The Leading Program for Innovation of Manufacturing in Japan

- The project outline of "SIP: Innovative Design/Manufacturing Technologies" -

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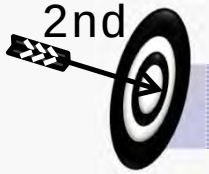
Outline of Presentation

1. Policy tools for innovation
2. Outline of SIP: Innovative Design/Manufacturing Technologies
3. Abstracts of R&D themes (Excerpts)
4. Closing Remarks

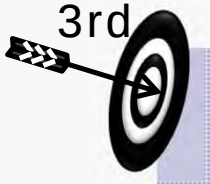
Japan Revitalization Strategy
– Japan is back -

Three Arrows of the Economic Policies

Bold Monetary Policy



Flexible Fiscal Policy



Japan Revitalization Strategy
New Growth Strategy

Cabinet decision on June 14, 2013

Closely linked with …

Prime Minister, Shinzo Abe

Three Action Plans

Ⅰ. Plan for the Revitalization of Japanese Industry

Ⅱ. Strategic Market Creation Plan

Ⅲ. Strategy of Global Outreach

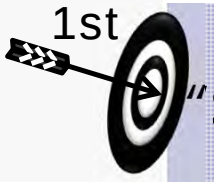
“Comprehensive STI Strategy” (Original, June 2013)

- ✓ Achievement of Council for Science, Technology and Innovation (CSTI)
- ✓ Cabinet decision on June 7th, 2013
- ✓ “Comprehensive STI Strategy 2014” was formulated on June 24th, 2014

HQ for Science and Technology to foster innovation
- CSTI: Council for Science, Technology and Innovation -

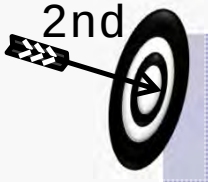
➢ ***Promoting effective measures across ministries to create innovation beyond the borders of disciplines, ministries and sectors***

Three Arrows of Reinforcement of the HQ



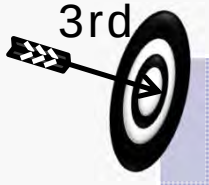
Improvement of the process for policy-making
"S&T Budgeting Strategy Committee" and "Action Plans for S&T Priority Measures"

- *Prioritized area: "Energy", "Next-generation infrastructures", "Local resources", "Health & Medical"*
- *Budget for FY2015: ¥296B*



SIP (Cross-Ministerial Strategic Innovation Promotion Program)

- *Budget for FY2015: ¥50B (FY2014: ¥50B)*



ImPACT (Impulsing PAradigm Change through disruptive Technologies)

- *Budget for FY2014-2018: ¥55B*

SIP（Cross-Ministerial Strategic Innovation Promotion Program）

Prioritized Societal Issues	Themes
Energy	Innovative combustion technology
	Next-generation power electronics
	Structural Materials for Innovation (SM^4I)
	Energy carrier
	Next-generation Technology for Ocean Resources Exploration
Next-Generation Infrastructures	Automated driving system
	Infrastructure maintenance, renovation and management
	Enhancement of societal resiliency against natural disasters
Local Resources	Technologies for creating next-generation agriculture, forestry and fisheries
	Innovative design/manufacturing technologies

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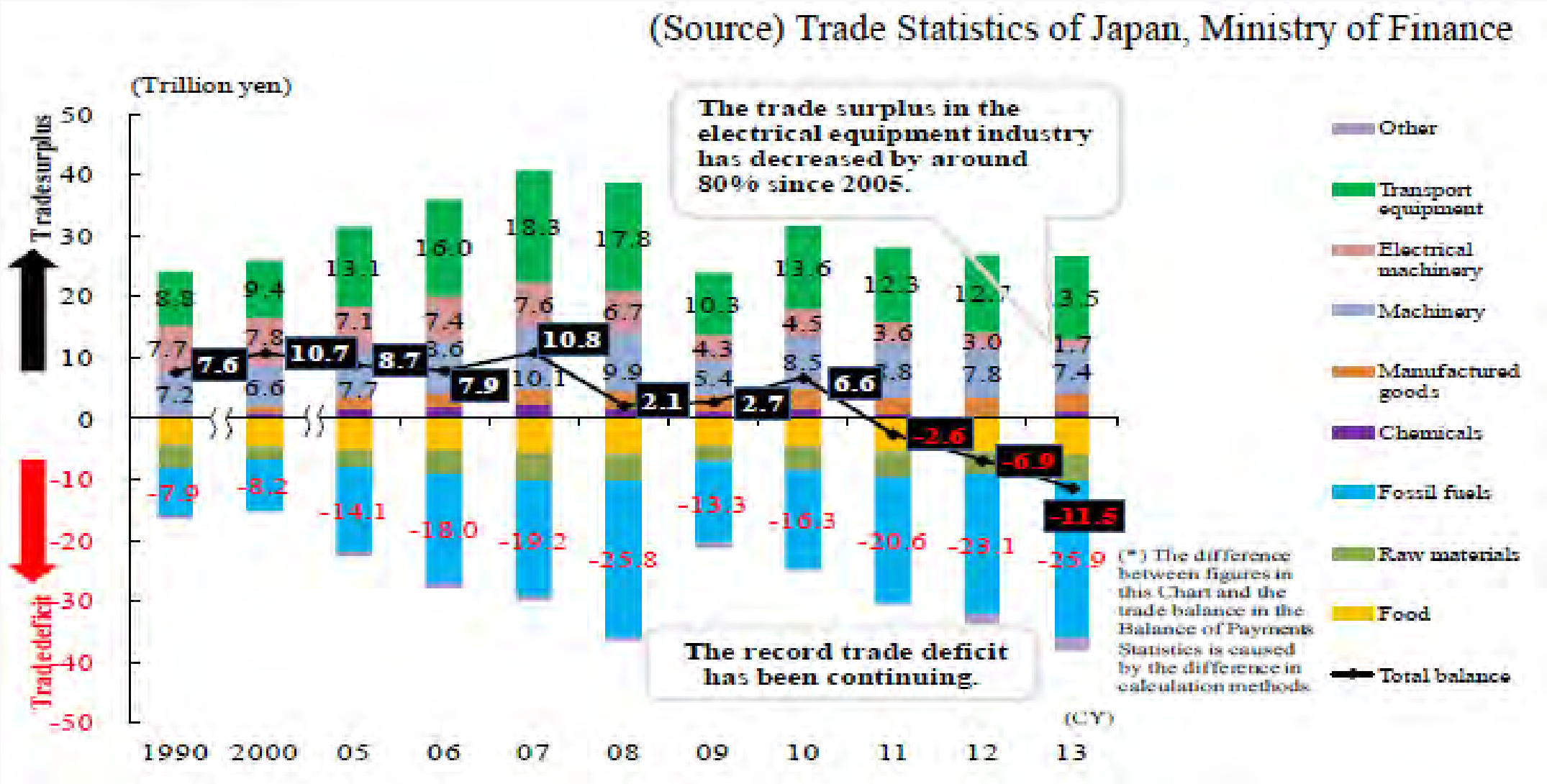
Shrinkage of Trade Surplus in Manufacturing Industry



