Exercise 1: Evaluation of the Electrolux® handle.

Product and components:

Disassembled model components:

- Plastic handle
- Latch
- Pin
- Latch spring (Type 1)
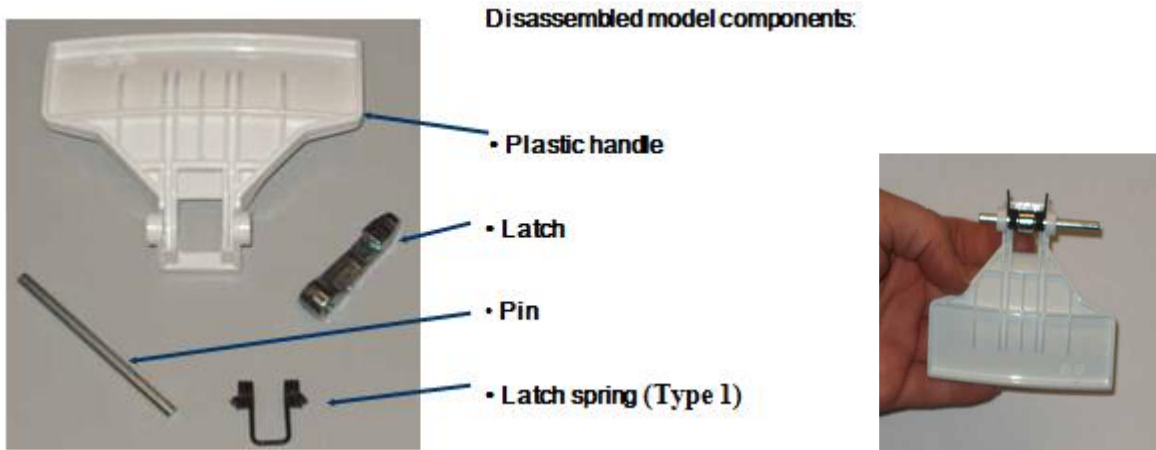
General process description:

Handle	• Place the handle in the fixture
Spring	• Take the spring and holding it in one hand
Latch	• Insert the latch in the spring with the right orientation
L+S	• Insert the "Latch-Spring" set in the handle
Pin	• Insert the pin keeping the alignment of the L+S set
Product	• Unload • Place in final holder
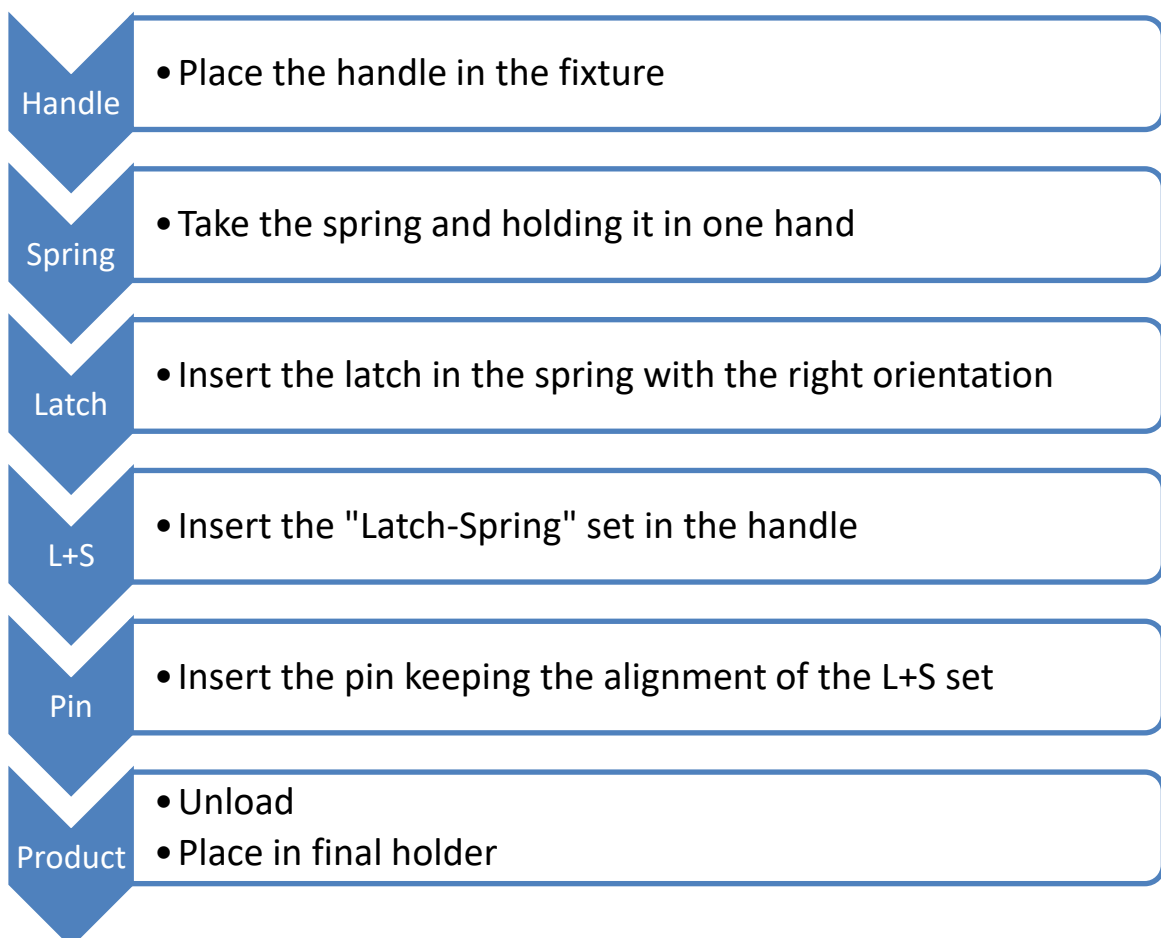
Theoretical minimum number of parts (N_{min}):

