PathTech

Successful Academic & Employment Pathways in Advanced Technologies

Annual Report 2013-2014
Attachment 2

NSF ATE Award #1104214

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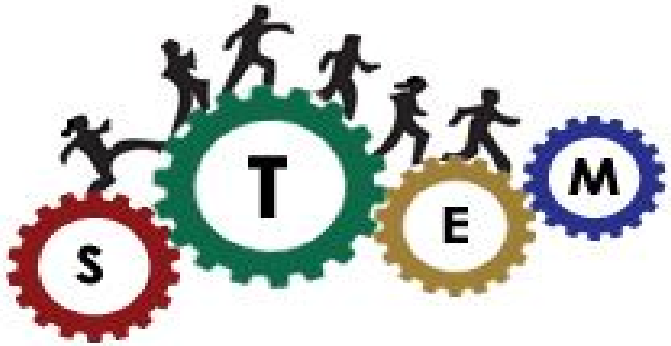


Successful Academic & Employment Pathways in Advanced Technologies

Understanding Engineering Technology Education and Career Pathways through Research and Community Engagement

Department of Sociology
University of South Florida
wtyson@usf.edu
pathtech@usf.edu
NSF#: 1104214

Presentation Overview

William Tyson and Lakshmi Jayaram

The "Pipeline" Metaphor: An Iconic Symbol for STEM Workforce Development or Mythical Understanding of Pathways into High-Tech Fields?

Rebekah Heppner

Pathways into High-Tech Manufacturing Careers: Where Do Internships in Engineering Technology Really Lead?

Chrystal A. S. Smith

Women Forging Ahead in Traditionally Male Dominated Engineering Technology Field

PathTech Overview

- Project Description
- Community College/University Partnerships
- Project Goals
- Interdisciplinary Research Team
- Research Methodology
- Tampa Bay Manufacturing Students
- Engineering Technology Pathways

Successful Academic and Employment Pathways in Advanced Technologies

- National Science Foundation (NSF) Advanced Technological Education (ATE) Targeted Research in Technician Education
  - $1.2 million over 4 years (2011-2015)
- ATE Center/University Partnership
  - Florida Advanced Technological Education Center (FLATE) at Hillsborough Community College
  - University of South Florida Department of Sociology and College of Education

What is ‘ATE’?

Advanced Technological Education

- Mission (from ATE program solicitation)
  - ATE supports targeted research on technician education, changing roles of technicians in the workplace, and topics that advance the knowledge base needed to make technician education programs more effective and more forward-looking
  - Results inform practices in technician education programs, emphasizing dissemination to practitioners
  - Projects represent a true collaboration--reflected in the activities, the leadership, and the budget--between well-qualified researchers, two-year college educators and other stakeholders

Role of Community Colleges and Technical Education

- Community Colleges:
  - Trains students for technical jobs
  - Provides continuing education in related fields for community members
  - Prepares students for transfer to a four-year institution
  - Known for welcoming non-traditional, immigrant, and first-generation college students

- Technician education:
  - Prepares students for entry into jobs across industries
  - Important for individuals not pursuing graduate degrees or manual labor fee-for-service jobs
  - Offers ‘re-skilling’ for technician jobs, making technicians more competitive for the job market

Project Goals

- Understanding recruitment and pathways into engineering technology
- Providing information to improve ET education
- Increasing the visibility of ET programs
- Providing information to help meet workforce demands

Interdisciplinary Research Team

- PI: **Will Tyson, PhD** (Sociology)
- Co-PI: **Lakshmi Jayaram, PhD** (Sociology)
- Co-PI: **Marie Boyette, PhD** (FLATE Associate Director)

- Project Manager: **Chrystal Smith, PhD** (Anthropology)
- Quantitative Investigator: **Eddie Fletcher, PhD** (Education)
- Post-doc: **Margaret Cooper, PhD** (Sociology)
- Qualitative Consultant: **Rebekah Heppner, MBA, PhD** (Anthropology)
- Graduate Assistants:
  - **Pangri Mehta, MA** (Sociology)
  - **David Zeller, MA** (Sociology)
  - **Michael DiCicco, MA** (Education)

Community Engagement

Presenting at Fall 2013 Florida Forum on Engineering Technology

Will Tyson meeting with Dr. Eric Roe, Polk State College

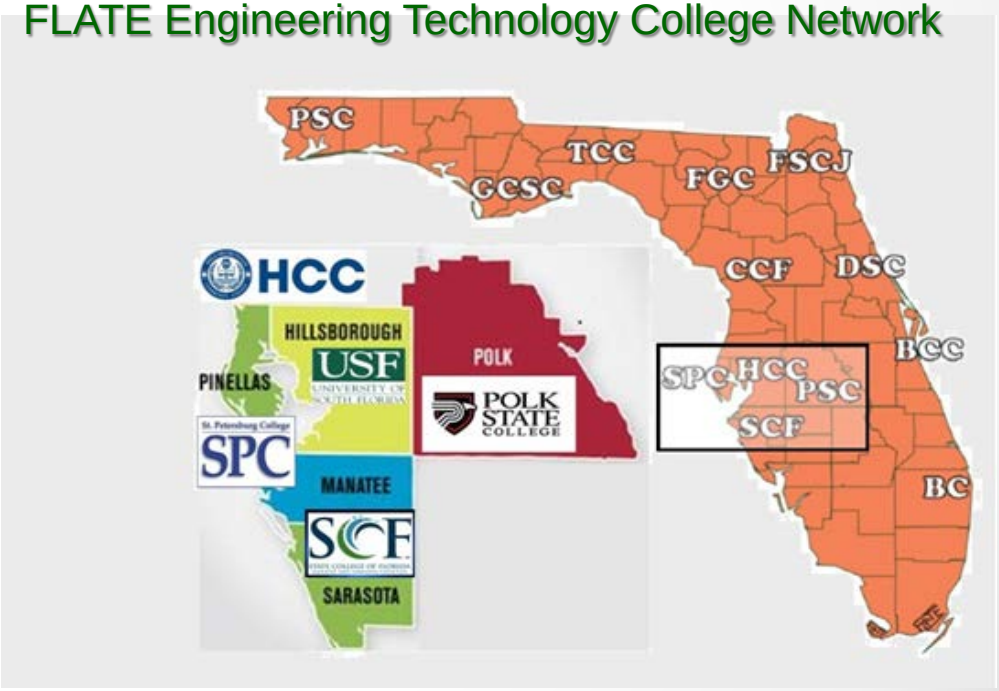
Will Tyson, FLATE Director Marilyn Barger, Rebekah Heppner touring Draper Labs (St. Petersburg) during FLATE Industry Advisory Council meeting

Community College Partners

PathTech partnerships with FLATE, ET program faculty, and administrators help researchers connect with:

- ET students
- ET graduates
- High school career academies
- Industry partners

FLATE Engineering Technology College Network



Qualitative Goals

- Develop narratives of ET pathways through interviews with high school students, community college students, employers and employees in the industry
- Understand background factors, current experiences, and expected future trajectories through in-depth interviews

Methodology

- Data collection - facilitated by community college and high school instructors who invited us to their classes
- Interviews - conducted by the PathTech qualitative team (faculty, post docs, and graduate research assistants)
  - Occurred on the community college and high school campuses during times specified by the school
  - Lasted 20-30 minutes
  - Interview transcripts were coded and thematically analyzed
    - High School Students~25
    - Community College Students~60

Interview Questions – Students

- High school students were asked to discuss:
  - what prompted their interest in pursuing advanced technology education
  - descriptions of their coursework
  - future plans

- Community college ET students were asked to discuss:
  - how they came to learn about ET programs
  - the factors that influenced their decision to enroll in an ET program
  - their high school preparation
  - their perceptions of the ET job market

Interview Questions – Administrators and Industry

- ET program administrators were asked about:
  - the institutional and historical development of engineering technology programs
  - key elements of ET degree programs
  - the type of students these programs attracted and retained
  - ways in which community colleges were working to support their graduates in pursuing employment opportunities

- Interviews with industry leaders focused on better understanding:
  - the skill sets they currently seek in ET workers
  - recruitment and hiring processes
  - their perception of the skill sets and fields of knowledge that will be essential for the future workers in this field

‘Pipeline’ or ‘Cycling’?

The "Pipeline" Metaphor: An Iconic Symbol for STEM Workforce Development or Mythical Understanding of Pathways into High-Tech Fields?

- William Tyson and Lakshmi Jayaram

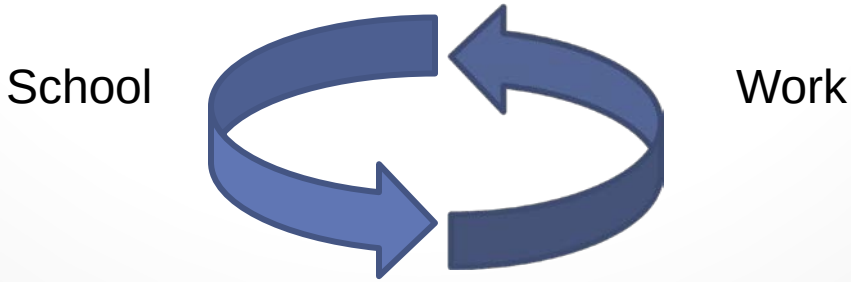
Focus of paper: the intersection of school, work, family, the economy and life course

‘Pipeline’ or ‘Cycling’?

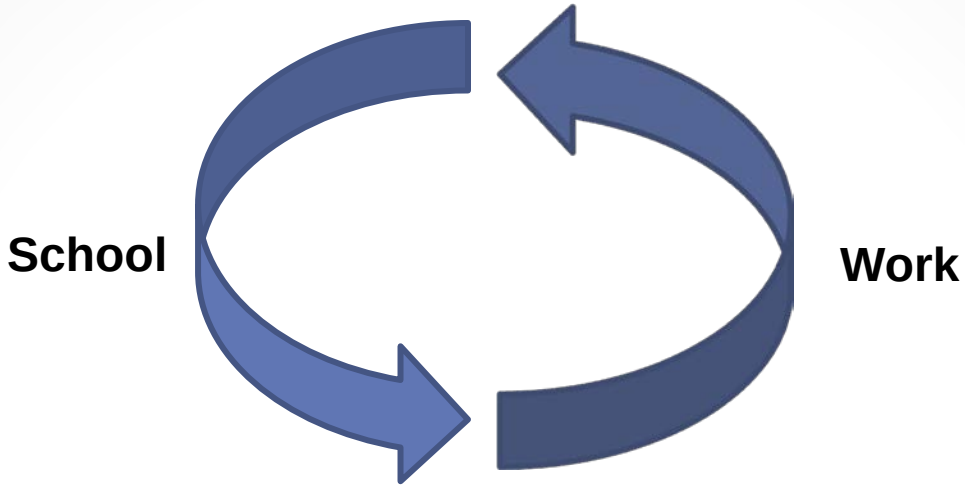
‘**Pipeline**’: linear progression from school to work

However, fewer and fewer students are experiencing linear progressions from school to work. Also, students experience other life transitions in addition to ‘school-to-work.’

‘**Cycling**’ addresses this disconnect and speaks to non-linear school-to-work transitions.



‘Cycling’ in Order to ‘Re-Skill’



‘Re-Skilling’: pathways characterized by fluid movement between school to work and work to school

- Re-skilling has become necessary to survive in the current economy and its demands for a highly skilled workforce

‘Cycling’: fluid system of transitions between school, work and family

- Contemporary economy requires re-skilling of technician workforce
  - Community college- not just a destination with a simple entrance and exit
  - Pathways between school and work are necessitated by broader market demands and personal life histories

Pathways Research

- Understanding the confluence of pathways and social forces gives leaders and policymakers the tools to:
  - support education and employment in technician education programs, emphasizing dissemination to practitioners
  - improve the life chances and well-being of the citizenry
  - foster progress as an educated and skilled nation

High School Student Findings

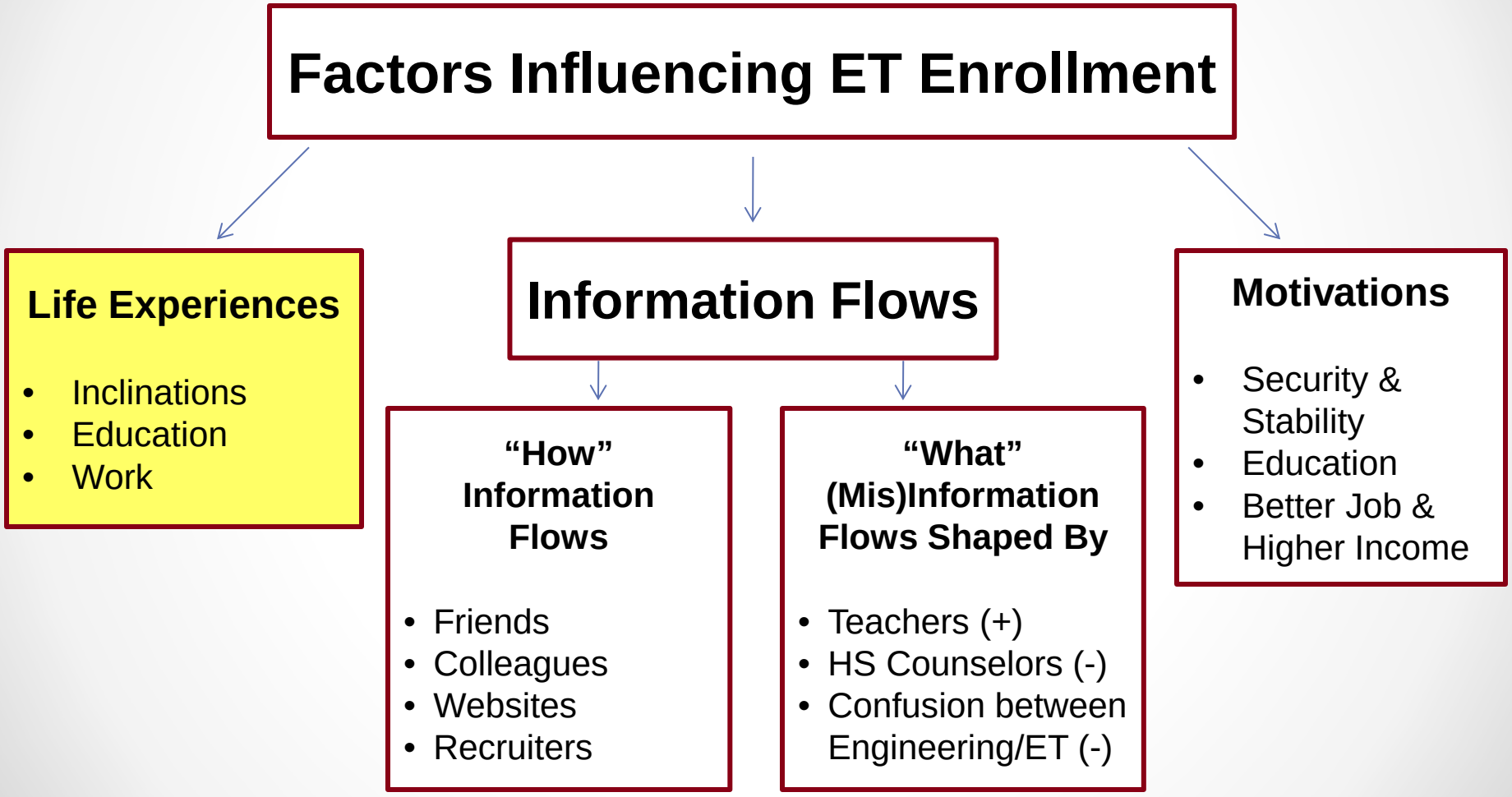
- High school data analysis reveals varied future plans:
  - About 1/3 had completed high levels of math and science coursework in high school and are **bound for four-year universities to study in STEM fields**
  - About 1/3 of the students were **considering associate's degree programs in technician education**
    - Most of these students are only interested in programs which offer formal co-operative education ("co-op") opportunities to work in relevant industry jobs while taking classes

High School Student Findings

- About 1/3 **could not afford to continue in school** without assistance. Their plans include:
  - joining the military in a technical field with hopes of going back to school with support from the GI Bill
  - entering the technician workforce

These students desired postsecondary schooling, however funding uncertainties potentially derail their hopes for future degree attainment.

