# TURMC

THE UNIVERSITY OF TULSA'S

# ROBOTIC MINING CREW

# Sponsorship Proposal

## 2018-2019

rmc.utulsa.edu
nasa-rmc-team@utulsa.edu
(405) 259-4522

THE UNIVERSITY of TULSA

TURMC

## Dear Potential Sponsor,

**Thank you** for your interest in sponsoring our team, and for encouraging worthy initiatives and organizations with your financial assistance and time. We believe that your support of TURMC is a wise investment of each.

**Our team is diverse and united –** comprised of freshmen, graduate students, and every level in between from a wide variety of majors, brought together by curiosity, creativity, diligence and fascination with 21st century technologies.

**Our team is passionate and focused** - thrilled to work under the guidance of NASA scientists and engineers and determined to hold our own in competition against formidable, well-established opponents from major universities.

**Our team is grateful and grounded** - giving back to our community through science and technology outreach to Tulsa area K-12 students and building solutions for children with learning disabilities at Little Light House.

**We welcome your help** in strengthening interdisciplinary cooperation, enriching the academic ecosystem, and elevating opportunities for students and faculty at our alma mater, *The University of Tulsa*. Your partnership is a catalyst for the growth of our members into professionals prepared to build the future wherever they go.

**Thank you** for your consideration, and please feel free to visit our website at rmc.utulsa.edu and to reach out with questions to nasa-rmc-team@utulsa.edu.

Sincerely,

Dallas Elleman
TURMC Vice President

## TEAM MISSION

**In our second year** at The University of Tulsa, TURMC's primary mission is to build on the success of last year's team efforts to design, fabricate, and integrate a fully autonomous robot that can compete at a high level against other well-established universities at the 2019 NASA Robotic Mining Competition (RMC).

**To compete**, we have to raise funds, not only to purchase the parts and materials to create a complex robotic system to execute a simulated resource mining operation, but also to travel to NASA's Kennedy Space Center in Florida and provide accommodations for our team from May 6-10.


*(above) Jack Drummond, an EE Sophomore, and Carson Ellsworth, a CS Sophomore, showing off a prototype mining system for the 2019 robot.*

**A major** component of NASA's RMC is community outreach. We are sharing our passion for science and innovation with Tulsa area K-12 students, inspiring future engineers and creating robotic toys customized for sensory development in children with learning disabilities. Our current outreach activities include work with The Little Light House, Booker T Washington's FIRST Robotics team, the Society of Hispanic Professional Engineers, and the Girl Scouts of Eastern Oklahoma, among others.

## OUR ROLE AT TU

**Our vision** for the future of TU's Robotic Mining Crew is that it grows to become a huge part of TU's identity and culture. There are many valuable skills and character traits that NASA RMC's activities are ideal for developing: teamwork, leadership, system design, communication, creativity, engineering analysis, prototyping and fabrication to name a few! We see in TURMC a golden opportunity to forge an enduring tradition for the ongoing benefit of students who will study at The University of Tulsa long after each member of this year's team have moved on.

## HOW YOU CAN HELP

Our passion, inventiveness, and hard work can take us far, but we need your financial support to complete this journey. Please consider sponsoring our team at one of the following levels as you read further about our team, our purpose, and our accomplishments.

**Spirit**…..…....…..$100 - $999
**Sojourner**……....$1000 - $2499
**Opportunity**……..$2500 - $4999
**Curiosity**…….....$5000+

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# >>SPACE MINING

The search for precious metals, water, and hydrocarbons will eventually shift from beneath the Earth's surface to beyond its orbit. Companies are already making plans to mine mountain-sized asteroids hurtling through space. NASA wants to help our nation's future workforce build the skills needed for robotic off-world mining and contribute to our nation's space vision, securing our place as leaders in a new resource based space economy. In response to this need and opportunity, NASA established an annual Robotic Mining Competition (RMC) for university teams in 2010. In the competition, teams create robots to mine, transport, and deposit soil samples, imitating a real space mining situation.

