Robotics & Automation in Clothing Manufacturing: State of the Art

Presenting
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In association with
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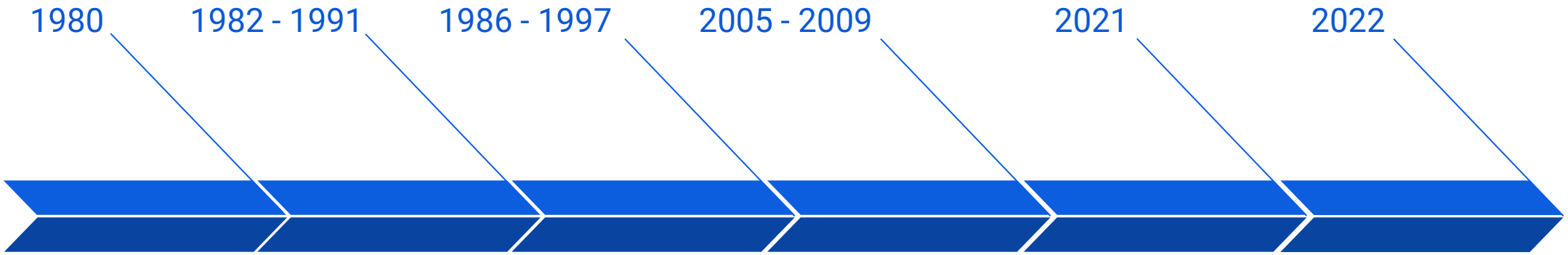
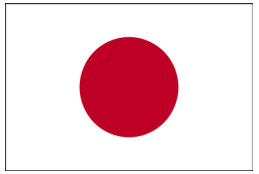
Advanced Textiles EXPO

Historical Timeline: Apparel Automation Projects, 1980 - Present*



Textile Clothing Technology Corporation

(TC)²



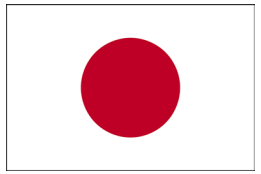
TRAASS
Technology Research Association for Automated Sewing Systems

BRITE / EURAM
Basic Research in Industrial Technology for Europe / European Research on Advanced Materials

Project LEAPFROG

EURATEX

Smart Sports Bra
Korea Institute of Industrial Technology / Sungkyunkwan University



Juki Smart Factory + 3D Sewing

Publicly Available information, not exhaustive

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Apparel Automation Project: 1980

Organization:

Textile Clothing Technology Corp. (TC)²

Funding:

N/A

Involved Parties:

American Institutes and 20+ garment and textile companies

Goal(s):

Develop automated production line to significantly reduce costs

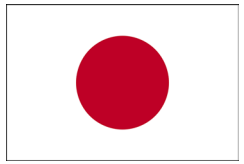
Approach:

Manufacture clothing components via automated production lines then use human labor to assemble final product

Results:

Solutions suitable for the serial production of the automated lines were not realized

Apparel Automation Project: 1982 - 1991



Organization:

Technology Research Association for Automated Sewing Systems (TRAASS)

Funding:

$55MM provided by Japanese Ministry of Trade and Industry (MTI)

Involved Parties:

27 Japanese textile & apparel companies

Goal(s):

Develop new clothing manufacturing processes

Approach:

Create fully automated pilot system to produce ladies' blazer

Results:

System could not be implemented due to technological gaps, high investment costs, and the lack of tolerance requirements. However, solutions for subproblems were realized (e.g. automatic needle threading and needle replacement).

Apparel Automation Project: 1986 - 1997

Organization:

BRITE / EURAM: Basic Research in Industrial Technology for Europe / European Research on Advanced Materials

Funding:

N/A

Involved Parties:

German and UK companies

Goal(s):

(3) Projects focused on development of new clothing manufacturing technologies

Approach:

Focused on partial automation of specific processes instead of fully automated lines

Results:

New material handling technologies (grippers & positioning)

Examples of 80’s - 90’s Automation

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Summary: Apparel Automation 80's – 90's

Characteristics –

- Automation characterized by ***human interaction with 'hard' automation.***
- 'Hard' (fixed) automation is fixed by equipment configuration, are non-programmable robotic systems requiring physical alteration to change function.

Pros –

- Significant increases in labor productivity
- Significant increases in quality consistency and repeatability
- Ideal for high volumes of the same product / SKU.
- Highly efficient.

Cons –

- Inflexible. Automation tends to be dedicated for specific operation. Materials changes can create challenges.
- Requires specialized technicians to maintain and adjust equipment.
- Style changes require significant re-configuring of equipment.