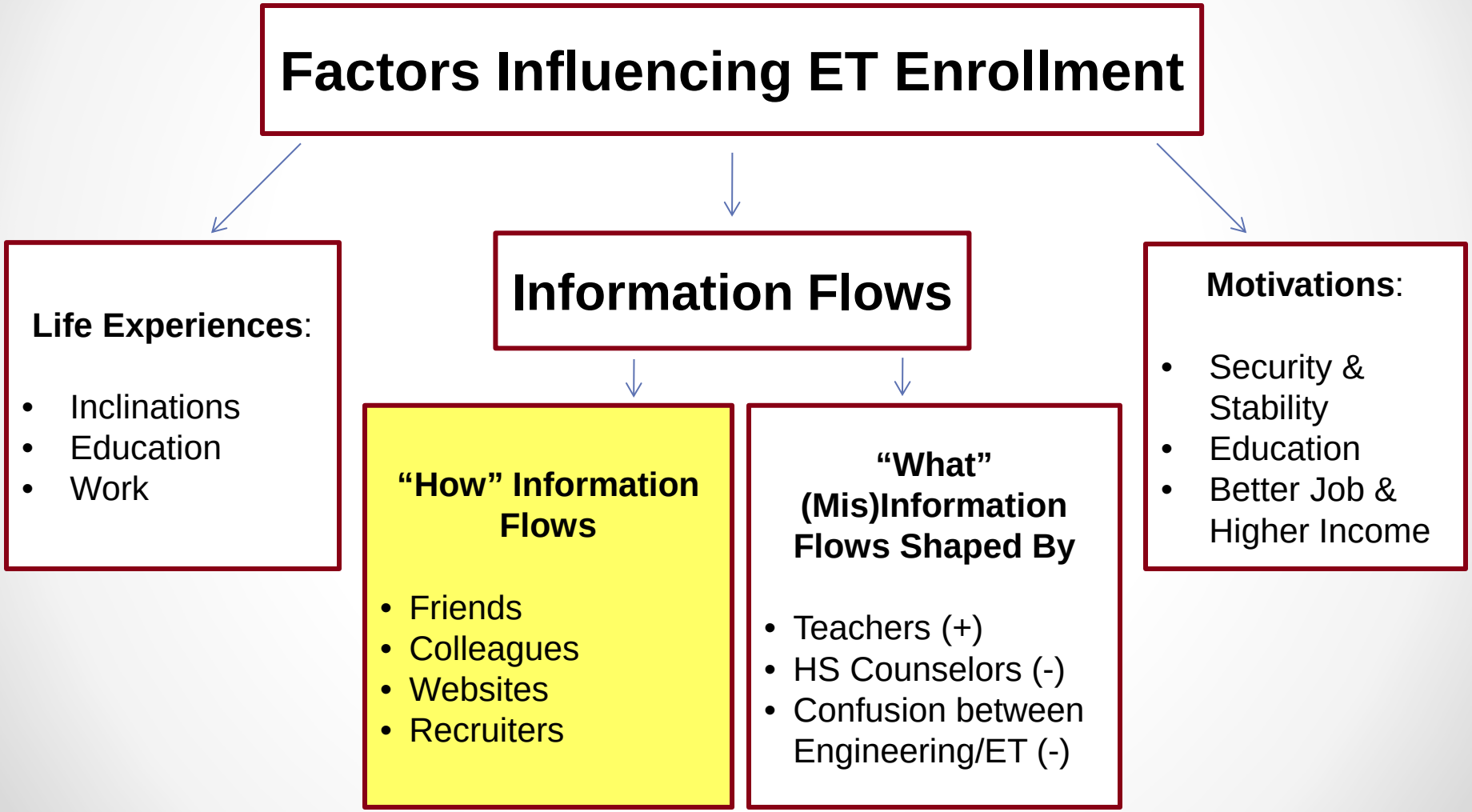
Findings


Factors Influencing ET Enrollment
Life Experiences
• Inclinations
• Education
• Work
Information Flows
"How" Information Flows
• Friends
• Colleagues
• Websites
• Recruiters
"What" (Mis)Information Flows Shaped By
• Teachers (+)
• HS Counselors (-)
• Confusion between Engineering/ET (-)
Motivations
• Security & Stability
• Education
• Better Job & Higher Income

Life Experiences

- Students articulate life experiences leading to pathways into ET:
  - inclination towards building, fixing things, and using their hands
  - previous education, and specifically, high school coursework and extracurricular opportunities lead students to the ET program
  - current work experiences, often in ET-related fields, propelling students into ET degree programs

Findings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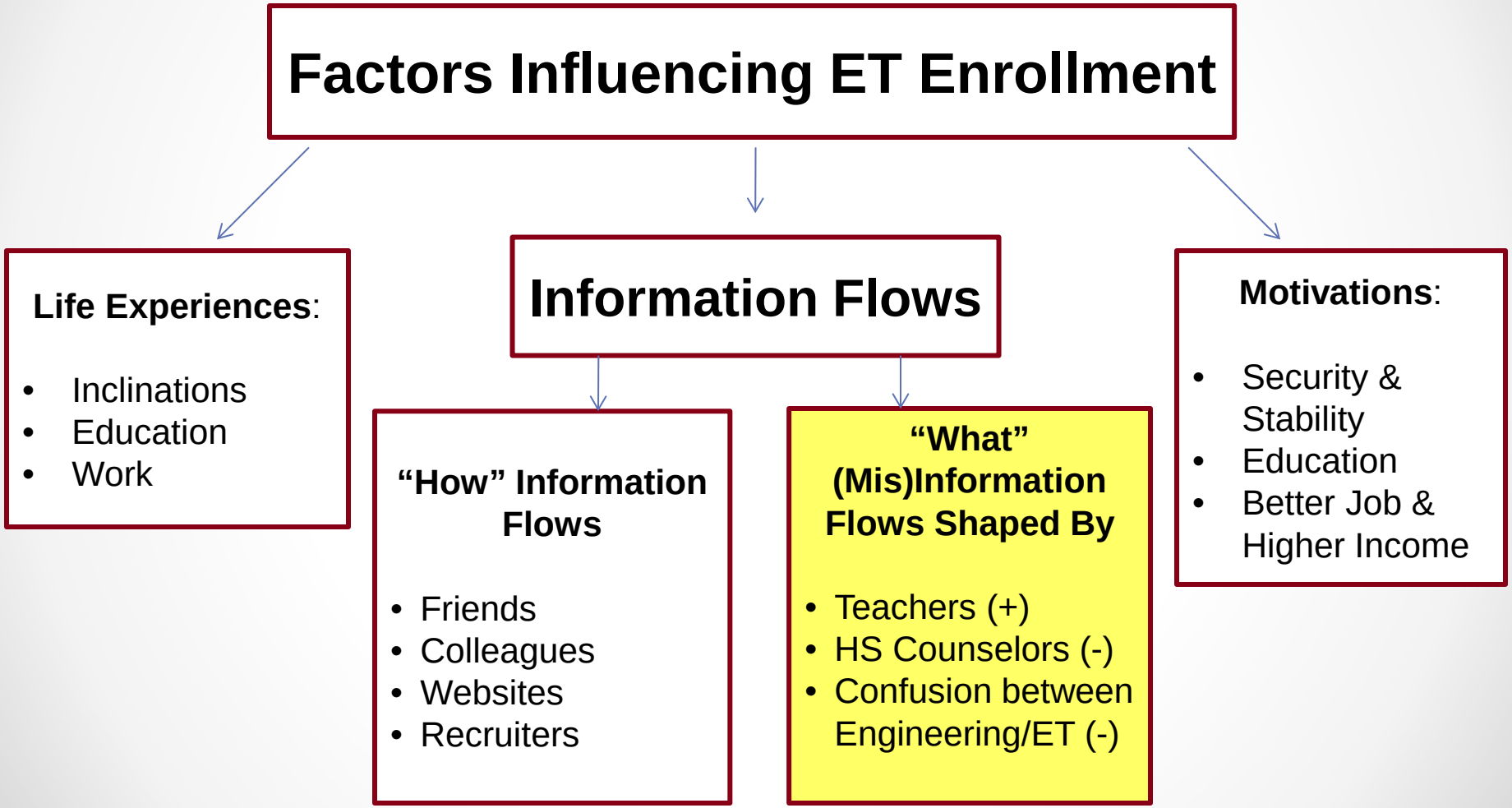
How Information Flows

- Students learn about ET programs through:
  - **Personal social networks**
    - discussions with a friend, partner or coworker
  - **Internet**
    - research on the internet to learn more about ET as a field and the courses offered
  - **Recruiters**
    - recruiters at military installations were particularly helpful in sharing information about the field

Findings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What Positive Information Flows: HS Teachers

- Findings reveal that instructors play an instrumental role in attracting students and motivating them to pursue ET
  - High school interviewees state that their instructor is the best aspect of their program, and explain how much he has taught them and nurtured their interests
  - Community college students discuss how they just keep taking classes with the same group of instructors, regardless of the course

These testimonials illustrate the transformative educational experiences instructors and classroom learning provides, and give us a mandate to explore educators' roles in supporting and improving pathways into ET fields.

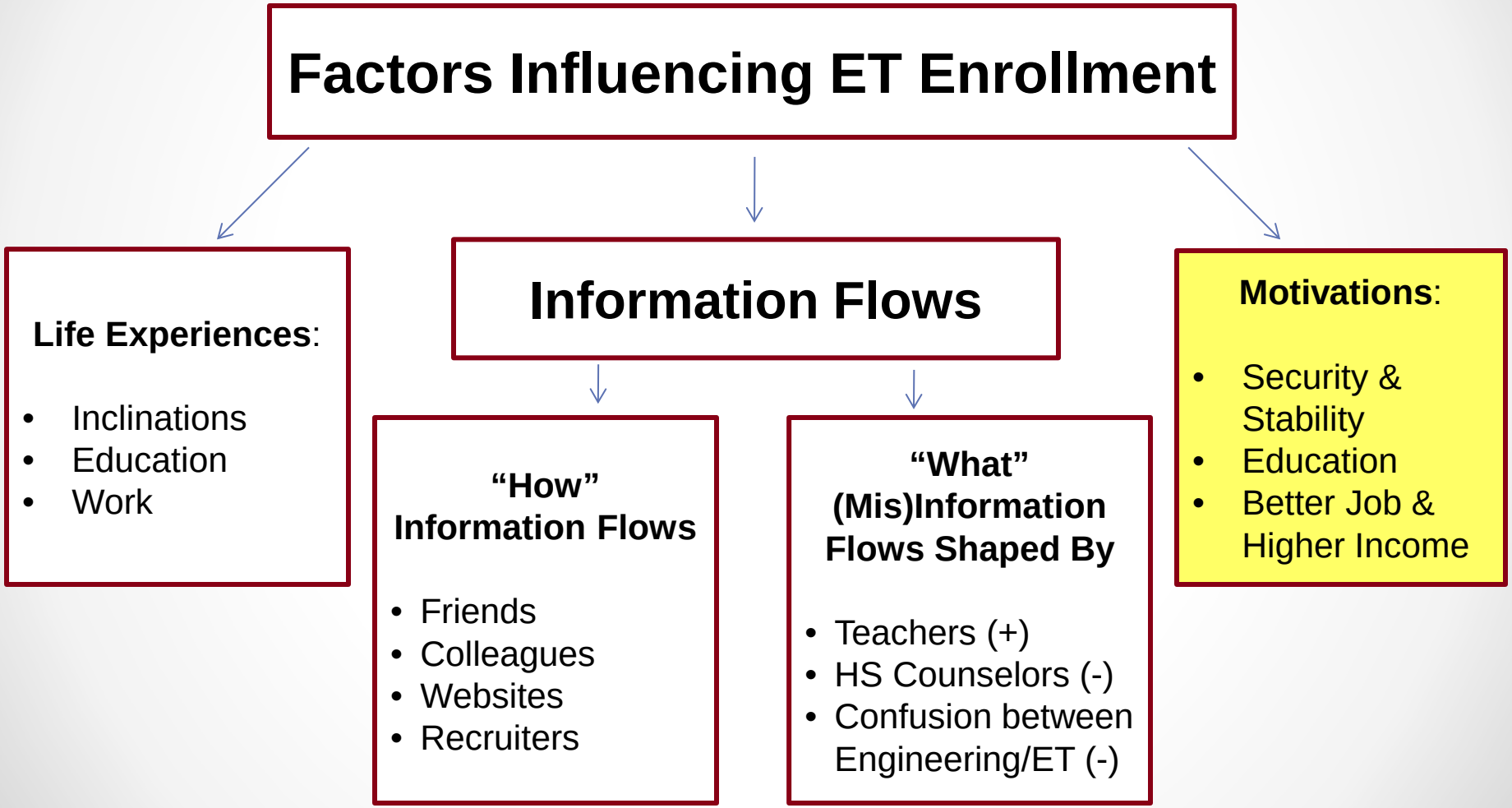
What Negative Information Flows

- An area of frustration was **high school counselors'** lack of knowledge about associate's degree programs in technician education
  - Several students wished they had learned of these technical education/employment opportunities sooner in their educational careers
- Students' narratives also convey some **confusion and ambiguity** over the differences between **engineering and engineering technology**.
  - Students discuss aspirations of becoming an "engineer," but often the work they are describing centers on technical tasks and processes
  - Some students even expressed disappointment that their ET coursework would not count as "prerequisites" for bachelor's programs in engineering

What Negative Information Flows

- **High School Counselors**
  - High school counselors are perceived by students as not really understanding their interests, unaware of the ET field and potential opportunities
  - Students exhibited frustration that counselors are not more helpful

Findings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Motivating Factors

- Students described factors that motivated them to seek degrees and/or credentials in ET:
  - hopes for social mobility
  - higher pay
  - better jobs
  - the possibility for the two-year degree to lead towards a bachelor's degree

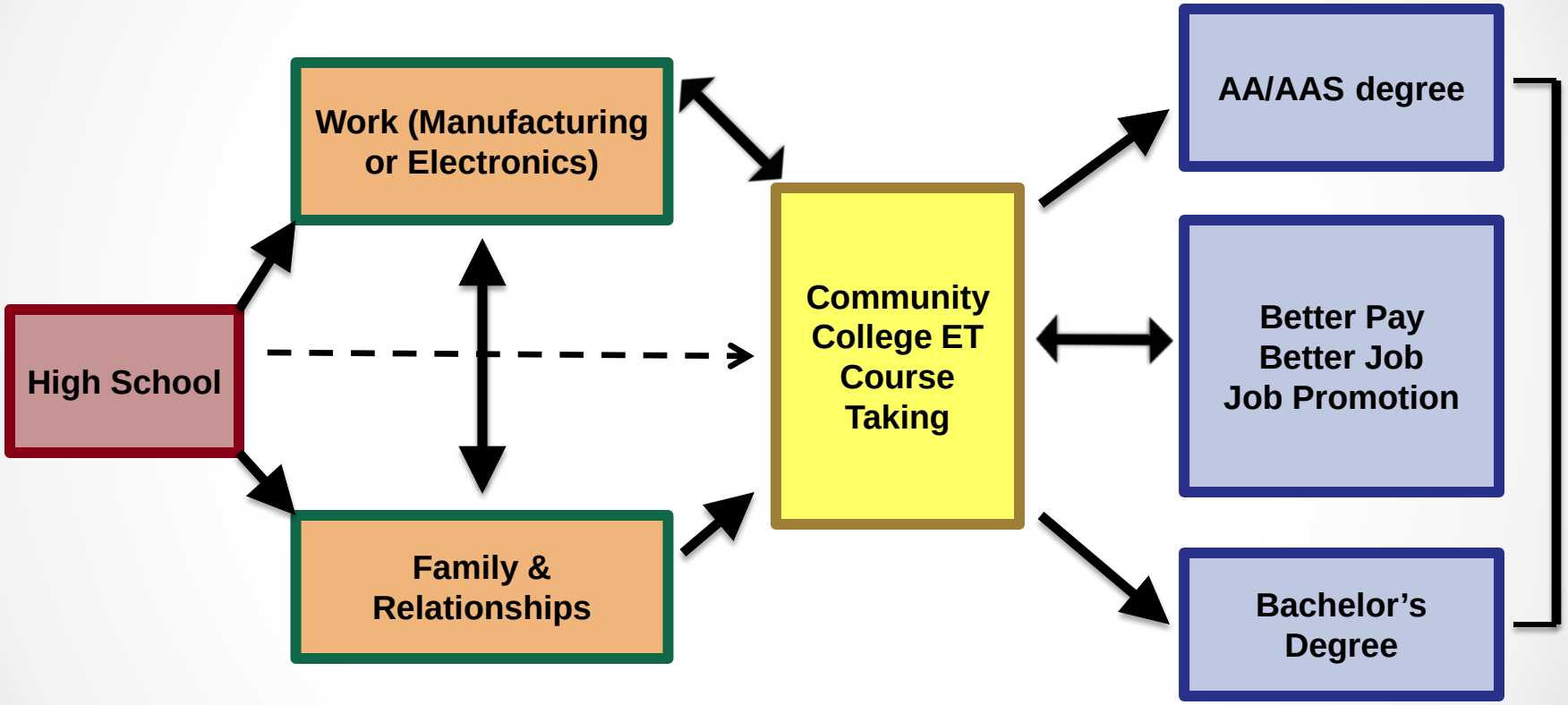
This theme is critical to note because all of the ET students interviewed so far are returning to school many years after completing high school. This age demographic appears consistent across programs in ET in the Tampa Bay area.

Motivating Factors

- Many students entered the workforce or military after high school and most already had experience in manufacturing or similar industry. Their return to school was often marked by:
  - a job loss and/or
  - need for re-skilling in advanced technologies
  - marketability in the current economy

These older students also often have partners and children, and many discuss their need to provide for their families as a key element motivating their desire to enter and complete the ET program.

Emerging Pathways



General Policy Recommendations for Community Colleges

- Develop highly informational websites to improve the information flows about both what technician education is, and how to enter and succeed in these programs
- Focus recruitment efforts on mid-career individuals seeking to re-skill and/or develop technical expertise to re-enter the workforce
- Work specifically with high school counselors to improve their knowledge of the differences between engineering and engineering technology and the many opportunities for technicians in the current economy

Suggestions for Improving the High School Recruiting into ET programs

Given the palpable stress personal finances presented for continuing in school, many more interested students with solid high school foundations would be attracted to associate's degree programs if **financial assistance** were more readily available. In particular, **scholarships, grants, and loans** would be very helpful.

Suggestions for Improving the High School Recruiting into ET programs

Community colleges should more actively promote existing **dual enrollment** programs and explore partnerships with high schools to encourage dual enrollment to make programs more convenient for parents and students. Dual enrollment programs allow public high school students to gain important industry certifications that could lead to pathways straight into technician jobs.

Suggestions for Improving the High School Recruiting into ET programs

High school and community college students are very attracted by opportunities for **co-op experiences**. This approach removes what students see as the abstract nature of what a technician's job is and allows students to understand and experience it first-hand. In addition, students view co-op opportunities as a concrete way to prove themselves and hopefully get a good job in the future with that experience.

Suggestions for Improving the High School Recruiting into ET programs

Educators can play a vital role in facilitating student development in technical fields. As a result, we recommend inquiry into **developing a professional network for technician educators** across educational institutions, spanning secondary and post-secondary programs, to connect and develop an infrastructure to "send" students from high school CTE classes into ET community college programs.

Next Steps

- Continued Full Qualitative Study in the Tampa Bay region:
  - Interviews at four high schools with ET programs
  - Interviews with ET program administrators and instructors
  - Interviews with employers in five counties
  - Focus groups and follow-up interviews to triangulate analysis

Thank You!

Web: sociology.usf.edu/pathtech

Email: pathtech@usf.edu

Pathways into Engineering Careers

Rebekah Heppner, Ph.D.

"The Skills Gap"

- Manufacturing Gap Analysis
  - August 2013

"The highest shortages were for the most advanced jobs, such as machinists and technicians."

Employer interviews

- 26 companies, 22 used in this analysis
- Range from under 25 employees to thousands
  - Most are small to mid-sized & locally owned
- Focus: Advanced Manufacturing
  - Range from machine shops to phosphate processing . . .
    - . . . Power generation to plastic cups!

Questions Asked

- Semi-structured interviews of employers who hire engineering technicians:
  - What skills are you looking for in engineering tech employees?
  - How could employees be better prepared for engineering technology jobs?
  - Do you have any engineering technology internship or apprenticeship positions in your company?

"Gaps" identified

- College degree (4 year) as the goal
- Public perception of manufacturing
- Community College ET programs
- Hands-on training/internships

The internship paradox, Part I

- Hands-on training is considered the best way to train engineering technicians
- Small manufacturers don't offer internships
- Mid & large manufacturers provide internships - but fill them with students from 4-year engineering programs

The internship paradox, Part II

Students from 4-year engineering programs are doing the work of engineering technicians . . .

reducing their access to training and job opportunities . . .

resulting in a shortage of engineering technicians!

"The Skills Gap"

- Manufacturing Gap Analysis
  - August 2013

"The highest shortages were for the most advanced jobs, such as machinists and technicians."

The Evidence from Employers

- 7 recommend internships for technicians
- 4 have technician interns (CC)
- 10 have 4-year engineering degree seeking students as interns - doing engineering tech work.