## Why Mars?

**NASA Rovers and Satellites** have detected large deposits of water, ice, and hydrated minerals on Mars - water that could be used for human consumption, hygiene, growing plants, radiation shielding, and making rocket propellant for the journey home. Almost all water on Mars today exists as ice, though it also exists in small quantities as vapor in the atmosphere and occasionally as low-volume liquid brines in shallow Martian soil. Capturing this water "in situ" (on site) is the key to allow humans to "live off the land" and is essential for sustainable human colonization and exploration of Mars and the rest of our solar system.

## NASA Robotic Mining Competition


**In NASA's Robotic Mining Competition,** teams design and build a robot that can traverse challenging simulated off-world terrain. During operation, the robot has to travel to the mining site, dig below a surface layer of martian rock/sand simulant, and excavate subsurface gravel. This gravel is then delivered to a collecter trough, where the team is scored on the mass.

There are many complexities of the challenge beyond terrain traversal and sample mining. Past winners of the NASA RMC have programmed their robots to be autonomous, that is to use computer vision to navigate the terrain, and TURMC is working towards building an autonomous robot of our own. While constructing the robot, teams also have to account for NASA's weight and size limitations and ensure that the electronic and mechanical parts are protected from dust and rocks. Energy is also very important, so we will try to limit our power and bandwidth use.

Our team's final score will be determined by both our performance and our overall design. Building, powering, and operating a system of this complexity will require the expertise and cooperation of our whole team.


## The Challenge

We are building a robot capable of completing a simulated Mars resource mining mission at NASA's Kennedy Space Center. In May of 2019, robotics teams from 50 universities will compete to win their share of over $15,000 in prize money and 11 awards. This year will be TU's second attempt to compete against teams like Case Western Reserve University and The University of Alabama which have well-established and funded Robotics programs. **We need your support** to level the playing field and bring TU to the top.

## Main Objectives:

» Build a robot and travel with a team to Kennedy Space Center

» Safely mine and deliver at least 1.0 kg of gravel from the field

» Maintain autonomous control, using remote control if needed

## Bonus Points :

» Minimize Robot's Bandwith

» Reduce Robot Mass

» Low Energy Consumption

» Dust Tolerant Design

» No Dust Projection

## Timeline of Events in 2019 :

| Mar28 | Apr2 | May1 | May7 | May8 |
|---|---|---|---|---|
| Outreach Report due to NASA | Systems Engineering Report | Proof of Life Video Posted | Presentation and Demonstration | RMC Competition |

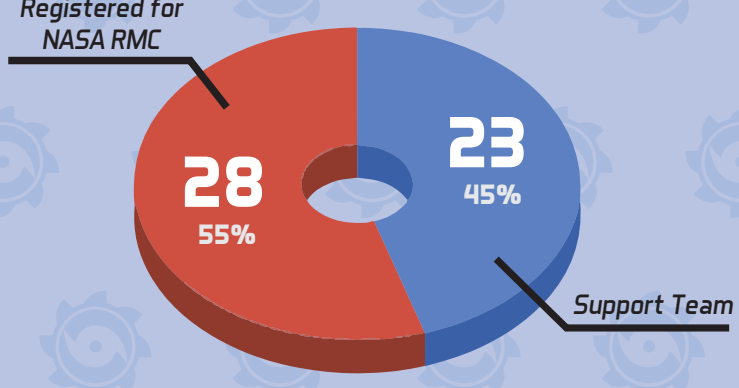
TURMC


## The TURMC Motto

"TURMC is driven by the ambitions and dreams of our diverse membership. We're not just building a clever assembly of wires, motors and gears - we are also creating and nurturing something that we and all students at The University of Tulsa can take pride in: a culture of excellence, creativity, and fun. We work hard, keep our minds open, and never give up. We encourage fearless exploration and creative expression. We discover new talents and sharpen our skills, and patiently support each other in teamwork and collaboration."

