The design project

Design project · SL and HL

Bags in the aisle

How might students keep bags off the floor, safely and cheaply?

- Students tripped over bag straps; no drilling allowed.
- One fictional project, start to finish.
- Check criteria and limits in your school's IB guide.

A good design problem

Feature	Mei's project
Real need	3 trips in two lessons
Clear context	Classroom desks, students
Manageable	Small, printable part
Testable	Strength, fit, cost, aisle clear

Research with a purpose

Method	Finding
Observation	21 of 28 bags on the floor
Questionnaire	Bags weigh 4 to 8 kg
Measurement	Desk edges 18 to 25 mm
Existing products	Adhesive hooks peel off

The design brief

> A low-cost hook for bags up to 10 kg, on any desk edge, without tools or damage.

- Problem, users, context, goal.
- **Product analysis** with ACCESS FM.

Measurable criteria

Requirement	Criterion
Strength	Holds 200 N for 1 minute
Fit	Desk edges 18 to 25 mm
Ease of use	Fitted in under 30 s, no tools
Safety	Sticks out at most 40 mm
Cost	Under ¥10 at 500 hooks

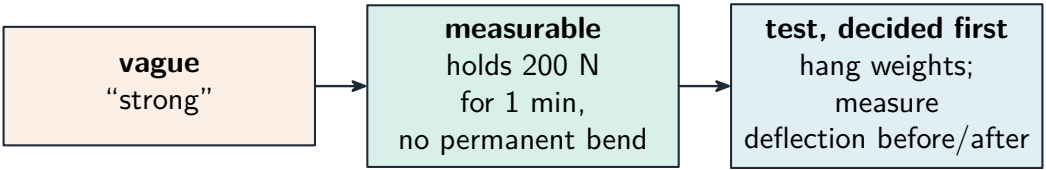
Setting the strength target

1. **Weight.** $9.6 \times 9.8 \approx 94$ N
2. **Factor of safety.** About 2
3. **Target.** Holds 200 N for 1 minute

Decision

A criterion the hook could fail

Make the criterion measurable



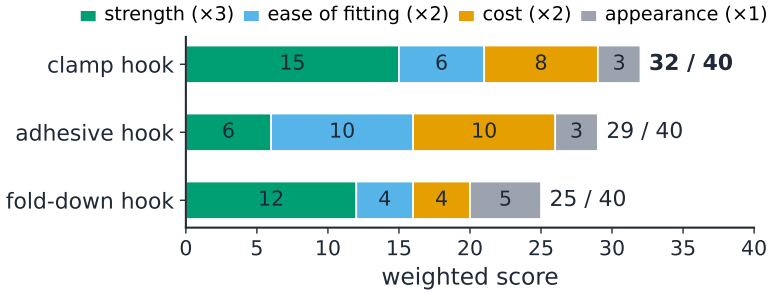
justified: heaviest bag 9.6 kg $\approx$ 94 N, safety factor about 2

> Decide the test when you write the criterion

Generating ideas

Technique	How it works
Brainstorming	Many ideas, no judging
SCAMPER	Substitute, combine, adapt, ...
Morphological chart	Ways to do each function
Biomimicry	Borrow from nature

Weighted decision matrix



- Strength $\times 3$, fitting $\times 2$, cost $\times 2$, looks $\times 1$.
- Maximum $(3 + 2 + 2 + 1) \times 5 = 40$.

Why weights matter

Unweighted

Clamp 15, adhesive 15.

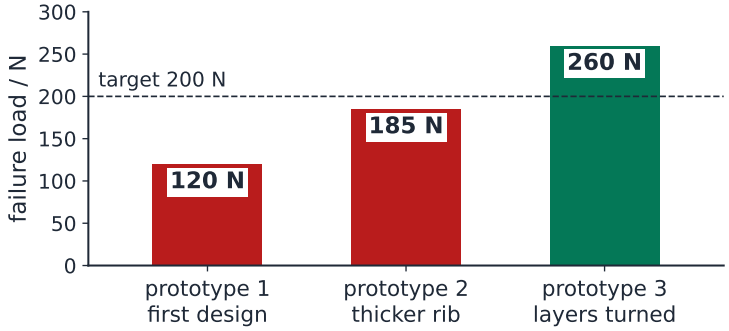
A tie.

