Research Institute of Advanced Manufacturing Technology (RIAMT)

(What is the Ppuri Technology?)

October 20, 2016
Outline

I. Introduction of KITECH

II. Ppuri Technology

III. Research Institute of Advanced Manufacturing Technology (Research Institute of Ppuri Technology)

IV. Lab. Tour
I. Introduction of KITECH

(Korea Institute of Industrial Technology)
KITECH is
- Government* funded research institute
  (* MSIP: Ministry of Science, ICT and Future Planning / MOTIE: Ministry of Trade, Industry & Energy)

KITECH was founded
- to provide the total supports for SMEs
- to provide technology platforms through Total Engineering Solution Package (TESP)
Mission of KITECH

- Development and Provision of Production Technology for SMEs
- Fostering Regional Industry through Proximity Support
- National Strategic Planning for Industry Development

Role of KITECH

The Universities

Government Supported Research Institute

The Industries


- Technology Transfer & Spread to SMEs
- Technology Support by Utilizing Technology, Manpower and Infra
- Improvement of Common Bottleneck Technologies for SMEs
- Research of Demand-oriented Production Technology

※ SMEs: Small & Medium-sized Enterprises
2 Core Tasks based on the 3 Grand Focused Research Areas

- **Ppuri Production**, **Clean Production System** and **Convergence** Areas’ Source Technology Developments and **Technology support for SMEs**

### Responsibility

**Industrial Technology Development**
- R&D based on Fundamental Manufacturing Technology such as Casting, Molding, Heat Treatment, Surface Treatment & Plating, Plastic Molding, Welding & Bonding
- Integration, Environmental Friendly Conversion, Efficiency Improvement, Automation & Intellectualization of Production System
- Convergence Production Technology Research & Development to Support New Industry Creation

**Technology Support for SMEs**
- Technology Support for SMEs through Local Distributed Technology Support System
- Technology Support for SMEs through Knowledge Based (R&D Based) Technology Support System

### Major Functions

- R&D based on Fundamental Manufacturing Technology such as Casting, Molding, Heat Treatment, Surface Treatment & Plating, Plastic Molding, Welding & Bonding
- Integration, Environmental Friendly Conversion, Efficiency Improvement, Automation & Intellectualization of Production System
- Convergence Production Technology Research & Development to Support New Industry Creation

### Focused Research

- **Ppuri Production Technology**
- **Clean Production System Technology**
- **Convergence Production Technology**

### Goals

- ACE Oriented Technology Development (Automatic, Clean, Easy)
- Environment-Friendly Technology Development
- Efficient Energy Production
- Productivity Enhancement
- Creation of New High Value Added Convergence Industry

※ SMEs: Small & Medium-sized Enterprises
Korea Institute of Industrial Technology

Structure of KITECH
(3 research institutes, 7 regional divisions, 5 national industrial strategic departments)

Research Institute of Advanced Manufacturing Technology
- Advanced Process and Materials R&D Group
- Liquid processing & Casting R&D Group
- Molds & Dies R&D Group
- Metal Forming R&D Group
- Joining R&D Group
- Heat Treatment R&D Group
- Surface R&D Group
- e-Design R&D Group
- Rare Metal R&D Group

PPuri Production Technology

Convergence Production Technology

Research Institute of Industrial Technology Convergence
- Technical Textile & Materials R&D Group
- ICT Textile & Apparel R&D Group
- Robotics R&D Group
- Micro/Nano Scale Manufacturing R&D Group
- IT Converged Process R&D Group
- Human and Culture Convergence R&D Group
- Korea Packaging Center

Research Institute of Sustainable Manufacturing System
- Manufacturing System R&D Group
- Green Process and Materials R&D Group
- IT Convergence Materials R&D Group
- Thermochemical Energy System R&D Group
- Thermal & Fluid System R&D Group
- Advanced Biomedical and Welfare R&D Group
- Smart Manufacturing Technology Group