***We are TURMC:*** ***Developing leadership, practicing teamwork, and overcoming challenges every day, together.***

## TURMC Team Breakdown




## 51 Students

- (25) Mechanical Engineer
- (11) Computer Science
- (6) Electrical Engineer
- (3) Engineering Physics
- (3) Mathematics
- (3) Petroleum Engineer
- (3) Chemical Engineer
- (1) Geology
- (1) Arts Management

# What's so great about TURMC?

The NASA RMC is an incredible creative outlet for students in fields like CS and Engineering, where creativity is often not practiced in the classroom. Very few organizations on campus offer the cross-disciplinary interaction that TURMC provides and requires. I have made lasting connections and honed important skills in my time with TURMC.

**- Samuel Taylor, Junior**

As a former robotics intern at NASA, TURMC has given me another great outlet to develop skills and talents related to my major, Mechanical Engineering. Whether it's hashing out system performance specifications, creating technical reports, or designing and fabricating hardware, there's always an opportunity to grow and learn from other talented teammates.

**- David Nnaji, Senior**

TURMC is a hands-on escape from the classroom. It's a great opportunity to enrich my studies and apply my knowledge to something bigger: a problem that is literally out of this world!

**- Emily Tran, Sophomore**

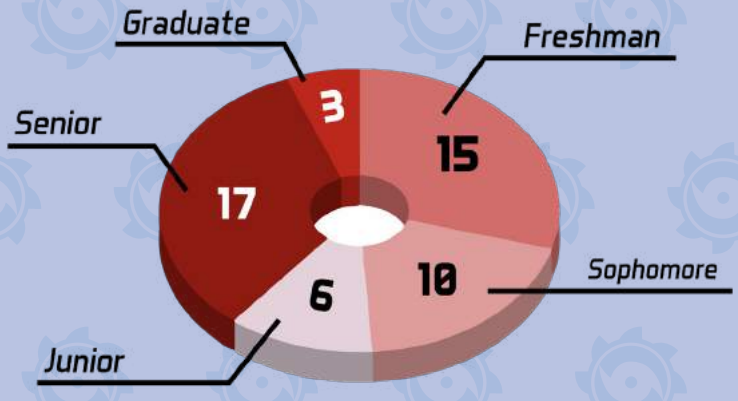
TURMC has really helped me, as a female in a STEM career, experience what it's like to work in a cooperative environment. The fun part about working on this team is collaborating with students from other majors and seeing how different perspectives and ideas can come together to create something great.

**- Alexandra Bejarano, Junior**

TURMC is incredibly important to me because I am able to take abstract concepts from computer science classes and apply the to a physical challenge, as well as think creatively and freely about how to solve complex problems. It has allowed me to enjoy my love for robotics at the university level, with new and amazing friends!

