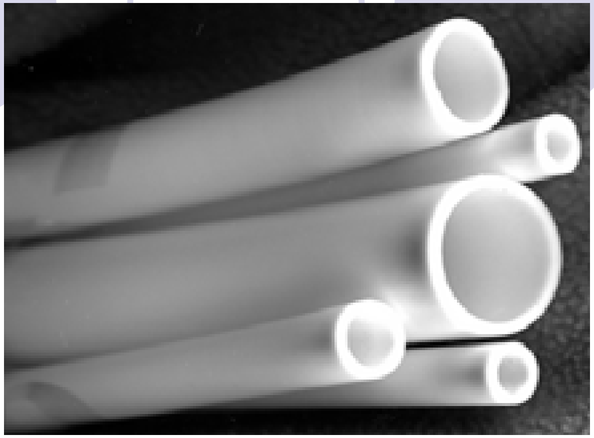
Brass Instrument

- Brass is any alloy of Copper & Zinc
- Substitutional alloy used for applications where LOW friction is required such as valves, bearings, etc.
- The malleability and acoustic properties are ideal for brass instruments
- Aluminium makes brass stronger and more corrosion resistant
- The density of brass is approximately 8.4 g/cm^3

Brass Instruments

- Brass instruments are normally made of brass, polished and then colour coated to prevent corrosion.
- They have also been constructed from other alloys containing significant amounts of copper or silver
- Brass is the chosen material for the valve body and for the mechanism

PTFE



- **Polytetrafluoroethylene**
- **Thermoplastic**
- **PTFE Rod is officially in the record books as having the lowest coefficient of friction of any solid material**
- **Low Density**
- **It has fantastic chemical resistance**

Material	LME Official Prices (GBP£/kg) for 30 Oct 2007
Copper	3.7289
Zinc	1.3642

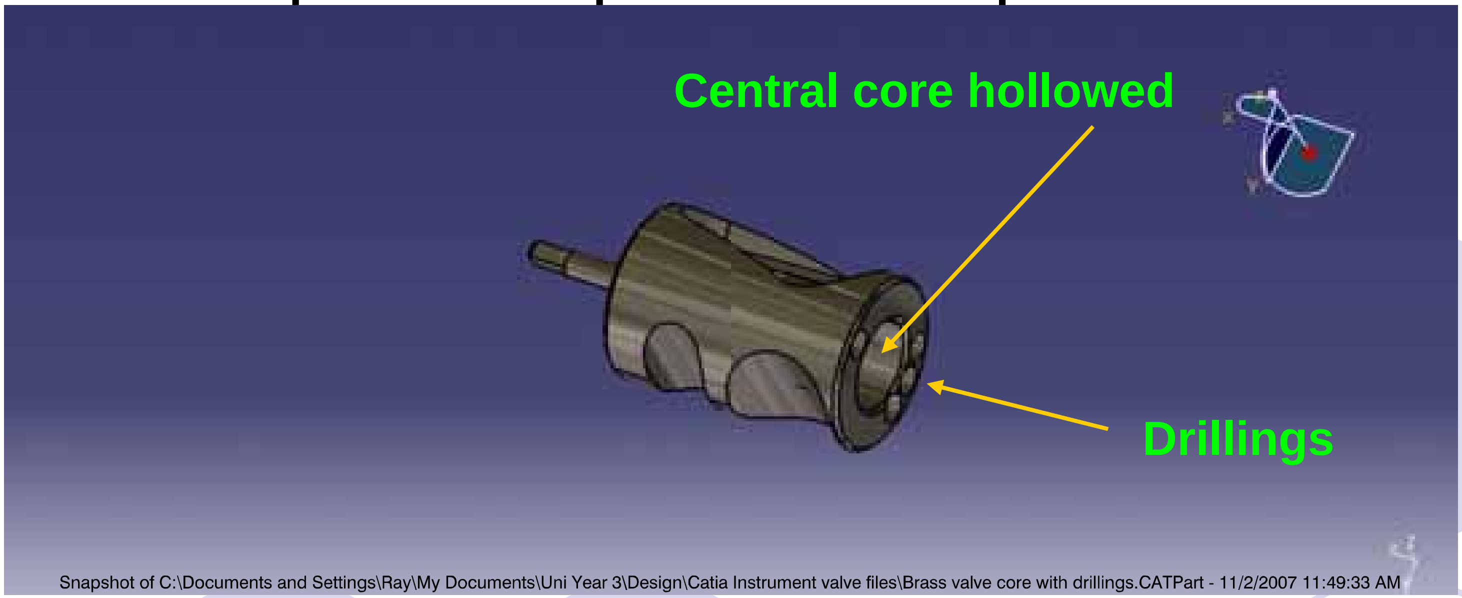
http://www.lme.co.uk/

PTFE rod 40mm diameter x 1000mm

Price: £33.71 (£39.61 inc VAT)

http://www.directplasticsonline.co.uk/

Concepts for the improvement of the patented valve:



The Brass valve core, currently modelled in another workshop was too heavy.