Challenges for Manufacturing Industry of Japan

Business Environment		Challenges Needed
High ratio of imported fossil fuel in the energy supply	→	Economizing energy in products and production processes
Decreasing birthrate & increasing aging population	→	Securing human resources and enhancing productivities
Progress of ICT and manufacturing technologies	→	Rapid and flexible production reflecting consumer's diversified requirements
Globalization, necessity of international cooperation	→	Contribution by utilizing the strength of technologies of Japan (including SMEs in local economy)

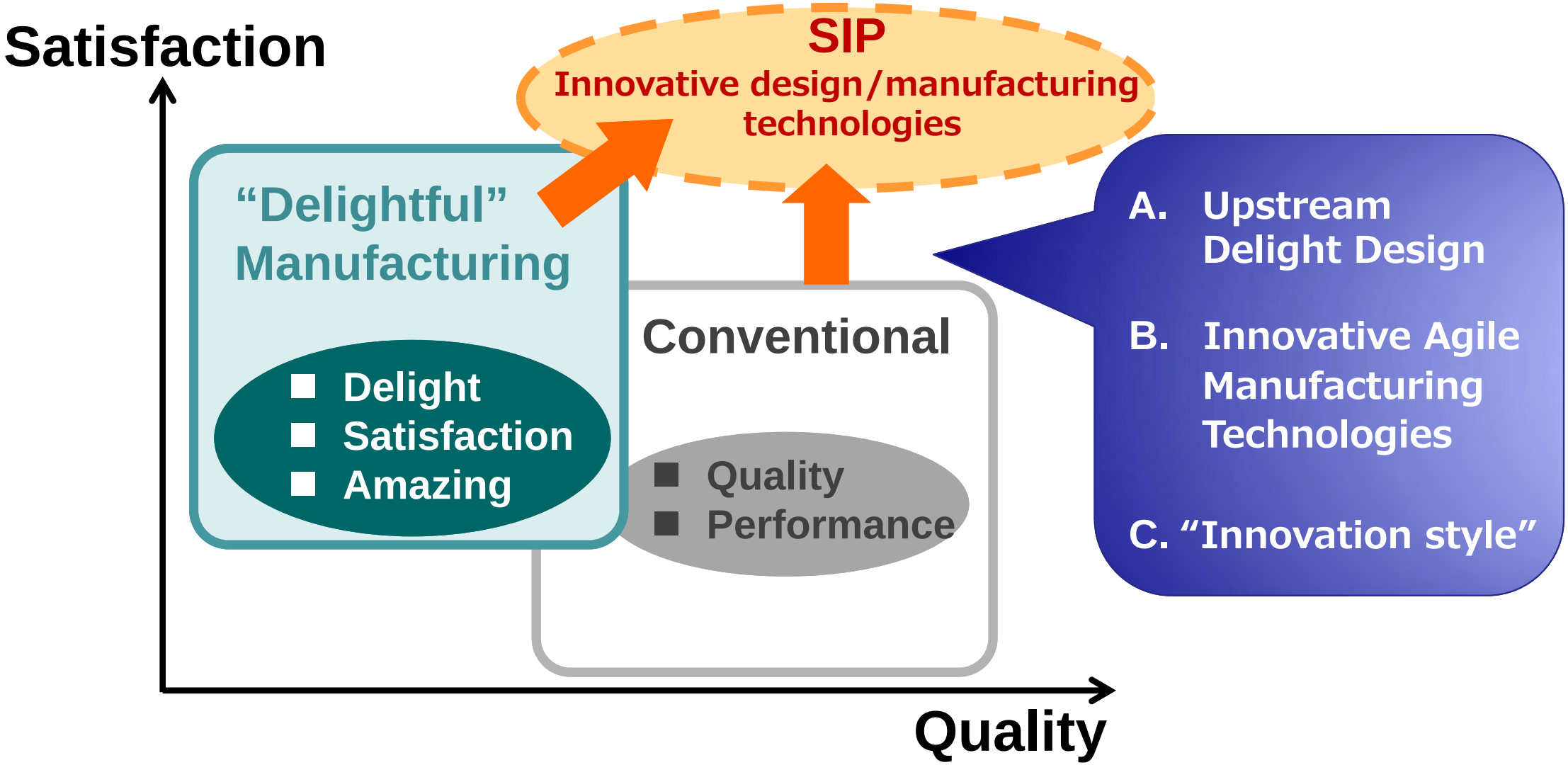
SIP - Innovative Design/Manufacturing Technologies -

Objectives of the Project

- To enhance the competitiveness of manufacturing industry by establishing **advanced design systems and novel manufacturing technologies** on the open innovation platform
- To create new markets through innovation in regions by rolling out the new **"innovation styles"** utilizing innovative design/manufacturing technologies and ideas and know-how of regional manufacturers or citizens

Budget for the program	¥2.55B for FY2015 (¥2.55B for FY2014)
Duration of the program	FY2014-2018 / 5 years (planned)
Program management agency (Funding agency)	New Energy and Industrial Technology Development Organization (NEDO) http://www.nedo.go.jp/english/index.html

