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SUSTAINABLE DEVELOPMENT GOALS

Digitally-supported manufacturing and manufacturing-oriented DX Save the World

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@Japan-India Pilot Symposium towards Decarbonization of the Global South

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<Abstract>

UNIDO (United Nations Industrial Development Organization) is cooperating with developing and emerging countries for achieving "Inclusive and Sustainable Industrial Development (ISID)". One of its core activities is technical cooperation for transferring technological knowledge and skills to the engineers/workers of those countries. Trainings and skill development help them to improve efficiency of operation within scientific (theoretical) and engineering boundaries. However, global warming cannot be easily solved with the current (existing) technologies. We may not achieve the optimal solution by simply combining/optimizing the existing technologies. We have to explore a "new science" and "new technologies" for decarbonizing industries and societies. Global South and developed countries must design a new collaborative framework for exploring industrial decarbonization based on new science, by comprehensively using data from every sector.

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1. Introduction

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- **What is UNIDO?**

  = United Nations Industrial Development Organization (Established 1966)

  = HQs at Vienna, 172 Member States, Headed by Director General Gerd Müller

- **What is the UNIDO's mission?**

  = Promote "Inclusive and Sustainable Industrial Development (ISID)" for developing/emerging countries to achieve SDGs (Especially, SDG #9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation, but UNIDO is contributing to all SDGs.)

- **What is the UNIDO's motto?**

  = Progress by Innovation

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- **What are the UNIDO's priorities?**

  1) Energy and climate

  Stop climate breakdown by promoting renewable energies, energy efficiency and industrial decarbonization

  2) Food security

  End hunger by helping businesses "from farm to fork"

  3) Sustainable supply chains

  Support sustainable supply chains for producers to get a fair deal and to preserve scarce resources

- **What are the UNIDO's mandated functions?**

  Technical cooperation, research and policy advisory services, normative standards-related activities, and fostering partnership for knowledge/technology transfer

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● **What are the representative activities for industrial decarbonization?**

(1) IDDI (Industrial Deep Decarbonization Initiative)

= **UNIDO and the Clean Energy Ministerial (CEM) established the IDDI in 2021, to ignite a thriving market for low or near-zero emission steel, cement and concrete.**

= **The IDDI aims to do this by establishing a collective approach to data collection and reporting on low and near-zero emission steel, cement and concrete, harmonizing global standards, and agreeing globally recognized public procurement targets and best practices.**

= **The IDDI is led by India and the United Kingdom. Brazil, Canada, Germany, Japan, Saudi Arabia, Sweden, the United Arab Emirates and the United States are members.**

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● What are the representative activities for industrial decarbonization?

(2) 14th Clean Energy Ministerial and G20 Energy Transitions Ministerial Meeting

= At the 14th Meeting of the Clean Energy Ministerial and G20 Meetings held in Goa, India, (19-22 July, 2023) Ministers and high-level representatives exchanged their views on how to put heavy emitting industries on track towards net-zero goals.

= UNIDO launched a call to action inviting partners across government, private sector, financial institutions and civil society to commit to collaborative action and to unlock financing for industrial decarbonization in developing/emerging countries.

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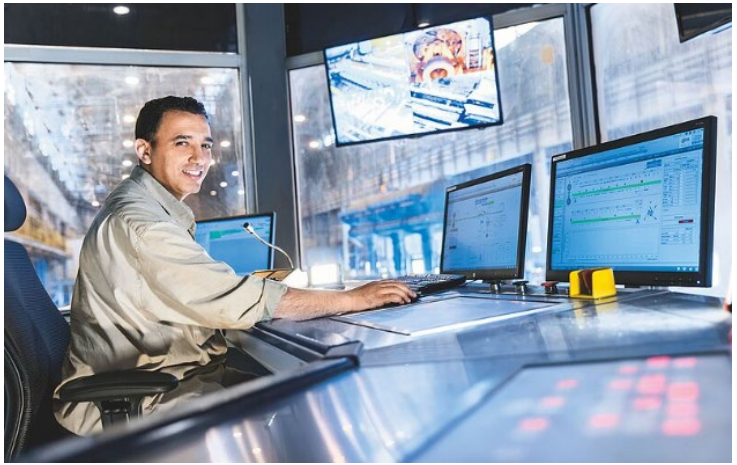
- **What are the technical cooperation activities for industrial decarbonization?**

  (Some examples of our “on-the-ground” types of technical cooperation.)

