Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

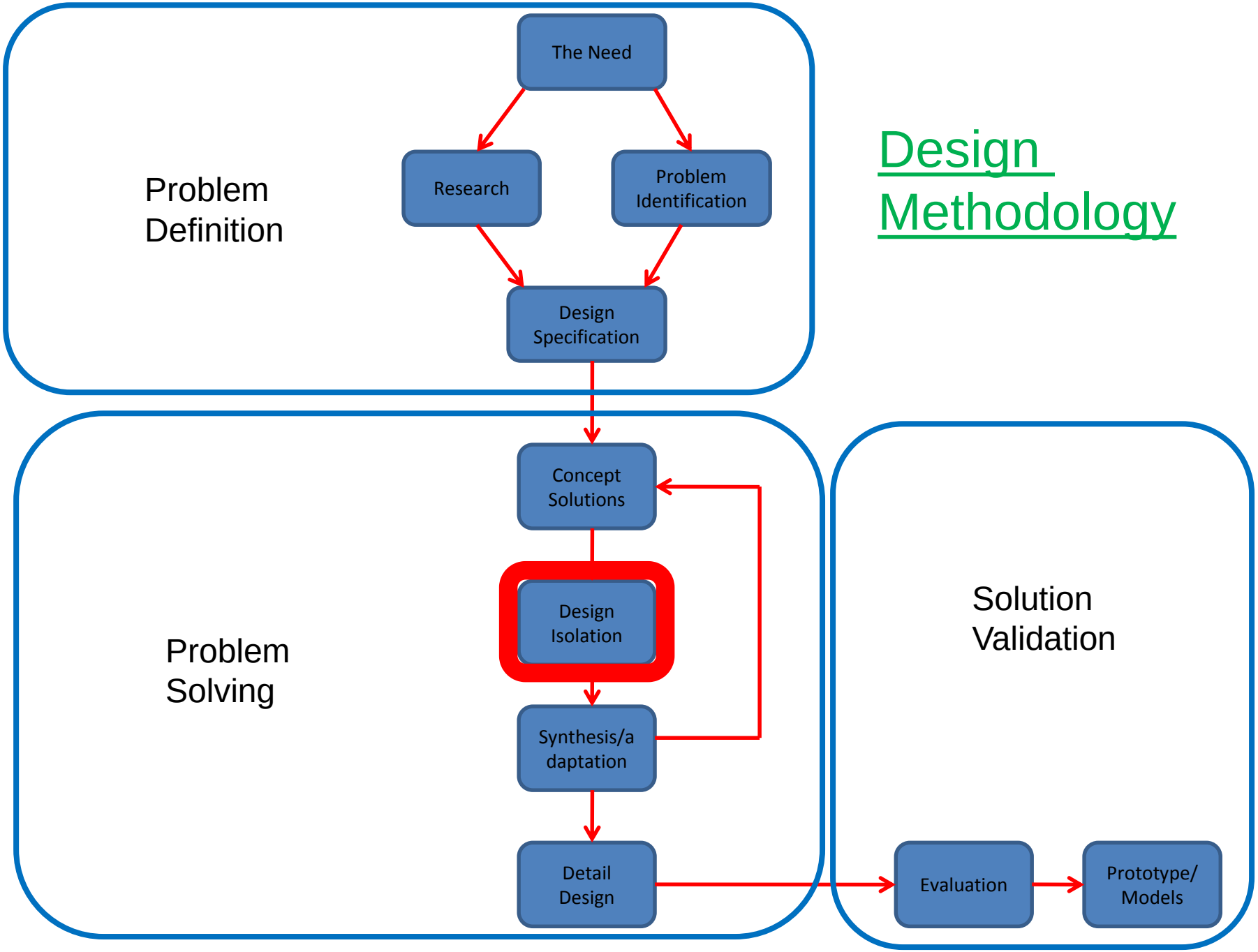
Design Toolkit

Systematic Idea Isolation

Decision/Pugh Matrix

Richard Morgan
School *of* Engineering

Design Methodology

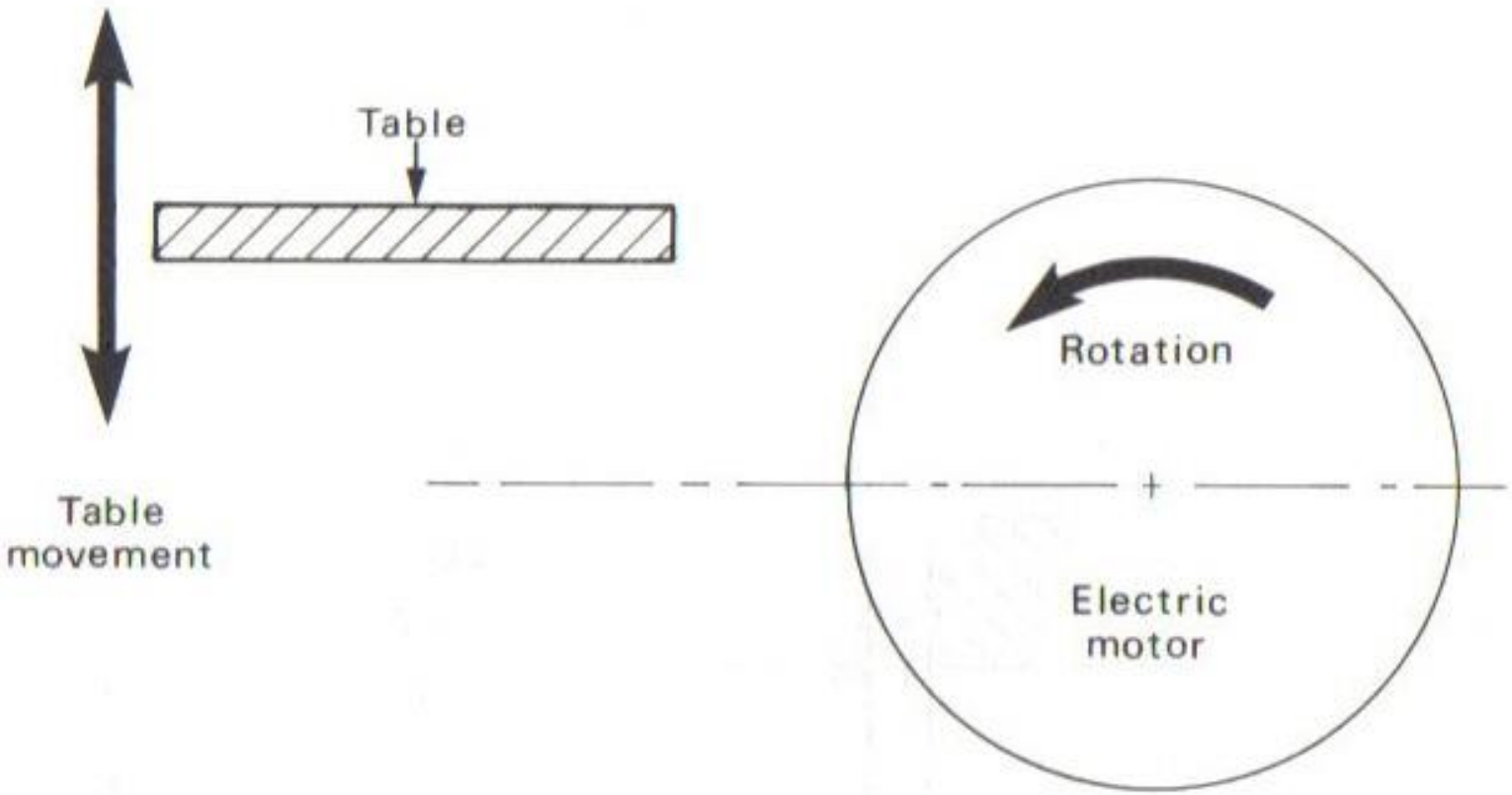


Synthesis, Comparison & Evaluation (Example)

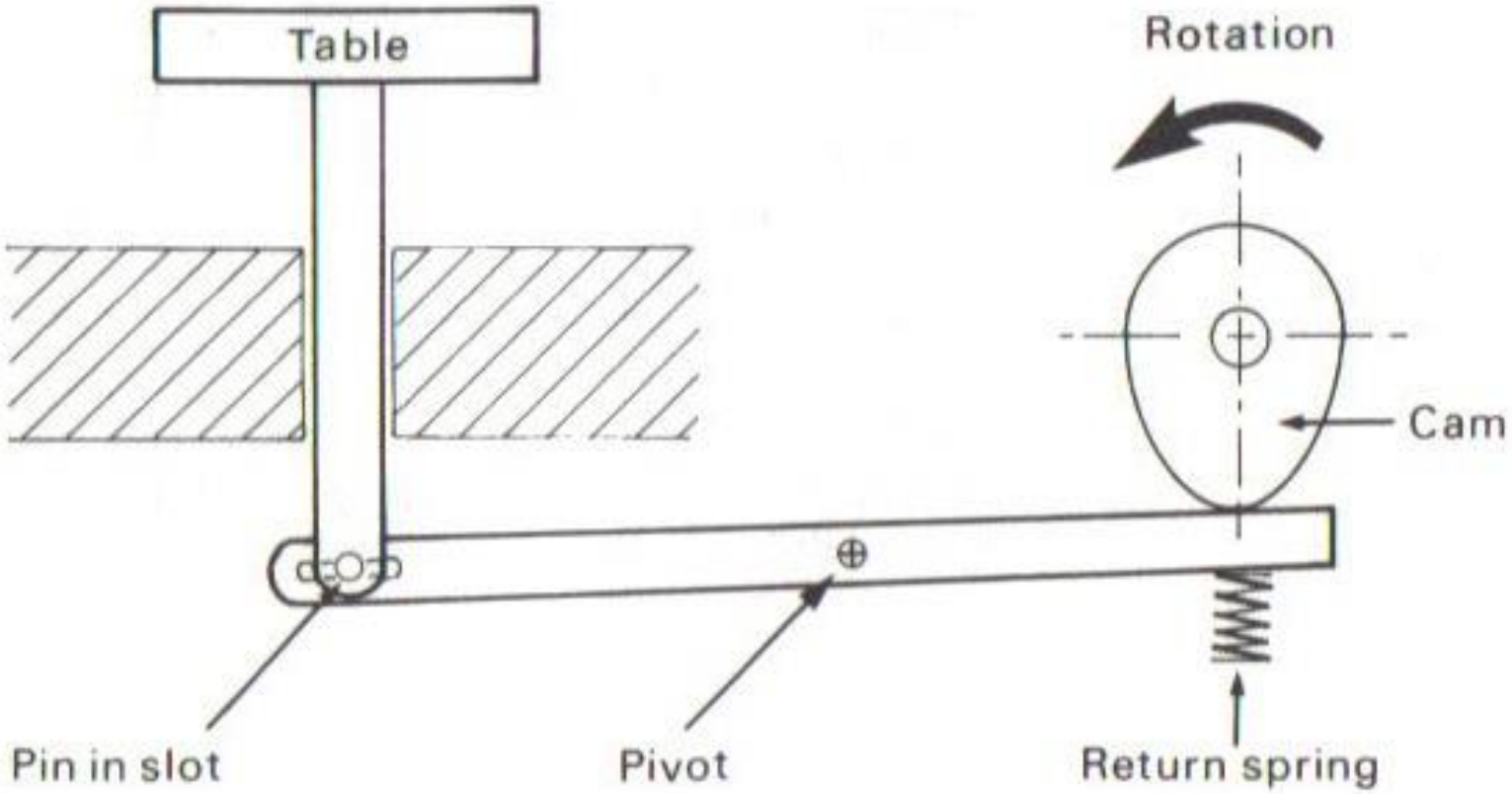
By way of an example we will consider the following design problem:

A brewery is producing large quantities of bottled beer, bottling occurs 'on site'. In an effort to maintain quality control the bottles are weighed to ensure that a specified quantity of beer has been injected. Due to problems with the current bottling process, a small number of bottles do not meet the required standard and must consequently be rejected from the conveyor belt .

