

Crisis In K-12 STEM Education

A national problem creates an opportunity for
Local Communities

MUST-INNOV8, INC.

The Fuel for Economic Prosperity

A National STEM Education Problem Can become an Opportunity

- ▶ **Background:**
 - The United States is only producing a small fraction of scientists, engineers and technologist that we need to power our economic engine.
 - High paying jobs that require STEM (Science, Technology, Engineering and Math) education are unfilled because of a lack of qualified candidates.
 - The source of the problem traces back to our children losing interest in studying science and math in middle school.
 - Economic developers and recruiters of STEM trained talent tell us that companies and top talent considering locating in the [Local Community] will first decide if the region is a good strategic fit. The next questions is almost always about the quality of our K-12 schools (and for high tech companies the quality of our K-12 STEM education).
 - The local K-12 Schools have the same challenges as their counterparts across the country.
- ▶ This caused the leadership of one Economic Development organization to consider the possibility that the region could turn what is now a deficiency into an opportunity to position the region as a leader and an innovator in K-12 STEM education.
- ▶ **Whoever solves this problem WINS!!!**

The Vision & Mission

- ▶ The vision is to be a catalyst for the creation of world-class STEM (Science, Technology, Engineering and Math) across the Piedmont Triad region.
 - Regional economic developers have determined that having an exceptional K-12 STEM educational system is a critical element in successfully recruiting new STEM companies and world class researchers.
- ▶ The mission is to be a collaboration among business leaders and educators to excite and engage local K-12 students about science, technology, engineering and math.
 - MUST-Innov8 was asked to be the catalyst and facilitator to develop a world-class K-12 STEM education program. Success in this endeavor is an economic necessity for the region to grow and prosper.
 - MUST-Innov8 will create a lean and nimble organization that is focused on developing the vision and enabling/facilitating the implementation. To that end organizations engaged in the enrichment of STEM education will be identified and to the extent they are willing to commit to achieving the goal of creating a world-class environment for learning STEM, they will be embraced and supported
- ▶ Short Term:
 - Identify up to 10 K-12 STEM education programs that can be implemented in the next 3 years. They must be things that when combined cause national media to consider the local community as an innovator and leader in K-12 STEM education.

The Vision & Mission (cont.)

Long Term:

- ▶ In 6 to 8 years develop a K–12 STEM education system across the entire local community that gives our children and grandchildren a significant strategic advantage as they compete for the best 21st century jobs. We will know we are successful when:
 - Our K–12 STEM Schools are generally regarded as THE place to go in order to get a head start on STEM studies in college.
 - Our graduates...
 - Are heavily recruited by America’s top STEM schools
 - Are employed in a wide variety of STEM career fields
 - Our faculty is second-to-none by all measures
 - Our student body is second-to-none in terms of academic achievements and awards.
 - Our STEM Schools have a deeply woven relationship with the major STEM employers and Universities so that our students have seen/heard about/visited/worked with these companies so much during their time here that they are truly motivated to come back home to work for them after pursuing their college education.
 - We have a curriculum development program that works with local leaders to constantly anticipate upcoming paradigm shifts
 - We are part of the National Consortium for Specialized Secondary Schools of Mathematics, Science and Technology (NCSSSMST), one of only two in the State of North Carolina
 - The region is known for the exceptional quality of our highly skilled workforce.