Regional Division

Seonam Regional Division
- Automotive Components & Materials R&D Group
- Applied Optics & Energy R&D Group
- Green Manufacturing Process R&D Group
- Center for Nano-Photonics Convergence Technology

Ulsan Regional Division
- Green Manufacturing 3Rs R&D Group
- Advanced Manufacturing Process R&D Group

Dongnam Regional Division
- Precision Manufacturing & Control R&D Group
- Energy Plant R&D Group
- Functional Components and Materials R&D Group
- Transport Machine Components R&D Group

Jeonbuk Regional Division
- Convergence Agricultural Machinery R&D Group
- Carbon & Light Materials Application R&D Group

Gangwon Regional Division
- Non-Ferrous Materials and components R&D Group
- Additive Manufacturing Process R&D Group

Jeju Regional Division
- Clean Innovation Technology Center

National Industrial Strategic Department

Korea National Ppuri Industry Center
Korea Institute for Rare Metal

Korea National Cleaner Production Center
Creative Industry & Engineering Center
**International Cooperation Bases**

**EU Region**
- 12 Nations, 59 organizations

**ASIA Region**
- 5 Nations, 46 organizations

**North America Region**
- 2 Nations, 29 organizations

**Central & South America**
- 2 Nations, 6 organizations

**Status of KITECH’s International Collaboration**
- 23 Nations, 141 Organizations, 175 Strategic Alliances
  - (76 R&D Institutes, 39 Universities, 26 Other Organizations)

* MSIP: Ministry of Science, ICT and Future Planning
* MOTIE: Ministry of Trade, Industry and Energy
Total employees: **1,178**
(Including Graduate Students **1,493**)

**Manpower**

- Ph. D holders: **447** (45%)
- Research: **987** (83.8%)
- Administrative work: **191** (16.2%)

**Budget**: **310 million USD** (2015)

**Revenue**
- Projects: **230** (74%)
- Private Contract: **41** (13%)
- Other: **41** (13.2%)

**Expenditures**
- Salaries: **127** (41%)
- Government Project: **142** (46%)
- Operations: **39** (12.8%)
II. ‘Ppuri’ Technology
(Industrial Root)
Our Institute is specialized in Ppuri Technology (뿌리)

What’s Ppuri?

Dictionary Definition

‘Ppuri’ means Root of the plants

Implied Meaning

The Ppuri Technology implies ‘Fundamental Manufacturing Technology’
(Ppuri Tech. = Industrial Root Tech.)
Importance of Production Ppuri Technologies

So, the roll of our institute is focused on strengthening ‘Ppuri Technology’ (Advanced Manufacturing Technology)
Definition of Ppuri Industry

**Definition of Ppuri Industry**

Fundamental industries that manufacture materials into parts, parts into complete products through **six main Ppuri technologies**

**Ppuri tech.**

**Scope**

- **Shaping process**
  - Casting
  - Molds & Dies
  - Plastic working
  - Welding
  - Surface treatment
  - Heat treatment

**Ppuri industries in the national core industries**

**Complete product**

**Parts**

- **Automobile**
  - Engine block
  - Wheel
  - Car body

- **Shipbuilding**
  - Ship body
  - Ship engine

- **Semiconductor, Electronics**
  - Module parts
  - Main board

**Applied Ppuri tech.**

- Engine block: Casting, heat treatment, etc.
- Wheel: Casting, surface treatment, etc.
- Car body: Die & mold, plastic working, welding, etc.
- Ship body: welding, surface treatment, etc.
- Ship engine: Casting, plastic working, etc.
- Module parts: Die & mold, plastic working, etc.
- Main board:
  - Surface treatment, connection, etc.
Importance of Ppuri Technologies  
(E.g.: Car Parts)

<table>
<thead>
<tr>
<th>Business</th>
<th>Casting</th>
<th>Molds &amp; Dies</th>
<th>Plastic working</th>
<th>Welding</th>
<th>Surface treatment</th>
<th>Heat treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of parts</td>
<td>5,400 (22%)</td>
<td>9,450 (38%)</td>
<td>7,650 (31%)</td>
<td>4,050 (16%)</td>
<td>10,350 (41%)</td>
<td>6,975 (28%)</td>
</tr>
</tbody>
</table>

