How to Improve the Absorptive Capacity (ACAP) of Local Industry

MODERATOR:

Joy Goswami

Chair Elect, AUTM

Sr. Director of Corporate Engagements - Research, Translation & Education

Johns Hopkins University

USPTO Registered Patent Agent

Registered Technology Transfer Professional

Email: jgoswami@jhu.edu

PANEL

- **Philip Hoekstra** RTTP, IP Manager, University of Cape Town (South Africa)
- **Brandon Paschal,** Deputy Director, Spin-out companies and funds, Stellenbosch University (South Africa)
- **Prof Fazilet Vardar Sukan** RTTP, USIMP (Turkey)

Dr. Helena Montiel Boadas RTTP, President Redtransfer (Spain)

- **Dr. Revel Iyer**, Director, Technology Transfer & Industry Linkages, Cape Peninsula University of Technology - CPUT (South Africa)
- **Ms Nontombi Maseko**, Director: Innovation and Technology Policy & Strategy at the Department of Trade Industry & Competition (South Africa)

Absorptive Capacity and Transformative Innovation: Closing the Innovation Chasm through Learning

Implications for Domestic Technology Transfer

Contributors

Philip Hoekstra RTTP

Intellectual Property Manager

Research Contracts & Innovation (TTO) at UCT

Presenter / Contributor

Nicolle Abrahams

Process Engineer

Ymodernise

Contributor

Danielle Badenhorst

Cybersecurity Analyst

Council for Scientific and Industrial Research (CSIR)

Contributor

The Innovation Chasm

Failure of R&D outputs to progress to commercial implementation due to lack of funding and critical support at higher TRLs (industrialisation)

- Associated with weak domestic technology transfer from public sector to industry

Common Policy Interventions to Close Innovation Chasm

But…Why Persisting Innovation Chasm in many LMICs?

WEAK ABSORPTIVE CAPACITY (AC)

PREMATURE DEINDUSTRIALISATION

SYSTEMIC FAILURE OF R&D TO ADDRESS WICKED PROBLEMS AND SDGS

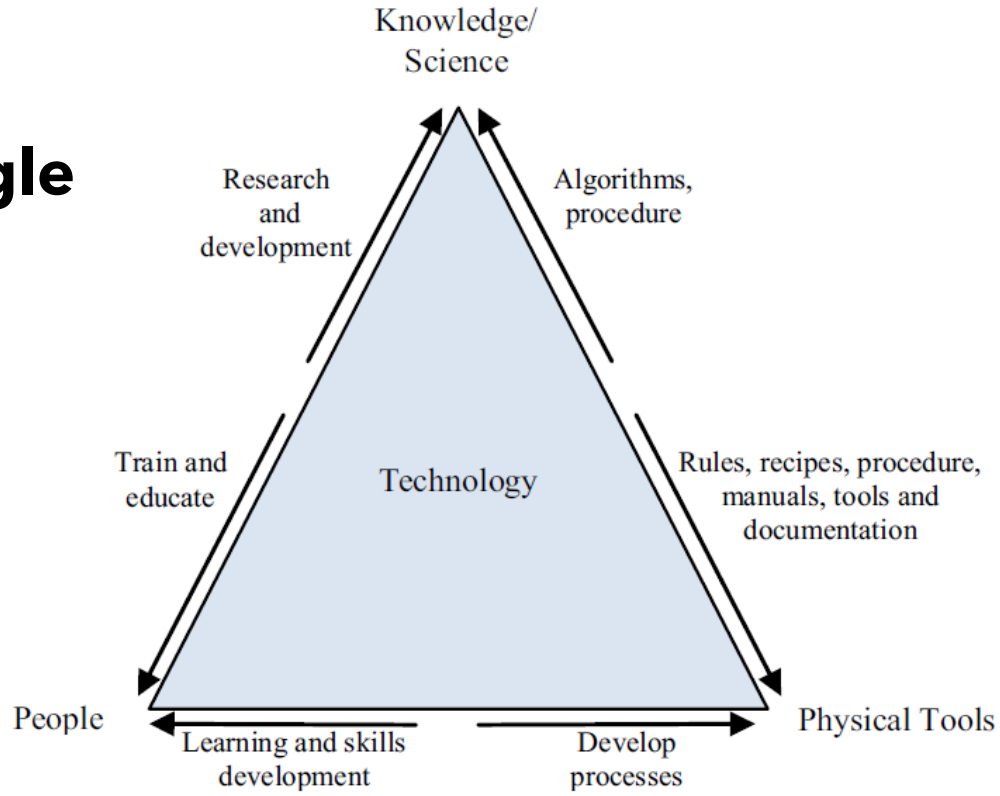
Key Concepts Defined

Technology

Technology is the integration of people, knowledge and physical tools (technology triangle) to assist humankind (Pieterse, 2005)

