

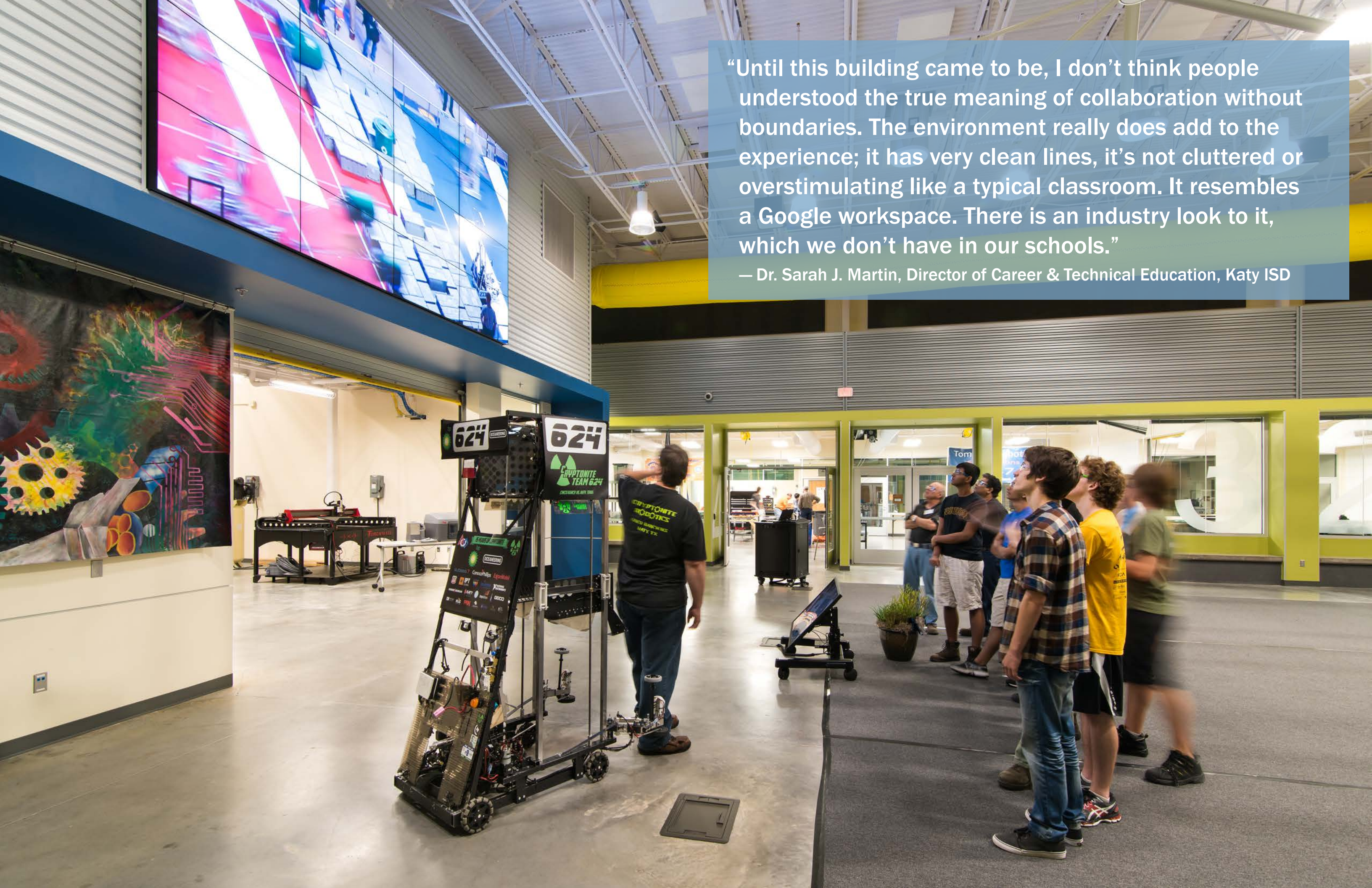


# One Small Facility, Infinite Possibilities

Robert R. Shaw Center for STEAM  
(Science, Technology, Engineering, Arts, and Mathematics)

“Until this building came to be, I don’t think people understood the true meaning of collaboration without boundaries. The environment really does add to the experience; it has very clean lines, it’s not cluttered or overstimulating like a typical classroom. It resembles a Google workspace. There is an industry look to it, which we don’t have in our schools.”

— Dr. Sarah J. Martin, Director of Career & Technical Education, Katy ISD





# EXECUTIVE SUMMARY



Imagine this — young inventors working on robotic creations, students investigating projected light color combinations, and learners taking fingerprints and conducting interviews on a simulated crime scene. Where can you find these activities on any given day? Katy Independent School District's Robert R. Shaw Center for STEAM.

Katy ISD and the community they serve have long embraced learning in the areas of science, technology, engineering, arts and mathematics (STEAM). However, in 2014, it became apparent that students involved in these areas needed more support. A particular group of students were participating in highly successful community robotics teams that were competing (*and winning*) at international competitions, but had no dedicated space for projects (they were using garages, closets, even renting various storefronts around the district). Katy ISD recognized the great potential these programs offered students, and fully committed to providing a permanent home to support not only robotics, but an infinite list of STEAM activities. This place brought students, teachers, and community mentors together to collaborate.

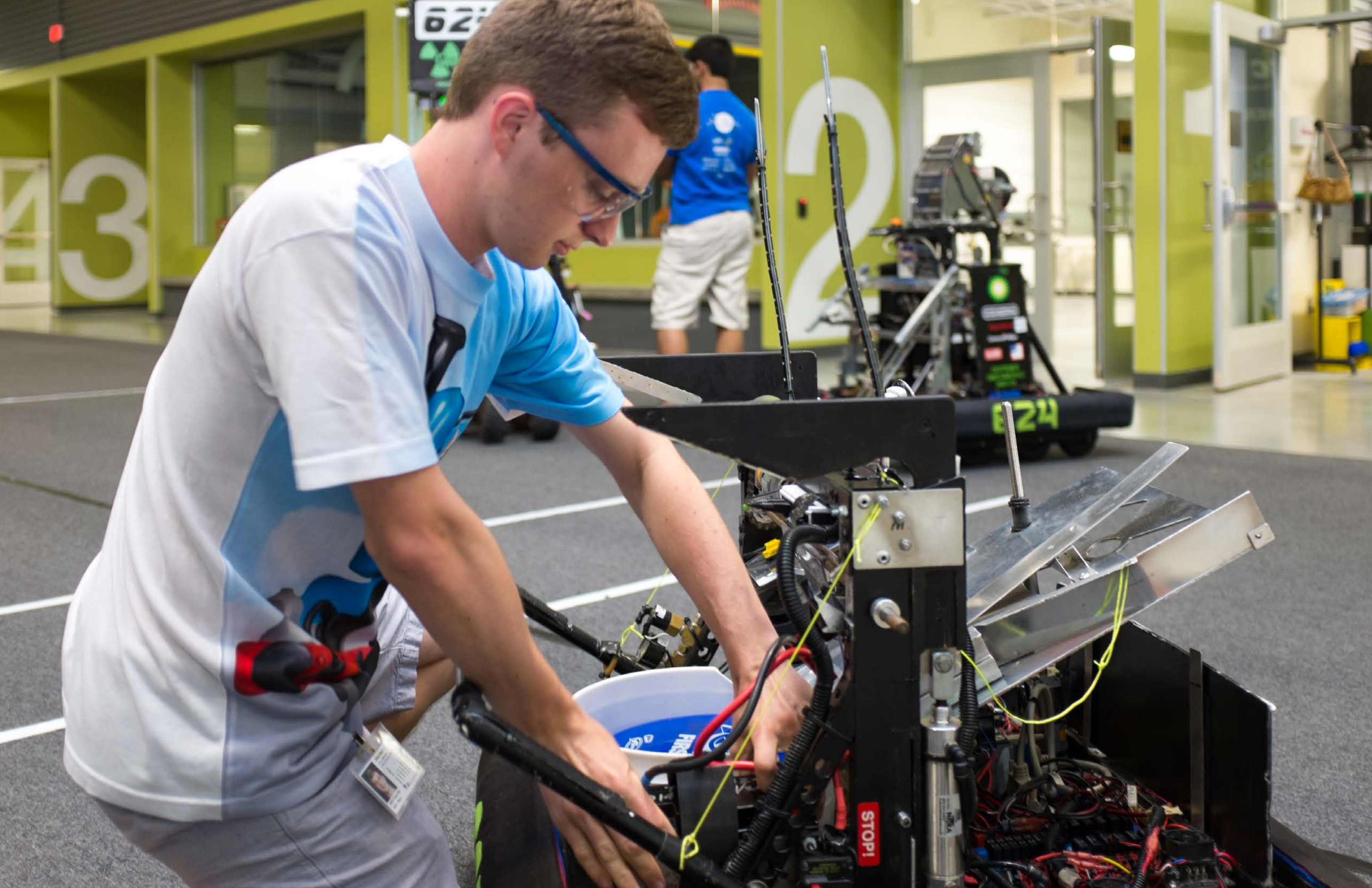
As a district-wide, multi-use facility, the 24,000 square foot Robert R. Shaw Center for STEAM is an incubator space designed to build interaction across Katy ISD. Upon entering the building, a visitor is greeted with a large, centralized high-bay space that is open to possibilities. It is used daily for project testing and demonstrations, large community events, presentations, and staff development initiatives. Direct views are provided from the high-bay space to

