5 INDUSTRY-SCIENCE LINKAGES AND COLLABORATION FOR INNOVATION

with some references to 4. Knowledge generation and absorption (S. Radošević) & to 6. Financing innovative entrepreneurs (A. Kaderabkova)

State Committee of Science of the Republic of Armenia & United Nations Economic Commission for Europe

Innovation Performance Review of Armenia
14 November 2014

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Main topics of the presentation

- Transition of Armenian innovation system
  Why are interactions important between S and I?
- How are Armenian key actors working for innovative society and to move away from isolated gov.-ind.-sci. relationships toward horizontal TH model?
  - Armenian government as facilitator of ISLs
  - Attempting to identify any buds of industry-science linkages
- Barriers to industry-science linkages
- Funding of innovative entrepreneurship
- Final remarks (lessons)
- Recommendations
• **Redeployment of science system and reforming HE system**
  - managing intellectual assets but inexperienced IPR-management
  - Value of science was re-evaluated by transformation and slow adjustment to new challenges (Disciplinary comparative advantage; reverse engineering-imitation)

• **Poor skills upgrading** in the last 20 years which has now become constraint to future growth

• **Upgrading IPR system** and joining WTO TRIPs; US most favoured nation clause;

• Re-coding the existing **institutions**, setting up missing institutions
Transition 2/2

- Privatization and redeployment of business organisations
  - A few remaining large firms that are poorly or not linked with the rest of economy dominated by small or micro enterprises of low technological level
  - A very limited integration into global value chains

- Creation of micro and small business
  - Enforced; family-owned; entrepreneurial; spin offs)

- FDI

Command-led industry-science linkages were interrupted when ’Soviet-type integration’ turned into disintegration

Resuscitating the government, science and industry linkages is very time-consuming.
Lesson from assessment of knowledge generation and absorption (Chapter 4)

- Development option: *to move towards a knowledge-based economy*, influenced by
  - Scarcity of natural resources
  - High transport costs (geographical position)

- Main asset: *skilled labourforce*
  - Weaknesses: Current educational system and vocational training

Some good training and education initiatives to **accumulate qualified staff** for knowledge-based industries
The biggest obstacle - irrelevant policy models

- A policy wish for **R&D driven growth** (directly commercializing results of public or private R&D through new technology based firms) vs. growth based on **production capability; move away from linear model** (feedback loops)

- Policy should broaden its view of innovation which is currently confined on ’commercialization of R&D results’ (Org. Marketing)

- Technology upgrading requires beyond R&D increased skills and increased **absorptive capacity of labour force**

- Which dimensions of tertiary education, vocational education and lifelong learning can be considered as bottlenecks to increased innovativeness and industrial upgrading > **growth-enhancing expenditure**
Government as facilitator for ISLs

- Legal regulations and framing
- Policies and programs
- Mechanisms for ISLs
Legal regulations framing interactions in Armenia

- Law on Scientific and Technological Activity
  Further legal reform *should extend economic autonomy of HEIs and NAS institutes:*
  - *Harmonising the Law on HEIs and the Law on State non-commercial organisations for removing factors burdening ISL*
  - Offering appropriate framework for *the creation of spin offs*

**Enforcement of the laws on IPRs**
Policies -- post 2008 phenomenon

- Industrial policy  -- Export led (2011)
- Innovation policy  -- Concept paper (2011)
  -- Cooperation project
- Science policy  -- Strategy of Science Development (2010)
  -- Action Plan (2011)

- The overall weight of Armenian industrial policy is around €0.6mn - really marginal even for poor country

Armenia does not yet have RDI policy for business sector -- absent statistics on business R&D and innovation

Based on: chapter 4 and 5
Impact of relevant policy targets depends on measures.

- Policies are frequently donor driven (a diversity of actions very often linked to donors programs and focused most often on ICT).

- Domestically driven policies and programs often have very limited funds at disposal.

