2th BRICS Working Group meeting on PHOTONICS

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Industry demands for Photonic Integrated Circuits in Russian Federation

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Content. Structure of financing of photonics in Russia

1. Why Photonic Integrated Circuits – PICs?
2. **ECOPIC** – **ECO**system for **P**hotonic **I**ntegrated **C**ircuits.
3. Commercial cooperation in the frame of **ECOPIC**.
4. Photonics Market - Growth, Trends, and Forecast (2020 - 2025).
5. Educational aspects.

Why Photonic Integrated Circuits – PICs?

Future of photonic – nomenclature of PICs

Microelectronics

Discrete electronics

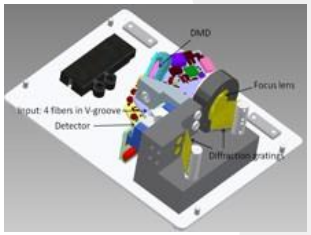
Qualitative transition

Modern microelectronics based on integrated circuits - ICs

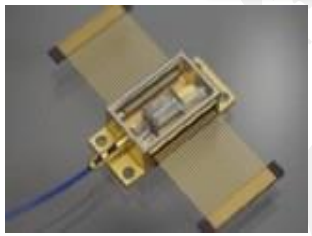
1950 1960 1970 1980 1990 2000 2010 **2019** 2010

Photonics

Qualitative transition



Discrete photonics



Semicondustor based PIC

Industrial standards for design and fabrication. Concept of foundries&PDK, MPW etc.

ECOPIC – **ECO**system for **P**hotonic **I**ntegrated **C**ircuits

- In spite of wide variety of the PIC types, whole area can be summarized in a Table “Markets vs technologies”
- The markets have been identified based on the tendencies and demands of industrial partners.
- The five PIC types covers the requests of all identified markets.

PIC-LF: Photonic Integrated Circuits, Low Frequency

PIC-HF: Photonic Integrated Circuits, High Frequency

PIC-THz: Photonic Integrated Circuits, Terahertz

PIC-Quantum: Photonic Integrated Quantum

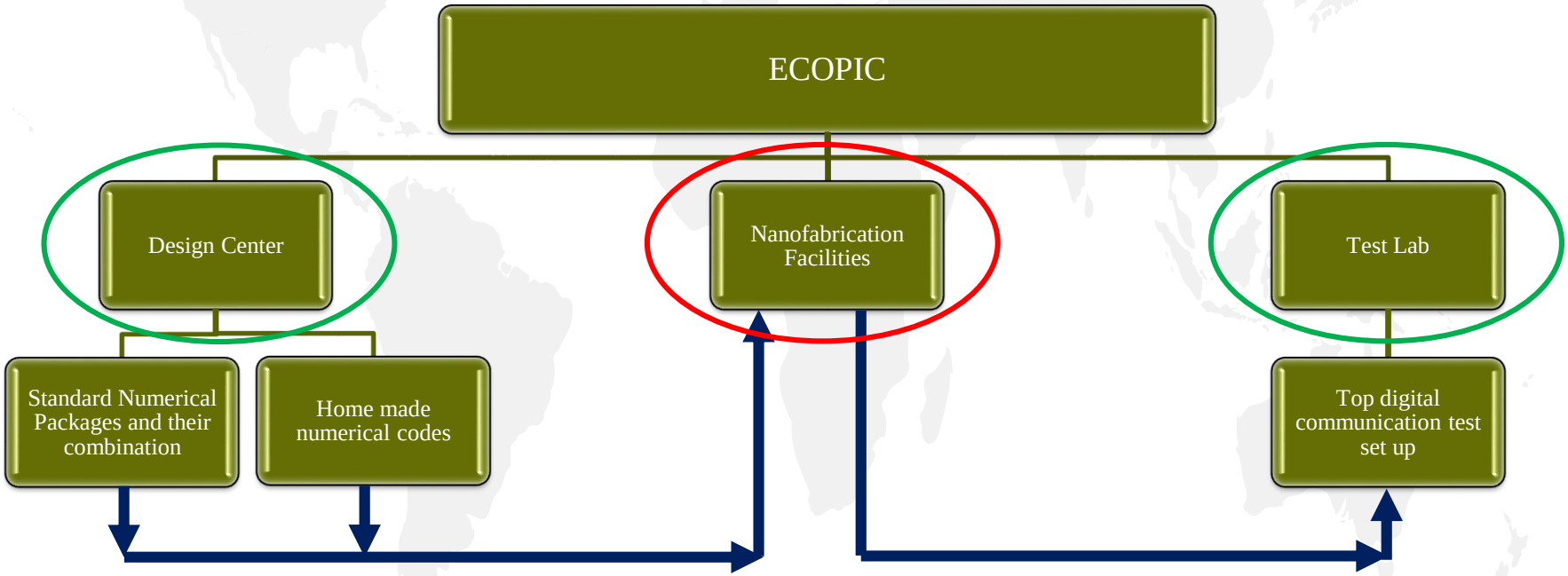
VCSEL: Vertical Cavity Surface Emitting Laser; **MEMS**: Micro Electro Mechanical Systems

