



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

Design Toolkit

Systematic Idea Isolation

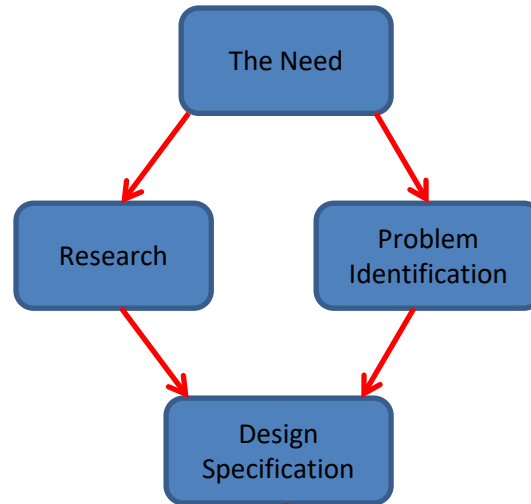
Decision/Pugh Matrix



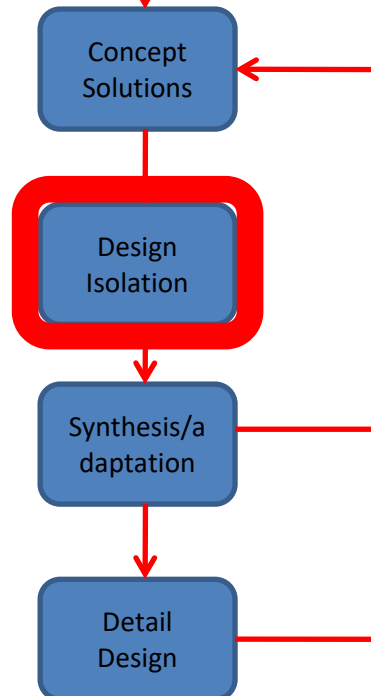
Richard Morgan
School *of* Engineering

Design Methodology

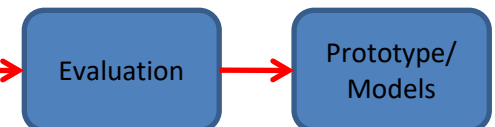
Problem Definition



Problem Solving



Solution Validation



Synthesis, Comparison & Evaluation (Example)

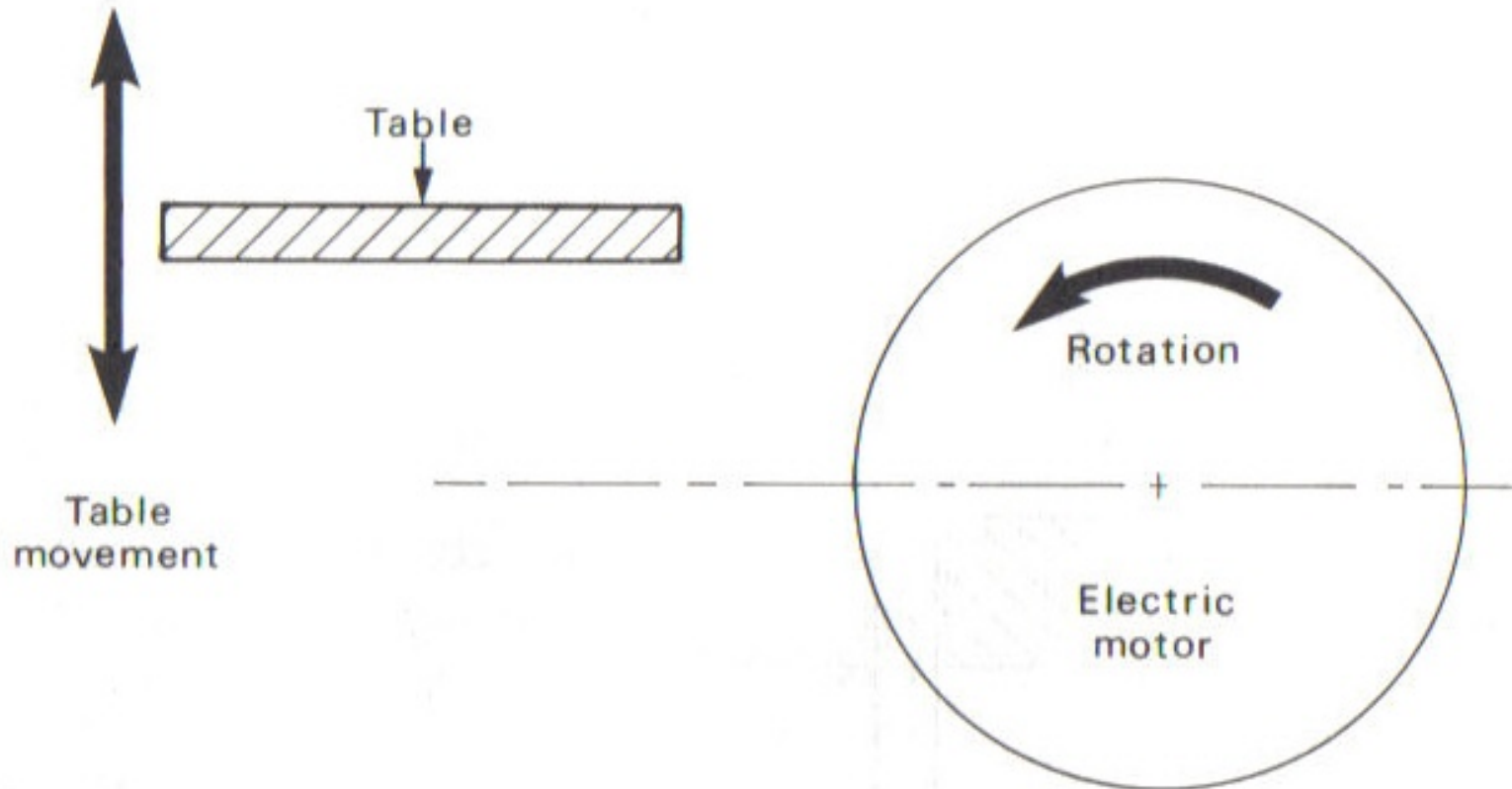
By way of an example we will consider the following design problem:

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 .

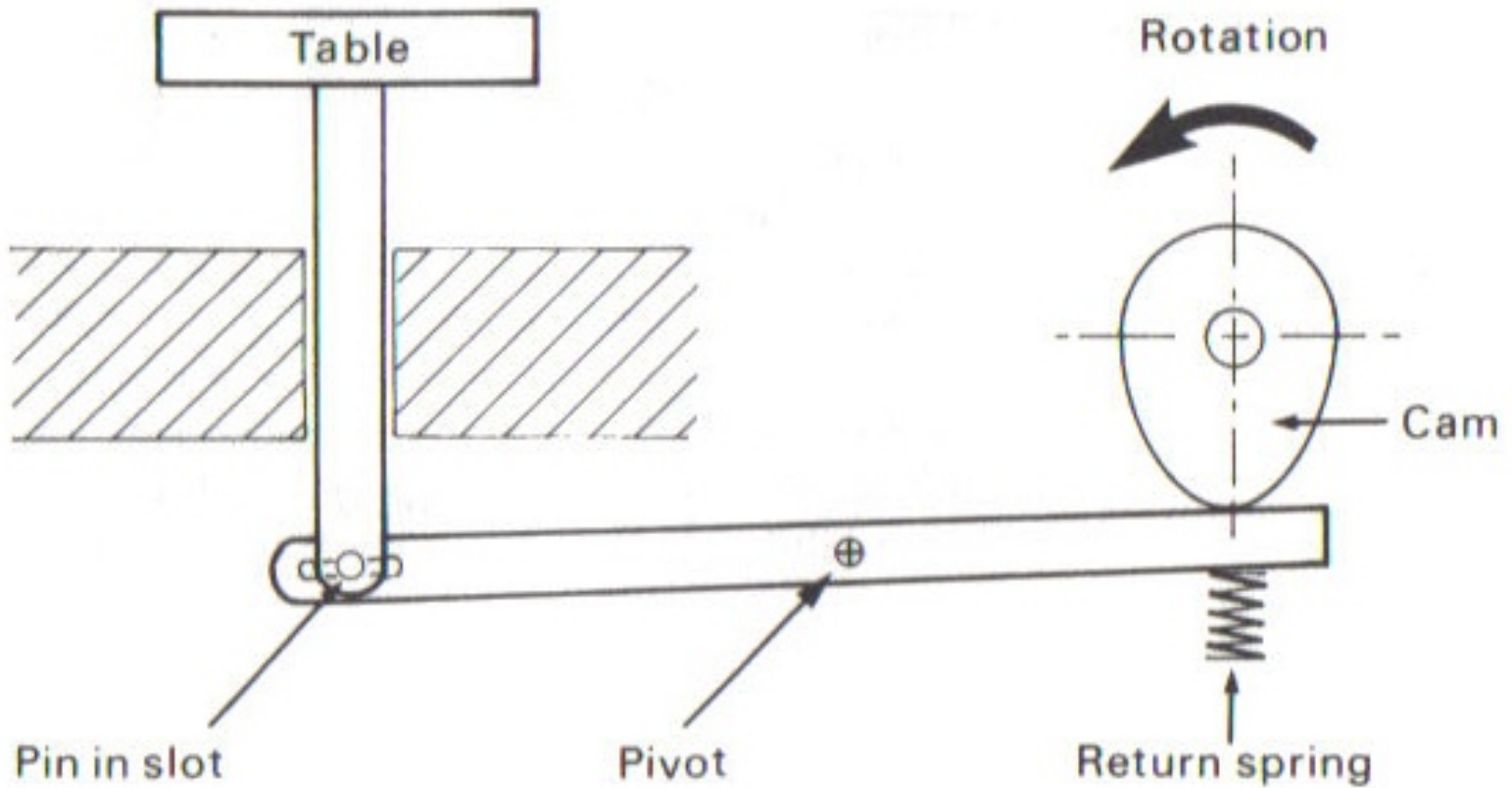