- Recently EUFP7 was the main funding program from abroad.

- Encouraging development of industrial export led policy supported by ADA.

- To upscale budget for initiatives & programs that turn out to be successful & promising.
Government policies and programmes can encourage industry partnership-building with a strong science base.

Innovation policy should emphasise the importance of ISLs and introduce relevant programmes for improvement situation

Public initiatives could include

- **Knowledge-based innovation** activities of firms
- Encouraging HE graduates to establish start-ups
- **Co-designing FDI & STI policy** to attract more foreign investors employing Armenian scientific assets.
- Promoting **cross-border IS linkages**
Mechanisms for interaction between Industry and Scientific Organisations (HEIs, PROs)

Governments for upgrading ISLs – encourages IS collaborations with incentives.

→ Pushing business toward outsourcing to universities, collaborating with universities.

**Impact of measures**

<table>
<thead>
<tr>
<th>Helping to build partnership and leading to relevant collaborations</th>
<th>Resulting temporary collaborations: business just exploiting the advantages of the incentives</th>
<th>Phoney collaborations can also occur</th>
</tr>
</thead>
</table>

**MAIN TOOLS introduced in Arm**
- Supporting agencies (matchmaking)
  Office in Silicon Valley, conf/exhib
- Grand projects
  Candle Centre for Radiation Medicine, Cyclatron
- Free economic zones
- IT firms
- Tech parks, Business incubators
- Competition based supporting prg.
- PPPs, infrastructure modernization

**MAIN TOOLKITs that may introduce**
- Tax incentives
- Innovative public procurement
- Facilitating the development of TTOs / TTO functions
- Supporting scheme for patenting
Characteristics of Industry

Influencing factors of ISLs:

- sectoral structure
- size of firms
- owners
- innovativeness
- business R&D
## Important Armenian export sectors:

- Brandy manufacturing
- Pharmaceuticals & biotechnology;
- Precision engineering

## Size, owners

### Domestic companies:
- small size,
- typically family-owned
- family–managed

### Inadequate managerial skills

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PharmaTech CJSC (overseas owned manufacturing company) in Yerevan
**Types of Industrial R&D**

- **Exploratory**
  - Search for the continuity of the innovation: *feeding exploitation with reliable technologies*

- **Exploitative**
  - Search for the innovation in the continuity: *obtaining new products out of well known methods*

- **Imitative**
  - Innovation in copying: *taking advantage of competitors’ innovations*

- **Non-existing**

**Few characteristics by the types**

<table>
<thead>
<tr>
<th></th>
<th>Exploratory</th>
<th>Exploitative</th>
<th>Imitative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology exchanged</td>
<td>More tacit, embodied in people</td>
<td>Less tacit, embodied in artefacts or texts</td>
<td></td>
</tr>
<tr>
<td>Linkage with universities</td>
<td>Many and stronger</td>
<td>Few and weaker</td>
<td>Negligable</td>
</tr>
</tbody>
</table>

Collaborations occur if industry is hungry for innovation.
Characteristics of Science

• Universities
• Types of collaborations by models of interactions
Universities: multi task organisations

1st Mission
Education

2nd Mission
Research

3rd Mission
Collaboration with economy and society

Type of Universities

- Teaching
  - Bachelor only
  - and master

- Teaching & Research
  - (B + Master + PhD)

- Research & Teaching

- Entrepreneurial

The main role of U-I collaboration:

- Fill the funding gap? (X)
- To make the science more useful to society?
The spectrum of research and funds

**Fundamental**
- Think tank universities
  - Criteria: academic excellence
  - Public sources are crucial
  - Private sources may be present

**Applied**
- Do tank universities
  - Criteria: Serve properly emerging need of industry
    - These universities are not leaders but followers of industrial development (Cooper)
    - Domestic industry has key role to create demand for ‘do tank’
      - Private sources has to be present
# Armenian examples on Research active universities

<table>
<thead>
<tr>
<th>Think tank universities</th>
<th>Do tank universities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yerevan State University</td>
<td>Yerevan State Engineering Univ.</td>
</tr>
<tr>
<td>Russian (Slavonic) - Armenian University</td>
<td>Yerevan State Medical University</td>
</tr>
<tr>
<td>American University</td>
<td>Agrarian University.</td>
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<tr>
<td></td>
<td>Architectural University.</td>
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</table>
Private fund may fluctuate because...

