THE FUTURE OF PRODUCTION
THE FUTURE OF PRODUCTION
The future of Production
Our Background

- Innovation and Technology Fund
- HK Government’s adoption of innovation & technology strategy
- Textiles and Apparel selected as a focus area
- HKRITA was established in 2006
- PolyU to host the R&D center
Global Awards

33 Global Awards so far

2016

• 6 International Invention Awards

• 1 Global Medical Innovation Award
<table>
<thead>
<tr>
<th>Year</th>
<th>Invention Description</th>
<th>Award</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>Solvent-assisted Dyeing</td>
<td>Gold Medal with Jury’s Commendation</td>
</tr>
<tr>
<td>2</td>
<td>PLA Fiber from Food waste</td>
<td>Gold Medal with Jury’s Commendation</td>
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<tr>
<td>3</td>
<td>Chitosan Yarn Spinning</td>
<td>Gold Medal</td>
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<td>4</td>
<td>Fetal Monitoring Belt</td>
<td>Silver Medal &amp; Special Award from Scientific Community of Romania</td>
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<tr>
<td>5</td>
<td>Dyeing of Natural Fibers using CO2 System</td>
<td>Bronze Medal</td>
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<tr>
<td>6</td>
<td>Superfine Wool</td>
<td>Bronze Medal</td>
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<tr>
<td>7</td>
<td>Degradable Polyester Fibers</td>
<td>Gold Medal with Jury’s Commendation</td>
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<tr>
<td>2015</td>
<td>Anti-Pilling Plasma System</td>
<td>Gold Medal</td>
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<tr>
<td>8</td>
<td>O-blanket</td>
<td>Silver Medal &amp; China Delegation Award</td>
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<tr>
<td>9</td>
<td>Assets Maintenance Management System (AMMS)</td>
<td>Silver Medal</td>
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<tr>
<td>10</td>
<td>High Performance Conductive Textiles</td>
<td>Silver Medal</td>
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<tr>
<td>11</td>
<td>3D Auxetic Fabrics</td>
<td>Gold Medal</td>
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<tr>
<td>12</td>
<td>Reusable Elastic Tapes for Rehabilitation</td>
<td>Gold Medal</td>
</tr>
<tr>
<td>13</td>
<td>Intelligent Footwear System (iShoe)</td>
<td>Gold Medal</td>
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<tr>
<td>14</td>
<td>Thermal Functional Textile</td>
<td>Silver Medal</td>
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<tr>
<td>15</td>
<td>Fabric Touch Tester (FTT)</td>
<td>Gold Medal with Jury’s Commendation</td>
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<tr>
<td>16</td>
<td>Imaging Color Measurement (ICM) System</td>
<td>Gold Medal</td>
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<tr>
<td>2013</td>
<td></td>
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<tr>
<td>17</td>
<td></td>
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<tr>
<td>2012</td>
<td>Sputtering on Textiles Products</td>
<td>Silver Medal &amp; Special Award from Romanian Association for Nonconventional Technologies</td>
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<tr>
<td>18</td>
<td>Quick Test System of Formaldehyde in Textiles</td>
<td>Silver Medal</td>
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<tr>
<td>19</td>
<td>E-Clustered Prototype Assessment System (EPAS)</td>
<td>Silver Medal</td>
</tr>
<tr>
<td>20</td>
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</table>
Our R&D Areas of Interest

• New materials and textiles and apparel products
• Advanced textiles and clothing production technologies
• Innovative design and evaluation technologies
• Enhanced industrial systems and infrastructure
PROJECT THEMES

Sustainability

Industry Advantage

Better Society
PROJECT THEMES

Manufacturing technologies
- Robotics - pick & place
- Automation - linking
- Seamless manufacturing

Material Science
- High performance sportswear
- Comfortable next to skin
- Active support

Supply Chain Solutions
- Agile manufacturing systems
- Demand forecasting
- Last mile solutions
- Omni channel solutions