Machine Shops

Computer Aided Design

Robotic Manufacturing

Computer controlled machine

3D Printer Programmer

Clean Room Workers

Pathways into Engineering Careers

Rebekah Heppner, Ph.D.

Women Forging Ahead in Traditionally Male Dominated Engineering Technology Fields

Chrystal A. S. Smith, Ph.D.
University of South Florida

Introduction

- College-educated workers earn higher wages and have lower levels of unemployment.
- Because of the weak economy and changes in the workforce, large numbers of women have enrolled in colleges.
- Community colleges are affordable, convenient, and flexible.

Radford, A. W., & Tasoff, S. (2009). Choosing a postsecondary institution: Considerations reported by students. National Center for Education Statistics 2009-186. Washington, DC: U.S. Department of Education.

Miller, K., Gault, B., & Gorman, A. (2011). Improving child care access to promote postsecondary success among low-income parents. Washington, DC: Institute for Women's Policy Research.

Introduction Cont'd

- In 2010, women were 57 percent of community college students, 3/10 women of color.
- 1/4 of these women are mothers with work, family, and caregiving responsibilities.
- Women are more likely to attend community colleges part-time than men.
- Slightly half of community college students earn a degree or certificate.

Hill, C., & St. Rose, A. (2013). Women in community colleges: Access to success. American Association of University Women. Washington, D.C.: AAUW.

Goldrick-Rab, S., & Sorensen, K. (2011). Unmarried parents in college: Pathways to success. Fast Focus, 9. Madison, WI: Institute for Research on Poverty, University of Wisconsin, Madison.

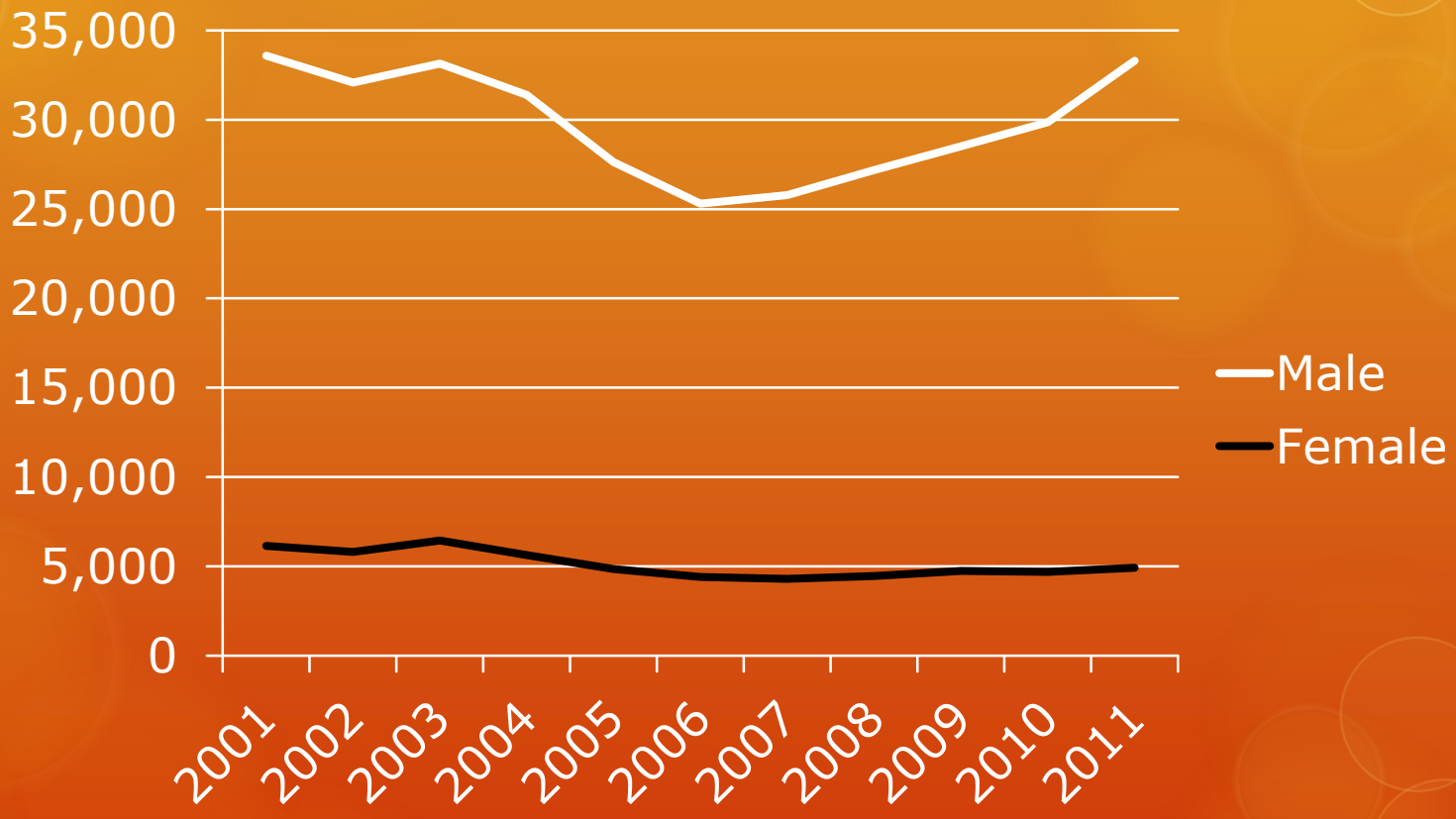
Background

- Over next 10 years, STEM jobs are expected to double.
- Women are underrepresented in STEM workforce, < 25 percent.
- Women with ET degrees/certification have higher average earnings and opportunities for advancement.

Hill, C., & St. Rose, A. (2013). Women in community colleges: Access to success. American Association of University Women. Washington, D.C.: AAUW.

Attwell, P., Heil, S., & Reisel, L. (2011). Competing explanations of undergraduate noncompletion. American Educational Research Journal, 48(3), 536–59.

Earned ET Associate's Degrees, by Sex, 2001–2011



National Science Board: *Science and Engineering Indicators 2014*
http://www.nsf.gov/statistics/seind14/content/chapter-2/at02-21.pdf

Barriers to Women in ET

- Women often lack information about ET occupations and opportunities at community colleges.
- Stereotypes and about "appropriate" occupations for women.
- Women entering ET need the support of faculty, family, and peers.

Starobin, S. S., & Laanan, F. S. (2008). Broadening female participation in science, technology, engineering, and mathematics: Experiences at community colleges. New Directions for Community Colleges, 142, 37–46.

Packard, B. W., Gagnon, J. L., & Moring-Parris, R. (2010). Investing in the academic science preparation of CTE students: Challenges and possibilities. Career and Technical Education Research, 35(3), 137–56.

Research Questions

What are experiences of women enrolled in ET degree programs at community colleges? To what extent are their experiences similar and/or different?

- Why they decided to enroll in community college?
- Why they decide to pursue ET degree/certification?
- What are their career ambitions?

Sample

- Six women enrolled in ET programs at four community colleges in southwest Florida.

Methodology

- Conducted semi-structured interviews
- Administered a socio-demographic questionnaire

Analysis

- Descriptive statistics
- Coding interview transcripts
- Case studies

Characteristics

Characteristics	Number
Ethnicity	
White American	4
Latino/Hispanic	2
Marital Status	
Married	4
Single	2
Caregiving - Children	
Yes	3
No	3

Characteristics Cont'd

Characteristics	Number
Education	
High school diploma	4
Associate's degree	1
Bachelor's degree	1
Current Employment	
Yes	4
No	2
Full-time Employment	
Yes	2
No	2

Characteristics Cont'd

- Age range: 30 – 56 years; Average 42 years
- Types of funding:
  - Grant/Scholarships
  - Tuition waiver/Cash
  - Loans/GI Bill
  - Savings
  - Savings/Grant/Scholarships
  - Loans/Savings/Grant/scholarships

Candace

- Married 40 year old white American (no kids)
- Works full-time in international sales
- Considered enrolling at ITT and DeVry
- Enrolled in ET part-time
- Plans to transfer to USF to pursue BS in electrical engineering
- EE BS will make her "a lot smarter," less reliant on company engineers and gain their respect

Honoria

- Recently divorced 44 year old Latino American (3 kids)
- Considered entering fast food industry
- Works part-time at HCC
- Enrolled in ET full-time
- Interested in a ET job in quality control rather than working with machines
- Would like to pursue 4 year degree with online courses

Megan

- Single 47 year old white American
- Laid off (electronics assembler)
- Enrolled in ET full-time
- Vet – VRAP, loans
- Considered ITT, but too expensive
- Wants a better paying ET job and more job opportunities

Adriana

- Married 30 year old Latino American (kids)
- Working part-time at SPC
- Enrolled in ET full-time (has certificate)
- Completing BS in Business Administration
- Unsure if to enter workforce now or finish ET degree
- Searching for job opportunities in manufacturing and engineering

Helena

- Married 56 year old white American
- Works full-time (purchasing manager)
- Enrolled in ET part-time
- 90 percent of ET courses online
- Intends stay with her current company
- Plans to transfer to supervisory position in engineering department where she will work with her hands

Sarah

- Married 35 year old white American
- Unhappy with her job in insurance
- Initially enrolled in ET part-time
- Recently stopped working to focus on school and 2 kids
- Interested in a cutting edge job that she is passionate about

Themes

- Work, family, and caregiving responsibilities means that education must be convenient
- Education must be affordable
- No fear of mathematics and/or science
- Earn their ET degrees to get increase wages/promotions and respect from their male peers and family

Conclusions

- Women in ET are meeting its challenges, but continue to face barriers: Family responsibilities, affordability, stereotype.
- Community colleges need to conduct outreach to women so as to increase their numbers in the ET program.
- Research needs to be conducted to examine barriers to women getting hired in ET.

Acknowledgements

- Dr. Will Tyson (PI), Dr. Lakshmi Jayaram (co-PI), Dr. Marie Boyette (co-PI), Dr. Margaret Cooper
- GAs: Pangri Mehta, David Zeller, Michael DiCicco
- National Science Foundation – Advanced Technological Education #1104214
- PathTech Web site: http://sociology.usf.edu/pathtech/

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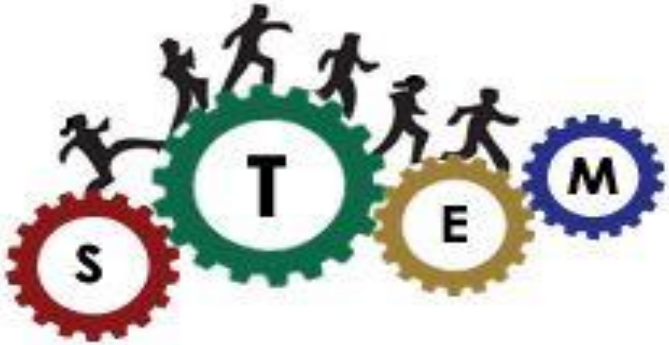

Successful Academic & Employment Pathways in Advanced Technologies

Will Tyson, Principal Investigator
Associate Professor
Department of Sociology
University of South Florida
wtyson@usf.edu
pathtech@usf.edu

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Community College Partners

Hillsborough Community College (Tampa)
- Advanced Manufacturing

St. Petersburg College (Clearwater)
- Biomedical Systems, Quality, Digital Design & Modeling

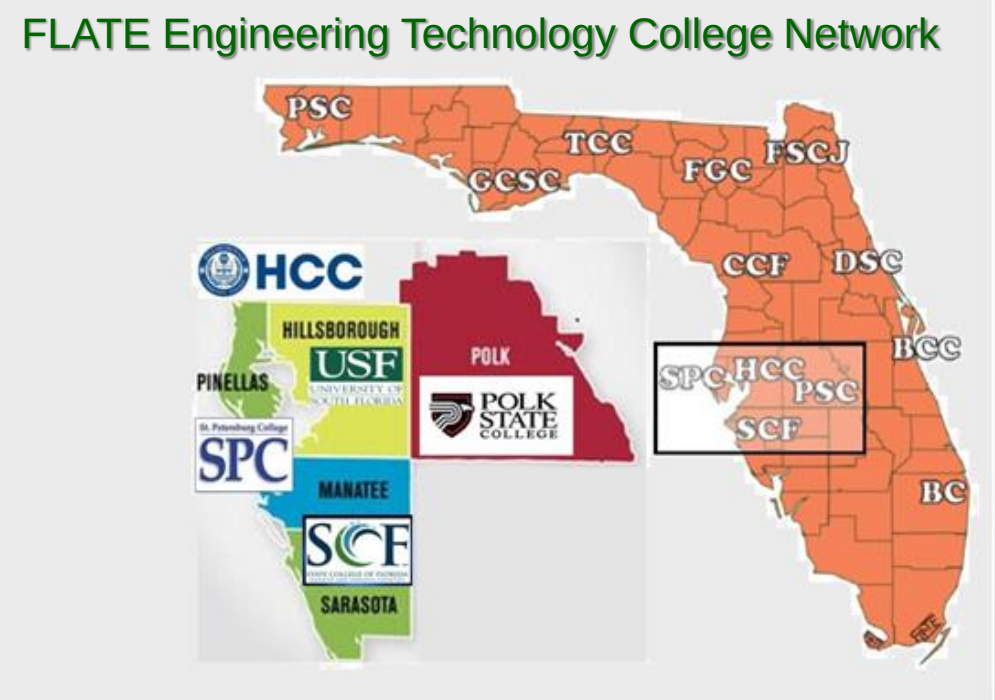
Polk State College (Lakeland)
- Advanced Manufacturing

State College of Florida (Venice)
- Electronics, Digital Design & Modeling

Community College Partners

PathTech partnerships with ET program faculty and administrators help researchers connect with:

- ET students
- ET graduates
- High school career academies
- Industry partners



Community Engagement

Project Objectives

- Understanding recruitment and pathways into engineering technology
- Providing information to improve ET education
- Increasing the visibility of ET programs
- Providing information to help meet workforce demands

Pathways Research

- Individuals transitioning from school to work often simultaneously experience other life transitions
- Expectations for educational and occupational attainment influenced by social class, race/ethnicity, gender, geography and societal norms

Pathways Research

- Decrease of a linear progression from school to work ("pipeline")
- Individuals "re-skill" by cycling between school and work
  - To meet economic demands for a highly skilled workforce
  - To keep up with innovations in technology

Pathways Research

- Targeted research reveals pathways to:
  - enroll in technician degrees
  - earn industry certification and degrees
  - get and keep a job
  - provide for their families

Pathways Research

- Understanding the confluence of pathways and social forces gives leaders and policymakers the tools to:
  - support education and employment
  - improve the life chances and well-being of the citizenry
  - foster progress as an educated and skilled nation

Interdisciplinary Research Team

- PI: **Will Tyson, PhD** (Sociology)
- Co-PI: **Lakshmi Jayaram, PhD** (Sociology)
- Co-PI: **Marie Boyette, PhD** (FLATE Associate Director)

- Project Manager: **Chrystal Smith, PhD** (Anthropology)
- Quantitative Investigator: **Eddie Fletcher, PhD** (Education)
- Post-doc: **Margaret Cooper, PhD** (Sociology)
- Qualitative Consultant: **Rebekah Heppner, MBA, PhD** (Anthropology)
- Graduate Assistants:
  - **Pangri Mehta, MA** (Sociology)
  - **David Zeller, MA** (Sociology)
  - **Michael DiCicco, MA** (Education)

Quantitative Goals

- Develop a profile of recent high school graduates who enroll in manufacturing AS/AAS programs
- Determine educational and employment outcomes among comparable graduates who:
  - Enroll in other Community College programs
  - Enroll in university STEM and non-STEM majors
  - Do not pursue post-secondary degrees
- Examine long range outcomes of ET graduates

Data and Variables

Transcript data from Tampa Bay area high school graduates

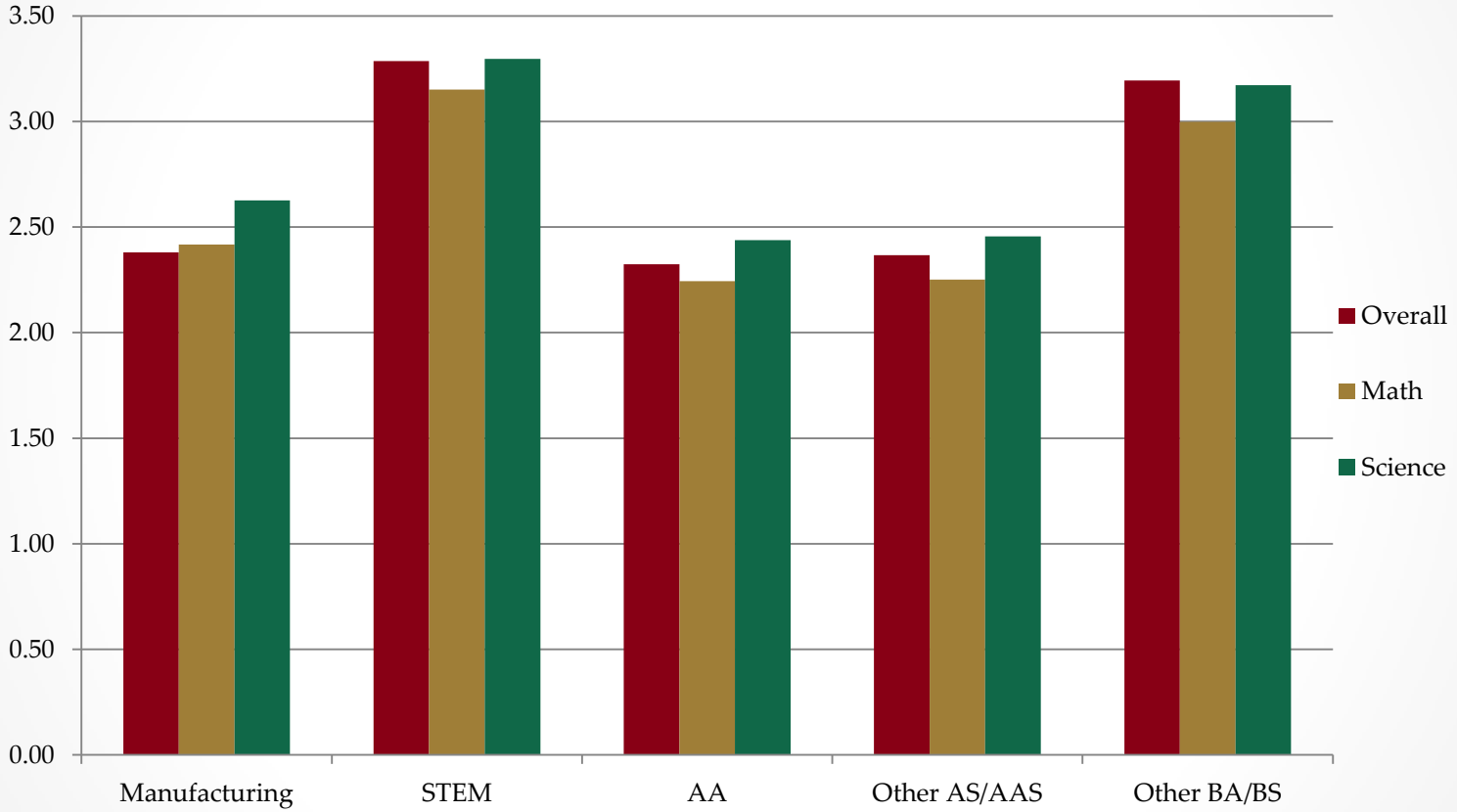
- Provided by Florida Department of Education (FLDOE) PK-20 Education Data Warehouse
- Articulation between high schools, community colleges, and universities
- Career academies and CIP codes → career clusters