The Questions

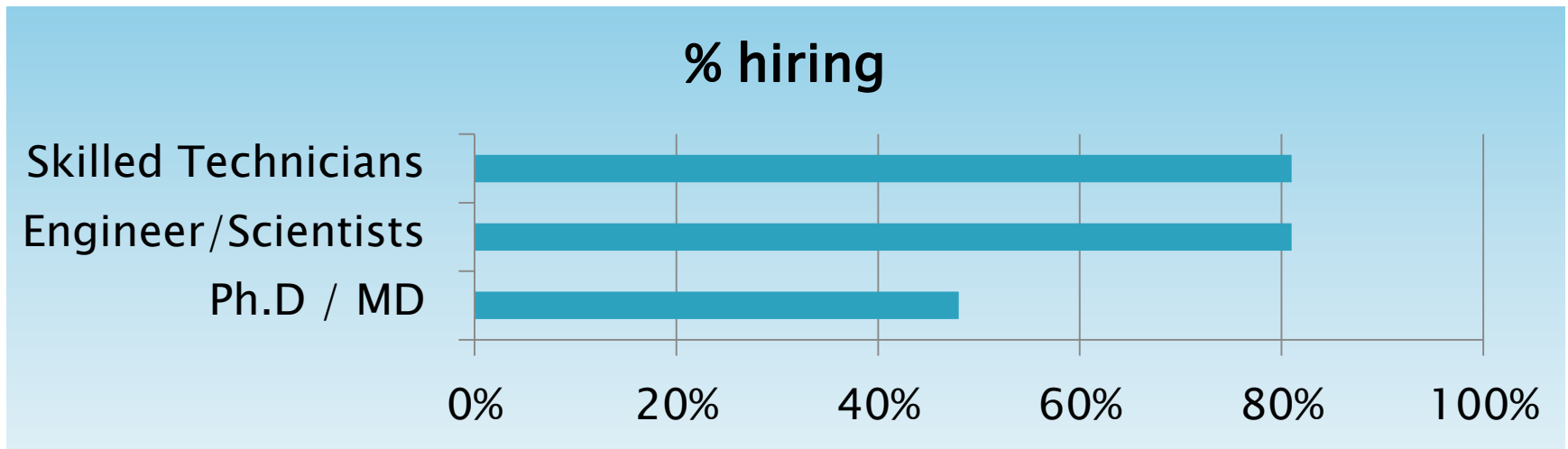
- ▶ This would be a huge and complicated project. It goes beyond the scope of what our K–12 educators can do by themselves. The project would require the backing and support from the leadership from across the region.
- Do the leaders from across the region have passion for the idea to create world–class K–12 STEM education?
- If they are passionate, what is needed for success?
- What are the leaders willing to do to support the implementation?

Is having world-class K-12 STEM education across the entire community Important?

We asked 92 CEO and leaders from across the
region

How Important is it to have STEM trained workers?

- ▶ 87% of the local CEOs of technology companies said that having a supply of STEM Trained Workers is critically important.
- ▶ The CEOs interviewed said they needed a broad spectrum of STEM trained workers.



The immediate crisis: Finding Skilled STEM Trained Technicians

The local community is losing high paying jobs to other regions and countries due to the lack of a trained work force.0

- ▶ One local county almost always has 500 to 1,000 open technical and professional jobs because companies cannot find STEM trained workers. (via Economic Developer)
- ▶ A company moved a large program to Florida because could not find the trained workers that they needed in the local region. (Aviation Company)

**“Most people think we
manufacturer in China for cost.
That is not true. We are in China
because of the quality of their
workforce training.”**

CEO – Global Computer Chip Manufacturer

Why is there a shortage of STEM trained workers?

- “Middle school grades are a critical time when students lose interest in STEM.” (VP – Local Community College)
- “Once interest is lost, it is difficult to re-engage because the curriculum is cumulative.” (Ph.D. Physics – Private University)
- Over the past ten years, the percentage of ACT-tested students who said they were interested in majoring in
 - engineering has dropped steadily from 7.6 percent to 4.9 percent.
 - computer and information science has dropped steadily from 4.5 percent to 2.9 percent. (ACT International Testing)
- In the highly competitive global economy, the United States faces the daunting task of supplying our own nation with capable science and technology workers.
 - Collectively, India, China, South Korea, and Japan have more than doubled the number of students receiving bachelor’s degrees in the natural sciences since 1975, and quadrupled the number earning engineering degrees.
 - Since the late 1980s, the European Union has produced more science and engineering Ph.D.'s than the United States.
 - **These countries are hungry to succeed and increasingly capable of doing so.** (Mel Schiavelli – President, Harrisburg University of Science and Technology)

