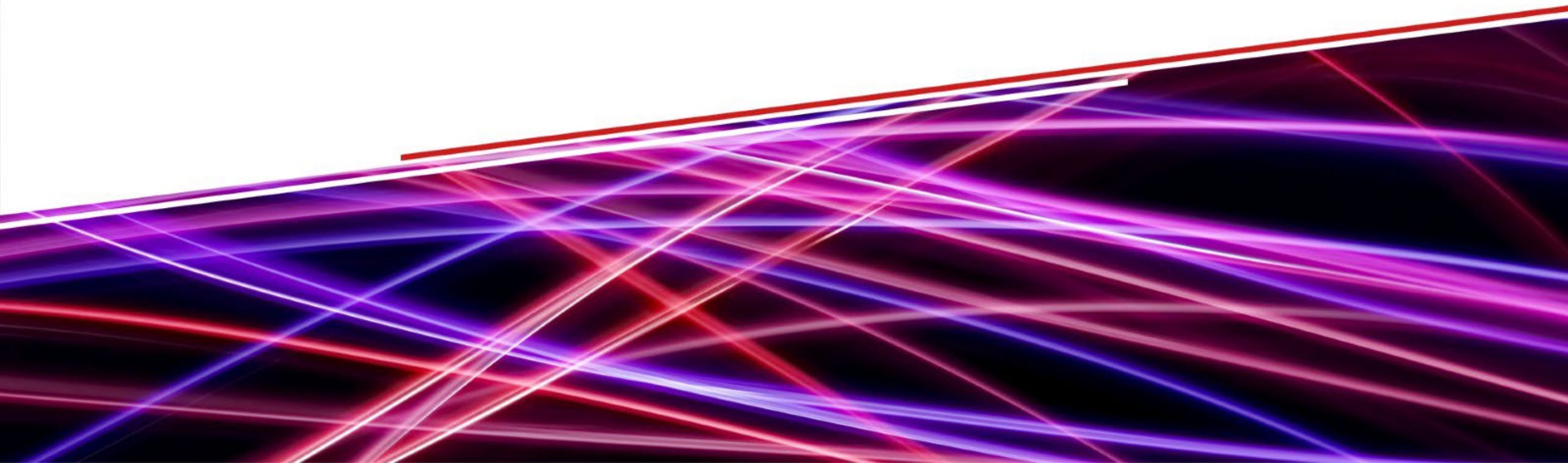
ACE2024

Building a Digital Thread Discipline at Purdue

Travis Fuerst & Sathvik

Tuesday, March 4th, 2024



Introductions

Travis Fuerst

Professor of Practice
Purdue University
School of Engineering Technology
fuerstt@purdue.edu

Sathvik Vudumula

Purdue University
Masters Student
svudumul@purdue.edu

John Koellisch

Major: Digital Enterprise Systems
DSP&T / Quarter Scale Tractor
jkoellis@purdue.edu

Raymond Frazee

Major: Mechanical Engineering
Railside Robotics
rfrazee@purdue.edu

Jorge Varela

Major: Mechatronics Engineering

Purdue IEEE ROV
varela4@purdue.edu

Evan Yoder

Major: Digital Enterprise Systems
Digital Systems Processes & Tools
yoder123@purdue.edu

Manan Singh

Major: Robotics Engineering Technology
Railside Robotics
sing1145@purdue.edu

Industry Advisors & Support

Industry Advisors and Support

SAIC

David Ewing Jr.

Digital Engineering Director
M.B.A. - Krannert
BS – Mechanical Engineering
University of Buffalo / 1998

Jacob Donovan

Digital Engineer
BS – Digital Enterprise Systems
Purdue University / May 2022

Essig

Paul Hanlon

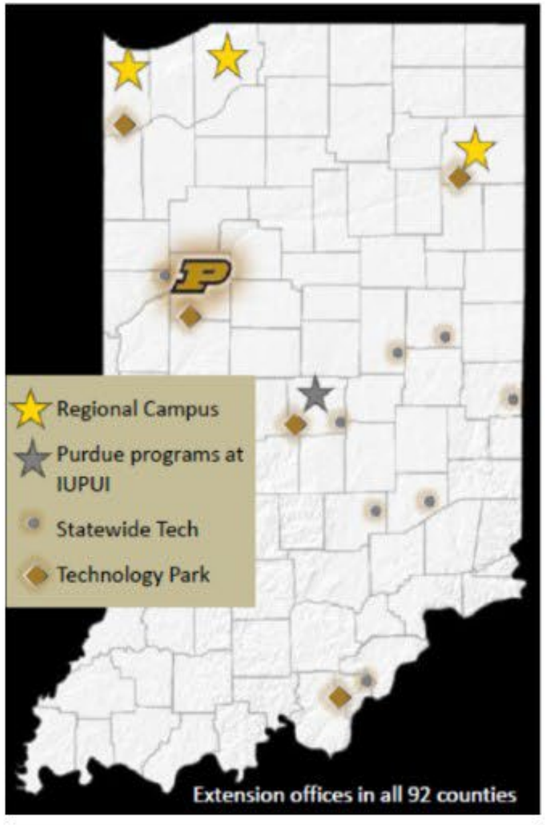
Director of Prod Dev
BS – Computer Science
Northeastern University/ 1986