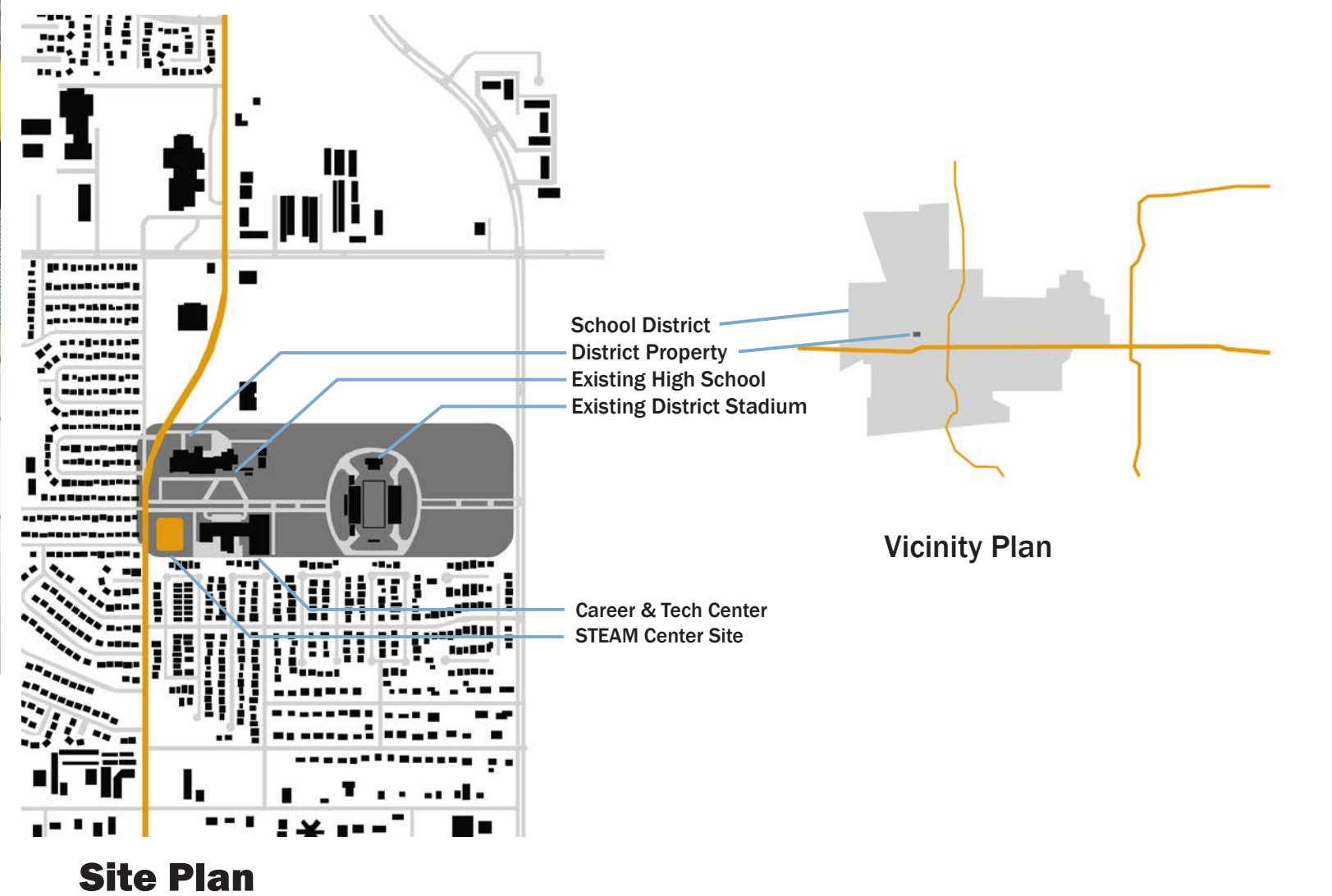
the 8 “project bays” which serve as design/build space for activities related to STEAM. At the North edge, a professional quality, multi-purpose meeting room supports interactive digital learning, and a shared shop with high-resolution tools bookends the Southern edge. To prepare for growing interest in build space and STEAM learning the facility was thoughtfully designed to allow for future expansion.

***Creativity, communication, and collaboration are explored as roles and responsibilities are rotated. For example, teachers can be learners, students can be leaders, and mentors can be collaborators.***  
— Stakeholder Vision

The building's design reflects this vision through its flexibility, and use of technology and transparency, which sparks interest in the activities and fosters collaboration between user groups and the greater community. It's a new forum for delving into diverse interests relevant to our changing world, one that is available not only to the school district, but the general public.

Many educators have recognized the profound impact that STEAM curriculum has on their students, but have found providing space for these types of activities financially daunting. In order to provide safe and flexible space for large projects, technology and equipment-rich spaces are needed. Through the creation of this district-wide facility, Katy ISD has demonstrated how a small footprint can open the door to infinite possibilities, at minimal cost, thereby making access to a robust STEAM program available to districts of all sizes.





## SCOPE OF WORK + BUDGET

Katy Independent School District (ISD) is a suburban district in southeast Texas encompassing 181 square miles, west of Houston. Katy ISD is a high performing district, and one of the country's largest, with many parents employed in the adjacent Energy Corridor and Houston energy & gas profession. Successful robotics clubs, led by these parents, petitioned the school board for a collaborative space that brings together geographically disparate stakeholders. Katy ISD decided to build a learning and project environment that would not only meet the immediate needs for robotics but serve as a catalyst to spark the imagination and spirit of innovation community-wide.

Due to urgency within the community the project team had a limited schedule for planning, design, and documentation as well as an equally limited budget that was dictated by the existing fund balance. However, despite those challenges, the design team achieved the district goals.