Synthesis, Comparison & Evaluation

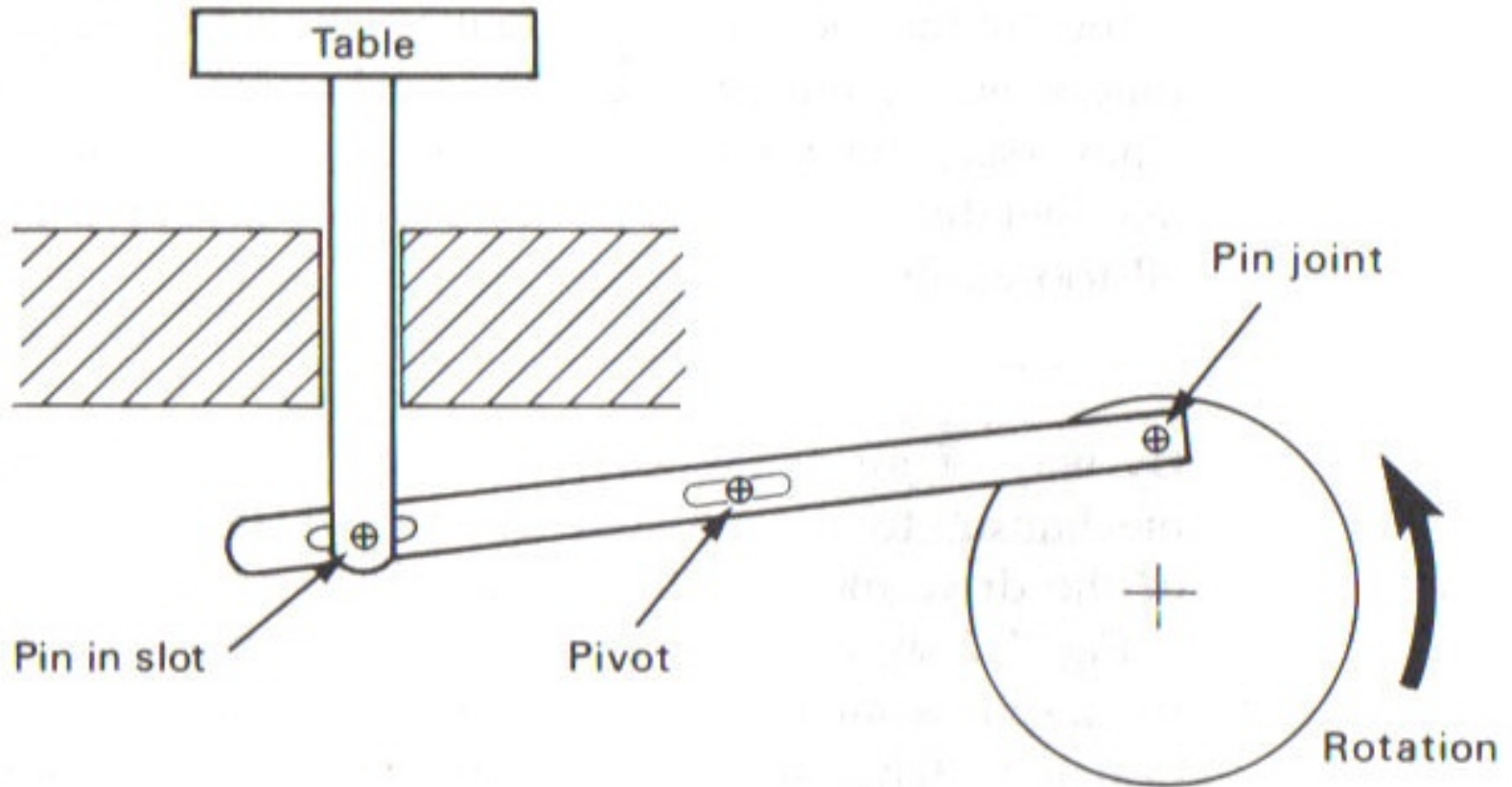
(Example)



