Measuring Science, Technology and Innovation Capacity To Tackle Development Challenges and Build the Global Knowledge Commons

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Global Knowledge Initiative

Knowledge, Youth and Global Commons

"Orienting Knowledge Systems and Inter-Generational Relations Towards Sustainable Development and Rio+20"

Sept. 2011

The Journey of the Global Knowledge Initiative (GKI)

April 08

Higher Education for Development (HED) Summit; 200 university presidents attend; opened by Rwanda's Pres. Kagame

Jan 09

Sam Pitroda and Nina Fedoroff meet Sara Farley; begin to conceptualize GKI as a response to the HED Summit participants' needs

July 09

Launch of Global Knowledge Initiative, housed within the US National Academy of Sciences; Advisory Committee established

Sept 09

Global Needs Assessment; 100+ institutions express requests for GKI's assistance in problem-solving through partnership

July 2010

Introduce concept at US-Indo Summit on Higher Education (Mumbai)

Stakeholder Meetings in South and East Africa

Begin LINK Pilot

Feb 11

Announce National University of Rwanda as inaugural LINK Winner

Mar 11

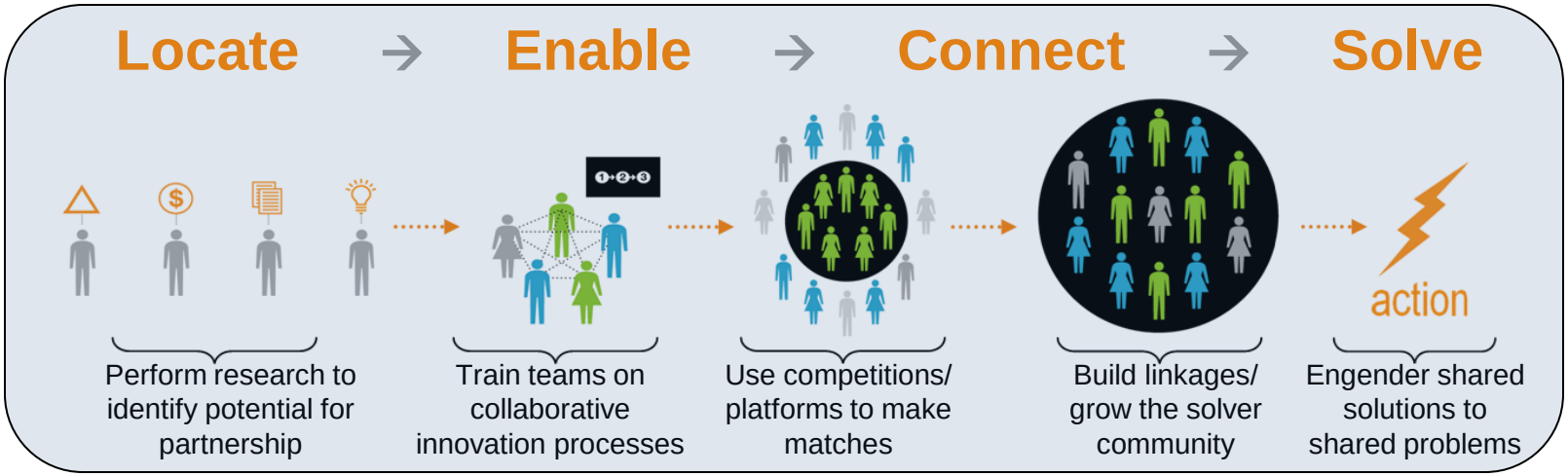
Begin Afghanistan/ Pakistan Pilot

June 11

LINK training with university team; Stakeholder outreach in advance of autumn 2011 announce-ment of East Africa LINK Round II

GKI in Summary:

Process



Approach

Innovation systems approach delivers benefits: Learning how to work within an innovation system requires an orientation toward system dynamics and processes.

We focus on people, not institutions: Universities and research organizations are repositories of resources and people—faculty, students, idealists, problem-solvers. We work with these institutions as a means to empower the people within them.

Technology-enabled collaboration platforms offer tools to engage solvers: We harness new tools, methodologies, metrics, and platforms to bring people and resources together to solve challenges. Ensuring wheels aren't reinvented and resources are smartly leveraged requires clarifying the STI context before solution design.

Training in collaborative process skills increases the success of collaborations: Universities create content experts. GKI trains them to become collaboration experts. Mastering process skills makes the difference.

A New Vision…

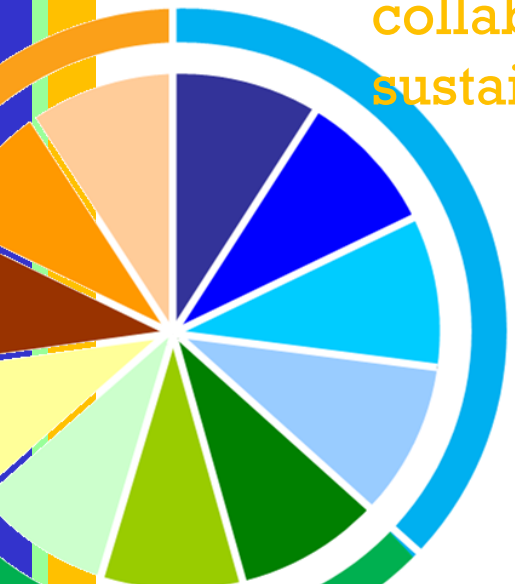
Imagine a Knowledge Network that will facilitate discussion and debate, resource sharing, and collaboration.

Information technology brings about openness and connectivity, builds a network, fosters democratisation, and decentralisation, and, as a result of all this, brings about generational transformation.