Materials Handling: The Holy Grail of Apparel Automation

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Challenges to Designing End Effectors for Textile Materials:

Textile components for apparel come in virtually infinite variations with regards to:

- Shape / dimensions.
- Mass / unit Area (material weight)
- Porosity
- Extensibility (Stretch) / Recovery
- Fragility
- Composition (e.g. polyester, cotton, nylon, wool, blends thereof…)
- Surface Texture
- Chemical Treatments

Why haven’t Materials Handling efforts been Successful?

- There is lack of fundamental engineering approach,
- There is lack of quantitative material data, and
- The original equipment manufacturers (OEMs) do not perform dedicated research to solve the problems.
- The problem is developing systems with requisite dexterity and sensitivity to work with textile substrates.

Apparel Automation Project: 2005 - 2009

Organization:

Project LEAPFROG - led by Euratex with Euro 25 million in funding

Funding:

€25MM

Involved Parties:

35 partner organizations from 11 EU countries

Goal(s):

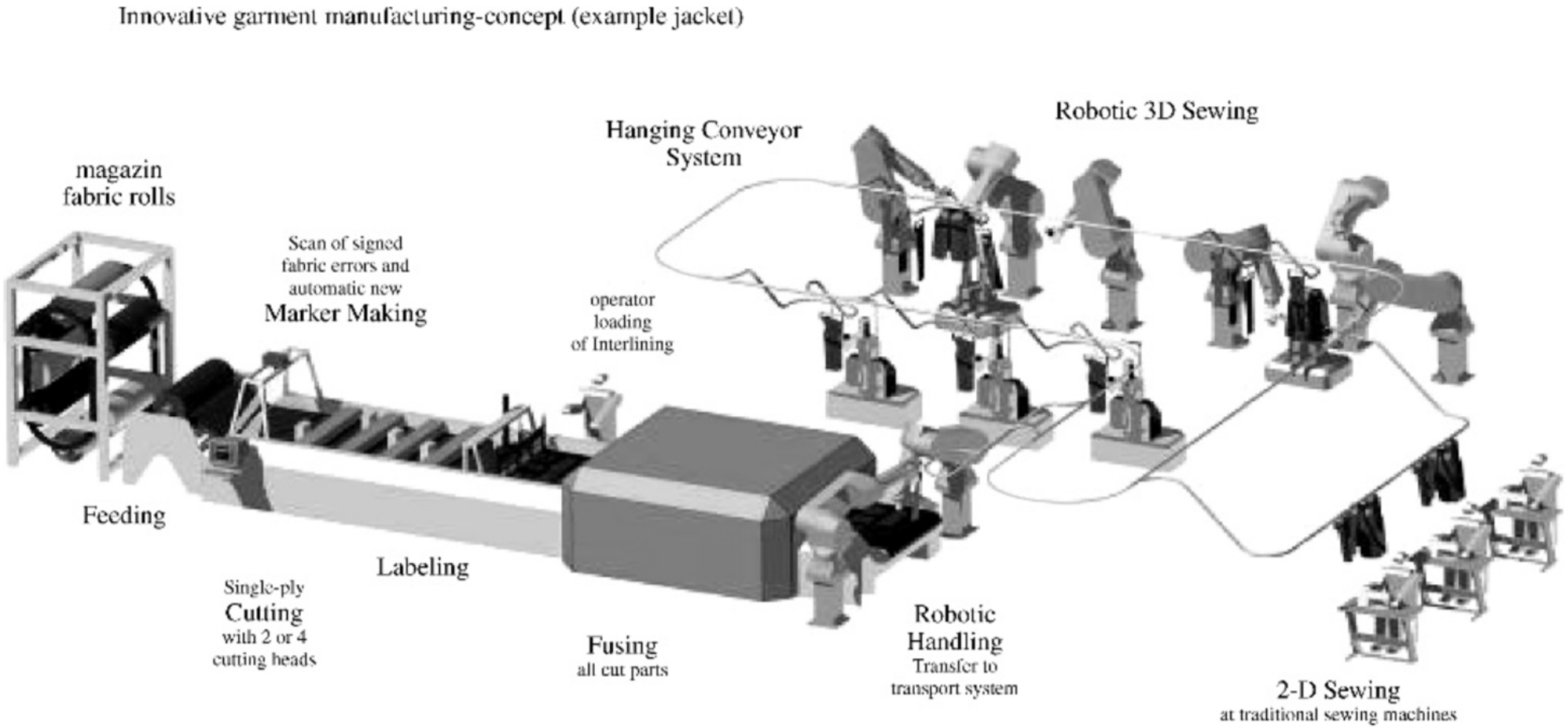
To prove that the necessary concepts and technologies for a radical transformation of the clothing industry are largely available today or will be in the very near future.