Weighted

Clamp 32, adhesive 29.

Strength decides.

One change at a time



- Prototype 2 changed only the rib.
- Prototype 3 changed only the print direction.

A morphological chart

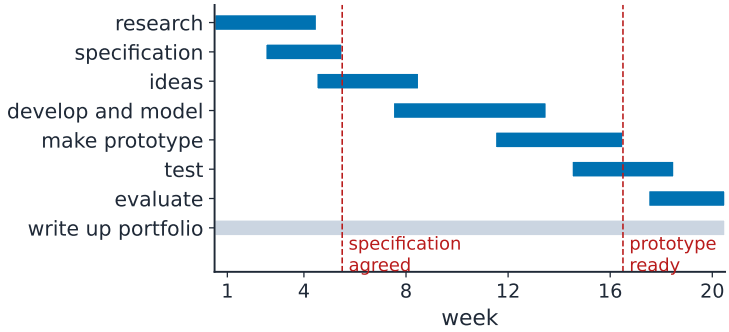
attach to desk	clamp	suction cup	hook over edge
hold the bag	hook	strap	shelf
store when unused	fold flat	slide away	detach

concept 1
concept 2

each path through the chart is one concept: $3 \times 3 \times 3 = 27$ to choose from

Two paths give two concepts to compare

Planning the make

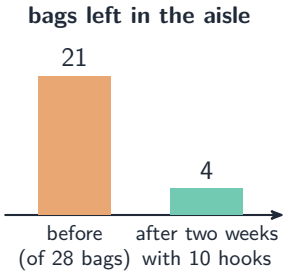


- **Production plan**, stages, tools, checks, time.
- **Risk assessment** before any machine.

Test every criterion

Criterion	Result
200 N, 1 minute	Held; 3 mm bend, recovered
18 to 25 mm desks	Loose on 25 mm, partly met
Under 30 s	Mean 12 s
Under ¥10	¥6.80, full cost unverified

Evidence from the trial



real users, real place, real time:
the trial also found two hooks
slipping on thicker old desks

> Count before and after to show the change

Evaluating honestly

Weak

Everyone liked it.

It was successful.

Strong

Held 200 N; fitted in 12 s.

Slipped at 25 mm, so add a pad.

Going further

1. **Equation.** $15\,000 + 0.90n = 6.80n$
2. **Solve.** $n = 15\,000 \div 5.90 \approx 2542.37$
3. **Choice.** Mould from 2543 whole hooks

Decision

Scaling up changes the process

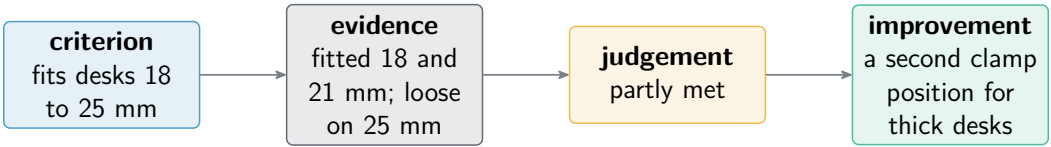
Check: a fair test?

Your turn

A prototype changes both material and wall thickness, and is stronger. What should come next?

A. Choose the new material
B. Choose the thicker wall
C. Test each change separately
D. Add a third change

Evaluate one criterion as a chain



not “everyone liked it”: say who, how many, measured how

> Partly met: add a second clamp position

Exam tips

> Research $\rightarrow$ specification $\rightarrow$ idea $\rightarrow$ test $\rightarrow$ change, all traceable.

- Every criterion has a number, unit and test.
- Change one **variable** per prototype.
- Evaluate with evidence, not opinions.

Check yourself

Try these

Rewrite "strong", "easy to use" and "cheap" as measurable success criteria with test methods.

A shelf must hold 12 kg of books. With a factor of safety of 2, state a strength criterion.

Evaluate "my project was successful because everyone liked it".