This concept initially staying with Brass, incorporates a central hollowed out core, and strategic drillings.

This has the effect of reducing overall mass, without interrupting the valve profile.

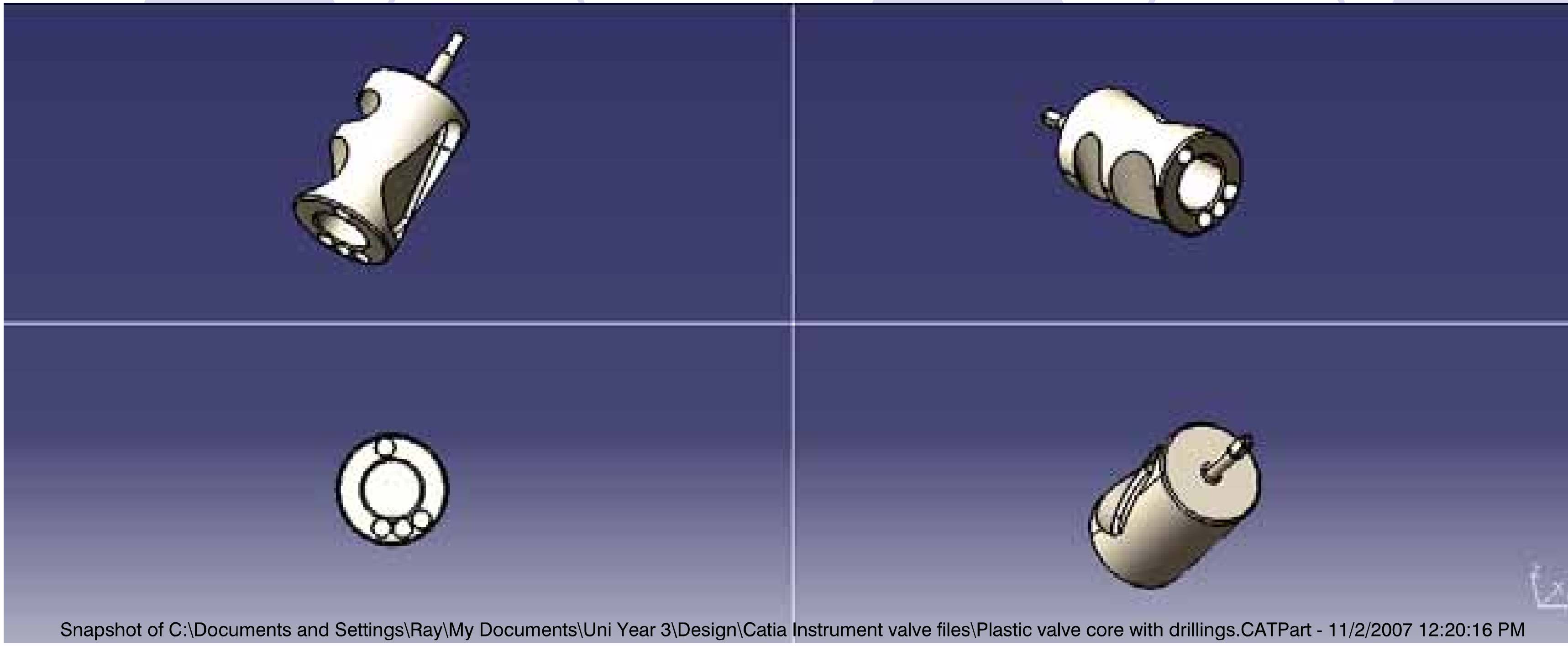
This Computer model gives us a mass of approximately 0.27kg

Keep this idea, and experiment with materials…

If Aluminium is chosen, the same valve core design will give an approximate mass of 0.1kg.

A substantial reduction, which also gives the benefit of reduced Inertia.