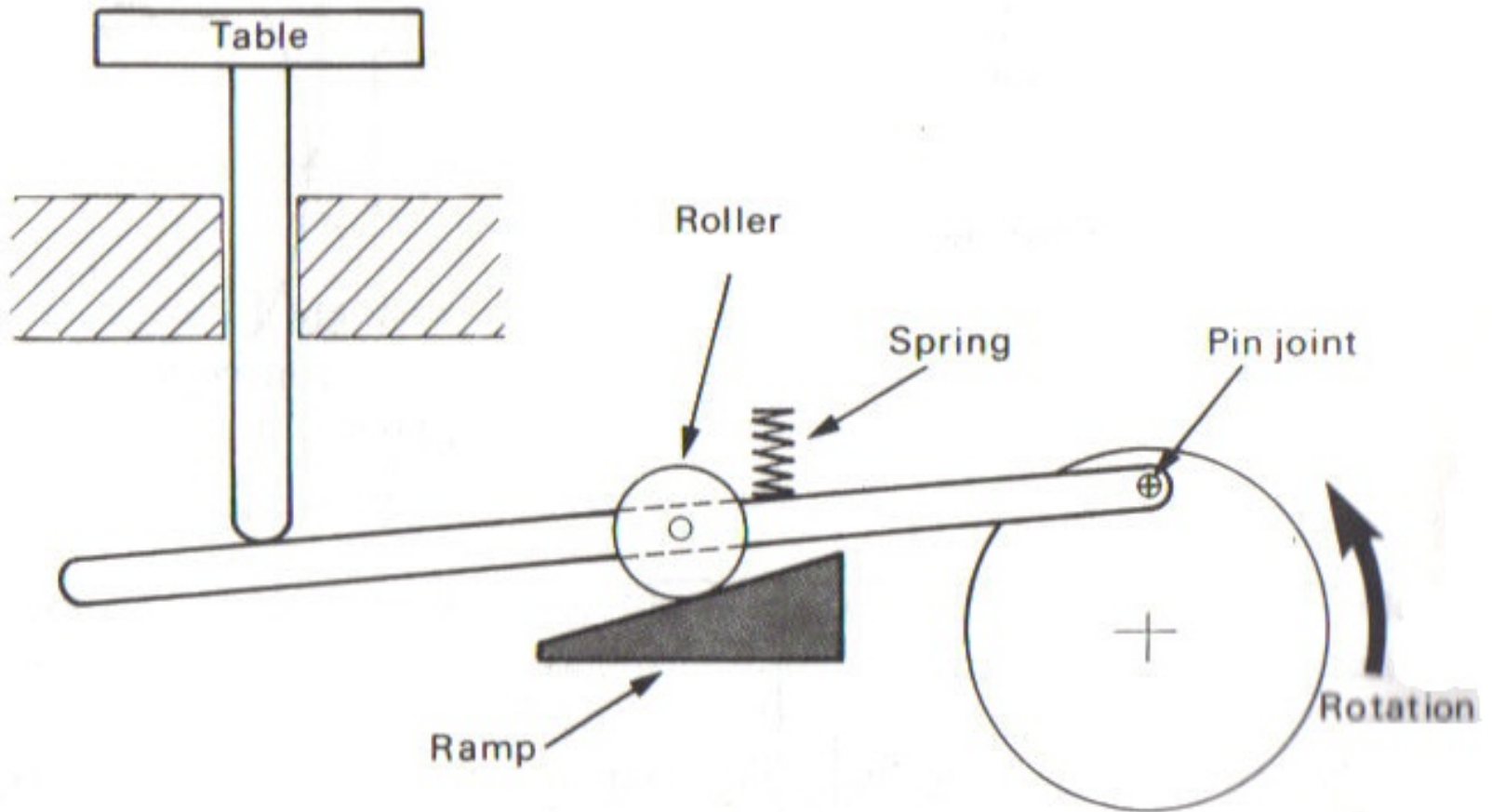
Design A



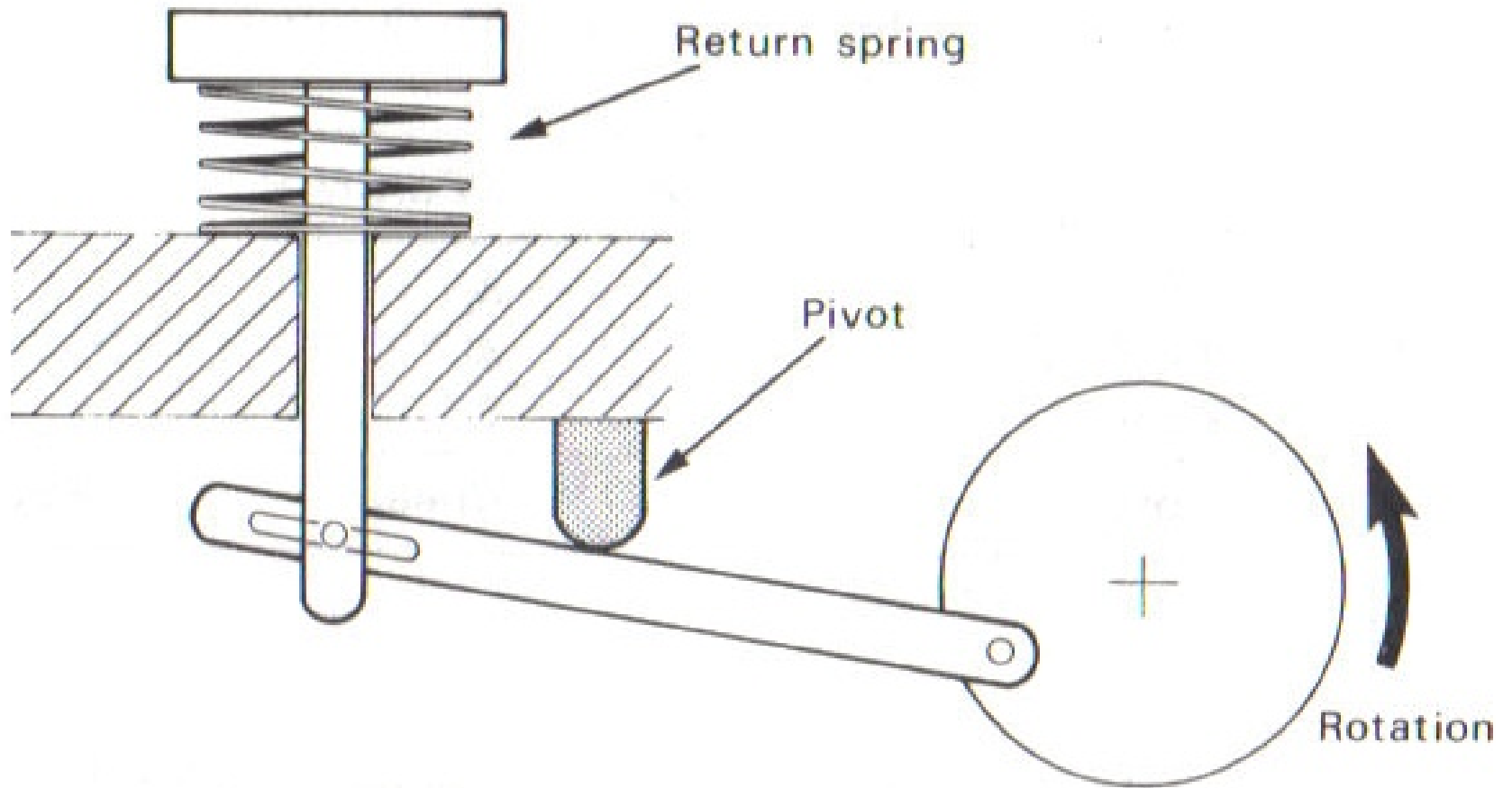
Design B



Design C



Design D



A More Detailed Grading Structure

[illegible]

Design Feature Ratings

A More Detailed Grading Structure

[illegible]

A More Detailed Grading Structure

[illegible]

Design Feature Ratings

A More Detailed Grading Structure

[illegible]

Design Feature Ratings

A More Detailed Grading Structure

[illegible]

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				

Quantify the grading scheme (where possible)

- [illegible]

[illegible]

Quantify the grading scheme (where possible)

- [illegible]

[illegible]

Quantify the grading scheme (where possible)

- [illegible]

Quantify the grading scheme (where possible)

- [illegible]

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 (£)	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				

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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			

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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

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- 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 (£)	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

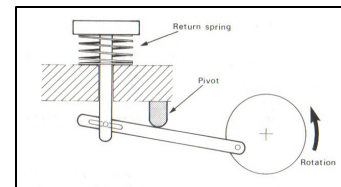
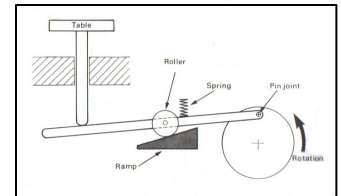
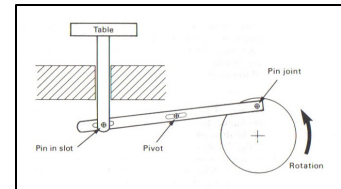
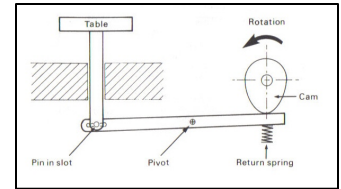
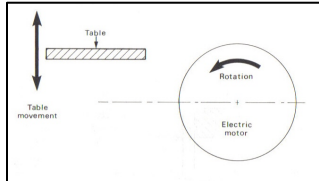
It is very user friendly