Target Outputs



What's "delight" ? :

The products give users the great pleasure or satisfaction

A: Upstream Delightful Design

New design method which can predict and evaluate the product value at the very early stage of designing process, and can reflect diversity of product value

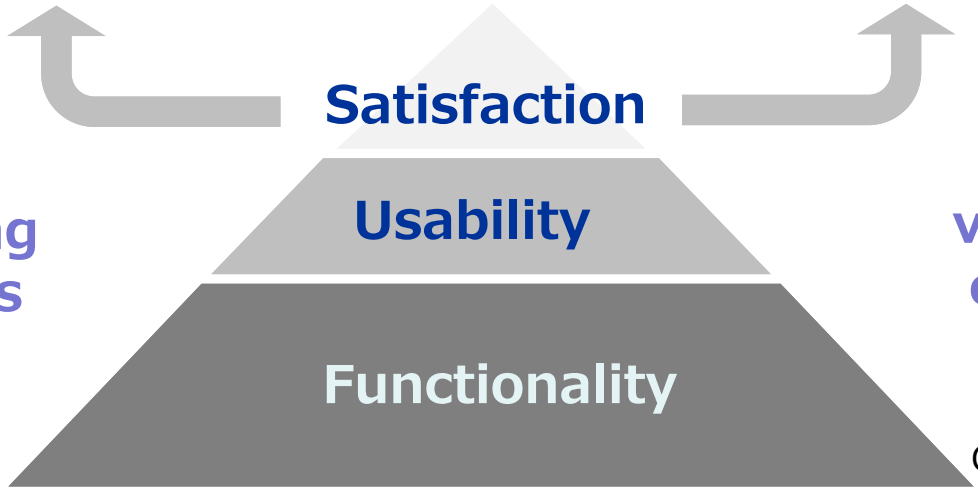
→ **Exceeding the functional design reflecting primary customer's needs, values, and performance, and bring delight (quality for pleasure, satisfactory, etc.) to users**

Personalized

(Eg. Electric appliances)
- New & attractive value indices
  - Sound: minimized → Comfortable
  - Design: Functional → Stylish
  - Spec: Maximized → Stable
- New concept appliances

Industrial

- Customized functions (specifications & costs)
  - →Combination of products & services
  - →Solution services
- New features to solve customer issues
- Systemized products and services



Providing new values exceeding customer needs

Providing new values exceeding customer needs

Customer needs model

B: Innovative Agile Manufacturing Technologies

Innovative agile manufacturing technology which can transform idea and design to products with rapidity

● Manufacturing which has not been practical by now

- Technology to generate high value-added product of high strength, long life, etc. using processing resistant material, composite material and advanced material (Ceramics, Gel, Rubber, etc.)
- New processing technique to dramatically improve functions and performance of conventional processing technique

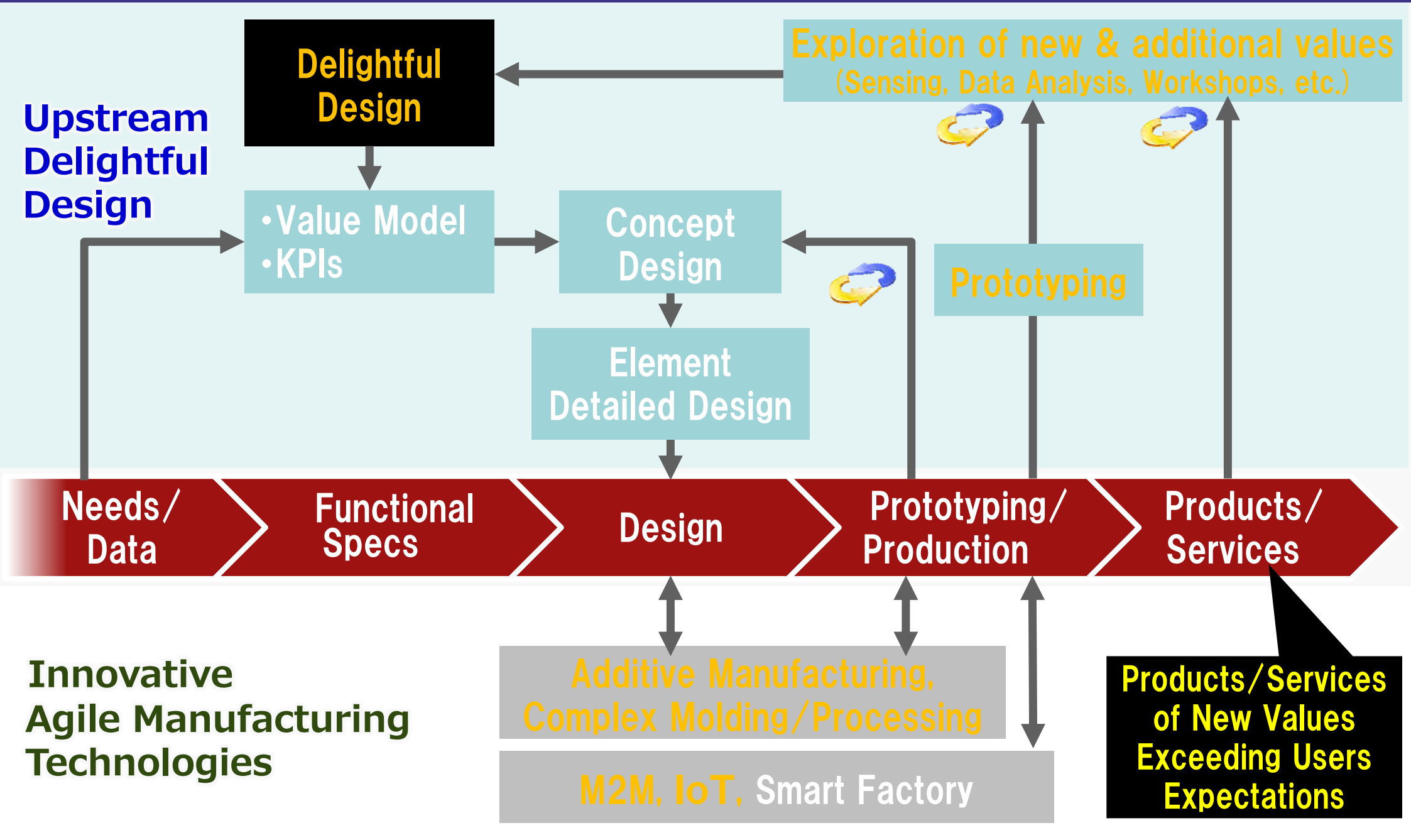
● Combination of technologies creating new values