Approach:

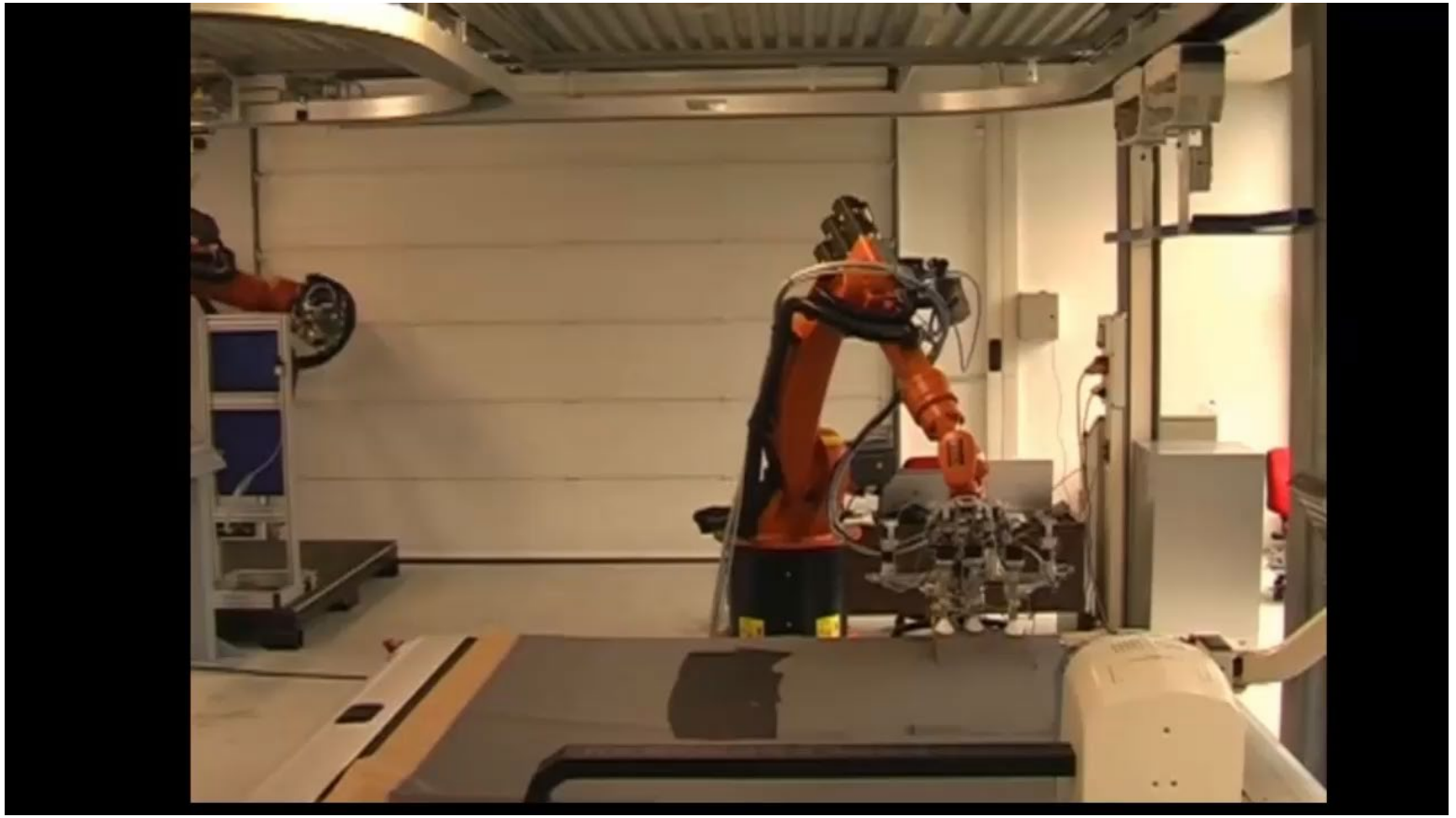
Overcome predominant paradigm of mass production apparel in low labour-cost locations; demonstrate that textile and clothing manufacturing sector can be transformed into a demand-driven, knowledge-based, high-tech industry

Results:

Apparel Automation Project: Project LEAPFROG



Apparel Automation – LEAPFROG (EU)



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Apparel Automation Project: 2021

Organization:

Korea Institute of Industrial Technology / Sungkyunkwan University

Funding:

N/A

Involved Parties:

