

Technology Extension: What it is, Why it is important, and How to get it started

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Technology Extension Workshop
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Objectives

1. Define technology extension
2. Present technology extension models
 - from the US, Canada, Spain
3. Discuss startup and development
4. Impart service delivery approaches
5. Share extension professional training*
6. Discuss evaluation methods and measures*
7. Conclusion: Practices and debates

**US Examples*

1. What is technology extension

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 Service Methods

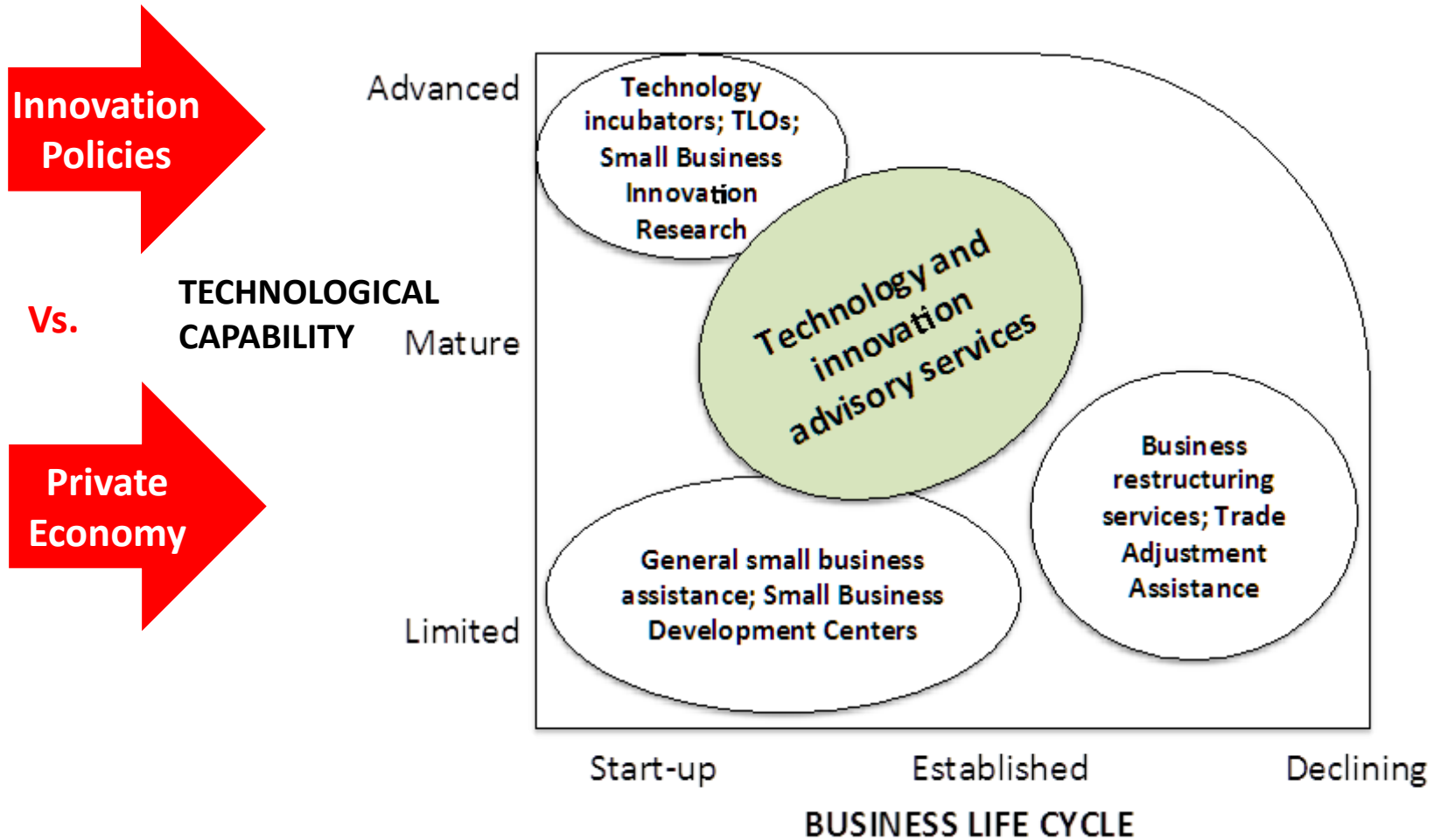
HOW?

- 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

Extension Service Examples

- Quality systems (e.g., six sigma, ISO/other standards, food safety, root cause)
- Lean manufacturing (e.g., value stream mapping, 5S, Kanban, Kaizen, setup reduction)
- Plant layout
- Energy audits
- Safety risk minimization
- Regulatory compliance preassessment
- Product development (e.g., prototyping, small batch assistance)
- Technology scouting
- Advanced machining
- Information systems
- Cybersecurity (e.g., compliance, risk management, incident recovery)

Positioning



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

2. Technology Extension Models

Technology Extension Models

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	<input type="checkbox"/> Manufacturing Extension Partnership (MEP) [USA]	<input type="checkbox"/> Industrial Research Assistance Program (IRAP) [Canada]	<input type="checkbox"/> Public Industrial Technology Research Institutes (Kohsetsushi) [Japan] <input type="checkbox"/> Fraunhofer Institutes (FhG) [Germany] <input type="checkbox"/> Tecnalia [Spain]

Key Characteristics

Dedicated Field Services	Technology-oriented Business Services	Applied Technology Center Services
<ul style="list-style-type: none"> • Core set of highly experienced field staff • Manufacturing orientation • Delivery of a set of services that resonate with manufacturing SMEs • Decentralized network of offices 	<ul style="list-style-type: none"> • Core set of top managers • Small business orientation • Range of small business needs, incl. entrepreneurship, finance, business assistance • Decentralized network of offices 	<ul style="list-style-type: none"> • 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 Technology Extension

Cases	Institution	Scale	Start	Features
US Manufacturing Extension Partnership (MEP)	Commerce (NIST)	60 centers, 400 offices, 1300 staff, \$300m total budget (\$123m federal government)	1989	Broad-based, flexible, decentralized
Canada Industrial Research Assistance Program (IRAP)	Research (National Research Council)	5 regions centers, 120 offices, 400 staff, \$293m budget (\$60m TES)	1962	Centrally-run, regional offices, funding to firms
Spain (Basque) TecNALIA	Private	10 regions, 21 offices (in Spain), 1473 staff, \$148m budget	2011	Extension services in a technology center

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
- 2 types of services
 - Continuous Improvement (e.g., lean/quality, sustainability)
 - Growth (e.g., product development, technology scouting)

US MEP: Institutional Context

- Evolution
 - 3 MTCs in Omnibus Trade and Competitiveness Act with private sector support → focus on transferring standards lab technology
 - National coverage and systemwide initiatives focused on pragmatic services
 - 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

Industrial Research Assistance Program (Canada): Operation

- 5 regions centers, 120 offices, 400 Industrial Technology Advisors (ITAs – primarily former executives)
- ~C\$400m budget (C\$60m TES)
 - Budget has steadily increased and has broad support
 - IRAP takes over administration of smaller (C\$10 million) economic development programs
- Targeted to SMEs based in Canada/performing R&D in Canada in product oriented industries (ITC, manufacturing, construction, food, energy, life sciences)
 - 1,800 served (though TES information not well tracked)
- Four services with TES linked to funding services
 - Support for R&D projects (non-TES)
 - Funding to organizations providing assistance to SMEs
 - Youth employment (non-TES)
 - Advisory services

Industrial Research Assistance Program

R&D Financial Support (non-TES)

- **Non-repayable contributions to firms.** SMEs to conduct R&D projects not affordable with in-house resources alone.
- 50-80% personnel, subcontractor costs
- Conditions attached, vs. grants, contracts which require deliverables
- Application in online template on the NRC-IRAP Innovation Portal requires: (1) business overview, (2) project description, (3) measurable objectives, (4) budget, (5) other financial resources.
- Each application must have technical, business and financial assessments to show SME has enough funds
- Cannot be used for capital, other non-personnel expenditures
- Applications go to a regional director, executive director, or VP depending on amounts
- All paperwork processed by Regional Contribution Agreement Officers (in region)
- Example: technology validation to test a technological solution's benefits. Project plan: (1) describe the technological solution, (2) tasks involved, (3) approach for measuring the solution's value, (4) how results will lead to commercialization.
- 2,000+ SMEs a year get contributions

Industrial Research Assistance Program (Canada): Institutional Context

- IRAP created in 1962 to increase Canada's business R&D
 - Thus situated in the National Research Council (NRC)
- Centrally run and funded by the NRC, but partners used to house some ITAs and provide services, mostly to smaller firms
- Governance
 - NRC, Ministry of Industry
 - Program-specific advisory board (7 of 11 from industry)
 - Executive directors, directors
 - Field manual, online portal, CRM
 - Contribution agreement conditions
- Evaluation through
 - Legislatively mandated five year review → NRC must respond in writing as to how it will redress recommendations
 - Annual reports

Tecnalia (Spain): Operation

- 10 regions, 21 offices (in Spain), 1473 staff,
- ~\$150m budget (50% from firms, 30% competitive public funding, 15% region)
- 4 key services
 - Technical services (e.g., testing, inspection, audit, certification)
 - Collaborative/contract R&D
 - Licensing and spin-offs
 - Innovation strategy
- 70% regional firms (primarily medium and large). Target sectors:
 - Sustainable construction
 - Energy and environment
 - ICT
 - Industry and transport
 - Health

Tecnalia (Spain): Institutional Context

- Established from merger of 6 technology centers
 - Centers were integrated, but none were closed, no staff layoffs
- Aim to enhance Basque regional innovation ecosystem (a la VTT, Fraunhofer)
- Shift from cooperatives members to a foundation
- Board of trustees: primarily firms, private organizations plus regional/provincial administration
- Monitoring through annual report featuring several metrics:
 - income from R&D contracts
 - projects within clusters
 - patents
 - entrepreneurship,
 - European projects
 - scientific publications
 - total income from R&D projects

Lessons from Cases

MEP	IRAP	Tecnalia
<ul style="list-style-type: none"> • Leveraging opportunities to national system of industrially-experienced specialists • Changing individual center orientations to national system • Evolving service offerings • Cooperative agreement • Emphasis on monitoring and measurement 	<ul style="list-style-type: none"> • Integration of TES and non-TES funding for applied R&D • Funding for partner organization service provision • Advisors who were former corporate executives • Program longevity, popularity, expansion as network for other program services • 5-year reviews 	<ul style="list-style-type: none"> • Startup of an applied R&D center including TES • Leveraging of small state funding with contract moneys • Involvement of private sector

Questions about Models?