Hunter Erfman

PLM Consultant
BS – Mechanical Eng Technology
University of Cincinnati

Purdue University

Indiana's Land-Grant University



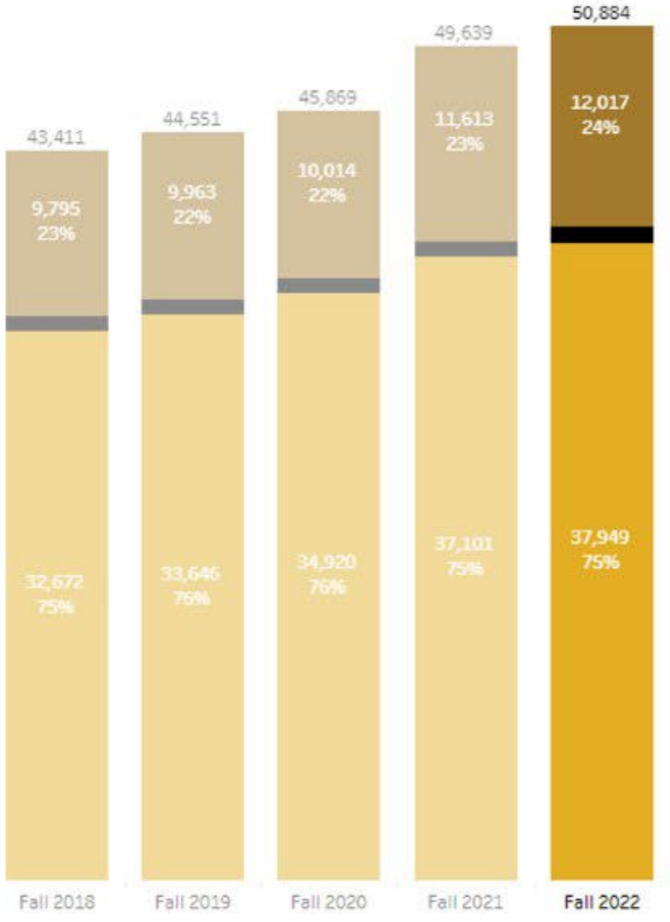
Purdue West Lafayette
Fall 2022 enrollment = 50,884

Undergraduate	37,949
Graduate	12,017
Professional	918

Purdue University Northwest
Fall 2022 enrollment = 8,911

Purdue University Fort Wayne
Fall 2022 enrollment = 9,069

Statewide Technology
Fall 2022 enrollment = 646



Purdue Colleges and Key Units

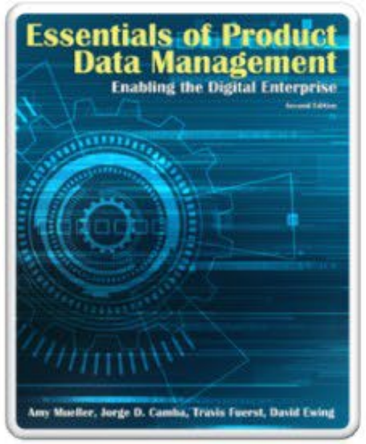
- Agriculture
- Education
- Engineering
- Health & Human Sciences
- Liberal Arts
- Krannert/Management
- Pharmacy
- Science
- **Purdue Polytechnic**
- Veterinary Medicine
- Libraries
- Honors College
- Graduate School

Purdue Polytechnic Institute

Undergraduate Curriculum

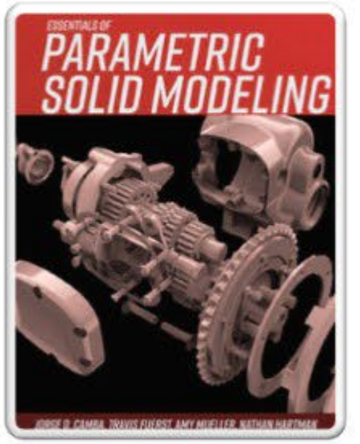
- PDM & Change Management in undergraduate Courses
  - MFET 10301 - Geometric Modeling Applications (~300 Students)
  - MFET 16300 – Graphic Communication & Spatial Analysis (~1200 Students)
  - MFET 11301 – Product Data Management (~30 Students)
  - MFET 20301 – Model Based Definition (~20 Students)
  - MFET 31301 – Business of Managing Product Data (~20 Students)

The CM2 Approach to Change & Config Mgnt

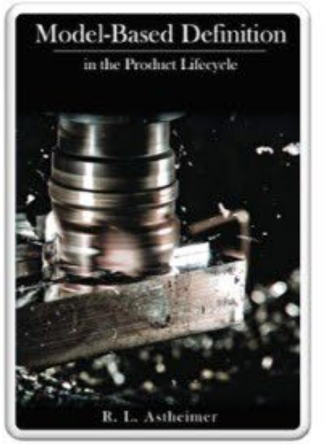


Essentials of PDM

Essentials of Parametric Solid Modeling (NX)



Essentials of Parametric Solid Modeling (SW)



MBD in the Product Lifecycle

Professional Certificates

PLM Certificate

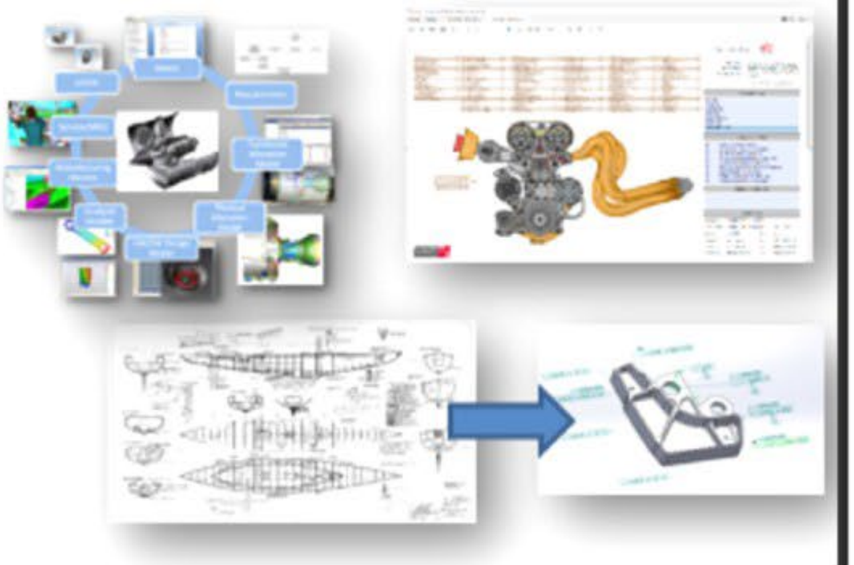
1. Digital Product Definition in PLM Environments
2. Product Data and Configuration Management in PLM Environments
3. PLM Across the Enterprise