N	Markets/Technologies	PIC - LF	PIC - HF	PIC-THz	PIC-Quantum	VCSEL&MEMS
1	Optical communication, QKD	X	X	X	X	X
2	Atomic Clock/Networking	X	X		X	X
3	Structural Health Monitoring	X	X	X		X
4	Radiophotonics (5G, 6G, radar&lidar, ADC, etc.)	X	X	X	X	X
5	Bio-medical photonics	X	X	X		X
6	Agricultural photonics	X	X	X		X
7	Emergency Communication	X	X	X	X	X
8	Optical Quantum Simulator	X	X		X	X
9	Optical computing (classic)	X	X		X	X

Markets vs Technologies

ECOPIC – **ECO**system for **P**hotonic **I**ntegrated **C**ircuits

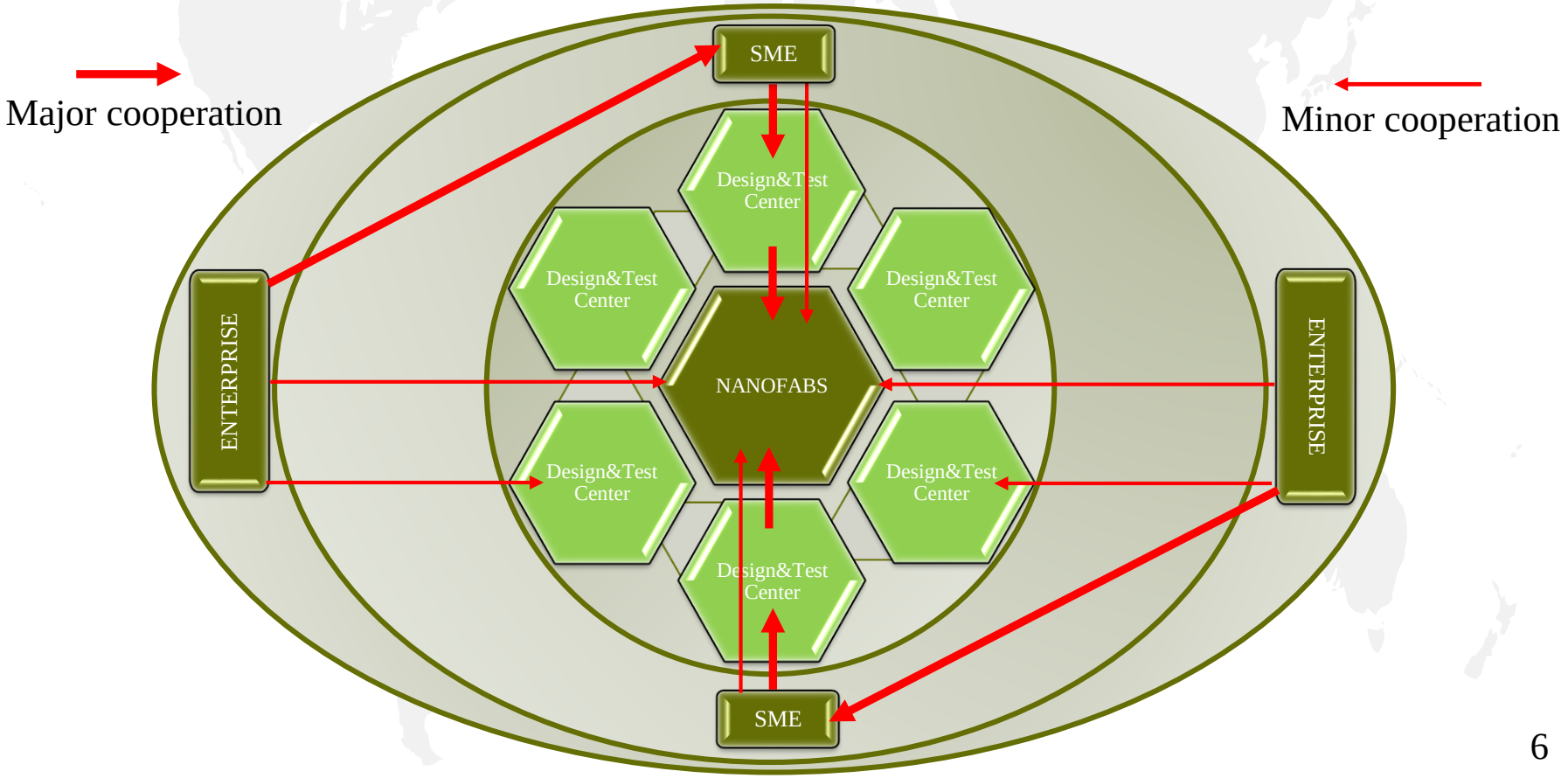
- Industrial demands can be satisfied only in the frame of **ECOPIC**.
- Design Centers consist of computer stations and standard numerical packages.
- PDK libraries have to be formed at each nanofab satisfying common standards that guarantees internal compatibility of all parts.