--Sam Pitroda
Advisor to India's Prime Minister
GKI Chairman

A Case Study in the Innovation of Metrics and the Metrics of Innovation

- Case Study: Global Knowledge Initiative
  - Goal: Find the best indicators available on science, technology and innovation (STI) to gauge the likelihood that a given context is "ripe" for collaborative innovation to tackle global sustainability and development challenges
    - » Metrics of science and engineering training key
    - » Constraints: GKI operates in Least Developed Countries
    - » Many with limited/intermittent statistical capacity
    - » Many global indicators on STI not reported
    - » Lots of input indicators, few output indicators



Measuring Innovation Systems

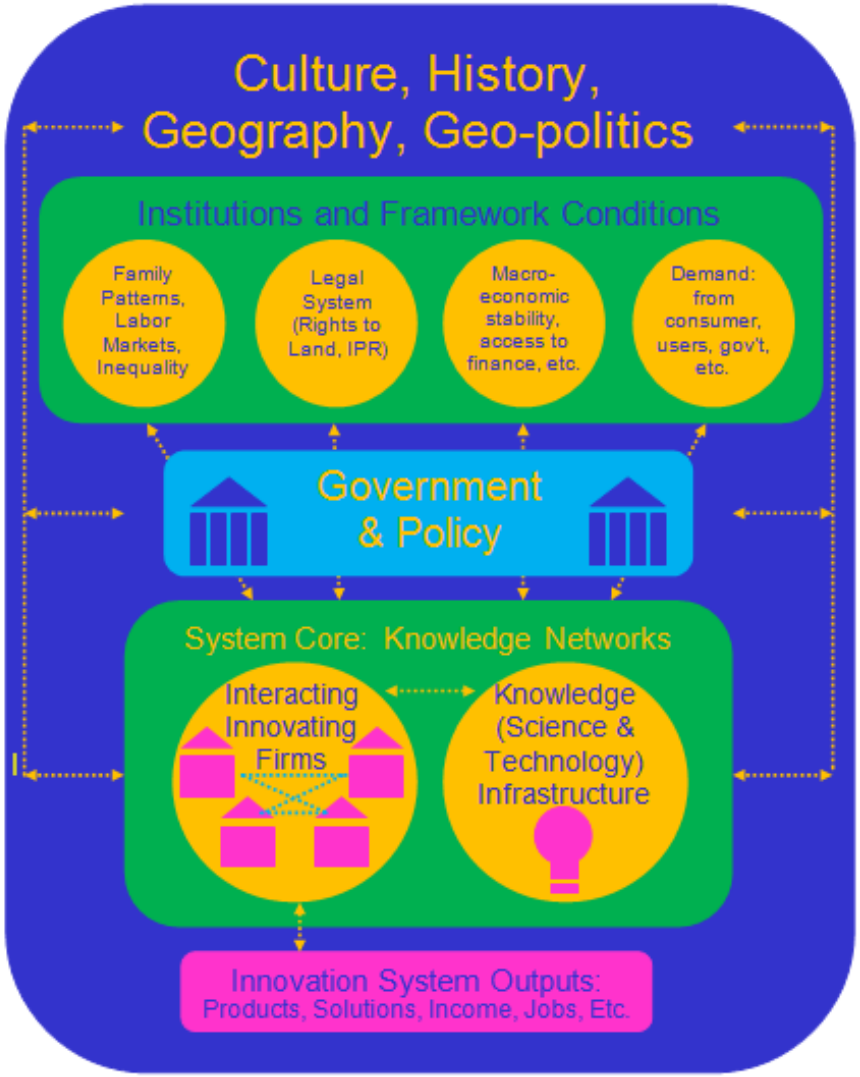
- Innovation Systems (IS) Framework tells a story of what actors/interactions/ enabling environment matters most for innovation to occur
- But, IS descriptive not normative

» Challenge: Innovate a new approach to measuring the degree to which a particular country context is becoming more conducive or less conducive to collaborative innovation → *metrics of science and education part of the story, not the whole story*

GKI's Aim

Use an STI index that ages well & deepens global insight on the signals that collaborative innovation is/can/will occur in a given country context