MBD Certificate

1. Overview of MBD and PMI
2. Transformation from 2D to 3D Product Data
3. Model-based Data Exchange and Geometry Reuse
4. Guided Practice for Creating MBD

TDP Certificate

1. Introduction to Technical Data Packages
2. 3Di PDF TDP Background & Process
3. Guided Practice
4. The Future



https://polytechnic.purdue.edu/digital-enterprise-center

Educational Research

Research papers

- Fuerst, T., Zhou, J., Graton, S., Rudd, K., Camba, J.D. (2020). **A Case Study on Product Lifecycle Management in SAE (Society of Automotive Engineers) Collegiate Design Teams**. 2020 American Society for Engineering Education (ASEE) Annual Conference & Exposition, Montreal, Quebec, Canada, June 21-24.

- Astheimer, R., Fuerst, T., Camba, J.D. (2020). **Work-In-Progress: Product Data Management to Promote Higher Order Thinking**. IEEE Global Engineering Education Conference (EDUCON 2020). Porto, Portugal, April 27-30.

- Del Re, K. J., Yun, S., Kozikowski, E. J., Fuerst, T. & Camba, J. D. (2019), **Integrating a Product Life-Cycle Management System into a Freshman Level Classroom Environment.** 2019 American Society for Engineering Education (ASEE) Annual Conference & Exposition, Tampa, Florida, June 16-19.

- Mueller, A., Camba, J.D., Hartman, N., Fuerst, T. & Astheimer, R. (2019). **Development and Application of PDM Curriculum in Undergraduate Engineering and Technology Coursework**. 11th International Conference on Engineering and Computer Education, ICECE 2019. Guimarães, Portugal. September 8 -11.

Background

Education

- Successfully deployed Aras Innovator as a Learning Management System (LMS) in five engineering and technology courses at Purdue University (~1,300/semester).

- Design Build teams to implement PDM using Aras Innovator and Essig CAD Connectors and are supported by Digital Enterprise Systems & Tools Club (DSP&T).

- Partnerships with companies like CADENA PART Solutions, ANARK, CAPVIDIDA, Hexagon, ITI, and CAPVIDIA to bring technologies into the classroom.

Course Analytics

Educational Research

Student Club PDM Implementation (Aras Innovator)

Digital Systems Processes & Tools Club

Implement PLM disciplines into Purdue Clubs!

- **Team size:** ~6 Students
  - Recruiting in progress
- **Majors**
  - Digital Enterprise Systems
- **Sub teams**
  - Training
  - Support
  - Documentation
- *"Purdue students to preach the PLM process"*

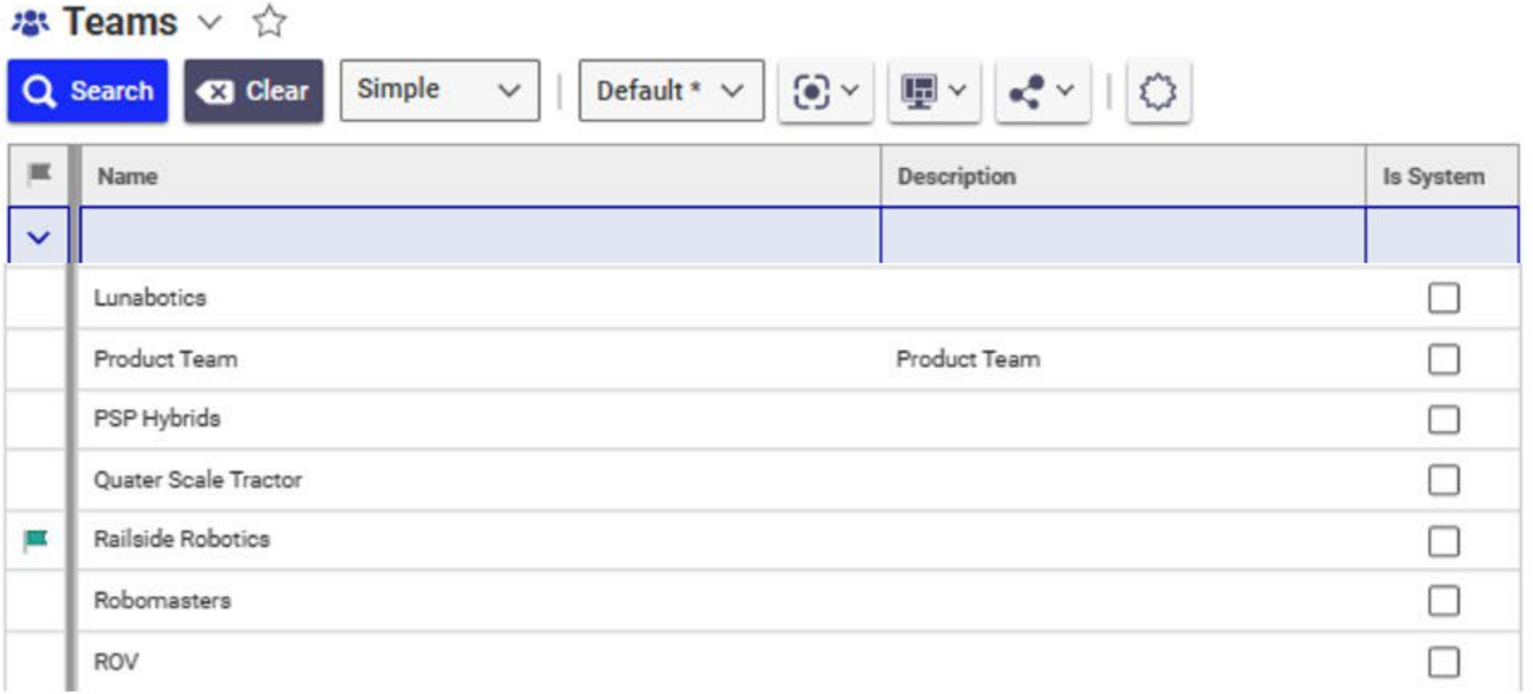
DSP&T

Digital Systems Processes & Tools Club

Our First Semester

- Club initiation
  - Leadership Board
  - Constitution
  - SLA
- Integrated clubs into Aras
  - Enterprise Management
  - Compliance Management
  - Data & Process Integrity