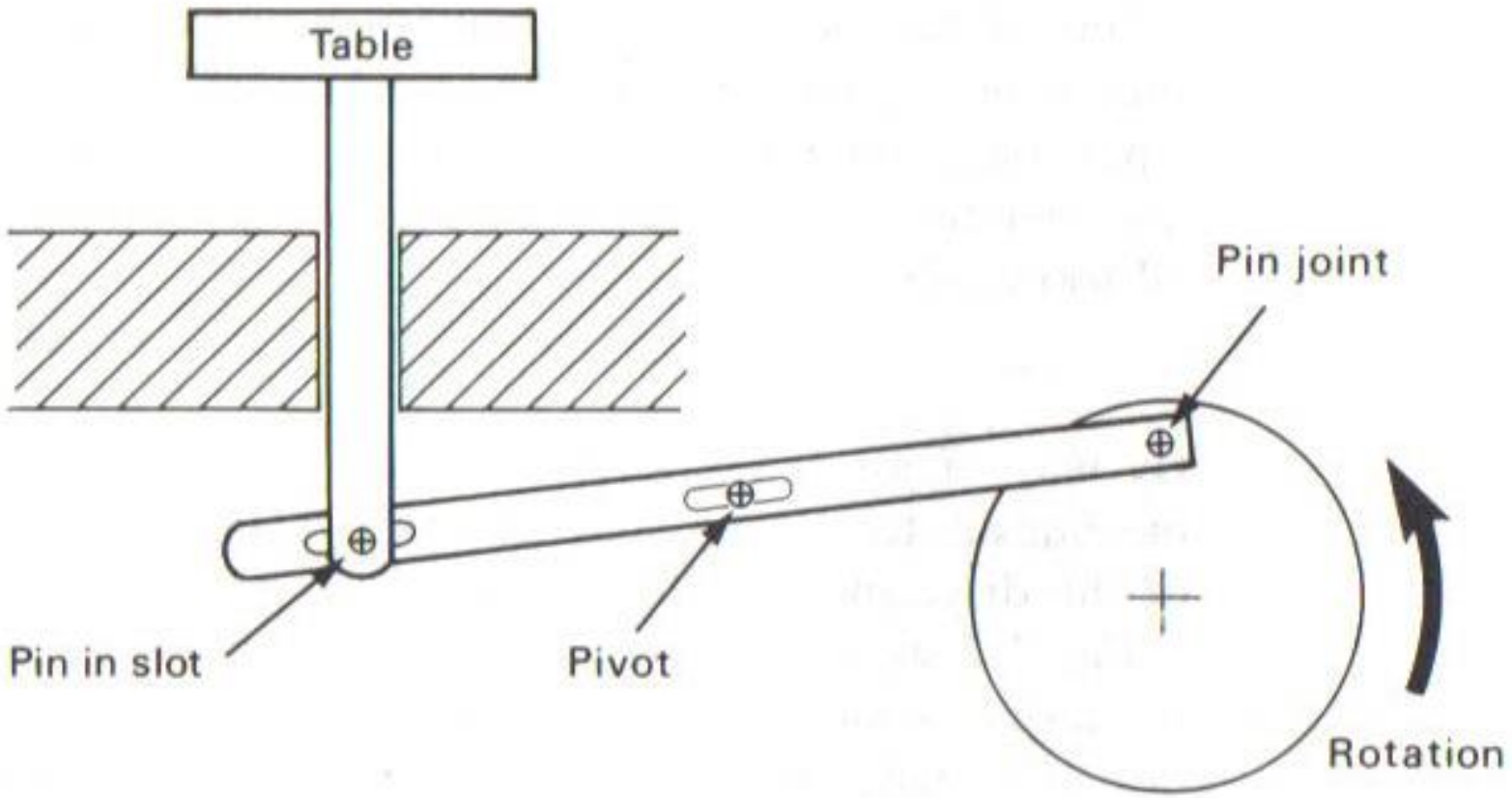
Synthesis, Comparison & Evaluation (Example)