The Technology Triangle

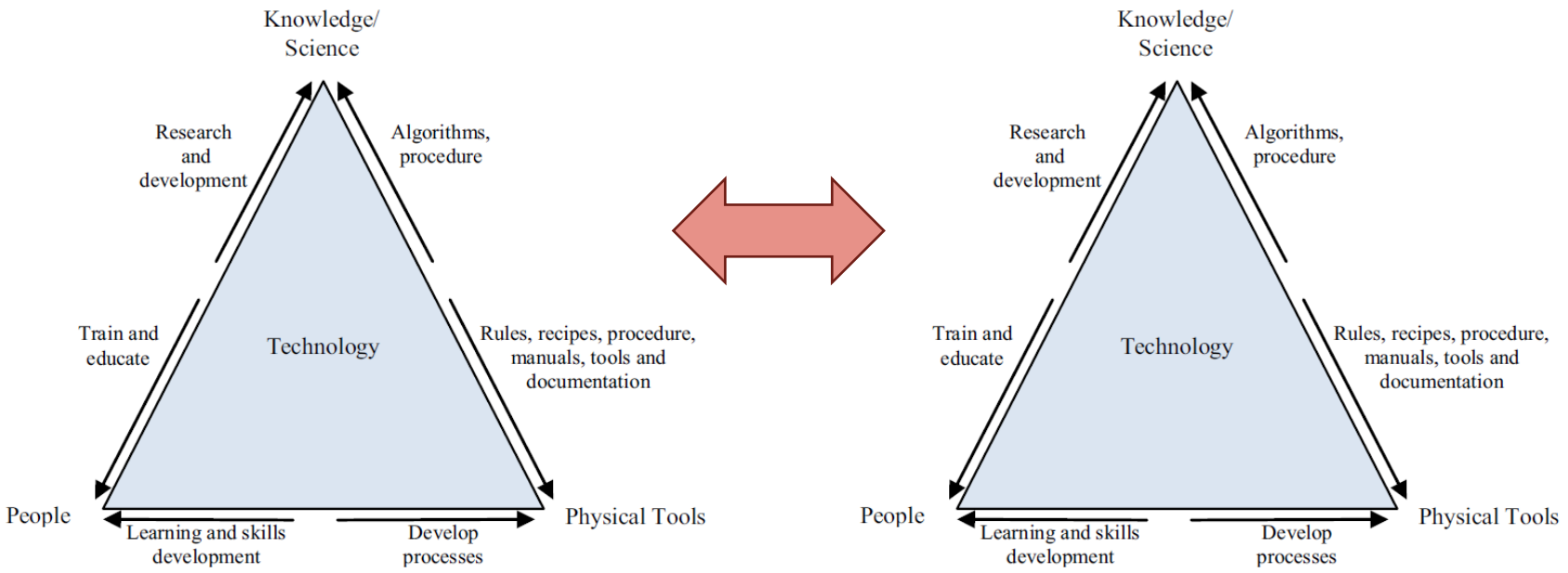
Source: Majid et al (2012) adapted from Pieterse, 2005



Key Concepts Defined

Technology Transfer (TT)

TT is "the movement of know-how, technical knowledge, or technology from one organisational setting to another" (Roessner,1993:37)



Technology System 1 **Technology System 2**

Source: Adapted from Majid et al (2012) adapted from Pieterse, 2005

Key Concepts Defined

Technology Transfer (TT)

Three Modes of Technology Transfer (Bozeman, 2000)

1

International TT (country to country)

2

Intra-company TT

3

Domestic TT (public to private)

Key Concepts Defined

Absorptive Capacity (AC)

AC is as a firm's **ability** to **recognise** the **value** of **new, external information** and **applying** it to commercial ends through **assimilation** (Cohen and Levinthal, 1990)

- AC depends on the firm's **prior technological knowledge**, which is a **requirement** for the successful acquisition of external technologies and innovation
- The higher the prior knowledge, the higher the AC, the stronger the ability to absorb new tech (particularly at lower TRLs)
  - Countries/industries with high AC can better utilise technologies at lower TRLs
- Process of **Learning** is the key element

Key Concepts Defined

Absorptive Capacity (AC)