Industry Advantage
PROJECT THEMES

**Sustainability**

- Waterless Technologies
  - Self-cleaning fabrics
  - Waterless dyeing
  - Waterless printing
  - Solvent based dyeing
  - Waterless treatments

- Energy Efficiency
  - Low heat treatments
  - Lean Manufacturing
  - Smart Energy Consumption

- Green Materials
  - Biodegradable
  - Material from Waste
  - Easy care
  - Nontoxic Solutions

- Recycling Technologies
  - Chemical recycle technologies
  - Fermentation technologies

- Zero Discharge
  - Nontoxic Chemicals
  - Waste treatment
  - Water/solids treatments
Research Vision & Purpose

Industry Advantage
Efficient, Effective, Disruptive

Sustainable
Less Bad, More Good

Better Society
Competitive, Healthy
• Nu Torque
• Fabric Touch Tester
• Imaging Color Measurement System
• Chitosan
• Anti-Pilling Plasma Treatment
• Thermal Heating Garment
• Sleeping Thermal Comfort Study
• Fashion Color Prediction System
• Solvent Assist Dye
• Conversion of Food Waste into Poly Lactic Acid Fiber
• Plant Structure Fabric
• Surface Cooling Fabric
• Fabric Impact Assessment
• Development of Non-aqueous Solvent Medium (NASM) Dyeing System
• Innovative Textiles Recycling (H&M)
• Elderly Care Apparel
• High Performance Sportswear
• Fire Service Uniform
• Marine Police Uniform
• Self Cleaning/ Self Sterilizing Fabrics
Nu-Torque Yarn

ITF/ HKRITA Project Title:
Finer Nu-Torque Cotton Yarn Production
(ITP/003/07TP)
Technology Mechanism

- A novel spinning technology was developed to produce low torque singles ring yarn **physically** in a single step on a spinning machine by changing the yarn structure.
Advantages of the Technology

- Reduction of yarn twist (18-40%)
- Low yarn residual torque and fabric spirality
- Low yarn twist but high yarn strength
- Low yarn hairiness
- Soft handle
- Physical, no chemical/water/steam
- Increased productivity (18-40%)
- Energy saving (337 KWh/ton)
Fabric Touch Tester (FTT)

ITF/ HKRITA Project Title:
Fast Fabric Hand Measurement Technology (ITP/024/10TP)
Fabric Touch Tester (FTT)

Subjective Hand Measurement

Objective & Scientific Measurement

- Fabric thickness
- Fabric compression
- Fabric bending
- Fabric surface friction
- Fabric surface roughness
- Fabric thermal properties
Imaging Color Measurement System (ICM)

ITF/ HKRITA Project Titles:

• Imaging Color Measurement (ICM) System for Textile and Garment Industry (ITP/009/07TP)

• The Second-Phase Research and Development of Imaging Color Measurement (ICM) System for Textile and Garment Industry (ITP/001/10TP)

• The Third-Phase Research and Development of Imaging Color Measurement (ICM) System for Textile and Garment Industry (ITP/048/13TP)
The system provides the fundamental functions in color measurement and color quality control for the solid color fabrics and multicolor printing samples. The project completes with the upgrade and optimization of optical and imaging system. The system is able to measure colors of differently sized samples, ranging from yarns, to laces, to accessories, and to printing fabrics. Industrial trials have been performed. A next level of spectral color measurement system was developed and achieving a further improved precision, accurate and repeatable color measurement. The system is able to measure full visible/UV spectral illumination for printing and yarn-dyed fabrics with gradational colors and complex patterns.
Innovative Spinning System for Chitosan Yarn

- Chitosan fiber
- Naturally anti-bacterial; anti-inflammatory & analgesic
- Healing & re-generative functions; strengthening immunity

Application
- Treatment for Epidermolysis Bullosa (EB)
- Wound healing

Barriers for mass production
- High wastage due to statics
- Low productivity
- Poor mechanical properties
- High Cost – US$80,000/ton
Our solution