**- Carson Ellsworth, Sophomore**

## TURMC By Year



TURMC

**6** Outreach Events

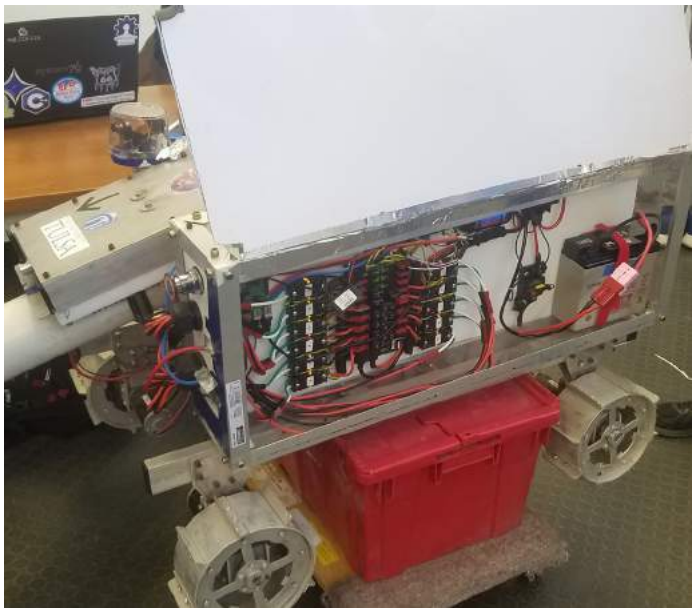
**22** Student Volunteers

**4**

## Mini Maker Faire

Maker Faire is a gathering of people who love to make stuff. Engineers, artists, and scientists of all ages share their projects and make connections. At this year's Maker Faire, the TURMC team set up a table, brought our NASA robot, and connected with kids and adults of all walks, sharing the joy of robotics and sharing academic and career options with young students.

*(right) TURMC Officers Sam Taylor and Emily Tran demonstrating robot basics at the Mini Maker Faire*



## TU STEM$^2$ Fair

Every Fall, TU's Student Team Engaging Minorities in STEM (STEM$^2$) invites junior high and high school students from all over Tulsa to their major outreach event, the STEM Fair. This year TURMC joined in the fun by demonstrating robotics, talking about NASA, and supporting the science and engineering ecosystem at TU. We showed off last year's robot and raised awareness for the team with prospective students.

*(left) Last year's robot, Julie, on display at the STEM$^2$ Fair.*

Robots Created

300+ Tulsa Youth Reached

1 Incredible Community

## Upcoming Events...

**Little Light House -** Tulsa's very own Little Light House (LLH) works to improve the quality of life for children with special needs, their families, and their communities by providing tuition-free educational and therapeutic services to children with special needs ages birth to six. TURMC Mechanical Engineering sophomore Emily Tran's experience working with LLH with another TU org, Make A Difference Engineering at TU (MADE at TU), prepared her to lead the effort to develop and deliver remote-controlled mining robot toys for LLH children this Spring.

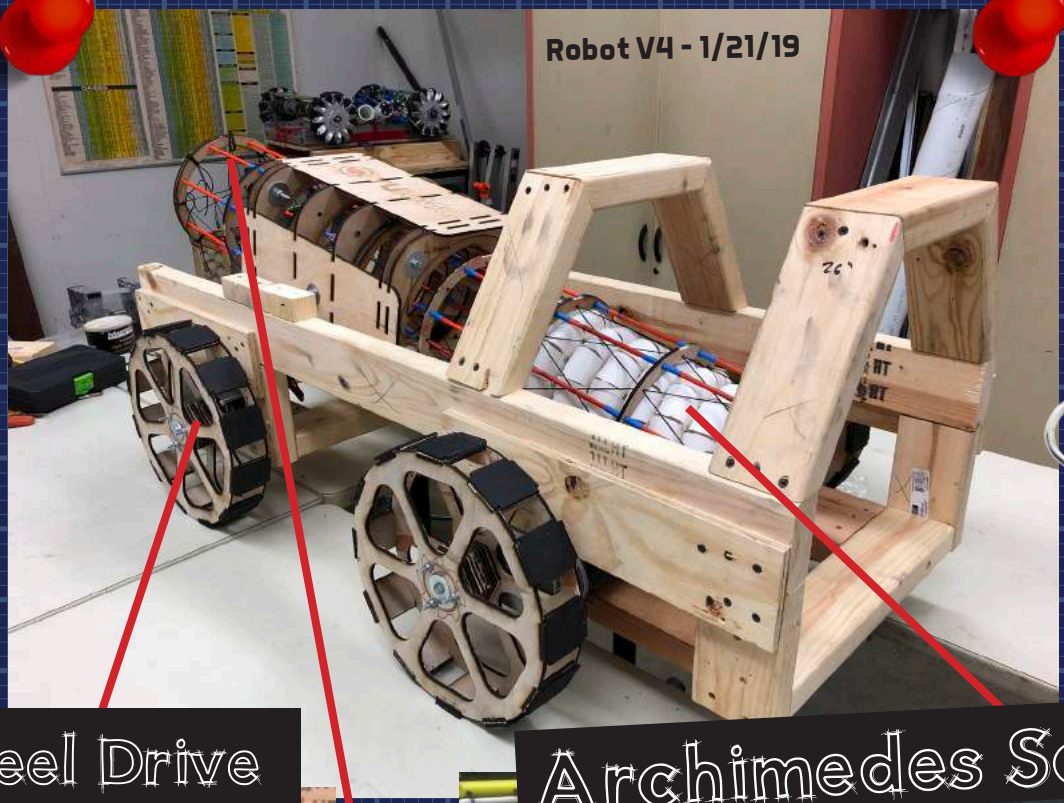
**IEEE Brownie Day -** This Spring TURMC will also join TU's student members of the Institute of Electrical and Electronics Engineers to provide hands-on STEM experiences for Girl Scout Brownie troops on TU's campus. We are designing an activity that involves robotic paper dolls with conductive ink circuits drawn by participants, but we need your support to make it happen!