※ ( ) is the no. of parts among the total parts

Car parts: 25,000 units
Portion of Ppuri Ind. per a car: 90% (22,500 units)

Key industry that determines product quality & performance
Technology which cannot be easily imitated by developing countries
Source of high-quality manufacturing industry
Core industry of manufacturing business, a major contributor to accomplishing 1 trillion dollars in trade
Technology Tree for Automobile Production

Automobile

- Engine
  - Power Train
    - Auto Body Parts
      - Tailor Welded Blanks
      - Electric Sub-Assembly
        - Fuel Cell

Six Ppuri Technologies

Surface Treatment

Heat Treatment

Molding

Casting

Welding

Plastic Working

- Abrasion resistance
  - High quality casting
  - Lighting metal welding
  - Plastic forming
  - Multi-Forming molding

- Abrasion resistance coating
  - Life-time heat treatment
  - High strength metal casting
  - Closed forming for plates

- Functional painting
  - Surface hardening
  - Intelligent spot welding
  - High precision bending
  - One-body forming

- Dry vacuum coating
  - Laser spot welding
  - Plate forming simulation
  - TWB forming, press mold

- High-end coating tech.
  - Lead-free soldering
  - Ultra-thin plate forming
  - Extrusion without welding

- Metal separate or coating
  - MEA
  - Stack blazing
  - MEMS
  - BPP/EP forming and molding
# Importance of Ppuri Industry (E.g.: Car Quality)

## J.D. Power* - U.S. Initial Quality Study

※ No. of problems experienced per 100 vehicles within 90 days of ownership

<table>
<thead>
<tr>
<th>Year</th>
<th>Industry Average</th>
<th>Porsche</th>
<th>Kia</th>
<th>Jaguar</th>
<th>Hyundai</th>
<th>Infiniti</th>
<th>BMW</th>
<th>Chevrolet</th>
<th>Lincoln</th>
<th>Lexus</th>
<th>Toyota</th>
<th>Buick</th>
<th>Ford</th>
<th>Ram</th>
<th>Honda</th>
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<td>2015</td>
<td>119</td>
<td>80</td>
<td>86</td>
<td>93</td>
<td>99</td>
<td>101</td>
<td>103</td>
<td>104</td>
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<td>111</td>
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<tr>
<td>2016</td>
<td>120</td>
<td>83</td>
<td>84</td>
<td>92</td>
<td>93</td>
<td>94</td>
<td>95</td>
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<th>Industry avg.</th>
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<td>104</td>
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</tbody>
</table>

* J.D.Power: American-based global marketing information services firm founded in 1968
# Importance of Ppuri Industry (E.g.: Smartphone production)

<table>
<thead>
<tr>
<th>Type</th>
<th>Molds &amp; Dies</th>
<th>Plastic working</th>
<th>Welding / Joining</th>
<th>Surface treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of parts</td>
<td>156 (20%)</td>
<td>19 (2%)</td>
<td>50 (6%)</td>
<td>91 (11%)</td>
</tr>
</tbody>
</table>

Smartphone parts: 800 units  
Weight of Ppuri Ind. per smartphone: 30% (240 units)

※ ( ) is the no. of parts among the total no. of parts  
A part is produced after going through several ppuri technology processes

Smartphone parts: 800 units  
Weight of Ppuri Ind. per smartphone: 30% (240 units)
Technology Tree for Smart Phone Production