Satisfaction of partners

- Periodicity in demand
- Business cycle
- Redeployment in the structure of partners
- Changes in government incentives for business

These factors are influencing the size and yearly changes of private fund in university / research institute budget.
Models of Interactions

Isolated

Far Distance

Arm's Length Cooperation

Triple Helix

Horizontal
<table>
<thead>
<tr>
<th>Type</th>
<th>Function</th>
<th>Armenian examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ad hoc consultation of firm at universities</td>
<td>Information gathering</td>
<td>Conferences have been organised for building linkages typically in specific sectors (e.g. ICT, medical)</td>
</tr>
<tr>
<td>Regular discussions between U/I on various issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchase of university research results on ad hoc basis</td>
<td>Knowledge dissemination</td>
<td>YSU Faculty of Radio physics</td>
</tr>
<tr>
<td>Lectures of firm employees held at universities</td>
<td></td>
<td><em>Synopsis</em> lecturers trained the staff to disseminate best practice</td>
</tr>
<tr>
<td>Lectures of faculty members held at firms</td>
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</table>
Collaboration for business demanded labour-force in Armenia

Comprehensive teaching and training programs in cooperation with leading technological companies:

Interdepartmental Chair of “Microelectronic Circuits and Systems” established by LEDA Systems (acquired in 2004 by Synopsys Inc.) & SEUA.

The Chair, now part of Synopsys University Program, supplies more than 60 quality VLSI and EDA specialists each year.

Later similar interdepartmental chairs were opened: at YSU, RAU and ERA;

• SUN educational laboratories formed by Sun Microsystems, EIF, and USAID at SEUA, YSU and RAU in 2008;

• Gyumri IT Training Centre, established by the Fund For Armenian Relief (FAR) and EIF in 2006, in Gyumri IT Centre;

• Microsoft Innovation Centre formed by Microsoft, EIF and USAID at SEUA;

Result: good qualified professionals for several companies and industry in general. (Filling the gap in teaching curricula)
<table>
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<th>Function</th>
<th>Armenian examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employing faculty members as regular consultants</td>
<td>Information gathering</td>
<td>Joint working as professors at university and engineers at firms (YSMU, YSEU, and YSU) – <strong>dual-jobs</strong></td>
</tr>
<tr>
<td>Coaching of firm employees by U researchers</td>
<td>Knowledge dissemination</td>
<td><strong>YSU / Faculty of Radio physics / - Synopsis PhD students conducting research</strong></td>
</tr>
<tr>
<td>Training of firm employees by professors</td>
<td></td>
<td></td>
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<tr>
<td>Joint supervision of theses by U-I members</td>
<td></td>
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</tr>
<tr>
<td>Joint publications by professors and firm employees</td>
<td>R&amp;D</td>
<td><strong>Scattered</strong>&lt;br&gt;<strong>Not yet (domestic, cross-border)</strong></td>
</tr>
<tr>
<td>Joint IPRs by I-U employees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Function</td>
<td>Armenian examples</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
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<tr>
<td>Formal R&amp;D co-operations - joint R&amp;D</td>
<td>R&amp;D</td>
<td>YSMU/Pharmaceutical Faculty) - Dental research firm in Garni - Arpimed pharmaceuticals</td>
</tr>
<tr>
<td>Regular acquisition of university research</td>
<td></td>
<td>YSEU – NIs, IBM, Nokia softwares</td>
</tr>
<tr>
<td>Formal R&amp;D co-operation – outsourcing</td>
<td>R&amp;D infrastructure</td>
<td></td>
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<tr>
<td>Access to special equipment of I/U</td>
<td></td>
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<tr>
<td>Investment in university’s facilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Types of vertical and arm’s collaborations + any kinds of R&amp;D linkages</td>
<td>Knowledge dissemination &amp; Information gathering</td>
<td></td>
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</table>
Towards a new innovation system