(Solar fish-drying tech transfer in Cambodia)



(Energy Management System tech transfer in Egypt)

2. What are we doing with developing/emerging countries for their industrial development?

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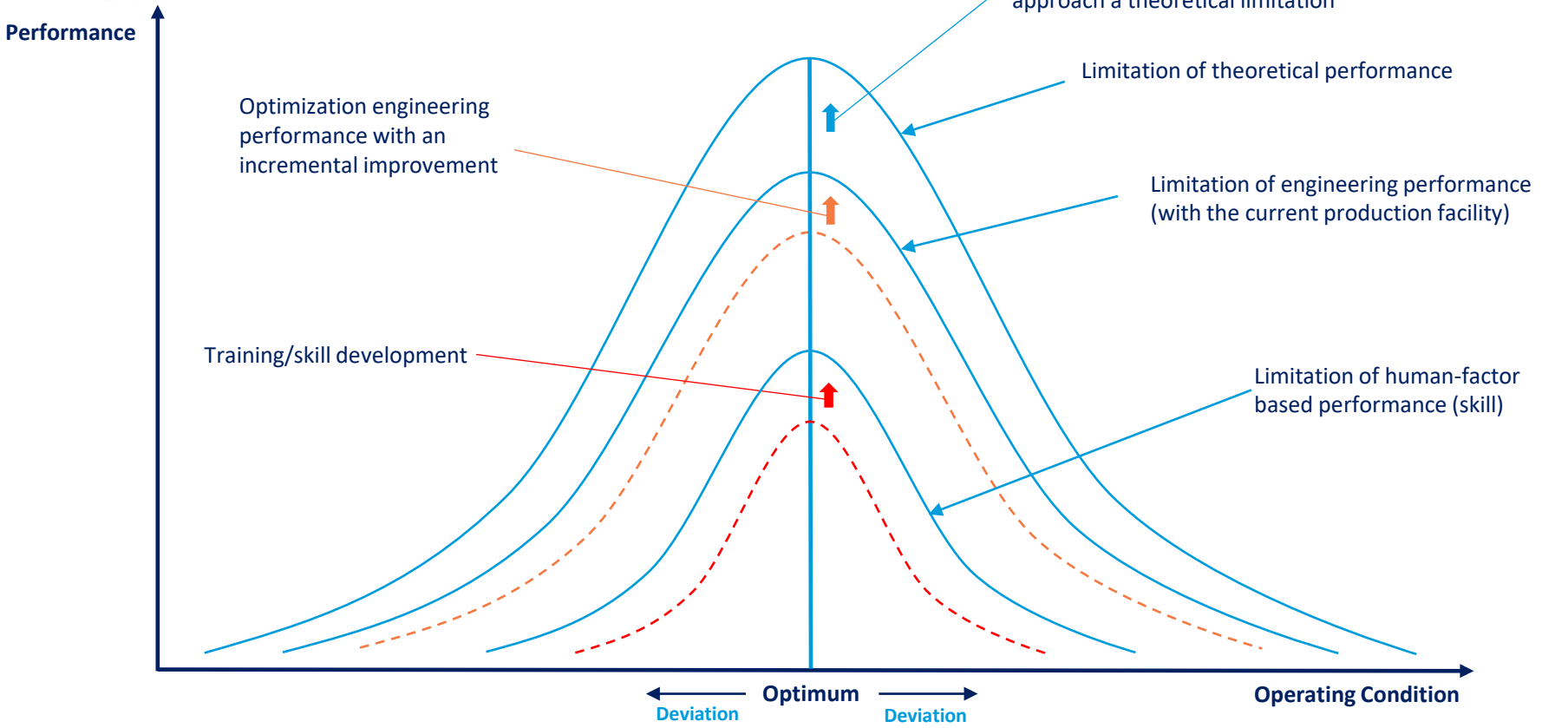


[Fig. 1] Basic and Simplified Structural Relationship between Science/Technology/Skill

- Every industries employ a specific set of technologies based on scientific principles (=theory), engineering (= equipment/facility), and human skills (operation).