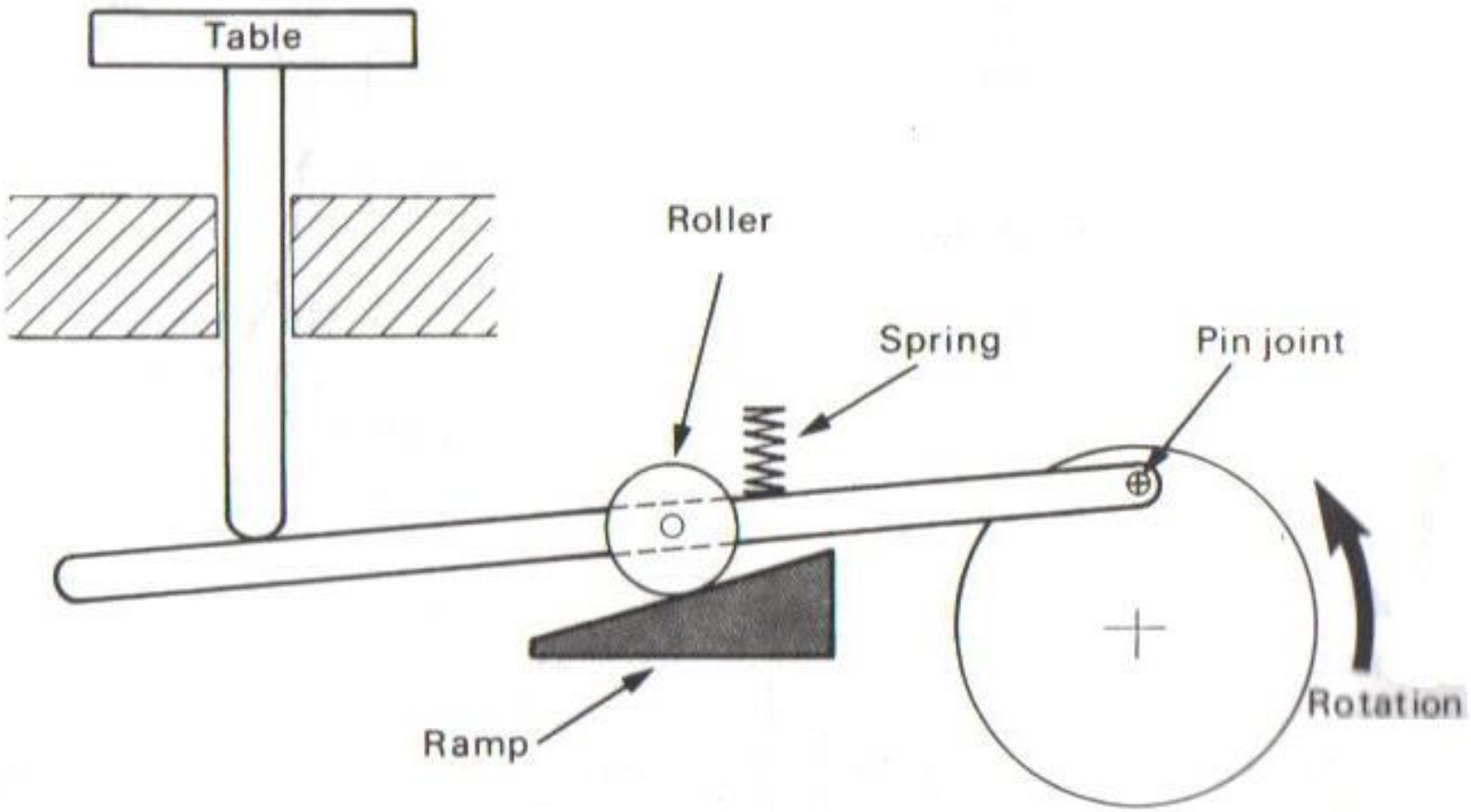
Design A



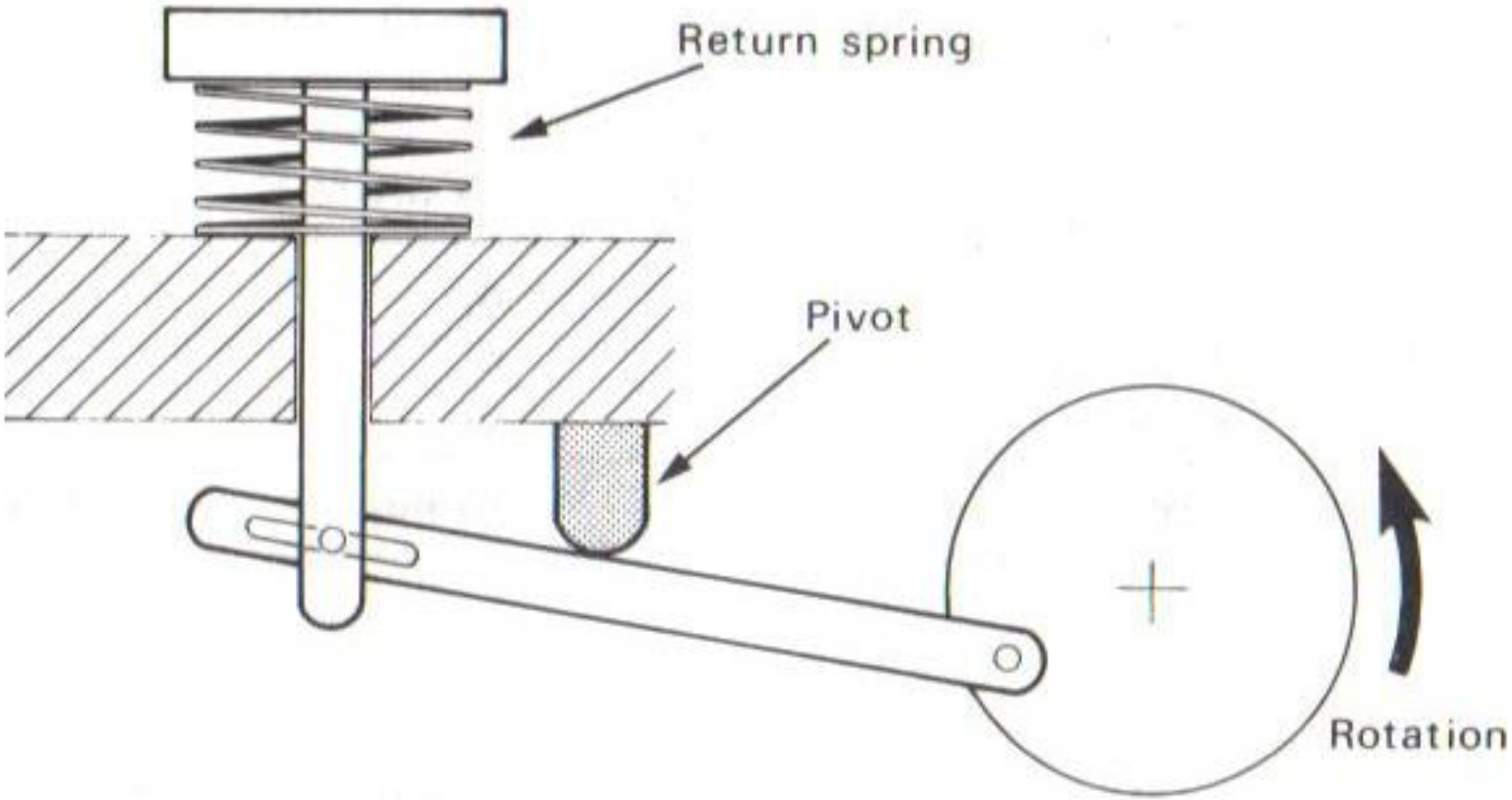
Design B



Design C



Design D



Design Feature Ratings

A More Detailed Grading Structure

Feature				

Design Feature Ratings

A More Detailed Grading Structure

Feature				
Fulfilment of function				

Design Feature Ratings

A More Detailed Grading Structure

Feature				
Fulfilment of function				
Reliability				

Design Feature Ratings

A More Detailed Grading Structure

Feature				
Fulfilment of function				
Reliability				
Serviceability				

Design Feature Ratings

A More Detailed Grading Structure

Feature				
Fulfilment of function				
Reliability				
Serviceability				
Life				

Design Feature Ratings

A More Detailed Grading Structure

Feature				
Fulfilment of function				
Reliability				
Serviceability				
Life				
Ease of maintenance				