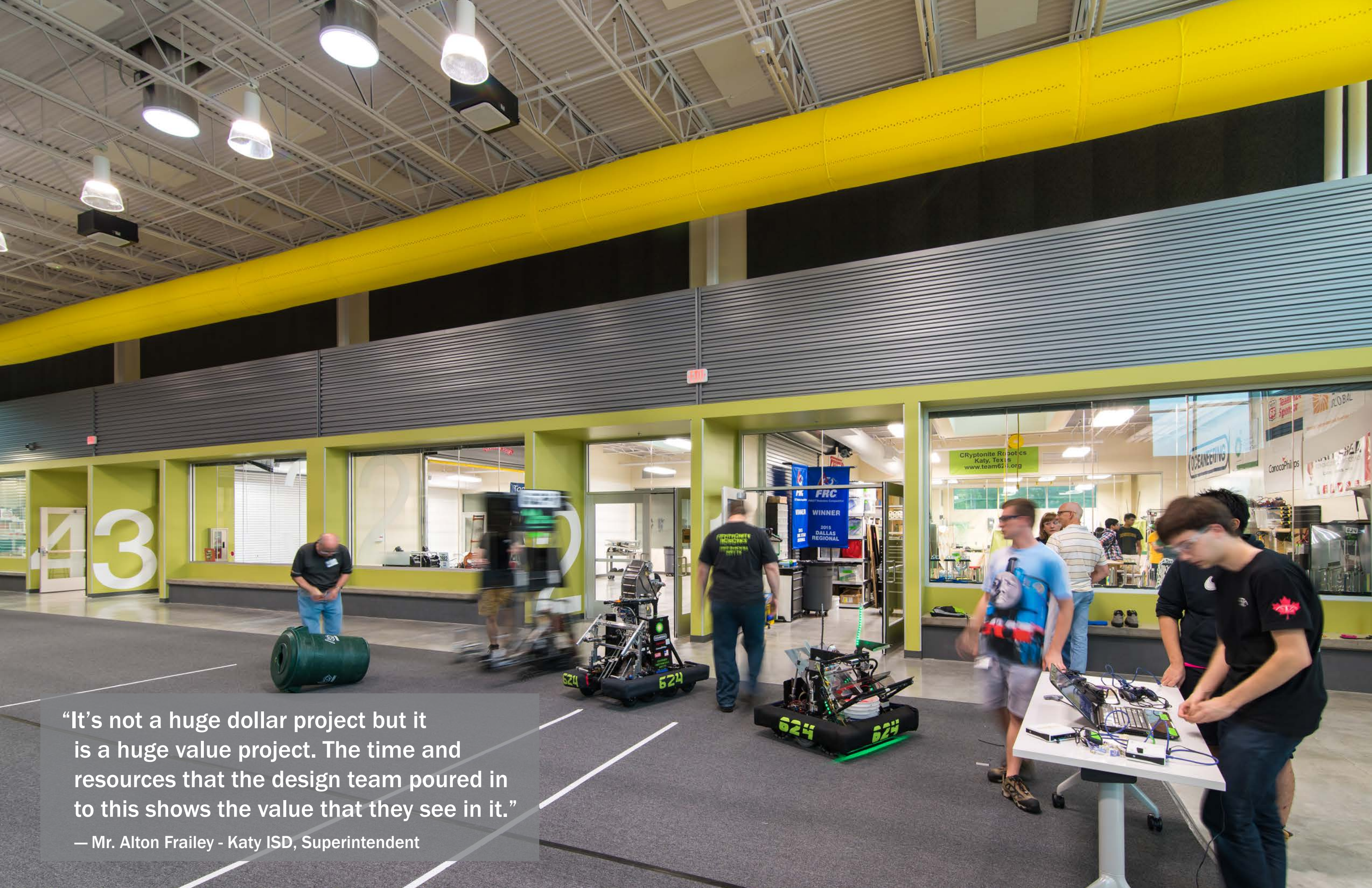
Also, to serve the entire community, the building is centrally located in the geographic heart of the district to serve as a hub for STEAM events. This new facility anchors the entry corner of a district site shared with a stadium and two existing learning facilities – the Miller Career Center and Raines Alternative High School.

The STEAM Center's Northeast corner is peeled away to offer an entry plaza welcoming visitors from both Miller and Raines. This close proximity provides high-bay and project space for students engaged in science, technology, engineering, arts and mathematic activities, from the adjacent facilities, and from schools district-wide, for all grade levels.

The project was designed to allow the facility to double in size in the future, which may be necessary due to its overwhelming success and use within its first year.

- Site:** 4 acres
- Facility:** 24,000 SF
- Capacity:** Varies (district-wide facility; 2000 students used the space in first 3 months)
- Cost:** \$4,979,000
- Grades:** K-12
- Completion:** January 2014
- Sustainability:** Texas Collaborative for High Performance School (CHPS)





“It’s not a huge dollar project but it is a huge value project. The time and resources that the design team poured in to this shows the value that they see in it.”

— Mr. Alton Frailey - Katy ISD, Superintendent



## COMMUNITY ENGAGEMENT

Due to the diverse nature of the activities housed at the STEAM Center, a broad base of stakeholders were required. The visioning process, led by the design team, used group-facilitated activities to identify and then build consensus around the project goals. Representatives on the committee included current as well as former students (for example one then interning at NASA), engineers (BP, GE), teachers, and even a local state representative with an engineering pedigree.

The primary challenge for this project involved changing two very different mind-sets. First, educators and district staff had to liberate their thinking from single-use space dedicated to a particular course content to a creation space or makerspace. Second, the community had to imagine beyond simple, utilitarian square footage similar to the garages they had been using to a facility that inspires idea generation and future leaders.

Katy ISD has a large population of parents that have careers in STEM-related fields. Their extensive knowledge of the problem-solving process including the four basic steps of – thinking, modeling, making, and demonstrating – drove the design response. Additionally, the business community offered insights and resources regarding safety procedures and

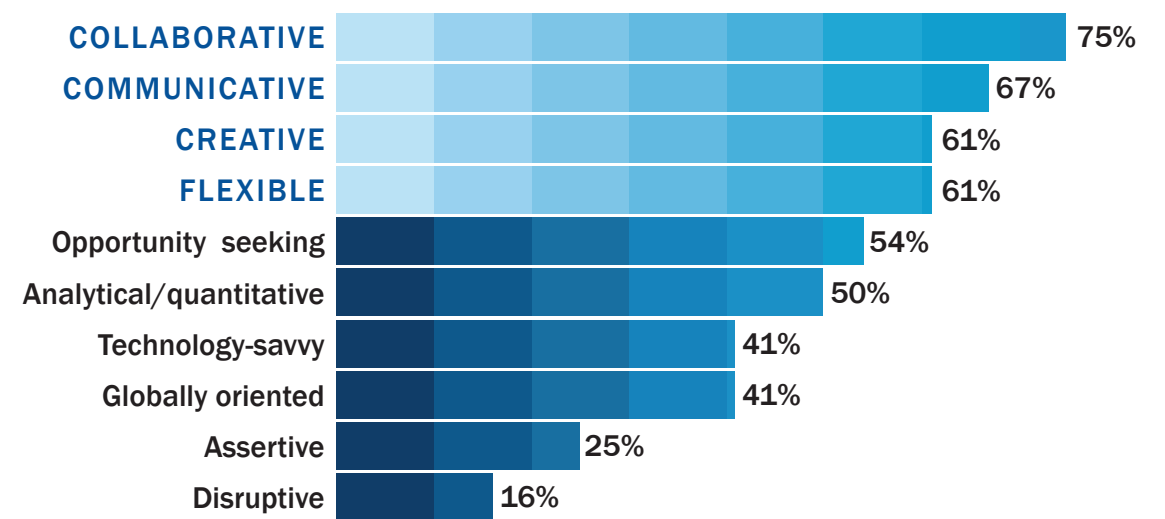
training. The multi-step visioning process started with the validation of the diverse perspectives represented in each stakeholder group – such as students, parents, educators and the business community. Additionally, the changing needs of these groups were identified, which created the framework to discuss future expectations of learners as they enter the work force and begin careers.

