Gloves R&D – The Next Frontier

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12th August 2022

Content:

1. Reflection and Heading Forward
2. Materials Research
3. Design / Construction Development
4. Material Informatics

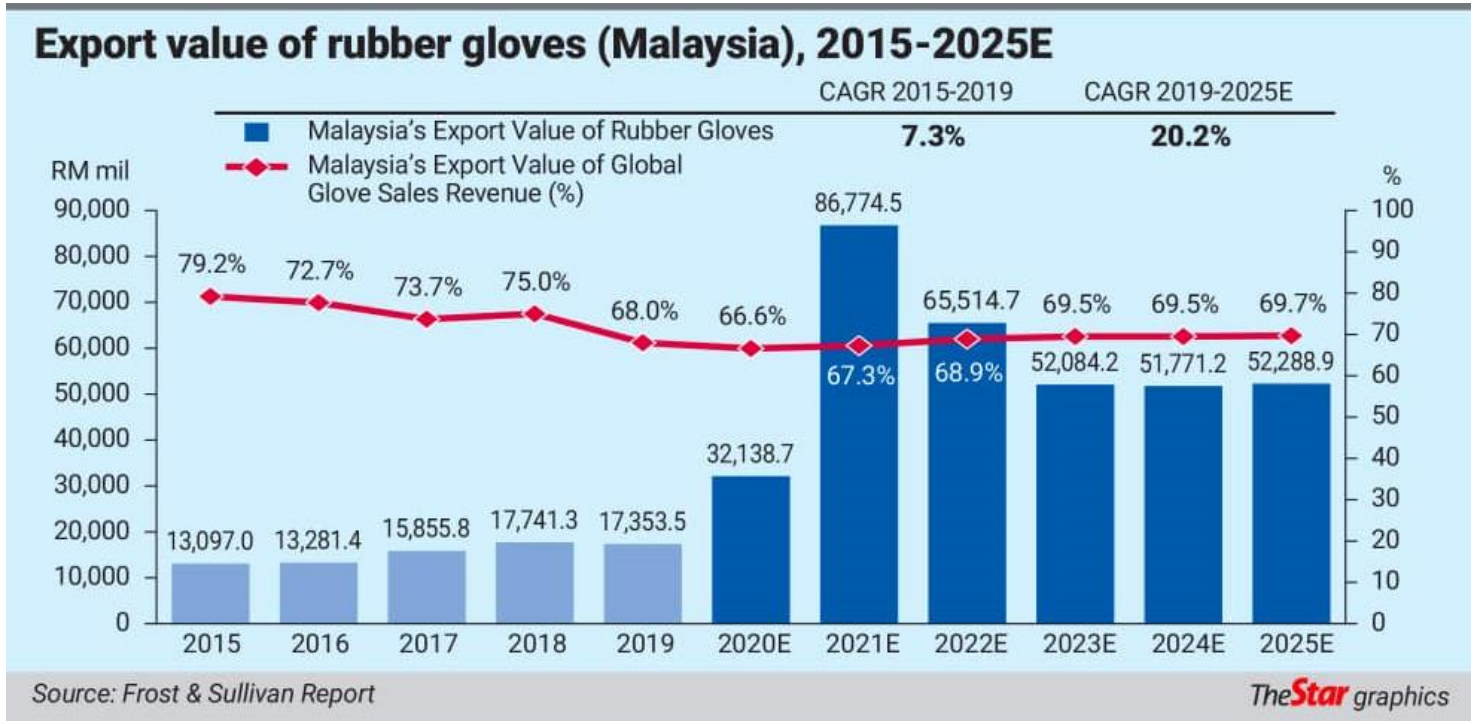
Content:

1. REFLECTION AND HEADING FORWARD

Rubber Glove Market – pandemic wave

In **2019**, it said out of the total, 188 billion gloves were produced by **Malaysia**, which is the world's largest producer and leading exporter of rubber gloves, contributing **63** per cent of global supply, followed by **Thailand** (18 per cent), **China** (10 per cent) and **Indonesia** (3.0 per cent).

In **2022**, around **65** percent of global output, or 240 billion gloves, will be produced in **Malaysia**, followed by **20 percent in China**, 10 percent in Thailand and 3 percent in Indonesia. (Rubber News, 11th Aug 202)

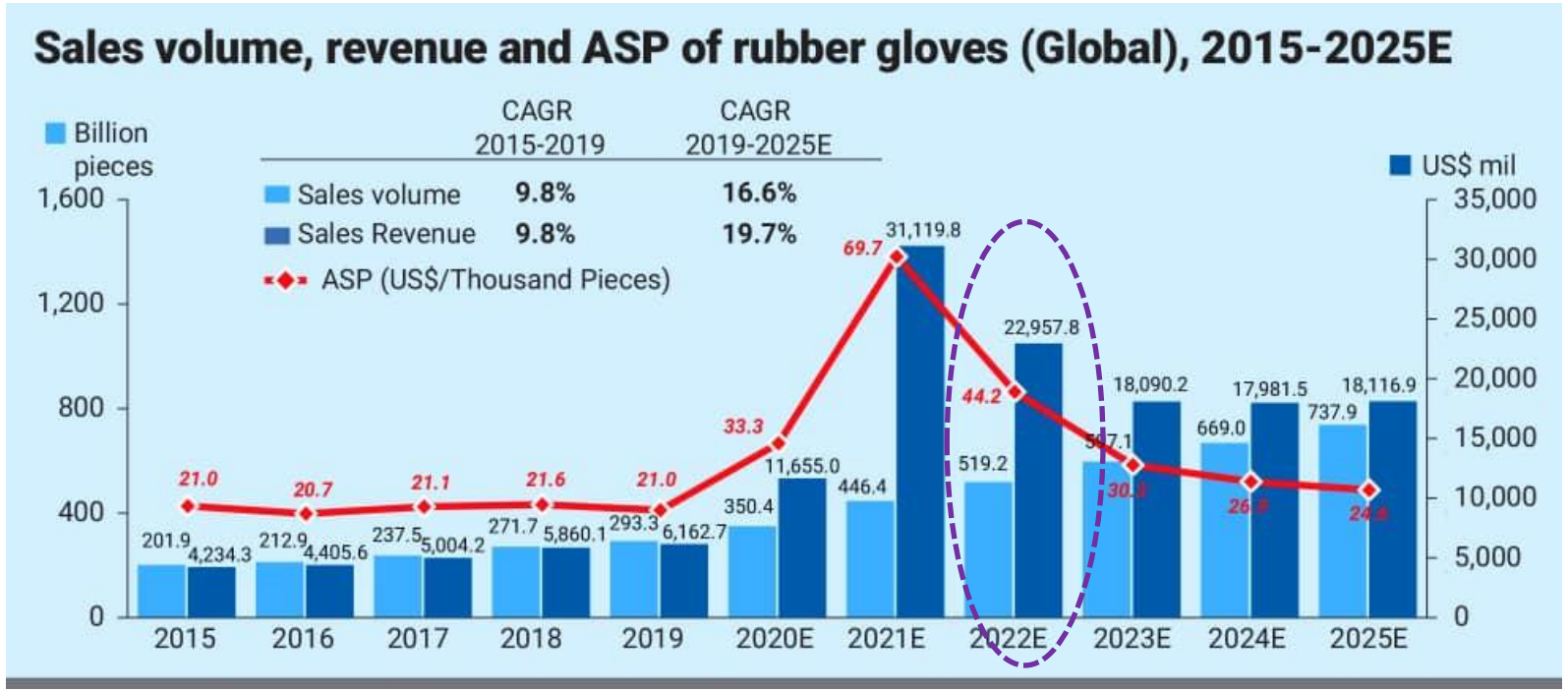


From: **The rubber glove bandwagon**
By RISEN JAYASEELAN and GANESHWARAN KANACORPORATE NEWS
Saturday, 01 May 2021

Sales, Revenue, ASP – quick surge and down fall

DRIVEN by the Covid-19 pandemic, numerous **new players** in the country are getting into glove manufacturing. Many of these are by public companies whose announcements have attracted a fair bit of investor interest, considering the bumper profits the large players have been reporting since last year.

The question is, will they be able to churn out those dream profits? Or will they fall on the wayside as increased capacities catch up with the demand and nudge the **average selling prices (ASPs) down**?