Human Convergence Technology R&D Department, Korea Institute of Industrial Technology; Department of Mechanical Engineering, School of Mechanical Engineering, Sungkyunkwan University

Goal(s):

To build a smart factory based on automated systems to improve productivity and allow responsive production in the market. Focus on mfg. a ‘Smart Sports Bra’

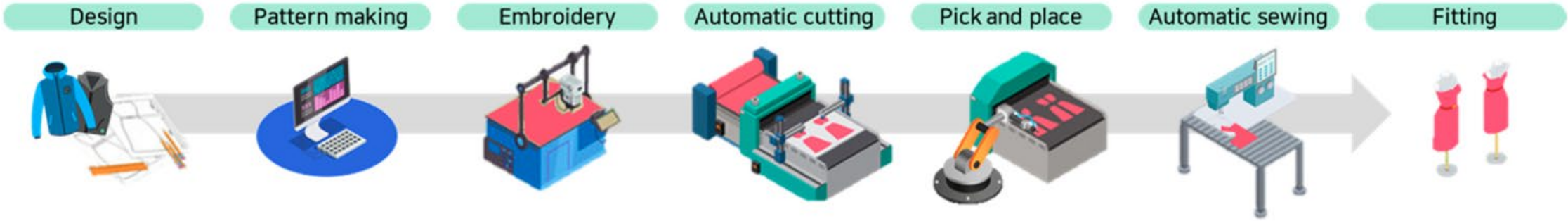
Approach:

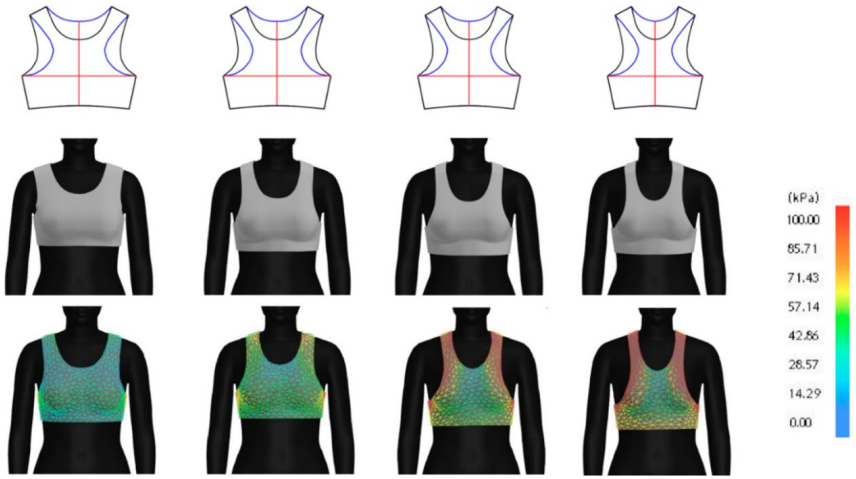
Buildout of pilot mfg. system with minimal / no human intervention using commercially available software and hardware.

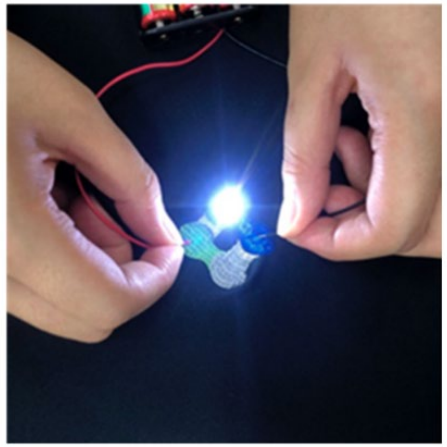
Results:

A simply constructed sports bra was assembled.

Automated Manufacturing Process for Smart Clothing: The Case Study of a Smart Sports Bra (Korea, 2021)







Lee,S.;Rho,S.H.;Lee,S.; Lee, J.; Lee, S.W.; Lim, D.; Jeong, W. Implementation of an Automated Manufacturing Process for Smart Clothing: The Case Study of a Smart Sports Bra. *Processes* **2021**, *9*, 289. https://doi.org/10.3390/pr9020289

Apparel Automation – Sports Bra (Taiwan - 2021)