### PROJECT GOALS

The STEAM Center will:

- Catalyze dynamic relationships across Katy ISD through the intersection of creative students, passionate teachers, and fully engaged mentors.
- Enable creativity, communication, collaboration, and flexibility as roles are explored and responsibilities rotated.
- Offer a new forum for learners to explore diverse interests through hands-on activities relevant to our changing world.

**Top 4 Traits of “Future Proof” Employees, According to 1,709 CEOs — Forbes**



The IBM survey of 1,709 CEO’s identified the top “future proof ” traits incoming employees need to have to be successful. The top four traits – collaborative, communicative, creative and flexible – created a framework for the visioning process centered around what kinds of activities will support development of these traits. And, what kinds of spaces will support those diverse activities.

**“We have a huge parent volunteer support system... kids have already graduated but their parents are volunteering with current kids. Parents have expertise and they have purpose around sharing that. Parents are committed - they have seen how their knowledge has benefitted other kids and they are bitten by the bug.”**

— Dr. Sarah J. Martin, Director of Career & Technical Education, Katy ISD



simple forms + natural materials



quality light + functionality



flexibility + openness

During divergent thinking exercises, the design team shared virtual and physical tours of internally and externally-designed production work places. The goal was to empower stakeholders to articulate the following design directives:

- Simple forms + natural materials
- Quality light + functionality
- Flexibility + openness

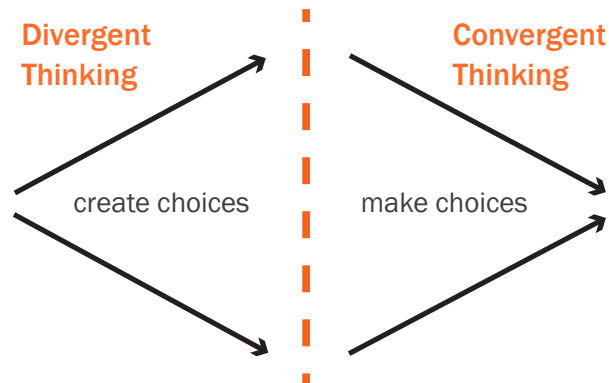
Throughout the planning process stakeholders worked in small groups to explore concepts and reported their findings to the large group to build consensus. Through this intentional process, every voice was heard from each representative stakeholder group.





After the project goals were identified, an interactive programming session gathered input focused around four categories:

- Activities
- Users
- Tools
- Aesthetics

Based on feedback at programming, the design team developed a very clear, simple group of space types that support learning activities that develop future-proof character traits, and most importantly allow for flexibility.

The inclusive planning process inspired stakeholders to carry their experience to the broader Katy community, creating excitement about the upcoming STEAM Center. Additionally, the iterative process of divergent and convergent thinking modeled during planning inspired educators and learners alike to re-shape their STEAM learning process.

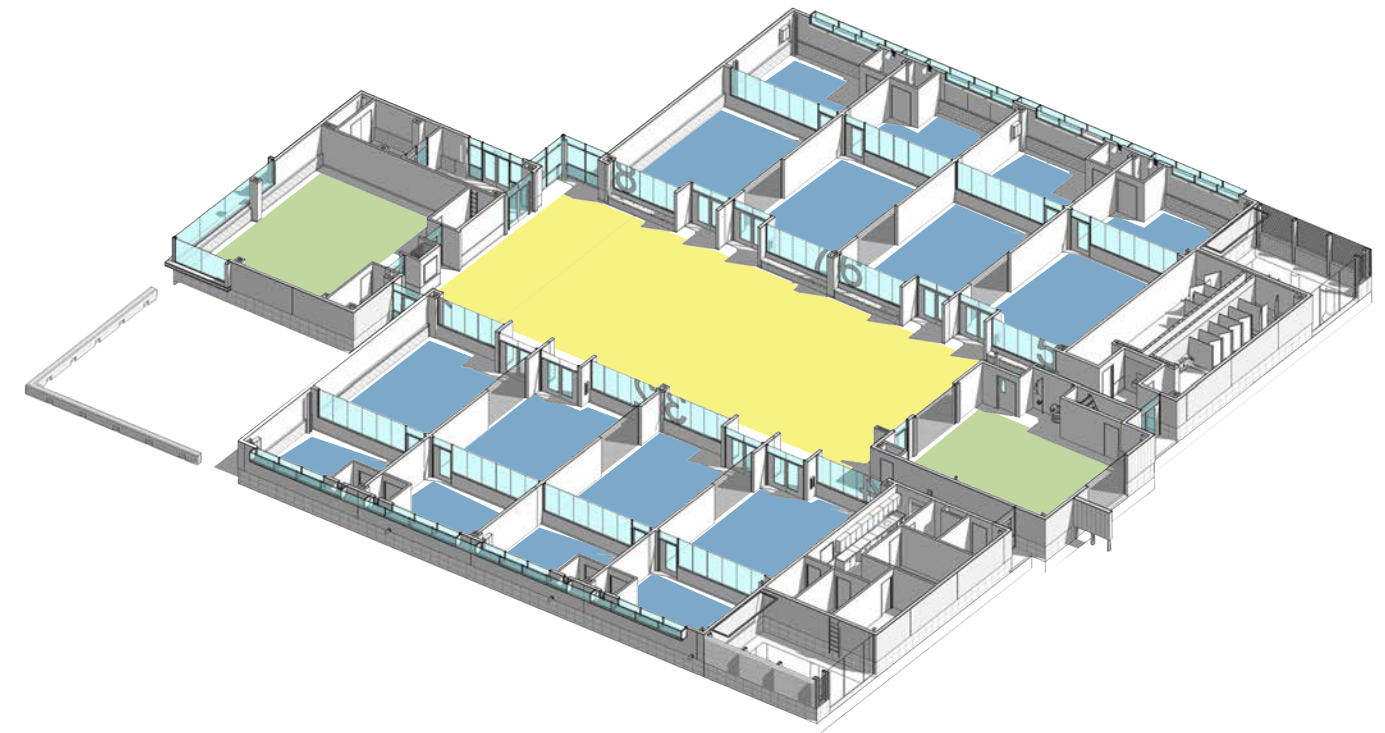
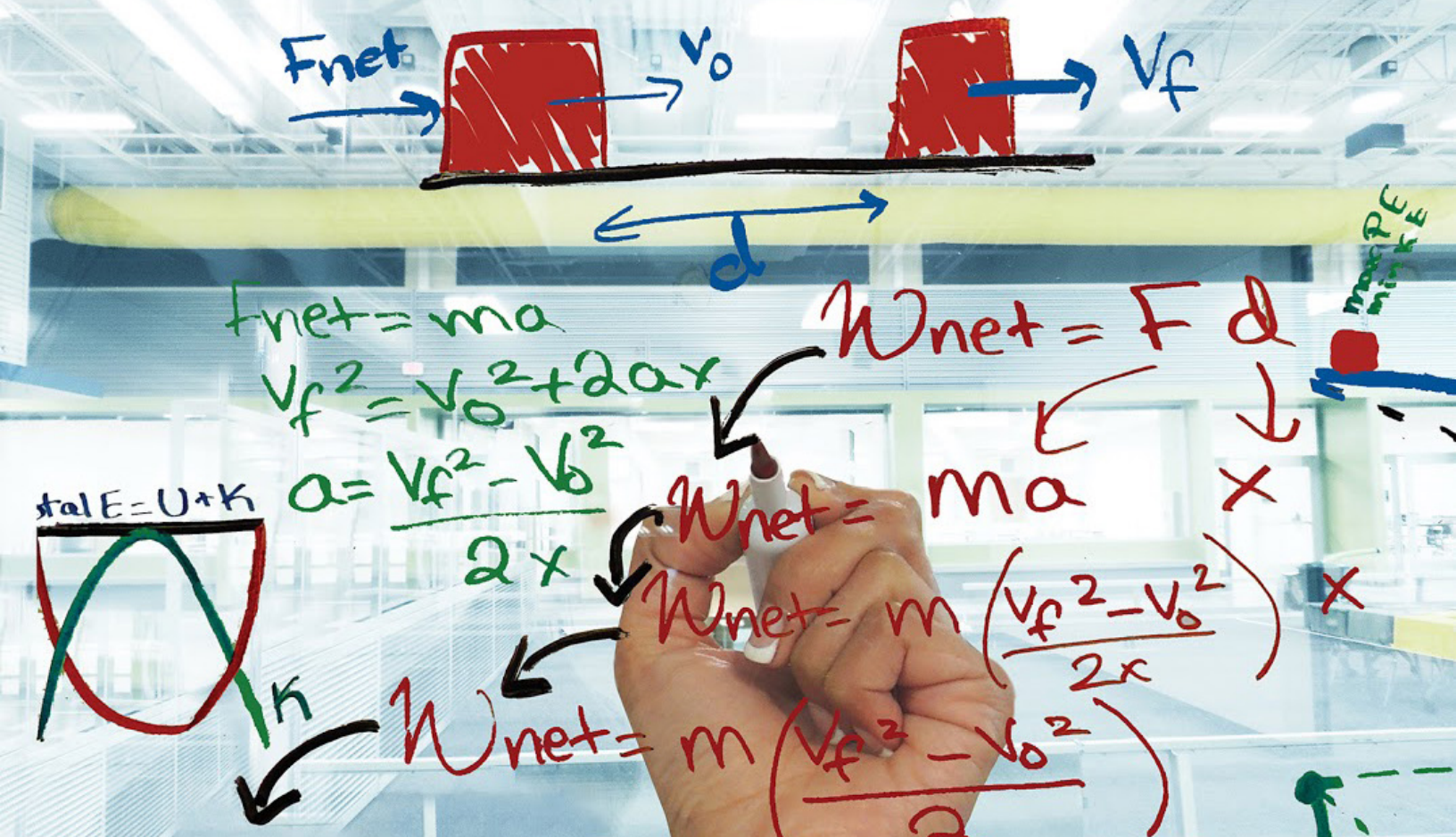