From:
The rubber glove bandwagon
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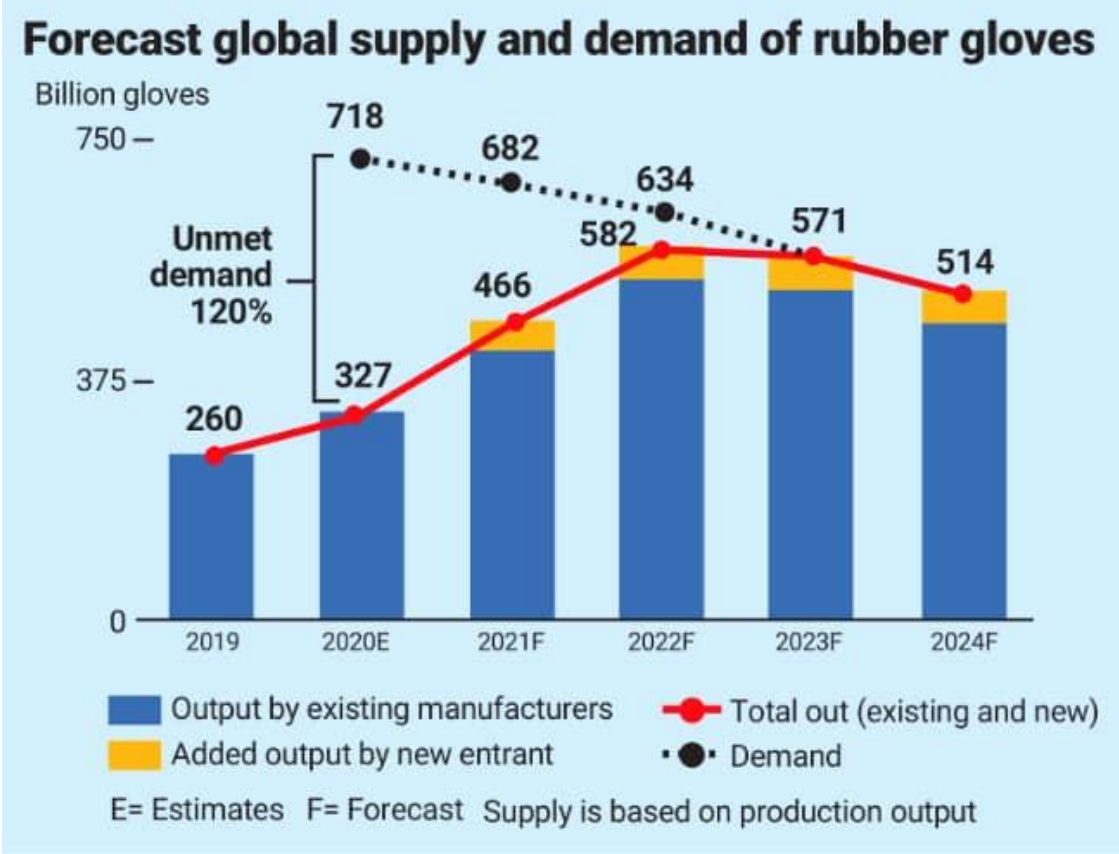
Sales, Revenue, ASP – quick surge and down fall

Other challenges include the need for **automation**, and dealing with **environmental, social and governance (ESG)** issues. Economies of scale will also determine the profitability of new players as they go head on with the big players.

Malaysia is the world's largest exporter of rubber gloves, accounting for 65% of market share and led by the big four of Top Glove Corp Bhd , Hartalega Holdings Bhd , Supermax Corp Bhd and Kossan Rubber Industries Bhd .



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The rubber glove bandwagon
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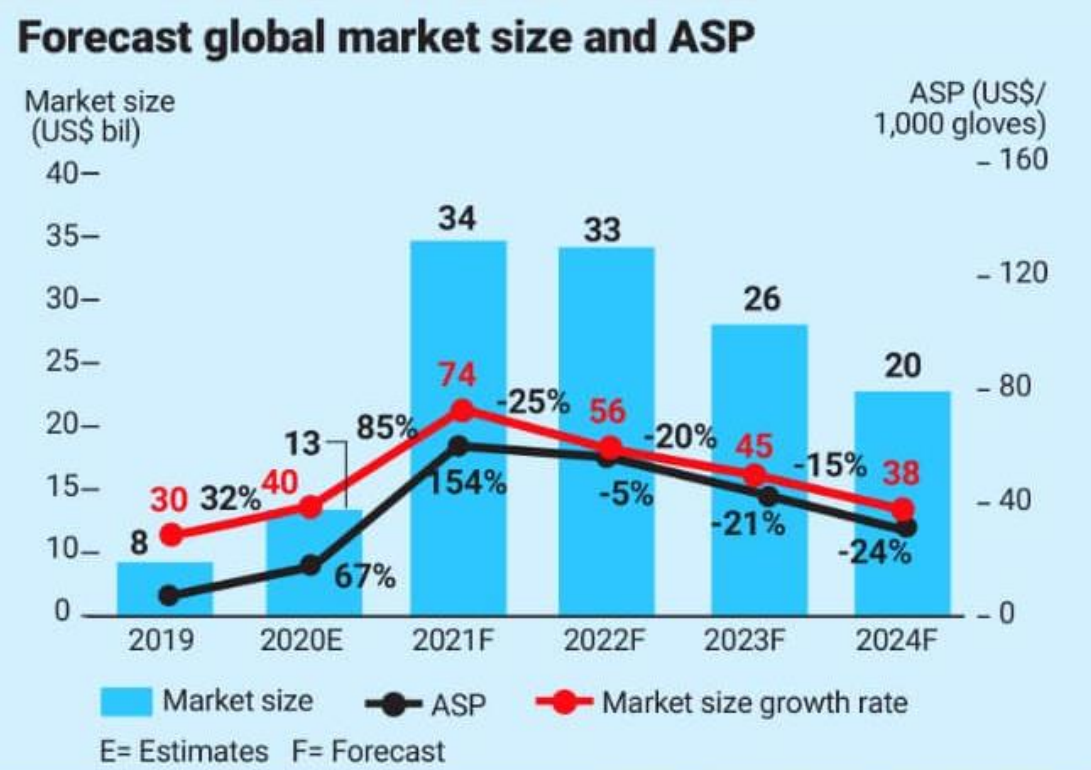
Sales, Revenue, ASP – quick surge and down fall

Recall also that Malaysia has had a chequered past with the glove manufacturing sector. In the **1990s**, there was a gold rush to build rubber glove facilities. However, the majority of the **200 manufacturers then went bust or sold out**, leaving **only around 40 players that existed** prior to the Covid-19 outbreak.



	2020	2021	2022	2023	2024
Unmet demand (billion gloves)	391	216	52	0	0
Excess production capacity (billion gloves)	0	0	0	101	254

Source: Vital Factor analysis TheStar graphics

From:
The rubber glove bandwagon
By RISEN JAYASEELAN and GANESHWARAN KANACORPORATE NEWS
Saturday, 01 May 2021

What's in store for the rubber glove sector?

By GANESHWARAN KANACORPORATE NEWS Saturday, 01 May 2021

A key message that can be derived from both reports is that the global demand for gloves is poised to **stay high** in the next few years to come, far exceeding the global output in 2019 prior to the Covid-19 outbreak.

Rising **hygiene awareness** and a stricter standard operating procedure among businesses, including in **non-healthcare** industries, would help to keep the demand for gloves high.

This would be further boosted by the demand growth from countries that previously had low glove consumption per capita. Among such countries are Brazil, China, Egypt, Mexico, India and Pakistan.

Nevertheless, with the **influx of new companies** jumping on the glove bandwagon and the global Covid-19 vaccination drive, the shortage of gloves being faced currently is expected to be addressed.

New players in glove business

Company	Targeted production lines	Glove piece capacity (per annum)	Note
Mah Sing	Up to 100 lines Phase 1: 12 lines	30 billion 3.68 billion (Phase 1)	
Gets Global	12 lines	4.14 billion	
GIIB	5 lines	1.05 billion	
Johan	42 lines	12 billion	In partnership with George Kent (M) Bhd
Fintec	14 lines	3.3 billion	
PNE PCB	5 lines	1.34 billion	
PDZ	4 lines	829 million	
Kuala Lumpur Kepong	15 lines	4.5 billion	
Jiankun	N/A	N/A	Terminated MOU to enter nitrile rubber business with Chuanplus Industries Sdn Bhd on April 19
EonMetall	9 lines	1.9 billion	Through acquisition of 51% stake in Lienteh Technology Sdn Bhd
LKL	N/A	N/A	Partnered AT Systematization to distribute gloves
Salcon	16 lines	3 billion	
Titijaya	N/A	N/A	Partnered Rubberex Corp Bhd to export gloves
Notion VTec	9 lines	2.16 billion	
Kanger	8 lines	Undisclosed	
AT Systematization	20 lines	3.2 billion	
Green Ocean	12 lines	2 billion	
Vizione	9 lines	500 million	
Hong Seng	6 lines	1.45 billion	
Iconic Worldwide	12 lines	3.1 billion	
GPA	12 lines	3.6 billion	
Karex	2 lines	500 million	

Source: Bursa Malaysia filings

TheStar graphics

PPE in Healthcare Industry

PPE-healthcare-infographic

https://ww2.frost.com/research/industry/chemicals-materials-and-nutrition/future-personal-protective-equipment-ppe/

FROST & SULLIVAN

IMPACT OF COVID-19 ON DEMAND FOR PPE IN THE HEALTHCARE INDUSTRY

Growth Opportunities in an Era of Change

DISRUPTION OF THE PPE INDUSTRY VALUE CHAIN

COVID-19 is impacting the availability of PPE for the healthcare industry value chain in various ways. Some of these changes are short-term and while some are transformative

Impact on Demands

PPE-healthcare-infographic

https://ww2.frost.com/research/industry/chemicals-materials-and-nutrition/future-personal-protective-equipment-ppe/