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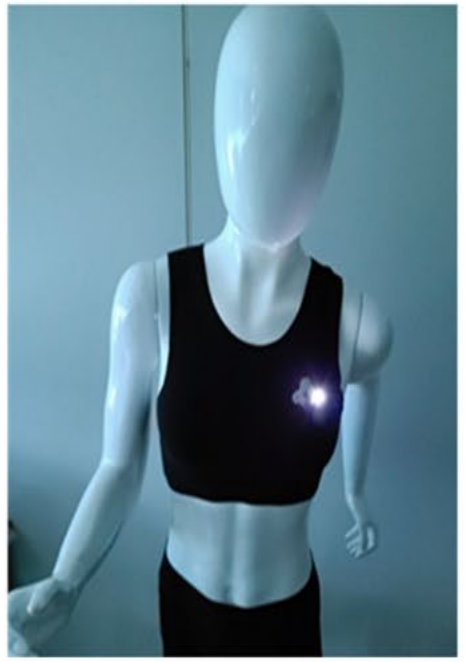
Apparel Automation – Sports Bra (Taiwan - 2021)



Apparel Automation – Juki Automated Sewing Concept + 3D Sewing (Japan - 2022)

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Apparel Automation – Juki Automated Sewing Concept + 3D Sewing (Japan – 2022)

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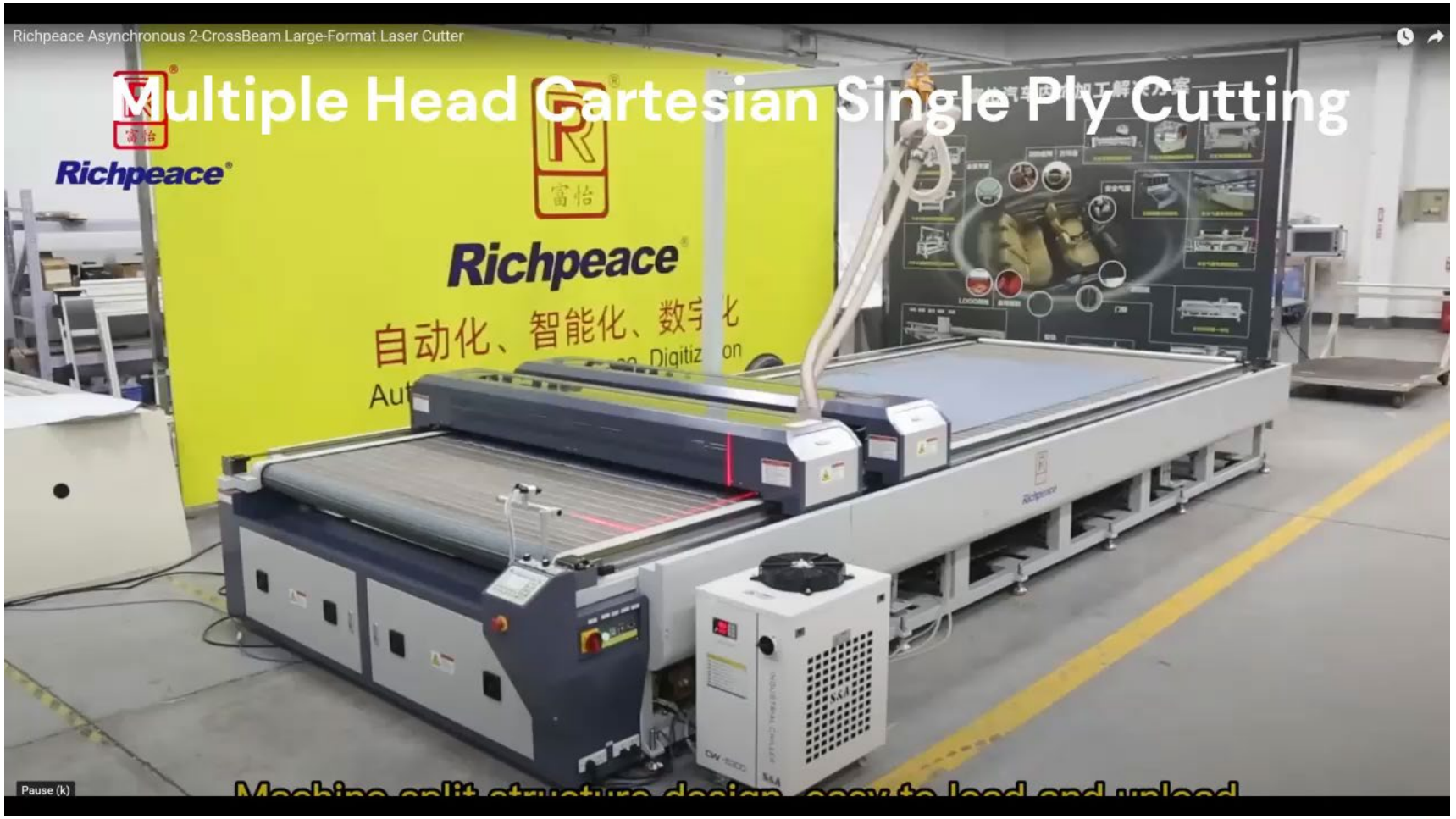
Apparel Automation – Innovations in Single Ply Cutting

Why Single Ply Cutting?