- To generate products of non-conventional functions or shape, combination and systematization of new technique and existing processing technique
- Research on phenomena of complicated machining

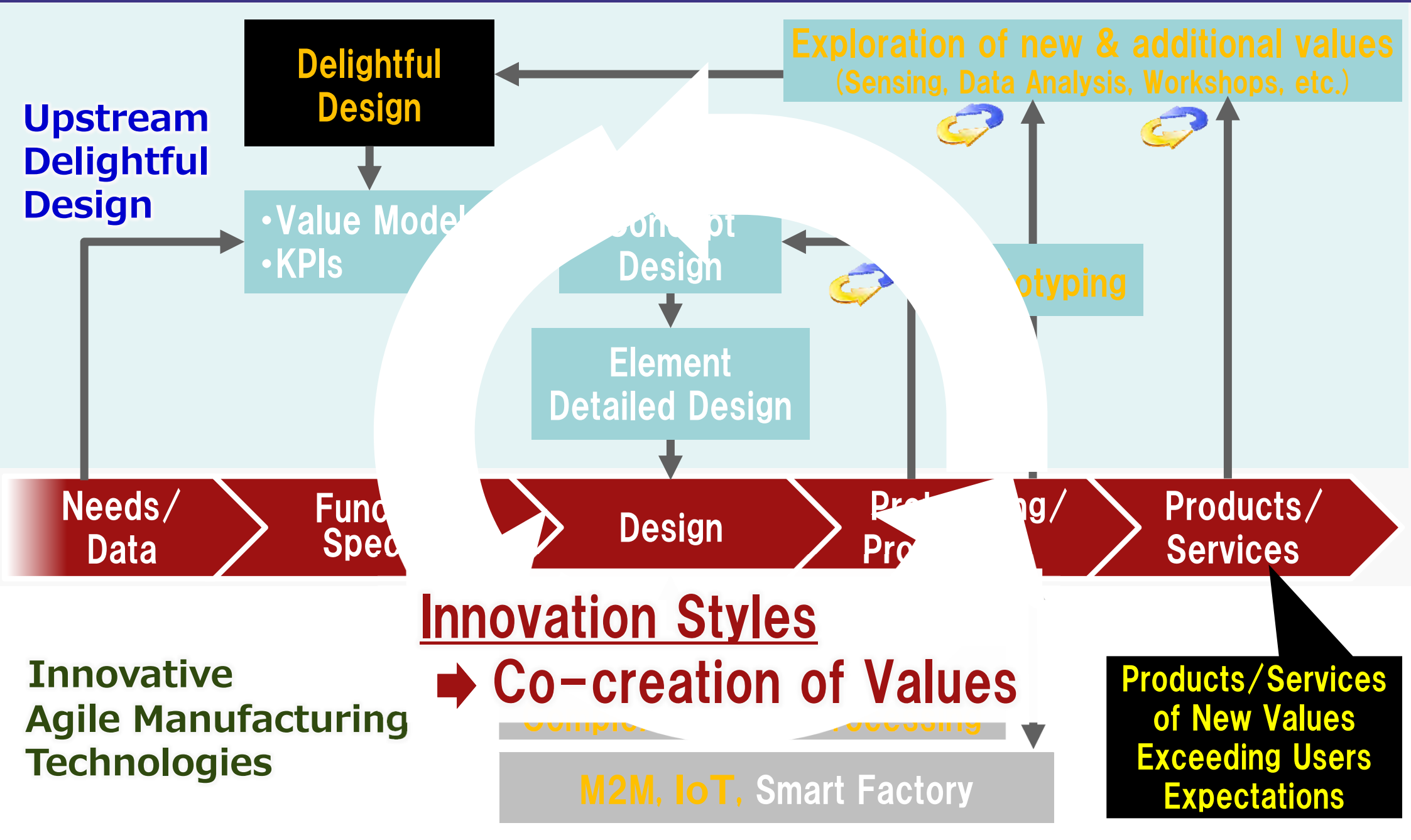
● Minimizing time and costs for R&D and production

- Technology of manufacturing which embody new values, concept design and users' needs with rapidity by fully utilizing IT (IoT, M2M, Smart Factory)
- Manufacturing and prototyping system to minimize dramatically time and cost of manufacturing process (ex. not to require die & mold)

