Technology Extension Concepts and Models

Jan Youtie

1. Georgia Institute of Technology, Atlanta, GA, USA

Email: jan.youtie@innovate.gatech.edu | stip.gatech.edu | Twitter: @JanYoutie

Overview

1. Introduction – What is Technology Extension
2. Why are Technology Extension Services important?
3. Positioning and Strategy – Where and How
4. Service Models, Practices, Characteristics
5. Key Insights

What is Technology Extension?

- **Advice and expertise** offered directly to enterprises to improve technology use and innovation
- **Targets** – small and medium-sized enterprises (SMEs), often in manufacturing, but also other types of firms
- **Diverse names in different countries**
  - "manufacturing extension"
  - "innovation advisory services"
  - a component of "business support services"
  - a component of "applied technology centers"

Why Technology Extension?

Technology Extension Services can be overlooked as policies focus on advanced R&D and selected high technology targets.

75% of potential productivity growth for G19 countries comes from catching up to current best practice

82% for emerging economies

(McKinsey Global Institute, 2015)

Technology Extension Services:

Rationales for Intervention

❑ Market failures

- Demand-side: SMEs lack information, knowledge, resources to implement modern methods and new technologies
- Supply-side: Large customers, vendors, consultants don't or can't support SMEs; Trade associations weak

❑ Government and service failures

- Gaps in *public* service provision for SMEs

❑ Strategic concerns

- Economic competitiveness – maintaining jobs while growing wages;
- Rebalancing, expanding exports
- Develop supply-chains and clusters, for new rounds of technological growth
- Foster local and regional economic development

Technology Extension Services

HOW?

Typical service methods

- Information provision
- Benchmarking and assessment
- Technical assistance or consultancy
- Referral, links with finance
- Training
- Group or network services; supply chain development
- Collaborative projects (R&D, implementation)
- Strategy development; coaching and mentoring

Example: Typical Information Technology Services

- Bar code readers, RFID
- Computer aided design (CAD) computer aided manufacturing (CAM)
- Information business software system, e.g., Enterprise Resource Planning (ERP)
- Supply chain management system
- Customer relationship management (CRM)
- Partnership with others for website design, computer networks, cybersecurity
- Stakeholder participation in advanced R&D projects
  - Additive manufacturing
  - Cyber Physical Systems/Internet of Things (linking the internet and manufacturing)
  - Mass customization
  - Cloud computing
  - Next generation digital manufacturing labs
  - Digital manufacturing commons for data sharing, analysis, modelling, tooling, building

History of technology extension in the US is a rural one

- Cooperative extension – 1914 Smith Lever Act
  - Partnership between USDA and US land grant universities to use "extension agents" to transfer university
  - research findings to farms
  - Cooperation between national-state-county government