• Anti-static rollers for spinning

![Anti-static rollers diagram]

• Blended with other materials to improve the physical performance, while maintaining the anti-bacterial property.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Antibacterial Rate by AATCC method</th>
<th>Antibacterial Rate by FZ method</th>
<th>Antibacterial Rate by ISO method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2% Chitosan</td>
<td>90.69%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4% Chitosan</td>
<td>99.02%</td>
<td>97.21%</td>
<td>1.55</td>
</tr>
<tr>
<td>6% Chitosan</td>
<td>99.02%</td>
<td>99.71%</td>
<td>2.53</td>
</tr>
<tr>
<td>8% Chitosan</td>
<td>99.02%</td>
<td>99.71%</td>
<td>2.53</td>
</tr>
</tbody>
</table>

4% can ensure the effectiveness of bio-function.
Anti-Pilling Plasma Treatment

- The project aims to develop an Industry-scale Plasma Treatment System using argon gas for Wool/ cashmere knitwear to improve the anti-pilling performance

- Features of Plasma Treatment
  - Short Treatment Time
  - Dry and Pollution-free

Treatment Sample: Cashmere/ Wool Sweater

<table>
<thead>
<tr>
<th>Loading Garments (20pcs)</th>
<th>Plasma Treatment Time (Pressure at 8.5 to 10 Pa)</th>
<th>Unloading Garments</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 to 15 mins</td>
<td>5 to 10 mins</td>
<td>5 mins</td>
</tr>
</tbody>
</table>

Total Treatment Time: 20 to 30 mins
Anti-Pilling Plasma Treatment

System Dimension (L x W x H): (6700 x 5800 x 2300) mm
Vacuum Chamber Dimension (L x W x H): (2000 x 1000 x 1700) mm x 2 Chambers
Thermal Heating Garment

• Heating without the use of electrical wires
• Conductive paths and the heating areas are sewn into fabric
• Hand feel will not be affected
• Machine-washable
• Solvent Assist Dye
• Conversion of Food Waste into Poly Lactic Acid Fiber
• Plant Structure Fabric
• Surface Cooling Fabric
• Fabric Impact Assessment
• Development of Non-aqueous Solvent Medium (NASM) Dyeing System
• Innovative Textiles Recycling (H&M)
Solvent-assisted Dyeing of Cotton Fiber (ITP/046/14TP)

- Waterless dyeing technology
- Solvent recycled and reusable
- Colorfast
- Effect for most natural fibers
Preparing dyeing bath

Dyeing

Fixation

Sound recycling

Floating color washing and drying
Food waste to PLA fiber

Leftovers  Bakery waste  Fruit Peel
Methodology

Food waste

PLA Life Cycle

Food

Consumption

Fermentation (發酵)

LA monomer (單體)

Polymerization (聚合反應)

PLA polymer (聚合物)

PLA fiber (繊維)

Compost or landfill

Biodegradation (生物降解)

Photosynthesis (光合作用)

H₂O + CO₂
Plant Structure Fabric

- Superior water absorption rate
- Excellent moisture management property
- Superior water transport property not deteriorated after repeated laundering
• Elderly Care Apparel
• High Performance Sportswear
• Fire Service Uniform
• Marine Police Uniform
• Self Cleaning/ Self Sterilizing Fabrics
2016 Olympic Projects

• Rowing Team – Training Apparel, Equipment, & Competition Suits
High Performance Sportswear
Light Weight, Variable Compression, Seam Optimized High Performance Competition Apparel

- Optimize suit design
- Advanced Sewing Technology
- Fit competition garments to individual athletes
- Continuous evaluation of performance with objective and subjective measurements
- Optimize fabric weight
Olympics 2016

Asymmetric Footwear
High Performance Sportswear

Fencing

• Study key requirements of fencing shoes

• Design cushions/insert for heel and hallux/forefoot protection

• Design and develop fencing shoes prototypes and conduct fitting

• Optimize the shoes design and develop asymmetric fencing competition shoes

• Evaluate the cushion/insert and shoes performance
Focus on the Future
20/20
2020 AND BEYOND
Fire Service Uniform