Collaboration between Delight Design & Manufacturing

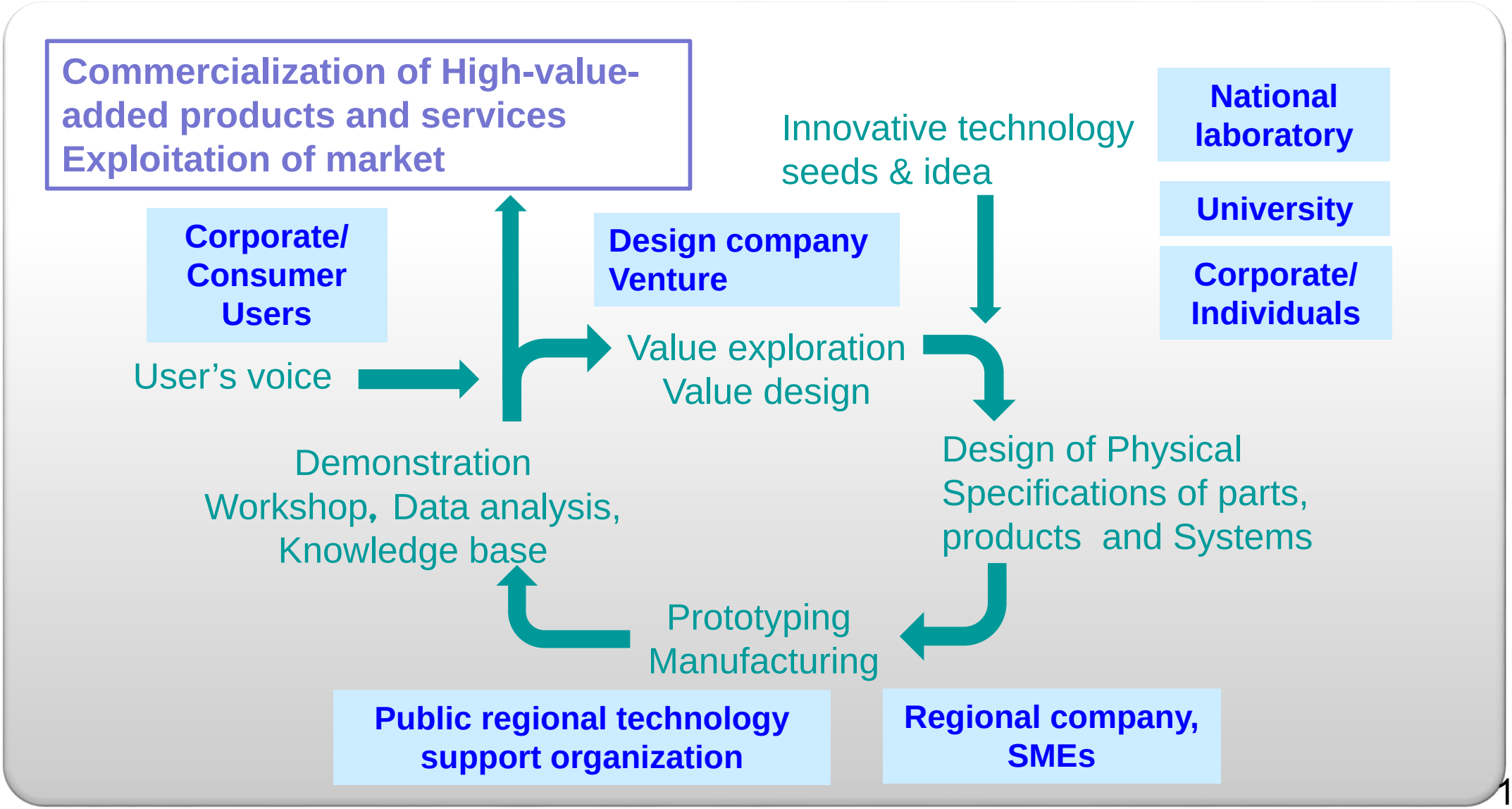


Collaboration between Delight Design & Manufacturing



C: “Innovation Styles”

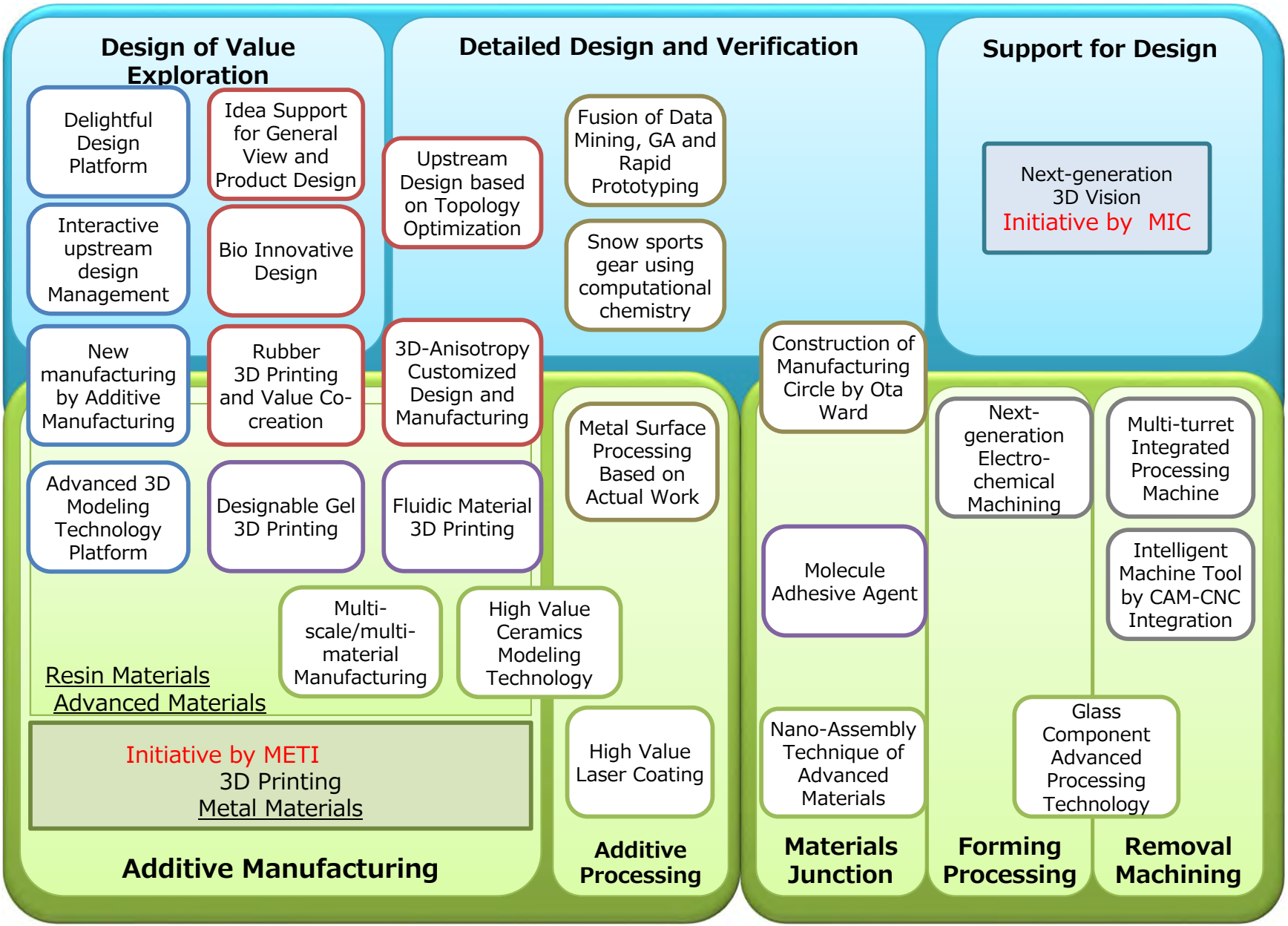
Collaboration between design and manufacturing + **Various groups of players** = **Co-creation of values**