	Activities	What activities/events will occur in the space? How often?
	Users	How many people need to be in the space at once? When/who needs access?
	Tools	What types of tools/technology need to be in the space?
	Aesthetics	How would you like the space to feel/look? What should the space be close to?









## EDUCATIONAL ENVIRONMENT

This building is an incubator for innovation. The environment supports students and allows them to engage in science, technology, engineering, art, and math activities without limiting access to space, tools, and expertise. “Creativity, communication, flexibility and collaboration are promoted as roles are explored and responsibilities rotated – teachers can be learners, students can be leaders, mentors can be collaborators”– Stakeholder Vision Statement.

**The interior nucleus of this one-story facility is a central, adaptable, high-volume space that was designed to enable learners to move in a fluid manner through the problem-solving process of thinking, modeling, making and demonstrating.**

Flanking this central nucleus are eight identical project bays. Each project bay is divided into two distinct spaces. The front space of each project bay – designed to support collegial project planning and modeling – faces the high volume space with large glazed windows, while the back space is dedicated to project development/shop space. It was vital to include space for tools and potential debris created in the shop separate from the clean project space where the computer programming occurred.

Overhead doors were installed between the project bays in a daisy chain to provide additional flexibility, nurture comradery, support learning between groups, and enable larger spaces for project needs. A large shared shop area designed to accommodate major production and construction equipment includes overhead access doors to both the high bay area and exterior loading plaza. At the opposite end of the high bay area is a flex classroom space divisible into two self-contained classrooms or collaboration spaces. This space is equipped with state-of-the-art technology including an interactive technology wall that spans two of the four walls.

Office space is located at the main entry to manage the secure vestibule. The operation of this facility is also supported by a cluster of ancillary spaces including restrooms, storage, coffee bar, custodial and technology/physical plant system spaces. These spaces have been provided at the southern end of the high bay space to minimize the impact on the functionality and maximize the future expansion possibility.

## ZONE 1

**CENTRAL ■ LARGE-GROUP ■ ADAPTABLE**

The Zone 1 high-bay space is naturally-lit from above while providing direct visual connectivity to the eight project bays. A large digital screen enables a variety of activities: guest lecturers, robotics practice, mock crime scene investigation, exhibitions, etc.



## ZONE 2

**FLANKING ■ MEDIUM-GROUP ■ SHARED RESOURCE**

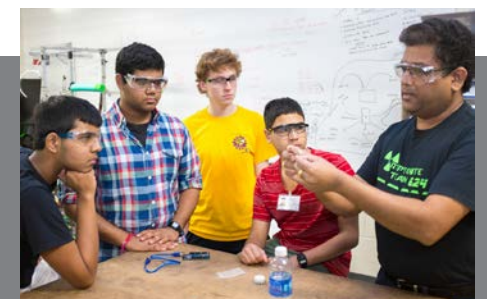
Zone 2 includes a technology immersive professional meeting room and a shared shop for high-budget tools.



## ZONE 3

**PERIPHERAL ■ SMALL-GROUP ■ FOCUSED**

Zone 3 project bays are designed to be assigned individually per project or connected through lateral overhead doors to accommodate teaming. Each bay is provided clerestory windows, ample wall space to store tools, and white boards for brainstorming.



To facilitate simultaneous, varied projects, the STEAM Center is organized in three zones: central, adaptable large-group area, flanking shared resource areas, and focused project bays.