Moisture and Temperature Management System

- **Fire Service Uniform**
- Fabric and garment objective measurement
- Required key properties
  - Moisture management properties
  - Wrinkle recovery
  - Range of motion
  - Fabric weight
  - Fiber contents
- Design and develop field wear trials
- Validate and optimize field wear trials
- Evaluate field wear trials performance
Marine Police
Thermal Management System

• **Thermal Uniform**

• Investigate the Marine police officers’ working environment, and their thermal protection requirements on-field.

• Required key properties
  - Keep warm
  - Moisture management
  - Flame resistance
  - Light weight
  - Easy care

• Select the best fabric based on their physical properties and design the uniform.

• Produce prototype garments and evaluate the performance
Impact Resistant Apparel with Tracking System

The Tung Wah Group of Hospital Elderly Care Centers

東網透視：外套識定位？長者失蹤唔使閉翳
Ongoing Projects
Development of Sleeping Thermal Comfort Assessment System for Textile Products (ITP/065/14TP)

- A infrastructure for sleeping comfort textile products develop and assessment
- Collaborate with Shinshu University Japan

Schedule & expected final outcome

**Layer 1 Factual survey**
- Obtaining Hypothesis of Sleeping Comfort Map (Number of dataset = 57 trials)

**Layer 2 Psychological assessment**
- Suggesting of Sleeping Comfort Map (Number of dataset = 110 - 175 trials)

**Layer 3 Physiological assessment**
- Investigation of Sleeping Comfort Map (Number of dataset = 15 trials)
Fabric Impact Assessment
(ITP/104/15TP)

• A tool for designer and products developer managing products risk impact.

Impact Assessment

- Define Scope
- LCA
- Weighting
- Assess Impact
- Interpretation & Scoring

Environmental
- Renewable resource
- Energy
- Greenhouse gas
- Water intensity
- Land intensity
- Physical waste
- Noise
- Odor (VOC)

Human/Social
- Acute hazards
- Carcinogenicity
- Reproductive toxicants
- Economic
- Employment
- Human right
- Child labor
- Culture
- Conflict minerals

Animal Welfare
- Animal ethic
Development of Non-aqueous Solvent Medium (NASM) Dyeing System (ITP/111/15TP)

Conventional wet dyeing

- High volume of wastewater with residual dyes and auxiliaries.
- Lower capital cost, but higher operating cost
- Dyeing, washing and drying require 3-4 hours per batch.

Supercritical CO2 dyeing

- No wastewater.
- Dyes remain as a solid form.
- Higher capital cost, but lower operating cost
- Dyeing, washing is around 1 hour. No drying is required.

A 2 in 1 NASM dyeing system

Garment

Yarn
Four-year Industrial Support from H&M

- Post-consumer textiles recycle technology
- Four-year project sponsorship
- IP owned by HKRITA
- Phase I projects (ITP/103/15TP & ITP/109/15TP) submitted to ITC
- Second phase industrial scale projects under development
Post-consumer Apparel recycling

Physical

Destructive method
Hydrothermal Treatment

Chemical

Non-destructive method
Dissolution

Biological

Enzymatic and fermentative treatment

Project 1: Hydrothermal Treatment and Dissolution Treatment to Recycle PET/Cellulose from the Cotton and PET Blends
--HKRITA (ITP/103/15TP)

Project 2: Textile waste recycling by biological method--
HKRITA & City U (ITP/109/15TP)
Recent Partnerships

Hong Kong Shanghai Hotel Group v 2.0
- Jackets using 2 innovations from HKRITA

CreateHK - PMQ “Sustainable Fashion Show”
- Sept 2016
- 11 designers using 8 innovations from HKRITA
New Partnerships
We are at an Inflection Point

• There is a **Shift** in manufacturing & supply chain

• There are some **Questions** we should be asking **externally**

• There are some things to **Consider** internally
The Shift

From Cost Center to **Competitive Advantage**

From Peripheral to **Core**

From Hierarchical (sequential) to **Peer to Peer** (real time)
The Questions

• What gets Made?