Variables of interest

- Math and science course taking and achievement
- Post-secondary program enrollment
  - Manufacturing (cluster 13)
  - STEM (cluster 15)
  - AA degree transfer
  - Other AS/AAS and bachelor's degrees

Student Profiles

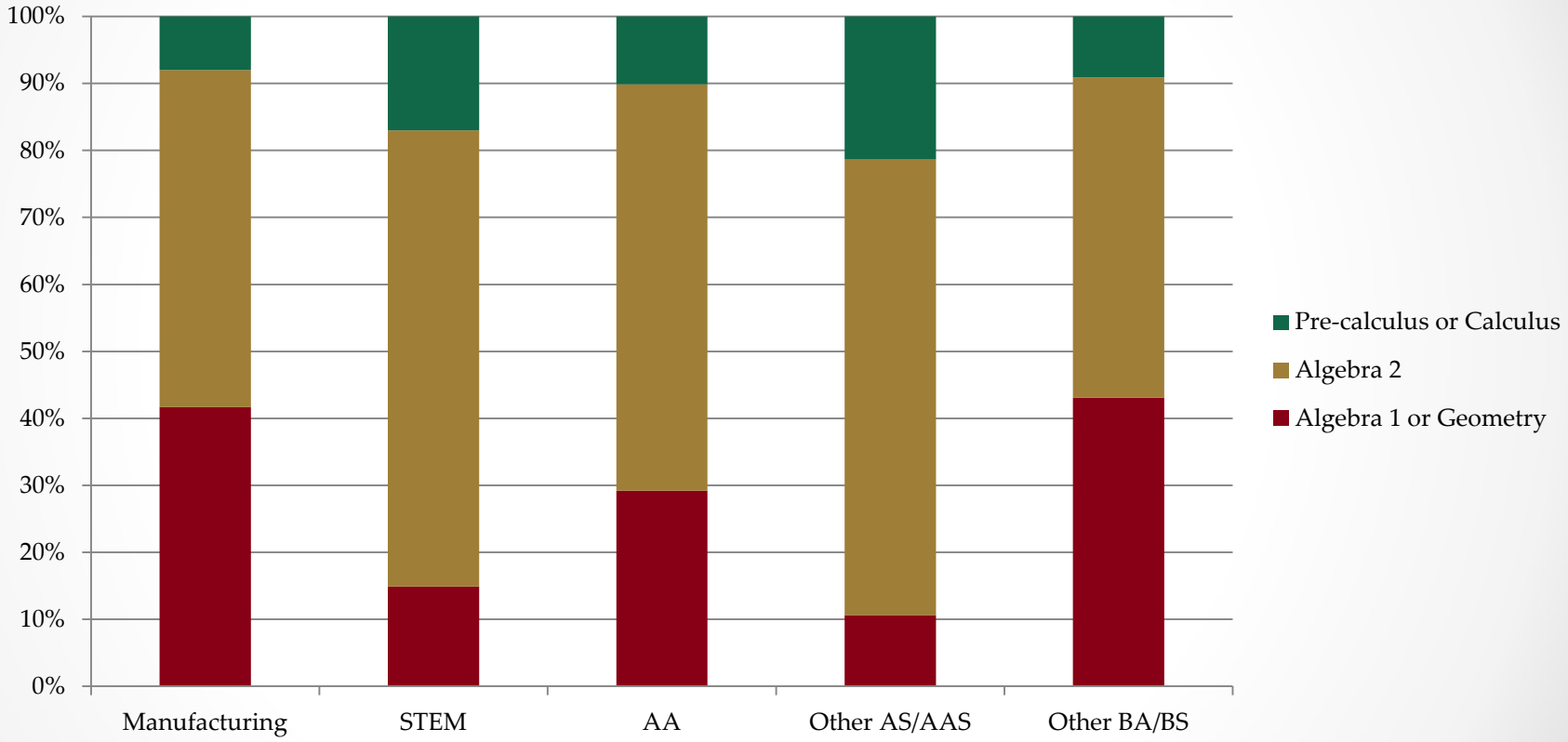
Mean high school GPA by degree program



Manufacturing students are comparable to AA and AS/AAS students, and STEM majors are comparable to other BA/BS students with only slightly higher math and science grades.

Student Profiles

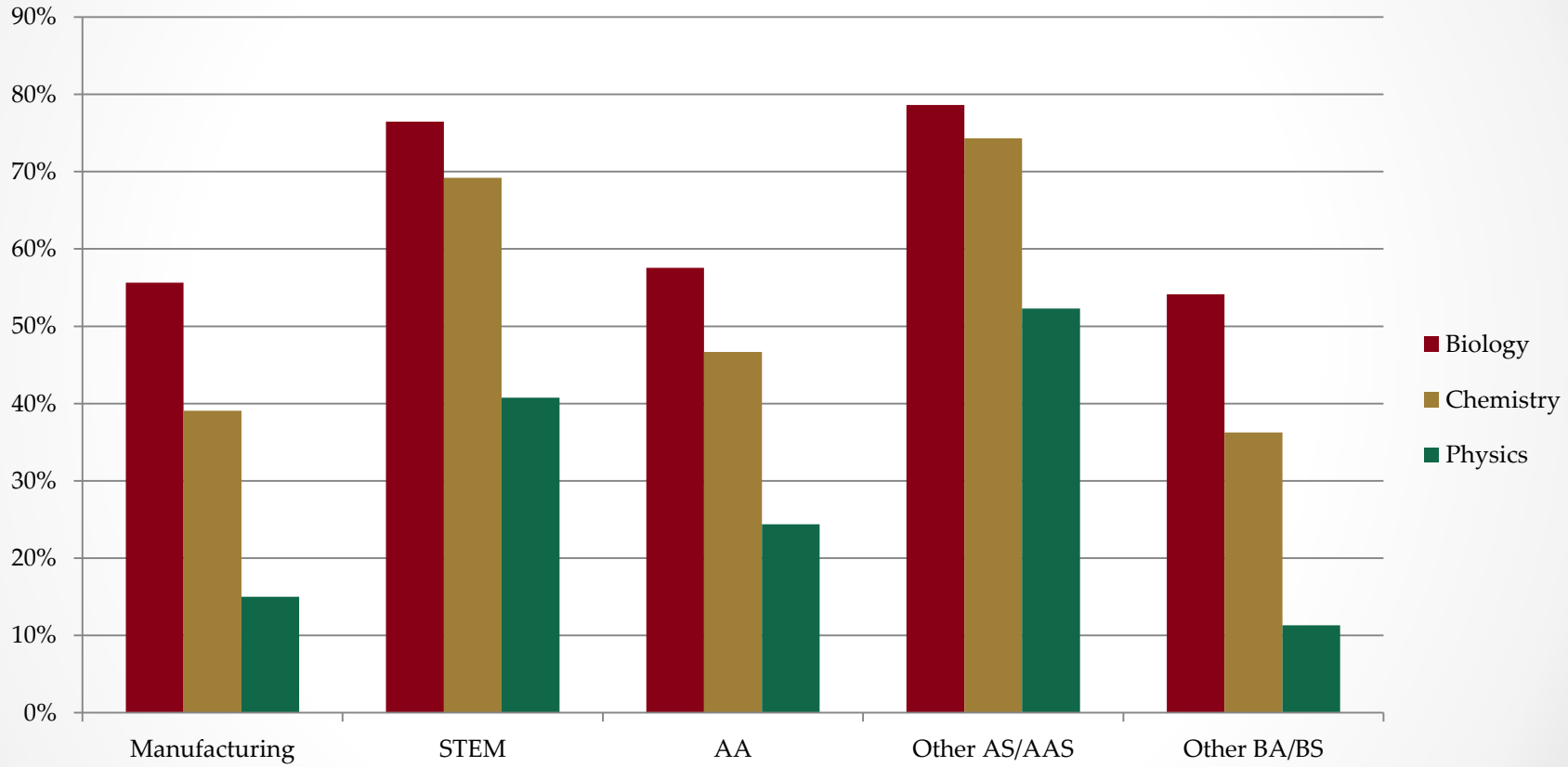
Math Coursetaking by degree program



Manufacturing students are least likely to take Pre-calculus or Calculus.

Student Profiles

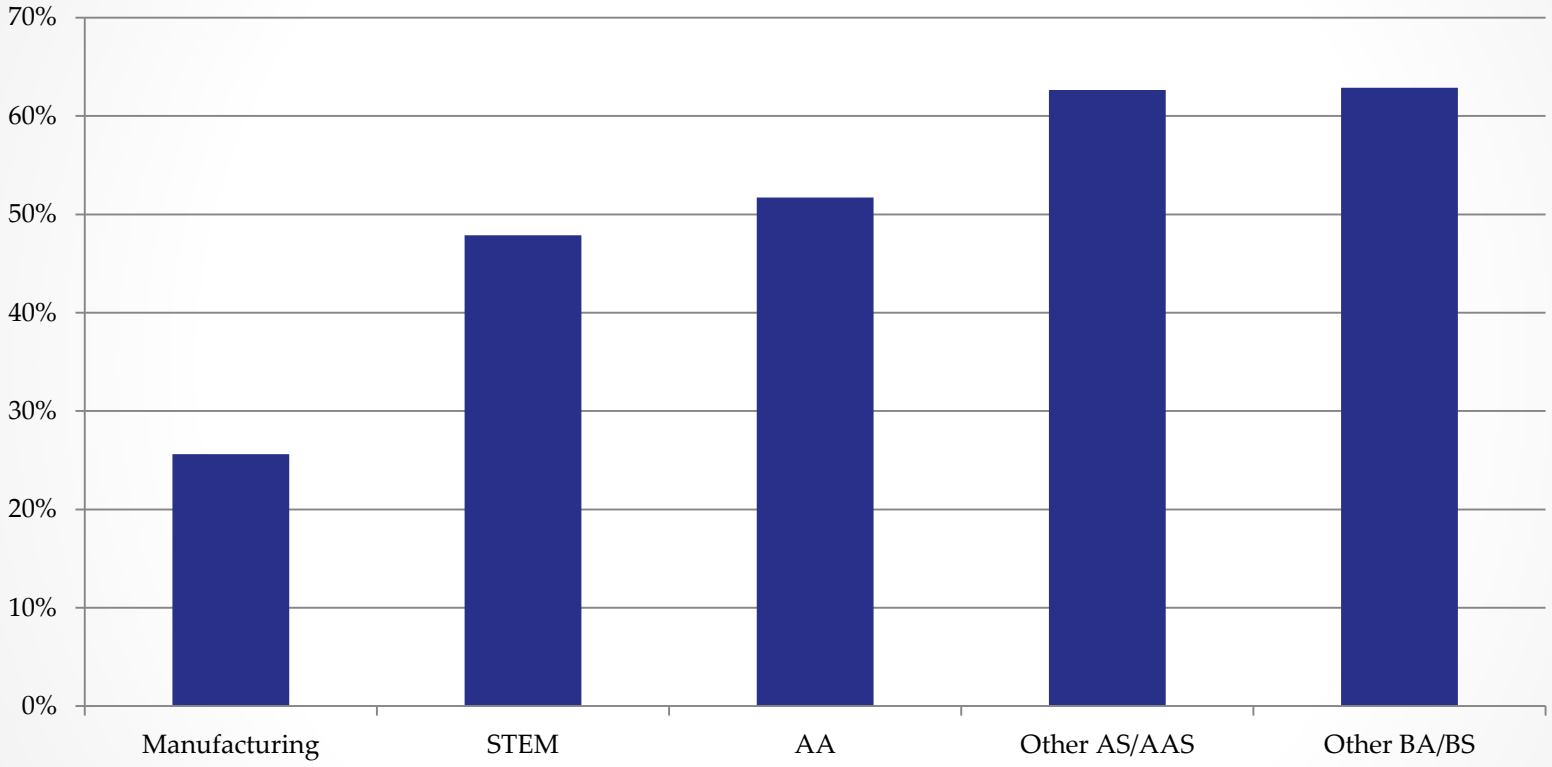
Science Coursetaking by degree program



Manufacturing students take science courses at a comparable rate to non-STEM BA/BS students.

Student Profiles

Percent Female by degree program



Women make up about a quarter of students who enrolled in Manufacturing programs compared to almost half of STEM programs.

Qualitative Goals

- Develop narratives of ET pathways through interviews with high school students, community college students, employers and employees in the industry
- Understand background factors, current experiences, and expected future trajectories through in-depth interviews

Interview Questions - Students

- High school students were asked to discuss:
  - what prompted their interest in pursuing advanced technology education
  - descriptions of their coursework
  - future plans

- Community college ET students were asked to discuss:
  - how they came to learn about ET programs
  - the factors that influenced their decision to enroll in an ET program
  - their high school preparation
  - their perceptions of the ET job market

Interview Questions - Administrators

- ET program administrators were asked about:
  - the institutional and historical development of engineering technology programs
  - key elements of ET degree programs
  - the type of students these programs attracted and retained
  - ways in which community colleges were working to support their graduates in pursuing employment opportunities

Interview Questions - Industry

- Interviews with industry leaders focused on better understanding:
  - the skill sets they currently seek in ET workers
  - recruitment and hiring processes
  - their perception of the skill sets and fields of knowledge that will be essential for the future workers in this field

Initial Qualitative Research

- In-depth interviews with 25 high school students and ET students
  - Purpose: to determine educational and occupational pathways leading them to ET education and employment opportunities
  - Findings add to our knowledge of ET education programs and inform future research questions

Methodology

- Data collection - facilitated by community college and high school instructors who invited us to their classes
- Interviews - conducted by the PathTech qualitative team (faculty, post docs, and graduate research assistants)
  - Occurred on the community college and high school campuses during times specified by the school
  - Lasted 20-30 minutes
  - Interview transcripts were coded and thematically analyzed

Interview Questions – Students

- High school students were asked to discuss:
  - what prompted their interest in pursuing advanced technology education
  - descriptions of their coursework
  - future plans
- Community college ET students were asked about:
  - their high school preparation
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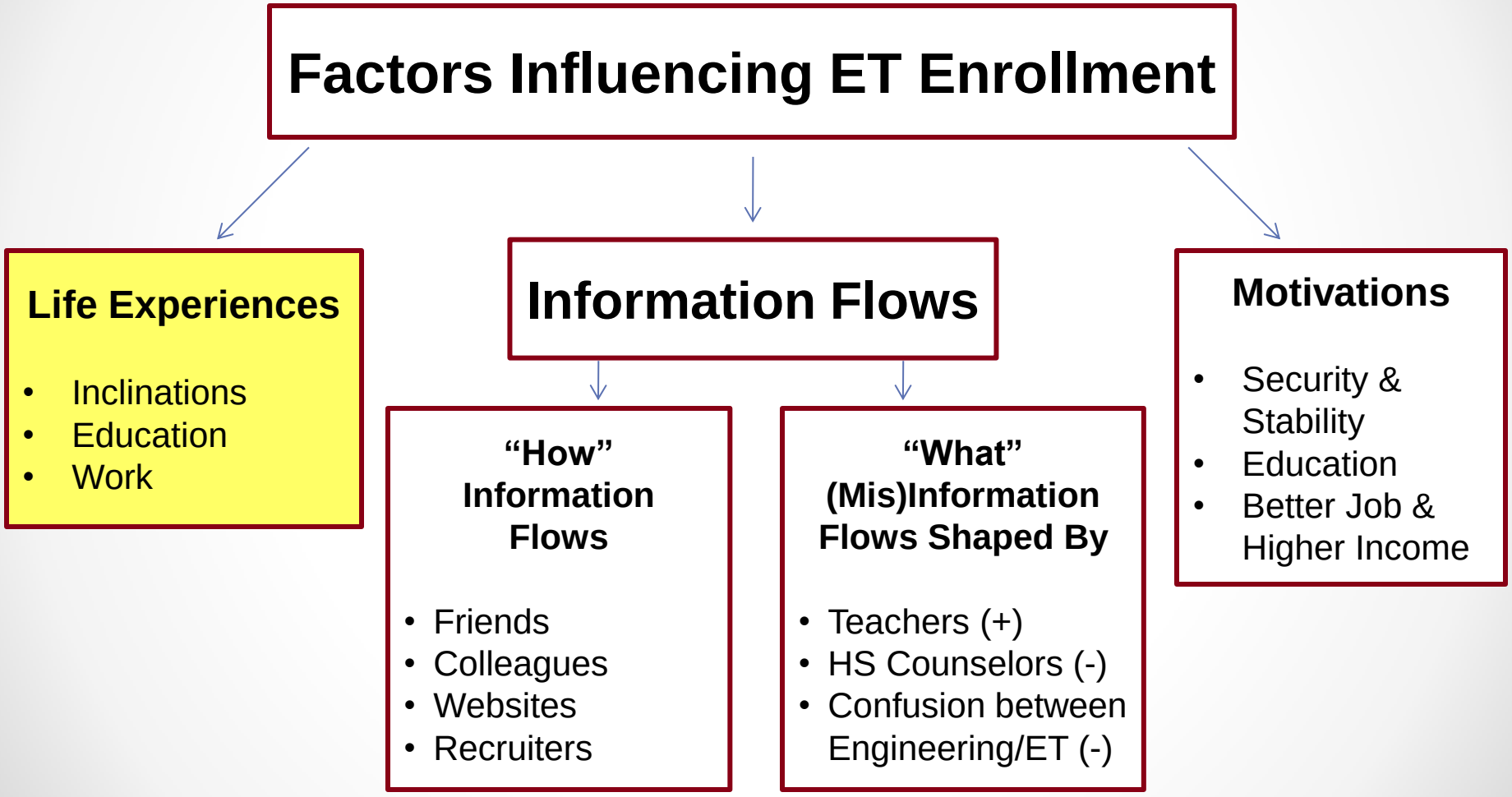
Findings


Factors Influencing ET Enrollment
Life Experiences
• Inclinations
• Education
• Work
Information Flows
"How" Information Flows
• Friends
• Colleagues
• Websites
• Recruiters
"What" (Mis)Information Flows Shaped By
• Teachers (+)
• HS Counselors (-)
• Confusion between Engineering/ET (-)
Motivations
• Security & Stability
• Education
• Better Job & Higher Income

Life Experiences

- Students articulate life experiences leading to pathways into ET:
  - inclination towards building, fixing things, and using their hands
  - previous education, and specifically, high school coursework and extracurricular opportunities lead students to the ET program
  - current work experiences, often in ET-related fields, propelling students into ET degree programs

Life Experiences

- **Personal Inclinations:**

  "…I was just interested in the field from the get-go. I had always been interested in the...blueprinting process and everything from architectural to mechanical anything really, blueprinting-wise. …it started like with 'Roller Coaster Tycoon' type of things and then you know progressing...it's very interesting, I think, I just take it that it's because it's what I'm into for me. …I think they had offerings to where you could take a test to see what you were supposed to do but I already knew. And so I had known since I was ten."