Design Feature Ratings

A More Detailed Grading Structure

Feature				
Fulfilment of function				
Reliability				
Serviceability				
Life				
Ease of maintenance				
Ease of manufacture				

Design Feature Ratings

A More Detailed Grading Structure

Feature				
Fulfilment of function				
Reliability				
Serviceability				
Life				
Ease of maintenance				
Ease of manufacture				
Efficiency of operation				

Design Feature Ratings

A More Detailed Grading Structure

Feature				
Fulfilment of function				
Reliability				
Serviceability				
Life				
Ease of maintenance				
Ease of manufacture				
Efficiency of operation				
Simplicity of layout				

Design Feature Ratings

A More Detailed Grading Structure

Feature				
Fulfilment of function				
Reliability				
Serviceability				
Life				
Ease of maintenance				
Ease of manufacture				
Efficiency of operation				
Simplicity of layout				
Cost				

Design Feature Ratings

Quantify the grading scheme (where possible)

- It is important to define how you are going to award/allocate points to each of the selection criteria.
- Criteria such as weight and cost are relatively simple to define.
- Criteria such as ease of use, manufacturability or aesthetics may require more complex definitions.

Cost											
Value (£)											

Design Feature Ratings

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Cost											
Value (£)	0 - 100	100 - 200	200 – 300	300 – 400	400 - 500	500 – 600	600 – 700	700– 800	800 – 900	900 – 1000	<1000

Design Feature Ratings

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Cost											
Value (£)	0 - 100	100 - 200	200 – 300	300 – 400	400 - 500	500 – 600	600 – 700	700– 800	800 – 900	900 – 1000	<1000
Point Score											

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Cost											
Value (£)	0 - 100	100 - 200	200 – 300	300 – 400	400 - 500	500 – 600	600 – 700	700– 800	800 – 900	900 – 1000	<1000
Point Score	10										

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Cost											
Value (£)	0 - 100	100 - 200	200 – 300	300 – 400	400 - 500	500 – 600	600 – 700	700– 800	800 – 900	900 – 1000	<1000
Point Score	10	9									

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Cost											
Value (£)	0 - 100	100 - 200	200 – 300	300 – 400	400 - 500	500 – 600	600 – 700	700– 800	800 – 900	900 – 1000	<1000
Point Score	10	9	8								

Design Feature Ratings

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Cost											
Value (£)	0 - 100	100 - 200	200 – 300	300 – 400	400 - 500	500 – 600	600 – 700	700– 800	800 – 900	900 – 1000	<1000
Point Score	10	9	8	7							

Design Feature Ratings

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Cost											
Value (£)	0 - 100	100 - 200	200 – 300	300 – 400	400 - 500	500 – 600	600 – 700	700– 800	800 – 900	900 – 1000	<1000
Point Score	10	9	8	7	6						

Design Feature Ratings

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Cost											
Value (£)	0 - 100	100 - 200	200 – 300	300 – 400	400 - 500	500 – 600	600 – 700	700– 800	800 – 900	900 – 1000	<1000
Point Score	10	9	8	7	6	5					

Design Feature Ratings

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Cost											
Value (£)	0 - 100	100 - 200	200 – 300	300 – 400	400 - 500	500 – 600	600 – 700	700– 800	800 – 900	900 – 1000	<1000
Point Score	10	9	8	7	6	5	4				

Design Feature Ratings

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Cost											
Value (£)	0 - 100	100 - 200	200 – 300	300 – 400	400 - 500	500 – 600	600 – 700	700– 800	800 – 900	900 – 1000	<1000
Point Score	10	9	8	7	6	5	4	3			

Design Feature Ratings

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Cost											
Value (£)	0 - 100	100 - 200	200 – 300	300 – 400	400 - 500	500 – 600	600 – 700	700– 800	800 – 900	900 – 1000	<1000
Point Score	10	9	8	7	6	5	4	3	2		

Design Feature Ratings

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Cost											
Value (£)	0 - 100	100 - 200	200 – 300	300 – 400	400 - 500	500 – 600	600 – 700	700– 800	800 – 900	900 – 1000	<1000
Point Score	10	9	8	7	6	5	4	3	2	1	

Design Feature Ratings

Quantify the grading scheme (where possible)

- It is important to define how you are going to award/allocate points to each of the selection criteria.
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Cost											
Value (£)	0 - 100	100 - 200	200 – 300	300 – 400	400 - 500	500 – 600	600 – 700	700– 800	800 – 900	900 – 1000	<1000
Point Score	10	9	8	7	6	5	4	3	2	1	0

Design Feature Ratings

Quantify the grading scheme (where possible)

Likert Scales

Example – ‘Ease of use’ or user experience of a system or product etc.