Next Steps…



DSP&T

aras

Essig

SAIC

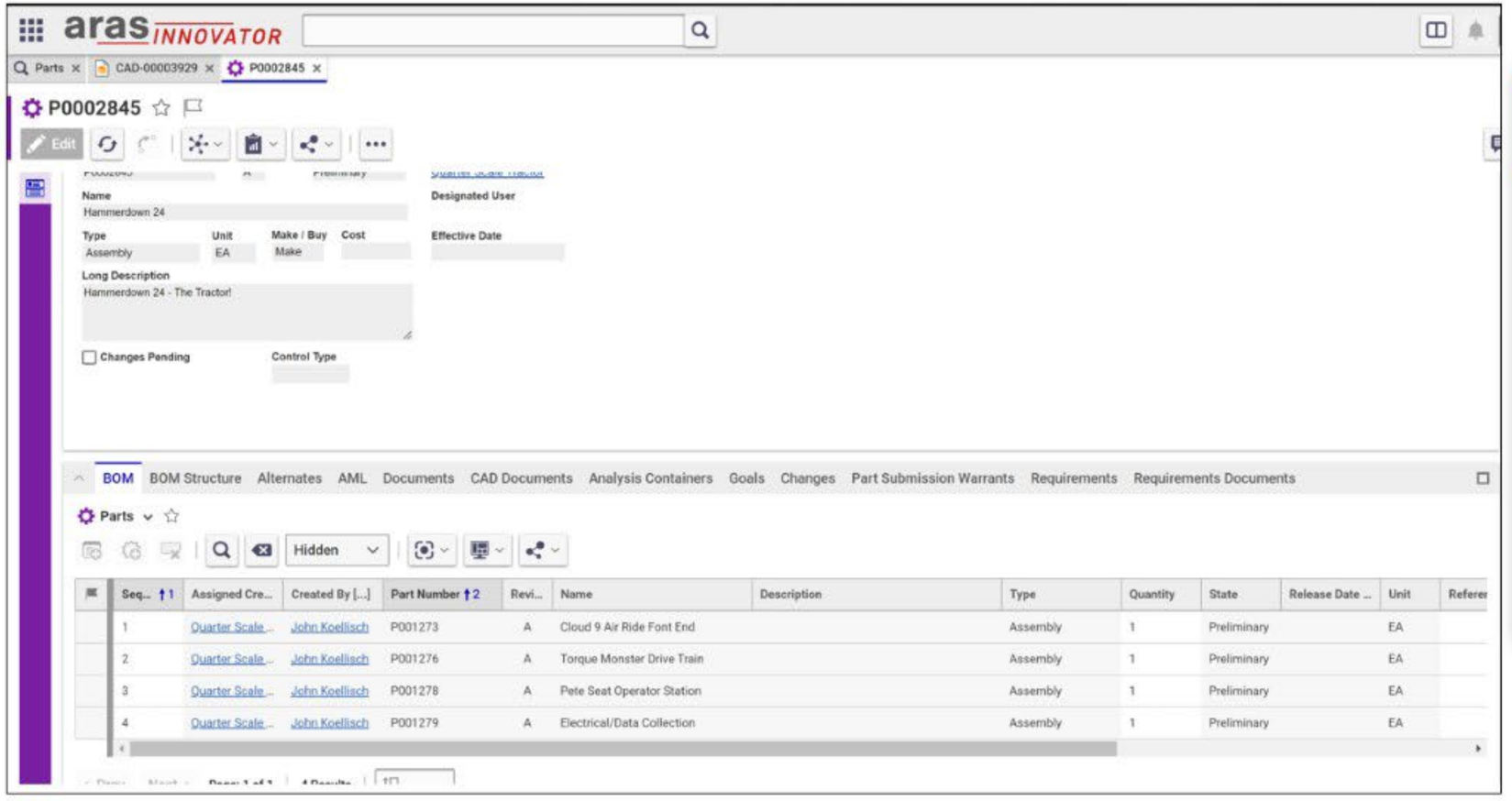
Razorleaf

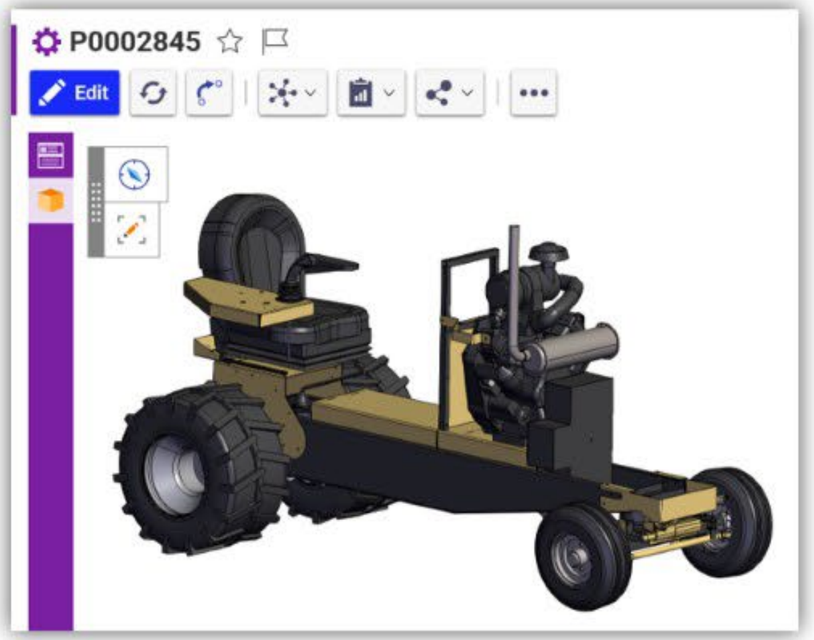
Purdue Pullers - Quarter Scale Tractor

Background

- Team size: 10-15 Students
- Majors
  - Ag Engineering
  - Ag Systems Management
  - Design Systems Management
  - Digital Enterprise Systems
- Competition(s)
  - Three North America events held in June
- Goal
  - Design a tractor that can pull farthest while also being able to turn well, and not fall apart going over large bumps

Product Data Management – Current State





Purdue Pullers - Quarter Scale Tractor

Experiences with Aras

- Ease of report making with cost calculation
- The learning process within the club had been slow
- Speed of Part finding and sharing files

Next Steps

- E-BOM
- CM2

Railside Robotics – Battlebots

Background

- Team size: ~30 Students
- Majors
  - STEM-focused
  - Open to all majors
- Competitions
  - Lots! (~1lb-3lb)
- Goals
  - We build battlebots!

PURDUE UNIVERSITY | Elmore Family School of Electrical and Computer Engineering

Railside Robotics

Railside Robotics - Battlebots

aras INNOVATOR

Parts × | P0001571 × | P0001733 ×

Parts

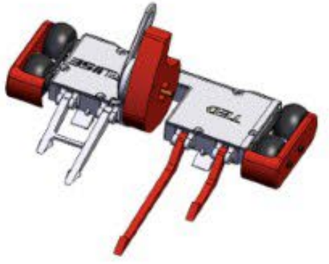
Search | Clear | Simple | Current | Today | Default

Assigned Cre...	Created By [...]	Part Number	Revi...	Name	Description
Railside R...					
Railside Robit...	Manan Singh	P0001553	A	TDCZ-P-0100 Master Sketch	