3. Startup and Development

Insights & Implementation 1

1. Evolutionary approach to development

- Initial pilot (1+ locations)
 - Temporary “supercenters”
 - Terminating nonworking centers
- Role of private sector support
- Evolutionary phases
 - Demonstrations and pilots
 - National build-up
 - Service honing

Open Call

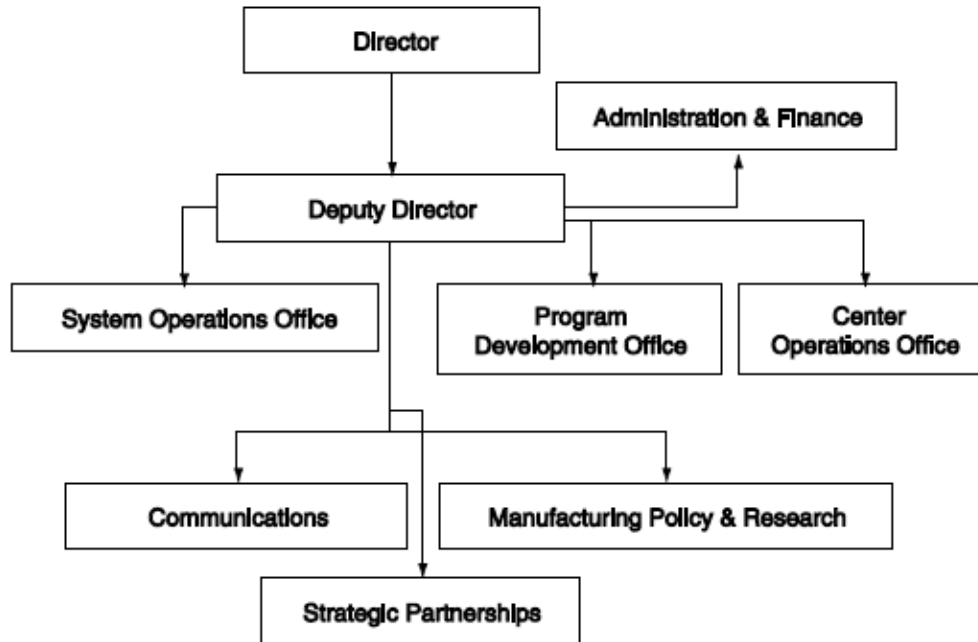
- Eligibility: types of organizations, advisory board for oversight
 - Key personnel, organizational structure and management, oversight board
- Strategy to deliver services to the region: strategy that balances penetration and impact, roles v. other entities in the business ecosystem
- Market understanding: market analysis, needs identification and product offerings
- Business model: outreach, service delivery, partnerships
- Performance measurement
- Budget and financial plan

Insights & Implementation 2

2. Appropriate organizational context

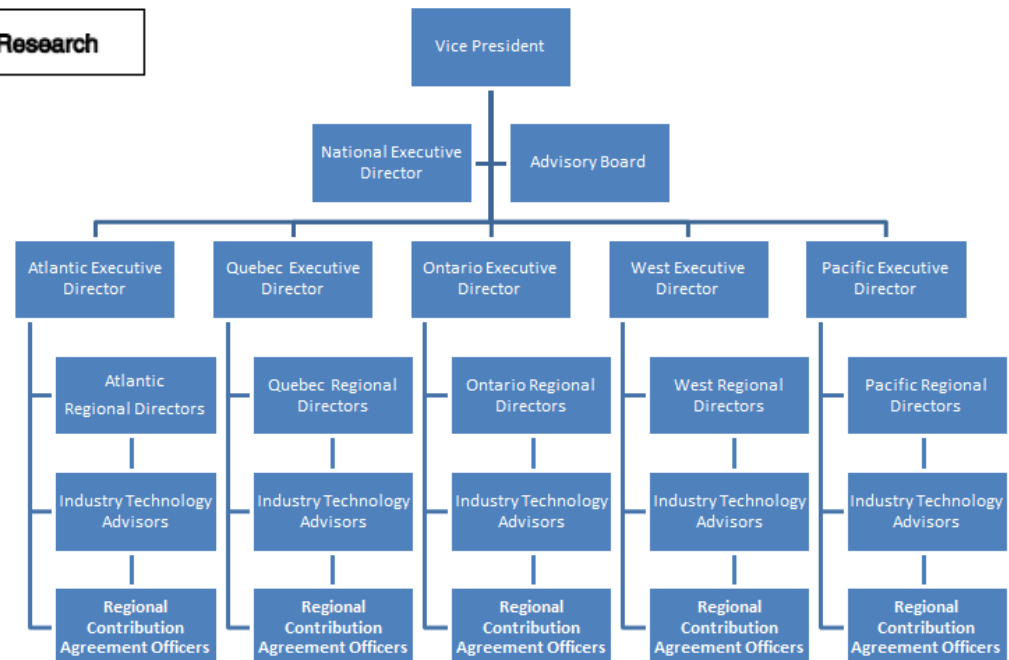
- Range of organizations (e.g., economic development, research, standards)
- Leveraging partner organizations
 - Performance review, termination in partnership agreements
 - Process for making referrals
 - Pre-qualification of third parties
 - Ongoing engagement management

National Organization

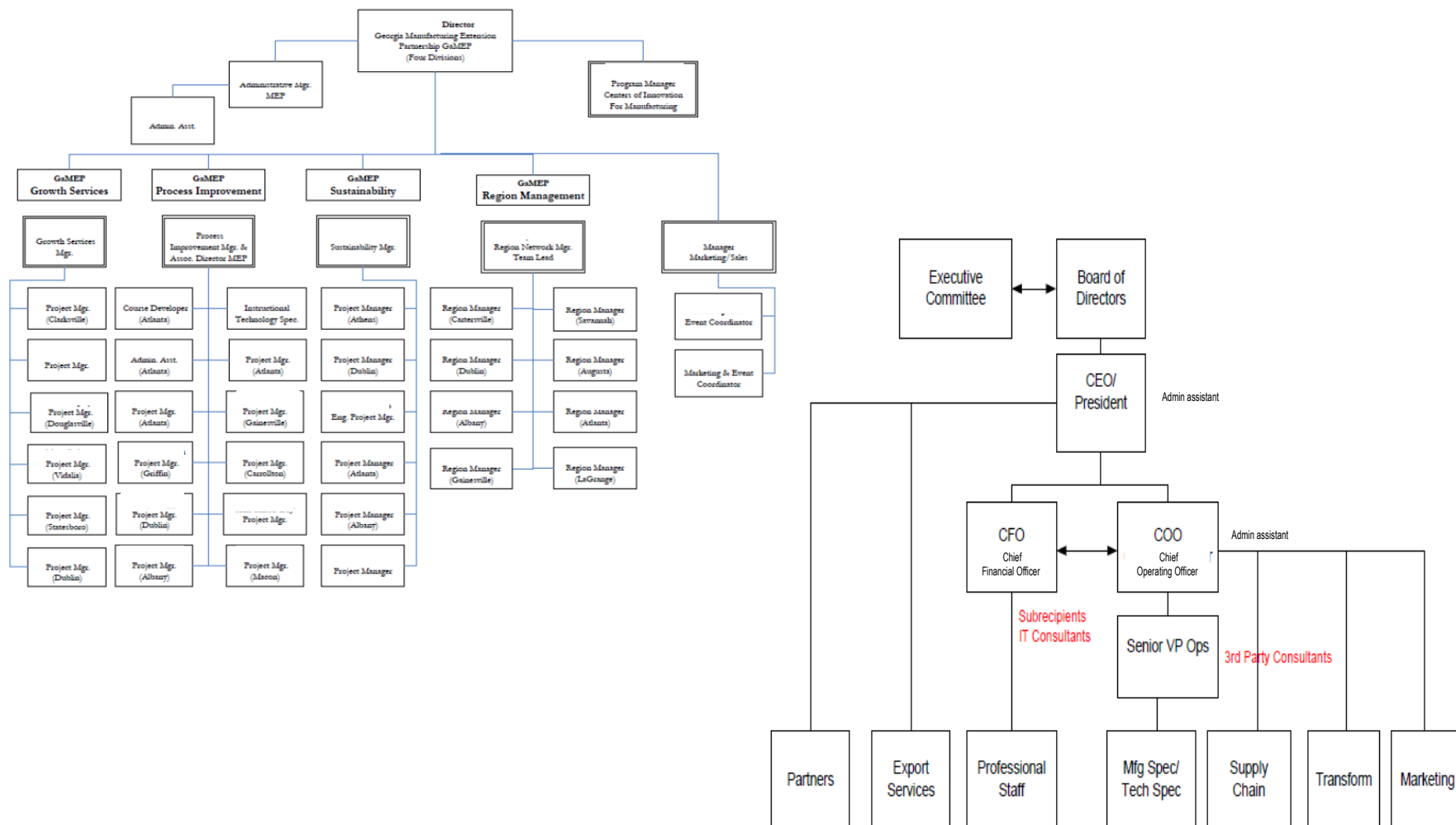


MEP

IRAP



Regional Organization



Working with Partners

Practice	Description
Shared system-wide partnership vision	Partnerships fit into the goals and vision of the program. Partners may take on central functions or play specific roles in providing service or access to new customer segments.
Structured flexibility	Strategic and operating plans recognize phases of change in partnership arrangements.
Joint marketing efforts	Collaborative activities for increasing outreach to customers, involving marketing materials, jointly sponsored seminars and workshops, co-locations.
Cross-training	Programs to learn skills and capabilities from one another as well as improve inter-organizational understanding
Shared information	Regular communication among organizations through periodic meetings, electronic systems, and informal mechanisms. The institutionalization of personal relationships is particularly important.

Working with Partners

Practice	Description
Development and sharing of tools	Collaborative development of assessment tools and database systems for distribution to centers throughout the MEP
Coordinated, program-wide system for making referrals	Program-wide mechanisms for accessing common information about external service providers for making referrals
Collaborative service delivery	For assessments and projects, teams involve staff from more than one organization.
Specific mechanisms to promote partnership	Functions for promoting and monitoring partnerships within the organization
Partnership performance review	Evaluation of partnerships against contractual goals or manufacturing needs

Insights & Implementation 3-5

3. Sufficient program scale

- Field specialists, offices, close to clusters of companies
 - Number of firms a field engineer can serve in a year → staffing levels
- 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 3-5

Needs assessment

- What are the important industry sectors in the service area?
- Are there concentrations of manufacturers in certain regions within the service area?
- Where should field offices be located?