Smart Phone
- Main Board
  - PCB
  - Pb-free
  - Flip chip/SIP
  - Progressive mold
  - High-precision circuit forming
  - BGA
  - Heat treatment for molds
  - Lead-frame
- Module Parts
  - Functional surface coating
  - FPCB
  - ACF/NCP
  - Under filling
  - BLU molding die
  - Micro patterning
  - Micro cup mold
  - ATO coating
- LCD/LED
- Keypad
  - Hard coating for lens
  - Au bumping
  - ACF/NCP
  - Lens mold
  - High precision molding
  - Lens machining
- Camera Module
- Battery
- Wire/flip chip bonding
- Sealing
- Insert molding
- Narrow pitch connector
- Micro forming, MEMS
- Anti-corrosion heat treatment
- High-precision casting
- Lead-free soldering
- Adhesive welding
- Thin foil forming
- Molding
- Controlled pressing
- Surface hardening for plates
- Functional coating
- Eco-friendly surface coating
- Pb-free mounting
- Housing
- High precision pressing
- Case forming
- Nano particles synthesis

Six Ppuri Technologies
- Surface Treatment
- Heat Treatment
- Molding
- Casting
- Welding
- Plastic Working
Global Smartphone Market Share

Source: Counterpoint Research Q3 2014

- **Samsung**, 23.8%
- **LG**, 5.1%
- **Apple**, 11.9%
- **Huawei**, 5.1%
- **Lenovo**, 5.0%
- **Xiaomi**, 5.5%
- **MS**, 4.4%

Korean Companies’ Market Share: **28.9%**
Technology Tree for Ship & Off-Shore Plant Production

Six Ppuri Technologies

Surface Treatment

Heat Treatment

Molding

Casting

Welding

Plastic Working

- Sand casting for monster engine parts
- Metal forming for large parts
- Heat treatment of crankshafts & gears for longer lifetime

- Big block propeller casting
- Automation of rudder blade welding
- Spray coating for enhanced corrosion-resistant

- Painting with high corrosion-resistant
- Advanced technologies of surface cleaning and painting
- Welding technologies covering a wide range of sizes
- Casting and Forming technology for large parts in mooring/towing/loading

- Forming technologies for composite and lightweight materials
- Dissimilar Materials Joining
- High-gross & high-quality Painting

- Molding technologies for large Al parts with variable curvatures
- Forming of structural parts for LNG storage tank
- Welding of high tensile low-temperature materials
- Welding of pipelines and related facilities
- Surface treatment technologies for enhanced sour-resistant
- Oxynitride coating by heat treatment for enhanced corrosion-resistant

Ship & Off-Shore Plant

Parts of Ship Engine

Steering & Propelling Parts

Assembly & Painting

Leisure boats

Equipment for Off-Shore Plants
Global Shipbuilding Industry Market Share

China: 34.0%
Japan: 11.0%
Others: 9.6%
Korean Companies’ Market Share: 45.4%

Total market share estimated by CGT*
(Source: Financial News, January 2014)
* Compensated Gross Tonnage
Ⅲ. Research Institute of Advanced Manufacturing Technology (Research Institute of Ppuri Technology)
Features

The Hub for Technology Development & Support to Ppuri Industry

- A national hub for ppuri technology
  - Technical supports covering all local areas

- Development of future technology
  - Creation of new growth engines and industries

- Development of commercialization technology
  - Increase in employment and revenue of SMEs

- Building networks related to academies and industries
  - Sharing technical infrastructures

- Human resource training
  - Training manpower of industrial technology

- Growth of global companies
  - Nurturing global hidden champion

- Reliability improvement of technology
  - Failure analysis and test evaluation

Research Institute of Advanced Manufacturing Technology

KITECH
Research Institute of Advanced Manufacturing Technology

Overall Status

Executive Managing Director of Research Institute of Advanced Manufacturing Technology

Region Advanced Manufacturing Technology Agency

Region Advanced Manufacturing Strategy Office

Budget

<table>
<thead>
<tr>
<th>Category</th>
<th>Independent Research</th>
<th>Government Project</th>
<th>Private Contract</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Budget (Million USD)</strong></td>
<td>19.6 (21.8%)</td>
<td>62.7 (69.8%)</td>
<td>7.5 (8.4%)</td>
<td>89.8 (100%)</td>
</tr>
<tr>
<td><strong>Number of Projects</strong></td>
<td>82 (22.4%)</td>
<td>213 (58.2%)</td>
<td>71 (19.4%)</td>
<td>366 (100%)</td>
</tr>
</tbody>
</table>
### Department Structure