Please circle the number that represents how you feel about the computer software you have been using

I am satisfied with it
Strongly Disagree ---1---2---3---4---5---6---7--- Strongly Agree

It is simple to use
Strongly Disagree ---1---2---3---4---5---6---7--- Strongly Agree

It is fun to use
Strongly Disagree ---1---2---3---4---5---6---7--- Strongly Agree

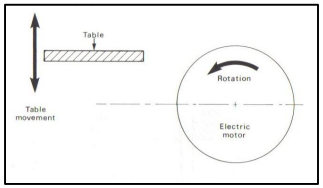
It does everything I would expect it to do
Strongly Disagree ---1---2---3---4---5---6---7--- Strongly Agree

I don't notice any inconsistencies as I use it
Strongly Disagree ---1---2---3---4---5---6---7--- Strongly Agree

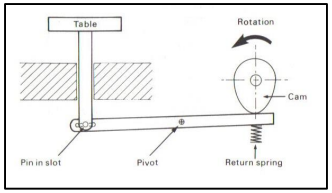
It is very user friendly
Strongly Disagree ---1---2---3---4---5---6---7--- Strongly Agree

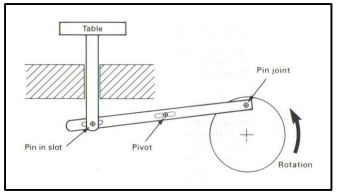
Design Feature Ratings

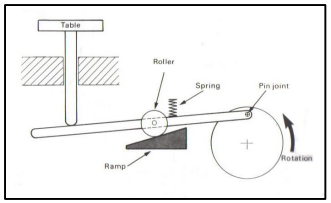
A More Detailed Grading Structure

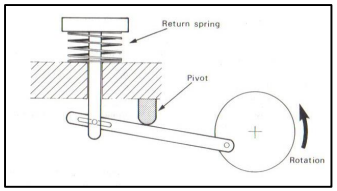


Feature	Design A	Design B	Design C	Design D
Fulfilment of function				
Reliability				
Serviceability				
Life				
Ease of maintenance				
Ease of manufacture				
Efficiency of operation				
Simplicity of layout				
Cost				









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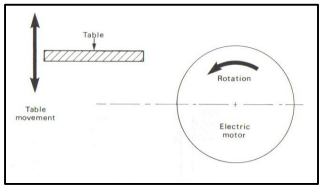
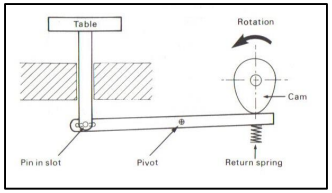
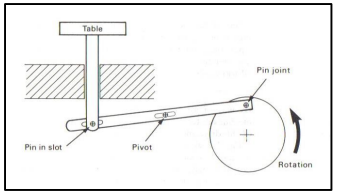
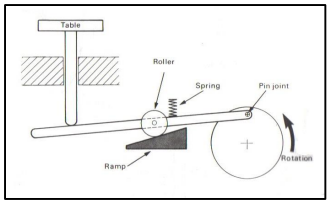
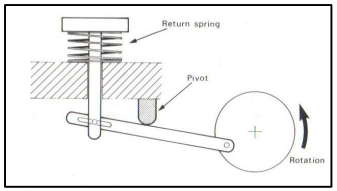


Feature	Design A	Design B	Design C	Design D
Fulfilment of function	10	10	10	10
Reliability				
Serviceability				
Life				
Ease of maintenance				
Ease of manufacture				
Efficiency of operation				
Simplicity of layout				
Cost				



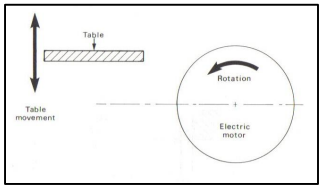




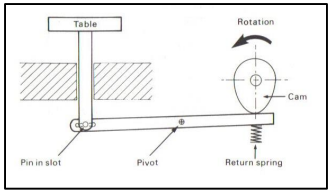


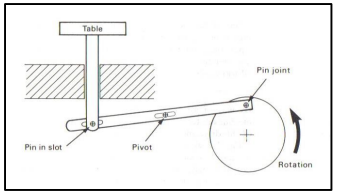
Design Feature Ratings

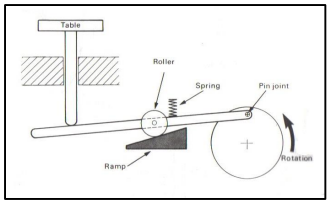
A More Detailed Grading Structure

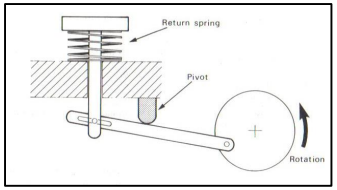


Feature	Design A	Design B	Design C	Design D
Fulfilment of function	10	10	10	10
Reliability	6	8	3	2
Serviceability				
Life				
Ease of maintenance				
Ease of manufacture				
Efficiency of operation				
Simplicity of layout				
Cost				



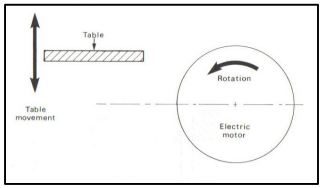




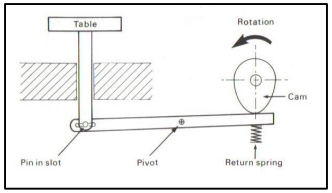


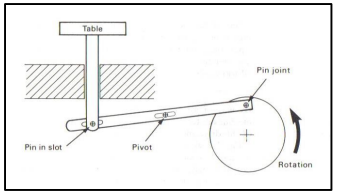
Design Feature Ratings

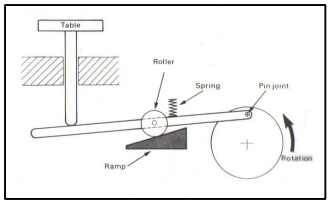
A More Detailed Grading Structure

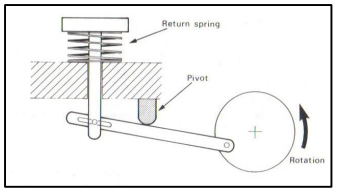


Feature	Design A	Design B	Design C	Design D
Fulfilment of function	10	10	10	10
Reliability	6	8	3	2
Serviceability	7	6	5	1
Life				
Ease of maintenance				
Ease of manufacture				
Efficiency of operation				
Simplicity of layout				
Cost				









