STEManalytics

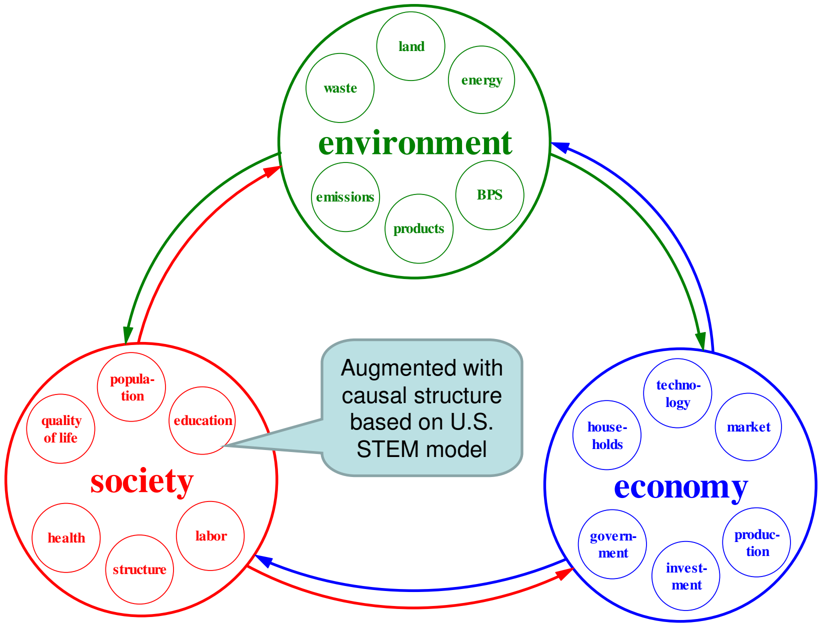
The Ohio State University

July 29, 2010

Overview

- **Central premise**: STEM education and workforce/economic dynamics must be modeled more realistically to meet state needs
- Developed model structure needed to enhance U.S. STEM model and coupled it to existing socio-economic model (T21-Ohio)
- Convened stakeholders to elicit knowledge of priority research questions, key variables, causal relationships and sources of data

From T21-Ohio to OH-STEM



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Rationale for OH-STEM Approach

- States are major loci of STEM education policy
  - Regional clusters also significant in many areas
- Current STEM educational initiatives typically linked to workforce and economic development aims
- T21-Ohio models comprehensive state/region-level dynamics, including economic, social, and environmental factors
- Coupling U.S. STEM and T21-Ohio models is an efficient way to build a model that allows rigorous study of inter-twined policies and outcomes across these spheres and examination of factors affecting STEM talent supply and demand

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Coupling of STEM Model with T21-Ohio System Dynamics Model

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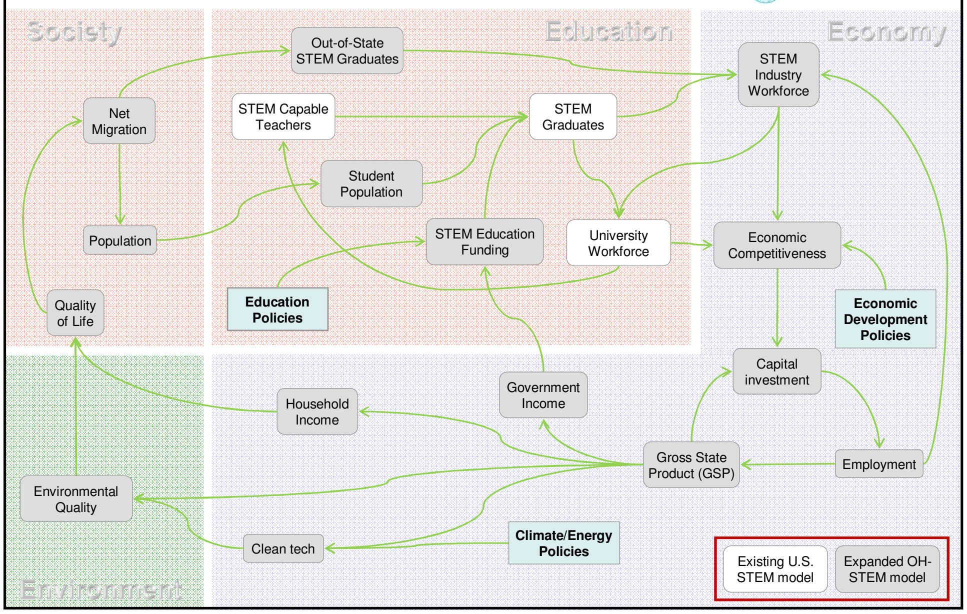