- Training and skill development help employees to improve efficiency of operation (both in manufacturing and services), within scientific (theoretical) and engineering (equipment) limitations (boundaries).

- Engineering performance of a factory can be improved by optimizing operating conditions and/or introducing modified equipment (based on the same scientific principles).

- In order to bring a breakthrough in entire industries, we often need a brand-new engineering with "a new scientific principle (a new paradigm)" to liberalize system (process) from the limitations.

3. **Under the current situation where “decarbonization” is critical, what shall we do?**

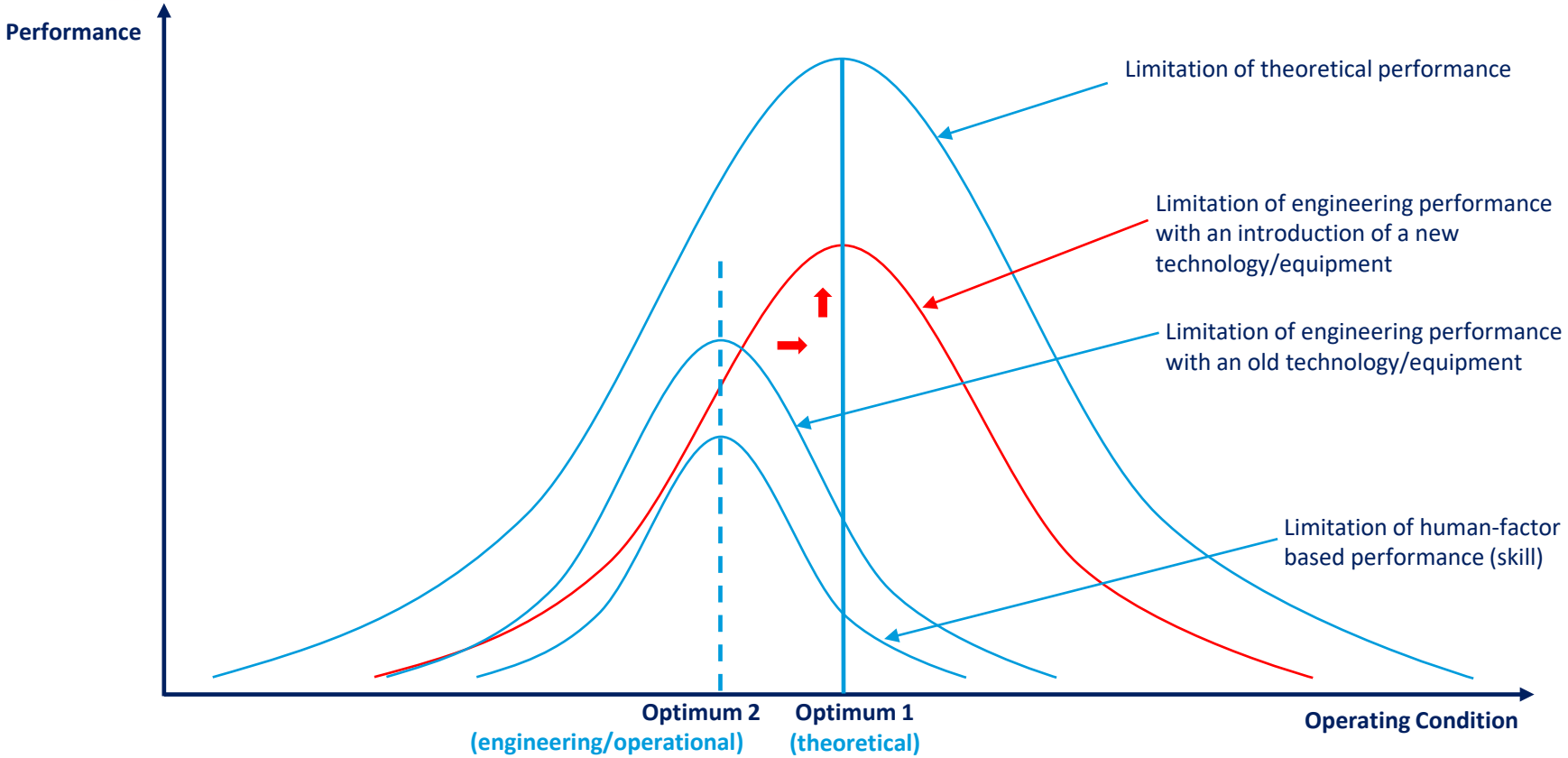
- Take an example of iron/steel making, the current iron/steel industry depends on following boundary conditions:
  - i) Uses the most abundant mineral resources which contain Fe = Hematite/Magnetite (= Oxide)
  - ii) Ores must be reduced (de-oxidation) for separation of iron from Hematite/Magnetite.
  - iii) Reduction can be most efficiently processed by blast furnace with coking coal (cokes).