Strongly Disagree —1—2—3—4—5—6—7— Strongly Agree

Design Feature Ratings

A More Detailed Grading Structure

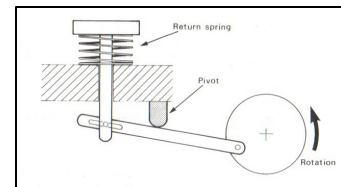
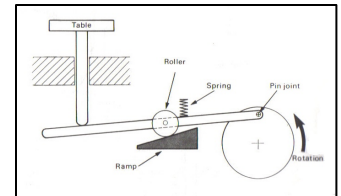
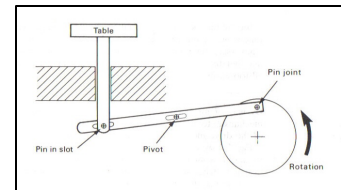
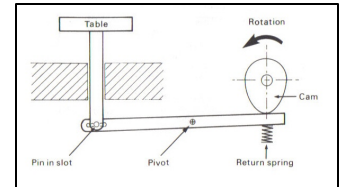
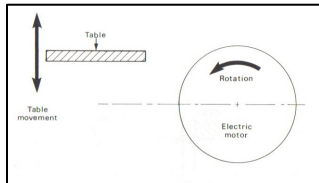
Feature	Design A	Design B	Design C	Design D
Fulfilment of function				
Reliability				
Serviceability				
Life				
Ease of maintenance				
Ease of manufacture				
Efficiency of operation				
Simplicity of layout				
Cost				



Design Feature Ratings

A More Detailed Grading Structure

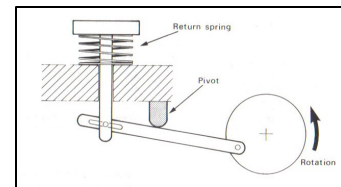
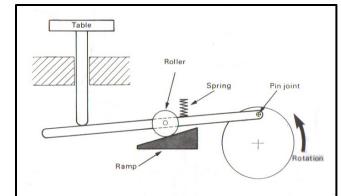
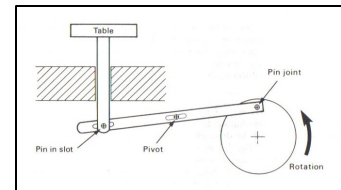
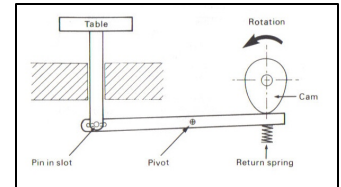
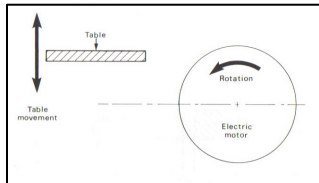
Feature	Design A	Design B	Design C	Design D
Fulfilment of function	10	10	10	10
Reliability				
Serviceability				
Life				
Ease of maintenance				
Ease of manufacture				
Efficiency of operation				
Simplicity of layout				
Cost				



Design Feature Ratings

A More Detailed Grading Structure

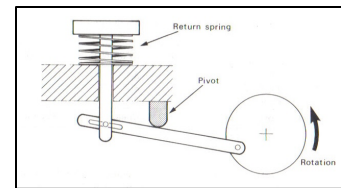
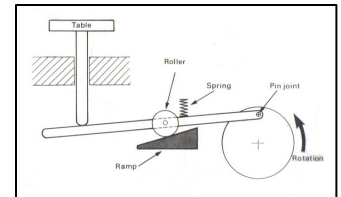
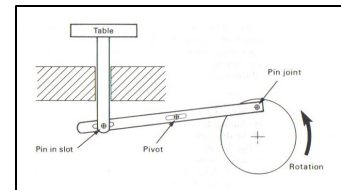
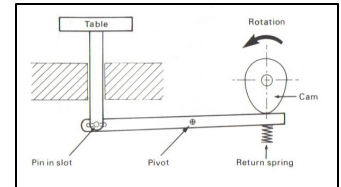
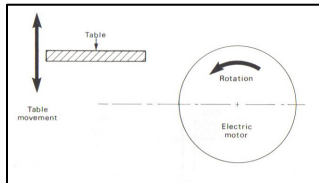
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Fulfilment of function	10	10	10	10
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Serviceability				
Life				
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Cost				



Design Feature Ratings

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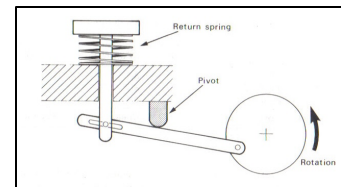
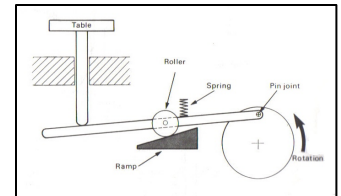
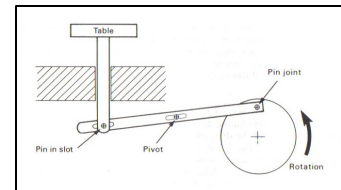
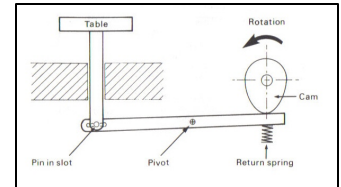
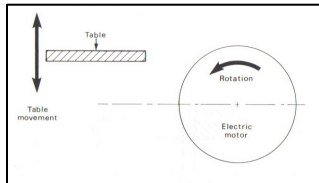
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Life				
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Design Feature Ratings