  (Edward)

Life Experiences

- **Educational Experiences:**

  "I took a couple of technical classes in high school, and thought it was fun…so I wanted to do more with it...They had computer programming. They had little majors for us like, mine was Pre-Engineering…. When they had me take computer programming classes then I took a drafting class on my own, basic softwares, stuff like that....I'm actually in the Solid Works class now and I had Solid Works in high school. So I pretty much know my way around because of the classes I took in high school and it helps me become better in what I am doing. Obviously I can further my education here, but it's not like I'm being thrown in and I don't know what I'm doing. I actually know what I'm doing by having high school experience."

  (Sarah)

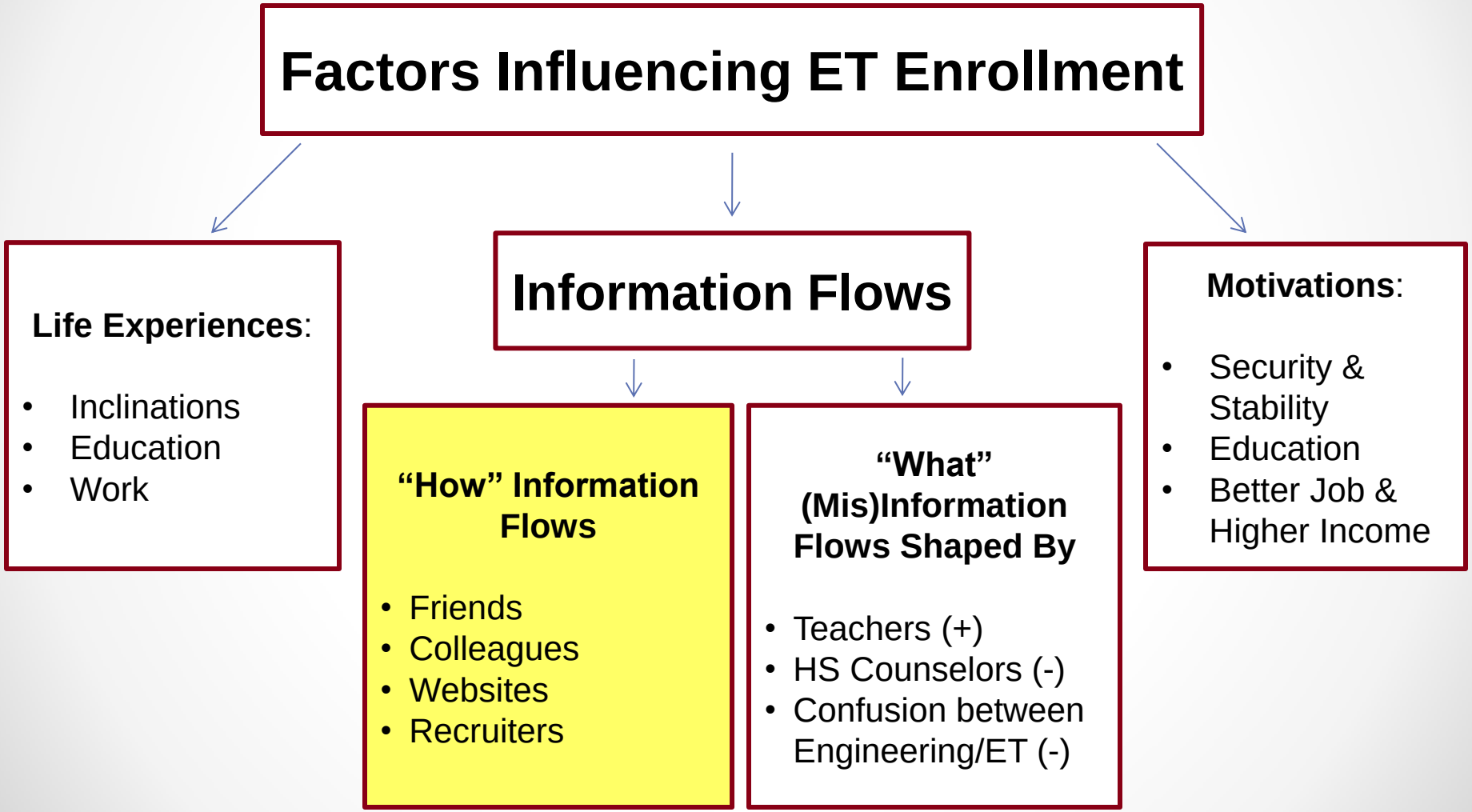
Life Experiences

- **Work Experiences:**

  "[M]ilitary-wise I'm a career avionics technician...So I've been military trained to work on aircraft avionics... gives me a little more, furthers my knowledge basically in military training... that I can apply outside civilian-wise when I retire from the military.... I graduated from electronics school from the military so [the ET program] really builds on to it, gives us a lot more in-depth knowledge into everything and makes us more of a technical level as well, instead of a systems trouble-shooter. Gives you a lot more in-depth as far as technical information goes and fixing."

  (Curtis)

Findings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How Information Flows

- Students learn about ET programs through:
  - **Personal social networks**
    - discussions with a friend, partner or coworker
  - **Internet**
    - research on the internet to learn more about ET as a field and the courses offered
  - **Recruiters**
    - recruiters at military installations were particularly helpful in sharing information about the field

How Information Flows

- **From Friends:**

  "…so far everything I heard from my friends who had gone through the program, the classes and stuff they were learning, it's right on par with what they told me. It's a very thorough program, lots of information, a lot of technical data, a lot of the stuff I was looking for…"

  (Curtis)

How Information Flows

- **Through Colleagues/Professional Networks:**

  Edward said he has “met a few people that work with engineering companies” and believes that these contacts will help him to “try and just get [his] foot out there.”

How Information Flows

- **From Internet Resources:**

  "Through the website, the Internet, pretty much I was looking for a job and they required me to have some technology background on certain softwares [*sic*] so I went on the community college website and looked up what kind of classes they've got available and there was a huge section of it."

  (Anthony)

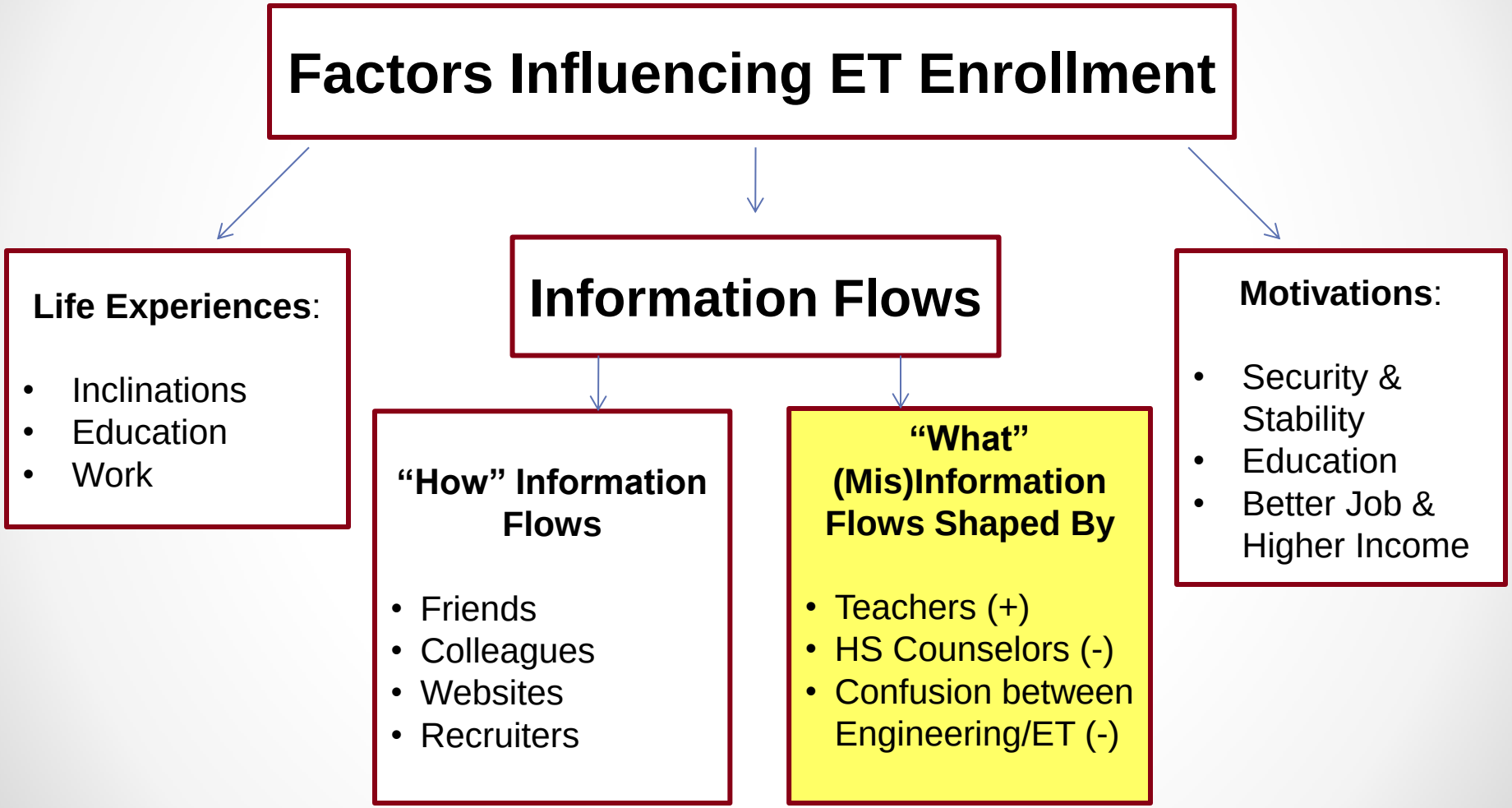
How Information Flows

- **Through Recruiting Efforts:**

  "…we have about four and a half miles of the St.Pete/Clearwater airport, it's a big base there, avionic/techs everywhere so this school is really close to where the base is. They do a good job of advertising there."

  (Curtis)

Findings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What Positive Information Flows: HS Teachers

- Findings reveal that instructors play an instrumental role instrumental in attracting students and motivating them to pursue ET
  - High school interviewees state that their instructor is the best aspect of their program, and explain how much he has taught them and nurtured their interests
  - Community college students discuss how they just keep taking classes with the same group of instructors, regardless of the course

These testimonials illustrate the transformative educational experiences instructors and classroom learning provides, and give us a mandate to explore educators' roles in supporting and improving pathways into ET fields.

What Positive Information Flows

- **Teachers:**

  "It's really interesting stuff when you've got someone like Mr. Bell who's as passionate about it as he is and can talk to people. And he's very outgoing and it's a catalyst for getting people involved, getting high school kids involved. Mr. Green is really good, does the AutoCAD classes. I took some of his, and my electronics teacher, he's great. He's fantastic. I mean I wouldn't be able to get through most of these classes without him because it's a lot, but it's a great program."

  (Dan)

What Negative Information Flows

- An area of frustration was **high school counselors**' lack of knowledge about associate's degree programs in technician education
  - Several students wished they had learned of these technical education/employment opportunities sooner in their educational careers
- Students' narratives also convey some **confusion and ambiguity** over the differences between **engineering and engineering technology**.
  - Students discuss aspirations of becoming an "engineer," but often the work they are describing centers on technical tasks and processes
  - Some students even expressed disappointment that their ET coursework would not count as "prerequisites" for bachelor's programs in engineering

What Negative Information Flows

- **High School Counselors**
  - High school counselors perceived by students as not really understanding their interests, unaware of the ET field and potential opportunities
  - Students exhibited frustration that counselors are not more helpful

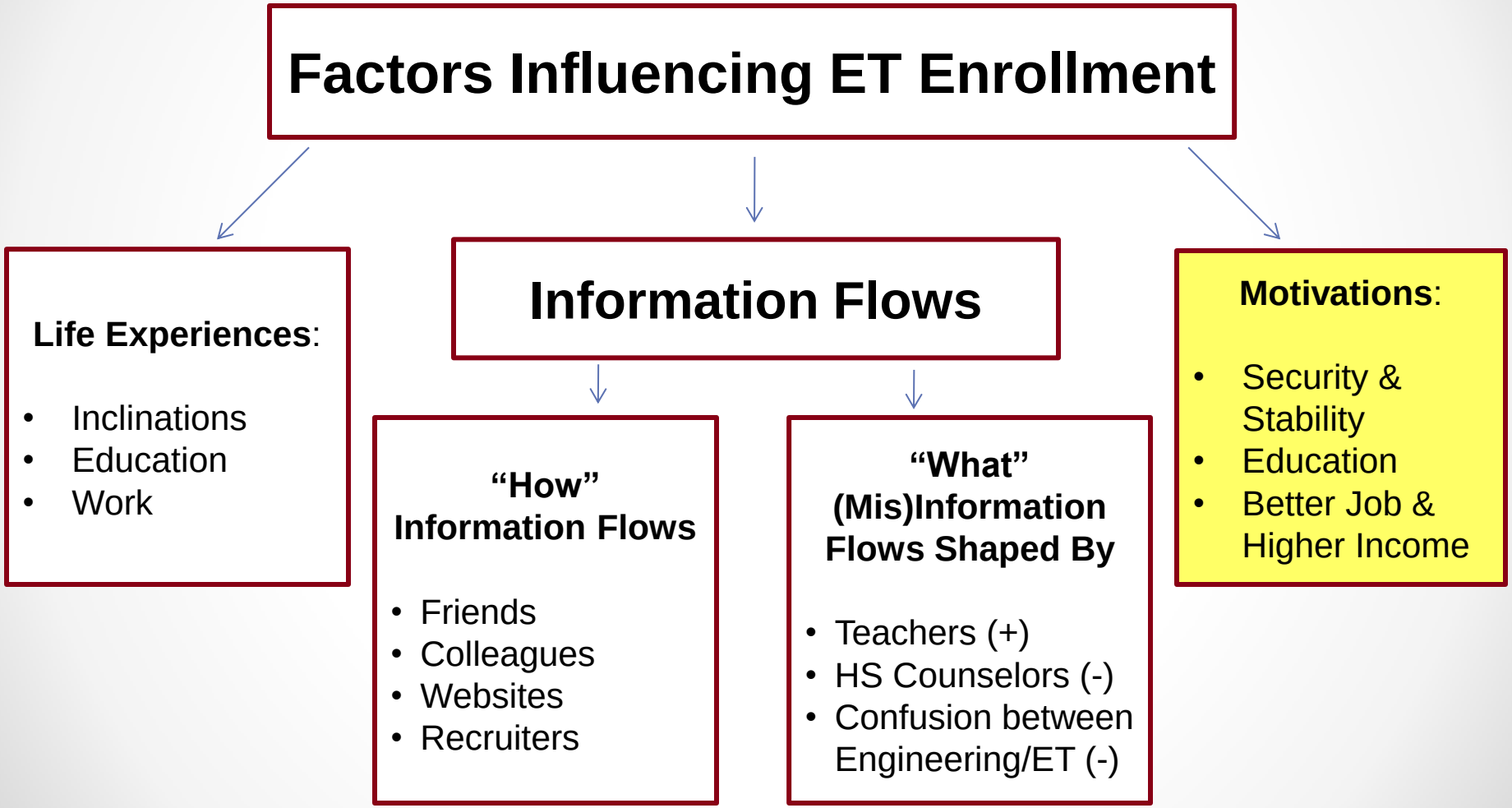
What Negative Information Flows

- **Engineering/Engineering Technology**

  "…[A] lot of people here are set on just getting their two year degree. Some people have been working for fifteen, twenty years and want to go back to school and just get their associate's which this is perfect, [this]is great but if you really want a four year degree I don't think they tell you enough…about how to get further educated."

  (Brian)

Findings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Motivating Factors

- Students described factors that motivated them to seek degrees and/or credentials in ET:
  - hopes for social mobility
  - higher pay
  - better jobs
  - the possibility for the two-year degree to lead towards a bachelor's degree

This theme is critical to note because all of the ET students interviewed so far are returning to school many years after completing high school. This age demographic appears consistent across programs in ET in the Tampa Bay area.

Motivating Factors

- Many students entered the workforce or military after high school and most already had experience in manufacturing or similar industry. Their return to school was often marked by:
  - a job loss and/or
  - need for re-skilling in advanced technologies
  - marketability in the current economy

These older students also often have partners and children, and many discuss their need to provide for their families as a key element motivating their desire to enter and complete the ET program.

Motivating Factors

- **Stability & Security**
  - Darryl had worked as a police officer, but now that he has a wife and children, he is concerned about his safety:
    - "My family depends on me and if I had to pay a small price and get my degree, I will have to do it because I have children and I have a wife at home, so I have to do what I have to do for them."