Innovation System Framework



Enabling Environment

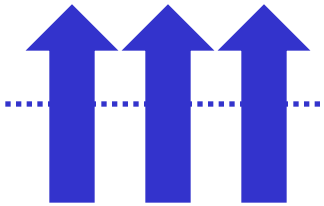
Actors

Interactions

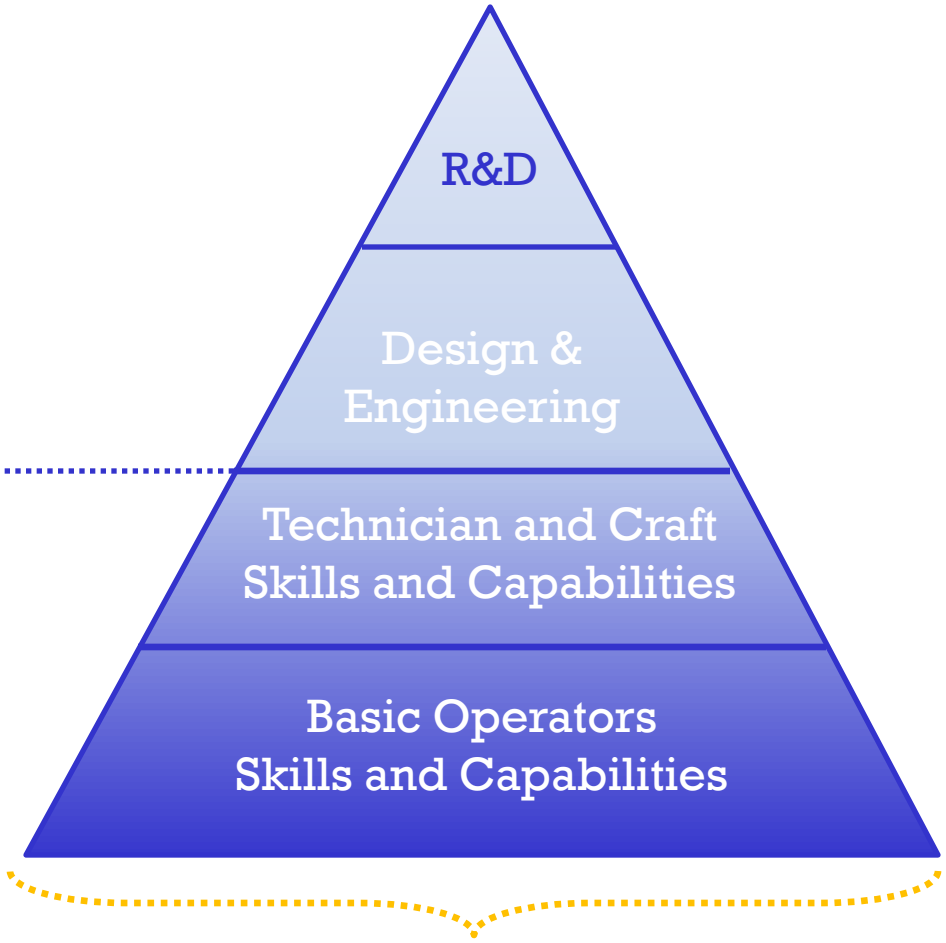
Outputs

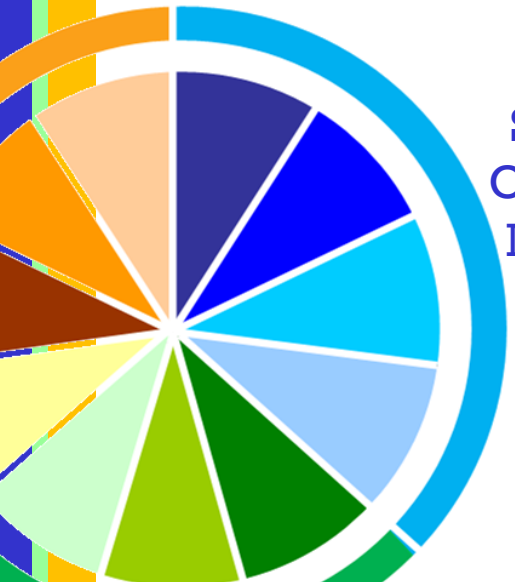
Different Features of the Innovation System Matter at Different Development Points

Science Development and Creation



Science Use, Operation and Maintenance





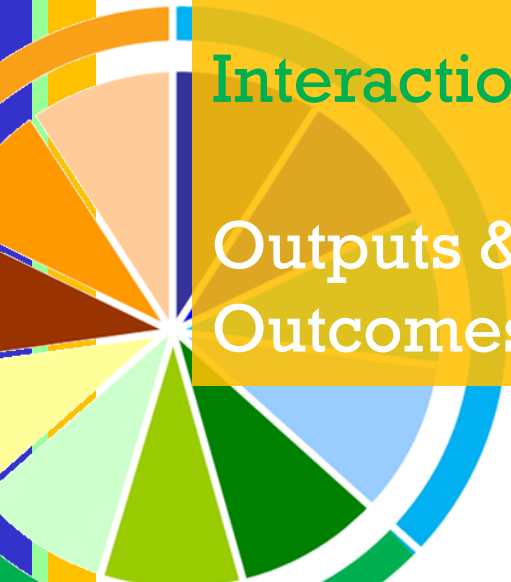
GKI's Question: What Index captures the evolving role of STI at differential degrees of development?