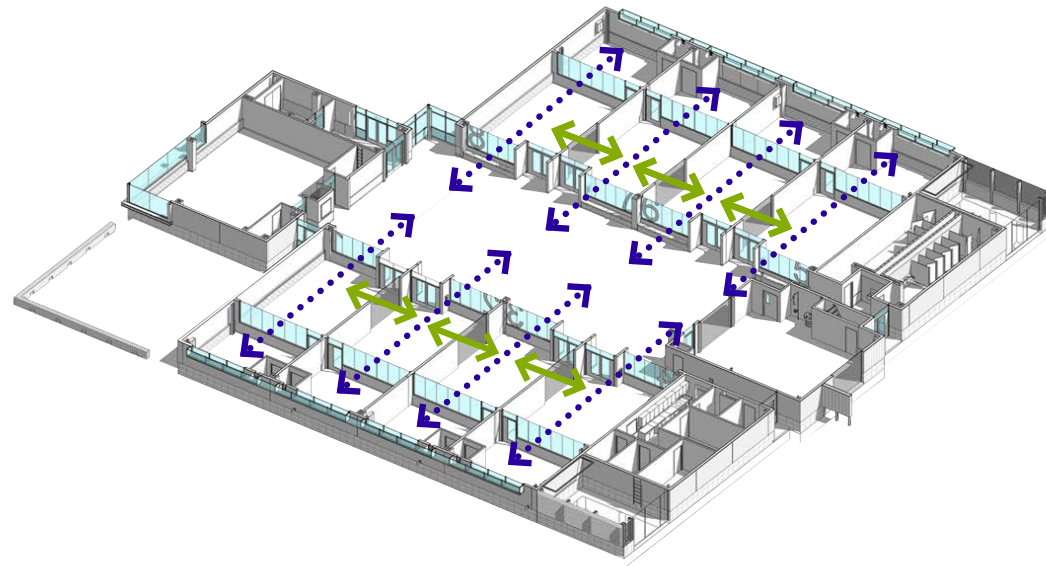
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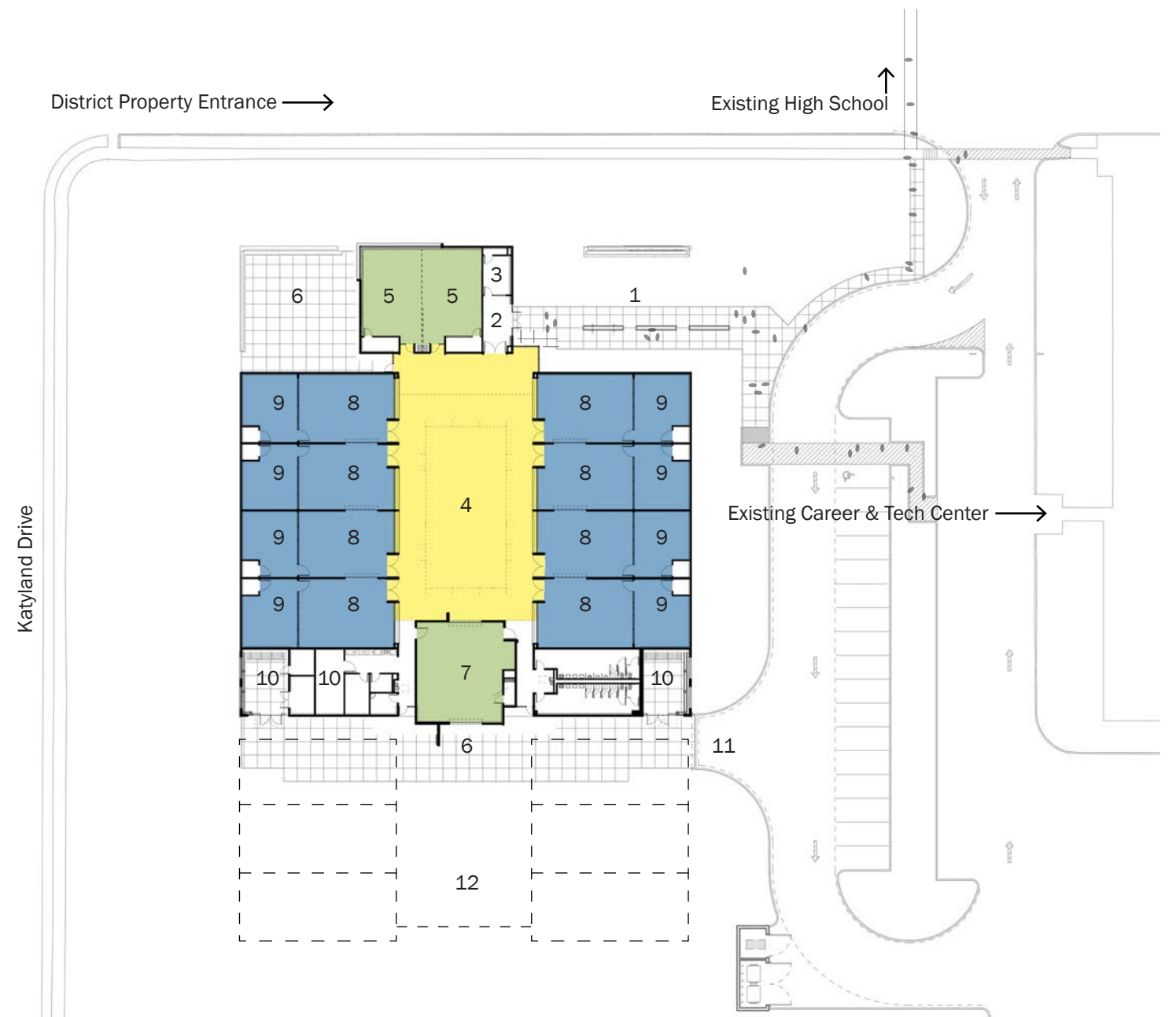
 VISUAL CONNECTIVITY

 PHYSICAL CONNECTIVITY



 PHYSICAL CONNECTIVITY

 VISUAL CONNECTIVITY



Site Plan + Floor Plan



- 1** Entry Plaza
- 2** Main Entry
- 3** Admin
- 4** High-Bay
- 5** Multi-Purpose
- 6** Work Yard
- 7** Shared Shop
- 8** Project Bay
- 9** Project Shop
- 10** Support
- 11** Loading
- 12** Future Expansion

Because many of the projects are completed on nights and weekends, and also due to community use, the facility is designed to provide safe after hours access with ample, energy-efficient artificial light both inside and surrounding the facility. At night, the strategic placement of glazing provides tempting glimpses of the magical activities occurring within.

Through experiments, workshops, teacher training and development, competitions, and camps, students have a chance to learn new things beyond the scope of a normal classroom — **perfectly supporting the curriculum set forth by the district.**



ConocoPhillips  
MYKE

at the whiteboard  
Green Science, The 11 months  
Power, Time & Water  
High Tech  
- Turb - Gravity  
- Gravity  
- Gravity  
12) Upper case / Corros  
1) Pump  
4) Inlet pump

CINCO RANCHO  
NATY. TX  
OCEANERING

NSHSS



## PHYSICAL ENVIRONMENT

The exterior of this one-story facility presents an architectural vernacular that is unlike any other facility in Katy ISD, one that reflects the exciting, progressive, cutting edge activities happening inside. The corrugated steel siding and simple massing denotes a contemporary, technological, engineering based environment with a connection to both natural and physical science. It sparks excitement and curiosity about what is happening inside.

In keeping with the primary objective of flexibility, the facility is situated on the site to enable expansion in the future, as well as provide outdoor plaza areas equipped with power and wireless access. The simple space organization, and the points of physical and visual connection between the major spaces enable projects of any size to be completed in the facility. From a robot to a large solar car, anything is possible thanks to this flexible facility.

The STEAM Center environment is one of creativity and inspiration. From the moment you walk in the door you see spaces filled with natural light. The fenestration design allows for the capture of direct and indirect natural light throughout the facility. Writable wall surfaces are integrated into all major spaces, including the high-bay space, project bays and flexible classrooms, inviting brainstorming and creativity during all project phases. High transparency and visual connections between the spaces inspire

interest and collaboration between different user groups. Technology is also integrated to promote communication within the facility, outside its walls, and beyond. A large video array in the high-bay space enables large presentations, live broadcasting, and video conferencing. Students from each of the district's high schools can easily communicate with a professor from across the country, or other students from around the world. Interactive technology walls in the meeting room/classroom further inspire creativity.