SHORT-TERM AND DIRECT

Responses that aim to cater to the current crisis and enhance availability of PPE for the healthcare industry. Some examples below

- Major PPE players are ramping up local production to try and meet the growing demand
- Export controls on masks, goggles, gloves and other PPE brought about by several Asian countries, particularly China are gradually easing but the demand is overwhelming and capacities are falling short
- Government agencies relaxing controls to ease supply challenges

LONG-TERM AND TRANSFORMATIVE

The drivers for transformation are very strong and current COVID pandemic could enhance the speed of change. Some examples below

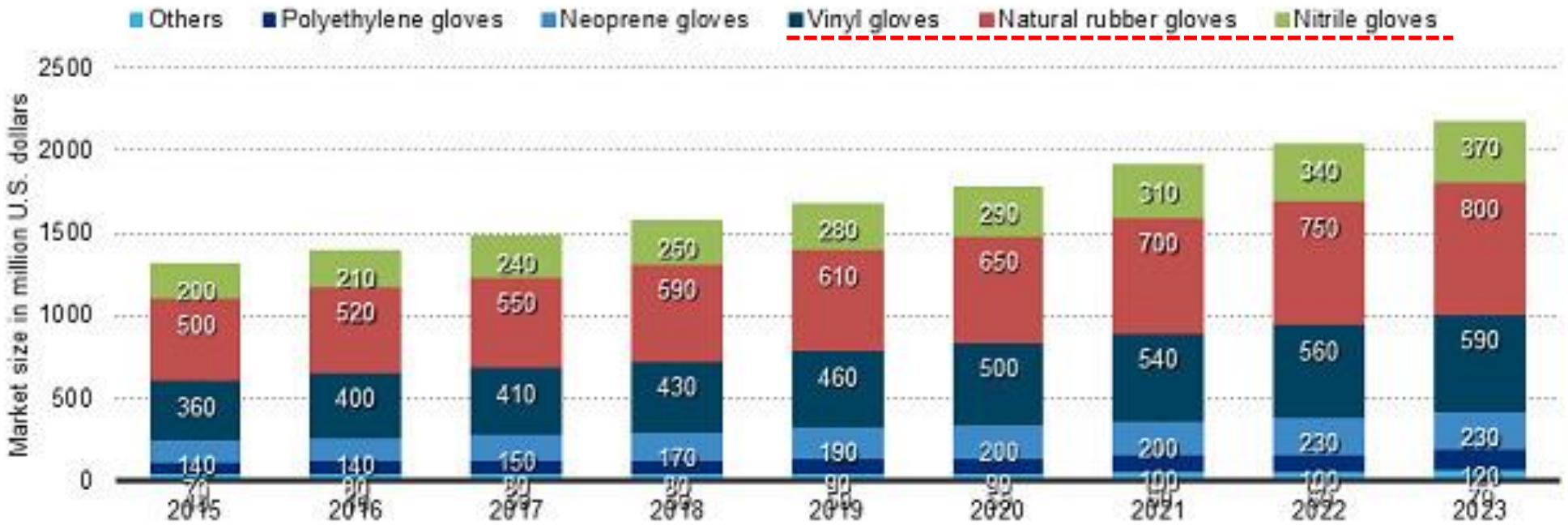
- Strategic stockpile of critical PPE supplies will grow multifold to address any such eventualities in the future, ensuring steady demand in the next 18-24 months
- Distribution strategies for the healthcare industry may witness changes
- Growth of industrial PPE companies catering to healthcare PPE and vice versa
- Substantial growth in indigenous manufacturing capacities to reduce dependence on imports
- Growth of new entrants , M&A activities

US Industrial Gloves Market Size

THOMAS — Thomas for Industry.

Projection of the U.S. industrial gloves market size from 2015 to 2023, by material (in million U.S. dollars)

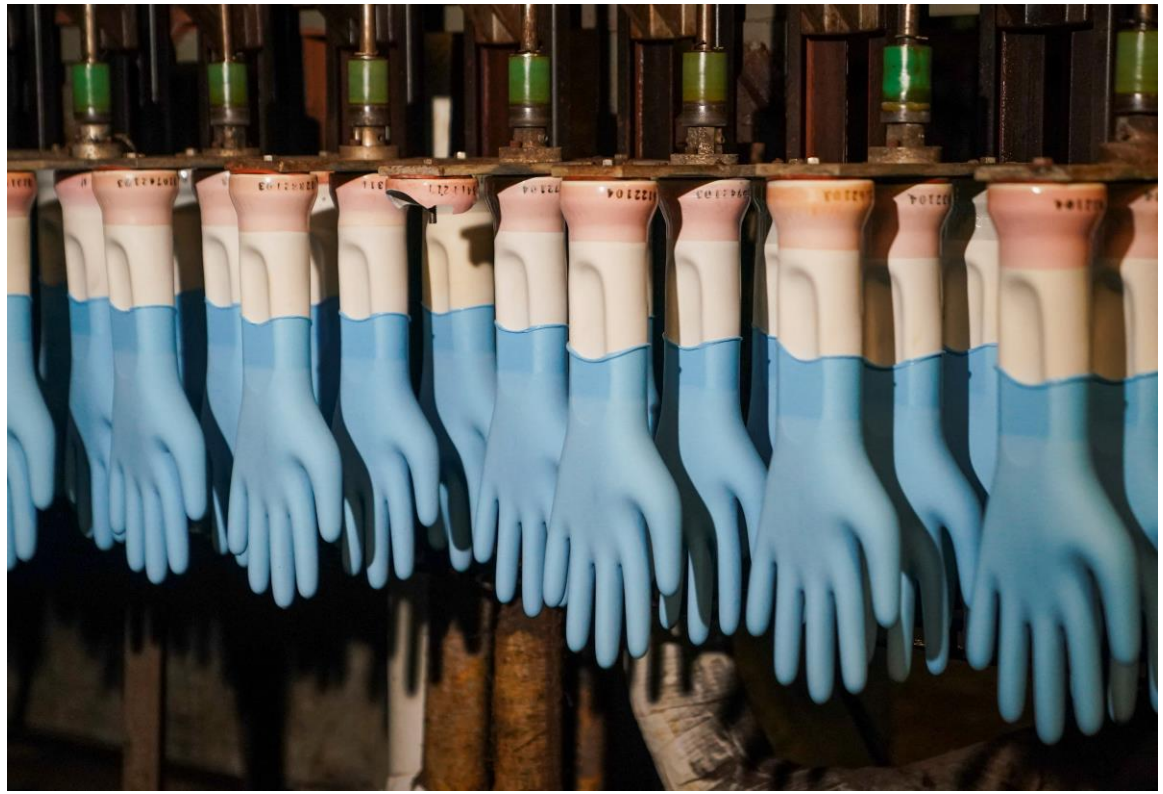
Projection of the U.S. industrial gloves market size by material 2015-2023



Note: North America, United States; as of February 2017
Further information regarding this statistic can be found on page 6.
Source(s): Statista estimates; Fractovia; ID 789121

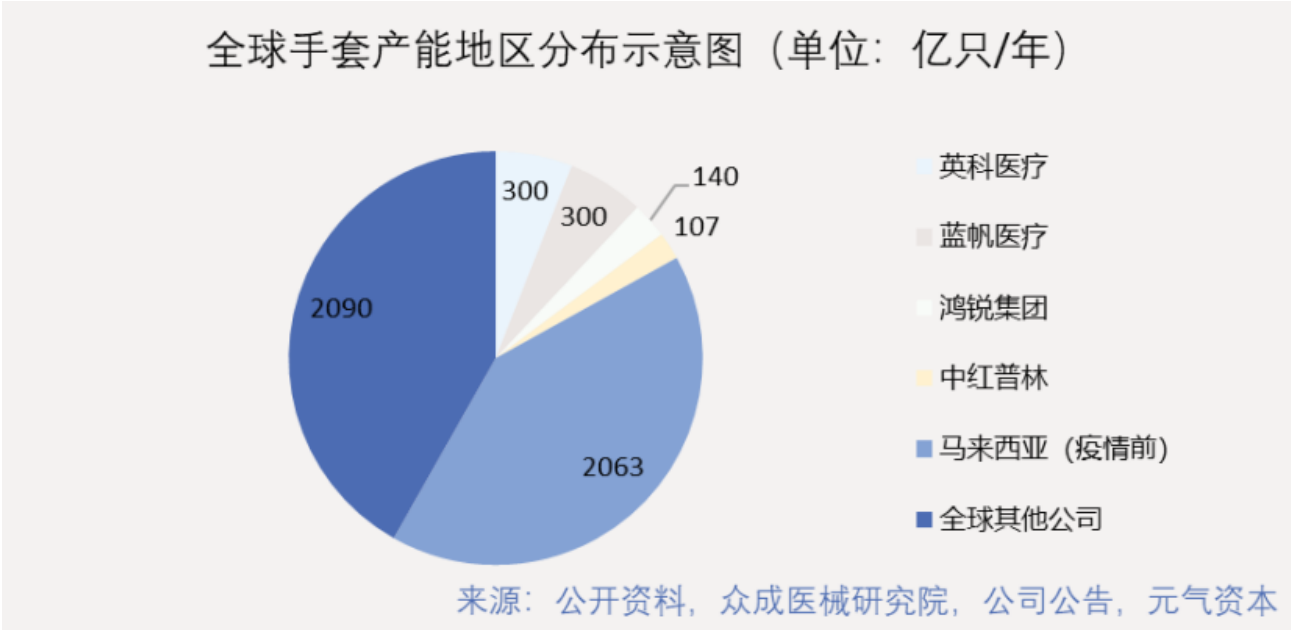
Global Supplies Dynamics, Landscape has changed!