Design Feature Ratings

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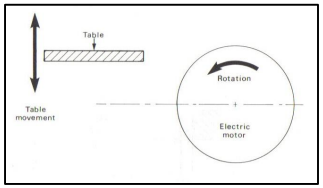

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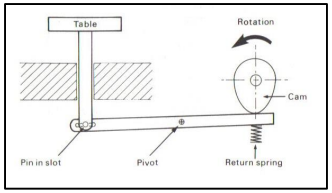
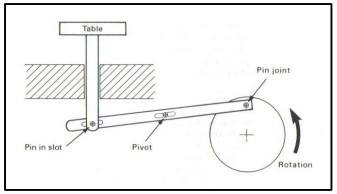
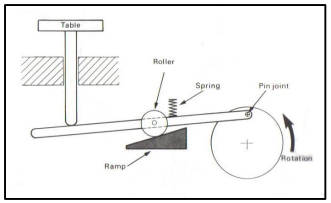
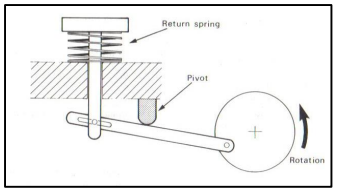
Serviceability	7	6	5	1
Life	3	7	3	2
Ease of maintenance				
Ease of manufacture				
Efficiency of operation				
Simplicity of layout				
Cost				









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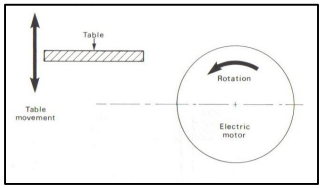

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Serviceability	7	6	5	1
Life	3	7	3	2
Ease of maintenance	5	6	5	3
Ease of manufacture				
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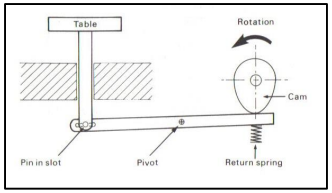
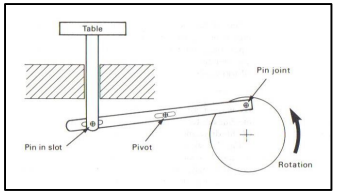
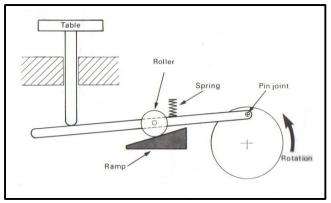
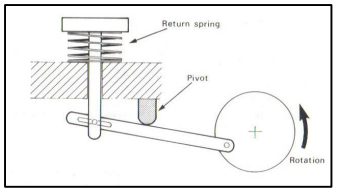
Simplicity of layout				
Cost				



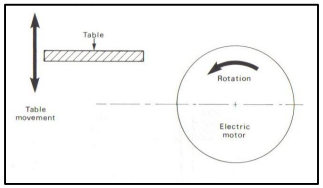




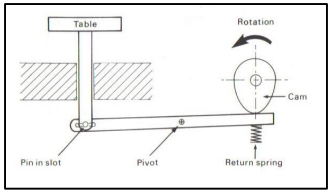


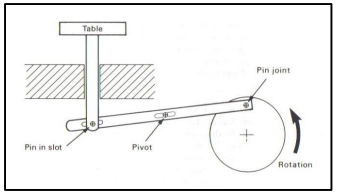
Design Feature Ratings

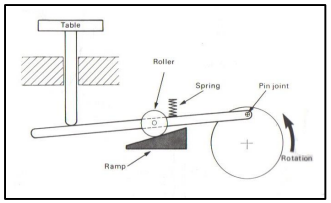
A More Detailed Grading Structure

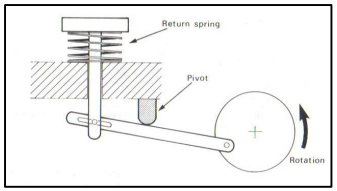


Feature	Design A	Design B	Design C	Design D
Fulfilment of function	10	10	10	10
Reliability	6	8	3	2
Serviceability	7	6	5	1
Life	3	7	3	2
Ease of maintenance	5	6	5	3
Ease of manufacture	6	9	3	2
Efficiency of operation				
Simplicity of layout				
Cost				









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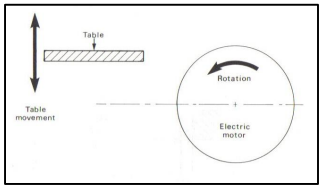

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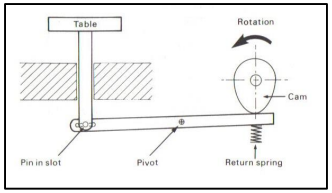
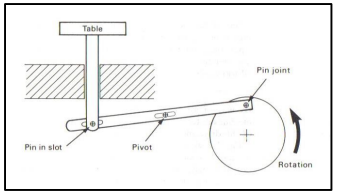
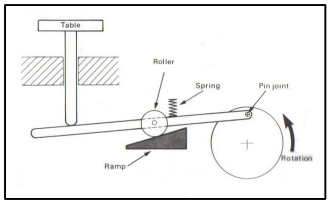
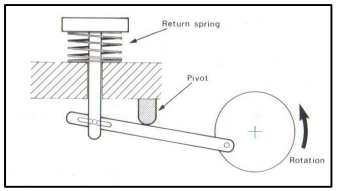
Ease of manufacture	6	9	3	2
Efficiency of operation	2	5	1	1
Simplicity of layout				
Cost				









Design Feature Ratings

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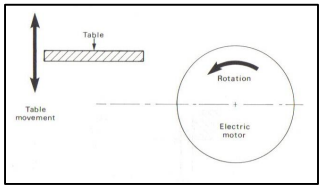