- Armenia has **functioning patches of innovation system** and it should try to **build on its functioning enclaves**.
- **Adequate institutional changes are crucial**
- Its future innovation system will emerge through a **series of trials and errors** which should involve all potential ‘agents of modernisation’ be it FDI, local new technology based firms, competent public and non-public organisations, or useful support programs.
- The role of policy should be to serve as **leverage to emerging niches of potential growth** with the aim to upscale them.

Based on S. Radojevic slide
Linkages between I-S are **rather poor**.

Inward FDI and outsourcing R&D from abroad are still playing limited role in Armenian ISLs

The **successful commercialization** of academic research can bring important **benefits** for the
- performing organisation
- overall economy

Improving ISLs **coordinate multiple policies**:
Science + Innovation + FDI + Industrial development

**Special government measures can facilitate** to involve FDI
- building up international industry-science collaborations
- commercialization of national scientific products;
- moving away from science push model
Policy-makers need knowledge on the barriers of collaborations:

• Weaknesses of firms?
• Failures of universities / institutes of Academy?
• Lack of technology supporting organisations?

Capability for collaboration may require changes within the organisations
Evidence-base policy making and the development of a strategy for HEIs and PROs requires:

- well-developed evaluation initiatives
- relevant statistics (data and indicators)

- To **harmonize R&D statistics with international standards** (Frascati)
- To introduce **innovation statistics** – extend twining programs in this area + establish surveys on R&D and innovation in business sector

The authorities should promote both **internal & external evaluation of** gov. agencies and HEIs, PROs by to the following principles:

- The results of evaluation should lead to decisions on strategy formulation and policy changes **incl. allocation of financial support**;
- Evaluation of scientific org. should be carried out on a **periodic basis** (covering scientific performance, scientific assets, physical and human capabilities, governance and management, and linkages with industry);
- State supported TTOs should be evaluated periodically
Recommendations

4. Knowledge generation and absorption
R 4.1: Modernise and internationalise HE

- **Modernise and evaluate curriculum** in order to ensure that skills of its graduates correspond to needs of future growth based on technological knowledge.

- **International training for teachers** should be based on highly competitive selection process and on promising career opportunities. This should be important component of modernisation of curriculum.

- All R&D institutes to be integrated into higher education system via joint PhD and other education programs.

- **Vocational based universities** could develop much better links with business sector, including foreign firms.

S. Radosevic
R4.2: Increase investment in R&D, especially in Business Enterprise Sector

- Support to R&D should be extended to engineering and innovation management, including support to quality improvement programs (like ISO9001 standards, ISO14000 environment standards and industry specific international standards, CMM Certificates).

  Innovation Vouchers can be used for innovation activities such as: innovation / technology audit; tailored training in innovation management; new business model development; new service delivery and customer interface; new service development; knowledge of product and service testing, economic impact assessment and efficiency audits.

- Armenia should introduce public innovation procurement for small technology based firms similar to known US SBIR program.

S. Radošević
R 4.3: Restructure R&D system: from survival to growth

- **Active RD restructuring** which until now was passive with some elements of active restructuring (e.g., mergers of some institutes). Some of R&D institutes to be reoriented to become technology supporting institutes to knowledge intensive SMEs and working in dual-mode (public funded programs / commercial services) focused on technology upgrading in specific sectors. These technical institutes should closely cooperate with technoparks.