U.S. factories pop up to make medical gloves, spurred by pandemic _ Reuters



Original nitrile glove producing machinery is pictured at a factory of SHOWA, a large Japanese glove producer, in Fayette, Alabama, U.S., June 2, 2022

进击的手套：被英科「包抄」的蓝帆医疗
Attacking Gloves: Blue Sail Medical "Flanked" by Inco
25 Dec 2020

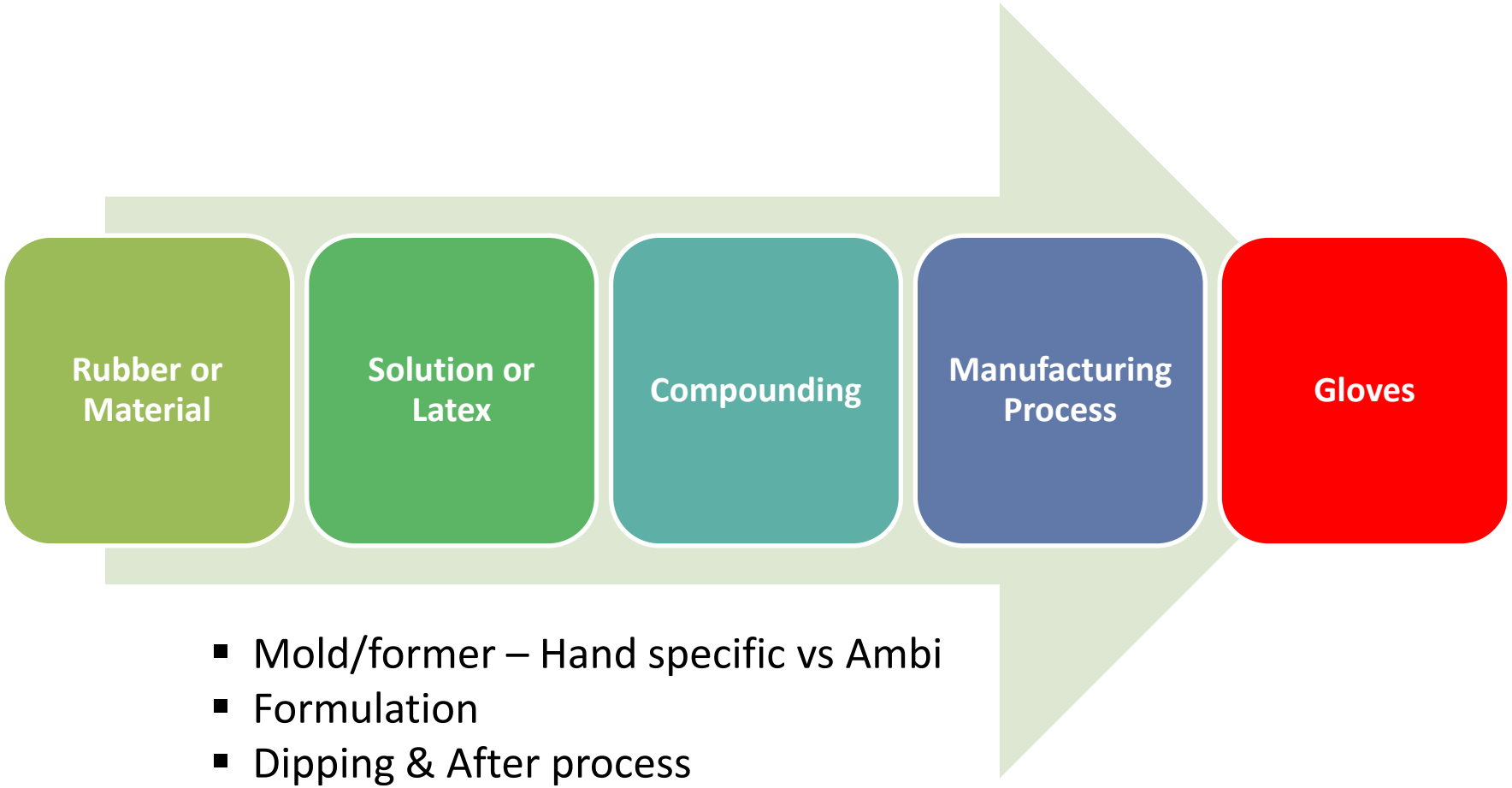


- **Supplies proximity.**
- **Talent relocation.**

Content:

2. MATERIALS RESEARCH

Design for Gloves

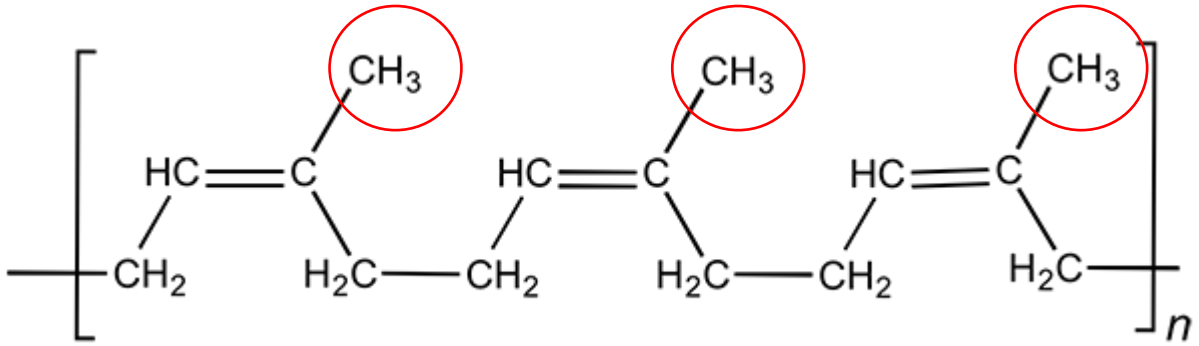


- Mold/former – Hand specific vs Ambi
- Formulation
- Dipping & After process
- Packaging
- Sterilization

Natural Rubber Latex Materials, C5 Isoprene

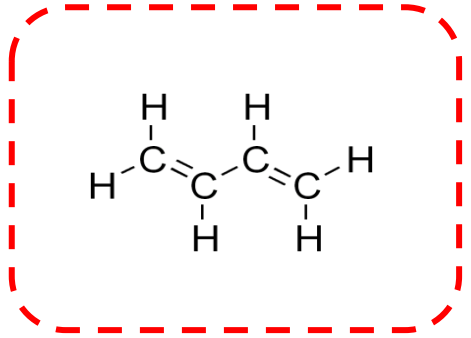
! Gloves must be durable, flexible, tactile-sensitive, resilient, fit, and comfortable.

- **Natural Rubber *Latex***
  - Latex is natural rubber. It has very **high elasticity, high durability and very good dry and wet grip**. The resistance against alcohol and water- soluble chemicals is high. Latex contains a **natural protein** which can cause allergic reactions for sensitive persons during both production and use.
  - Gold Standard!

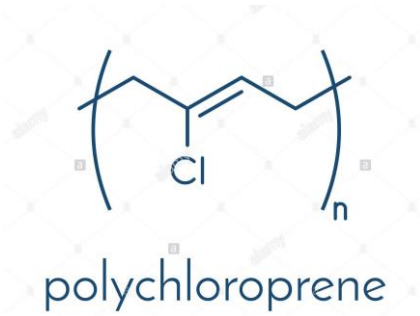


cis-1,4-polyisoprene

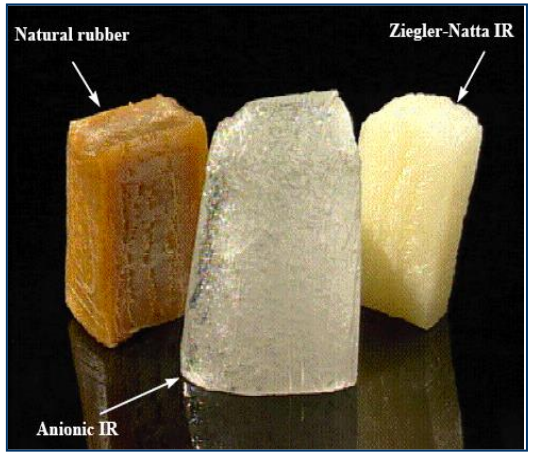
Synthetic Latex Materials, C4 Butadiene

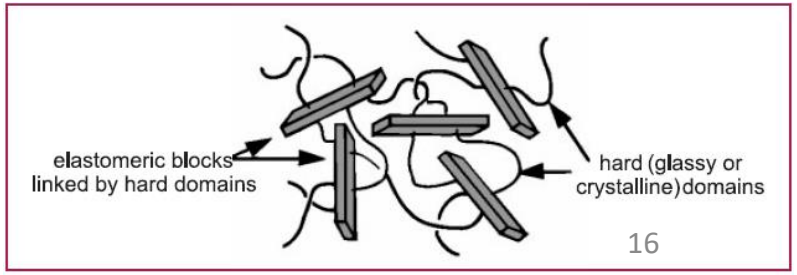


- **Polychloroprene (≈ Neoprene)**
  - first synthetic surgeon glove
  - accelerator free version available



- **Polyisoprene**
  - artificial latex
  - Latex-like comfort & performance, without the risk of latex sensitization.
- **Nitrile-Butadiene**
  - mainly for examination, not common for surgical gloves
- **Polyurethane**
  - first to market with this glove in 2000
  - limitations due to alcohol resistance
- **Block Copolymers**
  - Styrene-Isoprene copolymer
  - Thermoplastic elastomer





Design ⟷ Technology

Former design

- Straight finger, Curve finger, Cuff Design, Palm width, Length, Circumference.
- *Ceramic technology*

A thumb feature that replicates the anatomical position of a resting hand. The thumb on the mold is prominent and positioned away from, or in front of, the finger plane to allow for more natural movement.