R&D Themes - Technology Area – Adopted in 2014

Upstream Delight Design

Innovative Agile manufacturing



R&D Themes Review (1/2)

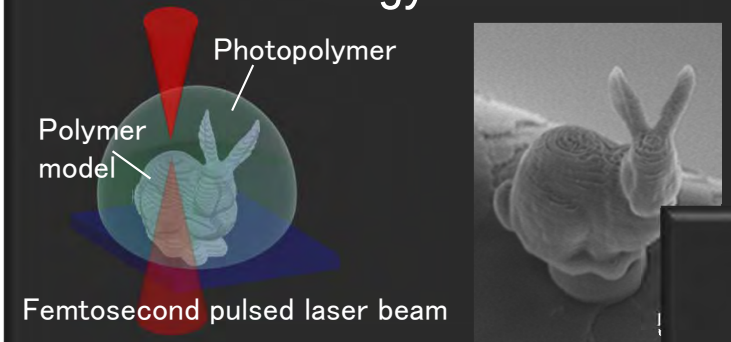
R&D Clusters	R&D Themes	Abstract
Optimized Design/ Manufacturing	Idea Support for General View and Product Design	Develop an integrated framework to manage various data to design products, analytic tools to extract data by various methods, and useful display technology to visualize information.
	Upstream Design based on Topology Optimization	Construct conceptual design methods for macro/micro structures using topology optimization, and develop manufacturing techniques for devices based on the obtained design solutions. Additionally, to fabricate practical devices using the developed manufacturing techniques.
	Bio Innovative Design	Biology that has the adaptability and robustness in nature is very attractive to design, but the design is rarely used in mechanical design. In this project, a new design technology called “Bio Innovative Design Technology” is developed.
	3D-Anisotropy Customized Design and Manufacturing	Realizing a continuous streamlined production model from design and rapid making to trial use, delight assessment, after-sales service and feedback, with “Anisotropy” and “Customization” as super upstream design concepts.
	Rubber 3D Printing and Value Co-creation	For integrated molding of shoes sole, novel 3D printer technology will be studied, e.g. using micro reaction field through two-liquid type ink jet nozzle or micro extruder, both of which require research of new rubber formulation.
Upstream Delightful Design/ Manufacturing	Advanced 3D Modeling Technology Platform	Development of super 3D fabrication platform and production of high value-added products using stereolithography, which is 3D modeling at the resolution ranging from sub-μm to sub-mm
	Delightful Design Platform	It is crucial to produce products with Attractive Quality in the future industry. Conventional design tools like CAD systems lack functionalities to support the design of such products (Delight Design). The main objective is to develop a “Delight Design Platform” which consists of tools and methodologies to achieve the above mentioned support for Delight Design.
	Interactive upstream design Management	Design communication tool sets “design brain mapping” with multi-layer/multi-scale/time shifting functions based on test use at consortium for design effectiveness, which is a sensing tool for design process in the companies.
	New manufacturing by Additive Manufacturing	・Thorough understanding of phenomena in powder melting and consolidation using laser and process development ・Design methodology development of high style sports prosthesis
Innovative Materials and 3D Molding	Molecule Adhesive Agent	Research development on the implementation as follow:1.Clarifying the utilization range through the experiments, 2.Development of materials with adhesion and processing properties, 3.Advancement of adhesion surfaces and 4.Practical application of new functional products
	Designable Gel 3D Printing	Based on the world-first 3D gel printing technology, we aim to develop 3D gel printing system to realize free-shape design of soft and wet materials.
	Fluidic Material 3D Printing	In this research and development, 1)To achieve nano-materials of ceramic hybrid functional materials, and to develop highly concentrated and highly functional inks (fluidic materials) 2)To develop 3D additive manufacturing by ink-jet

R&D Themes Review (2/2)

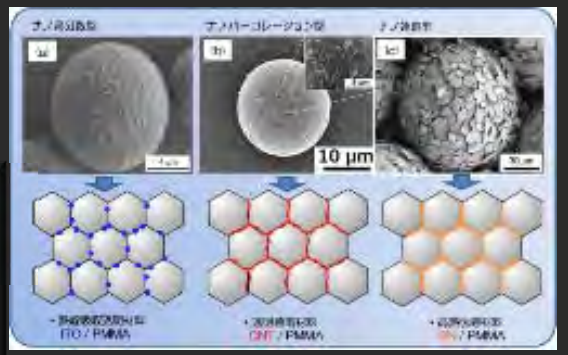
R&D Clusters	R&D Themes	Abstract
Innovative Complex Molding	Nano-Assembly Technique of Advanced Materials	To overcome difficulties in the conventional powder metallurgy process Development of Functional Powder and Advanced Composite Materials for Potential Use.
	Multi-scale/multi-material Manufacturing	Requirement of 3D printing technology to multi-scale and multi materials Innovation manufacturing of multi-scale and multi materials for seamless composites
	High Value Ceramics Modeling Technology	1) Ceramic powder/slurry layer manufacturing for complex-shaped/hollow- structured products. Ceramic laser sintering which realizes concurrent forming and sintering. 2)Hybrid aerosol deposition (AD) and ultrafine-particle thermal spraying for highly adhesive coating onto 3D surfaces, enhancing design freedom and product functions.
	High Value Laser Coating	The layers composed of high functional and processing-resistant materials and the high added value to overthrows the concept of manufacturing can be realized by the laser coating methods, which contributes the delight design-based manufacturing including user needs such as lightness, thinness, inexpensiveness, saving energy and long life time.
	Glass Component Advanced Processing Technology	In this research theme, we improve speed, precision and area of glass process drastically by elucidating a complicated phenomenon to occur at the time of glass processing.
Combined and Intelligent Machining Technology	Intelligent Machine Tool by CAM-CNC Integration	A new methodology to generate instruction commands for prompt machine control instead of preparing NC programs is developed to realize an innovative intelligent machine tool.
	Next-generation Electro-chemical Machining	Utilizing nanometer order removal unit with high efficiency, machining of cemented carbide and inconel with higher material removal rate and machining accuracy by 40% than conventional ECM, and surface roughness of Ra30nm will be achieved.
	Multi-turret Integrated Processing Machine	Necessity of turning-milling machine tools which are easy usage for high accuracy and high efficiency. In this research, 1)Development of technologies for optimum process planning, 2)Development intelligent machining technology for high accuracy and efficiency, 3)Verification experiment of intelligent machining system for a multi-turret turning-milling machine tool.
Field-Oriented R&D	Fusion of Data Mining, GA and Rapid Prototyping	Establish a streamlined process of SHISAKU(trial manufacture) business with Knowledge-intensive production and activation by Innovative Industry.
	Snow sports gear using computational chemistry	Based on advanced measurement technique and simulation, we develop snow sports gear (snowboard, chair sky, wax etc.) for the Olympics and Paralympics.
	Metal Surface Processing Based on Actual Work	Metal processing technology originated in manufacturers' craftsperson will be sophisticated by polishing up with cutting-edge sciences.
	Construction of Manufacturing Circle by Ota Ward	Sustainable and evolutionary system for developing innovative products, combined with marketing, business start-up and human resource development