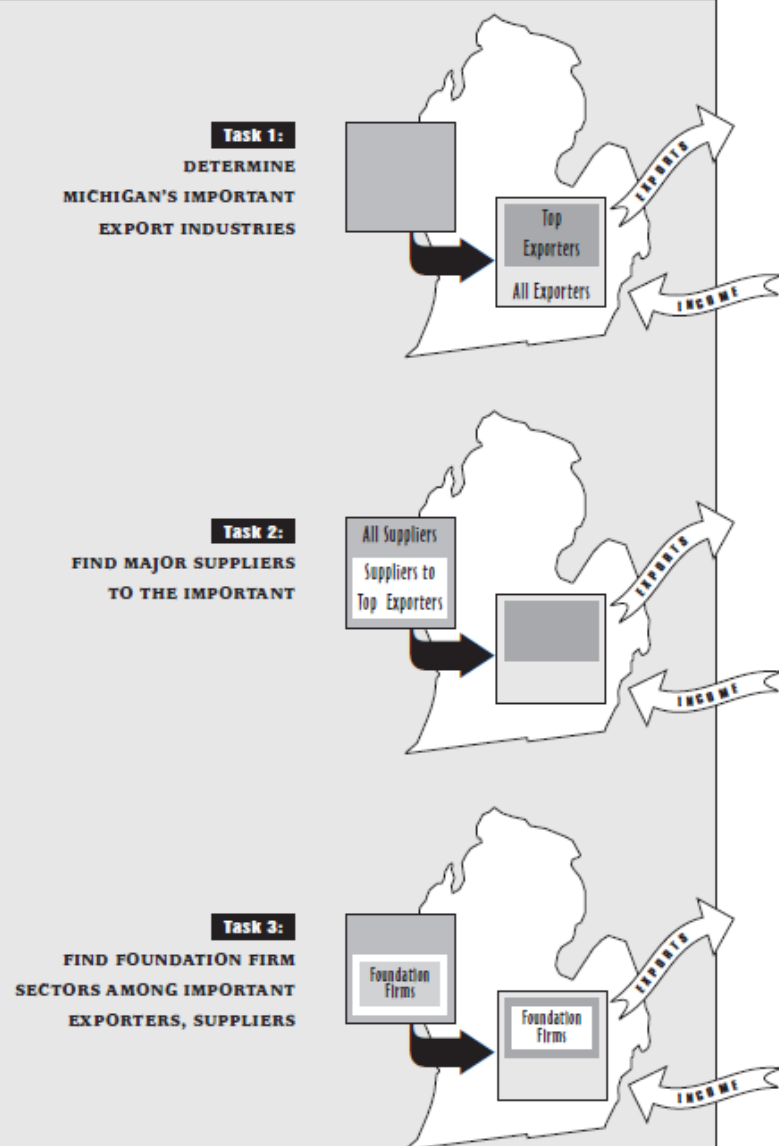
Methods

- Needs, technology/service use survey
- Industry, cluster analysis
- Advisory, user, focus groups

Targets

- Problems/needs
- Services interest
- Major industries
- Strengths/weaknesses of region in sector

FIGURE 1. IDENTIFYING MICHIGAN'S CRITICAL FOUNDATION FIRMS



Source: Industrial Technology Institute, Midwest Manufacturing Technology Center, Ann Arbor, MI.

FIGURE 2. DISTRIBUTION OF MANUFACTURING CLUSTERS AROUND THE GLMTC



CLUSTER: CLEVELAND/LORAIN/NORTHEASTERN OHIO

COUNTY	NUMBER OF MANUFACTURING ESTABLISHMENTS	NUMBER OF MANUFACTURING EMPLOYEES	PRIMARY SIC'S AND PERCENTAGES FOR 60% OR MORE OF ALL CLUSTER ESTABLISHMENTS
Cuyahoga	4,647	373,783	35-Ind. mach—29%
Lake	889	33,768	34-Fab. metal—18%
Lorain	561	56,793	27-Printing—9%
Ashtabula	198	11,099	30-Rubber—6%
Geauga	193	11,254	
Erie	149	11,608	
Huron	126	11,047	
Totals	6,763	509,352	62%

NUMBER OF MANUFACTURERS WITHIN A CLUSTER

1. Cleveland/Lorain/Northeastern Ohio	6,763
2. Dayton/Cincinnati/Northern Kentucky	5,638
3. Southwestern Pennsylvania	3,686
4. Columbus/Mansfield	2,651
5. Toledo/Lima	2,764
6. Akron and surrounding areas	2,173
7. Northwestern Pennsylvania	1,899
8. West Virginia	1,811
9. Canton and surrounding areas	1,450
10. Youngstown/Mahoning Valley	1,422
11. Northeastern Indiana	1,273
12. Southeastern Ohio	718
Total	32,107

Source: Cleveland Advanced Manufacturing Program, Great Lakes Manufacturing Technology Center, Cleveland, OH.

**FIGURE 3. RATING TECHNOLOGY NEEDS:
MACHINE TOOLS QUESTIONNAIRE**



Your title: _____

Location of your facility: __MI __OH Number of employees: __20-100 __101-499

Does your firm currently use computer numerically controlled equipment? _____

For each of the following needs please RANK its importance for machine tools builders. Place a "1" beside the need which you think is most important, a "2" beside the need which you think is next most important, a "3" beside the need which is third most important, and continue numbering until you place a "17" beside the need which is least important.

- ____ Improved techniques for design for manufacture and design for assembly.
- ____ Improved reliability and maintainability of machine tools.
- ____ Better approaches to global market and product development.
- ____ Alternative approaches to reducing environmental impact of machining operations.
- ____ Better approaches that promote access for machining and minimize contamination of fixtures and material handlers (e.g., fixtures).
- ____ Better approaches to control and removal of chips for high speed machining.
- ____ Better approaches to monitor and control machine operations and to compensate for errors (e.g., balance, thermal distortion, geometric positioning).
- ____ Improved means for rapid and accurate generation of holes.
- ____ Improved techniques for evaluation of simultaneous, multiple sensor input.
- ____ Improved position sensors.
- ____ Improved actuators to handle higher forces and greater displacements.
- ____ Improved surface sensing.
- ____ Better approaches to integrating non-traditional machining techniques (e.g., lasers, water jet, ultrasonics) in machine tools.
- ____ Better machine tool guarding (e.g., access, noise reduction).
- ____ Improved techniques for maximizing manufacturing operations per work station.
- ____ Increased flexibility in controls and drive electronics.
- ____ More efficient and effective means of coolant monitoring and reclamation.
- Other (specify): _____

Please return to the Industrial Technology Institute, c/o MMTC Technology Rating
2901 Hubbard Rd.
Ann Arbor, MI 48105
FAX: 313-769-4064

Source: Industrial Technology Institute, Midwest Manufacturing Technology Center, Ann Arbor, MI.

Focus Group Questions

- What are the most critical issues facing your business today?
- What are your firm's or industry's greatest problems?
- What are the most costly components of your operation?
- In what areas do you think your firm or firms in your industry need to modernize?
- What types of assistance are most needed by firms in your industry?
- What are the most important industries in your region?
- What are the most significant unsolved problems that impede manufacturers' growth in this region?
- What are your perceptions of strengths and weaknesses in this region's manufacturing industry?

Questions about startup and
development?

4. Service Delivery Approaches

Insights & Implementation 6

6. Structured approach to services

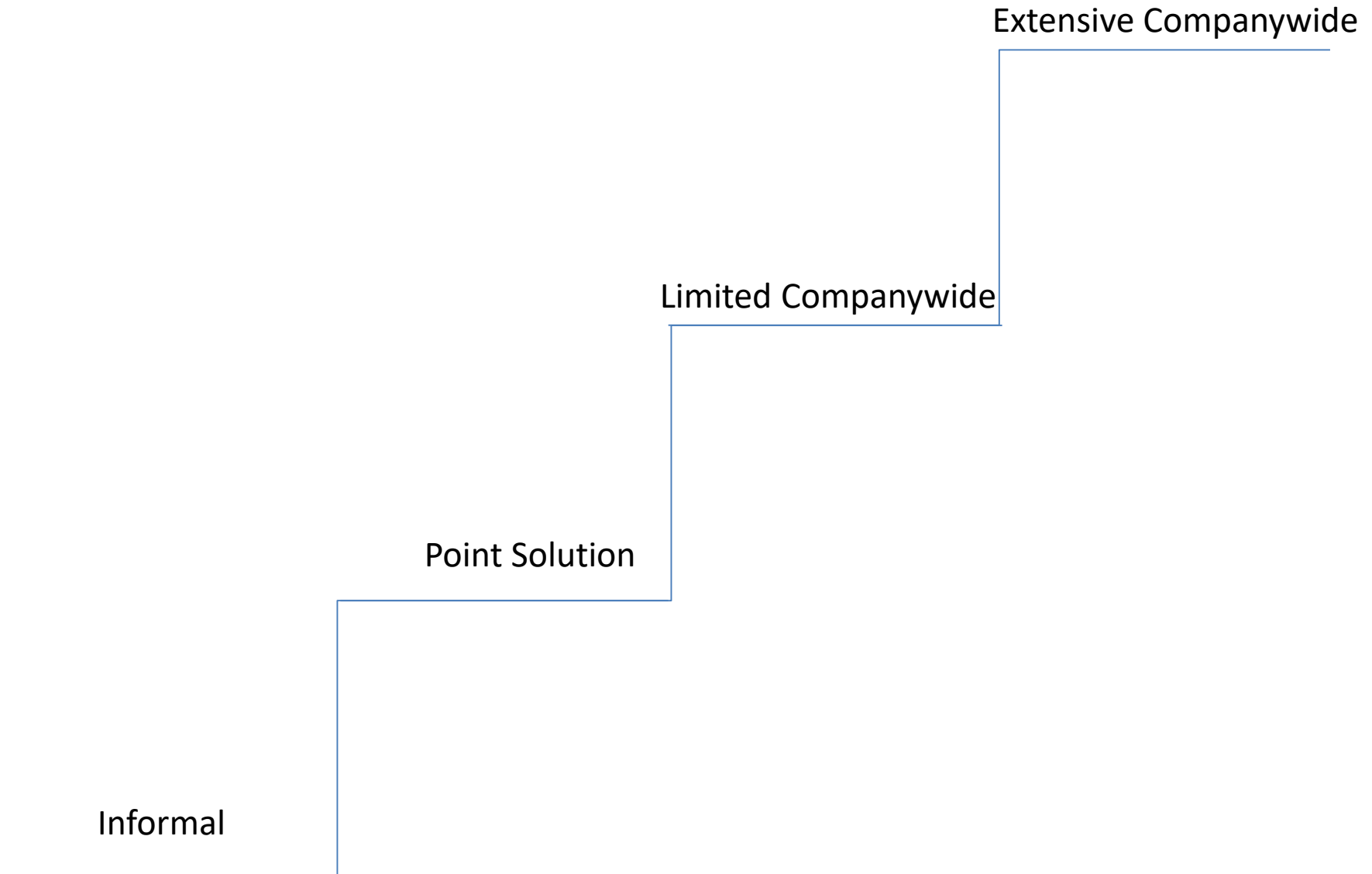
- Demand-led services
- Monitoring company needs
- Multiple service approaches/points of entry
 - Solving company problems (point solutions)
 - Companywide assessments
 - Group processes (training, peer-to-peer)
- Balancing cost saving/efficiency services and strategic and sales producing services
- Service pricing ramp down by company size
 - MEP pricing: \$500-\$1800+/day based on client employment size