- Mass Customization
- Small Batch Manufacturing

Innovations in Single Ply Cutting – Multi Head Cartesian Laser



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Innovations in Single Ply Cutting – Hi Speed Single Head Cartesian Laser

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Innovations in Single Ply Cutting – Galvonometer (‘Galvo’) Laser

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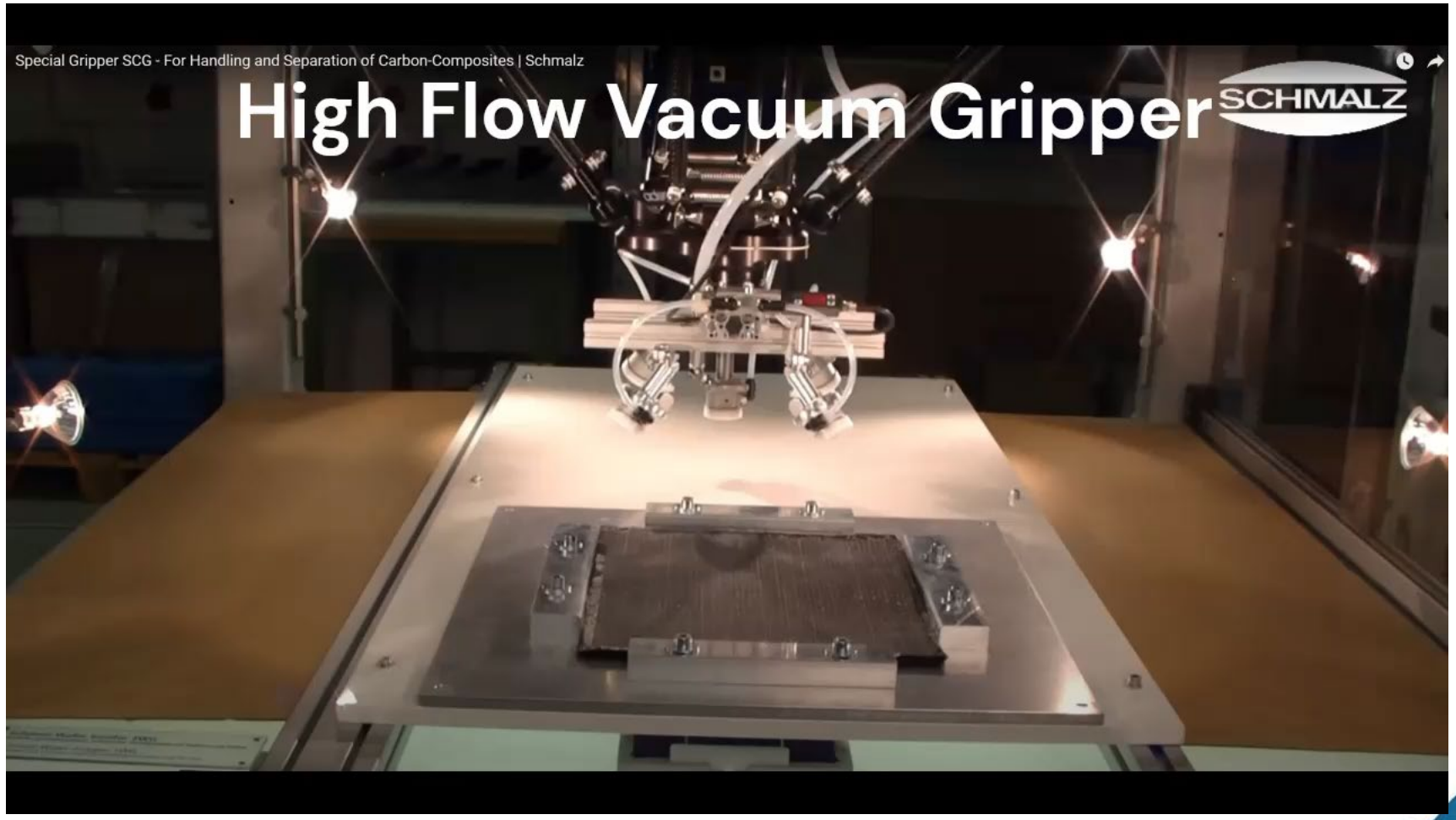
Apparel Automation – Innovations in Gripper Technology

- Gripper / End Effector is a key technical gap in automation of the apparel manufacturing process.
- Handling soft / drapey textiles is extremely challenging, requiring systems with requisite dexterity and sensitivity.
- Substrate characteristics in the textile industry are very broad, there are multiple solutions depending on the substrate.