The three dimensions of AC

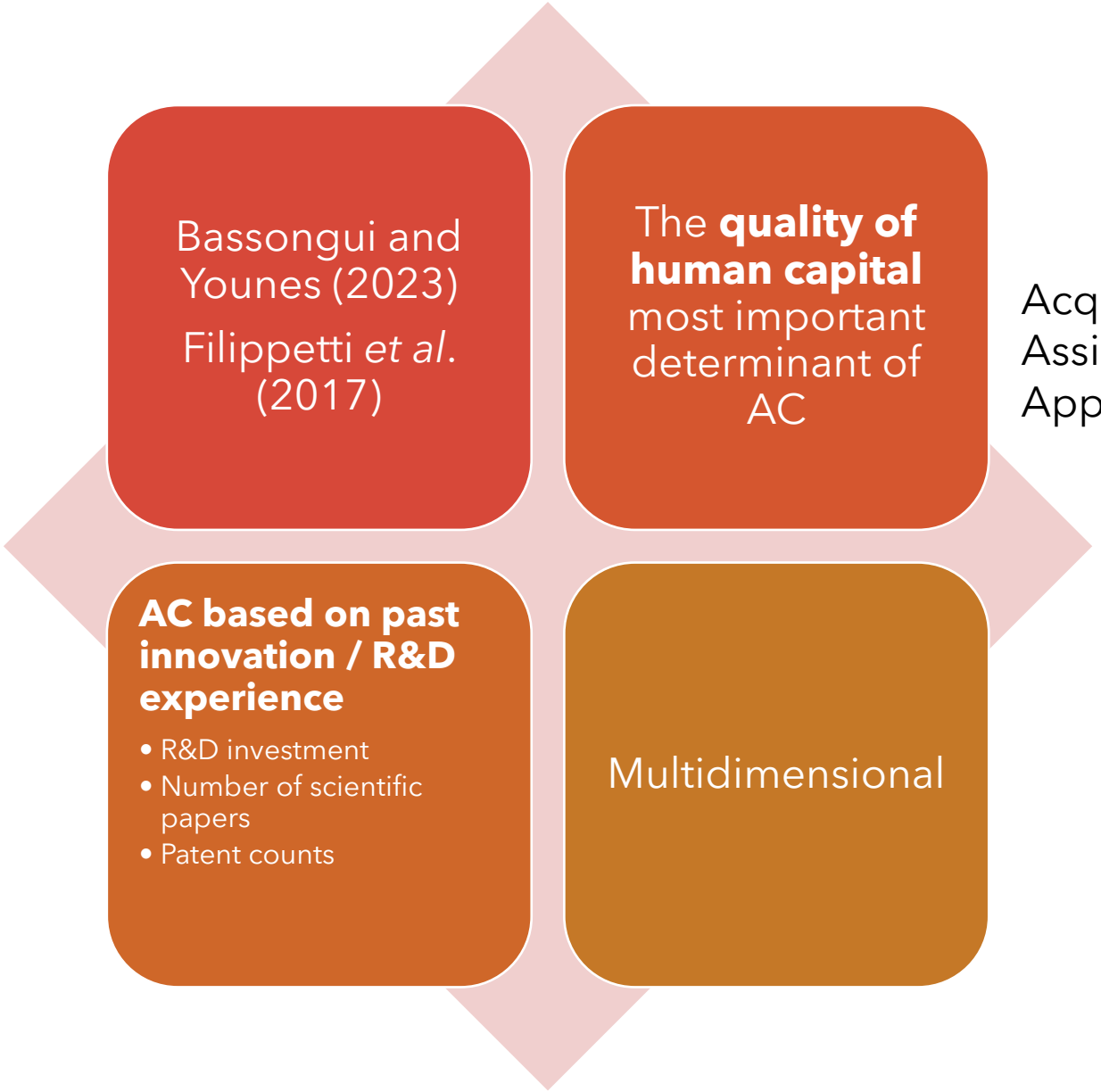
- **Acquisition** (a firm or country's ability to recognise new information)
- **Assimilation** (diffusion)
- **Application** (commercial)

Cohen and Levinthal (1990)

Key Concepts Defined

Absorptive Capacity (AC)

Measuring Absorptive Capacity (AC)



Strategies for increasing AC – Active Absorption

- **REVERSE ENGINEERING**
- **EQUIPMENT PROCUREMENT UNDER FIRM'S CONTROL**
- **COPYING AND IMITATION**
- **NON-DOING-BASED LEARNING**

Viotti (2002)

Strategies for Increasing AC – Passive Absorption

- **LEARN-BY-DOING**
- **TURNKEY PROJECTS**
- **IN-LICENSING**
- **EQUIPMENT PROCUREMENT WITH TECHNICAL ASSISTANCE**

Viotti (2002)

Key Concepts Defined

National System of Innovation (NSI)

National System of Innovation

Concept evolved in 1980s when Freeman and Lundvall tried to explain Japan's high rate of innovation compared to USA

Concluded innovation process not the result of a linear translation of R&D, but depended on different factors making up a National System of Innovation

BUT

Viotti (2002) reminds us that NSI approach was developed in context of **industrialised economies** and postulates that it **may not be appropriate for late industrialising economies**

Key Concepts Defined

National System of Innovation (NSI)

Why may NSI be insufficient for countries late to industrialisation?