Insights and Implementation 6

- Program staff may call on manufacturers at their site.
- Presentations may be made at meetings of potential clients.
- Program staff may conduct forums, workshops and seminars.
- Direct mail pieces maybe designed and distributed.
- Program staff may display at trade shows.
- Web sites, social media may be used.
- Local field offices maybe established to promote program awareness, credibility.
- Large manufacturers maybe approached about establishing supplier qualification programs of which assessments maybe a part.
- Economic development organizations or trade associations may refer manufacturers to the program.
- Manufacturers may recommend the program to others.
- Bankers, accountants, lawyers or venture capitalists may refer clients to the program.



Company Assessment Levels



Plant Tour

Cleanliness, orderliness

Layout, space utilization

Raw material

Work in process

Scrap, rework areas

Inventory levels, storage

Equipment age, condition

Tooling

Automation

Bottlenecks

Personnel use

Employee attitude

Safety



FIGURE 2. POTENTIAL INTERVIEW SUBJECTS BY BUSINESS AND TECHNICAL AREA

	Business and its Product/Service	Sales/Marketing	Manufacturing	Financial	Quality	Material Management	Design/Engineering	Personnel	Facilities	M.I.S.	Environment/Safety
Owner/President	●	○	○	○	○	○	○	○	○	●	●
Manufacturing Mgr.		○	●		○	○	○	○	○	●	●
Quality Manager					●		○			●	
Purchasing Manager					○					●	
Engineering Manager			○		○		●	○	○		
Financial Officer		○	○	●						●	
Sales Manager	○	●			○					●	
Personnel Manager								●			●
Materials Manager			○		●					●	
Plant Engineering Mgr.								●			●

Source: Indiana Business Modernization and Technology Corporation, Indiana

Questions

- Company overview
- Employee information
- Plant information
- Operational levels
- Lead time
- Costs
- Inventory
- Characteristics of the operation
- Leadership
- Culture
- Environmental, health, and safety (EHS)
- Order fulfillment
- Sales
- Internal results

Value Stream Map

FIGURE 4. FLOW PROCESS CHART

SUMMARY				PROPOSED				DATE/REVISION			
PRESENT		PROPOSED		NO.		TIME		NO.		TIME	
<input type="checkbox"/>	OPERATIONS										
<input type="checkbox"/>	TRANSPORTATIONS										
<input type="checkbox"/>	INFECTIONS										
<input type="checkbox"/>	DELAYS										
<input type="checkbox"/>	STORAGES										
DISTANCE TRAVELED				FT	FT	FT	FT				

PROJECT: _____
 INFO ☐ PERSON ☐ MATL ☐
 CHART BEGINS _____
 CHART ENDS _____
 CHARTED BY: _____ DATE _____

DETAILS OF (<input type="checkbox"/> PRESENT <input type="checkbox"/> PROPOSED) METHOD	MATERIALS										NOTES
	COILS	ROLLS	PIECES	WEIGHT	SIZE	TYPE	QUANTITY	UNIT	LOCATION	DATE	
1											
2											
3											
4											
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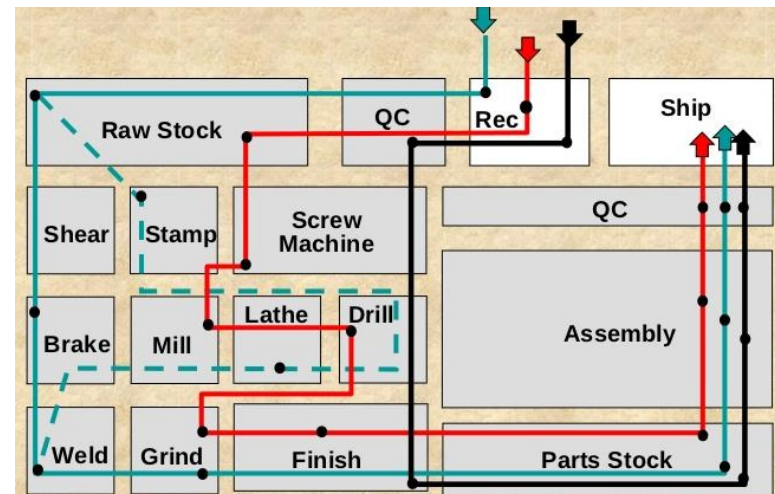
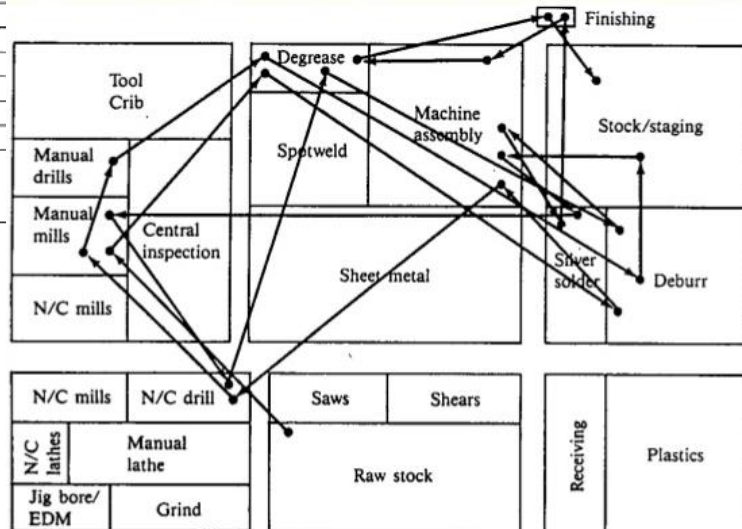
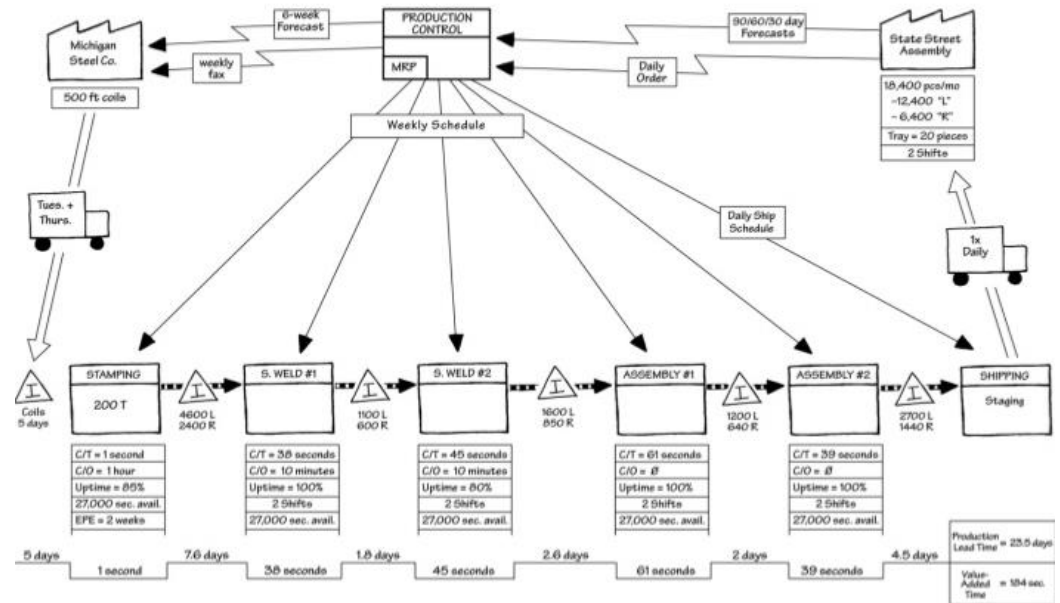


FIGURE 3. BI-FAR EXECUTIVE SUMMARY

Client #: Company X
SIC# 35453

Today's Date: 12/22/93
Analysis Processed On: 12/22/93
For Income/Balance On: 06/30/93
Assessor Initials: _____

BENCHMARKING INFORMATION AND FINANCIAL ANALYSIS REPORT

KEY BALANCE SHEET AND INCOME STATEMENT INDICATORS (%)

LINE ITEM	COMPANY (%)	IND. STD. (%)	VAR. (%)	SUGGESTED ACTION ITEMS
Inventory	29.84	28.6	4.3	Inventory trend is upward. Ratio poor. Increase unit sales and review Manufacturing flow.
Cost of Goods Sold	71.81	70.4	2.0	Watch direct material, direct labor and overhead expenditures. Improve overall production efficiencies.
Gross Profit	28.19	29.6	-4.8	Significant decrease in gross profit. Trend is downward. Analyze current product mix and competitive pricing.
Operating Costs	27.35	24.8	10.3	Reduce spending. Trend downward.
Total Current Liabilities	54.85	37.4	46.7	Trend is upward. Consider equity infusion to reduce short term notes payable.

KEY RATIO INDICATORS

RATIO	CO.	IND. STD.	% VAR.	BENCHMARK	ACHIEVE BY	SUGGESTED ACTION ITEMS
Quick Ratio	.3	.8	-61			Cash position is low. Increase sales, sell assets to obtain new cash.
COGS/ Inventory	2.3	4.5	-49			Reduce inventory levels by improving scheduling of production. Sell from existing inventory to raise cash.
COGS/ Payables	6.6	13.4	-51			Sell from existing inventory to raise cash and use cash to reduce accounts payable.
Total Debt/ Net Worth	3.2	1.4	126			Obtaining new paid-in capital or equity infusion and use proceeds to restructure debt.