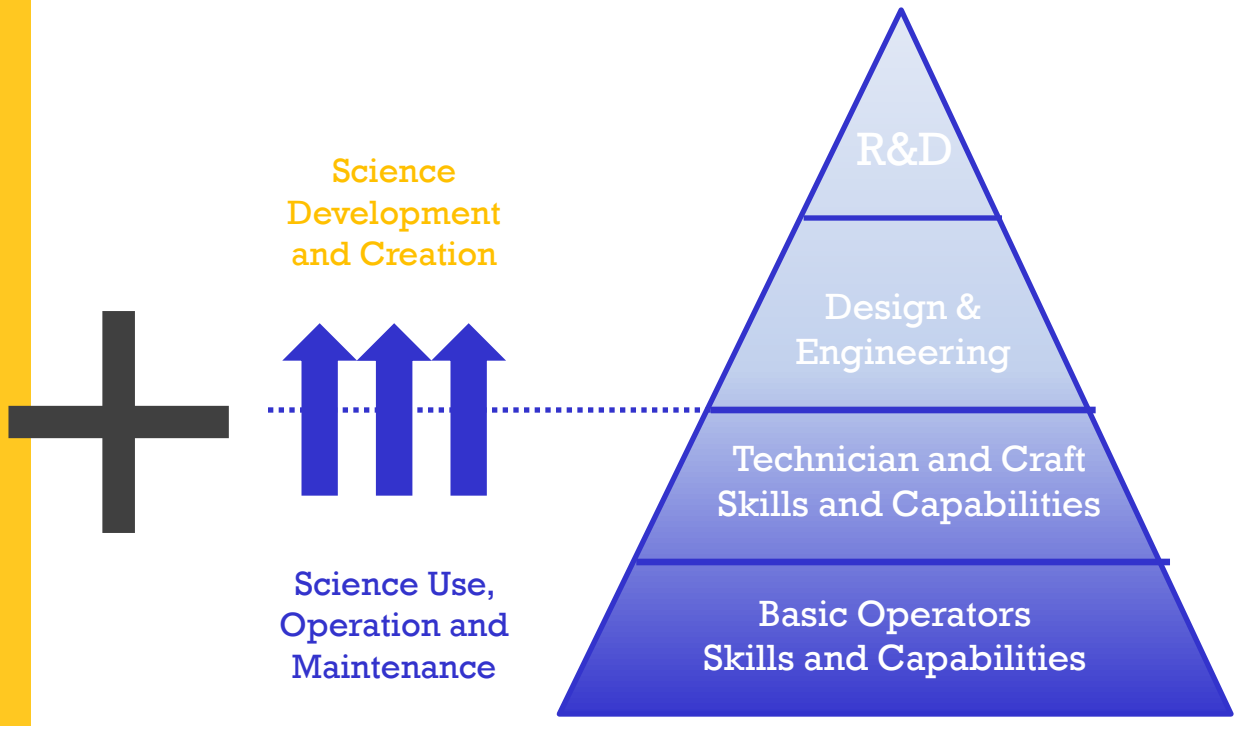
Enabling Environment

Actors & Institutions

Interactions

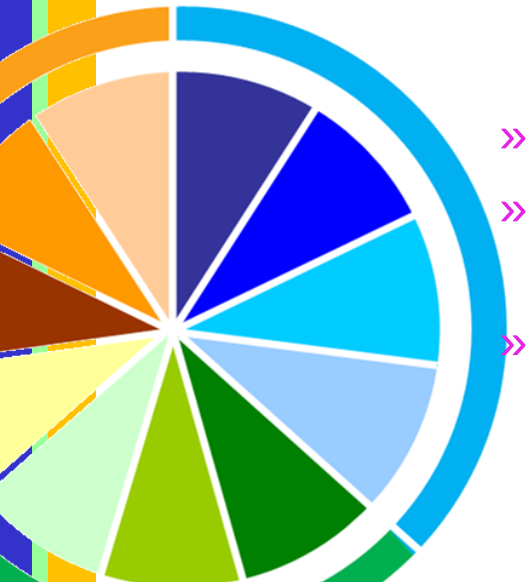
Outputs & Outcomes





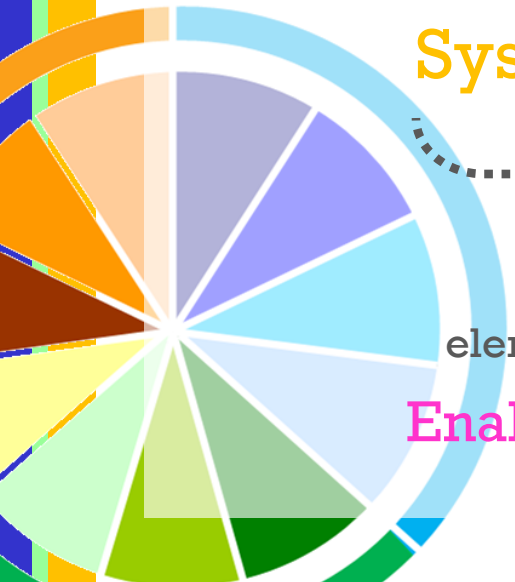
Research Approach: What metrics exist, what don't?

- GKI examined over 4,000 indicators in more than 28 indexes and numerous databases
- Observations on existing STI indexes and databases:
  - » Many economic development indexes (WEF Global Competitiveness Report, World Development Report) give only marginal attention to STI
  - » Existing OECD indicators often not available in LDCs
  - » Some STI Indexes (KAM) out of date /no differing indicator weighting for differing country contexts
  - » Some STI Indexes measure broad categories (infrastructure) without exposing the S&T elements required for innovation



Mapping Innovation Systems to Innovation Metrics

1. Innovation Actors
2. Linkages within the Innovation System
3. Outputs of the Innovation System



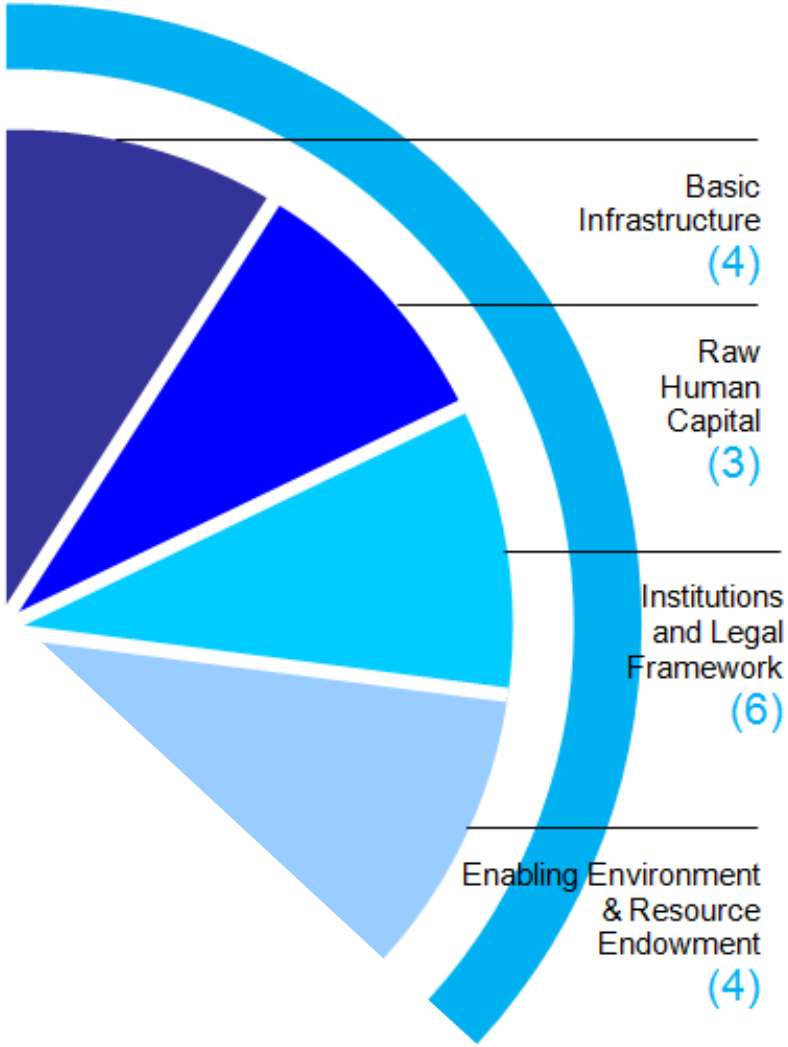
Each Innovation System element underpinned by the