<table>
<thead>
<tr>
<th>Department</th>
<th>Main mission</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Research Institute of Advanced Manufacturing Technology</strong></td>
<td></td>
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</tbody>
</table>
| **Region Advanced Manufacturing Technology Agency** | Control tower for 10 Region Advanced Manufacturing Technology Support Centers (Siheung, Jinju, Gimje, Gwangju, Goryeong, Busan, Ulsan, Daegu, Suncheon, Wonju)  
Efficient support of the integrated management system to regional branches |
| **Region Advanced Manufacturing Strategy Office** | R&D business management for Region Advanced Manufacturing Technology Agency  
Management support for Cyber Advanced Manufacturing Technology Support Center |
| **Liquid processing & Casting R&D Group** | Development of high value-added cast iron and multi-purpose nonferrous metals  
Establishing a casting technology center and upgrading eco-friendly casting complex |
| **Molds & Dies R&D Group** | Operation of Molds & Dies R&D Center, Optimization of design, production, and molding/forming processes  
Development of high-precision mold & dies for vehicles and IT components, and 3DP application tech. |
| **Metal Forming R&D Group** | Fundamental forming tech. development with low-cost and high efficiency for sustainable growth  
Development of enhanced ICT convergence-complex digital forming technology |
| **Joining R&D Group** | IT based welding technology, electronic packaging technology, solder/adhesive material technology.  
Microjoining center, support for reliability assessment on SMT and solder joint |
| **Heat Treatment R&D Group** | Stat-of-the-art heat treatment equipment, development of coating with multifunctional nanotechnology  
Support centers for ppuri tech., close technical support, business incubator and CHAMP biz incubator |
| **Surface R&D Group** | Innovation of traditional surface tech. and fusing with IT for the jump of surface treatment industry  
Technical supports of failure analysis and process diagnosis using materials & surface analysis center |
| **e-Design R&D Group** | Ubiquitous internet simulation design and prototype manufacturing support center  
Smart factory for the future, proceeding manufacturing innovation 3.0, ICT convergence support |
| **Advanced-Functional Materials R&D Group** | Development of fusion process and innovation of ppuri technology by integrating new materials  
Exploration of ppuri technology for climate change and future industry through fusion technology |
| **Rare Metal R&D Group** | Development of ppuri industry materials, rare metals, ECO-Mg/ ECO-Al and emotional materials  
Korea Institute for Rare Metal(KIRAM), Emotional material component commercialization center |
| **Project Support Office** | R&D project management for Research Institute of Advanced Manufacturing Technology  
Research environment and lab safety management provision and health support |
Comprehensive Support System Covering All Area of Korea

10 Regional Centers
(Siheung, Jinju, Gimjae, Gwangju, Goryeong, Busan, Ulsan, Daegu, Suncheon, Wonju)

Siheung Center
- Heat treatment
- Surface treatment
- Sihwa & Banwol Industrial Complex

Gimjae Center
- Special casting
- Special forging
- Gimjae Horizon Industrial Complex

Gwangju Center
- Welding automation solution
- Gwangju Hightech Industrial Complex

Suncheon Center
- Surface treatment
- Plastic working
- Haeryong Industrial Complex

Research Institute of Advanced Manufacturing Technology

Wonju Center
- Dongwha Indu. Complex
- Bio mold

Daegu Center
- Plastic working
- Daegu Technopolis

Goryeong Center
- Cast iron/ Cast steel
- Dasan Cast Complex

Ulsan Center
- Welding
- Die casting
- Ulsan Techno Industrial Complex

Busan Center
- High-tech surface treatment
- Mieum Industrial Complex

Jinju Center
- Ultra-precision forming
- Jeongchon Industrial Complex

Gangwon Regional Division

Research Institute of Advanced Manufacturing Technology

Seonam Regional Division

Daegyeong Regional Division
Vision of SME: ACE Ppuri Industry

**3D Industry**

- Dangerous
- Dirty
- Difficult

**ACE Industry**

- Automatic
  - System Integration
  - Robotic Engineering
  - Quality Resource Planning