Source: Indiana Business Modernization and Technology Corporation, Indianapolis, IN.

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 with heavy private sector participation
- Organizational home with good governance capacity
 - Cooperative agreements to combine flexibility with oversight

Cooperative Agreement

- Development of plans, startup-up plans, operating plans
- Reporting of surveys, studies, manuals
- Substantial involvement of the MEP national office through assistance and guidelines, linkages to the national system, guidelines for performance data collection and evaluation, timely response requirement, assistance to address technical and managerial problems, framework for high performance standards, participation in activities of center's host organization to address any issues
- Center obligation to develop and submit plans and budgets, complete tasks in a timely manner, review national system products prior to in-house tool development, participate in MEP meetings and conferences, submit technical and financial reports, participate in program reviews
- Submission of modifications to work, plans, management in writing
- Establishment of and regular meetings with a board of directors or trustees

Cooperative Agreement

- Participation in multi-center and national meetings and activities
- Engagement with NIST MEP in continuous improvement of program
- Record-keeping of administrative and financial information
- Approval of key personnel changes by NIST MEP
- Reporting on tools, systems, resources, and equipment with a value of US\$10,000 or more
- Approval of sub-awards over US\$100,000
- Submission of detailed financial and technical reports to the NIST MEP management information reporting system as specified by reporting guidelines
- Participation in statutory merit panel reviews
- Termination of center
- Contribution and documentation of cost sharing and matching
- Audit requirement
- Post-client project follow-up

Questions about service delivery?

5. Extension Professionals

Insights & Implementation 9

9. Industrially experienced specialists

- Years of experience in one or more industries
 - Mix of senior and junior specialists
- 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

Insights & Implementation 9

Hiring

- Internal – greater control, less breadth
- External – greater breadth and coverage
- Ideally mix of both with internal managing external

Insights & Implementation 9

Training (MEP)

- “MEP University” – ended in 2012
- National conferences
- Orientation programs for new center directors
- Emerging leaders where we ask centers to nominate an individual and we do a year-long training and peer-to-peer work



MEP UNIVERSITY

Strengthening American Manufacturing

[ABOUT MEP UNIVERSITY](#) [SCHEDULE OF COURSES](#) [WHAT'S NEW IN TRAINING](#) [UNIVERSITY STORE](#) [COURSE & PRODUCT CATALOG](#) [REGISTER](#)

Helping SMEs Implement Efficiency - a webinar series

- + Help clients realize cost savings
- + Identify ways to communicate the benefits
- + Be one of the first to try an innovative e-learning and implementation tool



GLOBALIZATION



GROWTH SERVICES



LEADERSHIP



LEAN MANUFACTURING



SUSTAINABILITY

WEBINARS

[GS-W 300 What Manufacturers Need to Know to Grow](#) - 6-Part Webinar Series with Michael Collins and Charles France - \$295 Dates: 08/16; 08/30; 09/13; 09/27; 10/11; and 10/18

[SU-W 100 Introduction to Green Business](#) - 2-Part Webinar Series with Dr. Amy Townsend - \$295 Dates: 08/02 and 08/09

[SU-W 200 Helping Manufacturers Implement Efficiency](#) - 3-Part Webinar Series with L. Hunter Lovins - \$75 Date: 07/12; 07/19; and 07/26

[TM-W 220 Dial-up Leadership ~ a](#)

CLASSES & WORKSHOPS

[06/27: TM 203 Focus on the Front of the Room \(2 Days\) Cheyenne, WY - \\$1,195](#)

[07/18: LE 202/402 Value Stream Mapping & TTT \(1 Day\) Ft. Worth, TX - \\$350](#)

[07/19: LE 206 Pull/Kanban Systems \(1 Day\) Ft. Worth, TX - \\$295](#)

[07/20: LE 406 Pull/Kanban Systems TTT \(1 Day\) Ft. Worth, TX - \\$375](#)

[07/21: LE 205 Principles of Cellular Flow Manufacturing \(1 Day\) Ft. Worth, TX - \\$295](#)

[07/22: LE 405 Principles of Cellular Flow Manufacturing TTT \(1 Day\) Ft. Worth, TX - \\$375](#)

[08/22: TM 309 Mastering the Front of the Room \(3 Days\) Sheridan, WY - \\$1,795](#)

AUTHOR SERIES

[06/02: TM-B 550 Finding Great International Markets \(Virtual 1 Hour\) with Jim Foley - \\$35](#)

[06/16: TM-B 551 Finding and Managing Great International Partners \(Virtual 1 Hour\) with Jim Foley - \\$35](#)

[06/23: SU-B 550 Climate Capitalism \(Virtual 1 Hour\) with L. Hunter Lovins - \\$40](#)

[06/30: TM-B 552 Special Topics in International Trade \(Virtual 1 Hour\) with Jim Foley - \\$35](#)

[07/14: TM-B 553 Saving American Manufacturing Pt 1 \(Virtual 1 Hour\) with Mike Collins - \\$50](#)

MEP University and Other Course Examples

- Lean manufacturing principles
- Value stream mapping
- 5S system
- Quick changeover/ setup reduction
- Cellular/flow manufacturing
- Pull/kanban
- Total productive maintenance
- Lean performance measures
- Supply chain
- RFID Basics workshop
- Markets and strategy
- Financial toolbox
- Lean product development
- Client management
- Consulting skills
- Energy performance
- Energy management system implementation (ISO 50001)
- Saving energy costs
- Carbon footprint estimate
- Environmental assessment (air, solid waste emissions, material intensity, hazardous waste, water pollution/usage)

Questions about extension
professionals?

6. Evaluation

Insights & Implementation 10

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

Objectives of Evaluation

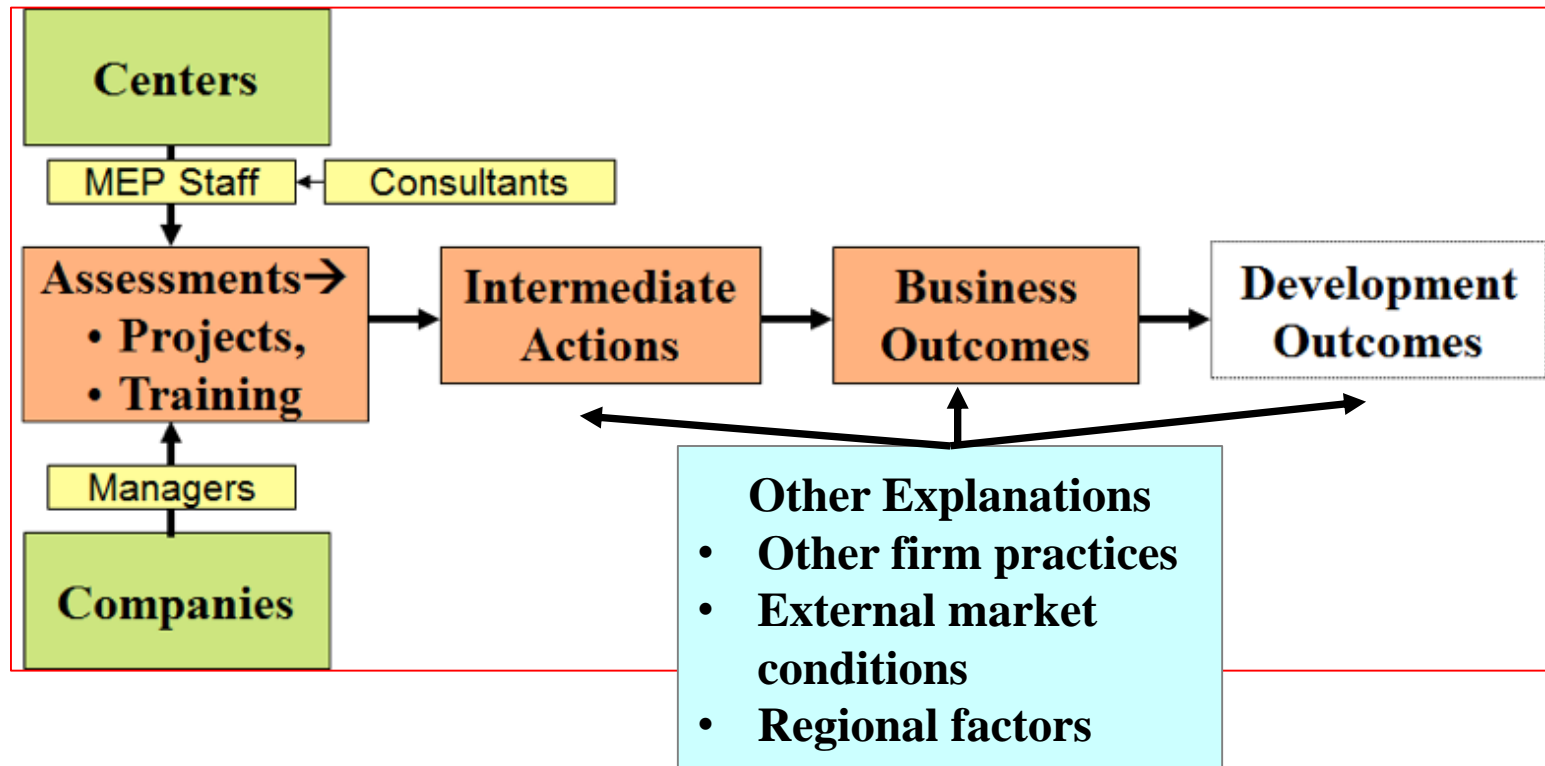
1. **Dissemination:** Furnish consistent information to stakeholders and sponsors
2. **Justification:** consistent feedback on effectiveness, targeting, and impacts of economic development interventions
3. **Learning and Improvement:** Support systematic learning about how services are being delivered and what services and approaches work best and why, so as to assist the ongoing improvement and management of program services

“Ideal” Evaluation: Philosophy

- Focus on (1) key elements of mission/objectives and which (2) program can influence
- Measures of impact > measures of efficiency
- Include a comparison group to understand what would have happened if the program were not there
- Understand how the program works—what happened, under what conditions and why – so we can replicate it
- Programs are part of a broader system → understand what broader changes are needed in state policies, institutions
- Stakeholders are interested in different types of information

TES Program Logic and Assessment

Typical TES Program Logic Model



Extension Evaluation Methods in Use

- ❑ Monitoring and tracking systems are used (tracking companies served, services provided)
 - Fraunhofer, TecNALIA include these counts in their annual reports
- ❑ Formal evaluations in US, Canada, some other countries – but difficult to track all impacts
 - Legislatively mandated external review in Canada every 5 years
- ❑ Evaluation methods vary, including surveys, controlled studies, case studies

Intermediate outputs

Capacity for change, changes in practice, improved firm capabilities

IRAP clients (Goss Gilroy, 2012)

increase in firm's business skills and knowledge	70%
increase in scientific and technical knowledge	82%
enhanced technical knowledge or capabilities	90%
enhanced ability to perform R&D	62%
enhanced business knowledge/capabilities	68%

Business Outcomes

Findings from MEP evaluations

Favored position of productivity measures (usually value-added per employee)

- 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 clients had 18% higher survival than non-clients [2]

1 Jarmin (1999); 2. Lipscomb et al. (2015).

Broader Economic Development Outputs

Positive economic returns generated

IRAP (Canada) [1]

- ❑ Benefits of more than 10 to 1 relative to public sector costs – based on multipliers derived from input-output models.