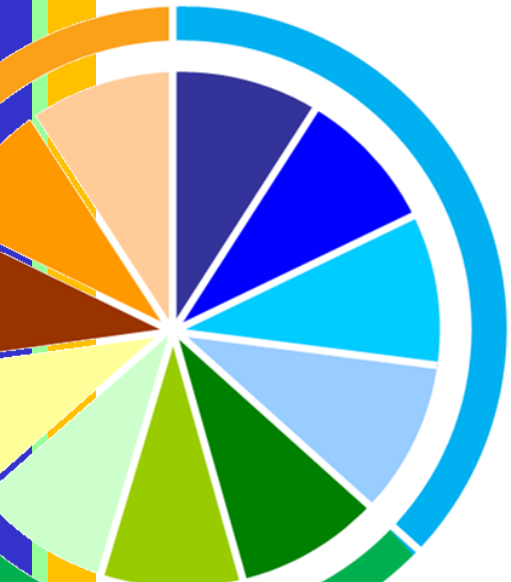
Enabling Environment

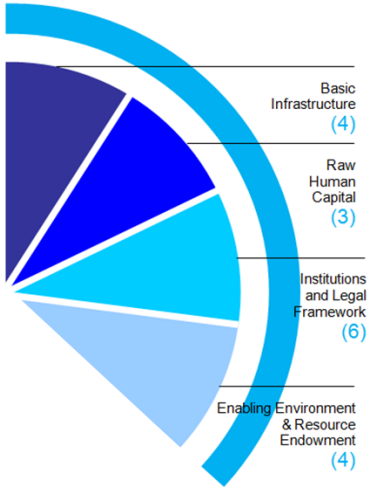
1. Inputs and Framework Conditions
2. Knowledge Networks and Interactions
3. Innovation Outputs and Outcomes

3 pillars with 11 clusters of variables

Pillar I: Inputs and Framework Conditions







Variables in Pillar I

Cluster 1: Basic Infrastructure:

- Examples:
  - Logistics Performance Index
  - Electric Energy Used per capita

Cluster 2: Raw Human Capital:

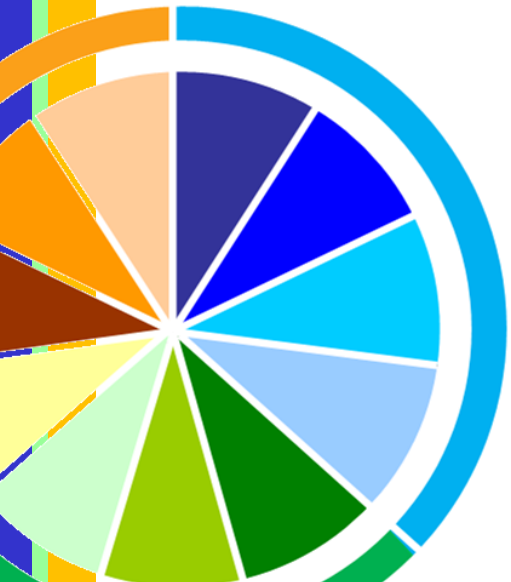
- Examples:
  - Primary School Enrollment (% Gross)
  - Life Expectancy at Birth

Cluster 3: Institutions and Legal Framework:

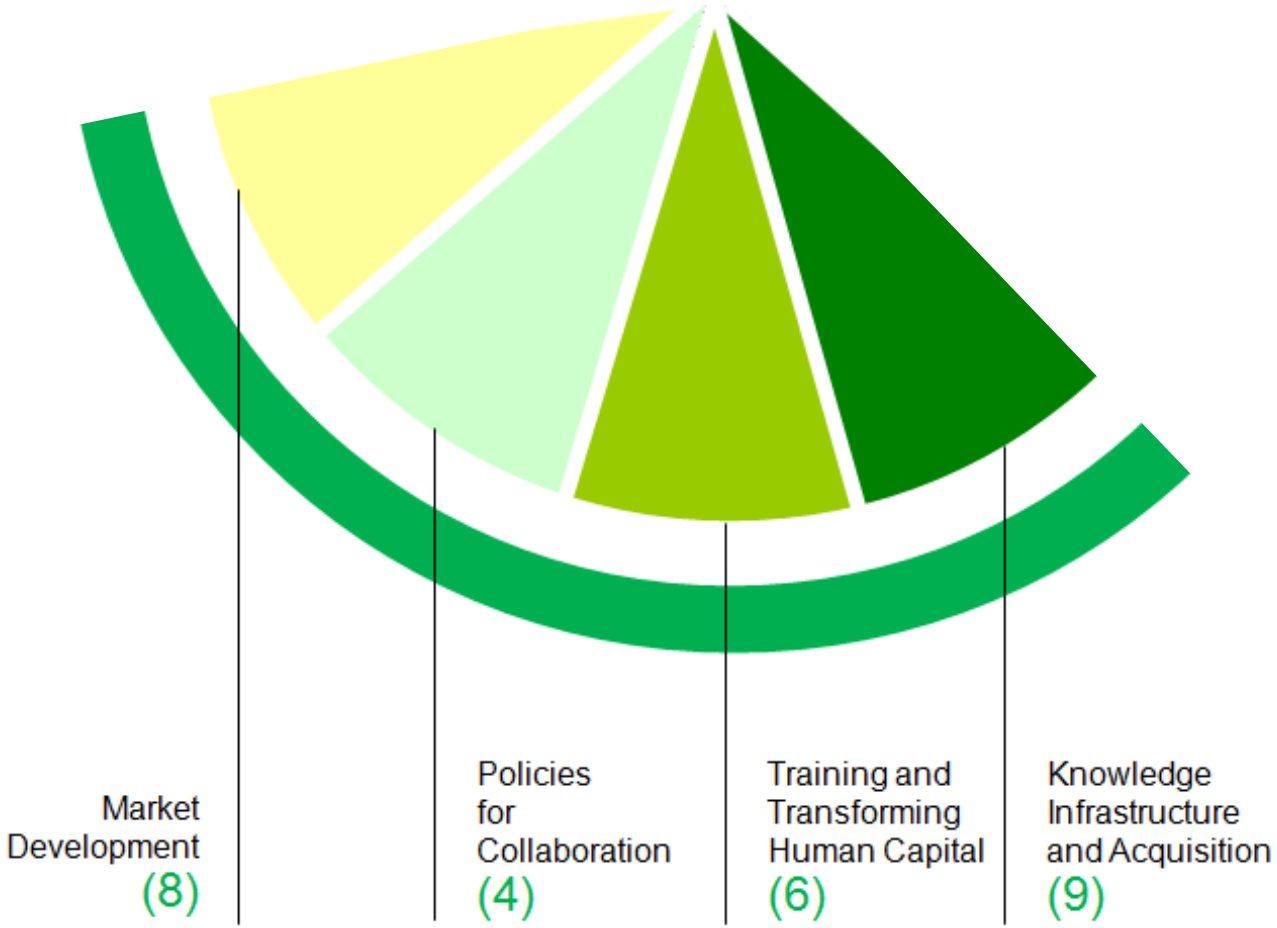
- Examples:
  - Government Effectiveness
  - Voice and Accountability
  - Education Policy Index