Innovations in Gripper Technology – High Flow Vacuum Gripper



Innovations in Gripper Technology – Needle Grippers

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Innovations in Gripper Technology – Soft Grippers

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Innovations in Gripper Technology – Electro adhesion

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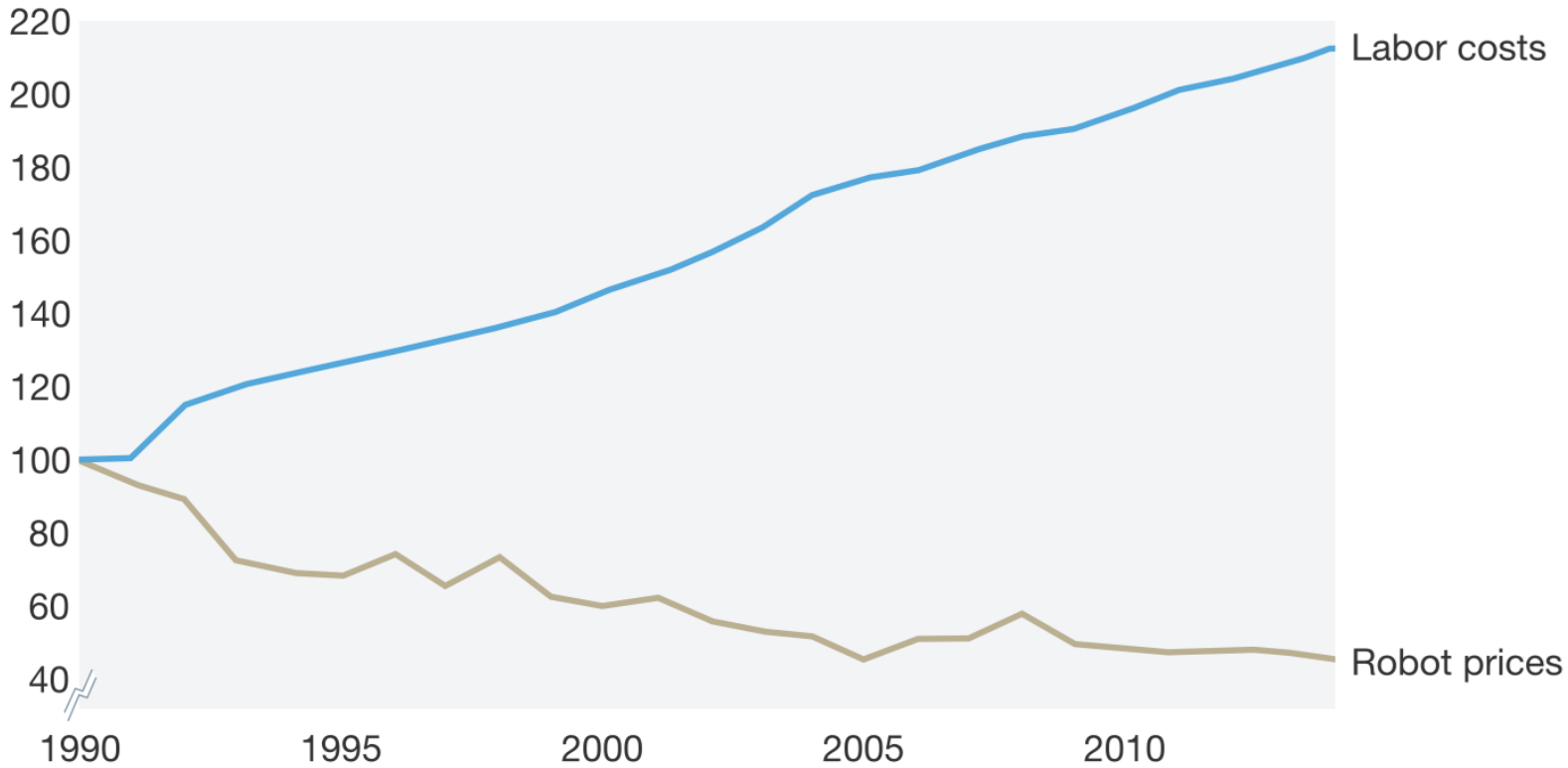
Apparel Automation – Tracing Robots

Robot prices have fallen in comparison with labor costs.