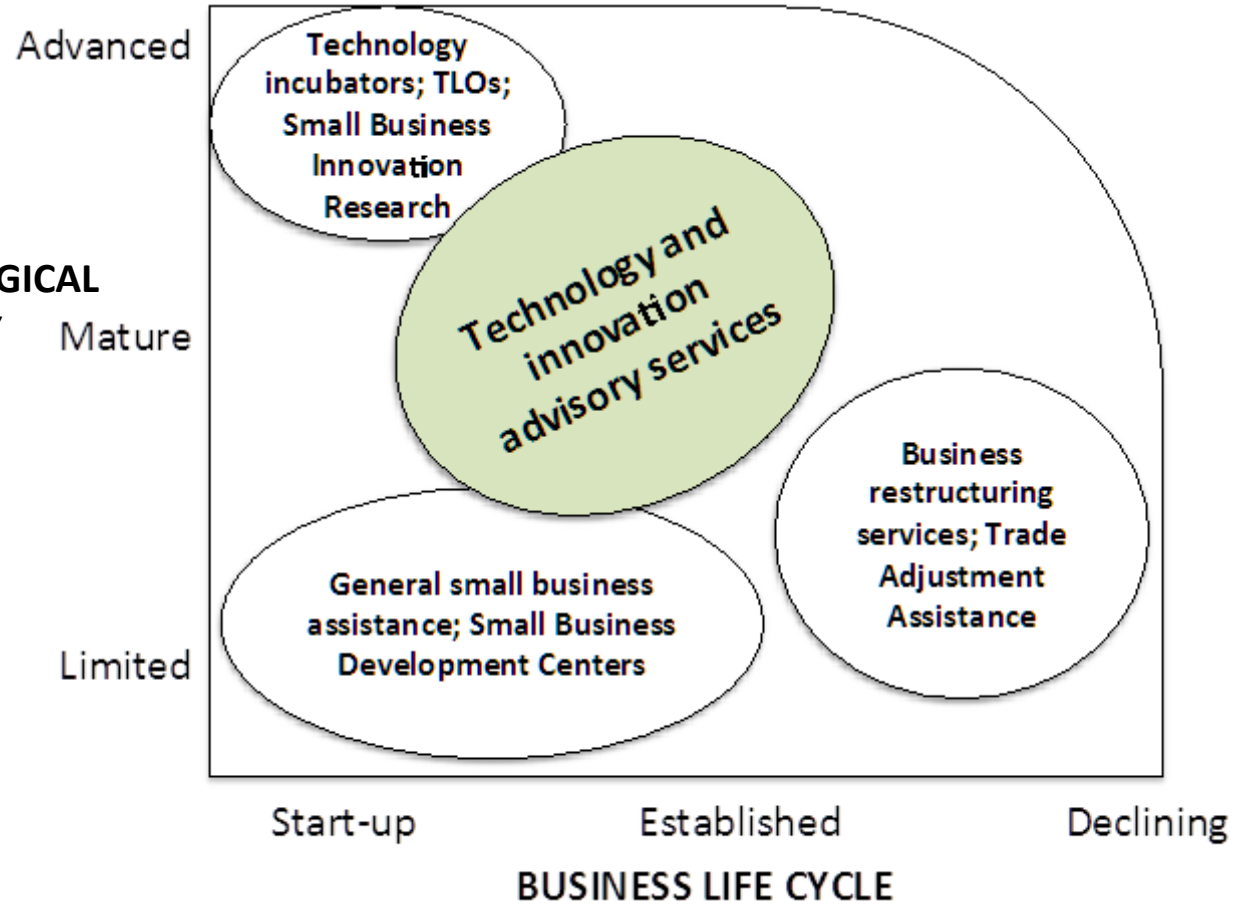
- Industrial extension
  - 1955 (North Carolina)
    1960 (Georgia)
  - Transfer pragmatic, off-the-shelf technologies and techniques to rural manufacturers to enhance their productivity, growth, competitiveness

Positioning

Innovation Policies

Vs.

Private Economy



Source: Shapira et al., 2015

TES Boundary Issues

- Manufacturing-services:
  - manufacturing as a “traded industry” v. manufacturing-plus programs (high value services) v. other goods & services sectors
- Integration
  - Of productivity and innovation services (TES core service) with business and marketing efforts (business assistance) and other support services (finance, training)
- Focus:
  - Technology v. sectoral v. regional? Best guidance: reflect the broader needs and makeup of a country’s industrial base

What TES it is not!

- **Not just about technology transfer from labs to firms**
  - but about systemic measures to improve firms technological and business capabilities for innovation
- **Not just about advanced technology**
  - but about pragmatic improvements in operations and practices, usually with commercially-proven technologies
- **Not a short-term jobs program**
  - Results will take time to materialize and require sustained efforts; and some direct jobs may be lost as productivity increased
- **Not a resolution to crisis or radical economic transition**
  - requires an existing, reasonably stable industrial base
- **Not just a government program**
  - but a *process* that is driven by industry needs and market opportunities and leverages existing resources

Key Characteristics of TES

- Capability to offer field services directly to client firms
- Breadth (including product, process, organizational and management assistance)
- Pragmatic view towards technology and innovation
  - Often focused on new to firm rather than new to the market
  - Platform rather than industry-specific