R&D Themes Examples

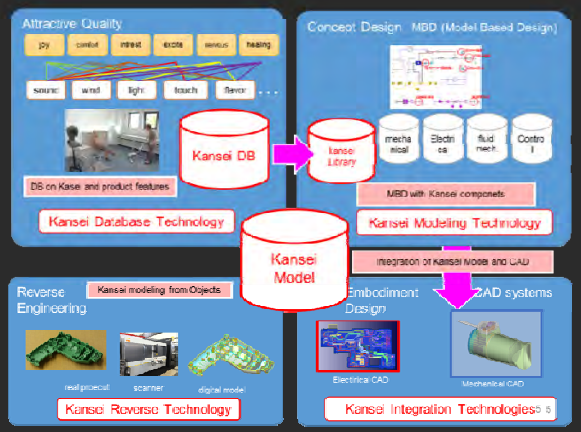
Advanced 3D Modeling Technology Platform



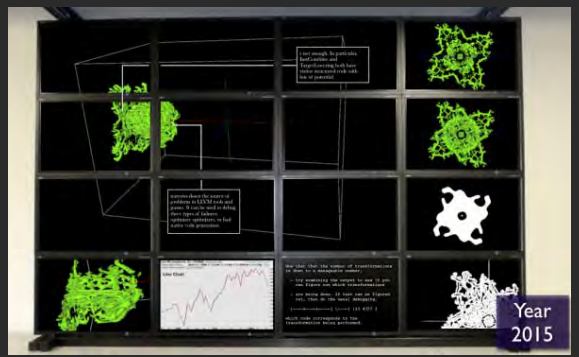
Nano-Assembly Technique of Advanced Materials