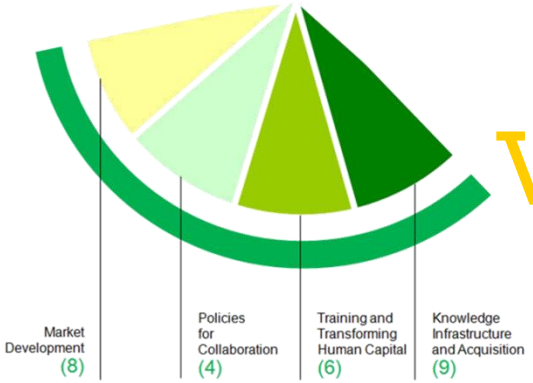
Cluster 4: Enabling Environment and Resource Endowment:

- Examples:
  - GDP Per Capita
  - GDP Growth (% Annual)
  - Environmental Performance Index



Pillar II: Knowledge Networks and Interactions





Variables in Pillar 2

Cluster 1: Knowledge Infrastructure and Acquisition:

- Examples:
  - Telephone Subscriptions total per 100 people
  - Internet Users per 100 people
  - Royalty and License Fee Payments
  - Imports of High-tech Goods

Cluster 2: Training and Transforming Human Capital:

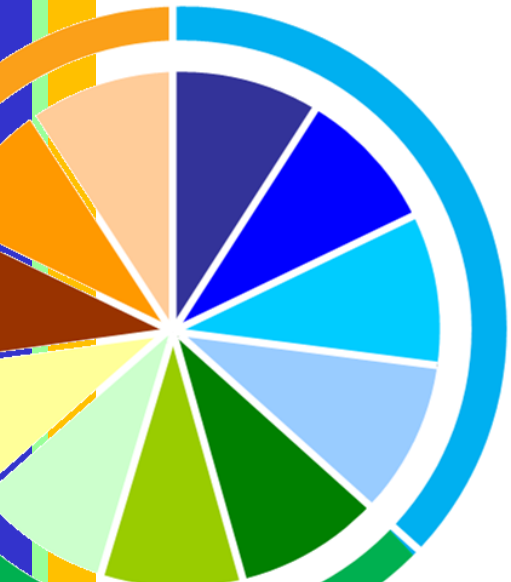
- Examples:
  - Tertiary S&E Students as % of Tertiary Students
  - Extent of Staff Training
  - Local Availability of Specialized Research and Training Services

Cluster 3: Policies for Collaborative Innovation:

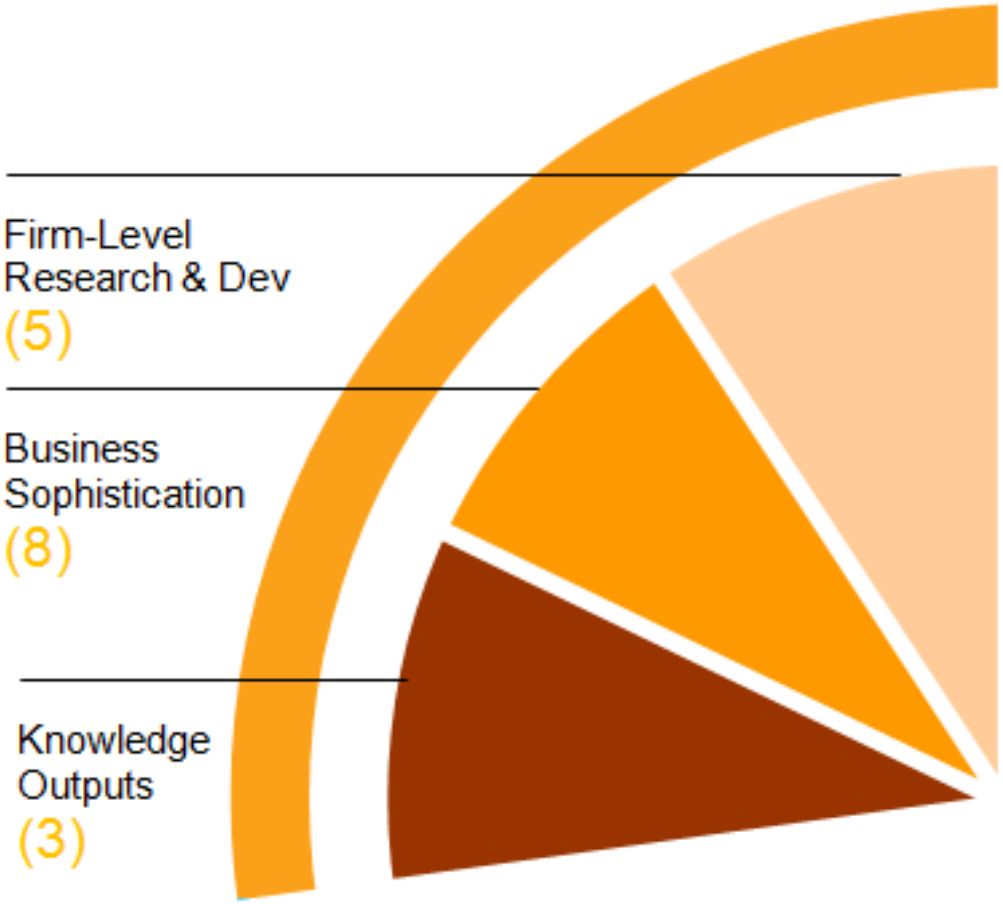
- Examples:
  - Government Investment in R&D
  - Research Policy Index
  - Protecting Investors

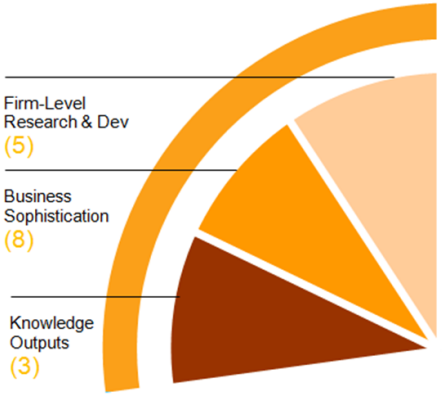
Cluster 4: Market Development:

- Examples:
  - Market Size
  - Labor Market Efficiency
  - Manufactures Exports as % of merchandise exports
  - Getting Credit



Pillar III: Innovation Outputs and Outcomes





Variables in Pillar 3

Cluster 1: Knowledge Outputs:

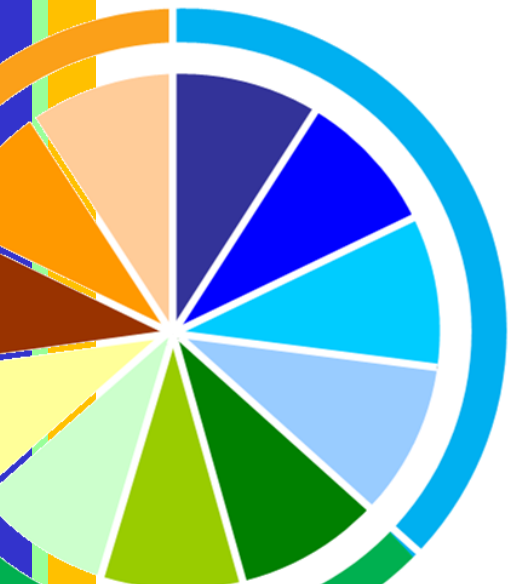
- Examples:
  - S&E Articles Published per 10,000 People
  - Intl Patents Per 10,000 People

Cluster 2: Firm-level Research and Development:

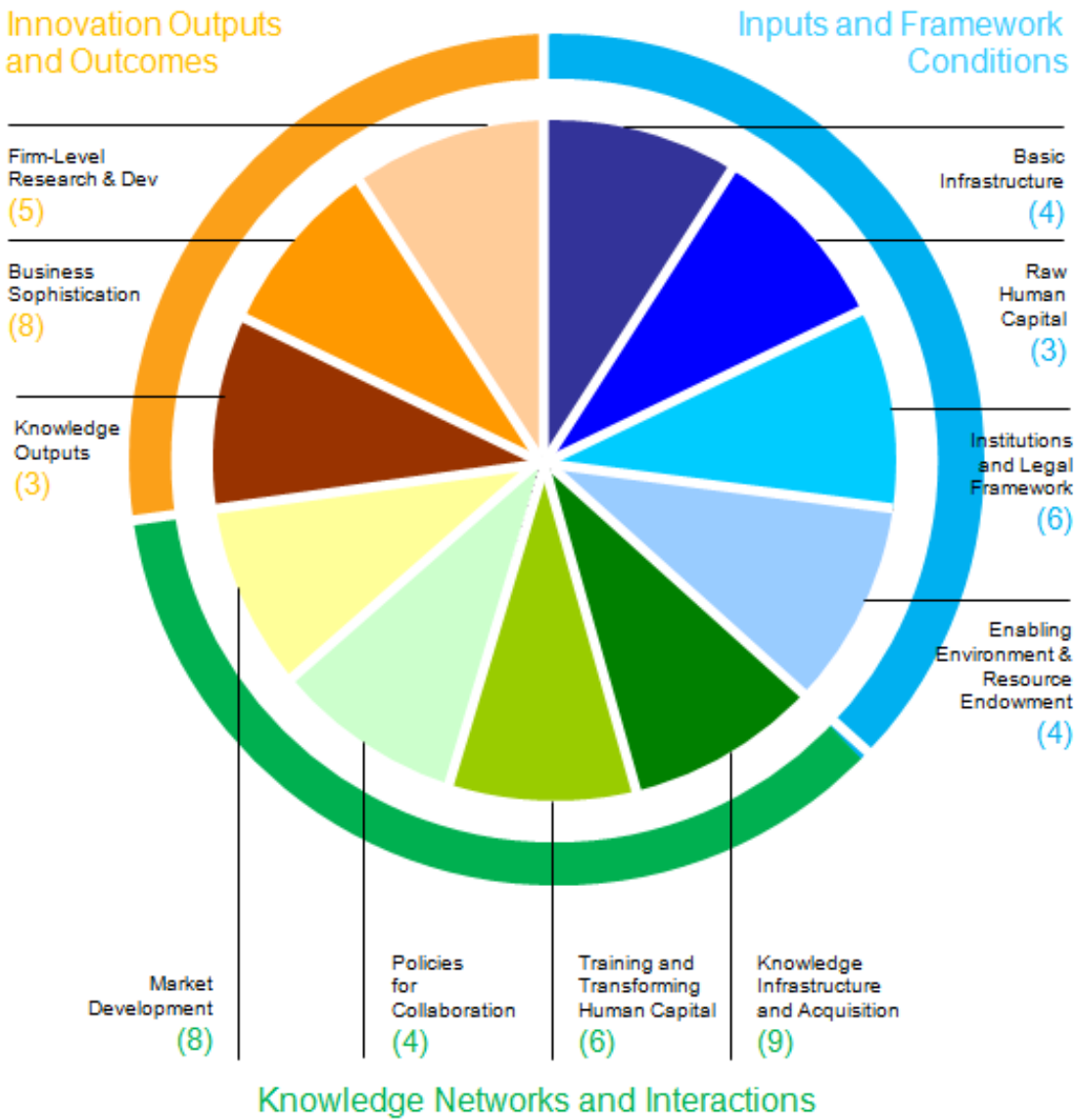
- Examples:
  - Company Spending on R&D
  - Royalty and License Fees Receipts (per capita)
  - University-Industry Collaboration in R&D

Cluster 3: Business Sophistication:

- Examples:
  - Extent of Business Internet Use
  - Value Chain Breadth
  - Venture Capital Availability
  - Ratio of Scientists to Firms



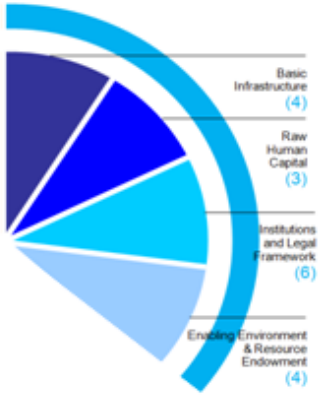
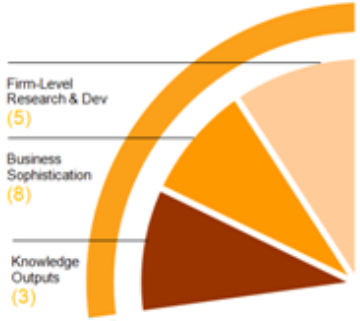
The Global Knowledge Initiative Collaborative Innovation Index



What matters when?