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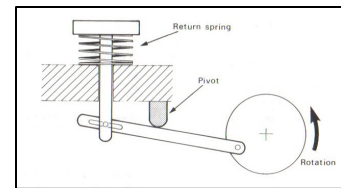
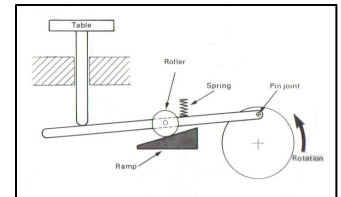
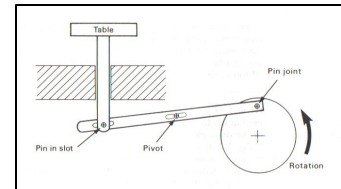
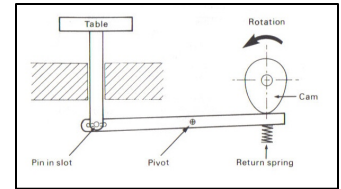
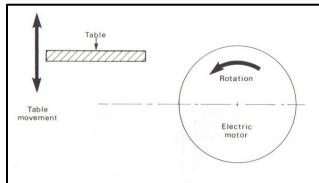
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Design Feature Ratings

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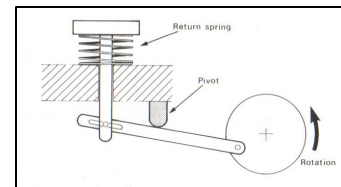
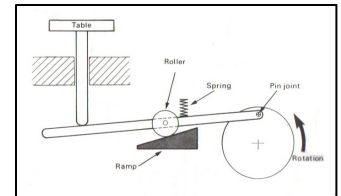
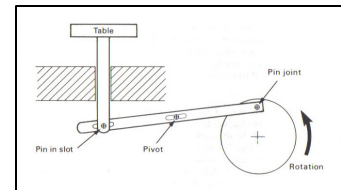
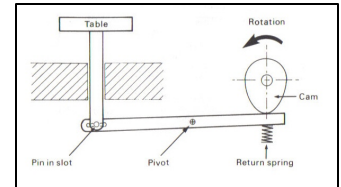
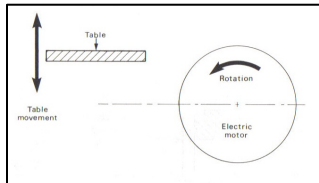
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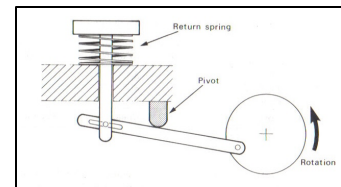
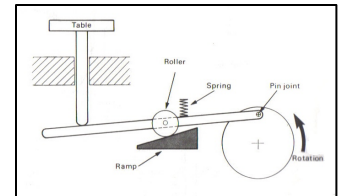
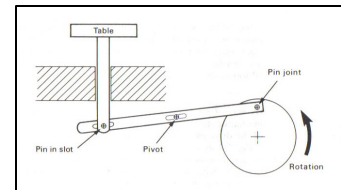
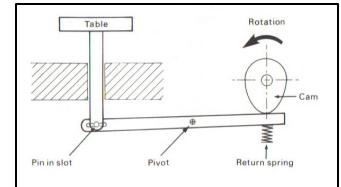
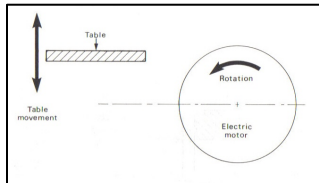
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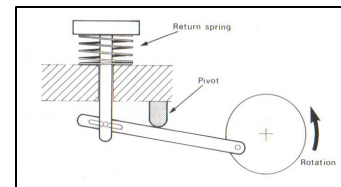
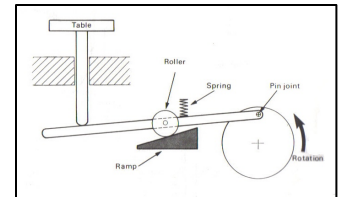
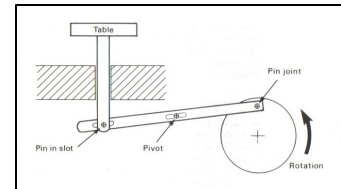
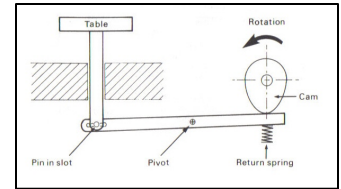
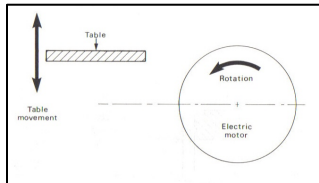
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Ease of manufacture	6	9	3	2
Efficiency of operation	2	5	1	1
Simplicity of layout				
Cost				