With wise design choice is theoretically possible to reduce the number of parts down to a single one. Nevertheless given than we don't have enough knowledge about the product use we can safely assume that

$$N_{min} = 4$$

This means that the required assembly time for a well-designed product would be:

$$Ideal\ Time = N_{min} * t_a = 4 * 3 = 12\ \text{s}$$

Assuming t_a equal to 3s as suggested in the method

Proposed assembly sequence of operations:

ID	HANDLING	INSERTING
1	Grasping and orienting the Plastic Handle	
2		Inserting the Plastic Handle in the Fixture
3	Grasping and orienting the Spring	
4	Grasping and orienting the Latch	
5		Inserting the Latch into the spring
6		Inserting the subassembly "Latch+Spring" in the plastic Handle, while keeping the alignment
7	Grasping and orienting the Pin	
8		Inserting the Pin while keeping the alignment
9	Unloading the fixture*	
10	Place in the final buffer*	

*not considered in the analysis

Relevant parameter of the part for orienting:

Part	Note	Angles	Size [mm]	Thickness [mm]
Plastic Handle: 	The part is in a bulk	α=360° β=360°	70-140	10-20
Spring: 	The part is in a bulk	α=360° β=360°	21	4
Latch: 	The part is in a bulk	α=360° β=360°	38	10
Pin: 	The part is in a bulk	α=180° β=0°	40	2 (0.5 Ø)

Proposed classification and timing for the operations*:

ID		Code	Timing
1	Grasping and orienting the Plastic Handle	Handling "30"	1.95
2	Inserting the Plastic Handle in the Fixture	Inserting "30"	2.00
3	Grasping and orienting the Spring	Handling "83"	5.60
4	Grasping and orienting the Latch	Handling "30"	1.95
5	Inserting the Latch into the spring	Inserting "08"	6.50
6	Inserting the subassembly "Latch+Spring" in the plastic Handle, while keeping the alignment	Inserting "18"	9.50
7	Grasping and orienting the Pin	Handling "00"	1.13
8	Inserting the Pin while keeping the alignment	Inserting "03"	3.50
		Total t$_{ma}$	**32.13s**

* Please refer to the relevant tables on the handouts for the code and timing

This means that an operator will on average needs 32.13 seconds to assemble one washing machine handle (in this case we have assumed the Delta model).

The consequent assembly efficiency is therefore:

$$E_{ma} = \frac{N_{min}t_a}{t_{ma}} = \frac{4 * 3}{32.13} \approx 0.37$$