Dayton STEM Goals

Student

K-12, Higher-STEM

GRAD Rate ↑

STEM Skill Identification

ENG. / STEM Rate↑

Social

STEM is cool

Access for Disadvantage

Recruit to Prevent Poverty

Culture

Credit

Raise Bandwidth

Workforce

Local Retention

Employment↑

Lead in R&D

Lead in STEM Employment

STEM Quality/Capacity

High STEM Quality

Pre K-12

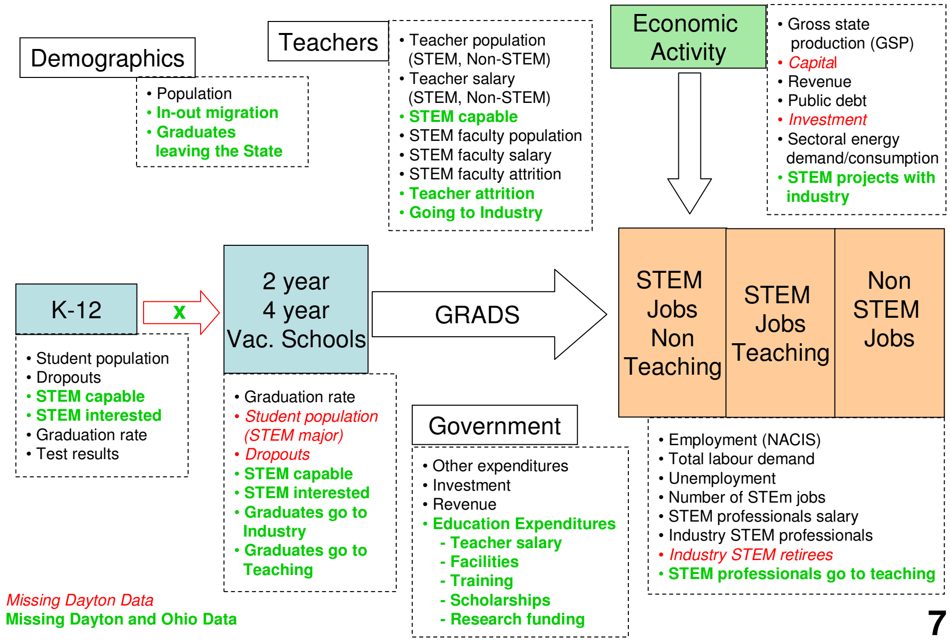
STEM Everywhere

Test Scores↑

STEM Rigor↑

Teacher Training and Evaluation

Ohio and Dayton Region Data Availability



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Stakeholder-Defined Obstacles / Barriers

Marketing & Understanding Options	Dayton Bias
Counselor Training	Lack of Skilled Workforce
Depend on Government	High-Cost Economy
Private Sector Engagement	Program Rich – System Poor
Imperfect Assesment Tools	Resource Alignment
Teacher Quality and Training	Disconnect Job vs. Skills
Teacher Pool	Poor Information for Students
Skills Gap After K-12	Race
No Funding for Talent Development	Family and Community Support
Financial Aid	Private Sector takes brights
Students Lack of Career Vision	Student Preferences

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Potential Interventions

Factors of Interest	Key Indicators
STEM teacher salaries vs STEM industry salaries Classrooms (class size; equipment) Scholarships STEM capable/non-capable teachers (recruitment, retention, professional development) Curriculum Instructional methods Computer based teaching Distance learning opportunities Internships for students Research funding Private sector help (help teachers teach certain topics, and volunteers in schools; provide funding; tax incentives)	Student STEM Proficiency College STEM attrition rate No. of STEM graduates go to industry/teaching No. Of STEM graduates go to grad. school No. Of STEM capable teachers No. of jobs created Gross state product Net migration Environmental quality

Summary: Developing a State Model

1. Assemble a model development team: Researchers + Modelers
   - Expertise and knowledge of data sets across education, workforce and economic development
2. Convene or interview stakeholders to identify key causal relationships and identify questions of interest for the state
   - Example: How can we double the number of STEM graduates by 2020?
3. Modelers create stock and flow model based on stakeholder feedback
4. Data gaps are identified and missing data is tracked down; where there are no data, assumptions are made
5. Calibrate and run the model
6. Reconvene key stakeholders to validate model and default assumptions