MEP (US) [2]

- ❑ \$32 to \$1 relative to federal costs based on multipliers from REMI; Net private benefits v. public investment fall in the 1:1 to 3:1 range

SCALE OF AGGREGATED ECONOMIC OUTCOMES

- ❑ Small level of effort and resources involved in most TES interactions

1. NRC and Goss Gilroy, 2007; Goss Gilroy 2012;

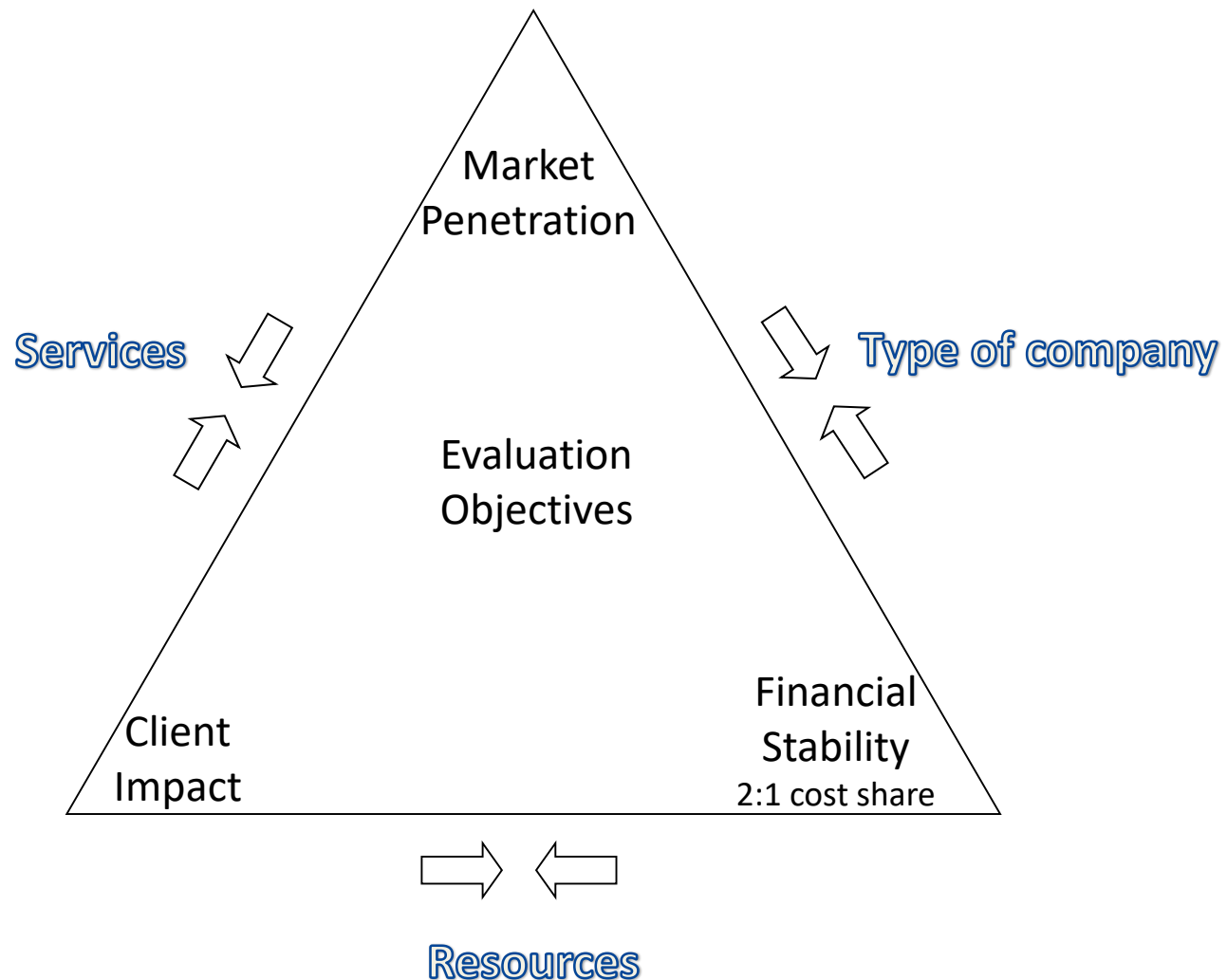
2. MEP 2011, Shapira and Youtie 1995

Issues

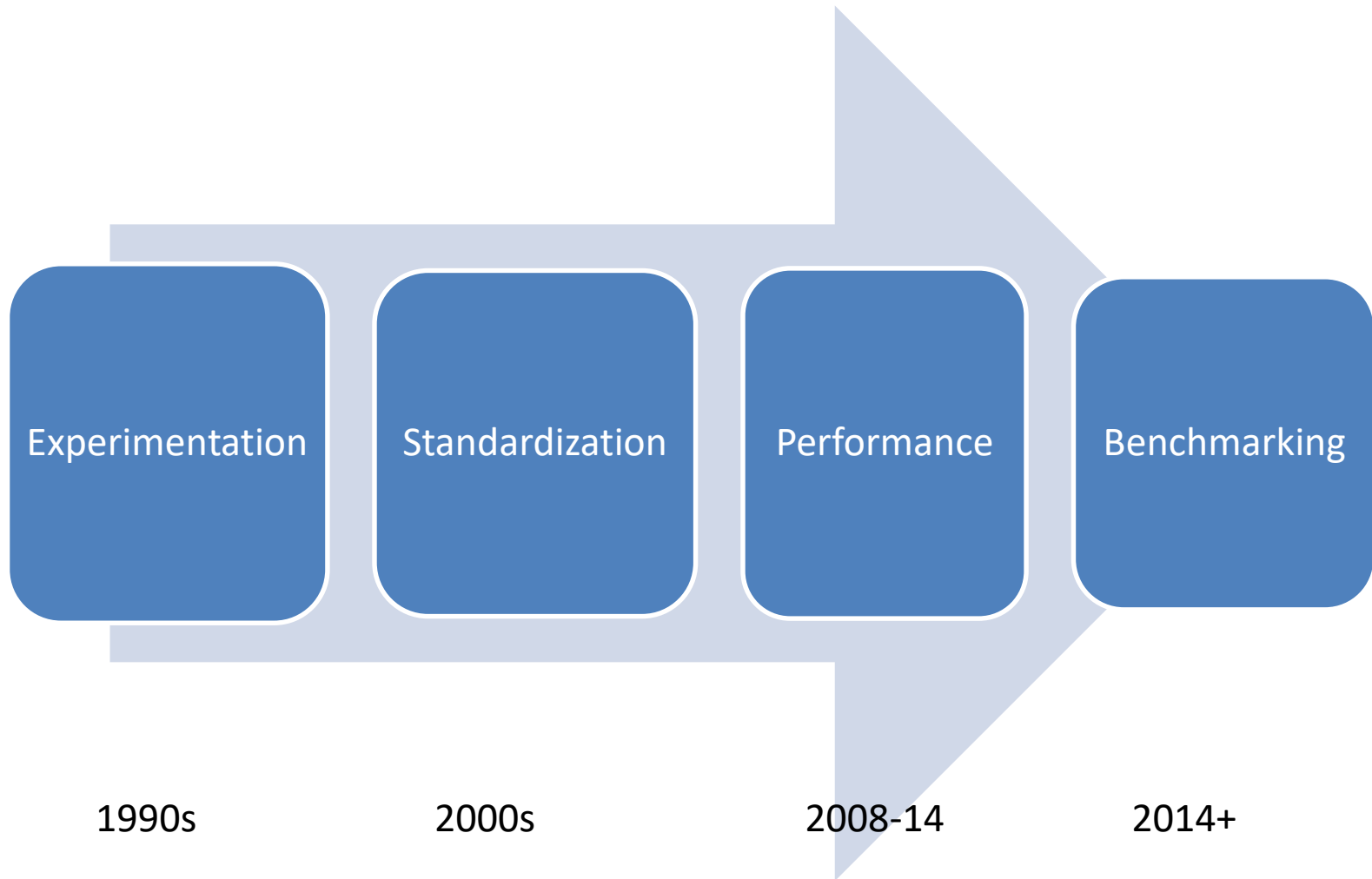
- Differences in stakeholder perspectives
- The intervention should come BEFORE the outcomes (no reverse causality, simultaneity)
- Time-lags (for technology-based interventions, 7-15 years)
- Indirect link between program intervention & desired outcomes
- External factors, e.g., regulatory changes, shifts in federal R&D priorities, other state and local, economic development policies, business cycles, availability of local downstream investment capital, entrepreneurial management skill, technological developments elsewhere, market demand growth
- Difficulty of finding counterfactual evidence (what would have happened without the program)
- Other classic threats to validity: Maturity (firms naturally get better over time), Testing (surveys, etc. lead to improvement), Selection bias (the best firms use the service, survive)

Stakeholders	Evaluation Interests/Needs
Customers	<ul style="list-style-type: none"> • Evidence of success • Minimal reporting burden • Information with value
Extension specialists	<ul style="list-style-type: none"> • Information to understand and improve service delivery • Minimal reporting burden
Program managers	<ul style="list-style-type: none"> • Timely feedback on program activities and performance • Procedures that are easy to follow/administer • Information to enable improvement
Organization	<ul style="list-style-type: none"> • Evidence of meeting sponsor, program goals • Recognition, visibility
Partners	<ul style="list-style-type: none"> • Assessment in the context of what they do • Coordination with their information systems • Timely feedback on performance
Sponsor – State	<ul style="list-style-type: none"> • Economic development impacts • Recognition, visibility
Sponsor - Federal	<ul style="list-style-type: none"> • Meeting program goals • Timely information reporting • Learning