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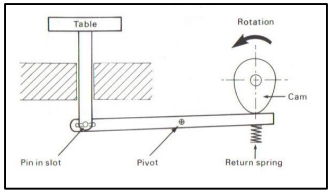

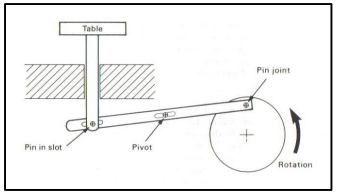

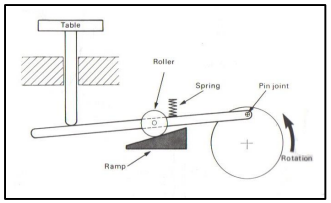

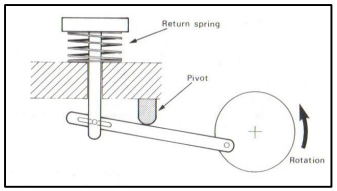

Design Feature Ratings

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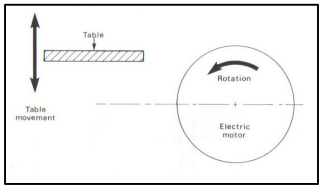

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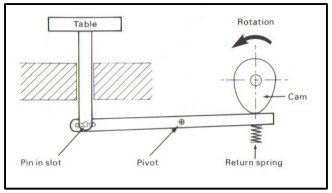
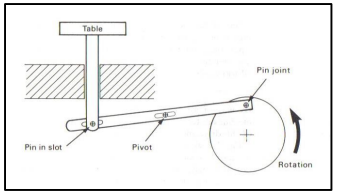
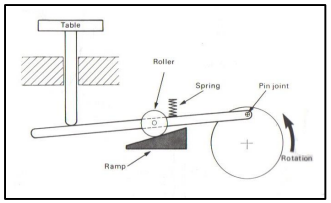
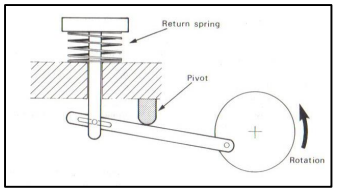
Ease of manufacture	6	9	3	2
Efficiency of operation	2	5	1	1
Simplicity of layout	5	8	2	1
Cost	5	8	6	2



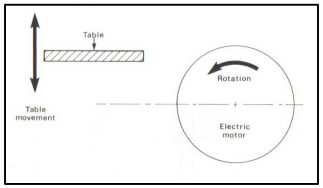




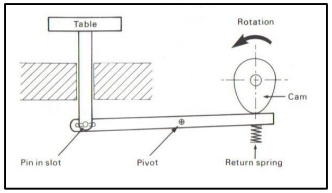


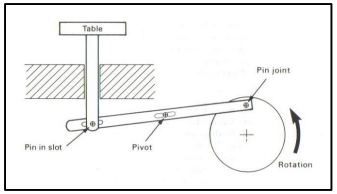
Design Feature Ratings

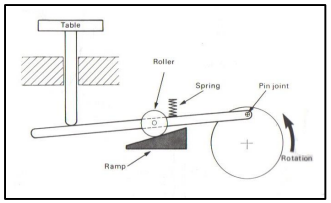
Applying Weightings to the Selection Criteria

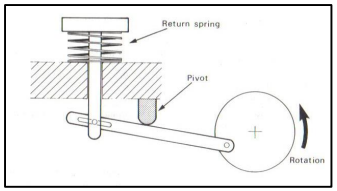


Feature	Weighting	Design A	Design B	Design C	Design D
Fulfilment of function	**3**	10	10	10	10
Reliability	**3**	6	8	3	2
Serviceability	**2**	7	6	5	1
Life	**2**	3	7	3	2
Ease of maintenance	**2**	5	6	5	3
Ease of manufacture	**1**	6	9	3	2
Efficiency of operation	**1**	2	5	1	1
Simplicity of layout	**1**	5	8	2	1
Cost	**2**	5	8	6	2









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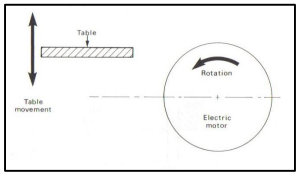
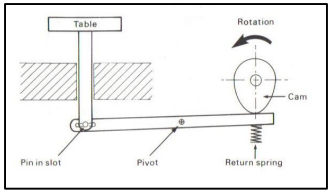
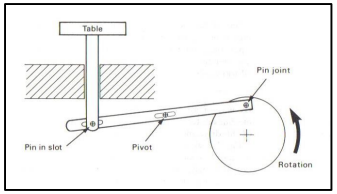
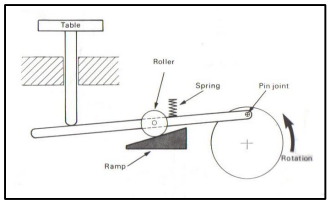
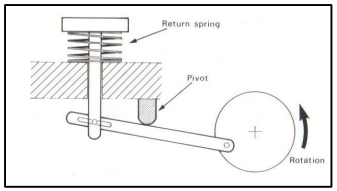


Feature	Weighting	Design A	Design B	Design C	Design D
Fulfilment of function	**3**	30	30	30	30
Reliability	**3**	18	24	9	6
Serviceability	**2**	14	12	10	2
Life	**2**	6	14	6	4
Ease of maintenance	**2**	10	12	10	6
Ease of manufacture	**1**	6	9	3	2
Efficiency of operation	**1**	2	5	1	1
Simplicity of layout	**1**	5	8	2	1
Cost	**2**	10	16	12	4
Design total weighted ratings		**101**	**130**	**83**	**56**









Summary of Technique

Does this technique tell you which concept designs to develop?

It does not make a decision for you!

Use the output to inform your decision

Consider ‘controlled convergence’ to incorporate desirable or optimal features from a concept designs.

If you use this technique to help your team to isolate desirable design features or concept design functions, don’t just use the selection criteria applied in this example.

Use your Design Specification to help to identify what’s important.