- Criteria for evaluating of R&D cannot be only international excellence but also local relevance. Criteria for evaluation should be manifold reflecting different functions of different organisations.

- The international evaluation of R&D organisations for restructuring of R&D system (World Bank loan) should be accompanied by plan for gradual relative increase of public expenditures for education and R&D in GDP over 10 year period as strategic orientation.

R4.4: Integrate FDI and innovation policy – see 5.1.

S. Radošević
5. ISLs and Collaboration in the Innovation Process
R 5.1 **Innovation policy should emphasize the importance of ISLs and introduce relevant programmes to improve the current situation.**

Public initiatives could include:

- *Developing instruments* that target links between I-S public financing depends on the existence of collaboration;
- *Encouraging HE graduates* to establish start-ups;
- *Co-designing FDI policy and STI policy* to attract more foreign investors employing Armenian scientific assets;
- *Promoting cross-border linkages* between Armenian science and innovative foreign companies, creating a source of income and facilitating access to global networks of knowledge.
Substantial public support is required to promote ISLs at the early development stages, with initial public funding necessary before TT activities can be profit making.

To encourage the development of the necessary capacities and facilitate commercialization, the authorities could consider:

• Facilitating the development of TT functions within scientific organizations, through
  • training on licensing and research contracts and IP related issues;
  ◦ Designing a scheme to support patenting
    • that includes advice on international protection and grants
  ◦ Strengthening the capacity of the IP Agency to offer broader services to its clients.
The authorities should extend the economic autonomy of HEIs and the NAS’s research institutes, through legal reforms and encouraging to develop internal regulations concerning technology transfer.

Legal reforms could include:

- Harmonizing *the Law on HEI and the Law on state non-commercial organizations* in order to remove legal barriers to ISLs;
- Providing *equal opportunities* to different organizations to revise their *Charters* -- they can engage in entrepreneurial activities;
- Putting in place an appropriate framework for the *creation of spin-offs* emerging from HEIs or NAS's;
- Developing *guidelines on IPR* issues to be included in employee contracts on the *management of TTOs*. 
6. Financing innovative entrepreneurs
The authorities should make efforts to develop better information regarding entrepreneurship and support initiatives, which should be widely shared.

The following actions could be considered:

- *Learning lessons from entrepreneurship support initiatives*, identifying good practices, factors explaining their success and the conditions required to scale-up or expand the scope of these initiatives. Strengthening of **analytical capacities & impact evaluation methodologies**;

- Joining the Global Entrepreneurship Monitor surveys **for making comparisons** between business activities across time and in relation to other countries; and

- Developing *information and awareness campaigns*, with the support of entrepreneurial associations and other stakeholders, to ensure that potential beneficiaries are aware of the possible forms of support and how to access them.
The authorities should strengthen their efforts to provide a strategic orientation for entrepreneurship support.

The following actions could be considered:

- Defining *strategic targets*, which are regularly *evaluated* and *updated*. The implementation of the strategy should envisage clear responsibilities, allocation of resources and coordination mechanisms;

- *Involving* beneficiaries and other sources of expertise, such as the diaspora, in determining the strategic orientation;

- Sitting up a body with *clear responsibilities and competencies for implementation and monitoring of the strategy*;

- *Identifying synergies and complementarities* among various programmes. Coordinated approaches should introduce schemes that build on previous experiences or seek to complement different programmes.
The authorities could explore further ways to tap into the potential of the Armenian diaspora to support innovative entrepreneurship in the country.

Initiatives that could be considered include:

- **Awareness and information campaigns targeting the diaspora** in existing and planned research programmes as a source of potential business opportunities;

- Development of a **framework for business angel financing** which takes into consideration cross-border aspects, so it can attract resources from the diaspora; and

- **Involving the diaspora in the design and implementation of mentoring and coaching** schemes for entrepreneurs and, in particular, those originating for educational research organizations.
Thank you for your kind attention!

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