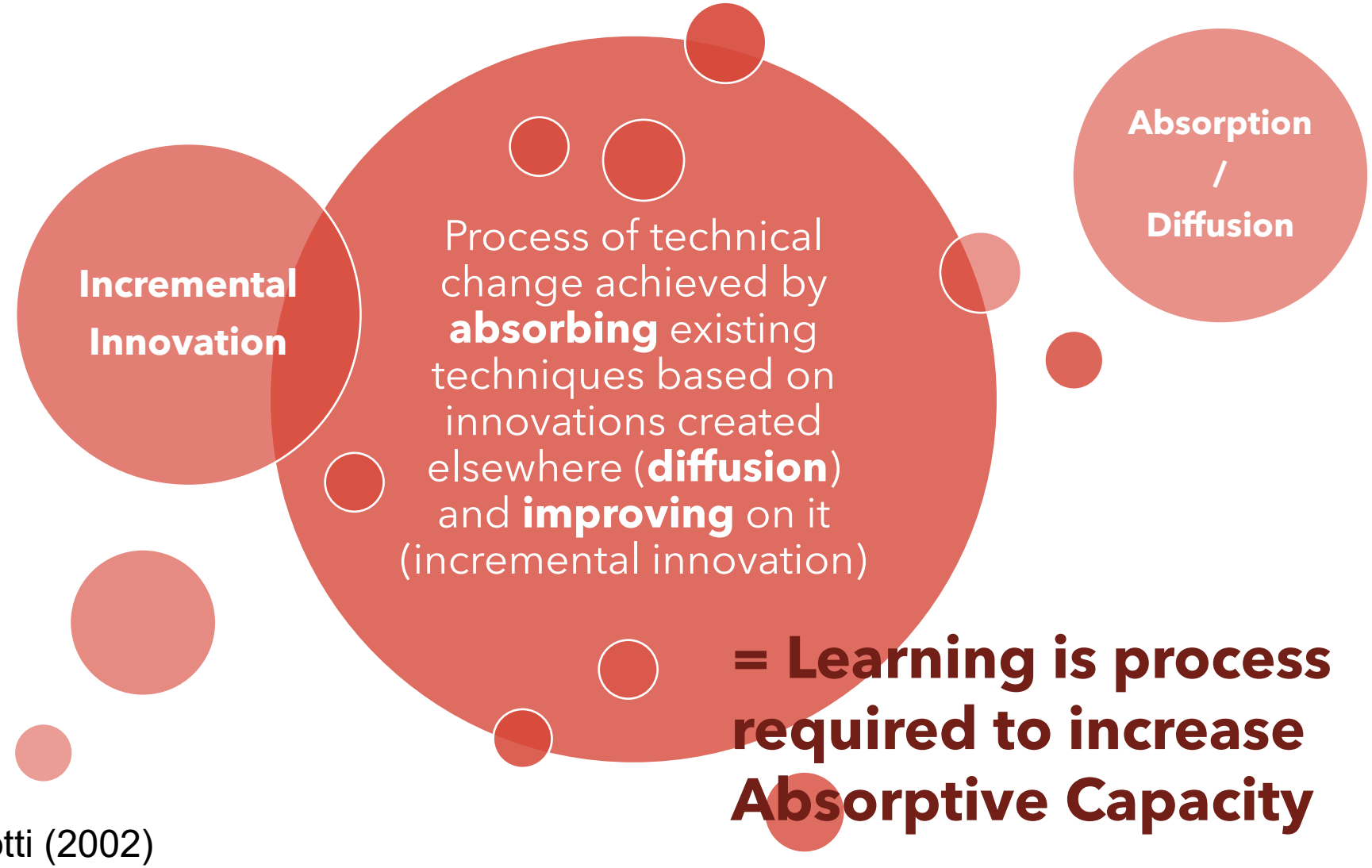
Reason: processes of "technical change" in countries late to industrialise differ from that in fully industrialised countries (Viotti, 2002)

- Industrialised countries: **original innovation** drives technical change;
- Late industrialising countries: technical change driven by **learning,** shaped outside typical institutions associated with innovation and the NSI

Key Concepts Defined

Learning

What is Learning in context of Innovation?