### Safety First

Operating the facility in a safe and efficient manner, without diminishing the creativity of the space, presented a challenge. Securing building access was a high priority, and since the facility was going to be used beyond the regular hours of the school day, access had to be well designed and easily monitored. The center was equipped with a card entry system for both exterior and interior doors. This system provides direct control over who enters the building and who enters each work bay. For instance, if a group of students will be working in a particular project bay for a pre-determined length of time, the district can grant them access to the main entry of the building, and their assigned work bay for that period of time. They would not be able to gain access to other project bays unless prior arrangements had been made with the district. The Raptor system at the front desk was installed to do background checks on non-district

adults who use the building. Security cameras were also installed at exterior entry points and inside of work bays. The safety of students is of the utmost importance, therefore, a Katy ISD employee is present anytime a student is scheduled in the facility, day or night.

Transparency throughout the facility provides added safety for students by enabling adults to monitor the activities, including the use of the tools and equipment in the building. It also sparks collaboration and fosters mentorship between groups of students engaged in their work.

### Serving the Community

Due to the broad range of activities occurring within the facility, it has the ability to serve thousands in the community. It also provides a platform for local businesses to contribute to the education of Katy ISD students through communication, mentorship and sponsorship. It's central location, shared by the district stadium and two other existing learning facilities, further reinforces its accessibility to the district and larger community.

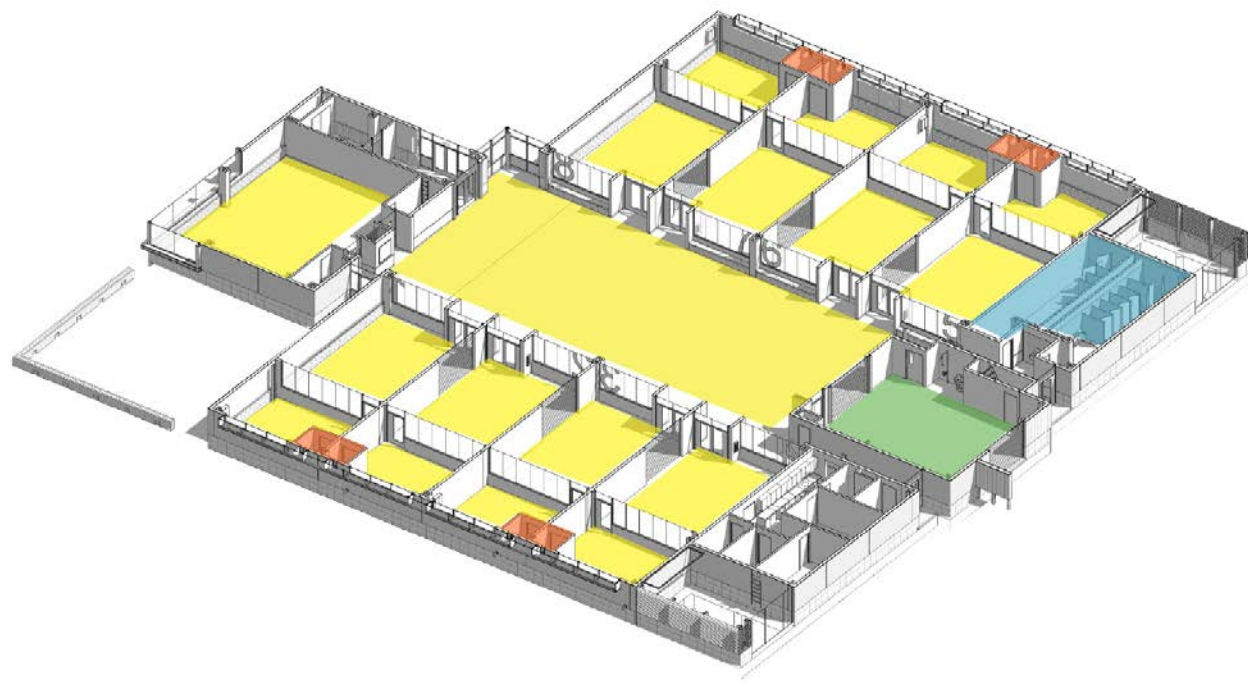
Over 900 Katy ISD students took part in the forensic science field trips and were taken through fingerprint analysis, interview and interrogation strategies, arson investigation, and a tour of the Fort Bend County

Sherrif's mobile command stations. The facility also hosted the Young Inventors Showcase for students in third through eighth grade. **"The students brought invention-based projects to be judged through the Young Inventors Association of America, and our first-, second-, and third-place students qualified for the regional competition in Houston, where they had a chance to win a patent with their name on it,"** says Mariam Manuel, instructional specialist for the Shaw STEAM Center.



**"Walking into this *imagination and innovation* facility, you see the expanse of open space, the integrated technology, the specialized equipment, and the visual connectivity. It gives those who have the creative bug an opportunity to imagine endless possibilities... it is magical."**

— Mr. Alton Frailey, Katy ISD, Superintendent



**ENERGY**

- » Individual HVAC control of rooms enable energy use reduction when not all rooms are in use
- » District staff trained in energy efficient systems

**LEADERSHIP, EDUCATION, INNOVATION**

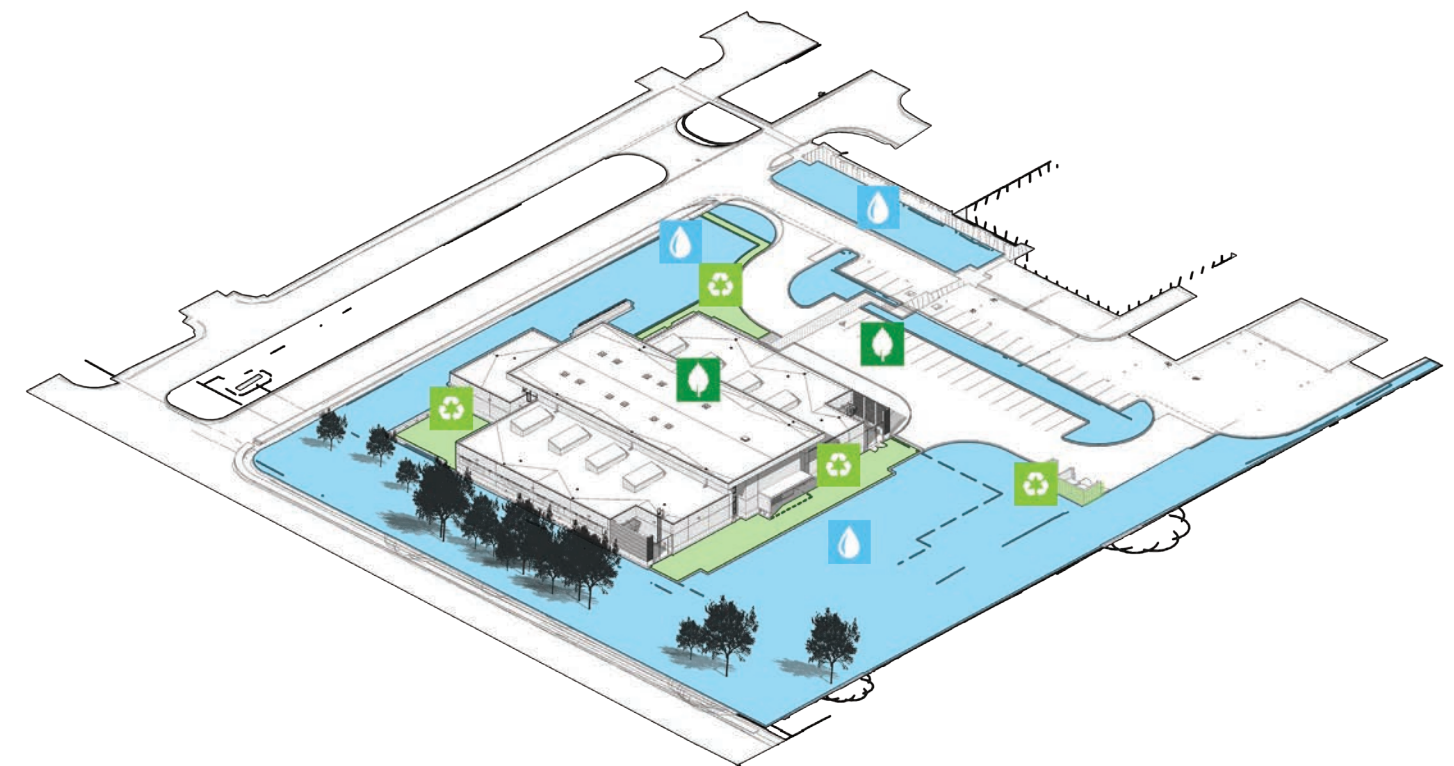
- » Several integrated design team meetings were held to discuss and implement high performance design features
- » Facility utilized 50% of time by community
- » Facility is teaching tool for sustainability