A Scenario

Scenario

Base Case:

- No changes to the system

STEM Non-Capable Teacher Attrition:

- 15% increase in attrition rate among STEM non-capable teachers with 0 to 3 year experience for 9th-12th grades

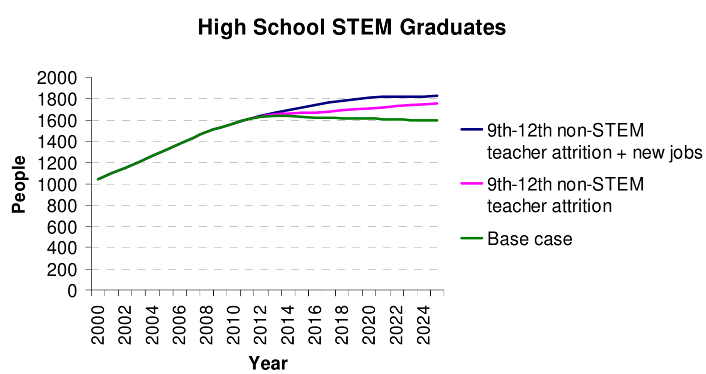
STEM Non-Capable Teacher Attrition and New STEM Jobs:

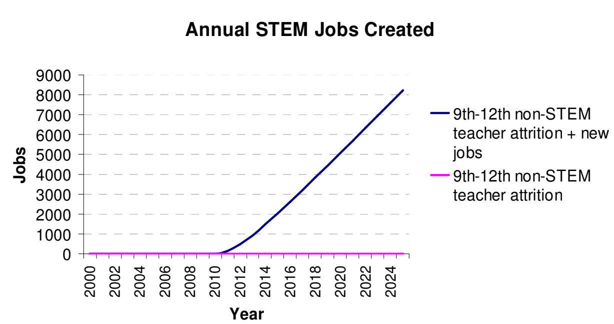
- STEM non-capable teacher attrition scenario
- 10,000 new STEM jobs added between 2010 and 2025

  Industry STEM jobs introduced = 5000
  Service STEM jobs introduced = 2000
  High Tech STEM jobs introduced = 500
  Healthcare STEM jobs introduced = 2500

Scenario: Results

STEM Non-Capable Teacher Attrition	STEM Non-Capable Teacher Attrition and New STEM Jobs
Total STEM jobs created: none **GSP generated:** none **GSP per employed person:** same as base case **Government revenues:** same as base case **STEM graduates:** increased by average 4% compared to the base case	**Total STEM jobs created:** 17,320 (direct and indirect) **GSP generated:** on average about $120 million/year **GSP per employed person:** on average about $123,000 person/year **Gov't revenues:** approximately $163 million in 15 years (increased compared to based case) **Unemployment rate:** down by 0.85% in the short term; **STEM graduates:** increase by average 3.7% compared to Scenario 1



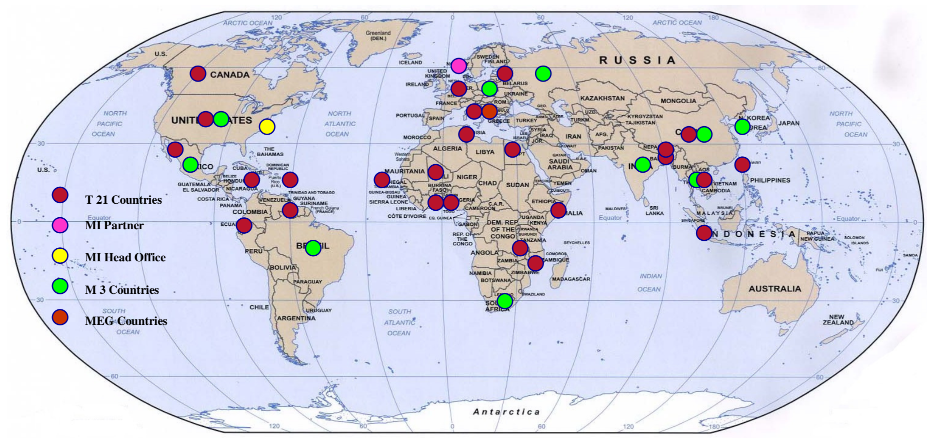


Conclusion

- We find strong interest in the potential of systems models among stakeholders engaged in STEM education/workforce initiatives
- Developing state-level model structure is fairly straightforward; data availability and quality challenges can be significant
- Less comprehensive model structure may be adequate to capture basic workforce/economic dynamics
- Awaiting confirmation of award under NIH “Modeling the Scientific Workforce” initiative

