

Yamazumi: movable elements and constraints

Build and interpret work-element stacks, propose a feasible ownership change, and distinguish a balanced work-content chart from verified cycle performance.



Move an element, then test the real work

Fictional window-preparation teaching case: three trained operators share ten named elements. The team has 400 net available minutes and demand for 300 units. The supplied element times describe human work content for one unit, not observations proving sustained throughput.

Your role and the reference condition

Team leader facilitating a trial with the three operators and process engineer.

Normal: A proposed sequence must meet demand while retaining quality checks, safe access and the required precedence.

Gap: Operator 1 has 85 seconds of assigned work against 80-second takt; operators 2 and 3 have 65 and 60 seconds.

Work within these conditions

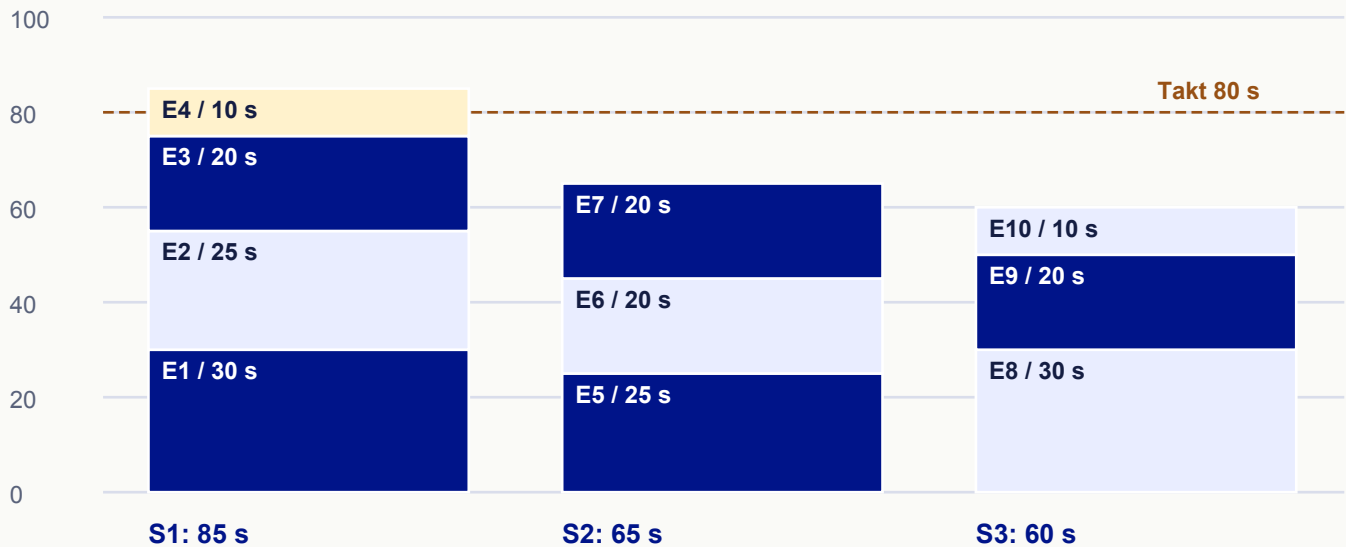
1. Only E4, return empty tote, is provisionally transferable from operator 1 to 2.
2. Walking, machine overlap, competence, access and variation need confirmation before adopting the proposal.

Fictional teaching case. Supplied observations support the exercise; proposed actions are not verified customer results.