**INDOOR ENVIRONMENTAL QUALITY**

- » Visual connection to the outdoors in each bay and shop area
- » High efficiency lighting works with natural daylight to improve the quality of light at a minimal energy consumption
- » All facility lighting is high efficiency LED
- » Low emitting paints and coatings
- » Separate exhaust systems control the individual bays

**WATER**

- » Water efficient fixtures used throughout the facility reduced potable water use by 30% + sewage conveyance by 30%



The STEAM Center also exemplifies stewardship in sustainability. It has been recognized under the TX CHPS (Collaborative for High Performing Schools) Designed rating system and sets a good example for its users. When you first enter the facility, you are welcomed by a display that outlines and illustrates the sustainable design features of the project. This compact facility is equipped with an HVAC system that is zoned to enable each of the project bays to be controlled separately, increasing efficiency. Large, high-velocity fans are placed in the high-bay space

to increase user comfort and reduce cooling loads. Natural lighting is utilized throughout the building through solatubes in the high-bay space, as well as light monitors in each project bay. Control of energy in rooms, efficient water fixtures, LED lighting and a reflective cool roof are just a few of the sustainable design elements. These elements, along with the use of highly durable materials, minimize maintenance costs and will help to ensure the longevity and vitality of this facility for years to come.

**SUSTAINABLE SITE**

- » Minimal parking to promote carpooling
- » Storm-water management
- » White reflective cool roof
- » A joint use facility integrates the community

**WATER**

- » A water management system and native water efficient plants led to a 55% water use reduction for irrigation

**MATERIAL & WASTE MANAGEMENT**

- » Concrete flooring used throughout the facility is highly durable, low maintenance, and will last the lifetime of the building
- » Storage and collection of recycling
- » Diverted 93%, or 194.5 tons, of construction waste from landfill through recycling

**“The design team rose to the challenge of creating a world-class space on a tight budget that provides a modern, technology-rich space that is flexible to respond to the changing needs of the district as the science, technology, engineering, art and mathematics curriculum is modified over time.”**

**— Mr. Alton Frailey, Katy ISD, Superintendent**





## RESULTS OF THE PROJECT

The community planning committee set the expectation for this facility to not only support STEAM activities in the district, but also ignite and support activities that hadn't even been imagined yet. Shortly after opening, it became clear that this goal was achieved. In just the first three months of operation, the Center hosted over 2,000 students from across the district. A quick glance through the list of events occurring at the Shaw Center demonstrate its remarkable flexibility. From large field trips and various classroom learning experiences, to summer camps, robotics construction and practice, science movie nights, family science nights, staff development, formal banquets, and large scale crime scenes, the flexibility of the space afforded hands-on learning with STEAM activities.

The building was also planned to foster collaboration and innovation. Its transparency, simplicity and flexibility have provided an environment for students, teachers and mentors to collaborate across disciplines to create new and exciting opportunities for discovery. According to Dr. Martin, **“This building ties to every discipline of study and ties to every type of learning that is happening within the district. Space is not bound by one particular discipline and in fact**

**encourages overlap between disciplines. Therefore it is the most successful learning space in the district.”**

The environment created by the STEAM Center has empowered students to be mentors, thus taking a more active role in their education. For example, the district has seen the dynamics of the robotics groups change since the facility opened. First, the more experienced robotics teams have taken the new teams under their wings to become active mentors and help push them towards success. In addition, while each team previously identified themselves exclusively with their home high school, they now refer to themselves as the collective “Katy ISD Robotics Team.”

The school district wanted a place that was truly a district-wide incubator for STEAM. They wanted the facility to be in a central location, offer flexibility for various uses, and encourage an interest in STEAM-related activities and careers. This vision has been achieved. So far, nearly 5,000 students have visited the facility within the past 1 ½ years, and these numbers are expected to increase each year as more events and field trips take place. This helps the district broaden their reach within the educational community

by encouraging collaboration with other educational institutions to bring more opportunities to the Katy ISD students. STEAM also partners with Rice University’s Civic Scientist program, and the University of Houston on workshops. Additionally, the center offers field trips for students and professional development sessions for Katy ISD teachers.

From its opening in February 2015, the STEAM Center has reached thousands of students and community members. During the spring semester the building was in use seven days a week closing at 10 PM during the week and midnight or later on the weekends. Robotics teams use the building to build world class robots, winning competitions in Houston, Dallas and Salt Lake City. Teachers brought classes to the Center to complete projects such as building a sound cannon, catapults, a hovercraft, and creating life-sized games for children in need. A world class forensic event was hosted where every student in the district, enrolled in Forensic Science, came to the building and participated in solving a simulated crime in a simulated environment. A local sheriff’s department

provided multiple experts to guide students through the process of discovery, inquiry, information processing, and communication.

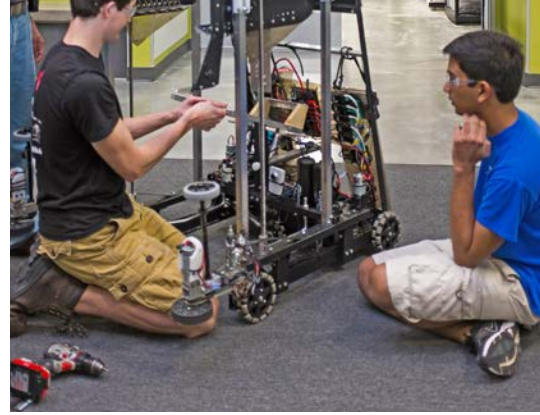
The building has been used for events, professional development, competitions, and science summer camps. Two examples are the Young Inventors Science competition and the Family STEAM Night. The Young Inventors competition involved students bringing their inventions to the center to be judged in a national competition. A summer camp was held to help students prepare for this contest. The Family STEAM Night had 340 students and their families participate in a variety of science activities ranging from a Rice University presentation on the neuroscience behind optical illusions, to investigating chemical reactions to building prototypes of bridge structures.

The potential of the building is only beginning to be realized and is as unlimited as the creativity of the students who use it. This Center has been, and will continue to be a success for the entire community it serves!

**“All 5 KISD teams spent a considerable amount of time prototyping, building, testing this robots, and best of all, practicing with their robots! The collaborations between the teams was amazing this year. If someone needed parts or advice, help was never more than a few steps away.”**

— Lana Henderson, Cryptonite Robotics Team Mentor







**Robert R. Shaw Center**

Science, Technology, Engineering, Arts, and Mathematics  
Katy Independent School District