[Chemical reaction of iron/steel making] Hematite : Fe_2O_3 Magnetite : Fe_3O_4 ($FeO + Fe_2O_3$)

$C + ½ O_2 \rightarrow CO$ (CO has a big reduction function)

$Fe_2O_3 + 3 CO \rightarrow 2 Fe + 3 CO_2$ (Reduction of iron ore in blast furnace)

- As long as we have to continuously use Oxide ore and its reduction with blast furnace, we need to develop a "brand new" engineering with a new scientific principle. Now R&D of reduction technology using Hydrogen is being conducted, with a participation of industrial consortia, academia., and government. (It is in a R&D phase, knowing that 100% reduction of CO_2 emission is deemed to be very difficult.)



[Fig. 2] Shift in optimal operating conditions with an introduction of a new technology

- Suppose a new technology (in a form of equipment) is introduced for further improvement of performance, the optimal operating conditions should also be adjusted (may be shifted/changed).

- In many cases, “finding an optimal operation conditions” is one of the most expected skills for engineers and workers for maximum operation efficiency in industries.

- An introduction of a new technology and adjusting human skills must go together. This is what many ODA agencies and international organizations are doing for/with developing countries.

- However, at the same time, we must know that an optimal set of technology and needed skills may not be identical (to the older ones). It varies country by country, given endowment of industrial inputs.