The Center Balancing Act



Overview and Evolution of MEP Evaluation



MEP Evaluation System

Reporting	Customer	Review	Indicators	Special Studies
<ul style="list-style-type: none">•Customer reporting•Project Reporting	<ul style="list-style-type: none">•Customer survey•Success stories	<ul style="list-style-type: none">•Center operating plans•External panel reviews	<ul style="list-style-type: none">•System•Center•Client	<ul style="list-style-type: none">•Comparison group•Strategic•Case studies•State*•Trade association*

Reporting

Customer Information File

- Client name, industry code, # employees, first year of service, address, contact name, phone, email

Project Information File

- Initiation, completion date, title, center staff/ hours, 3rd party organization/staff/hours, \$ billed, substance, delivery mode, surveyed

Center reports client project data quarterly

Customer

Survey

- Methods
 - 3rd party
 - Web/phone/other
 - 1 year after 1st project
- Items
 - Cost savings
 - Capital investment
 - Jobs created
 - Sales (new, retained)
 - Improvements in:
 - Manufacturing systems
 - Human resources system
 - IT systems
 - Marketing and sales systems
 - Management systems

Success stories

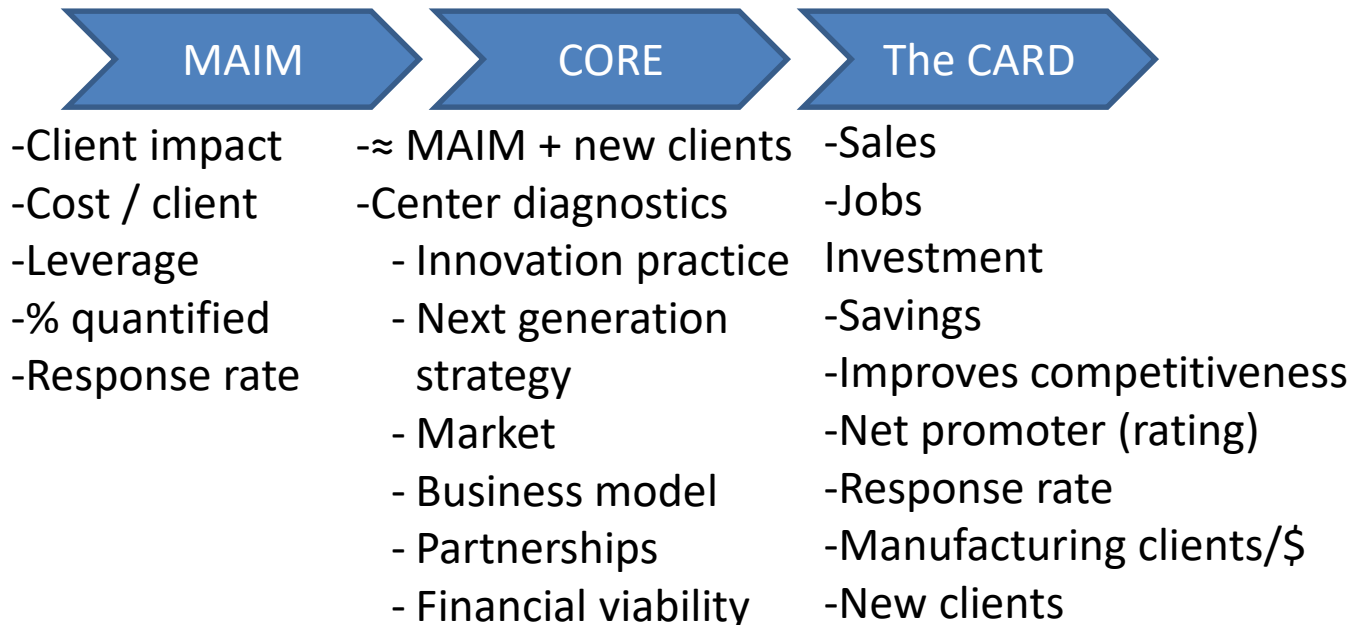
- Client name
- Center name
- Story title
- Client profile
- Situation (client problem)
- Solution (services from center)
- Results (quantitative, qualitative)
- Testimonial (quote from client, client name, title)

Review

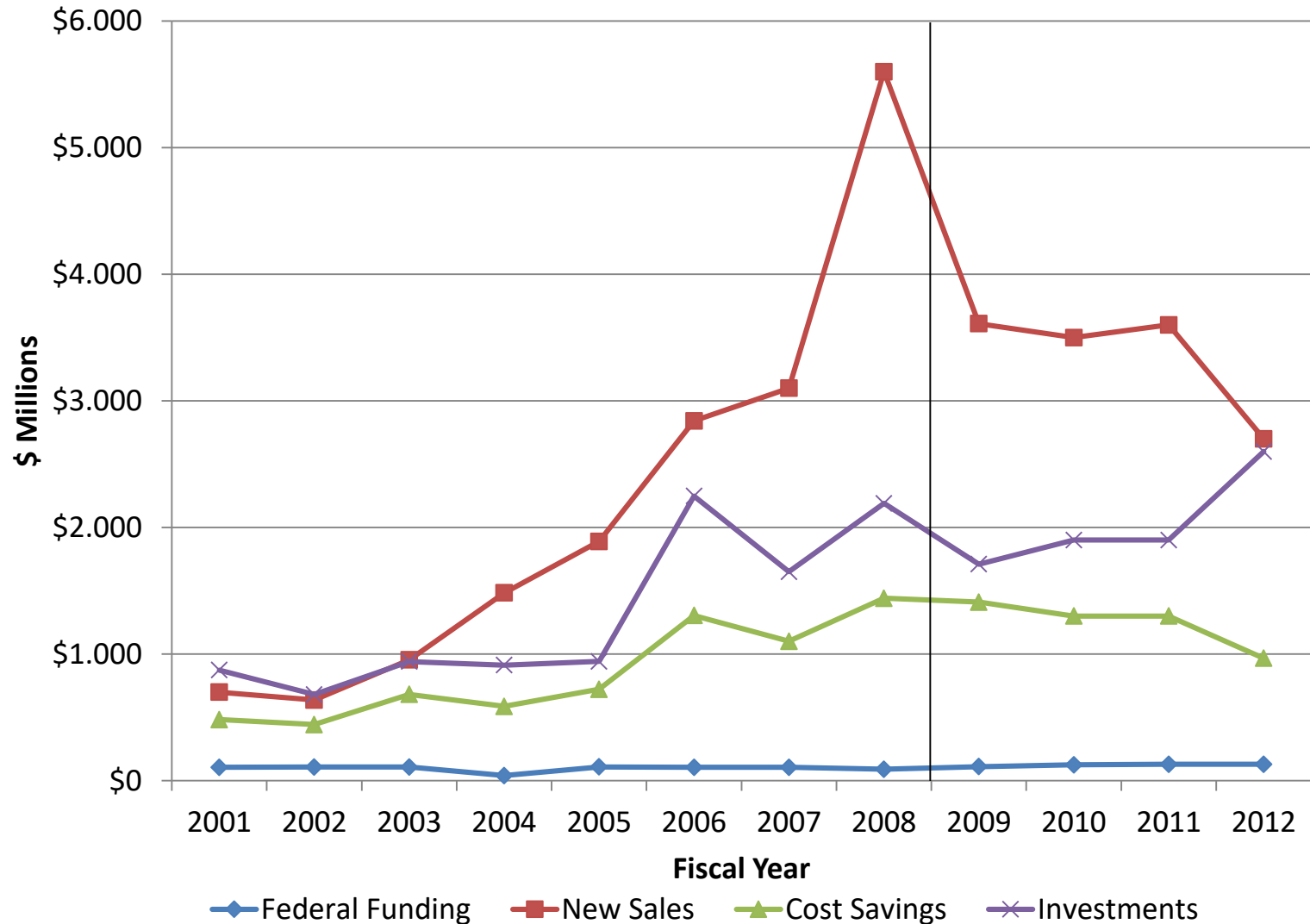
- Quarterly progress reports
- Annual operating plan
 - History, organization, advisory board, locations, financials (revenues, expenses), center personnel, characteristics of the region, products/service delivery model, partnerships, response to previous year's review comments
- Strategic plan
 - Strategic planning requirements (state, host, MEP)
 - Business model, market understanding, partnerships, financial viability
 - Performance metrics
 - Strategic directions (business model, marketing/communications, services, professional development, partnerships, performance goals)
 - Past achievements
 - Requirements, short-term/long-term responses
- Center review
 - Annual by MEP staff
 - Every two years: external panel of other center directors, etc.
 - Recommendations require response in center plans

Indicators

- Program: Government Performance and Results Act (GPRA) - annual performance reports review success/failure in meeting its performance goals
 - Clients served, increased sales, cost savings, capital investment
- Center: Survey, customer, center data as indicators



MEP Performance Indicators and Federal Funding



Special Studies

Economic research and analysis: uses of data mining, advanced research techniques to better understand the MEP program, U.S. manufacturing, and the relationship between the two.

Case Studies: focus on successful MEP projects to gain insight into variables at both the firm and industry-level that impact technology adoption and business transformation.

Longitudinal Studies: compare the competitive performance of MEP clients relative to non-MEP clients.

7 “Learnings” from MEP Evaluations

1. \$1 in public investment leverages \$3-\$13 private investment
2. MEP complements rather than competes with the private sector
 - 73% manufacturers said MEP complements private sector, only 7% said it is duplicative
 - Performance improvement 5.4 X higher than with just a consultant alone

7 “Learnings” from MEP Evaluations

3. Impacts vary by the services provided

Project Type	Sales Increase	Capital Spending Increased	Capital Spending Avoided	Inventory Savings	Cost Savings	New Jobs Created	Jobs Saved	Mean Customer Time (index)
	Likelihood of an Impact, as Reported by Customers*							
Computers	0.90	1.41	1.12	2.55	1.21	1.02	1.22	1.21
Plant Layout	1.18	1.20	1.57	1.23	1.22	1.34	1.28	0.95
Environmental	0.35	0.86	1.96	0.30	0.78	0.38	0.78	0.57
Human resources	0.80	0.75	0.33	1.29	1.18	1.10	1.54	0.82
Marketing	1.66	0.65	0.43	0.21	0.07	2.20	0.80	0.64
Materials testing	0.65	0.81	0.80	0.26	0.73	0.81	0.50	0.57
Management	1.37	1.15	0.41	2.17	1.10	0.85	2.27	0.76
Process improvement	1.24	1.37	1.21	1.18	1.07	0.96	0.80	1.02
Energy	0.27	1.34	0.19	0.36	1.59	0.34	0.35	0.81
Product development	1.64	0.87	1.24	0.35	0.73	1.18	0.67	1.01
Quality	1.09	0.67	0.65	1.09	1.05	1.07	0.87	1.99

*Index of impact (actual and anticipated) by project type as a ratio of average impact by project type (column). A ratio of greater than one means above average impact. A ratio of less than one means below average impact.