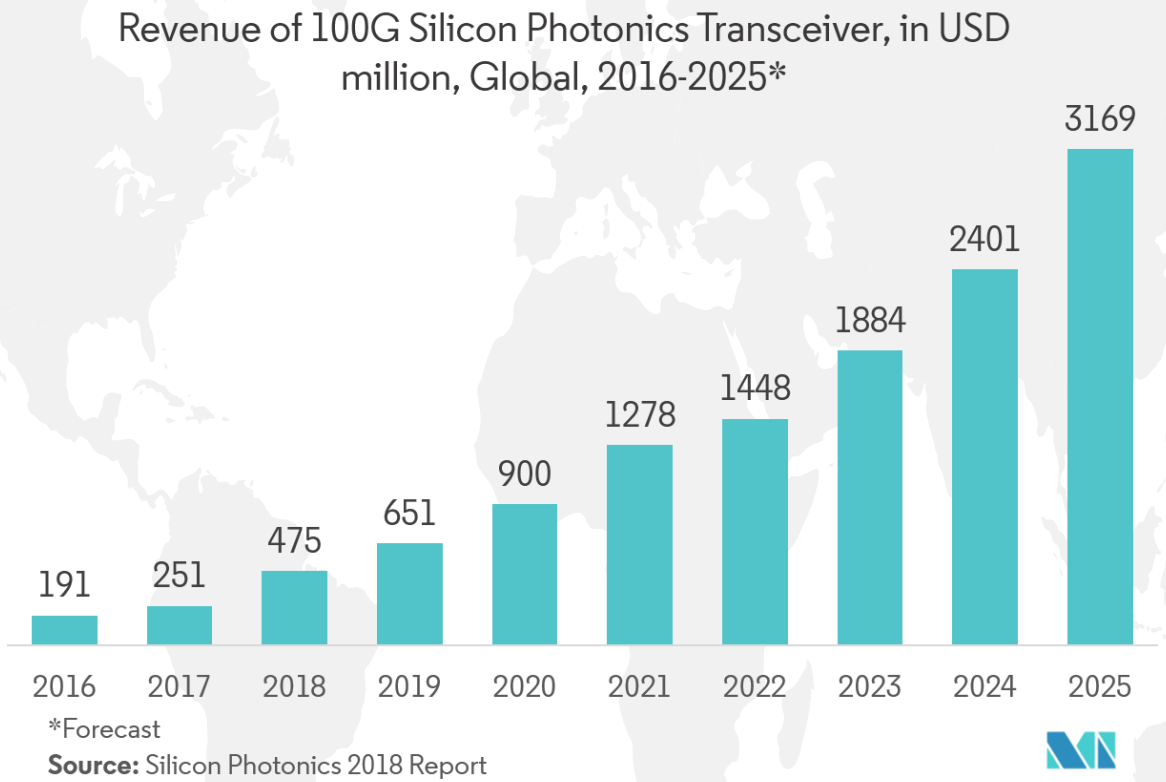
Design, Producing, Testing

Commercial cooperation in the frame of ECOPIC

- It is expected that **SME becomes a major partner of ECOPIC**. Main cooperation SME-Design Center does not exclude interaction SME-NANOFAB, especially for standard samples with PDK.
- **Enterprises cooperate mainly with SME**, which does not exclude cooperation with SME and ECOPIC directly.