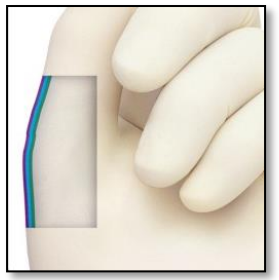
Formulation & Compounding

- stabilizer, sulfur, with/without accelerator, activator, antioxidant, additives.

Design ⟺ Technology, Regulatory

Coating technology & surface treatment

- Polymer donning, chlorination, hand friendly coating, antimicrobial, washing, lubrication.



Multi dip Synthetic coating
- PFL, Neo, NBR

Hydrogel/Polymer coating
- PFL, PI, Neo

Emollient coating
- Glycerin, others

Thickness profile

- Standard, microsurgery, orthopaedic, high risk trauma, chemotherapy, chemical resistance,..

(0.15-0.20mm)	(0.20-0.25mm)	(0.30-0.35mm)
micro	standard	ortho

Regulatory and quality standards

- ASTM D3577, ASTM D3578, ASTM D6319, EN 455, ISO 10282, AS/NZS 4179, JIS T 9107.
- ISO 10993 Biocompatibility; Toxicology.
- FDA QMS, 510(k) PMN, ISO 13485.

Design, Technology, Property

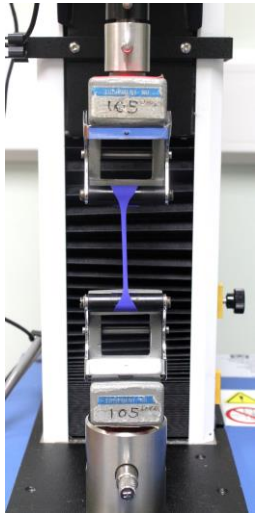
Colors – for the right purpose

- straw, cream, color for synthetic, dark color to reduce glare, or as underglove.




Physical and surface requirements

- tensile, tear, puncture, grip, tackiness, texture.

Addressing Clinical Concerns

- May contribute to delayed wound healing and post-operative complications.
- Irritant that contributes to compromised skin health.
- Patient safety **and** workers' health concerns.

Powder-Free

- Estimated that 8-12% of healthcare workers are latex sensitive
- Can be difficult to determine patient's sensitivity before a procedure.

Latex-Free

- Protects against transmission of HIV, HBV and other blood borne pathogens
- For every 10 minutes of surgery, the risk of a glove breach increases by 15%.

Double Gloving

Single-use device (disposable device)

- Intended for use on one patient during a single procedure ... and is not intended to be reprocessed (cleaned, disinfected/sterilized) and used on another patient.

Addressing Clinical Concerns

Sharps Safety and Risk Exposure

Additional protection is needed when needles and sharps are involved. Research shows that double-gloving represents an increased barrier protection for the wearer compared to single-gloving.

The addition of a second pair of medical gloves significantly reduces perforation to the innermost gloves, which reduces the risk of exposure to infectious fluids and helps prevent the transmission of infectious diseases between the medical team and patient. In addition, wearing one pair of gloves on top of a pair of differently colored gloves facilitates the wearer's rapid recognition of perforation to the outer glove.[1] Double-gloving reduces the risk of exposure to patient blood by as much as 87% when the outer glove is punctured. Volume of blood on a solid suture needle is reduced by as much as 95% when passing through two glove layers, thereby reducing viral load in the event of a contaminated percutaneous injury.[2]

Dark color highlights a break in the outer layer.

1 Tanner J, Parkinson H. Double-gloving to reduce surgical cross-infection. Cochrane Database of Systematic Reviews. 2006; Issue 2. Art. No.:CD003087. DOI:10.1002/14651858.CD003087.pub2. http://www.cochrane.org/reviews/en/ab003087.html

2 Berguer R, Heller P. Preventing sharps injuries in the operating room. Journal of the American College of Surgeons. September 2004;199(3):462-467.

Content:

3. DESIGN / CONSTRUCTION DEVELOPMENT

Kimtech™ Prizm™ Multilayered Glove

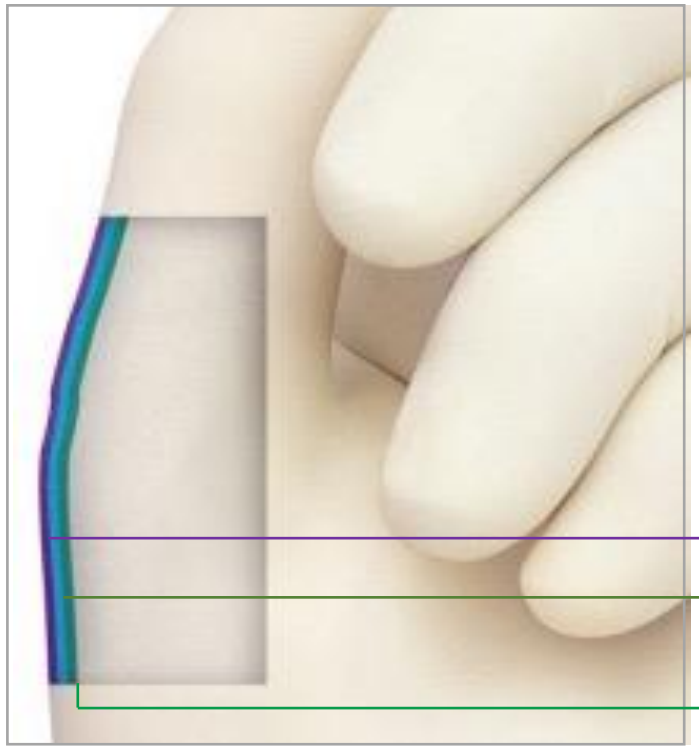
- Scientific & Research / Lab Environment

Kimtech™ Prizm Gloves
Multi- Layered Neoprene Nitrile

- Crafted with a proprietary combination of polymers proven to protect against a wide range of common chemicals
- Ultra fingertip grip helps to reduce risk of drops and breakage accidents, even when wet
- Certified ergonomic comfort ensuring comfort in-use without compromising protection
- Multi-coloured dark violet and dark magenta design to enhance wearer safety by visually identifying mechanical breaches
- Tested against a wide range of cytotoxic drugs
- Nitrile accelerator-free donning layer, reducing the risk of allergic reaction

EN 374 Type A certified

Multiple dip technology



- The intermediate rubber blend layer provides a micro-texture surface morphology to help enhance the inner synthetic coating to the natural rubber substrate
  - These features increase material stiffness near the surface and minimize stickiness between inner and outer surfaces to improve donnability
- Multiple dip technology aids in donning and enhances strength and barrier protection
- Better resistance to pinholes and tearing
  - Outer layer – soft feel, high tensile strength and elasticity
  - Intermediate layer – blend of synthetic and rubber specially formulated to enhance adhesion
  - Inner layer – synthetic to provide comfortable donning