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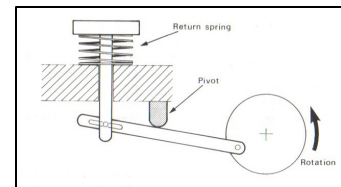
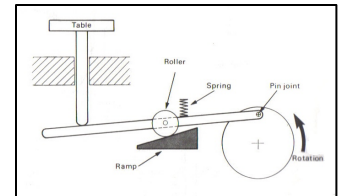
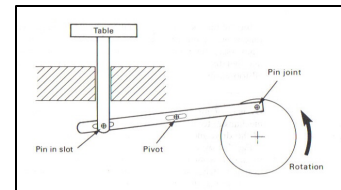
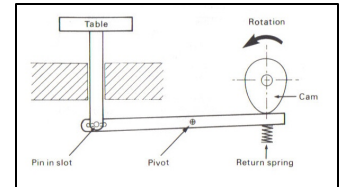
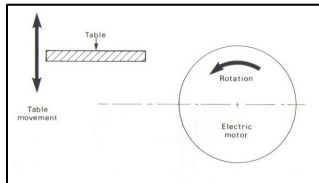
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Efficiency of operation	2	5	1	1
Simplicity of layout	5	8	2	1
Cost				



Design Feature Ratings

A More Detailed Grading Structure

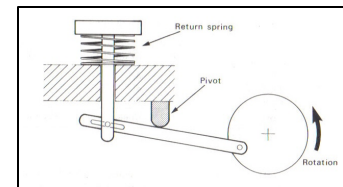
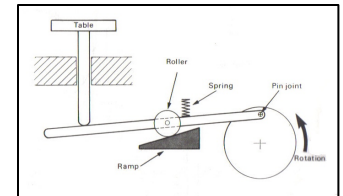
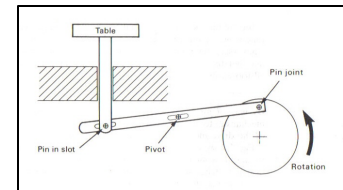
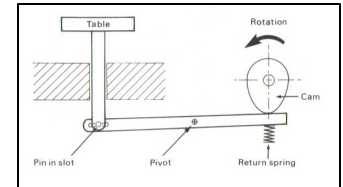
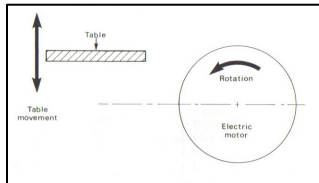
Feature	Design A	Design B	Design C	Design D
Fulfilment of function	10	10	10	10
Reliability	6	8	3	2
Serviceability	7	6	5	8
Life	3	7	3	2
Ease of maintenance	5	6	5	3
Ease of manufacture	6	9	3	2
Efficiency of operation	2	5	1	1
Simplicity of layout	5	8	2	1
Cost	5	8	6	2



Design Feature Ratings

Applying Weightings to the Selection Criteria

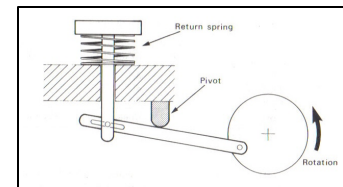
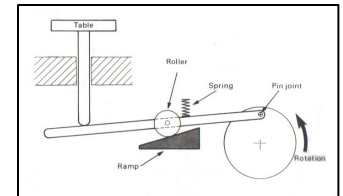
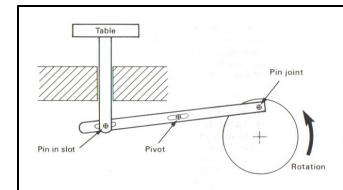
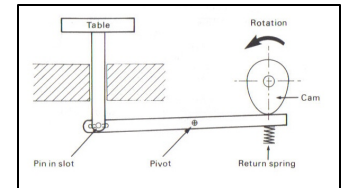
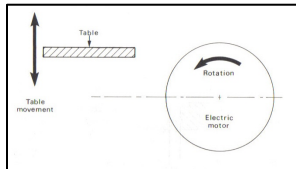
Feature	Weighting	Design A	Design B	Design C	Design D
Fulfilment of function	3	10	10	10	10
Reliability	3	6	8	3	2
Serviceability	2	7	6	5	8
Life	2	3	7	3	2
Ease of maintenance	2	5	6	5	3
Ease of manufacture	1	6	9	3	2
Efficiency of operation	1	2	5	1	1
Simplicity of layout	1	5	8	2	1
Cost	2	5	8	6	2



Design Feature Ratings

Applying Weightings to the Selection Criteria

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	16
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	69



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.

Think about the importance weightings (you don't have to use 1-3)

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.