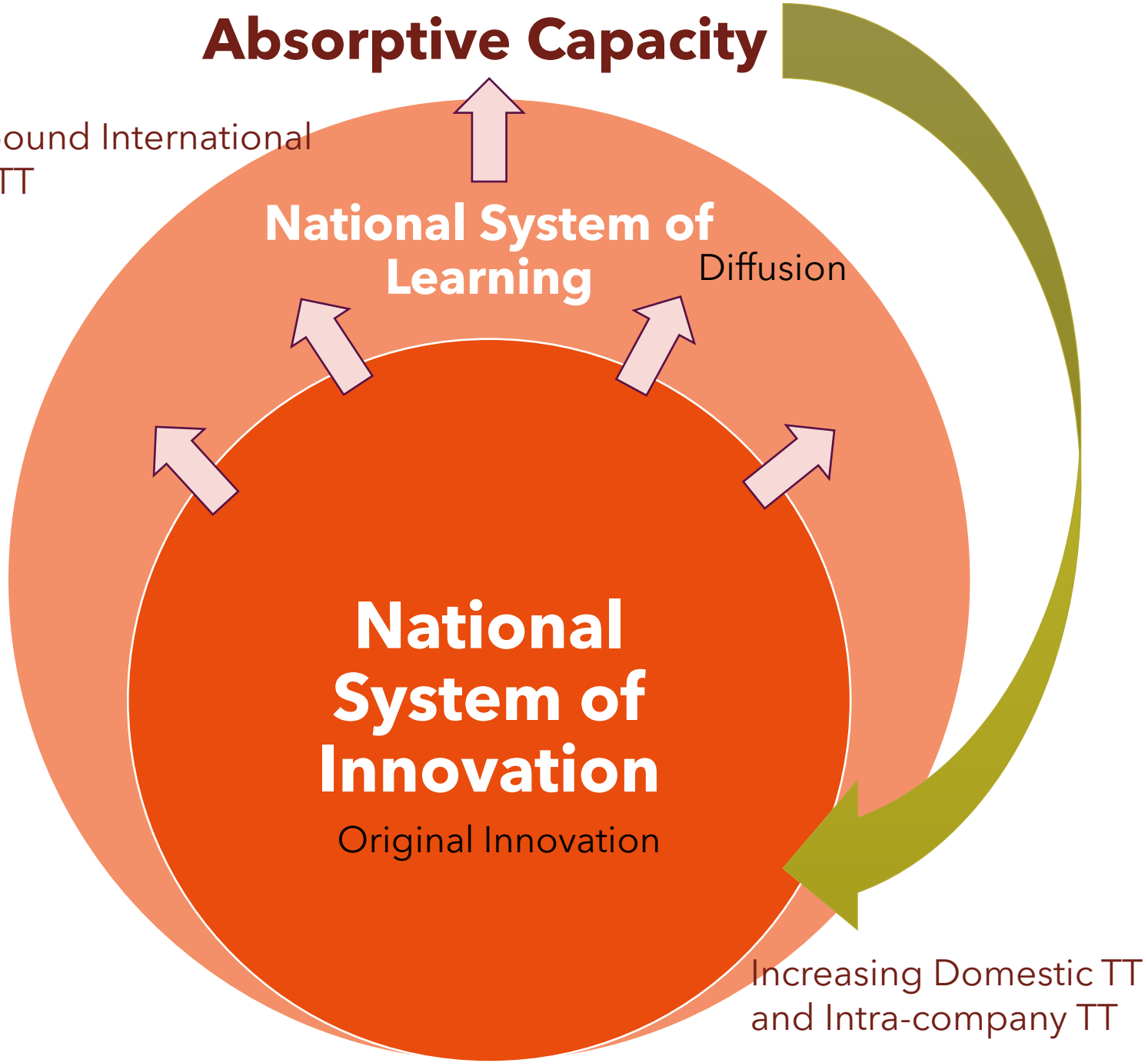


= Learning is process required to increase Absorptive Capacity

Viotti (2002)