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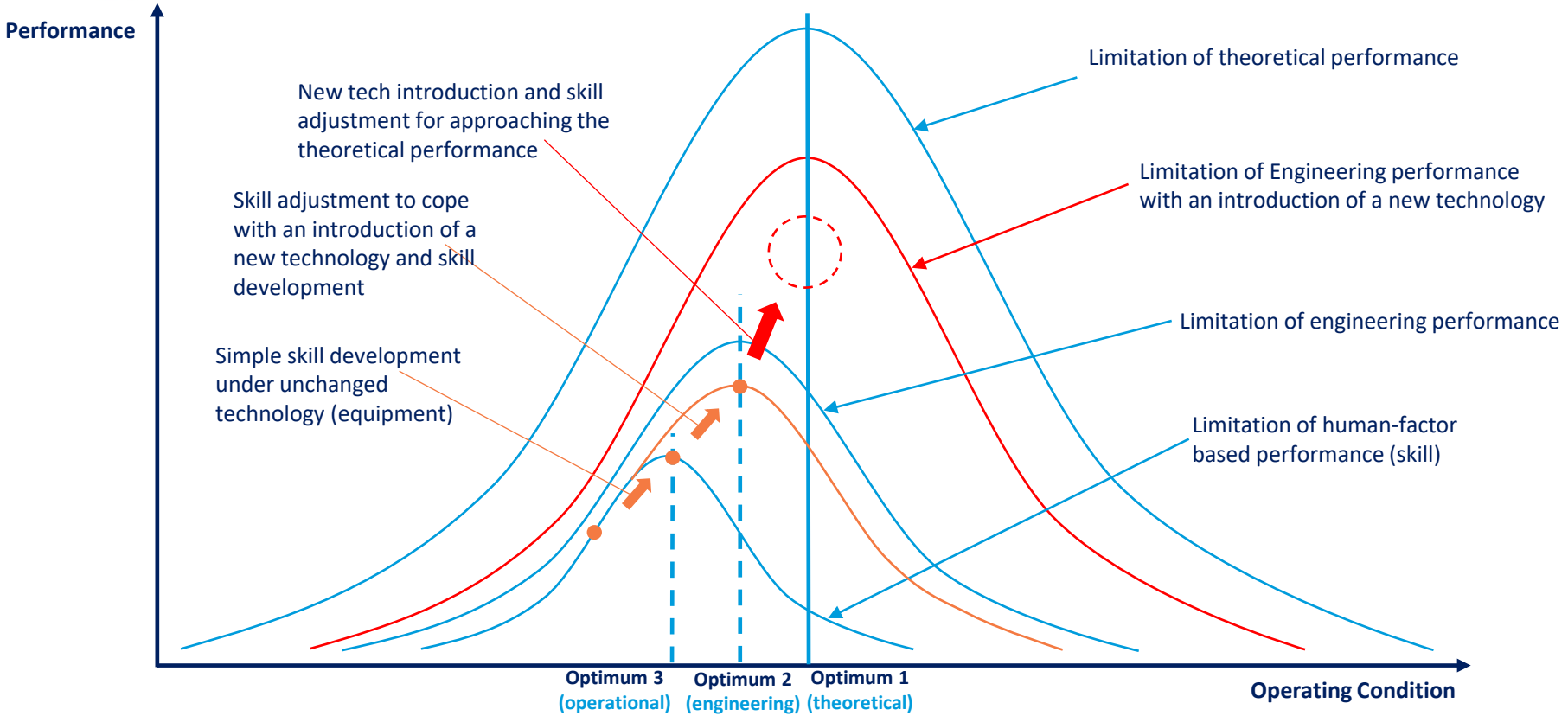


[Fig. 3] Dynamic Change in the Relationship between theoretical/engineering/operational Optimum