**SHPE Noche de Ciencias -** For the second year, TURMC will participate in the Noche de Ciencias, hosted by the TU's chapter of the Society of Hispanic Professional Engineers (SHPE). The event focuses on the ever-increasing number of students pursuing their goals in higher education within STEM fields. Last year, high school student teams deconstructed and reassembled drones to learn about their assembly, and TURMC provided support. We look forward to once again joining this fun night to lend our hands to the inspiration of future STEM students.

**FIRST Robotics -** Since many of TURMC's members participated in FIRST Robotics competitions during junior and high school, we are now very excited to mentor Booker T. Washington High School's FIRST team! B.T.W. students have their own dedicated space in our Robotics Lab in Keplinger Hall to work on their projects, as well as access to TURMC tools, members, and faculty.

# TURMC WORKSHOP

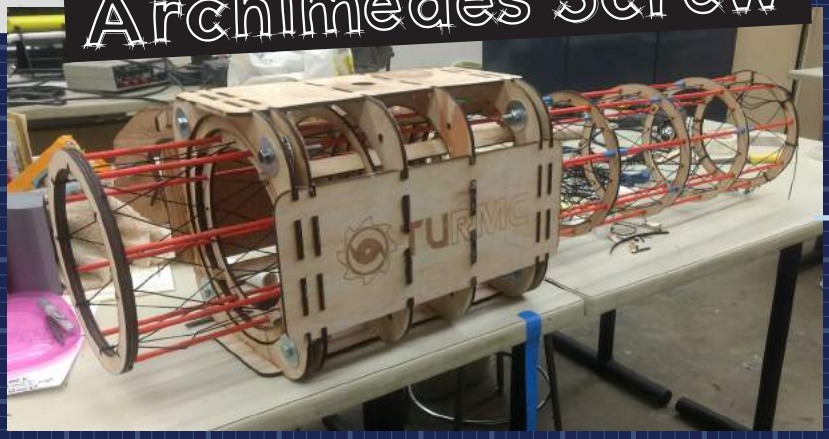
## Robot Prototype




### 4-Wheel Drive

* Tight turn radius
* Improved terrain traversal

### Archimedes Screw



* Independent tilt, rotate, and plunge
* Hollow drill tip guides gravel into elevator

### Filtration, Collection, & Delivery

* Innovative, all-in-one design
* Dust projection control to preserve robot
* *Optimal carrying capacity

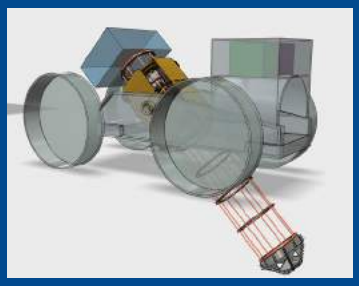
# Concepts & Progress

## Phase 1: Initial Ideas

The first ideas, including a bucket ladder and the Archimedes screw. We used paper and spare parts to quickly craft our ideas.