Students Are Not Prepared for College

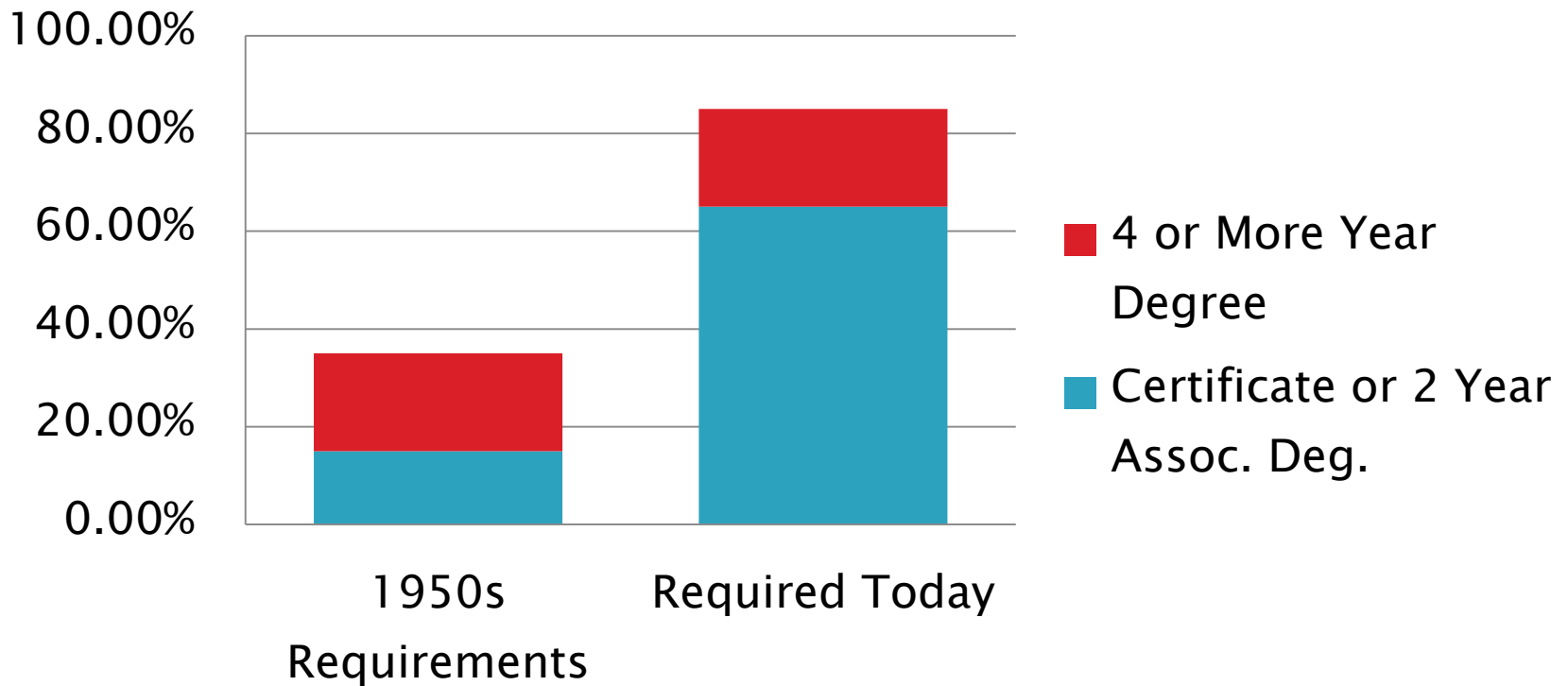
- **FACT:** Only 41% of ACT-tested 2005 high school graduates achieved or exceeded the ACT College Readiness Benchmark in Math.
- **FACT:** Only 26% of ACT-tested 2005 high school graduates achieved or exceeded the ACT College Readiness Benchmark in Science.
- “On average it takes a full time Community College student 3 to 3 ½ years to obtain a 2 year Associate’s Degree because of the time that it takes to remediate their skills” (retired President local Community College)
- Almost all of the University Presidents, Chancellors and Provosts reported significant problems with college preparedness (particularly in STEM fields).

“Historically this region has not valued education...it simply was not needed to work on an assembly line in a factory”

Retired Dean
of the School of Medicine

The needs of the marketplace shifted and the pipeline has not responded

Marketplace Job Requirements



“80% of the jobs created in the next decade will require some form of STEM skills.”

The National Science Foundation

“Our education system has not adapted to the change in the work place from when most jobs were manufacturing line jobs where individuals did single focus assembly line jobs to today where the vast majority of jobs require technology, team work, critical thinking and problem solving skills.”

Executive Director – Global Logistics Center

CEOs were
asked what
they needed

“Research tells us that innovative firms are twice as profitable (on average) than other firms , but innovation is becoming less and less of a luxury. The choice is to Innovate and grow or disappear.”

Managing Innovation by J. Tidd, J. Bessant, K. Pavitt, 2005.

What skills Sets Do you need?

The CEOs said they needed the following:

- ▶ Problem solvers
- ▶ Critical thinking skills
- ▶ Ability to work as a team
- ▶ Ability to communicate (written and verbal)
- ▶ At a minimum basic math/science and most needed advanced STEM capabilities
- ▶ Persistence after a failure

**“Innovation is the child of the
Engineering Design Process.”**

Senior Advisor to Virginia Commonwealth for STEM
Initiatives.