Motivating Factors

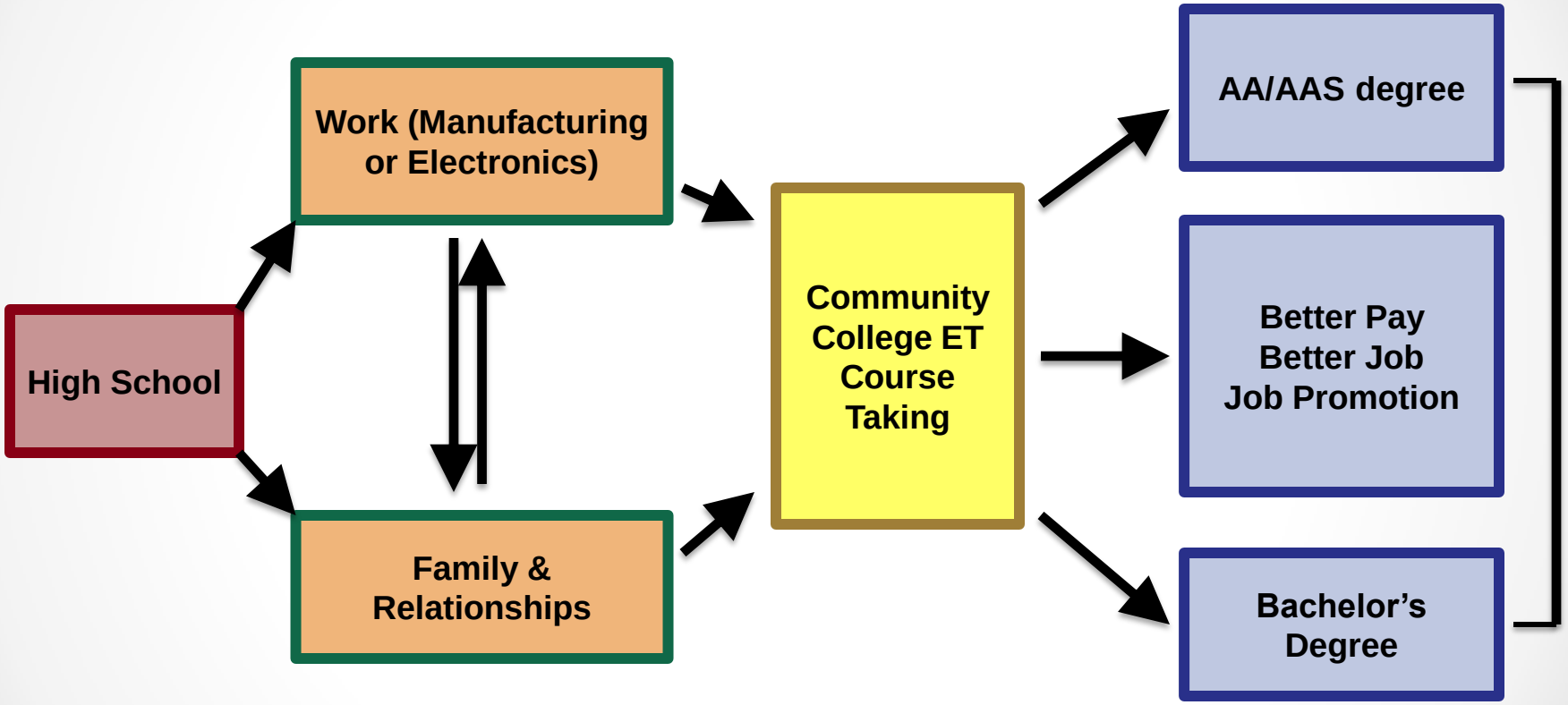
- **Further Education**
  - "I don't want to just stop at the associate's level. I do want to get a bachelor's also, but I want a stepping stone right now, and get my associate's and get into the field that I want to get into, and then I'll work on my bachelor's."

(Darryl)

Motivating Factors

- **Higher Income**
  - Ian talked about his goals of improving his income. He talked about now being able to break "the glass ceiling" of $15 or $16 dollars an hour. Although some thought that was a good salary, he felt that, "In reality, that isn't very much, you know…That's why I went back and I finished my AS degree and I'm taking a few more classes for my AA. I'm just hearing a lot that there's a lot of engineering jobs but there's not enough people to fill them."

Emerging Pathways



High School Student Findings

- High school data analysis reveals varied future plans:
  - About 1/3 had completed high levels of math and science coursework in high school and are **bound for four-year universities to study in STEM fields**
  - About 1/3 of the students were **considering associate's degree programs in technician education**
    - Most of these students are only interested in programs which offer formal co-operative education ("co-op") opportunities to work in relevant industry jobs while taking classes

High School Student Findings

- About 1/3 **could not afford to continue in school** without assistance. Their plans include:
  - joining the military in a technical field with hopes of going back to school with support from the GI Bill
  - entering the technician workforce

These students desired postsecondary schooling, but share an uncertainty about funding post-secondary education due to their family finances, thus potentially derailing their hopes for future degree attainment.

General Policy Recommendations for Community Colleges

- Develop highly informational websites to improve the information flows about both what technician education is, and how to enter and succeed in these programs
- Focus recruitment efforts on mid-career individuals seeking to re-skill and/or develop technical expertise to re-enter the workforce
- Work specifically with high school counselors to improve their knowledge of the differences between engineering and engineering technology and the many opportunities for technicians in the current economy

Suggestions for Improving the High School Recruiting into ET programs

Given the palpable stress personal finances presented for continuing in school, many more interested students with solid high school foundations would be attracted to associate's degree programs if **financial assistance** were more readily available. In particular, **scholarships, grants, and loans** would be very helpful.

Suggestions for Improving the High School Recruiting into ET programs

Community colleges should more actively promote existing **dual enrollment** programs and explore partnerships with high schools to encourage dual enrollment to make programs more convenient for parents and students. Dual enrollment programs allow public high school students to gain important industry certifications that could lead to pathways straight into technician jobs.

Suggestions for Improving the High School Recruiting into ET programs

High school and community college students are very attracted by opportunities for **co-op experiences**. This approach removes what students see as the abstract nature of what a technician's job is and allows students to understand and experience it first-hand. In addition, students view co-op opportunities as a concrete way to prove themselves and hopefully get a good job in the future with that experience.

Suggestions for Improving the High School Recruiting into ET programs

Educators can play a vital role in facilitating student development in technical fields. As a result, we recommend inquiry into developing **a professional network for technician educators** across educational institutions, spanning secondary and post-secondary programs, to connect and develop an infrastructure to "send" students from high school CTE classes into ET community college programs.

Next Steps

- Continued Full Qualitative Study in the Tampa Bay region:
  - Interviews at four community colleges and four high schools with ET programs
  - Interviews with ET program administrators and instructors
  - Interviews with employers in five counties
  - Focus groups and follow-up interviews to triangulate analysis

Papers in Progress

- The Impact of Florida Career Academy Legislation on In School and Postsecondary Student Outcomes
- Multiple Educational and Occupational Pathways Intersecting with the Life Course: Preliminary Analysis of PathTech Pilot Data
- Industry Perceptions of Technician Skill Acquisition and Development: A Case Study of Tampa Bay
- Improving Pathways from High School to Community College Technician Education Programs: Policy Recommendations from the PathTech Pilot Analysis
- Deindustrialization, Reindustrialization, and Engineering Technology Education in Florida
- Women forging ahead in traditionally male dominated Engineering Technology fields
- Pathways into High-Tech Manufacturing Careers: Where do internships in engineering technology really lead?
- The Pipeline Metaphor: An Iconic Symbol for STEM Workforce Development or Mythical Understanding of Pathways into High-tech Fields?

ATE Targeted Research in Action: FLATE/PathTech and Fox Valley/METTE Partnerships to Improve Student Outcomes

Presenters:
University of South Florida
Will Tyson, PI
Lakshmi Jayaram, co-PI
Edward Fletcher, co-PI

Fox Valley Technical College
Patricia Frohrib, co-PI
University of Wisconsin-Madison
L. Allen Phelps, PI

Introductions: PathTech Team and METTE Team

Workshop Overview

The ATE Targeted Research Priority

Why Targeted Research on Technician Education Matters

- The National College Completion Agenda
- State Level Performance Funding (WI and FL)
- Local college initiatives (FVTC)
  - Strategic Planning
  - Program Improvement and Performance Scorecards

To focus our remarks: What information, if available, would be most useful for improving ATE student success or outcomes?

Mixed Methods Research Design

Quantitative

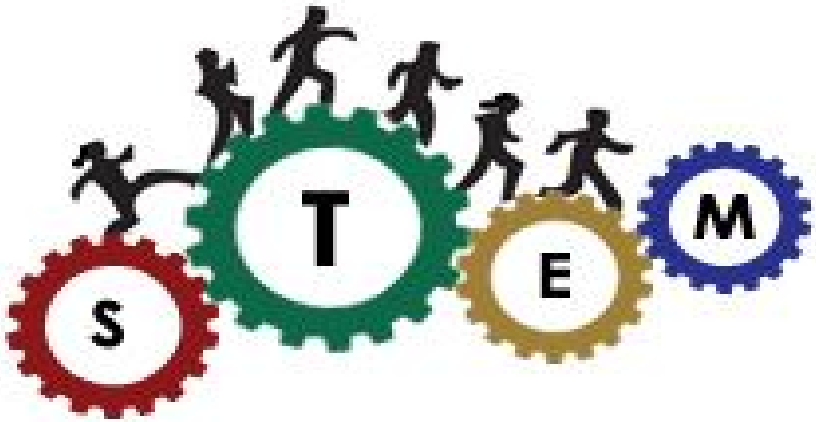
- Education and employment administrative data
- Institutional, state, and national public and private data sources
- Study transition from high school and the workforce into advanced technologies
- Study short-term and long-term post-schooling outcomes

Mixed Methods Research Design

Qualitative

- In-depth understanding of educational and employment experiences through open-ended questions
- Opportunity to gather data from sources not typically included in large datasets (e.g. administrators and employers)
- Ability to articulate a process using personal histories to construct school-work trajectories

PathTech



Successful Academic & Employment Pathways
in Advanced Technologies

- ATE Center/University Partnership
- FLATE Regional Center of Excellence/University of South Florida

  (Tampa, FL)

PathTech
Successful Academic & Employment Pathways in Advanced Technologies

NSF

Hillsborough Community College (Tampa)

- Advanced Manufacturing

HCC

St. Petersburg College (Clearwater)

- Biomedical Systems, Quality, Digital Design & Modeling

St. Petersburg College SPC

Polk State College (Lakeland)

- Advanced Manufacturing

POLK STATE COLLEGE

State College of Florida (Venice)

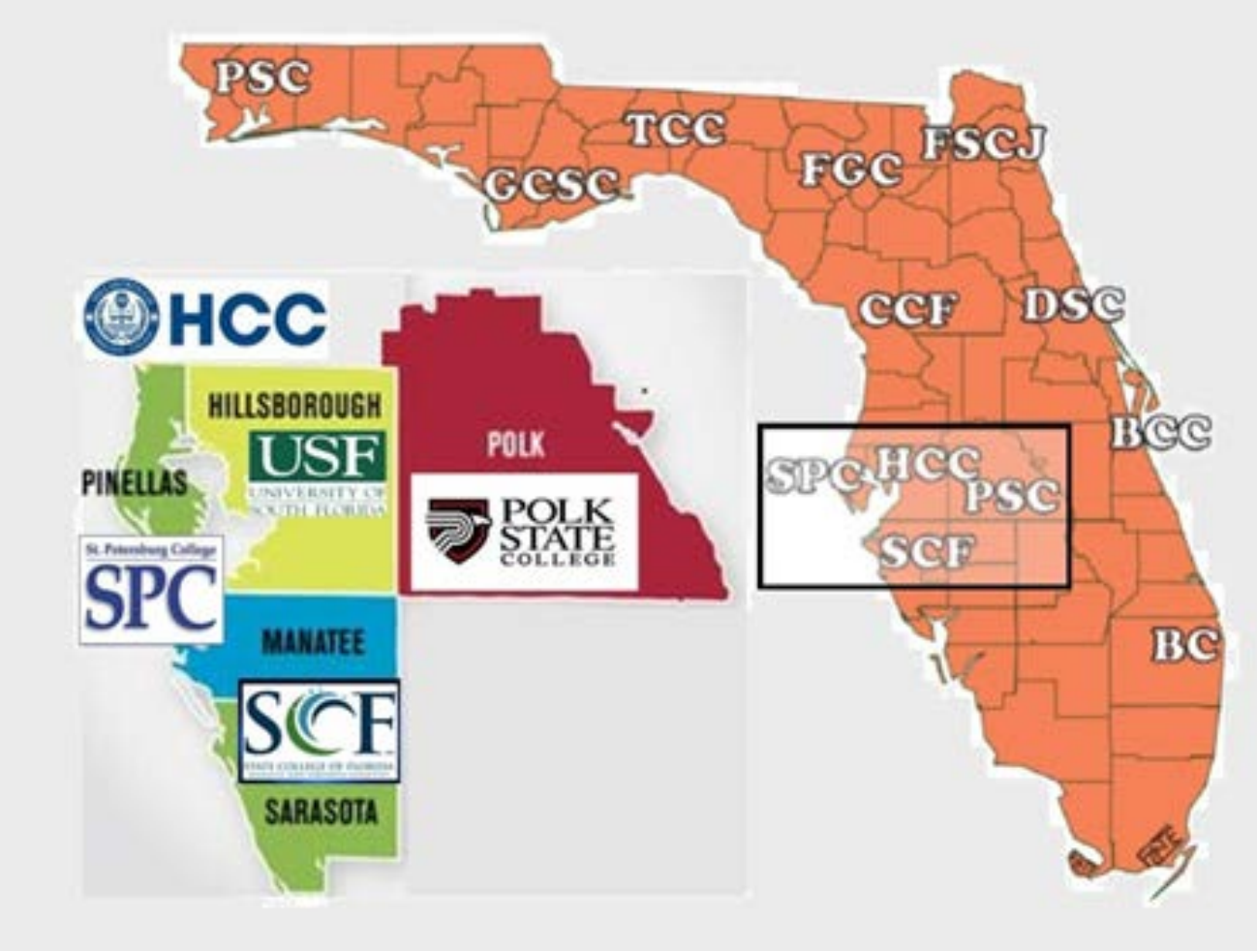
- Electronics, Digital Design & Modeling

SCF
STATE COLLEGE OF FLORIDA
MANATEE AND SARASOTA COUNTIES

PathTech
Successful Academic & Employment Pathways in Advanced Technologies

NSF

FLATE Engineering Technology College Network



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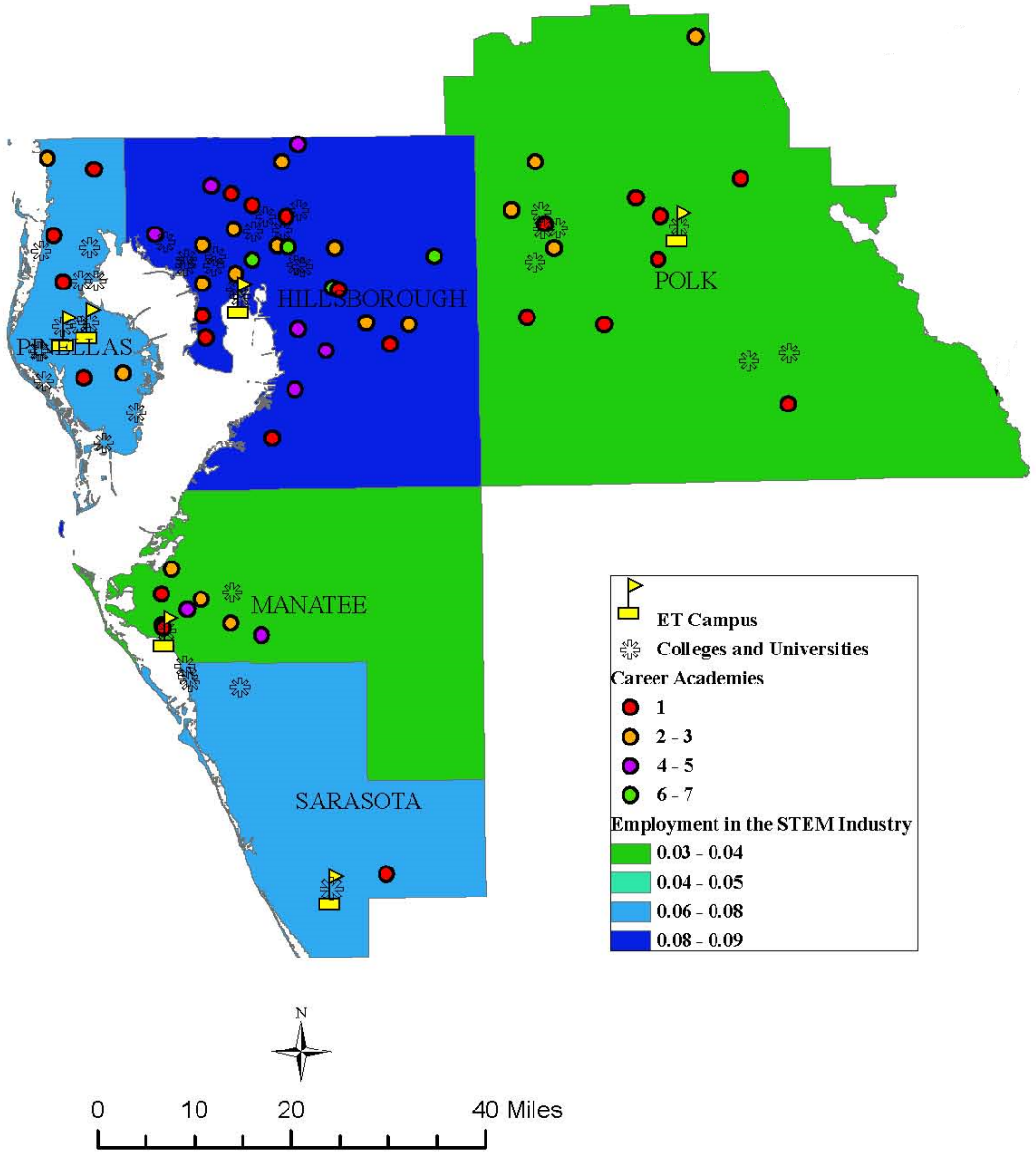
Successful Academic & Employment Pathways in Advanced Technologies

- FLATE connects USF researchers to Tampa Bay area ET community
- ET students
- ET graduates
- High school career academies
- Industry partners



PathTech
Successful Academic & Employment Pathways in Advanced Technologies

NSF

Primary Research Objectives:

1. Understanding recruitment and pathways into ET
2. Providing information to improve ET education
3. Increasing the visibility of ET programs
4. Providing information to help meet workforce demands

PathTech
Successful Academic & Employment Pathways in Advanced Technologies

NSF

Pathways Research Model

- Individuals transitioning from school to work often simultaneously experience other life transitions

- Fewer and fewer students experience a linear progression from school to work, or a “pipeline”.