Railside Robit...	Manan Singh	P0001556	A	FHCS 4-20 X 0.5 LG Plastite	#4 1/2 flathead torx drive plastite screw M.
Railside Robit...	Manan Singh	P0001557	A	BHCS 4-20 X 0.75 LG Plastite	#4 3/4" buttonhead torx drive plastite scre.
Railside Robit...	Manan Singh	P0001558	A	Fingertech Mini BL-HELI 20A Bru...	Fingertech Mini BL-HELI 20A Brushless Sp.
Railside Robit...	Manan Singh	P0001560	A	Malenki Nano	Malenki Nano https://itgresa.com/product.
Railside Robit...	Manan Singh	P0001561	A	Fingertech Mini Power Switch	Fingertech Mini Power Switch https://itgre.
Railside Robit...	Manan Singh	P0001562	A	Fingertech F2822 Motor	Fingertech F2822 Motor https://www.fing...
Railside Robit...	Manan Singh	P0001569	A	TEST-P-0201 Chassis	pdm testing model
Railside Robit...	Brandon Crud...	P0001570	A		
Railside Robit...	Owen Galvin	P0001571	A	BACN-A-0000 TLA	Team Bacon Bad Top Level Assembly
Railside Robit...	Owen Galvin	P0001572	A	BACN-P-0100 Master Sketch	Team Bacon Bad Master Sketch
Railside Robit...	Manan Singh	P0001724	A	TEST-P-0301 Wheel	
Railside Robit...	Manan Singh	P0001725	A	TEST-A-0000 TLA	

Prev | Next | Page: 1 | 25

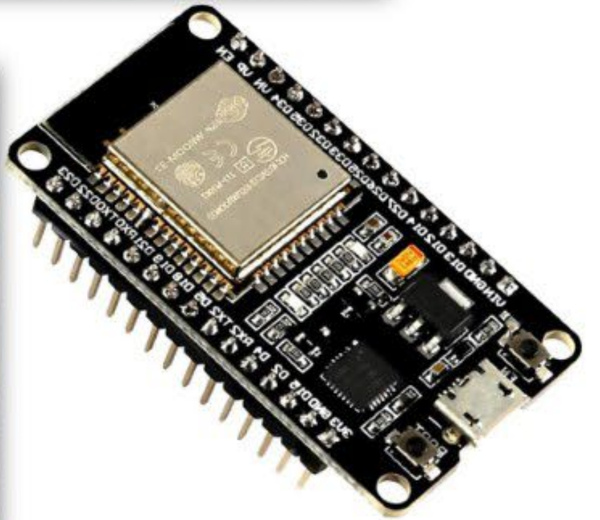
P0001739

P0002522



Product Data Management – Process

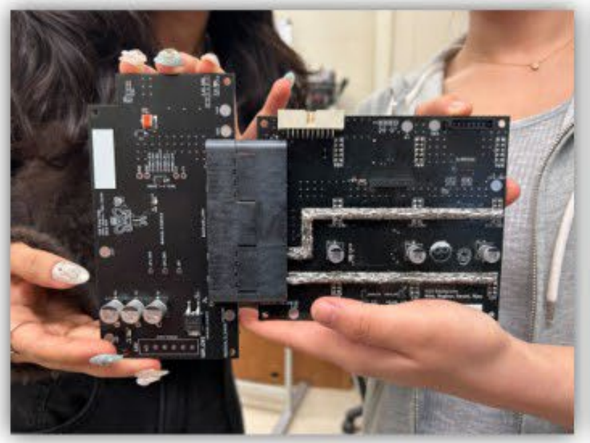
- Current State
  - All Standard/Custom models uploaded to Aras
  - Non-CAD files housed on Google Drive
- Next steps
  - Integrate design reviews with ARAS
  - Utilize product traceability alongside compliance management
  - Use Office Connector and mechatronics management