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How Important is Having an exceptional K-12 STEM education system?

- ▶ In general, CEOs responded that the quality of K-12 schools was critically important when they are recruiting top talent.
 - After determining that the job is a good strategic fit, the next questions are almost always about the quality of K-12 schools
 - When recruiting executives for technology companies there are frequent questions about the quality of K-12 STEM education
- ▶ Economic Developers reported the same comments and questions when they are recruiting companies and in particular technology companies to come to the region.

“When we are recruiting top talent, I spend a lot of time convincing the spouse that our schools are capable of meeting the needs of their children.”

- ▶ Chairman Local School Board

Company Presidents were asked: What can be done to engage more kids in STEM?

- Teachers need to be passionate
 - Need to get more teachers interested in STEM
 - Industry and teachers need to talk
- Industry needs to provide more role models
- Competitions
- Make it FUN
- Integration of STEM into all lesson plans
- Real world relevance/Make it practical
- Companies need to provide apprenticeship (internship) opportunities
- Schools need
 - Strong leadership
 - To encourage and support innovation
 - Allow leaders and teachers to take risks
- Universities can change the way they prepare teachers and principals

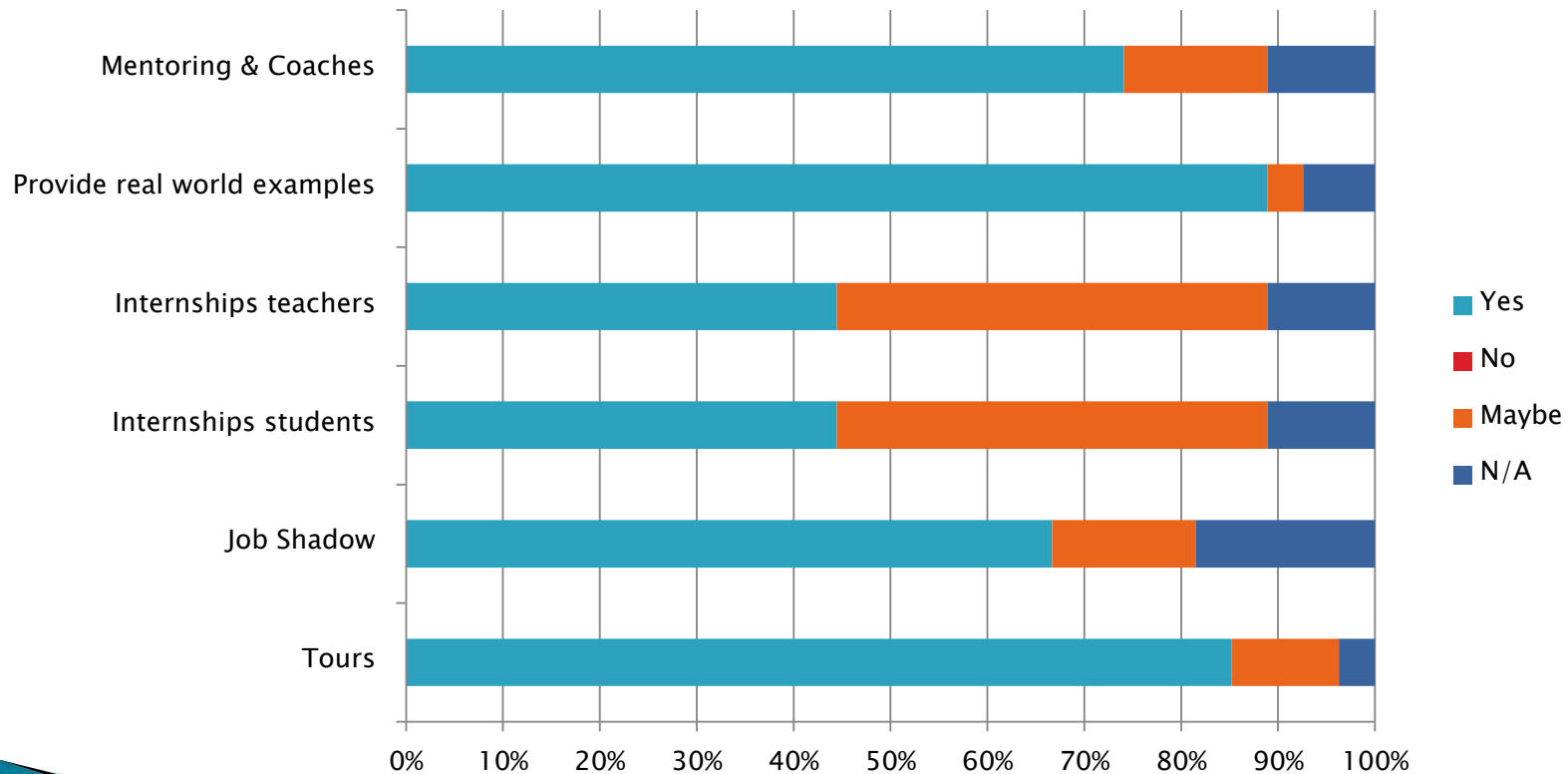
We asked Industry leaders: What would you do to cause K-12 students to want a career in a STEM field?