Gloves that are multiple dipped

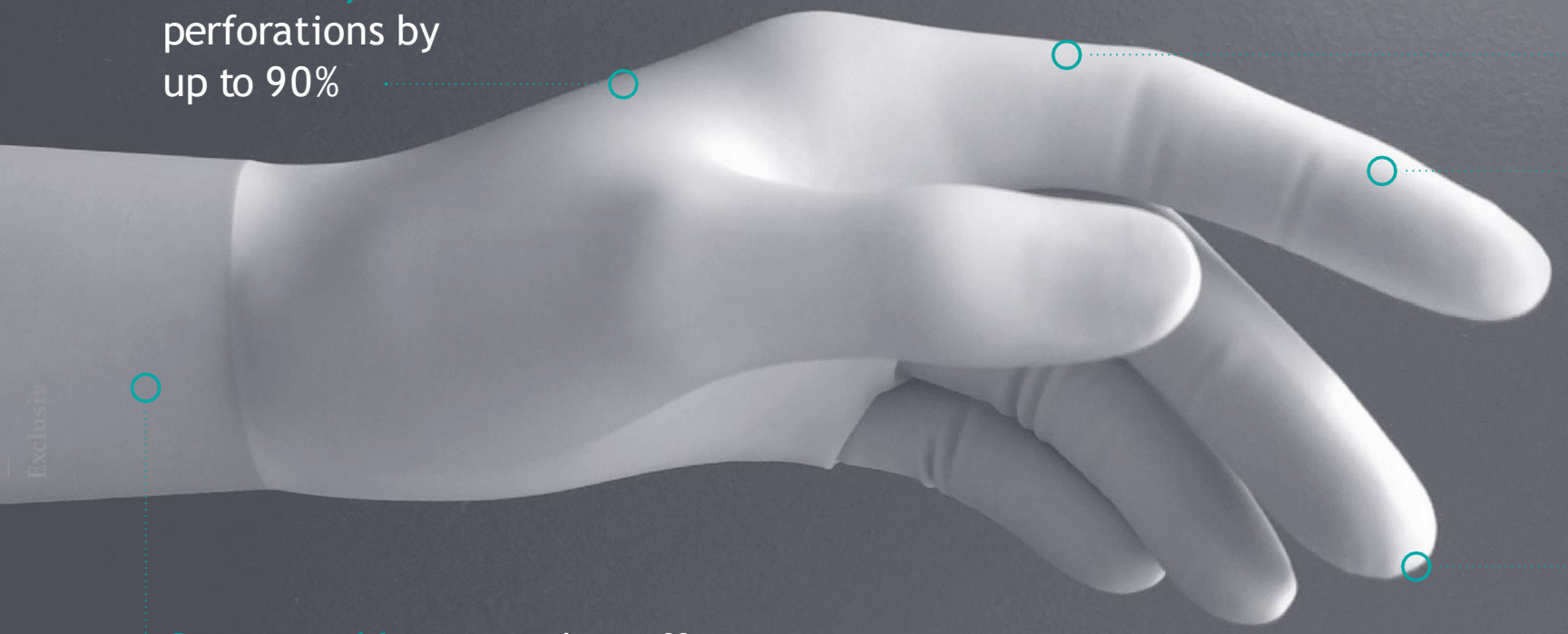
Gammex® PI Hybrid

<u>Polyisoprene</u> and <u>neoprene</u> blend surgical glove delivering the best of both materials: exceptional comfort and superior durability

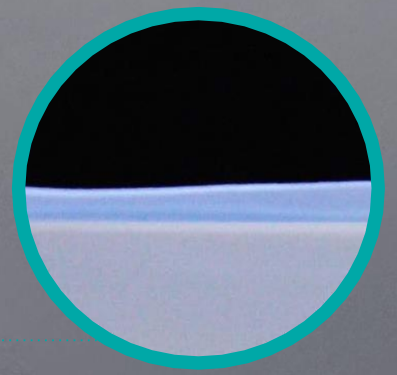
- KEY FEATURES AND BENEFITS

- Patented HYBRID™ Technology delivers latex-like comfort and high durability
- Ideal for use as an outer glove when double gloving
- Non-latex, Zinc 2-mercaptobenzothiazole-free (ZMBT-free), diphenylguanidine-free (DPG-free) and cetylpyridinium chloride-free (CPC-free)

Smarterials Two-in-One*



Enhanced, to reduce perforations by up to 90%



Layered structure

Smart indicator to warn in case of perforations

Thin at the fingertips for superior tactile sensation

Connected layers at the cuff

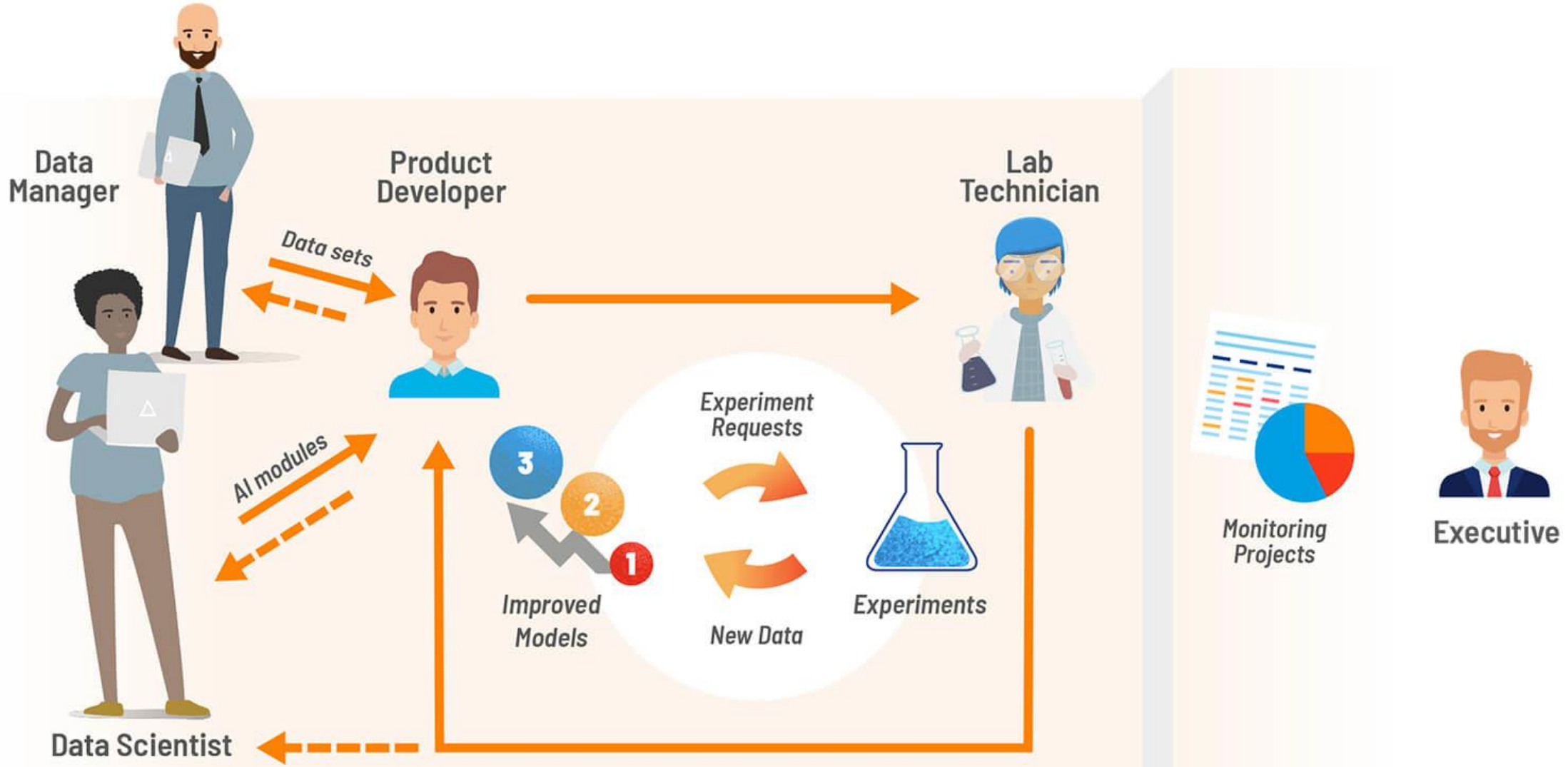
* Abbreviated TiO

Smarterials TECHNOLOGY

Content:

4. MATERIAL INFORMATICS

How AI impacts R&D in Materials and Chemicals

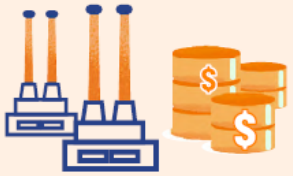


Artificial Intelligence Data Sciences Machine Learning Materials Informatics

Material Informatics

SET OF FEASIBLE RECIPES
Given ingredients available and possible processing steps