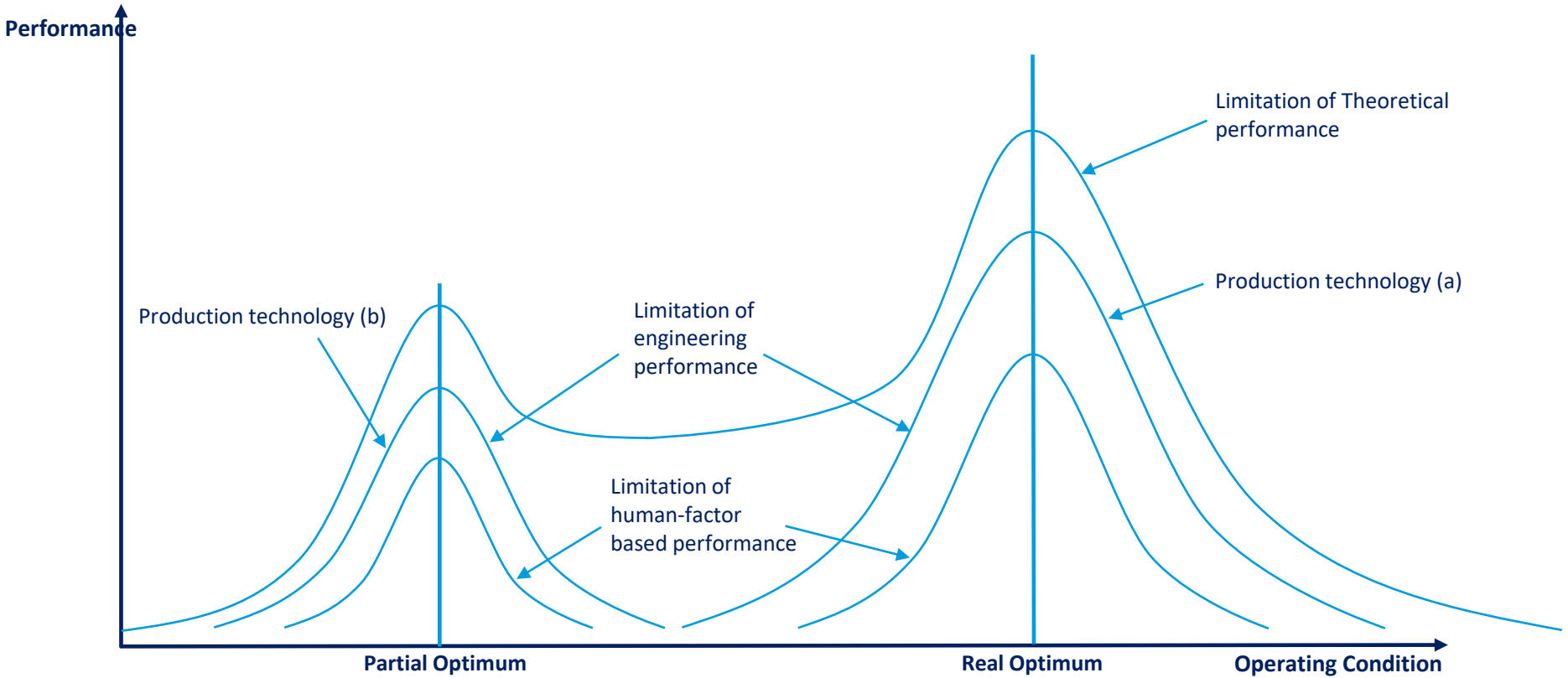
- The previous illustration represents the dynamic shifts in technologies (engineering) and human skills (operation).

- After an introduction of a new technology (engineering), human skills shall be also adjusted to get a maximum performance.
  - New technologies (equipment/facility) are introduced when the economic return is deemed to be clearly larger than the cost of the investment needed.
  - New training/learning for upgrading skills can be more regularly introduced because of its cost-effectiveness.

- Digital technologies can identify true necessity of new investment both in equipment/facility and training/learning, as well as defining the ”limitation (boundaries)” of the current technologies (+skills).

- This is the starting point of the Green Innovation. We can find the true necessity of a new science.

4. What will be the “new” paradigm of the “decarbonized” industries?



[Fig. 4] Real world's relationship between different paradigms in science/technology/skill

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- Global warming cannot be easily solved with the current (existing) technologies. But we may NOT achieve the optimal solution for both fulfilling industrial development and environmental sustainability BY SIMPLY combining/optimizing the existing technologies.

- We have to explore a "new science" to achieve a new industrial system.
  - new science for making iron/steel without emitting CO_2 (reduction of iron oxide w/o cokes)
  - new science for making plastics without using hydrocarbons (not from coal/oil/natural gas)
  - new science for minimizing energy consumption in communication/computation/transportation

- We must know that hints for a new science/technology/skill can be found everywhere, at laboratories, at factories, at user's bench, and in our/your brain.

- We also need new engineering for industrialization of the ideas from new science and insights for building a new societies based on new business models.

5. How to promote collaborations among nations?

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- How to promote a collaboration between India and Japan?
  - Data is another resource for creating a new paradigm in science/technology/skill.
  - Both India and Japan have actual production facilities in carbon-intensive industries.
    (iron/steel industries, chemical and materials industries, power generation plants, …, etc.)
  - Both India and Japan have research capabilities in academia/industries/governments.
  - Both India and Japan have large markets in consuming those carbon-intensive products (B2B).
  - Both India and Japan have large number of households to drive macro-economic growth (B2C).

- Now's the time for designing **India-Japan collaborative framework for exploring industrial decarbonization based on new science,** by comprehensively using **DATA** from every industrial sector of two countries.

Thank you very much for your attention!