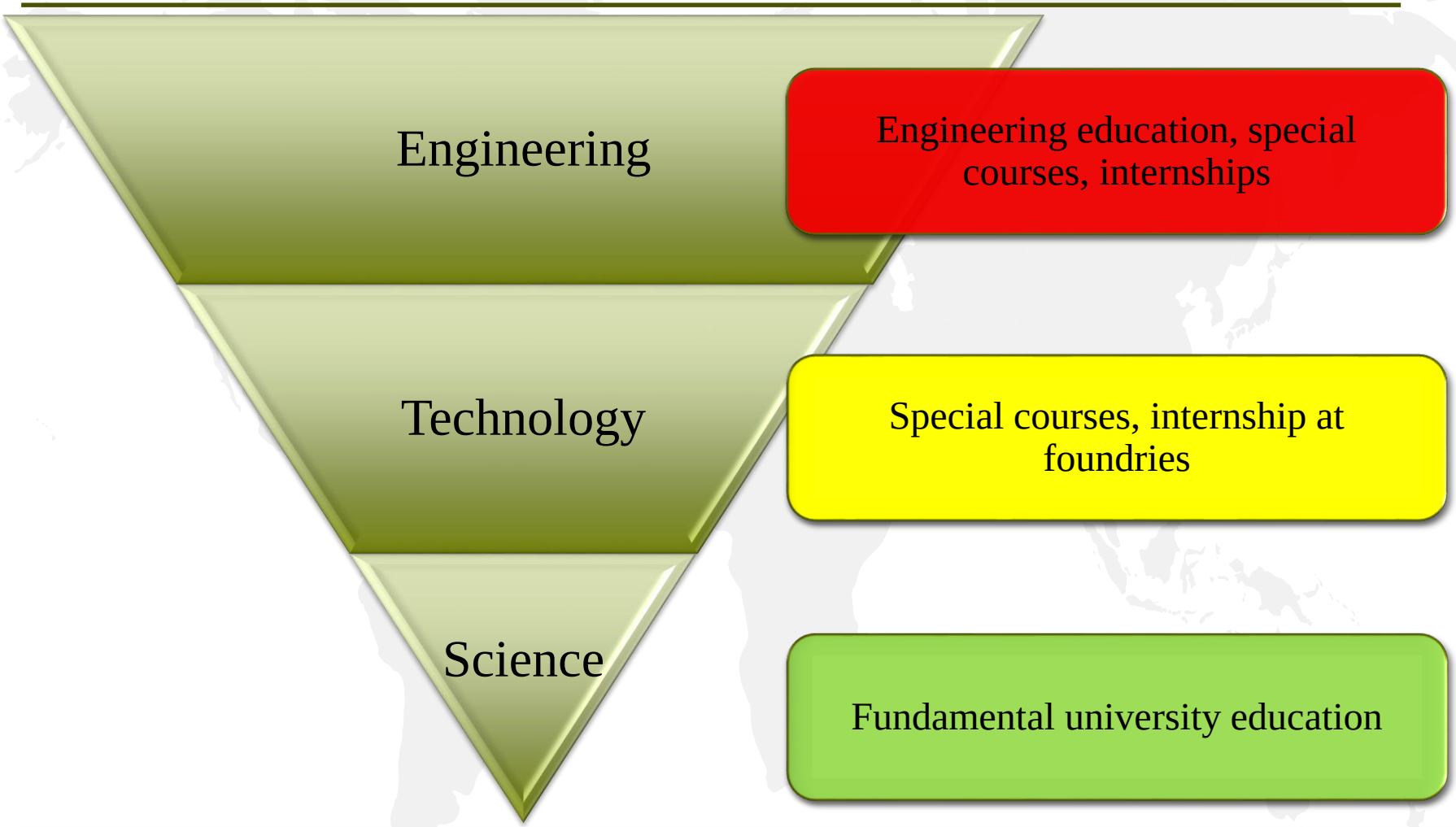


Photonics Market - Growth, Trends, and Forecast (2020 - 2025)



https://www.mordorintelligence.com/industry-reports/photonics-market-market

Educational aspects



The most critical part - is the engineering education

Conclusions/suggestions

1. In 21-th century it is expected a competition between eco-systems rather than between companies/countries.

2. There are similar Roadmaps in PICs in BRICS countries – it is necessary to analyze them and elaborate a Joint Action Plan (JAP), which clearly shows the benefits of synergy between the Roadmaps.

3. It is suggested to initiate this activity and come up with a roadmap for Joint Integrated Photonic Ecosystem for BRICS – JIPE BRICS before the next WG meeting.