Customer-specific constraints



INGREDIENT COST DATA

DESIGN SPACE

RUN AI MODEL

RECIPE BANK
Predicted chemical properties of each recipe

CALCULATE
approximate cost of production of recipes

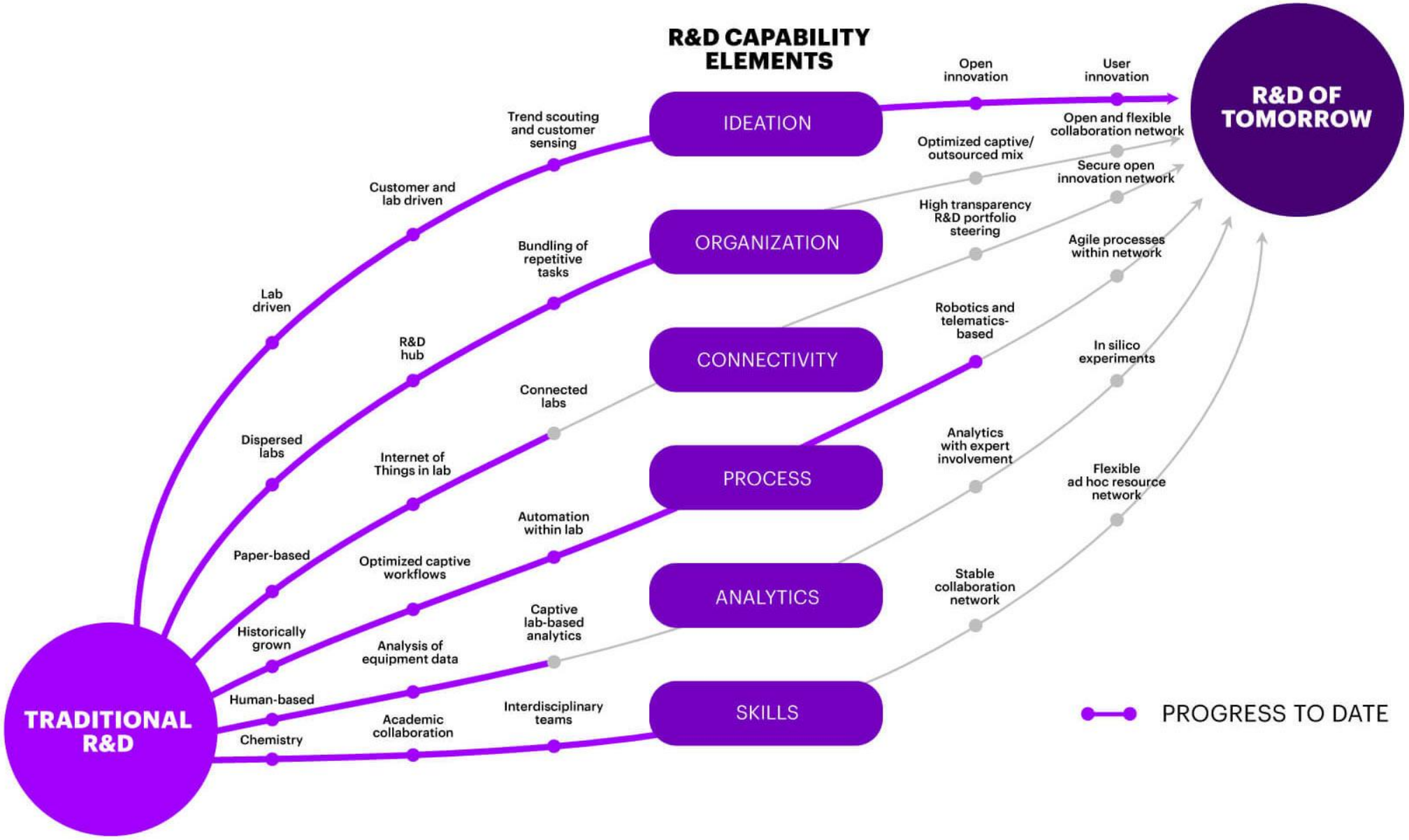
CALCULATE
approximate carbon footprint of recipes

RANK RECIPES
by performance, cost, and carbon footprint

INGREDIENT CARBON FOOTPRINT DATA

R&D Evolution Paths

FIGURE 1:
R&D evolution pathways



SOURCE: DIGITAL DISRUPTION IN THE LAB: THE R&D OF TOMORROW, ACCENTURE, 2015.

Transforming Innovation

Lux Research

7 TECHNOLOGIES TRANSFORMING INNOVATION

Corporate innovation leaders have a robust toolkit to help them do their jobs, but fail to integrate and use these tools effectively. **Digital tools will improve innovation** – and will be a source of competitive advantage.

Transforming Innovation

NATURAL LANGUAGE PROCESSING

NLP can automatically analyze vast amounts of text data to provide insights on market & technology trends.

10x
funding in past 7 years

75%
time reduction for development

MATERIALS INFORMATICS

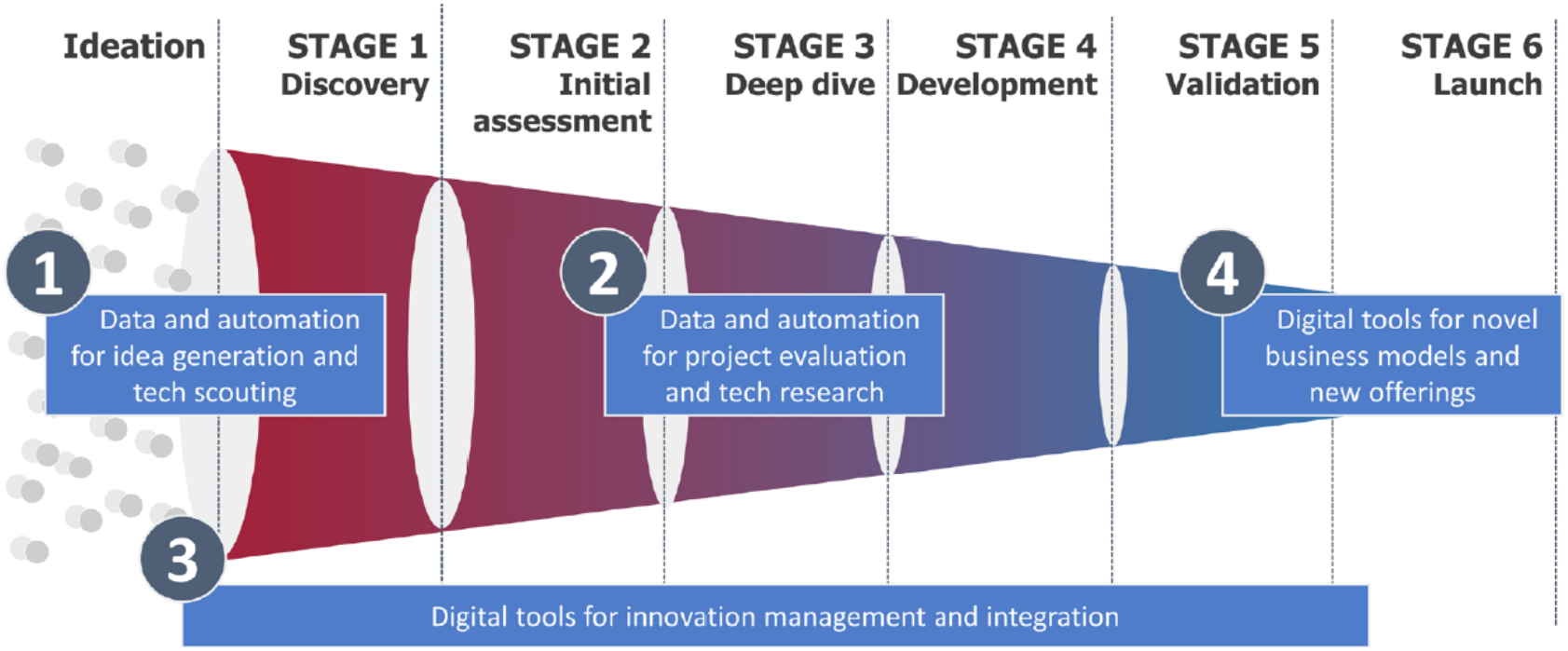
Using AI on materials data allows researchers to develop the right formulation in **1/4** the time.

Machine Learning & Innovation

MACHINE LEARNING CAN IMPROVE THE EARLY STAGES OF INNOVATION

We have looked at the impact of digital tools across the entire innovation process in various reports. The scope of this white paper is to specifically look at the impact of AI/ML at the front end of the innovation process, which we here call the Ideation, Discovery, and Initial Assessment stages.

Figure 1. Digital impact across the innovation funnel



Lux Research

Overall Purpose & 4 Key Activities of Research and Development (R&D)

NU ANGLE WHITE PAPER, Developing a strong R&D structure to drive company growth, DECEMBER 15, 2014 BY RACHEL

Overall Purpose & 4 Key Activities of Research and Development (R&D)