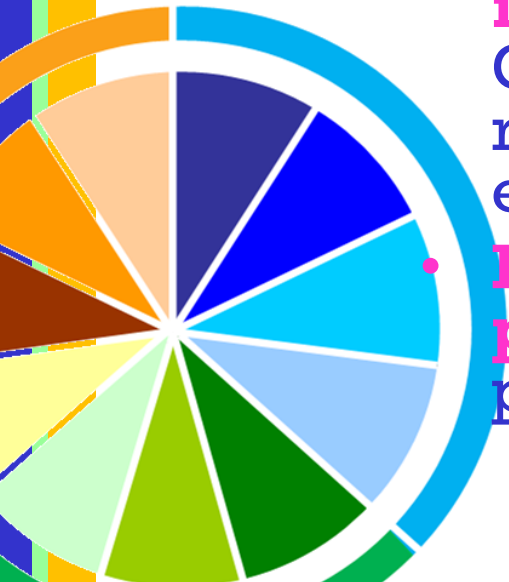
Measuring Collaborative Innovation

Weightings Used for the Collaborative Innovation Index Indicators

"Basic Indicators" Inputs and Framework Conditions	"Efficiency Indicators" Knowledge Networks and Interactions	"Innovation Indicators" Innovation Outputs and Outcomes
		
Weights of the three main pillars for a Factor-Driven Economy (Examples: Rwanda, Uganda, Bolivia, Chad, Haiti, India)		
60%	35%	5%
Weights of the three main pillars for an Efficiency-Driven Economy (Examples: Botswana, Hungary, China, Costa Rica, Jamaica, South Africa)		
40%	50%	10%
Weights of the three main pillars for an Innovation-Driven Economy (Examples: Australia, Netherlands, Japan, United Arab Emirates, Slovenia)		
20%	50%	30%

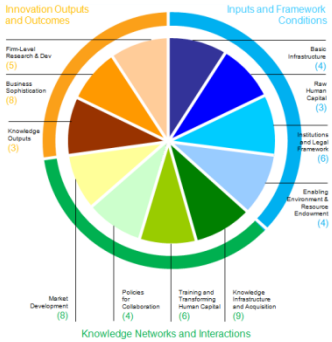
Taking GKI's Collaborative Innovation Index Further

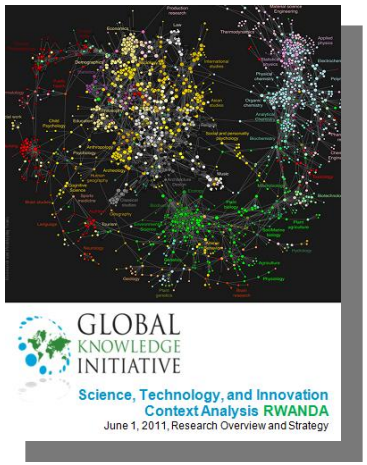
- **Indicators + Qualitative Analysis:** Buttress Index results with insights produced through the STI Context Analysis
- **Interview country experts:** Deepen the institution-level analysis with the Knowledge Partnership Landscape Analysis surveys
- **Push the knowledge frontier in STI indicators:** Continue progress in understanding complex relationships between institutions, enabling environment and international partner context
- **Involve scientists and innovators in the process:** Ensure scientists involved in painting the composite picture the CII reveals



Mapping the Challenge Genome

National STI Context: Review of National STI Policy; STI Skills and Learning Opportunities; Orientation of Existing Knowledge Networks and STI Interactions; Knowledge Infrastructure; Science Entrepreneurship and the Private Sector





Sectoral Analysis of the Challenge: A recent history of innovation in the sector; Business and economic context; Institutional profiles; Beneficiary profiles

Institutional Analysis of the Challenge:

Interview and survey-based analysis of critical STI resources at play to enable or hinder collaborative innovation at the level of the institution and the team presenting the challenge to be tackled; Uses a World Bank-published methodology designed by GKI team;

Knowledge Partnership Landscape Analysis

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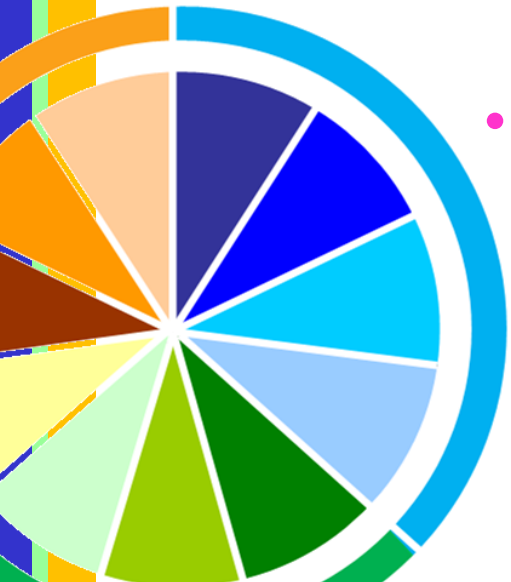
Contributing to the Knowledge Commons with GKI's Collaborative Innovation Indexing and STI Metrics

- **Mind the gap:** Let's fill the gap in measures of innovation inputs and outputs
- **Networks need nurturing:** Locating resources an essential first step toward building purpose-driven STI networks
- **Knowledge commons enable tackling global challenges:** Access to data vital to bridging communities that must collaborate to solve complex development challenges



For more information about the Global Knowledge Initiative's

Collaborative Innovation Index

www.globalknowledgeinitiative.org

Thank you.

Global Knowledge Initiative

Questions? Email:
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