Quantitative Goals

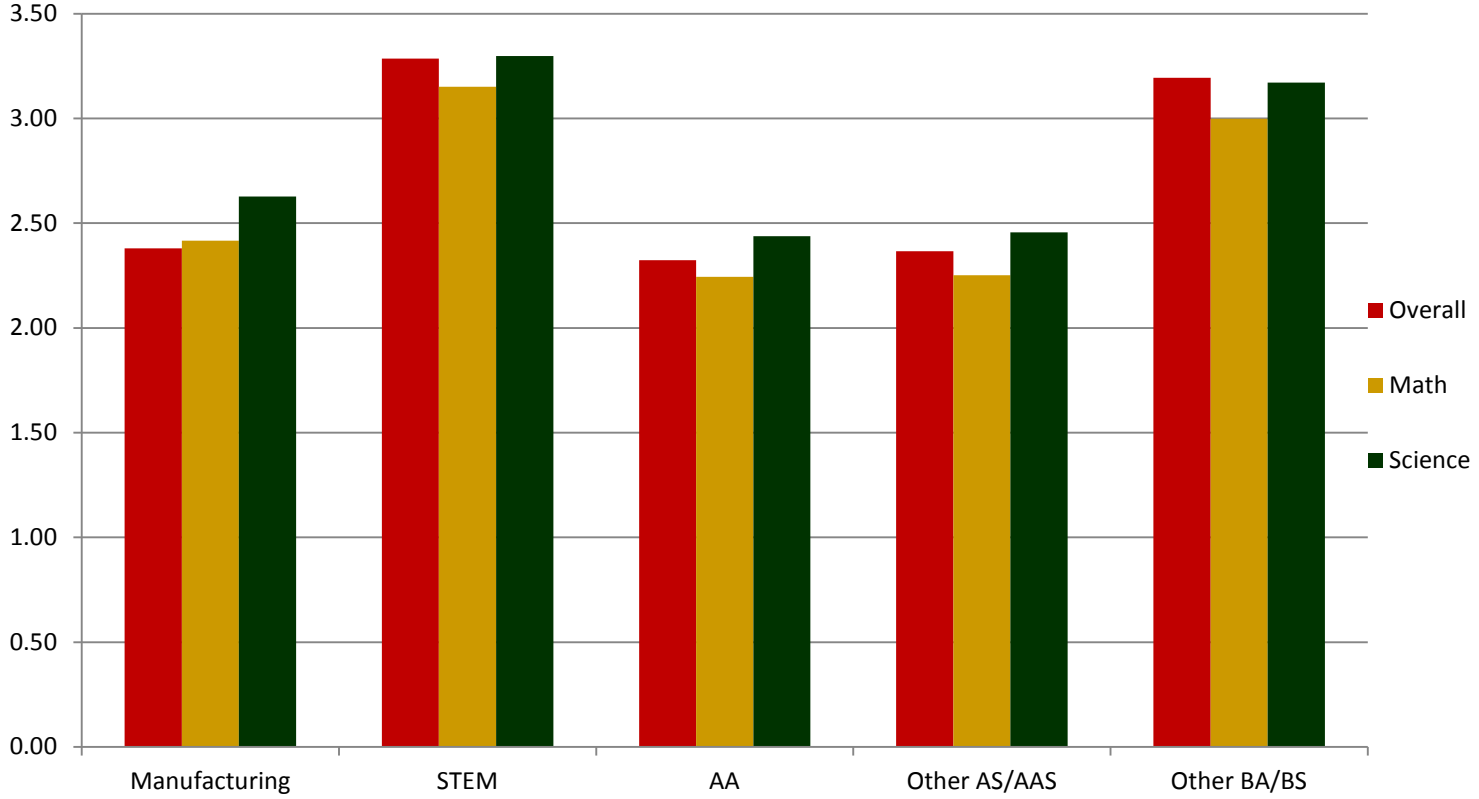
- Data: Education and employment data from Florida Department of Education PK-20 Education Data Warehouse of Tampa Bay high school graduates

- Identify a profile of HS students who enroll in ET and other manufacturing programs
- Compare educational and employment outcomes among comparable students

Student Profiles

PathTech
Successful Academic & Employment Pathways in Advanced Technologies

Mean high school GPA by degree program

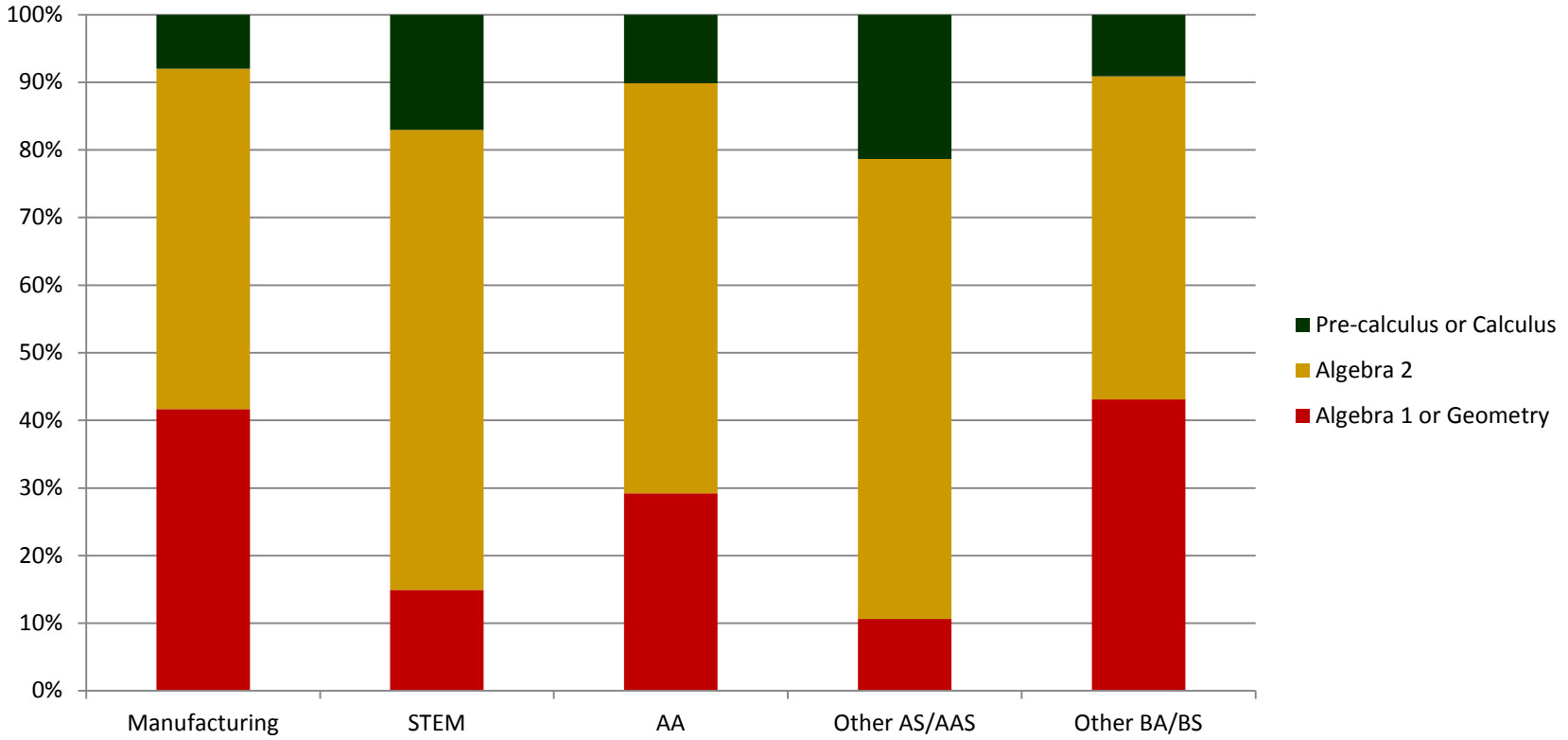


Manufacturing students are comparable to AA and AS/AAS students and STEM majors are comparable to other BA/BS students with only slightly higher math and science grades.

Student Profiles

PathTech
Successful Academic & Employment Pathways in Advanced Technologies

Math coursetaking by degree program

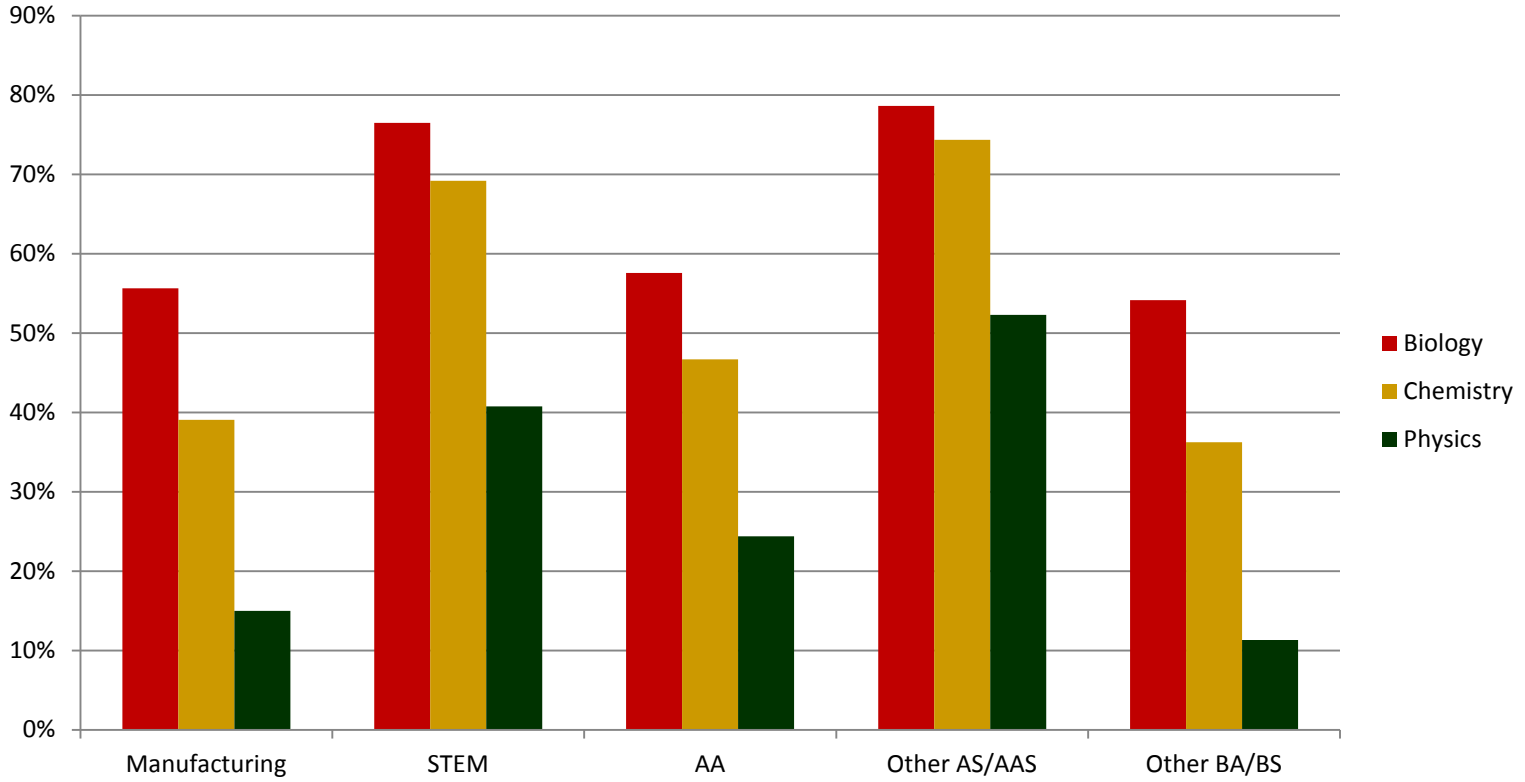


Manufacturing students are least likely to take Pre-calculus or Calculus.

Student Profiles

PathTech
Successful Academic & Employment Pathways in Advanced Technologies

Science coursetaking by degree program



Manufacturing students take science courses at a comparable rate as non-STEM BA/BS students.

Student Profiles

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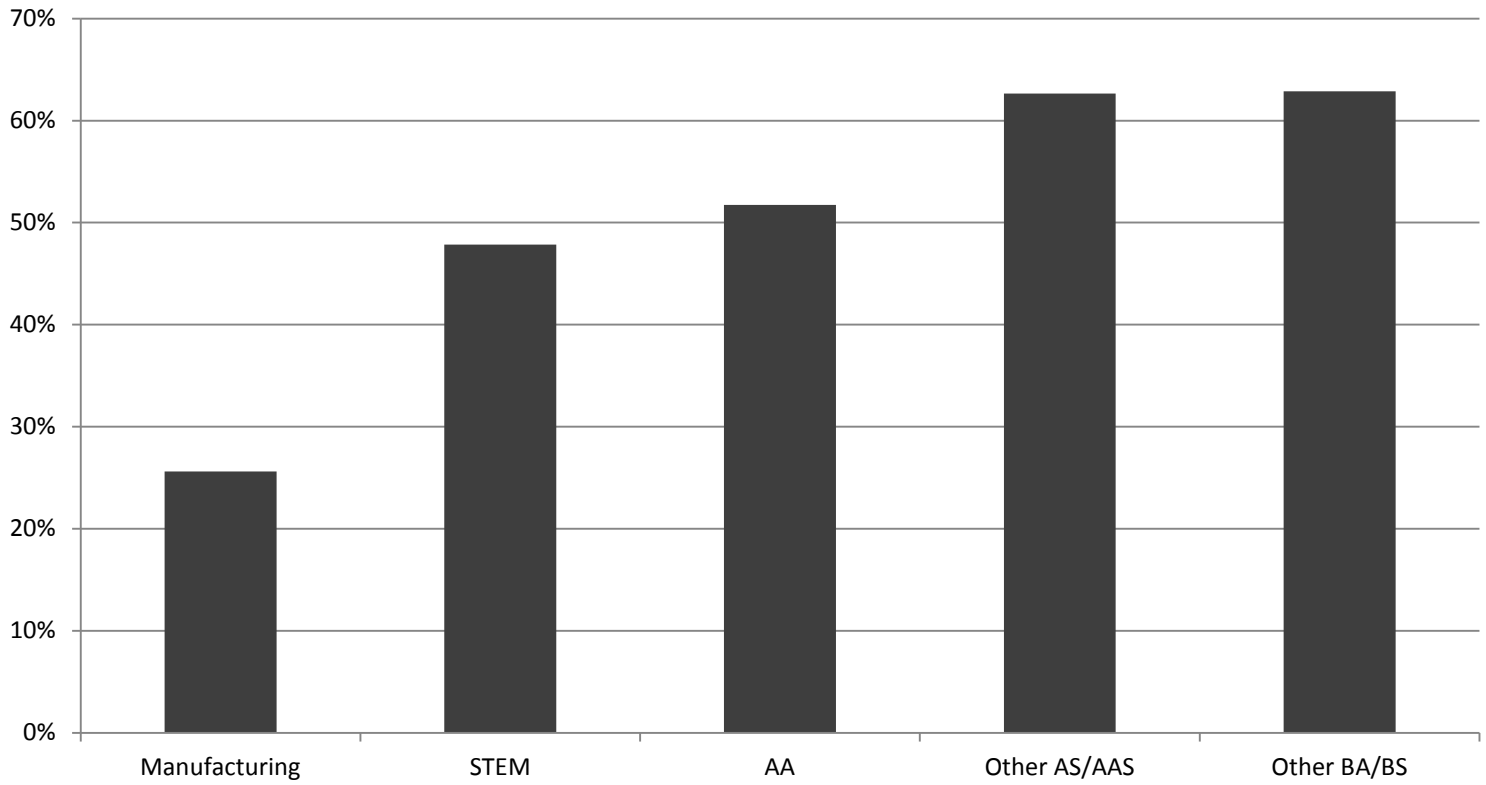
Successful Academic & Employment Pathways in Advanced Technologies

Percent Female by degree program



Women make up about a quarter of students who enrolled in Manufacturing programs compared to almost half of STEM programs.

Qualitative Goals

- Interviews and focus groups
- College students, faculty, and administrators
- High school students and personnel
- Employers and key stakeholders

- Reveal alternative ET pathways, particular because ET students generally come from the workforce

PathTech
Successful Academic & Employment Pathways in Advanced Technologies

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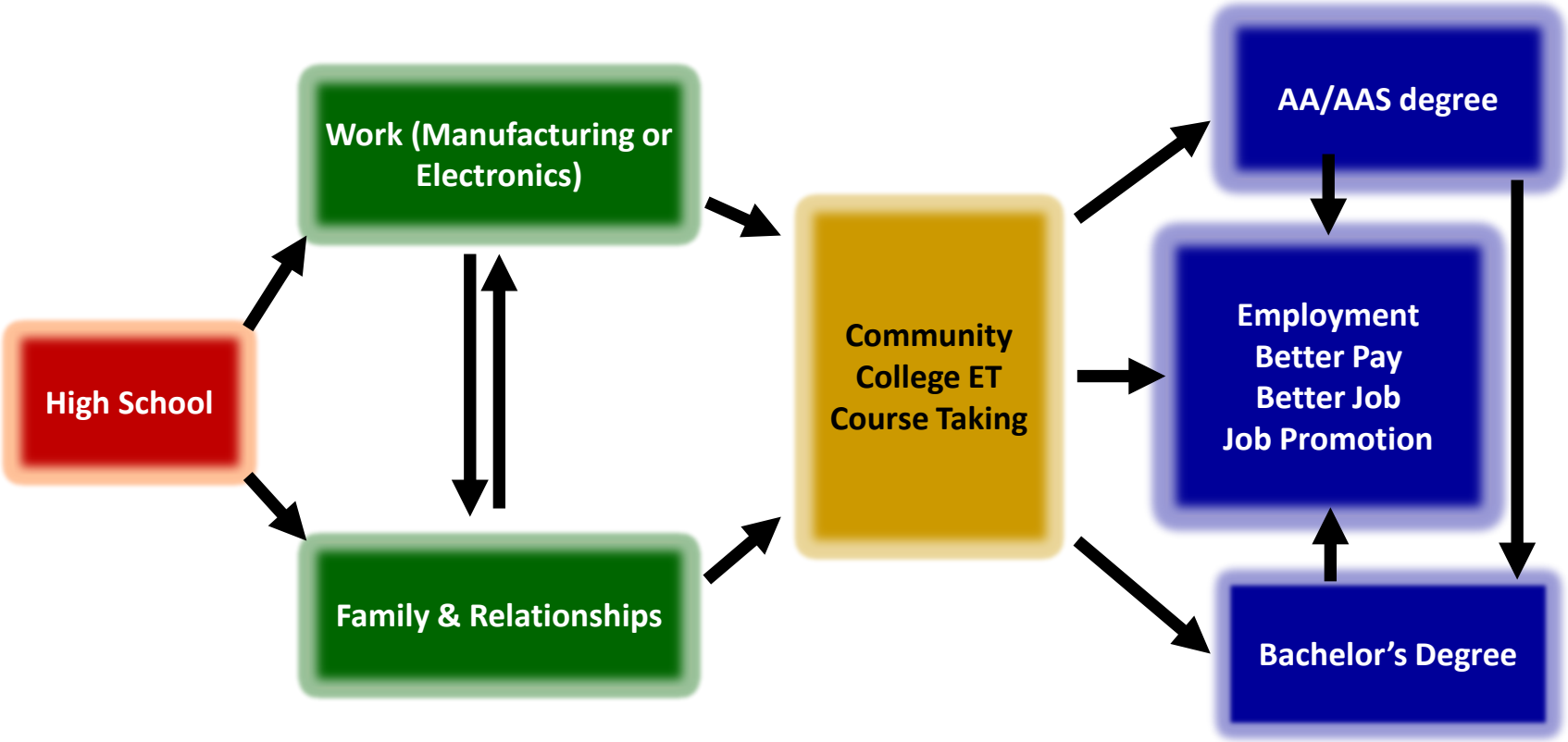
Emergent Pathways