- Provide role models
- Highlight women and minorities in Science
- Get kids involved in science at an early age
- Teachers need exposure to real world/Teacher Internships
- Provide opportunities for kids to “dream” about the future
 - Set a lofty goal
 - Show them examples of people who look like them working in exciting and interesting STEM professions
 - Highlight the earning potential of those careers
- Elementary students need to do more experiments
- Stimulate students creativity/problem solving skills
- Science must be taught every year K through 12
- Improve teacher’s knowledge about STEM and exciting careers in real STEM jobs
- Internships where Students work in all areas of a technology companies business (interdisciplinary need & STEM in all aspects of business)

CEOs were
willing to
commit
resources

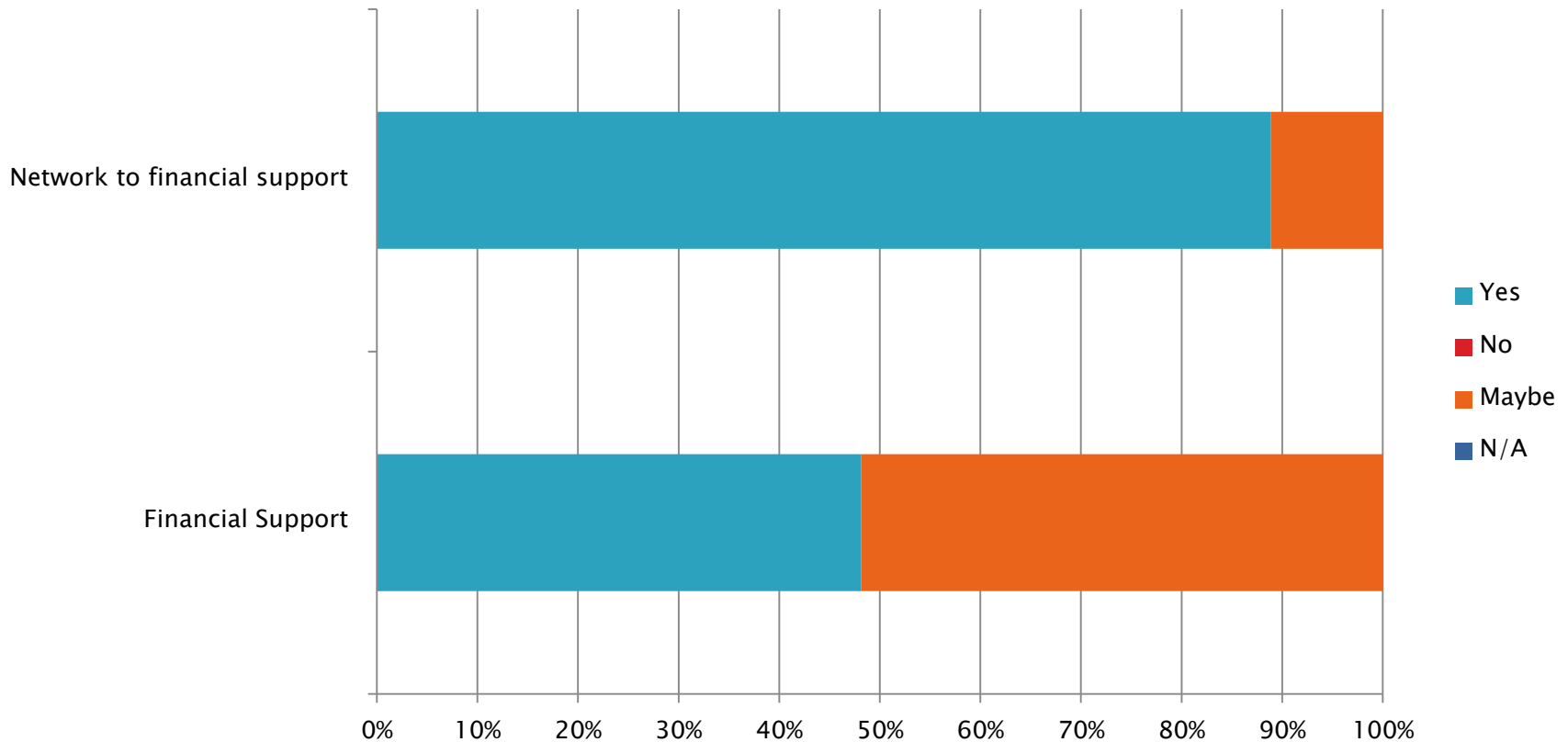
Would you Provide:

In-Kind Business Support



Would you Provide:

Financial Support from Business



That is
what CEOs
thought

The good news

- Responses from K–12 teachers and administrators echoed many of those ideas.
- On a small scale many of the ideas that the CEOs shared have/are being developed and tested across the region.
- Early results indicate that the approaches that the CEOs suggested excite and engage kids in STEM.

The bad news

- Industry has no idea what is being developed and tested in STEM education in K-12 schools
- K-12 Administrators and teachers know very little about the need of companies across the region.
 - There is a low level of awareness of the companies and what they do
 - There is extremely low awareness of the careers available in these companies and the knowledge/skills needed to qualify for the jobs.

K-12 Educator Thoughts

Educators thinking outside the box

- ▶ “We have to prepare our students with the skills that 21st century job skills. It is a transformation that impacts both curriculum content and the life skills necessary to succeed in today’s competitive job market.”
 - ▶ Magnet Schools Program Manager
Local County Schools
- ▶ “STEM is an important part of our curriculum. As an example we have included robotics in our elementary school curriculum. It teaches students to work as a part of a team.”
 - ▶ Superintendent
Local County Schools
- ▶ “Our County is focused on putting our students on a fast track to obtain a 2 year Associate’s Degrees in 5 years. We are collaborating with our business partners on curriculum development. We are focused on providing students with the knowledge and skills necessary to prepare them for highly skilled technical jobs.”
 - ▶ Superintendent
Local County Schools
- ▶ “Our County has designated a STEM Elementary, STEM Middle School and STEM Technology High School as STEM Magnet Schools. Our business leaders, K-12 Administration and School Board believe that K-12 STEM Magnet Schools have the best chance of exciting and engaging students in STEM...particularly in the difficult middle school years where they lose interest in STEM.”
 - ▶ Superintendent
Local County Schools

Educators thinking outside the box

- ▶ “Our County has partnered with our colleges and universities to develop Early Colleges. The Early College program has generated excellent results in terms of college graduation. We are currently working on a STEM Early College.”
 - ▶ Superintendent
Local County Schools
- ▶ “Problem based learning works. I am way more effective as teacher during the afterschool clubs like First Lego League and rocketry club than I am lecturing in a class room. The interactions among the students, their approaches to problem solving and learning how to apply what they have learned occurs in these afterschool teams.”
 - ▶ Curriculum Coordinator
STEM Technology High School
- ▶ “We knew that we needed to expose students to real-world applications of STEM concepts. It was difficult to learn about all of the companies that use STEM and learn what they are doing.”
- ▶ It is wonderful to have someone like Samantha McGill, Ph.D. from Honda Jet teaching our Project Lead The Way pre-engineering students the basics of aeronautical engineering using the process of designing a paper airplane.”
 - ▶ Curriculum Coordinator
STEM Middle School

“The STEM Middle School has undergone an amazing transformation. From worst to best in 5 years.

To have a STEM Middle School that mirrors the demographics of the community with 1,100 students and a waiting list is a tremendous accomplishment.

We need to study this school and figure out how to replicate their success. It can give us insights into what we need to do to prepare teachers and principals for the next generation of schools.”

Chancellor
State University

K-12 Educators: Dealing with the scope and magnitude of change

- ▶ “Our education system mirrored our manufacturing plants for decades. Classrooms were an efficient assembly line model.
- ▶ In order for businesses to survive in a global economy they had to be more nimble...innovative...restructure...and respond to constant and rapid change.

Our education system needs to mirror that change.”

Change Coach
State New Schools Project