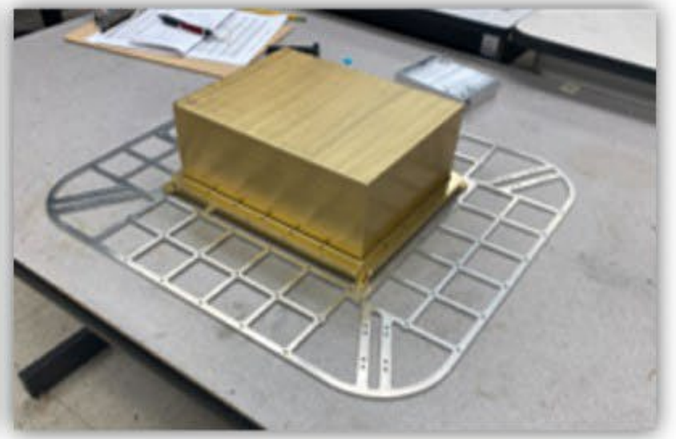


PURDUE IEEE ROV – Submarine Rover

Background

- Missions:
  - Win MATE ROV World Championship
  - To build up new engineers
- Team size: 45 Students
- Sub teams:
  - Mechanical Team
  - Electrical Team
  - Software team

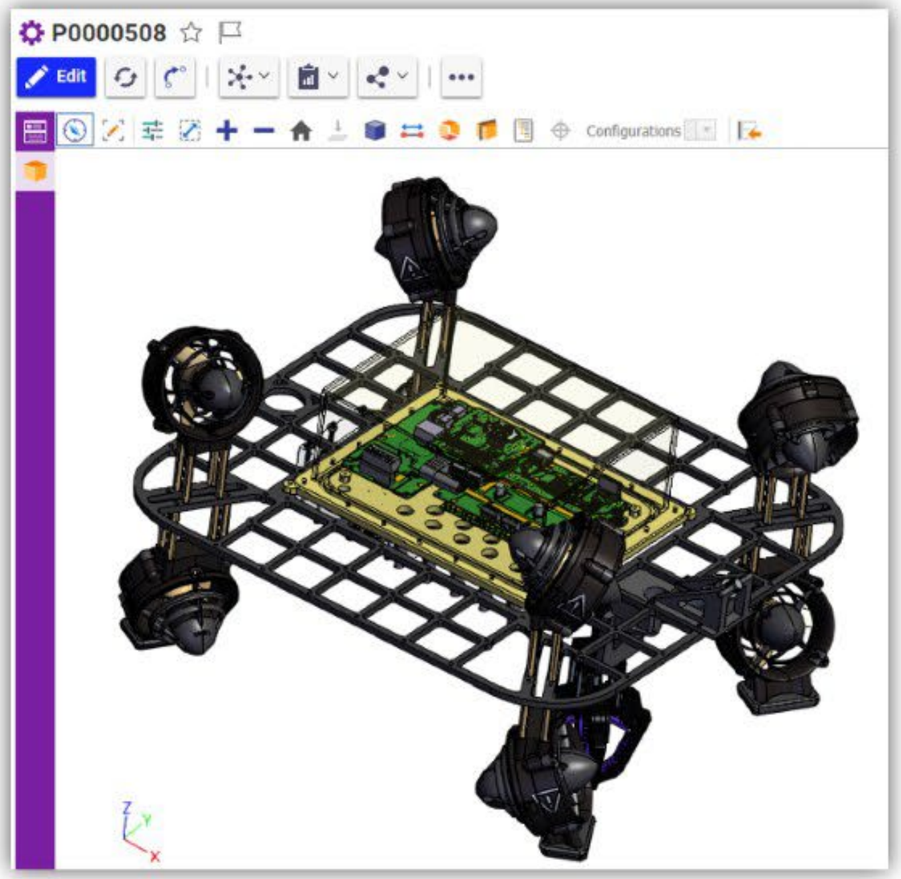




PURDUE ROV X

Product Data Management – Current State

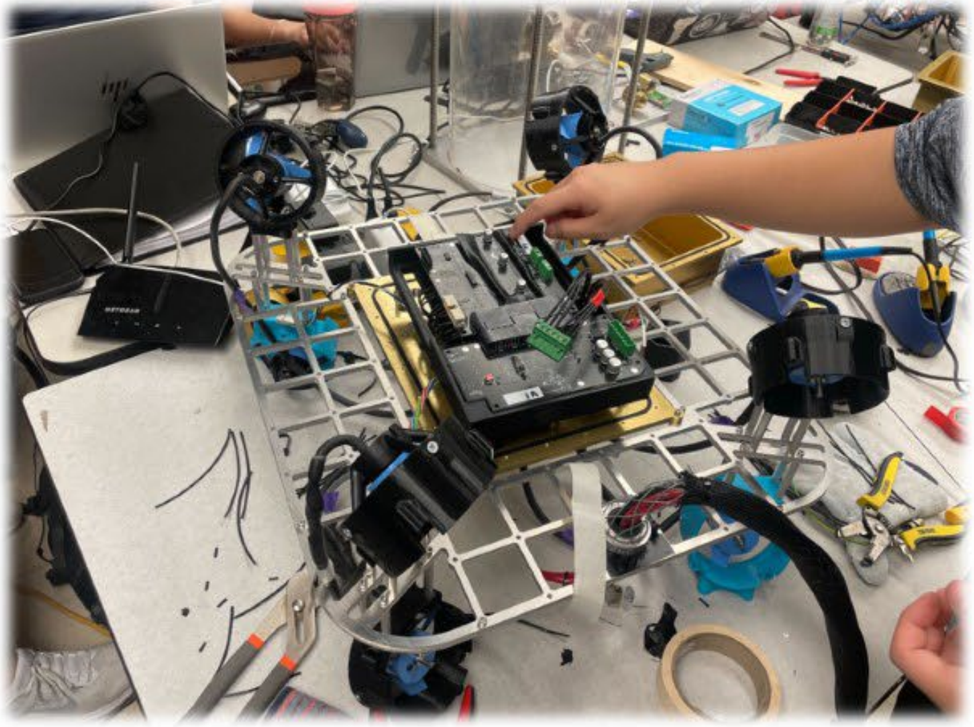
- Aras Innovator platform since November
- Less platform limitations
- Lots of growing pains
  - Transition year
  - Learning curve
  - Fighting for adoption

