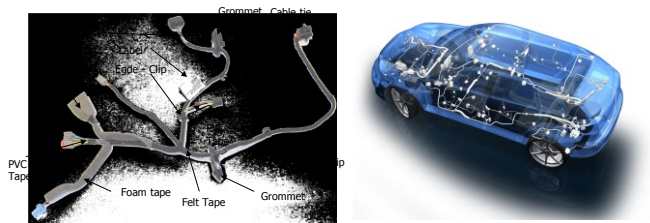


Automation Solutions for Human Labor Intensive Tasks in Wiring Harness Manufacture

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INTRODUCTION

A wiring harness consists of connectors, terminals, wires, and the additional components for fitting in the vehicle and protection against medium conditions.



Competency Descriptor
 Security Classification (edit in Header and Footer)

INTRODUCTION

DELPHI AUTOMOTIVE SYSTEMS



Global: 133.000 Employees in 138 Production sites
 EMEA: 47.000 employees in 52 production sites
 Turkey: 6000 employees in 3 Production sites



- R&D – Automation Scopes;**
- 0,13mm² cable production
 - In-door transportation by AGV's
 - Automatic plugging
 - Material Handling

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Automatic Fuse Torque Station

Manual Method



- Manual spindle positioning
- Manual loading / unloading of work piece
- 3D positioning measurement and control
- Manual feeding of nuts to the spindle
- Electrical continuity test

Drawbacks of manual operation

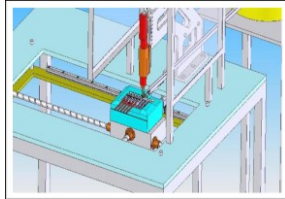
- Cycle time of operation depends on operator capability & experience
- Instable quality output
- Fully labor intensive task

Renault X98 Eng. Boom Harness	Current Time	New Time
Screwing operation (sec)	20	20
Harness preparation (sec)	90	38
Total time (sec)	110	58
Total time (min)	1,83	0,96
Improvement in cycle time	48%	

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Automatic Fuse Torque Station

Automation application



Guides and rails	25 mm-H shaped
Transmission	2.5x5 threaded shaft
Axial velocity	250mm/sec
Vertical axis payload	1.2 kg
Motors	2.4 Nm servo motors
Controller	MLC 32 DI, 32 DQ

- Manual loading / unloading of work piece
- Automatic spindle positioning
- Automatic 3D positioning measurement and control
- Automatic feeding of nuts to the spindle
- Electrical continuity test

Advantages of automation

- High level of repeatability
- Flexibility against engineering changes
- Labor saving

- 2D cartesian system actuated by servo motors for positioning the fuse box
- Stationary structure provides the vertical movement of spindle
- Nuts are conveyed beneath the spindle by vibration feeder in the correct alignment
- Magnetic nut holder
- System operates in a safety cell

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Automatic Relay and Fuse Plugging

Manuel Method



- Relays and fuses are manually plugged to the terminals and connectors
- The correct position and type of the component is controlled and verified by an additional camera control system

Drawbacks of manuel operation

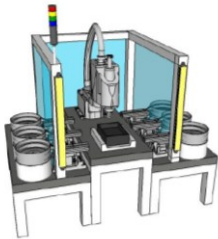
- Success of operation depends on human capability & experience
- Health and safety issues arise due to repetitive operation
- Relatively high level of mistakes
- Process inspected at the last station
- High equipment investment
- Synchronicity difficulties
- Time and labor waste due to transportation between stations

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Automatic Relay and Fuse Plugging

Automation application



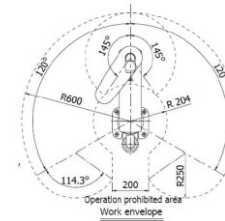
- Automatic insertion of relays and fuses by a conventional scara type robot
- Components are fed by vibrating containers at the right orientation
- Software guarantees the assembly correct part to the correct place
- Build-in camera provides error-proof handling
- System eliminates an additional camera control station

Model	IX-NN6020-SL-KETX-P1-EEE-2-2 Scara Robot
Reach (radius)	600mm
Standard Cycle Time	0.52s
Payload	2kg @max. Speed - 10kg @ max. Load
Speed	XY: 7121mm/s - Z: 1393mm/s - R: 1200°/s
Positional Repeatability	XY: ±0.01mm - Z: ±0.01mm - R: ±0.005°/s

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Automatic Relay and Fuse Plugging



Advantages of automation

- High level of repeatability
- Elimination of H&S issues
- In process control (check/apply/check)
- Flexibility against engineering changes
- Single station
 - Low floor space allocation
 - Elimination of transportation labor
 - Decrease in terms of component damage

	Manual	Automation
Relay Plugging	5	4
Fuse Plugging	3	2
Total Relay&Fuse Plugging time	177	122
Total Relay&Fuse Plugging time	2.95	2.03
Camera Control (sec)	30	X
Load/Unload components (sec)	30	30
Total time (sec)	237	152
Improvement in cycle time		26%
Manual labor	237	30
Labor saving		87%

Competency Descriptor
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Automatic clip tie cutting

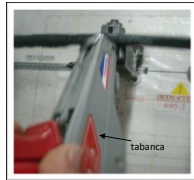
Manuel Method



- Clips are used to attached the harness on the vehicle body.
- In order to assure the correct position on the cable bundle, clips cut manually on the production boards by the operators.
- Operators use a cutting gun activated by hand force or pneumatically.
- The tightness and cutting length is controlled by
- Some holders have electrical presence test

Drawbacks of manuel operation

- Some clip ties has irregular orientations making the cutting operation difficult or impossible
- Losing time for handling the clip cutting gun.
- H&S issues due to repetitive triggering operation

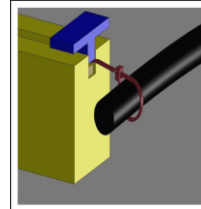


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Automatic clip tie cutting

Automation application



- The extremity of clip tie is inserted into the lock and holder by the operator, holder pulls the tie inside and cuts at the correct tightness.
- Position and limit sensor system verifies the correct tightening force and correct cutting length of clip tie
- Pneumatic actuator to pull and tighten the tie
- Pneumatic actuator blade to cut the tie
- Adjustable tightening force between 50N – 200N
- Electrical presence test on holder

Advantages of automation

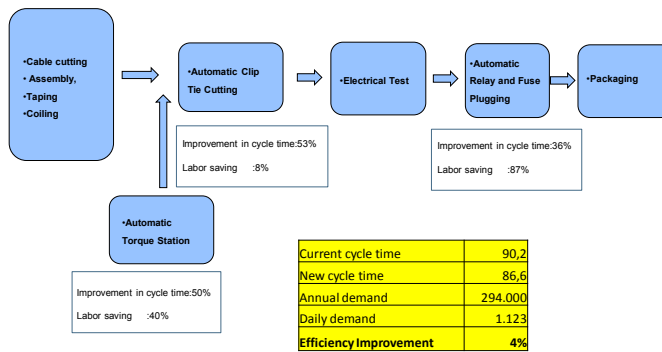
- Possibility to cut the clips that have problematic orientations (clip direction towards the board)
- Elimination of H&S issues
- Elimination of damages due to incorrect handling
- Operator time saving

Renault X98 Eng. Room Harness	Current Time	New Time	Qty
Regular Retainer/Clip	8	4	16
Irregular Retainer/Clip	13	5	4
Total time (sc)	190	84	
Total time (min)	2,4	1,12	
Improvement in cycle time	53%		

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Overall Process Flow & Improvement



Competency Descriptor
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Thanks...

Competency Descriptor
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