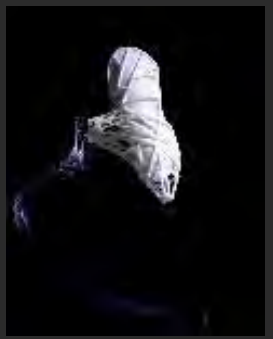
Delightful Design Platform



Intelligence-based workspace optimize design process



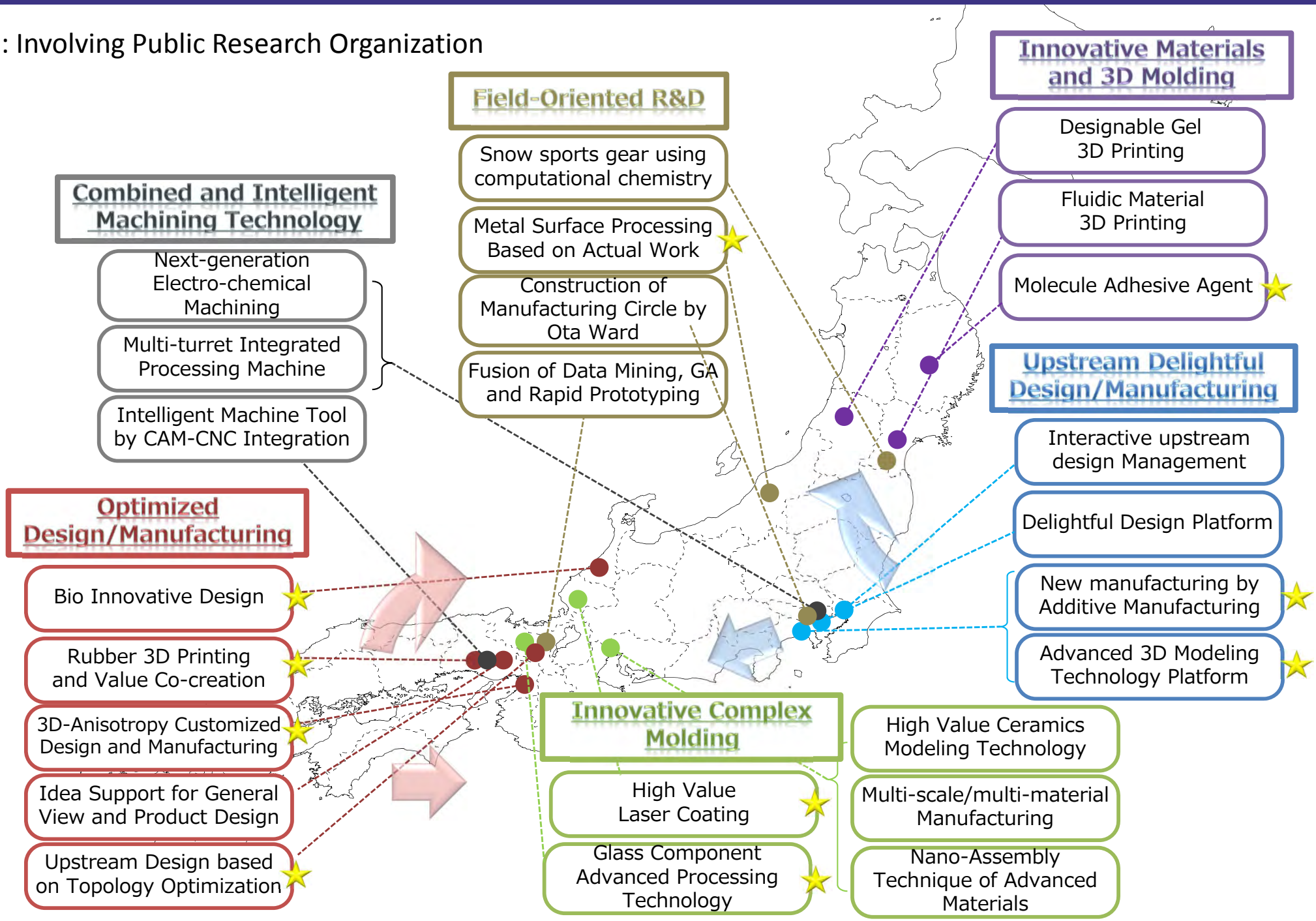
Additive Manufacturing



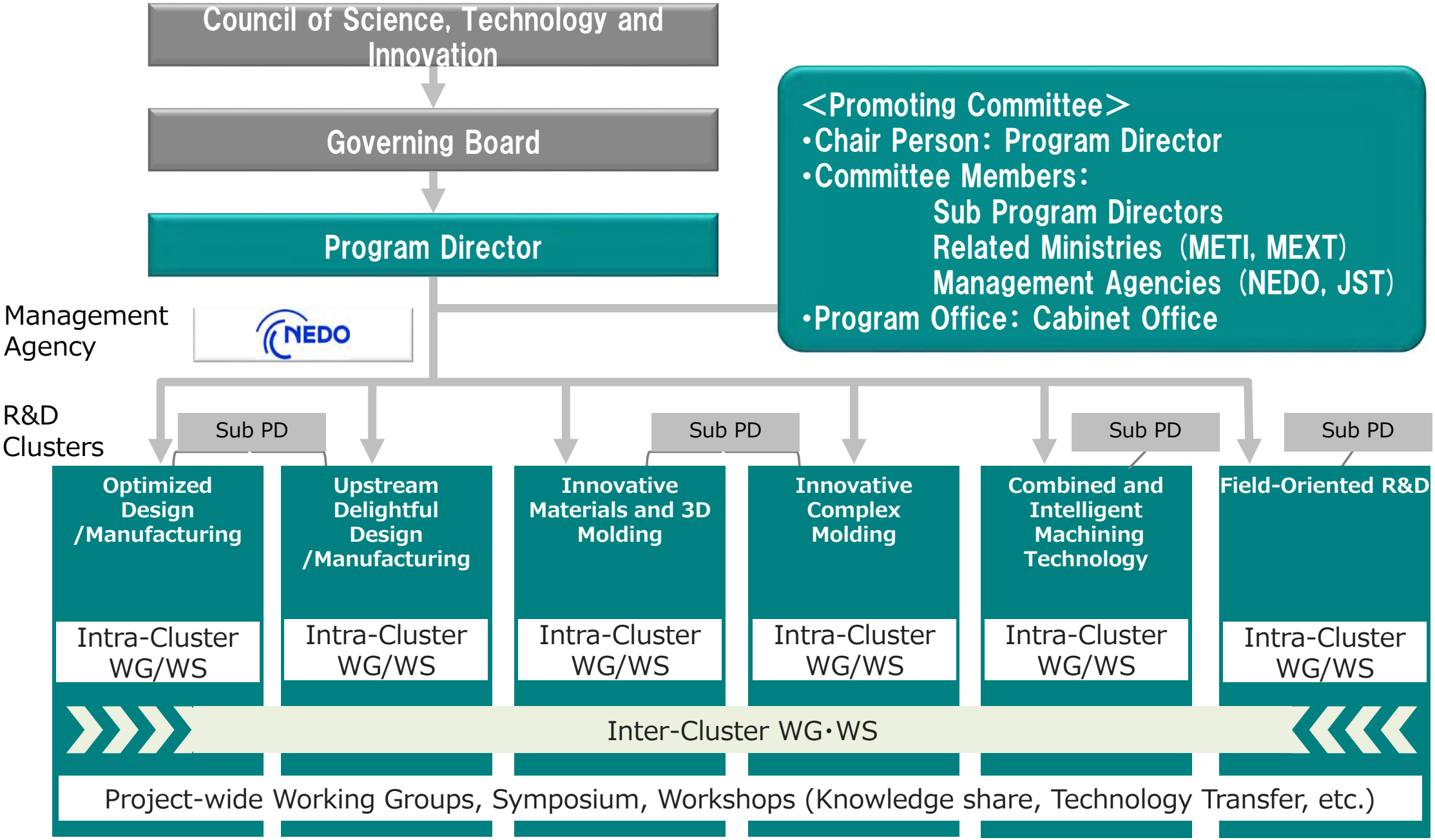
Artificial leg

R&D Themes – Geographical Distribution

★ : Involving Public Research Organization



Governance Structure



WG: Working Groups / WS: Workshops

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Closing Remarks

- New paradigm in manufacturing must realize the total system including design and production process to create new market of “delight products and services”.
- National initiatives are adopted for innovation in manufacturing today in various countries and areas.
  - US: NNMI (Additive manufacturing, Next Generation Power Electronics, Digital Design and Manufacturing, Advanced Light-weight Metal)
  - UK: Catapult Centre
  - DE: Industry 4.0
  - EU: Factories of Future
- New paradigm in manufacturing will be established through collaboration and competition in the global scale.
  - Enough room to learn and collaborate from each other in terms of future technologies

Thank you very much
for your kind attention!

http://www8.cao.go.jp/cstp/english/index.html