Key Concepts Defined

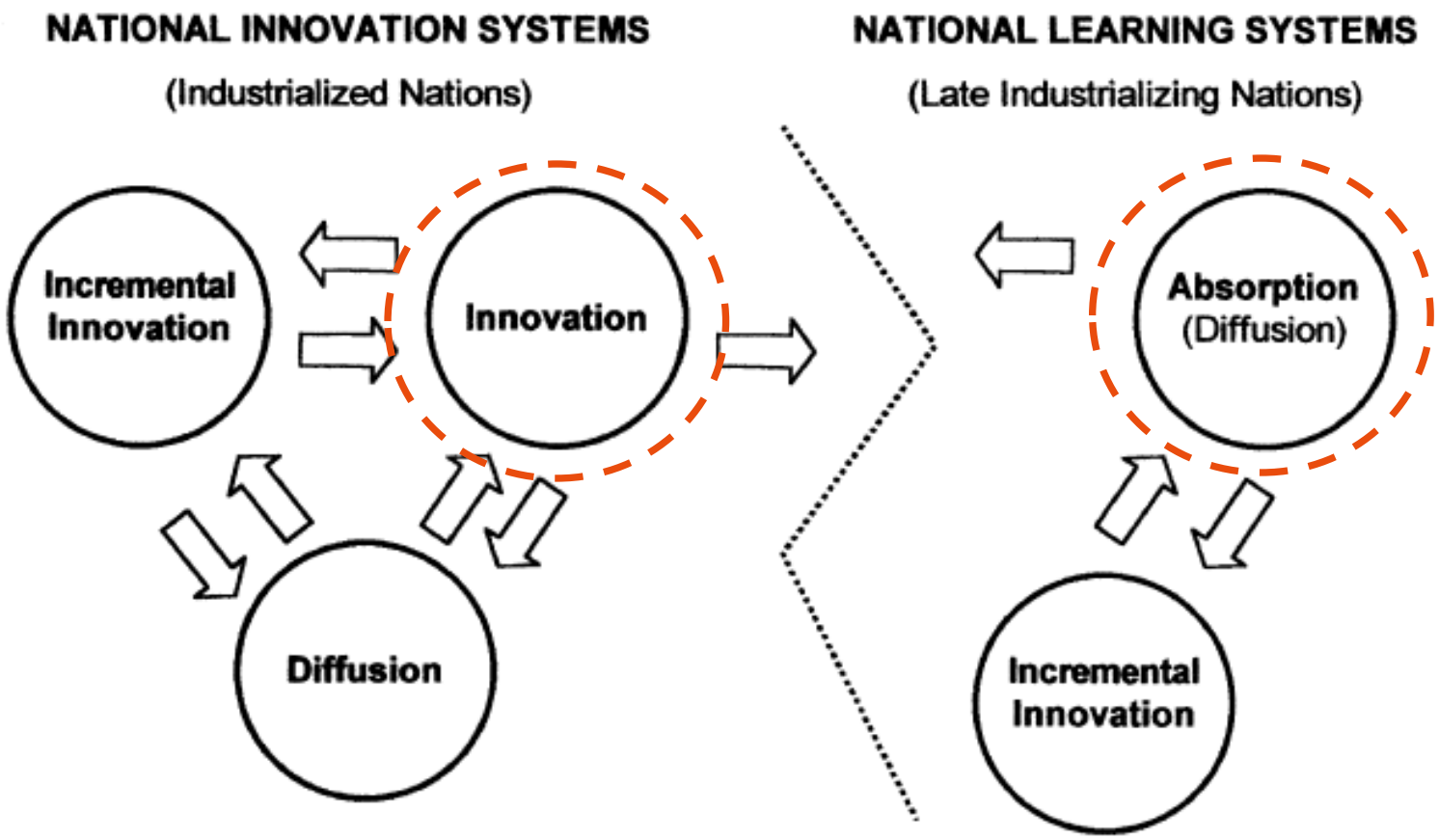
National System of Learning (NSL)



Viotti (2002)

Key Concepts Defined

National System of Learning (NSL)



Premise: Industry knows how to innovate

Premise: Industry needs to learning how to innovate

Figure 1 from Viotti (2002): Systems of Technical Change

Strengthening AC and Learning: The Case of Korea

Transitioned to learning nation by **leveraging active absorption** (Viotti, 2001); now highly innovative.

Focused on **human capital development** and **education** (Viotti, 2001).

Increased **number of scientists and engineers**: crucial role in absorbing / improving external knowledge (Viotti, 2001).

Used imitation, in-licensing & reverse engineering to develop **manufacturing skills**

Invested money in **importing capital goods** to re-engineer and improve (Viotti, 2001).

Clusters and "industrial **complexes**" to promote R&D, share knowledge, and promote innovation (Xiao et al., 2023).

Inequality in AC: The Case of South Africa

The ability to recognise, assimilate and utilise new knowledge or technologies varies across sectors	Insufficient AC of DOH resulted in an underutilisation of funding to address **HIV/AIDS crisis in 90s** (Lopez, 2006).
	However, within **medical devices sector**, coordinated policy has increased AC (Ramoaka and Kraemer-Mabula, 2021).
	Some innovation and localisation in **automotive manufacturing and military sectors** (Jacobs and Buys, 2010).