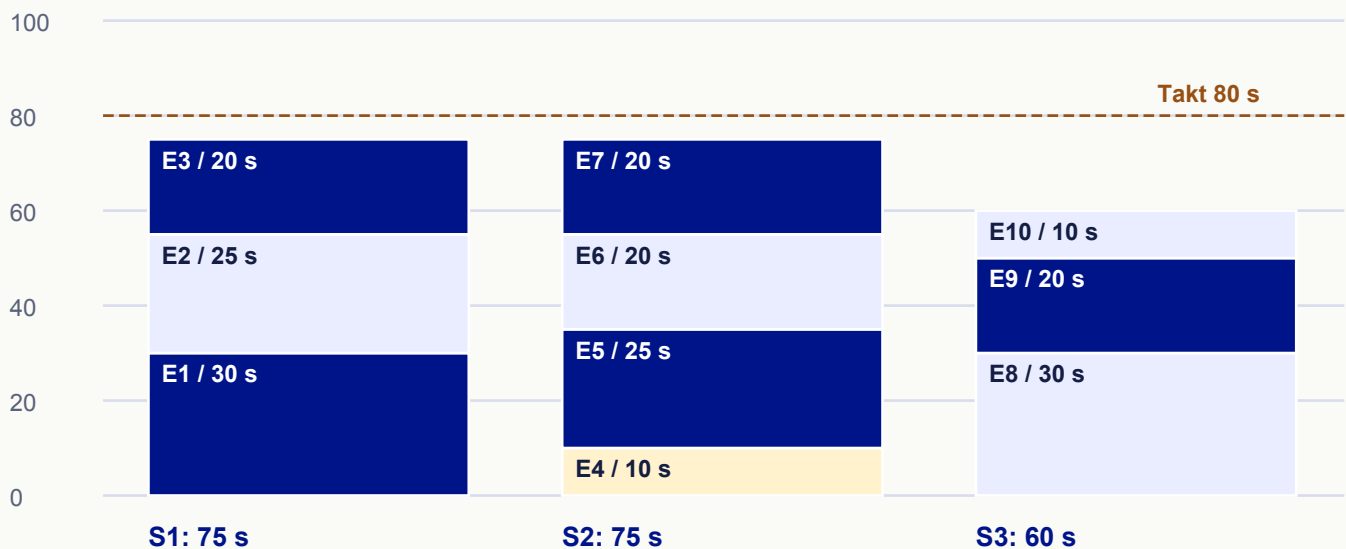
See how the method works

Build each bar from observable work elements so a proposed change remains traceable. Here, operator work content is 85, 65 and 60 seconds against an 80-second takt. Moving E4, the ten-second empty-tote return, from operator one to operator two produces 75, 75 and 60 seconds. Total work remains 210 seconds. This is a theoretical redistribution, not a demonstrated new cycle. Check precedence, walking, skills, ergonomics, variability and machine overlap. The elements and their labels must stay visible in both views. Balanced bars can guide a trial; they do not by themselves justify a staffing decision.

Before / human work content (seconds)



Proposed / human work content (seconds)



Method exhibit: Before, Move E4, Proposed, Validate.

Follow the evidence and decisions

Match each element ID to the observed task

ID	Work element	Seconds
E1	Position frame	30
E2	Prepare corner kit	25
E3	Confirm fixings	20
E4	Return empty tote	10
E5	Prepare seal kit	25
E6	Check component identity	20
E7	Record job reference	20
E8	Check frame readiness	30
E9	Confirm kit identity	20
E10	Acknowledge handoff	10

Inspect the supplied case inputs

Reference	Supplied teaching value
Net time / demand	400 min /300 units
Takt	$400 \times 60 / 300 = 80$ sec/unit
Operator 1	E1:30; E2:25; E3:20; E4:10 sec
Operator 2	E5:25; E6:20; E7:20 sec
Operator 3	E8:30; E9:20; E10:10 sec
Transfer candidate	E4 only:10 sec; operator 1 to 2

01 / Establish the comparison

Convert 400 minutes to 24,000 seconds and divide by 300 demanded units. Label the reference line 80 sec/unit and the vertical stacks human work content in seconds.

Why: Using gross shift time or comparing minutes with seconds would create a false gap. Work content and elapsed cycle time answer different questions.

Evidence / check: $24,000 / 300 = 80$ seconds per required unit.

02 / Keep each element identifiable

Stack E1-E4 for operator 1, E5-E7 for operator 2 and E8-E10 for operator 3. Preserve element heights proportional to time and retain the E1-E10 legend.

Why: A total bar shows overload but does not show which real piece of work could move. Removing a quality check just to lower a bar changes the method.

Evidence / check: $85 + 65 + 60 = 210$ seconds of total human work.

03 / Test the proposed allocation on paper

Remove only the 10-second E4 segment from operator 1 and add it to operator 2. Keep the other nine elements, their durations and identities unchanged.

Why: Redistribution changes ownership; it does not eliminate work. The total is a useful reconciliation against accidental omission.

Evidence / check: 75 / 75 / 60 seconds; total 210. Nominal margins below takt are 5 / 5 / 20 seconds.

04 / Check the physical dependency

Walk the tote-return route with the operators under the local safe trial procedure. Confirm when the empty tote becomes available and whether operator 2 can reach it without delaying E5-E7 or crossing another task.

Why: The arithmetic assumes E4 is transferable. Precedence and access can invalidate a visually attractive balance.

Evidence / check: A trial plan names route, handoff point, permitted sequence, observer and stop conditions; actual results remain unfilled.

05 / Compare prediction with observation

Record multiple representative cycles and the element causing any wait, including mix, abnormal events and quality outcome. Compare observed performance with the 75 / 75 / 60 prediction before revising the standard.

Why: An average stack below takt does not prove that variability or machine interaction permits every required cycle.

Evidence / check: Retain timing sheets and a decision to adopt, adapt or stop; do not label the proposed chart an achieved improvement.