Key Characteristics of Types of Technology and Innovation Advisory Services

Dedicated Field Services	Technology-oriented Business Services	Applied Technology Center Services
• Core set of highly experienced field staff • Manufacturing orientation • Delivery of a set of services that resonate with manufacturing SMEs • Decentralized network of offices	• Core set of top managers • Small business orientation • Range of small business needs, incl. entrepreneurship, finance, business assistance • Decentralized network of offices	• Mix of in-house, consultants, students • Range of government, large and small business clients • Primarily contract applied R&D, testing, material analysis, instrumentation as well as TES services • May use decentralized network of institutes

Examples of Types of Technology and Innovation Advisory Services

Type	Dedicated Field Services	Technology-oriented Business Services	Applied Technology Center Services
Distinctive Rationale	Lack awareness, tacit knowledge	Weak business technology linkages (including finance)	Under-investment in & exploitation of applied R&D
Examples	❑ **Manufacturing Extension Partnership** (MEP) [USA]	❑ **Industrial Research Assistance Program** (IRAP) [Canada]	❑ **Public Industrial Technology Research Institutes** (Kohsetsushi) [Japan] ❑ **Fraunhofer Institutes** (FhG) [Germany] ❑ **Tecnalia** [Spain]

US Manufacturing Extension Partnership: Operation

- 60 centers, 400 offices, 1300 staff (mostly industrially experienced)
- $300m total budget ($123m federal government)
  - Each center must provide 2/3 match
  - Federal portion has fluctuated ($40m-$130m)
- Targeted to manufacturing SMEs
  - 31,000 reached, 7000 served intensely
- 5 types of services (Next Generation Strategies, 2008)
  - Continuous Improvement
  - Technology acceleration/growth
  - Supplier development
  - Sustainability
  - Workforce

US MEP: Institutional Context

- Evolution
  1. 3 regional centers in Omnibus Trade and Competitiveness Act with private sector support → focus on transferring standards lab technology
  2. National coverage and systemwide initiatives focused on pragmatic services
  3. Growth services/innovation/advanced manufacturing ecosystem
- Situated in National Institute of Standards and Technology within Commerce to reflect technology orientation
- Local center organization: decentralized and flexible
  - Private non-profit, university, state government models
  - In-house versus 3rd party provider
  - Different types of partnerships
- National program governs through cooperative agreement
  - Advisory boards required at national and center levels – must include private manufacturing SMEs
- Extensive monitoring, annual reviews + periodic special studies, assessments
  - Each center undergoes annual review process

US MEP Business Outcomes

Findings from MEP evaluations

- Compared with non-clients, MEP clients had 3.4%-16% greater growth in **labour productivity** over a 5-year period in the late 1980s and early 1990s[1]
- MEP client establishments 18% less likely to go out of business [2]
- MEP services were associated with significant **productivity improvements for smaller firms** (5% 1997-2002, 1.2% 2002-2007), and certain kinds of services. [2]

1. Jarmin (1999); 2. Ordowich et al,. 2012, Lipscomb et al., 2014

Insights & Implementation 1

1. Evolutionary approach to development
   - Initial pilot (1+ locations)
   - Role of private sector support (e.g., private council on competitiveness)
   - Evolutionary phases
     - Demonstrations and pilots
     - National build-up
     - Service honing

Insights & Implementation 2

2. Appropriate organizational context
   - Range of organizations
     - Preferred: Innovation organization
     - Used: Economic development, research, standards agencies
   - Organizational characteristics : dedicated field staff, R&D centers, technology-oriented business support
   - Leveraging partner organizations
     - Performance review, termination in partnership agreements
   - Smaller regions can be combined, especially in initial roll-out

Insights & Implementation 3-5

3. Sufficient program scale
   - Field specialists, offices, close to clusters of companies
   - TES has minimal scale economies (fewer, bigger centers not better than multiple, smaller locations in integrated system)
4. Core public funding
   - Mission orientation towards SMEs
   - Program stability and trust
   - Pricing as *private* consultancy will drive program to serve larger and repeat clients and/or standardized services
5. Broad client base
   - Broad base of companies
   - Target sectors not rigidly applied