- Clean
  - Emission-free Process
  - Encapsulated Process

- Easy
  - Energy Efficiency
  - Simplified Process

• SMEs: Small & Medium-sized Enterprises
Application of Ppuri Technology for Emerging Market

Core Concept of New Technology
- Advanced joining bonding
- Energy mass transfer
- High temperature properties
- Light weight component
- Smart multi-function
- Ultimate physical properties

Ppuri Technology
- Casting
- Molding
- Welding
- Machining & plastic working
- Surface modification
- Heat treatment

Creation of Emerging Market
- High value-added automobile industry
- Energy industry
- National security industry
- Bio-industry
- Extreme environmental industry
- Photovoltaic industry
Ⅳ. Lab. Tour
Research Institute of Advanced Manufacturing Technology

- Micro-joining Center (2F)
- Material Testing Center (1F)
- Materials Analysis Center (1F)
- Heat Treatment & Plating Technology Center (1F)
- Fundamental Analysis Center (2F)
- Common Experiment Lab. (2F)
- Engineering Design Center (1F)
- Chemical Analysis Lab. (1F)
Research on Energy Efficient & Precision Manufacturing Technologies in Molding/Forming, Heat-treatment and Welding/Joining Industries

Development of Prototype Manufacturing Process by Solid-State Controlling Technology, Distribution to Small and Medium-sized enterprises for Industrialization
Evaluation and Testing of Mechanical properties, Physical properties, Workability of new material, trial component and product of small and medium-sized enterprises

Quality assurance of the products of small and medium-sized enterprises and Reliability assessment of developed components and materials (ISO17025 accredited)
Micro-Joining Center
(P.P.#1 / 2nd floor)

- High precision SMT (Surface Mount Technology), PCB (Printed Circuit Board), FPD (Flat Panel Display), Mechanical/Electrical assembling/Joining Technology
- Development and reliability assessment of frontier technology on high precision and high value-added flexible joining processes
Eco-friendly and high value-added manufacturing technology on casting, Fusion process, Engineering design, rare metals industries

Development of Prototype manufacturing process by liquid state controlling technology and Distribution to Small and Medium-sized enterprises for Industrialization
Fundamental Analysis Center
(P.P.#2 / 2nd floor)

- Microstructural characterization (Microscopy, Image analyzer), Thermal analyzers (DSC, DTA, DMA, etc.), Pre-treatment of specimen (polishing, etching, etc.)
- Fundamental Metallurgical analyses and Pre-treatment for precision analyses
High vacuum induction melting, arc melting, precision heat-treatment (vacuum quenching, isothermal), uni-directional solidification etc.

Lab. scale new alloy and process design by using equilibrium and non-equilibrium transformation behaviors
Industrial X-ray Computed Tomography, Rapid prototyping, casting and mold design of trial component, prediction of properties and defects

IT-based heat and fluid analyses, supporting development of trial components in small and medium-sized enterprises by prediction of properties and defects
Chemical Analysis Laboratory
(P.P.#2 / 1st floor)

- Instrument analyses of chemical substance, wet chemical analyses, tracer analyses, precision analyses of hazardous substances and rare metals
- Precision analyses and reliability assessment of chemical components of new materials and trial parts (ISO17025 accredited)
High value-added printed circuit board (PCB), patterning, Eco-friendly Plating, surface treating, thin film process, high density/wide surface modification

Development of high value-added functional surface treating processes and Evaluation of electrochemical characteristics
Nano-machining of micro components, qualitative surface analysis, precision analyses of grain growth/texture, atomic scale surface analyses, etc.

Precision instrument analyses of surface structure, trace elements, electrochemical characteristics of materials and trial parts