Source: Georgia Manufacturing Extension Alliance, Customer Evaluation of Service Surveys, February 1, 1994-December 31, 1996, based on 538 surveys.

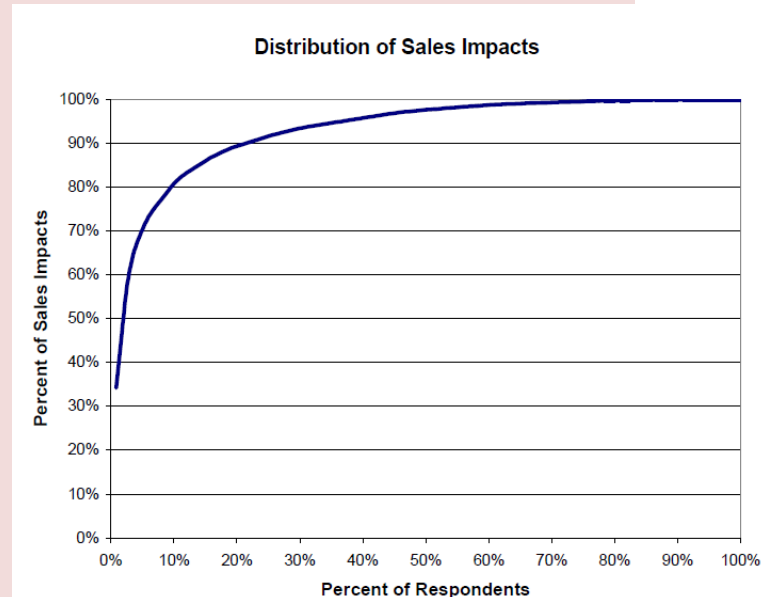
1. Shapira and Youtie 1995; 2. Oldsman 1997; 3. Youtie and Shapira 1997; 4. Oldsman 1996, Oldsman and Heye 1998; 5. Youtie and Shapira 1997, Oldsman 1996; 6. Chapman 1998, Wilkins 1998, Youtie 2005, 7. GAO 2011

7 “Learnings” from MEP Evaluations

4. Customized services in product development, marketing lead to bigger benefits; routine services for quality, process improvement lead to more modest firm effects

- Reducing scrap from 3% to 1% = \$125,000 savings
- But being able to raise piece prices from \$5 to 5.10 (reflecting higher value goods) = \$200,000 revenue

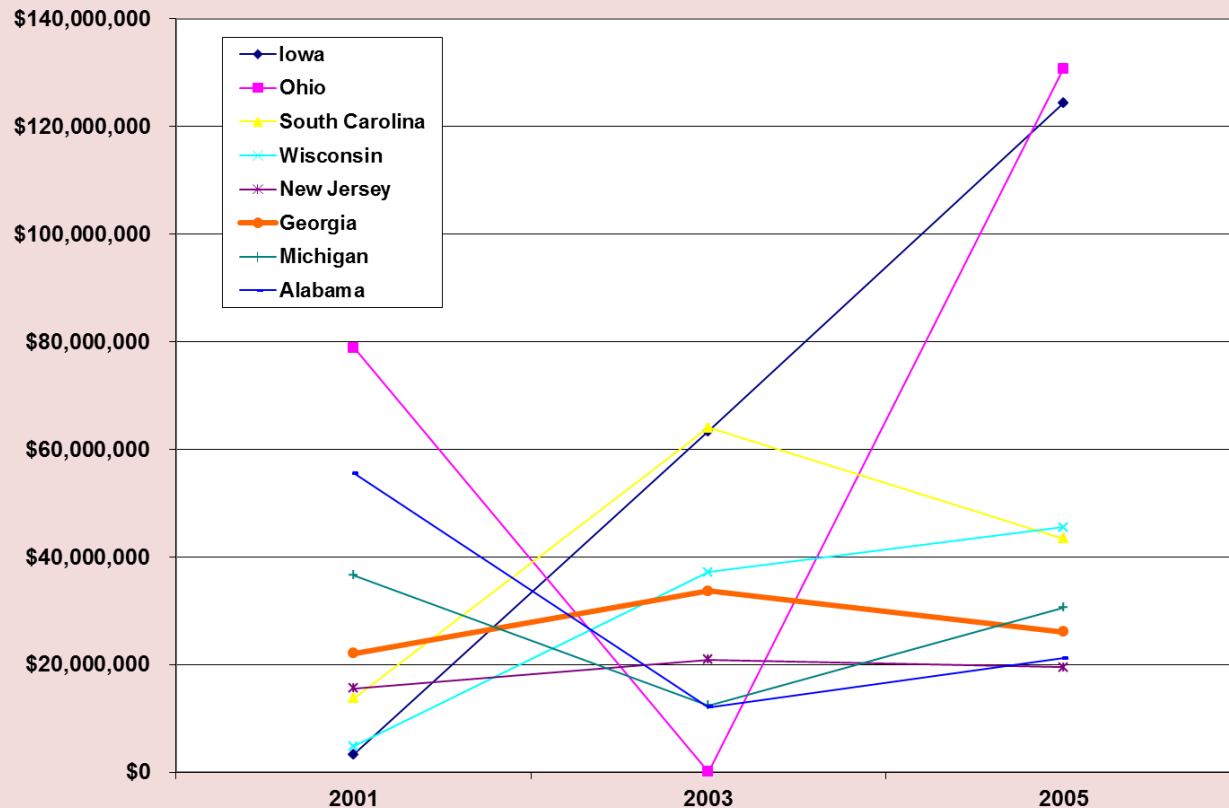
5. A few customers account for most of the impacts (results are skewed)



Source: Based on NIST MEP follow up survey for the period Q3 2000 to Q2 2001.

7 “Learnings” from MEP Evaluations

6. Results at the center level will vary from quarter to quarter



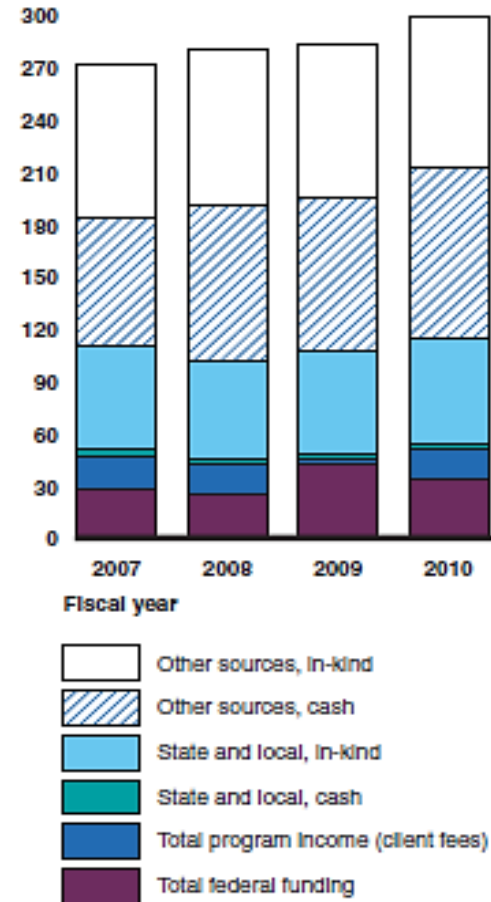
1. Shapira and Youtie 1995; 2. Oldsman 1997; 3. Youtie and Shapira 1997; 4. Oldsman 1996, Oldsman and Heye 1998; 5. Youtie and Shapira 1997, Oldsman 1996; 6. Chapman 1998, Wilkins 1998, Youtie 2005, 7. GAO 2011

7 “Learnings” from MEP Evaluations

7. Lack of stability in federal funding leads to customer “creaming,” reduction of state funding match

- 26 MEP centers in 2010 received 50%+ of nonfederal contributions from client fees
- Only 2 centers received <10% of nonfederal contribution from client fees

Total MEP center funding, including federal and nonfederal contribution (Dollars in millions)



Source: GAO analysis of data provided by NIST.

1. Shapira and Youtie 1995; 2. Oldsman 1997; 3. Youtie and Shapira 1997; 4. Oldsman 1996, Oldsman and Heye 1998; 5. Youtie and Shapira 1997, Oldsman 1996; 6. Chapman 1998, Wilkins 1998, Youtie 2005, 7. GAO 2011

10 MEP Evaluation Challenges

1. Many clients cannot monetize impacts
2. Timing issues (for measuring impacts) exist
3. There are a “zero sum” considerations
4. “Selection bias” exists, but controlling for it is difficult
5. Hard to learn from program justification indicators
6. Important soft impacts are de-emphasized
7. Measures beyond one-on-one engagements are de-emphasized
 - Firms operate in value chains, firm networks
 - Role of MEP in coordinating services to manufacturers
8. Retaining indicators to enable comparison should be balanced against the need for periodic change
9. “Bandwidth” issues in evaluation v. other claims on centers’, companies’ time
10. Potential for bias in encouraging positive responses



“Hummer” evaluation for a “Chevrolet” program?



- Use a pragmatic, balanced approach
- Devote minimally required resources to program justification, e.g.,
 - Customer/assistance information (# customers served)
 - Comparison groups
 - For surveys, be mindful of customer limitations, costs v. benefits
- Devote more resources to program learning
 - Cross-center review panels
 - External studies/reviews
 - Flexible analyses of service elements

Questions about evaluation?

7. Conclusion

Implementing Technology Extension Services

Key Questions

1. Can an initial pilot be carefully **rolled out** into a national program and **integrated** with **national 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 integrated?
7. How can TES services be linked to other **infrastructural/R&D programs** and centers?
8. How can **private sector participation** be incorporated?
9. How can **industrially-experienced specialists** be attracted?
10. How can **effective monitoring and evaluation** be introduced, also couple with **learning** from best practices, and **program improvement**?

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
- ☐ Linking SMEs to research base & commercialization of ideas
- ☐ Measurement: What counts?
- ☐ Sustaining & justifying public funds
- ☐ Integrating extension services into broader economic policy, including demand-side incentives

Proposition

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