## Phase 2: Material Experimentation

A more sturdy version of the Archimedes screw was made out of aluminum tube and PVC to test if it could transport gravel.



## Phase 3: Low-Res CAD Modeling

From our physical prototypes, digital models were made to further conceptualize the robot. The Drill tip was added at this step.


(left) ***First Archimedes Screw Prototype 10/17/18*** | (middle) ***Third Prototype 12/8/18***
(right) ***A TURMC member cuts slits for the Archimedes Screw on a saw***

TURMC

# Estimated Budget 2019

Creating a robot and traveling with our team to Kennedy Space Center is very rewarding, but it's also expensive. We need your help to take us the final mile! We plan to save money this year by renting a van and driving down with a small team, and we'll need additional transportation for the rest of the team in Florida. The chart below breaks down our expected budget for this year.

| Estimated Spendings | | Cost |
|---|---|---|
| **Robot** | Raw Stock for Chassis, Wheels, etc. | $800 |
| | Hardware, Connectors | $600 |
| | Motors & Transmissions | $2000 |
| | Fabrication | $600 |
| | Batteries, Distribution, Cameras, Sensors | $1000 |
| | Tools, Tape, Adhesives, etc. | $400 |
| **Room & Board** | Florida Housing (28 students x 5 nights) | $5000 |
| | Food (28 students x $30 x 5 days) | $4200 |
| **Transportation** | **PLAN A: 2–van road trip for 18 students, fly 10 Students** | |
| | Airfare ($250 Round Trip x 10 students) | $2500 |
| | Robot Shipping | $0 |
| | Van Rental + Fuel | $3840 |
| | **TOTAL:** | **$5340** |
| | **PLAN B: 1–van road trip for 8 students, fly 20 Students** | |
| | Airfare ($250 Round Trip x 20 students) | $5000 |
| | Robot Shipping | $0 |
| | Van Rental + Fuel | $3420 |
| | **TOTAL:** | **$8420** |
| | **PLAN C: Rent 3 Vans in Florida, Ship Robot, fly all 28 Students** | |
| | Airfare (28 students @ $250/round trip) | $7000 |
| | Robot Shipping | $1800 |
| | Van Rental + Fuel | $3000 |
| | **TOTAL:** | **$11800** |
| | | **TOTAL** |
| | PLAN A: **$20,940** /PLAN B: **$24,020** /PLAN C: **$27,400** | |

# Sponsorship Levels & Benefits

Please consider supporting our team at the following levels. To make a contribution, please contact Natalie Adams - TU ENS Development Director at natalie-adams@utulsa.edu or call 918-631-3287. To reach a TURMC Officer, contact nasa-rmc-team@utulsa.edu or call 405-259-4522.

## Spirit ($100 - $999)

> TURMC Gear (T-Shirt & Sticker)
> Company Logo on **Website** as **Spirit Sponsor**

## Sojourner ($1000 - $1999)

> TURMC Gear (T-Shirt & Sticker)
> Logo on **Website & T-Shirt** as **Sojourner Sponsor**

## Opportunity ($2000 - $4999)

>TURMC Gear (T-Shirt & Sticker)
> Logo on **Pit Display** @ RMC Competition
> Logo on Website & T-Shirt as a **Opportunity Sponsor**

## Curiosity ($5000+)

> TURMC Gear (T-Shirt & Sticker)
> **Featured Logo** on all TURMC Branding, including Robot, Pit Display, Website, and T-Shirt

**To make a contribution, contact Natalie Adams at natalie-adams@utulsa.edu or call 918-631-3287. To reach a TURMC Officer, contact nasa-rmc-team@utulsa.edu or call 405-259-4522.**

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