Backup Slides

Threshold 21 (T21)



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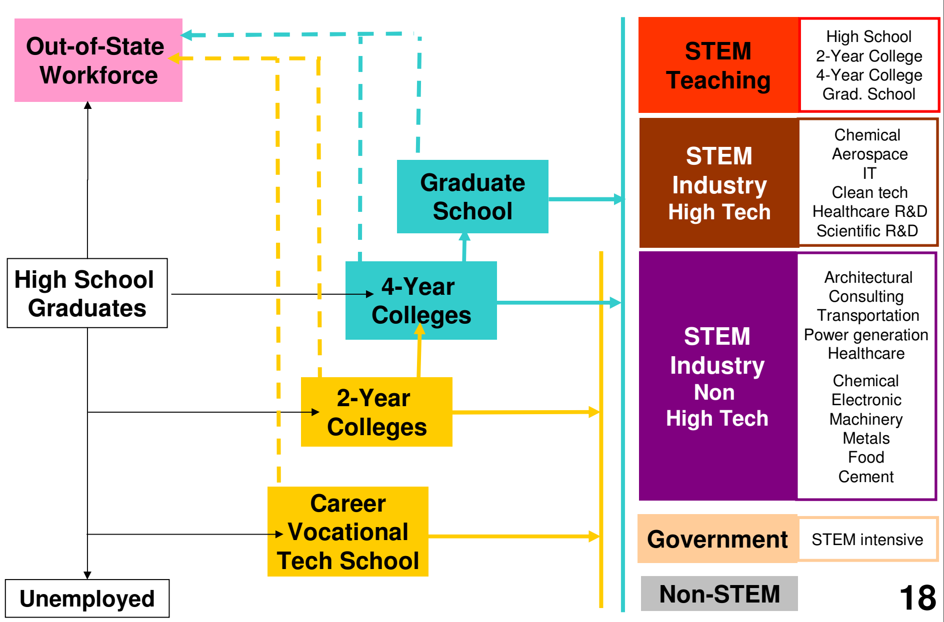
- T21 can be applied to most countries or regions
- More than 25 unique, customized T21 models have been developed to date.

Potential Student Pathways
(data needed to quantify flows)



Workforce Demand

STEM Teaching	High School 2-Year College 4-Year College Grad. School
STEM Industry High Tech	Chemical Aerospace IT Clean tech Healthcare R&D Scientific R&D
STEM Industry Non High Tech	Architectural Consulting Transportation Power generation Healthcare Chemical Electronic Machinery Metals Food Cement
Government	STEM intensive
Non-STEM	

Ohio State Level and Dayton Region STEM Data Acquired

Data Type	Collected	Source
Demographics	Population (1992-2008) Median Income (1999-2008)	U.S. Census
Education K-12 2-year col. 4-year col.	No. of high school graduates (1996-2008) Student populations (K-12) (1992-2008) High school dropouts (1996-2003) Test results (1999-2009) Total enrollment (2005-2008) Number of teachers (2001-2009) Avg. teacher salary (2001-2009)	Ohio Department of Education Interactive Local Report Card Ohio Higher Education Information System (HEI) National Center for Education Statistics (NCES)
Labor	No. of Sectoral Workforce (1992-2009) No. of of STEM jobs (1999-2008) No. of Non-Teaching STEM Jobs (1999-2008) No. of Teaching STEM Jobs (1999-2008) No. of High Tech Jobs (2000-2008) Avg. Non-Teaching STEM Salary (1999-2008) Avg. Teaching STEM Salary (1999-2008) Avg. High Tech Salary (2000-2008)	Ohio Labor Market Information U.S. Bureau of Labor Statistics

Missing STEM Data Required for Models

Data Type	Ohio	Dayton
Education K-12 2-year col. 4-year col.	STEM capable students STEM interested students STEM teacher attrition College grads go to Industry/Teaching College grads. leaving the state STEM capable teachers STEM teachers go to industry	Student populations (college - major) STEM capable students STEM interested students STEM teacher attrition College dropouts College grads go to Industry/Teaching College grads. leaving the state STEM teachers go to industry Cost of K-12 education/college Government education expeditures
Labor	STEM professionals go to teaching	Industry STEM professionals (ages) Industry STEM retirees STEM professionals go to teaching