Insights & Implementation 6

6. Structured approach to services
   - Demand-led services
   - Monitoring company needs
   - Multiple service approaches/points of entry
     - Solving company problems (point solutions)
     - Companywide assessments
     - Group processes (training, peer-to-peer)
   - Balancing cost saving/efficiency services and strategic and sales producing services
   - Process for making referrals
     - Pre-qualification of third parties
     - Ongoing engagement management
   - Service pricing ramp down by company size
     - MEP pricing: $500-$1800+/day based on client employment size

Insights & Implementation 7-8

7. Links to equipment/infrastructure/R&D
   - TES not an infrastructure program
     - High cost of acquisition, customization, maintenance, upgrading, operation
   - Link to equipment/infrastructure services
8. Public-private governance
   - Advisory board of private companies
     - Fiduciary (e.g., management) v. advisory (e.g., customer needs)
   - Governance mechanism
     - Cooperative agreements to combine flexibility with oversight (v. contractual outsourcing)

Insights & Implementation 9-10

9. Industrially experienced specialists
   - Years of experience in one or more industries
     - Consultants not university professors
   - Ability to be broadly conversant in services rather than deep target industry experience
   - Budget allocation for training, certification
   - Incentives
     - Monetary performance based not always possible
     - Emphasize other benefits
10. Effective monitoring and robust evaluation
   - Learning as well as justification
   - Client impacts should be primary goal
     - Surveys + other methods, including qualitative case studies
     - Occasional comparison group studies
     - Planned change in indicators

Defining Technology Extension:
Main Take Away Points

1. Technology extension is assistance provided directly enterprises to foster technological modernization and improvement
   - Particularly at the location of the firm
2. TES focuses on established SMEs
   - Many innovation services target high tech firms but a few are designed for regular SMEs
3. TES is associated with a set of services
   - Pragmatic, off the shelf business assistance involving soft and hard technology
4. Most important, TES is about the sharing of tacit knowledge of highly experienced/capable field staff rather than any set of services

Technology Extension Services

Good Practices … and Debates

Good practices

- ❑ Pragmatic approach to technology
- ❑ Build client capabilities – beyond problem solving
- ❑ Customized, intensive & flexible support
- ❑ Expert-led, long-term relationships with business to develop trust
- ❑ Program scale and reach – long-term perspective
- ❑ Linkages with other service networks, finance, customers

Debates

- ❑ Focus on high-growth potential firms rather than blanket support
- ❑ Effectiveness of general versus specialized business support
- ❑ Regional networking and cluster approaches
- ❑ On-line v. face-to-face v. group
- ❑ Role of demand-side incentives
- ❑ Linking SMEs to research base & commercialization of ideas
- ❑ Measurement: What counts?
- ❑ Sustaining & justifying public funds
- ❑ Integrating extension services into new manufacturing initiatives

Implementing Technology Extension Services

Key Questions

1. Can an initial pilot be carefully **rolled out** into a TES program and **integrated** with **national/regional innovation strategies**?
2. Organizational context: How can **good governance** be combined with **flexibility and experimentation** for TES?
3. How can offices/services be located to achieve **effective coverage**?
4. Will there be **core public funding**, and will it be effective and stable?
5. Can a **broad client base** be established?
6. What **services should be offered**, and how structured and linked to other **infrastructural/R&D programs** and centers?
7. How can **private sector participation** be incorporated?
8. How can **industrially-experienced specialists** be attracted?
9. How can **effective monitoring and evaluation** be introduced, also couple with **learning** from best practices, and **program improvement**?
10. What role can technology extension play in reducing the **informal economy**?

Proposition

..an effective set of upgrading, innovation support, and networking mechanisms for small and medium-size firms is one of the foundation measures that nations and regions seeking to improve their economic standing need to have in place.

STIP
Georgia Tech Program in Science, Technology and Innovation Policy

Program in Science, Technology, and Innovation Policy

Enterprise Innovation Institute,
School of Public Policy
Georgia Tech, Atlanta USA