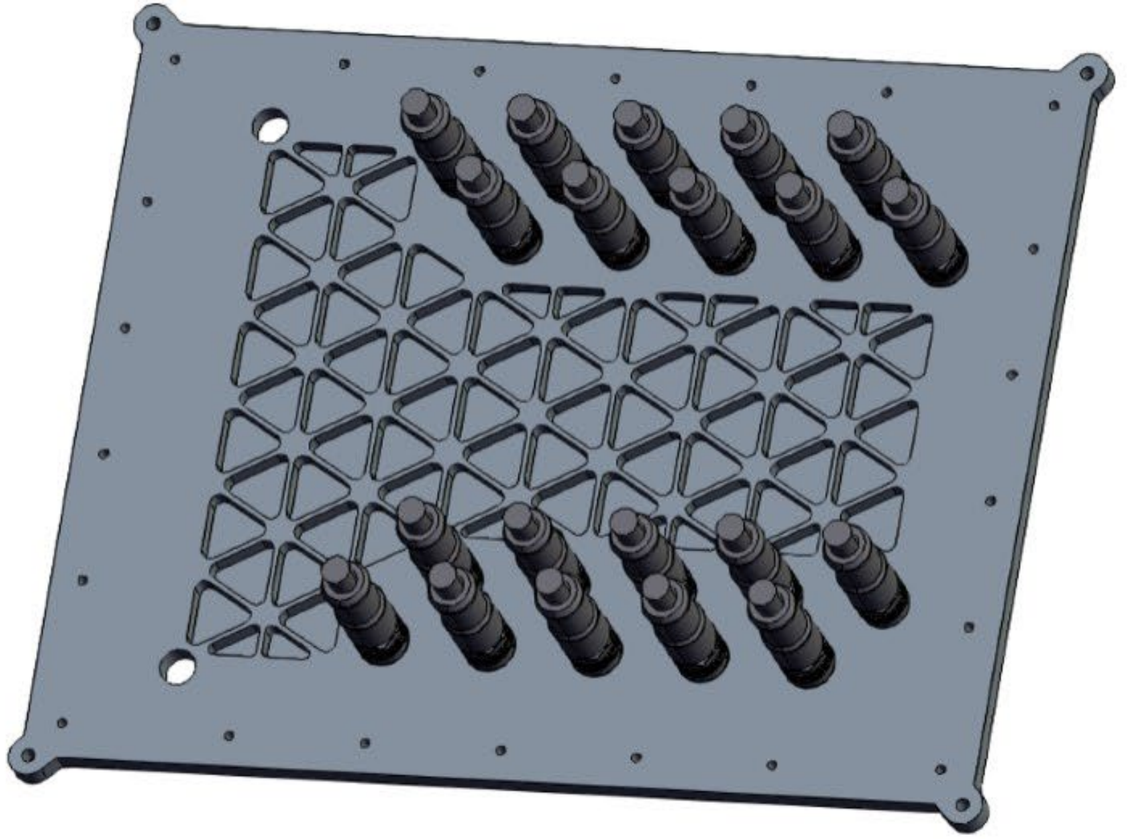


ROV – Submarine Rover

Our goals with Aras Innovator:

- Making Aras *easier to use*
- Improve Data Integrity
- Implementing change management