• How is it Made?

• Where will it be Made?

• Who will Make it?
Who is taking care of who?
The New Marketplaces

- E-textiles/clothing
- LED clothing
- Tattoos
- Wrist bands
- Smart shoes
- Eyeglasses
- Earbuds
- Jewelry
- Rings
- Ankle bands
The Questions

• How is it Made?
INTRODUCING
THE SEAMLESS JACKET
Exhibit 2: Zara’s Competitive Economics

Compared to an unnamed but real specialty retailer, Zara (a fashion retailer owned by the Inditex Group) has lower prices and higher production costs. Its advantages: gross margins (light blue areas) that are 55 percent greater and sales of approximately 20 percent more units per square foot.

**Source:** Company financials and Booz Allen Hamilton
Speed and Centralized Decision Making
From Batch Production to Continuous Production...
Apple’s Greater China revenue change, y/y

The tech giant has pushed to expand in the region (which includes Taiwan and Hong Kong)
Oppo Beats Huawei, Apple To Top Smartphone Market In China For The First Time

Fast-rising Chinese smartphone maker Oppo topped China’s smartphone market for the first time last month, according to a recent report by research firm Counterpoint Technology Market Research. Oppo surpasses Huawei, Apple and Xiaomi with a record 22.9% market share as its shares volume jumped 337% annually for the month.
Buick Envision
Cadillac CT6 Plug-in Hybrid
Important priorities for the different types of manufacturing processes and products:

**Capital Intensive Process**
- Invest in process technologies
- Build manufacturing capacities
- Manage suppliers

**Commodity Products**
- Outsource aggressively
- Build scale
- Orchestrate supply chain

**Unique Manufactured Products**
- Invest in brand & marketing
- Manage IP protection
- Improve user interface
- Innovate new products

**Labor Intensive Process**
Things to Think about and Actions to Consider:

- Structural Skill issues within my organization – training & retooling
- Do I have an incentive scheme that rewards long term thinking?
- Decision Making Frameworks- “One Team One Dream”
Things to Think about and Actions to Consider:

• Partnerships & Investments – Who do I believe in? Who do I trust?

• Do I have the capacity to invest in some experiments?

• Where is value being created? Where is innovation happening?
The Questions

• Who will Make it?
| **Born**     | 小林 崇 (Kobayashi Takeru)  
March 15, 1978 (age 38)  
Nagano, Japan |
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<thead>
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<tbody>
<tr>
<td><strong>Other names</strong></td>
<td>&quot;The Tsunami&quot;, &quot;Kobi&quot;, &quot;The Prince&quot; (in Japan) [1]</td>
</tr>
<tr>
<td><strong>Height</strong></td>
<td>5 ft 8 in (173 cm)</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>128 lb (58 kg)</td>
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<tr>
<td><strong>Website</strong></td>
<td>Takeru-Kobayashi.com [2]</td>
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</table>
Born in **Nagano, Japan**, Kobayashi set his first record at his rookie appearance on July 4, 2001, when he ate 50 hot dogs in 12 minutes at the **Nathan's Coney Island Hot Dog Eating Contest**, doubling the previous record of 25. The record was so unexpected that when Kobayashi got to the later numbers, the organizers ran out of signs indicating how many dogs Kobayashi had eaten and had to resort to handwritten signs. Kobayashi would go on to break his own record three times in winning the contest six consecutive times (2001–2006).
Roger Bannister

6 May 1954
3 minutes 59.4 seconds
after 62 years…
6% improvement

3 minutes 43.13 seconds 2016
The Manufacturer of the future...
edwinkeh@hkrita.com

香港紡織及成衣研發中心
The Hong Kong Research Institute of Textiles and Apparel