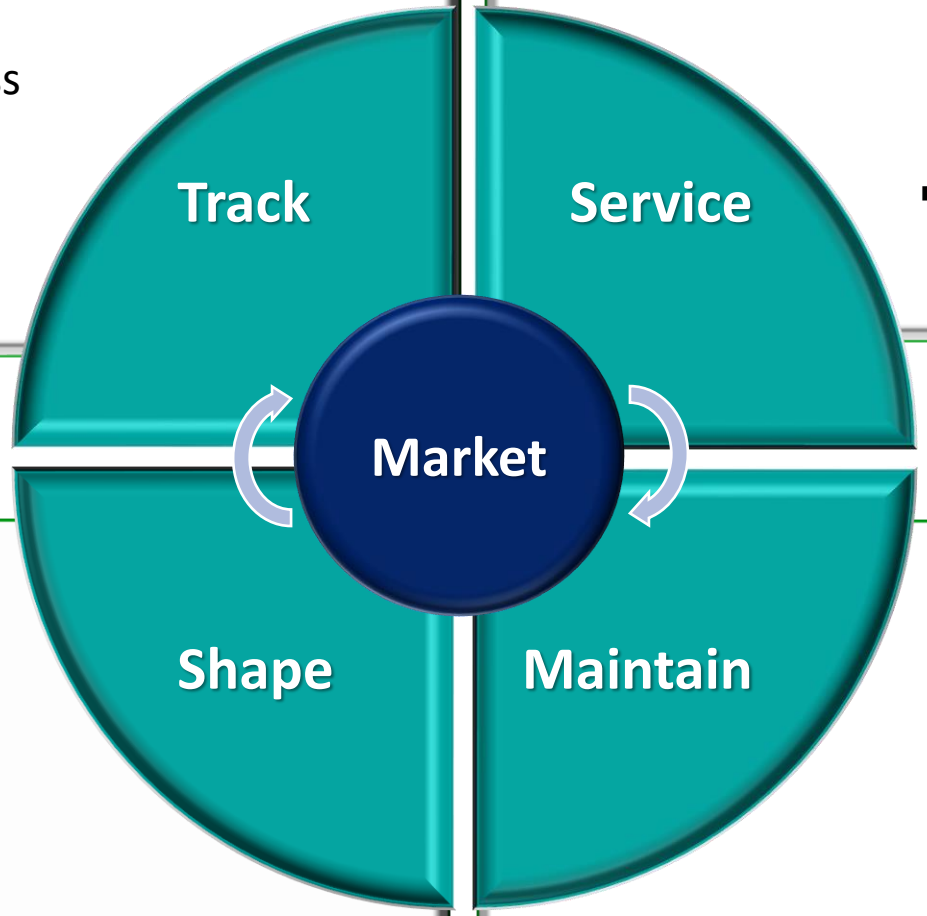
12th Aug 2022

RESEARCH

- Reduce uncertainty
- Explore future in advance of business needs (foresight)
- Build competencies for the future
- Proof of principle new technologies from outside

DEVELOPMENT

- Create new products efficiently
- Improve processes to enhance performance
- Product modifications and extensions



INNOVATION

- Launch smart ideas
- Create new markets
- Look for ways to disrupt in target markets
- Solve problems in new ways

SUPPORT

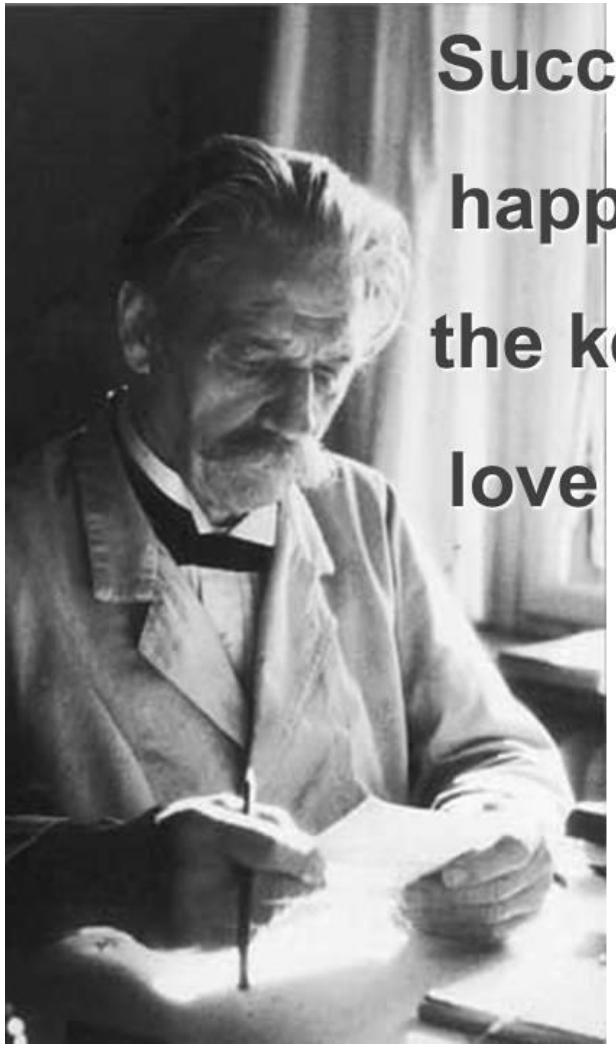
- Reduce product costs
- Solve process and line problems
- Current product modifications
- Customer technical support

NU ANGLE WHITE PAPER, Developing a strong R&D structure to drive company growth, DECEMBER 15, 2014 BY RACHEL

SUMMARY

Keeping Wide Exposure and Looking into the Next Frontier.

Being yourself and successful

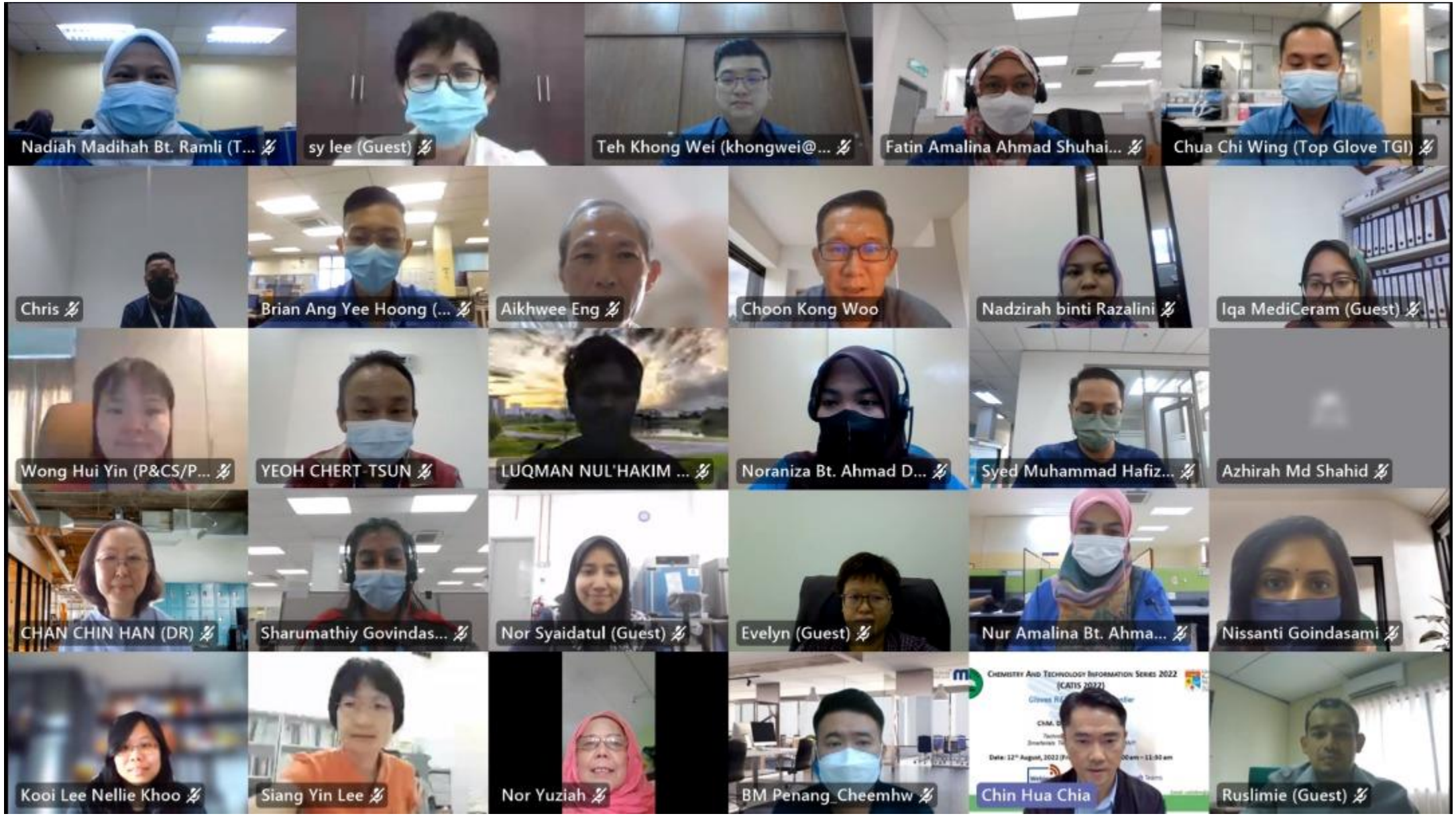


Success is not the key to happiness. Happiness is the key to success. If you love what you are doing, you will be successful....

Albert Sweitzer

THANK YOU!

Q & A


Nadiah Madihah Bt. Ramli (T...
sy lee (Guest)
Teh Khong Wei (khongwei@...
Fatin Amalina Ahmad Shuhai...
Chua Chi Wing (Top Glove TGI)
Chris
Brian Ang Yee Hoong (...
Aikhwee Eng
Choon Kong Woo
Nadzirah binti Razalini
Iqa MediCeram (Guest)
Wong Hui Yin (P&CS/P...
YEOH CHERT TSUN
LUQMAN NUL'HAKIM ...
Noraniza Bt. Ahmad D...
Syed Muhammad Hafiz...
Azhirah Md Shahid
CHAN CHIN HAN (DR)
Sharumathiy Govindas...
Nor Syaidatul (Guest)
Evelyn (Guest)
Nur Amalina Bt. Ahma...
Nissanti Goindasami
Kooi Lee Nellie Khoo
Siang Yin Lee
Nor Yuziah
BM Penang_Cheemhw
Chin Hua Chia
Ruslimie (Guest)