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Successful Academic & Employment Pathways in Advanced Technologies

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Factors that Influence ET Enrollment

Life Experiences:

- Inclinations
- Education
- Work

Information Flows

"How" Information Flows About ET Programs

- Friends
- Colleagues
- Websites
- Recruiters

"What" (Mis)information Flows Shaped By

- Teachers (+)
- HS Counselors (-)
- Confusion about Engineering vs. ET (-)

Motivations:

- Education
- Better Job
- Higher Income
- Security & Stability
- Mobility

METTE

PathTech
Successful Academic & Employment Pathways in Advanced Technologies

NSF

Improving Educational Outcomes in **M**anufacturing **E**ngineering **T**echnologist and **T**echnician **E**ducation

- Research and Innovation Partnership to Improve Student Success
- Five Partners: UW-Madison, FVTC, MATC-Milwaukee, MPTC, and WCTC
- Student Success Model
- Research and Innovation Framework

Fox Valley Technical College

MATC

Moraine Park Technical College

WCTC Waukesha County Technical College

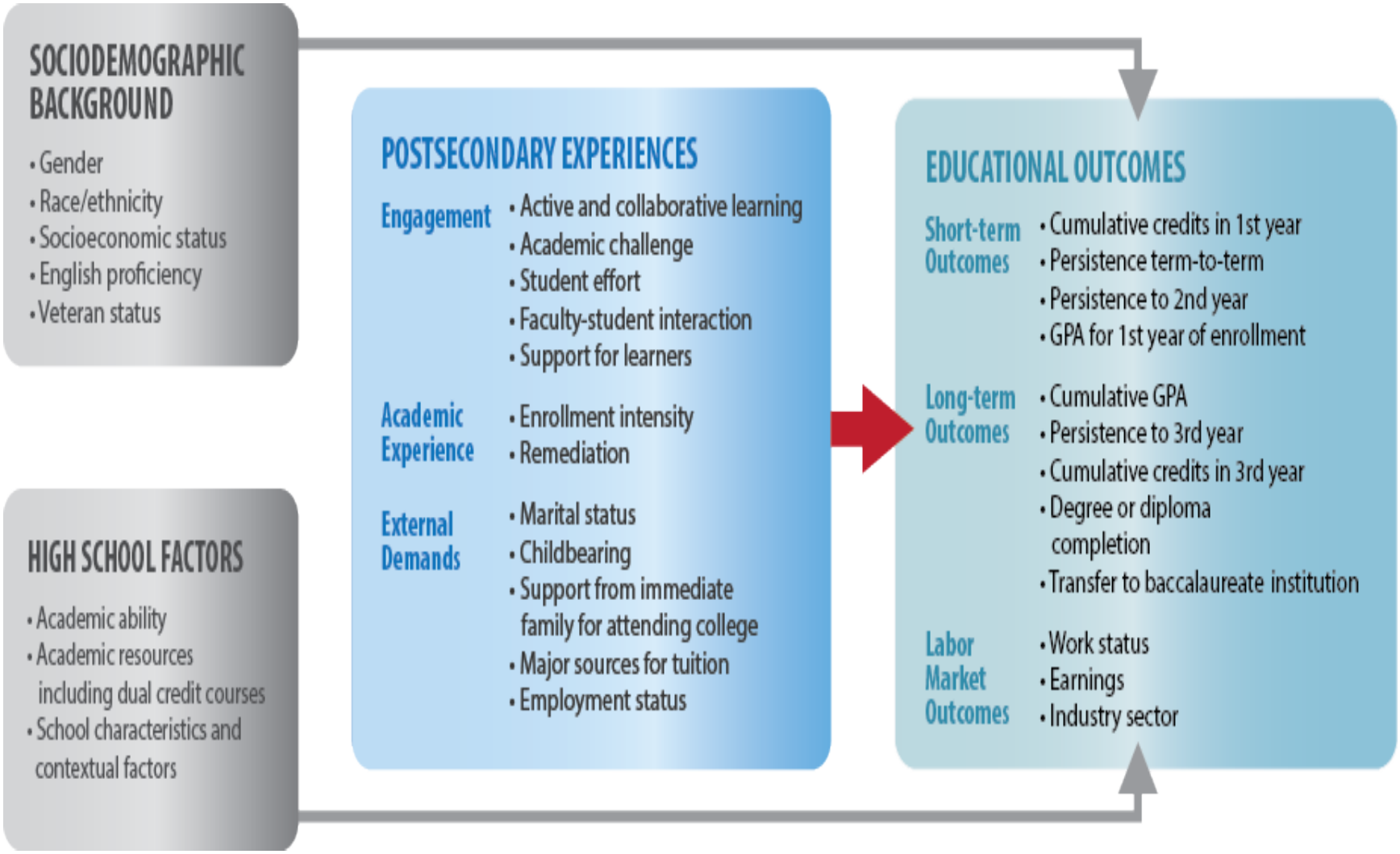
Wisconsin Technical College System

Two Guiding Questions:

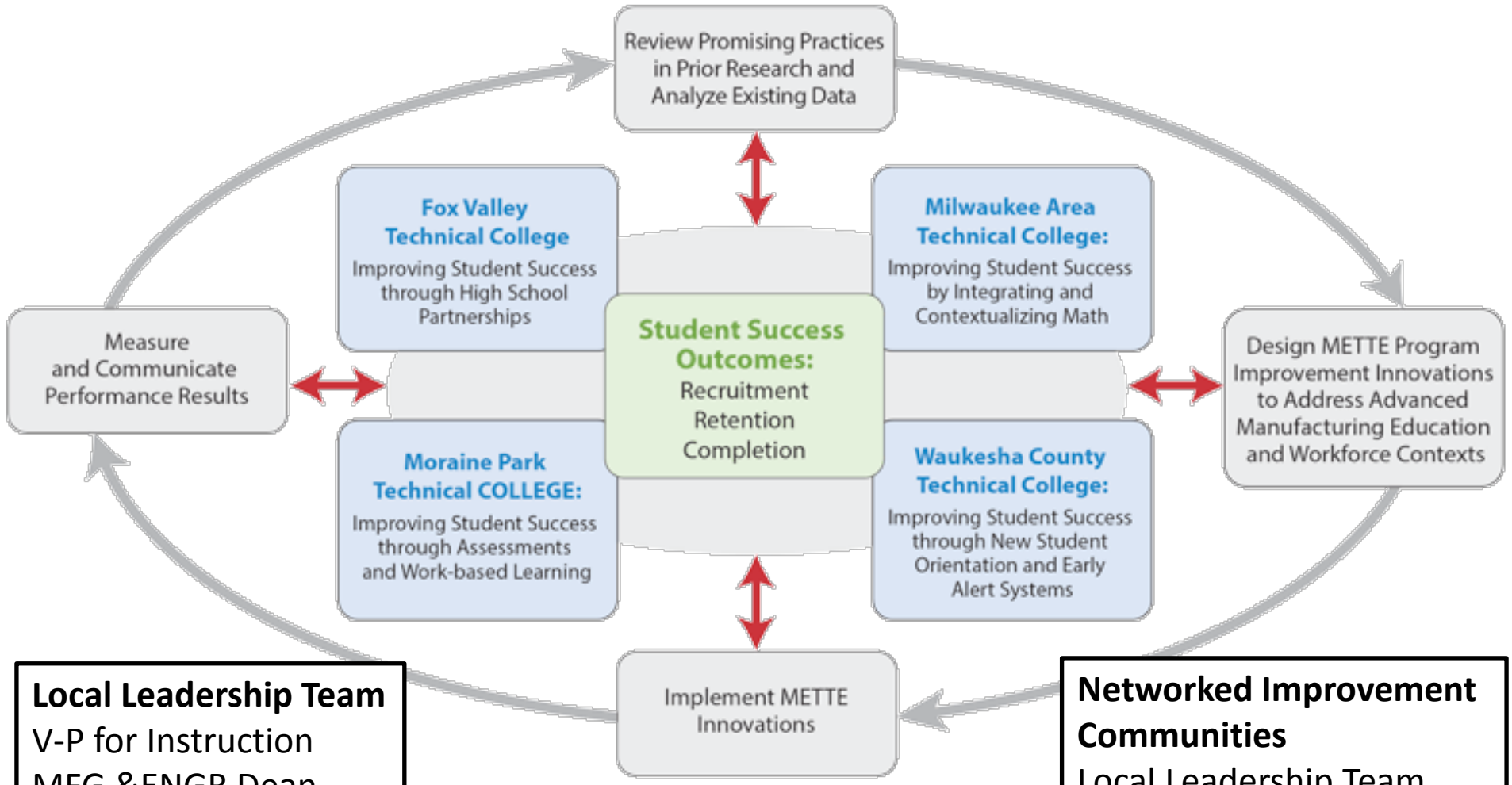
1. What are the specific METTE program features that are associated with optimal student outcomes?

2. How can key METTE stakeholders use research data and findings to inform strategic program improvement decisions?

METTE Student Success Model



Research and Innovation Framework



Local Leadership Team
V-P for Instruction
MFG &ENGR Dean
Institutional Research Office
UW Mad Researcher

Networked Improvement Communities
Local Leadership Team
Associate Deans
Faculty Leaders
Inst. Research Analysts

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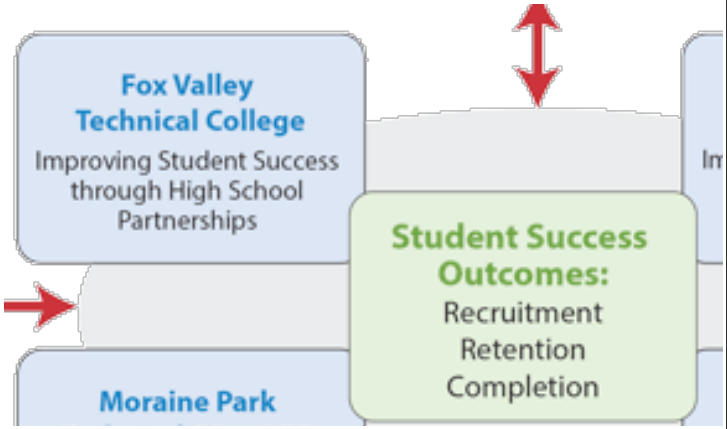

METTE at FVTC
Improving Student Success Through High School Partnerships

2013-16 Strategic Priority:
Increase by 10% each year the number of high school graduates who enter FVTC programs with prior FVTC credits (2012 Baseline: 13.4%)

Research Questions

1. In what ways do school-level and student-level characteristics influence students' early success at FVTC?
2. Do school-level measures have an effect above and beyond their corresponding student-level measures?

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PROJECT OUTCOMES

1. Provide each high school community with a report describing their graduates' success at FVTC and beyond.
2. Create a baseline for documenting and tracking the effects of various FVTC Early Career Success partnership projects:
   - Career Jump Start—Machine Tool (3 new dual credit courses in 5 high schools during 2013-14)
   - Dual Credit Summer Teaching Academy (2013--5 CTE inst.)
   - Completion of ACCPLACER by all students in Grade 11
   - New academy development -- manufacturing, technical or engineering
3. Benchmark the effectiveness of high school partnership linking practices

FVTC College Success Report for XXX High School

PROFILE: Fall Enrollment, 2009-11 Cohort	Other Large FVTC High Schools (n=16)	Career Jump Start (CJS) High Schools (n=5)	XXXX High School
Direct	2485/64%	695/69%	231/70%
Within 2 years	1398/36%	312/21%	100/30%
Male	46%	52%	49%
Female	54%	48%	51%
White	73%	76%	73%
Hispanic	12%	9%	10%
Asian/Pacific Islander	8%	6%	9%
African American	7%	5%	7%
English Language Learners	4%	2%	5%
Students with Disabilities	15%	15%	18%

CAREER PATHWAY INDICATORS: Fall Enrollment, 2009-11 Cohort	Other Large FVTC High Schools (n=16)	Career Jump Start (CJS) High Schools (n=5)	XXXX West High School
Engineering Programs	109	33	7
Manufacturing Programs	75	30	6
Other STEM Programs	90	42	10
Other Programs	150	89	25
Technical Diploma, 1 Year	245	86	40
Technical Diploma, 2 Year	330	113	21
Associate Degree	1504	374	132
Associate Degree, Transfer	55	18	1

LOCAL LEADERSHIP TEAM:

Patricia Frohrib, Director, College Effectiveness; Chris Matheny, VP – Instruction; Steve Straub, Dean of Engr & Mfg; Mary Hansen, Director, K-12 Partnerships; Allen Phelps, Researcher, UW-Madison

STUDENT SUCCESS INDICATORS: Fall Enrollment, 2009-11 Cohort	Other Large FVTC High Schools (n=16)	Career Jump Start (CJS) High Schools (n=5)	XXXX High School
Percent of successful course completion	74%	75%	81%
Percent retained from Fall to Spring term	68%	65%	70%
Percent graduating in 3 and 5 years	43%/51%	40%/45%	50%/55%
Percent of graduates employed within 6 months	89%	78%	92%

INNOVATION-LINKED STUDENT SUCCESS INDICATORS: Fall Enrollment, 2009-11 Cohort	Other Large FVTC High Schools (n=16)	Career Jump Start (CJS) High Schools (n=5)	XXXX High School
No./% of high school graduates entering with prior FVTC credits	11%	12%	18%
No./% Jump Start Summer Enrollment	2%	3%	6%
No. of basic skills students transitioning to program courses	75	18	9
% with admissible A/R/W ACCUPLACER scores	90%	85%	92%
% transferring in from 2-year	10%	8%	2%
% transferring in from 4-year	15%	7%	3%
% co-enrolled at 2-year college	15%	7%	1%
% co-enrolled at 4-year college	8%	8%	3%
% transferring to 2-year college	5%	2%	1%
% transferring to 4-year college	12%	7%	8%

-- OVER --

BENCHMARKED EVIDENCE, INNOVATIONS and INDICATORS: High School-Community College Partnership Practices

Longitudinal and Trend Evidence

Student Success Indicator/Outcome	*Practices/Policies/ Effects*	*Methods/ Comparisons*	*Population Served*	*Citation/Website*	*Implications for METTE/NIC*
Enrollment in 2YR college METTE program	HS enrollment in academic & technical track (p<.05) Do AP math (p<.05)	2002-2006 longitudinal study/two logistic regression models	National sample of 2002 sophomores	METT Brief #1 mette.wceruw.org	Build METTE programs of study with rich math and science. Support Common Core Standards implement.
Retained to 4th term or completed	Dual Enrollment HS Course/+5%; Initial summ enroll/+19%	Path Model	All WTCS students enrolled 2009-10	METTE Brief #2 mette.wceruw.org	Develop incentives for summer enrollment
Significantly higher rates of: college enrollment, persistence to 2nd term and yr. plus	FL Dual Enrollment Courses in HS/+17% enrollment in HE,+15 credits in 3 Yr./ +5% return for 2nd year	HS graduates with and without DE courses/controls for school & student characteristics	All FL high school graduates (299,685) in 2000-01 and 2001-02.	Community College Research Center (2012)	Benchmark ways of delivering DE courses.

Empirical and Case Study Evidence

Student Success Indicator/Outcome	Practices/Policies/ Effects	Methods/ Comparisons	Population Served	Website/Citation	Implications for METTE/NIC
Initial Community College Enrollment (+11%) and 2nd Year Retention (+11%)	Regional half-day academy featuring project based learning labs sponsored by industry partners	Propensity score matching with similar students attending same home high schools over 7 years	Diverse urban/ suburban community	Center for Advanced Research and Technology/ http://www.cart.org/	High schools should incorporate project-based learning experiences and labs for each career pathway.

NETWORKED IMPROVEMENT COMMUNITY CHARTER

Research Questions:

1. In what ways do school-level and student-level characteristics influence students' early success at FVTC?
2. Do school-level measures have an effect above and beyond their corresponding student-level measures?

FVTC-High School Linking Innovations:

Career Jump Start—Machine Tool Operations coursework (3 new dual credit courses in 5 high schools during 2013-14)
Dual Credit Summer Teaching Academy (2013--5 CTE instructors)
High School Academies and Programs of Study: Manufacturing, Technical or Engineering-focused
Completion of ACCPLACER by all students in Grade 11

Some Early Findings

Aspirations and Enrollment in STEM Fields

From a national sample of 2002 high school graduates, we found:

- Students who described themselves as being in both the academic & occupational tracks in high school were more likely to enroll in manufacturing programs instead of other STEM fields.
- Having at least one advanced placement (AP) math credit in high school was associated with 70.3% (girls) or 25.8% (boys) more likely to aspire to manufacturing fields, and 44.2% (girls) and 7.6% (boys) more likely to actually enroll in manufacturing fields at two-year colleges.

Source: Students in Manufacturing and Other STEM Fields at Two-Year Colleges: An Exploration of Aspirations and Enrollment (Spring 2012)

Some Early Findings

For recent high school grads who attended one of the technical colleges in Wisconsin in 09-10 academic year, we found that:

- Summer enrollment in 2009 is the strongest predictor of future educational success: Students who took summer courses were 19% more likely to be retained at the 4th term or to graduate earlier than their counterparts.
- Students who experienced delayed entry to college were 6% less likely to be retained or graduate at the 4th term.

Source: The Influence of Dual Enrollment and Early Academic Momentum on Two-Year Technical College Student Success (AERA, April, 2013)

Discussion Questions:

How can longitudinal data be used to evaluate ATE projects, program improvements, program innovations, and to track student progress?

In what ways can qualitative research methods (e.g., interviews and focus groups with students, instructors, and industry partners) clarify the importance of engineering technology (ET) programs, understand the factors affecting ET students' decisions, and enhance our understanding of the challenges and transitions encountered in different settings by increasingly diverse students?

When integrated, how can mixed methods of targeted research improve student outcomes and success in ATE pathways?

WEB-BASED RESOURCES FOR ATE PROJECTS

PathTECH http://sociology.usf.edu/pathtech/team/

METTE http://mette.wceruw.org/

Evidence-Based Innovations

- CCSSE http://www.ccsse.org/center/
- Policydirect.org http://www.policydirect.org/
- OCCRL http://occrl.illinois.edu/
- NRCCTE http://www.nrccte.org/
- Teaching Technicians – Proven and Promising Practices

  https://www.teachingtechnicians.org/Resources/PPP/
- CCRC http://ccrc.tc.columbia.edu/
- CAPSEE http://capseecenter.org/