Cost of automation

Index of average robot prices and labor compensation in manufacturing in United States, 1990 = 100%



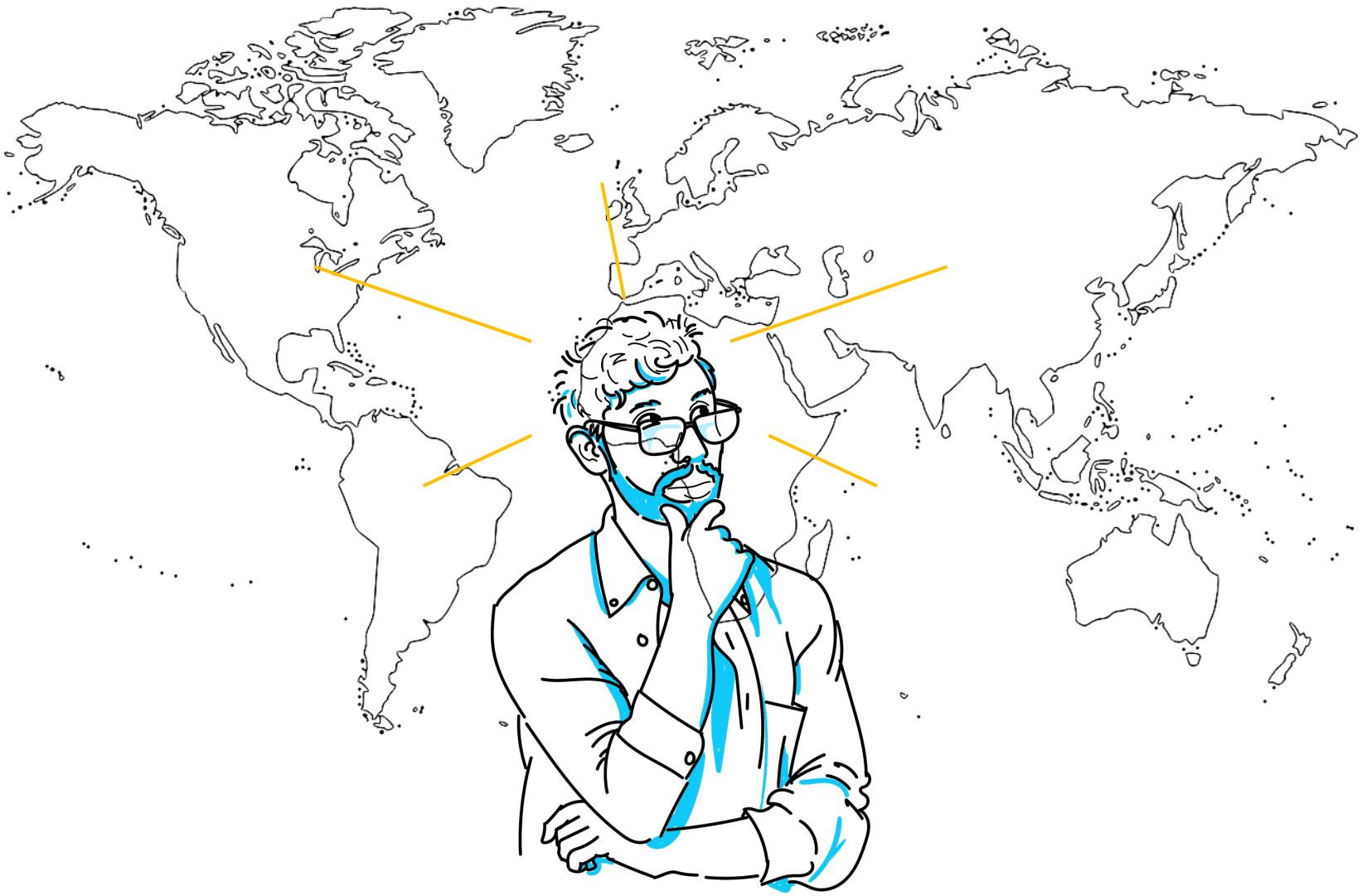
Source: Economist Intelligence Unit; IMB; Institut für Arbeitsmarkt- und Berufsforschung; International Robot Federation; US Social Security data; McKinsey analysis

McKinsey&Company

Apparel Automation – Big Takeaways

- Gripper / End Effector for handling textiles is key remaining technical gap in the automation of the apparel manufacturing process.
- Robotic handling of apparel textiles is within reach.
- Enabling flexible apparel lines is possible.
- Economics of automation are more favorable with each passing year.
- Forces moving toward automation are technological, economic, and increasingly geopolitical.

Not IF but WHERE



Thank You!

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See you next year!

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