Key Concepts Defined

Transformative Innovation Policy (Frame 3)

Frame 1: Market Failure	Market failure explains lack of innovation
	Policy interventions required to stimulate R&D and innovation in market (e.g. tax incentives, IP laws, etc.)
	Focus: economic impact
Frame 2: Systems Failure	Failure of innovation systems explains lack of innovation
	Policy intervention to strengthen different actors in an NSI
	Focus: economic impact (social impact as secondary)
Frame 3: Transformation Failure 	Failure to **transform socio-technical systems** explains lack of truly impactful innovation
	Policy intervention required to redirect R&D pathways to address SDGs (**Transformative Innovation Policy**)
	Emphasis on social and environmental impact, socio-economic development and **learning** through supporting niche actors in NSI

Closing the Innovation Chasm: Three-Pronged Approach

Reasons for Innovation Chasm

- **Transformative Innovation Policy (TIP)** to Re-direct Innovation to Address SDGs → **SYSTEMIC FAILURE OF R&D TO ADDRESS WICKED PROBLEMS AND SDGS**
- Increase **Systems Thinking** and **Systems Engineering Skills** to Reverse Deindustrialisation → **PREMATURE DEINDUSTRIALISATION**
- Conceptualise a **National System of Learning** to Increase AC and Promote Domestic Tech Transfer (Viotti, 2002) → **WEAK ABSORPTIVE CAPACITY (AC)**

Recommendations: Government

Build learning systems through collaboration

- Increase vocational training, skills development and human capital in 4IR tech and reverse engineering (learn-by-doing)
- Prepare children and youth for 4IR: from primary to tertiary education
- Strengthen collaborative partnerships for increasing AC
- Transformative Innovation Policy: focus on SHAPE, grassroots innovation, TK frugal innovation (supporting smaller institutions and niche actors)

Develop key infrastructure and political support

- Improve physical and digital infrastructure
- Reform political processes and structures to ensure that critical coordination and support is provided for large and long-term technology projects

Recommendations: Universities / TTOs

Universities could better prepare students for 4IR and technology learning

- Develop skills that truly align with industry needs
- Develop skills in IOT, robotics, assembly and Reverse Engineering
- Develop systems thinking and systems engineering skills

TTOs should support startups with high-growth / scaling potential (HGFs)

- HGF's shown to have most economic impact (Mason *et al.*, 2014); Kapa Biosystems
- Technology-based or otherwise

TTOs should evaluate IDs from Transformative Innovation Policy perspective

- Compare competing technologies and support those that address the most SDGs

TTOs should strengthen innovation capacity in SHAPE innovation

Opportunities for Africa to Strengthen AC


CREAMER MEDIA'S ENGINEERING NEWS

https://www.engineeringnews.co.za/article/africa-should-embrace-smart-advanced-manufacturing-to-add-greater-value-2024-10-18

Africa should embrace smart, advanced manufacturing to add greater value

18TH OCTOBER 2024 BY: SCHALK BURGER - CREAMER MEDIA SENIOR DEPUTY EDITOR

Smart Factories

Advanced 4IR tech such as **IOT** can be adopted to **modernise** existing **manufacturing** infrastructure

- Enhanced competitiveness
- Increased AC in areas such as **big data** and **digitalisation**
- See article by Schalk Burger in Engineering News (18 October 2024)

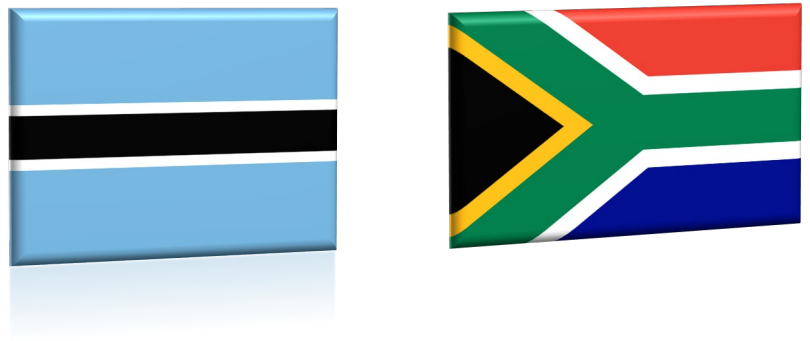
https://www.engineeringnews.co.za/article/africa-should-embrace-smart-advanced-manufacturing-to-add-greater-value-2024-10-18

Opportunities for Africa to Strengthen AC

Assembly of Electric Vehicles (South Africa and Botswana)

Potential to redirect local automotive sector to the assembly of Electric Vehicles (EVs) under license

- SA can build on existing AC in motor vehicle assembly to develop new AC in EV assembly
- Botswana: more than 150 Batswana were recently trained by Botswana Institute of Technology Research and Innovation (BITRI) to assemble EVs for Skywell and CHTC https://www.youtube.com/watch?v=GTTQTNF3RNc



Opportunities for Africa to Strengthen AC

Robotics Manufacturing

Teach technicians in mining and automotive sectors to reverse engineer robotics; establish local manufacturing capability