Remembering PTFE…



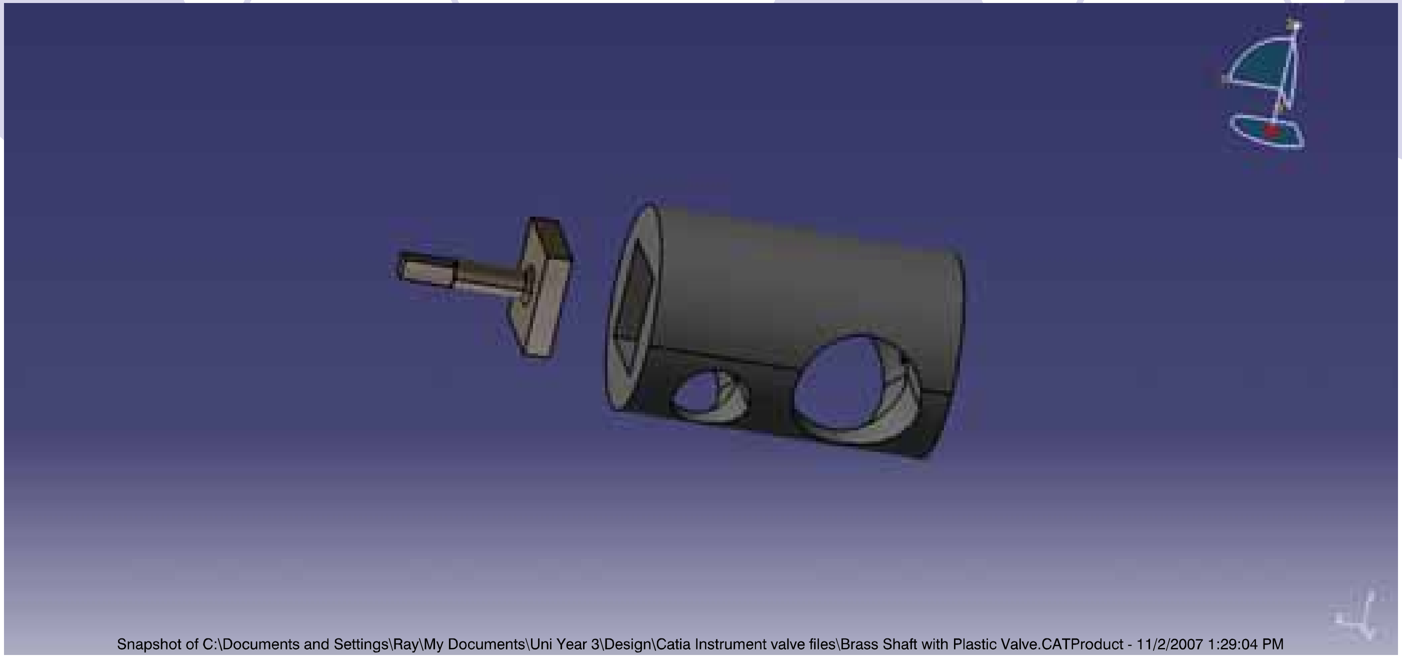
PTFE will reduce the mass down to approximately 0.08kg. Slightly less than 1/3 that of Brass.

Lower Inertia, with the added benefit of lower friction.

The use of PTFE will reduce the need for lubrication, and possibly eliminate it.

The drive shaft could be a problem. Small diameter plastics can be weakened easily…. To overcome this disadvantage:

PTFE valve core, with Brass driveshaft



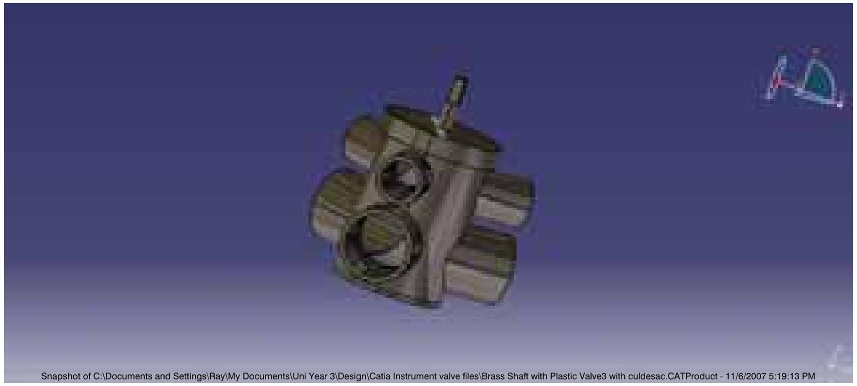
Advantages:

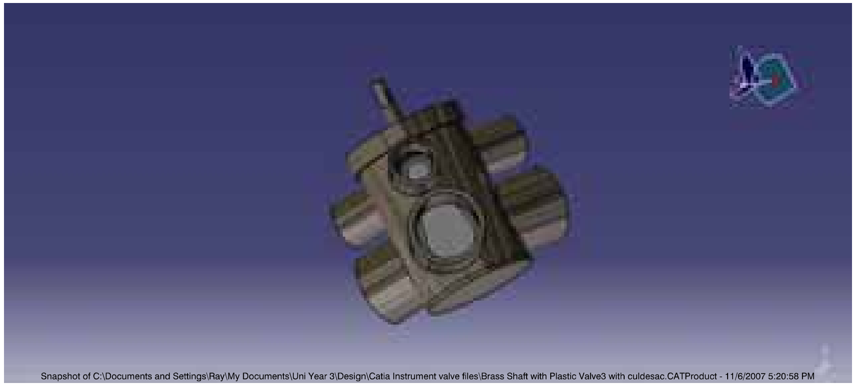
1. **Low mass, Low inertia valve body.**
2. **Only Polished Brass is visible. Beauty of the Instrument is preserved.**
3. **PTFE has very low frictional properties, lubrication could be eliminated.**
4. **Brass shaft avoids weaker plastic problems.**

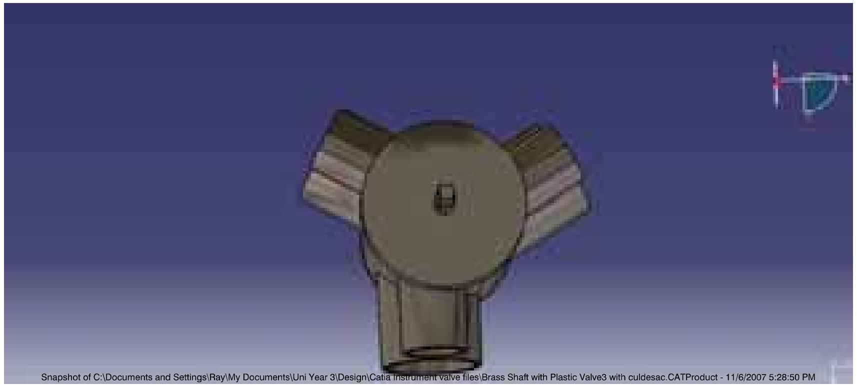
Split Valve core and Drive shaft

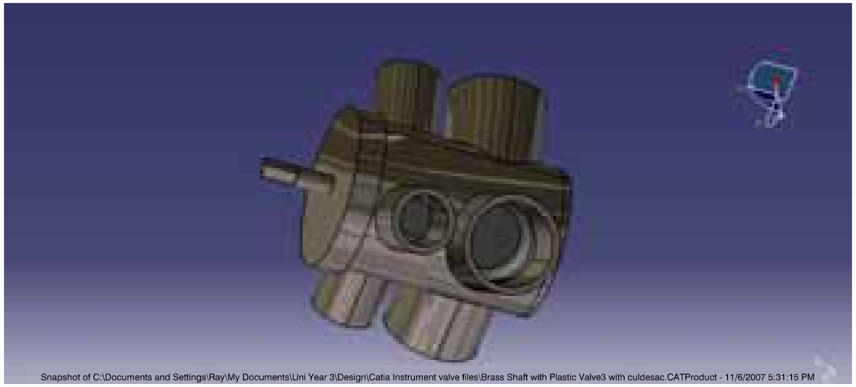
Combined mass: 0.12kg

Thin walled Brass bodied valve, with Brass drive shaft, fitted to a PTFE internal core:









Team Calendar - November

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1 EGPR Team Meeting: 16.00 - 19.00	2	3
4	5 EGPR Team Meeting: 16.00 - 19.00	6 EGPR Team Meeting: 16.00 - 19.00	7 EGPR Team Meeting: 14.30 - 17.30	8 EGPR Team Meeting: 16.00 - 19.00	9 EGPR Team Meeting: 11.00 - 18.00	10
11	12 EGPR Team Meeting: 16.00 - 19.00	13	14	15 EGPR Team Meeting: 16.00 - 19.00	16	17
18	19 EGPR Team Meeting: 16.00 - 19.00	20	21	22 EGPR Team Meeting: 16.00 - 19.00	23	24
25	26 EGPR Team Meeting: 16.00 - 19.00	27	28	29 EGPR Team Meeting: 16.00 - 19.00	30	

Gantt Chart

Thank you for listening!

Any Questions?