Completed allocation proposal - seconds of human work

Operator	Before elements / total	Proposed elements / total	Decision
1	E1 E2 E3 E4 /85	E1 E2 E3 /75	Release E4 to 2
2	E5 E6 E7 /65	E4 E5 E6 E7 /75	Receive E4 provisionally
3	E8 E9 E10 /60	E8 E9 E10 /60	No ownership change
All	210 sec	210 sec	Trial required; takt 80 sec

The route adds eight seconds

A hypothetical trial reveals that operator 2 needs 8 additional seconds of walking per unit to perform the tote return. This was absent from the supplied element model.

Decision

Update operator 2 to 83 seconds and total work to 218 seconds for this trial condition. Do not approve the original transfer unchanged; redesign access or test another authorized method.

Reasoning

83 exceeds 80-second takt by 3 seconds. Averaging the three operators together would conceal the local overload.

What would change the decision?

Record the extra walking as a new observed element, its timing basis and operating condition; retain the original proposal for comparison.

Practise with a changed case

Demand changes before approval

Separate fictional planning exercise using the same E1-E10 durations: net time remains 400 minutes but demand rises to 320 units. E4 remains the only provisionally movable element. A trial then observes E4 taking 12 seconds at operator 2 instead of 10, with all other supplied elements unchanged.

Changed input	Value
Net time	400 min
Demand	320 units
Original allocation	85 /65 /60 sec
Paper transfer	E4:10 sec from 1 to 2
Trial E4 at 2	12 sec; other elements unchanged

Your task

1. Calculate the new takt and paper-proposal totals/margins.
2. Recalculate operator 2 and total work under the 12-second observation.
3. Decide what can be concluded and specify the next trial evidence.

Use the next page to record your reasoning before reading the answer.

Your practice worksheet

Demand changes before approval

Takt calculation with units

Before and proposed element stacks

Trial change and revised totals

Constraint/quality checks

Adopt, adapt or stop with evidence

Complete your reasoning before turning to the answer. Use the separate learner workbook for group practice.

Check your reasoning and transfer it

1. $24,000 / 320 = 75$ seconds per unit. The paper allocation is 75 / 75 / 60, with margins 0 / 0 / 15 seconds; equality to takt leaves no nominal allowance for variation.
2. Replacing the 10-second E4 with 12 seconds gives 75 / 77 / 60 and total 212 seconds. Operator 2 exceeds the new takt by 2 seconds.
3. The proposal is not demonstrated capable of meeting the changed demand. Investigate the E4 condition and authorized alternatives, then collect representative cycle and quality evidence. Do not delete checks or demand faster work to make the graph fit.

Suggested completed record

Calculation / decision	Worked result
New takt	75 sec/unit
Paper proposal	75 / 75 / 60; total 210 sec
Observed E4 variant	75 / 77 / 60; total 212 sec
Decision	Adapt and retest; no achieved capacity claim

Plausible wrong turns

1. Equal total work does not mean unchanged elapsed flow or safe access.
2. A below-takt average is not proof of sustainable output.

Evidence of a sound answer

1. Correctly preserve all ten elements in the proposal.
2. Calculate both changed cases with units and reconcile totals.
3. Identify at least one physical constraint and one verification measure.

Take the learning back to work

Commitment	Agreed follow-through
Owner	Team leader and affected operators, supported by process engineering
Record	Element observation sheet, proposed assignment and trial decision
Review	Before changing the standard and after representative trial cycles
Verification evidence	Element timing/variation, safe access, precedence, quality and actual cycle behavior
If unresolved	Retain the authorized method, address the limiting condition and revise the trial; escalate systemic capacity gaps through daily management.

Help someone else apply the method

Prepare

1. Ten E1-E10 element strips proportional to supplied times
2. 80-second and 75-second takt references
3. Blank allocation and trial record; calculator

Minutes	Activity and coaching prompt
5	Define units and demand What does this vertical axis measure?
8	Demonstrate E4 transfer Which work disappeared? None: reconcile 210.
10	Individual calculations, then pair challenge Does zero nominal margin prove the new demand is feasible?
7	Debrief constraints and trial What observation could invalidate your neat bars?

Debrief

1. If totals change in the paper proposal, inspect element identity before recalculating.
2. Separate a planning hypothesis from a measured standard and a staffing decision.

Individual or remote practice

Draw stacks on a shared scale, complete the changed-demand problem, then compare reasoning with the answer.

Connect the method and check its boundaries

Before application

1. Comparable demand and tasks
2. Skills and precedence checked

Outside this lesson

1. Equal bars do not prove feasibility
2. Do not infer headcount from this exercise

LEI: Operator Balance Chart

LEI: Operator Balance Chart

Proportional work-element stacks versus takt, also called yamazumi

Method reference; original OPEX scenario and diagram are synthetic teaching content, not source case results.

[Open this lesson and its visual aids](#)