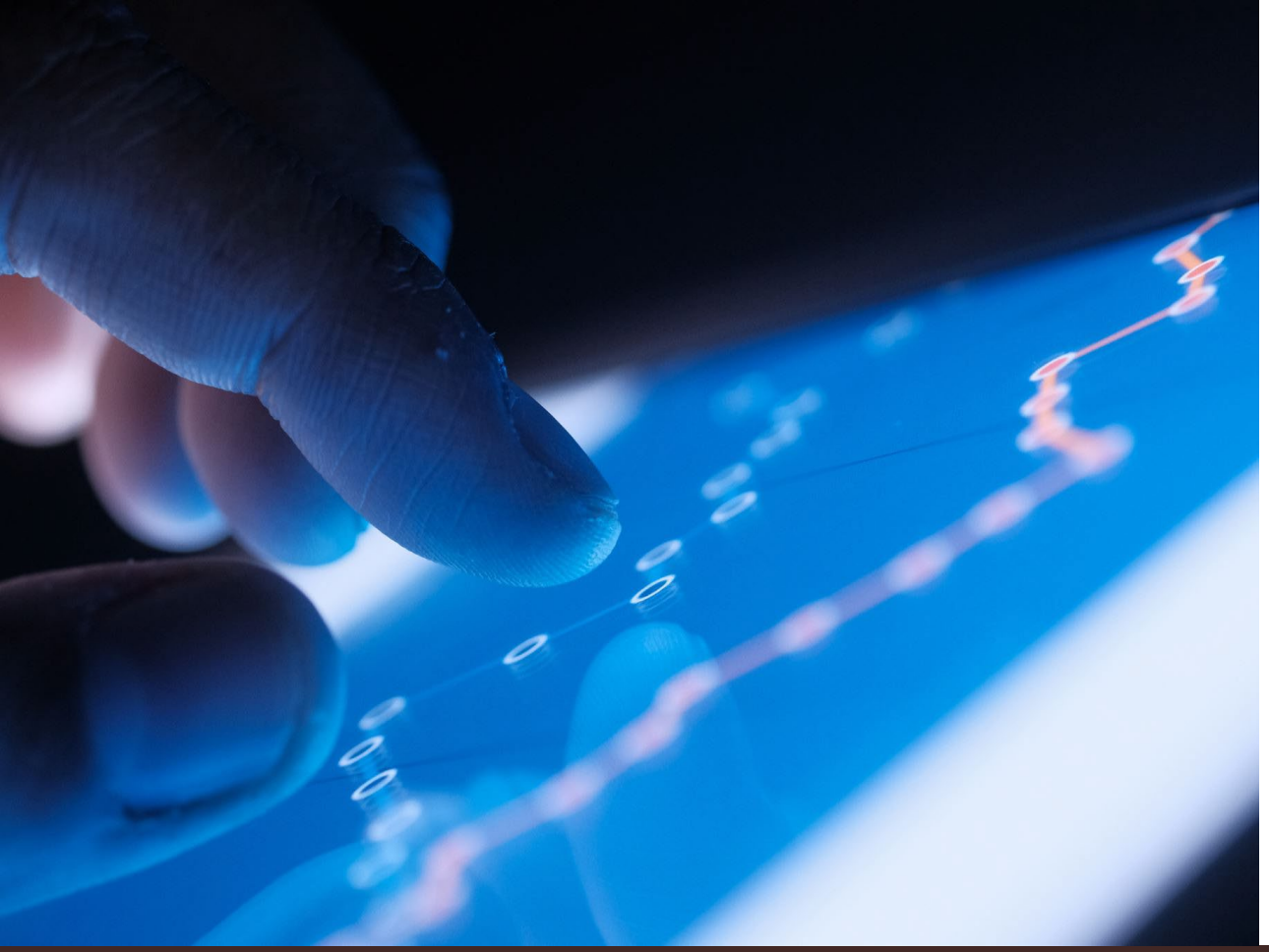
- This will mitigate against job losses caused by adoption of robotics
- Creates AC in robotics that could lead to original innovation

Vutula (2009) suggests that an important factor in **closing the innovation chasm** is the **technological advancement of industry**

Closing the Innovation Chasm through Strengthening AC in an NSL

Mukoyama (2003) suggests that **imitating innovation** can **enhance** the overall **rate of technological progress**

Closing the Innovation Chasm through Strengthening AC in an NSL



Swart (2015) suggests that the **best route to innovation** is often **repackaging existing technologies**, where securing a new patent is not required, which **lowers the risk of innovation** substantially.

Closing the Innovation Chasm through Strengthening AC in an NSL

Thank you!

Philip Hoekstra

+2721 650 2609

Philip.Hoekstra@uct.ac.za

https://www.linkedin.com/in/philiphoekstra/

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