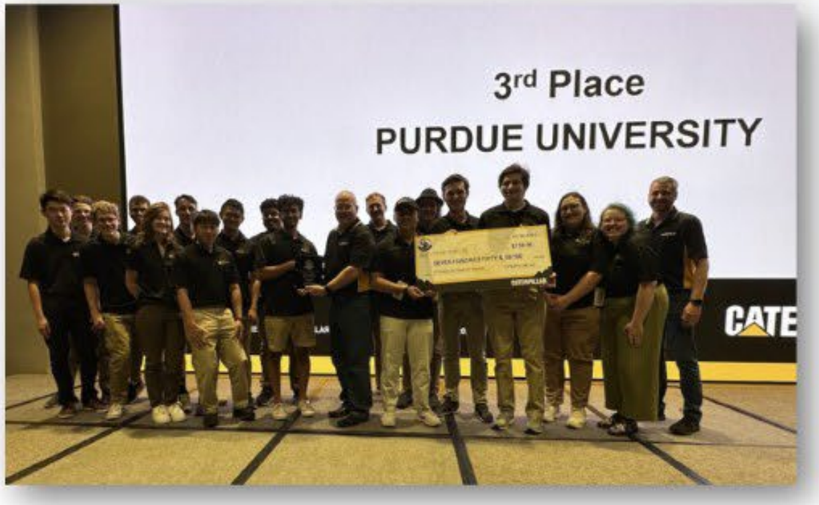




Purdue Lunabotics – Lunar Mining Robot

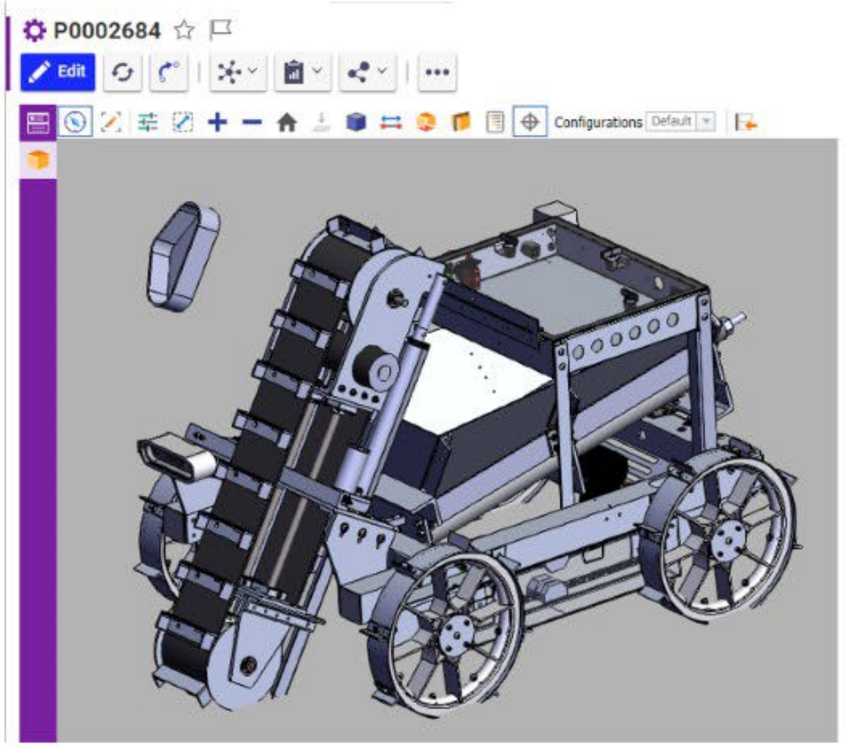
Background

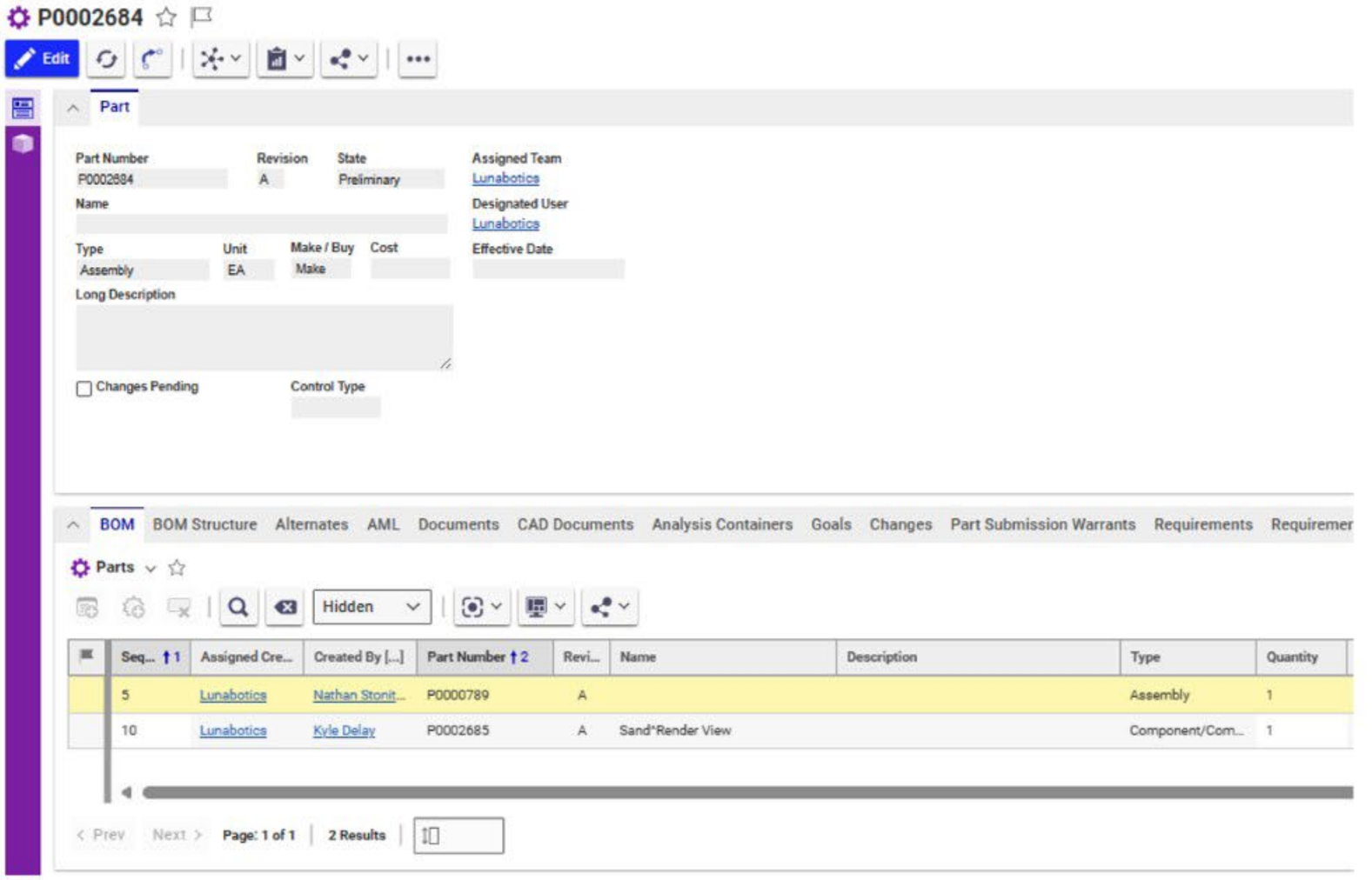
- Team Size
  - 30 – 40 students
- Majors:
  - Engineering and Engineering Tech Majors
  - Computer Science
- Competition:
  - UCF Exolith Lab Qualifiers – May 11th – 14th
  - NASA Kennedy Space Center Finals – May 15th – 18th
- Goal
  - Design and Build an autonomous lunar construction rover



PURDUE™ LUNABOTICS

Purdue Lunabotics – Lunar Mining Robot





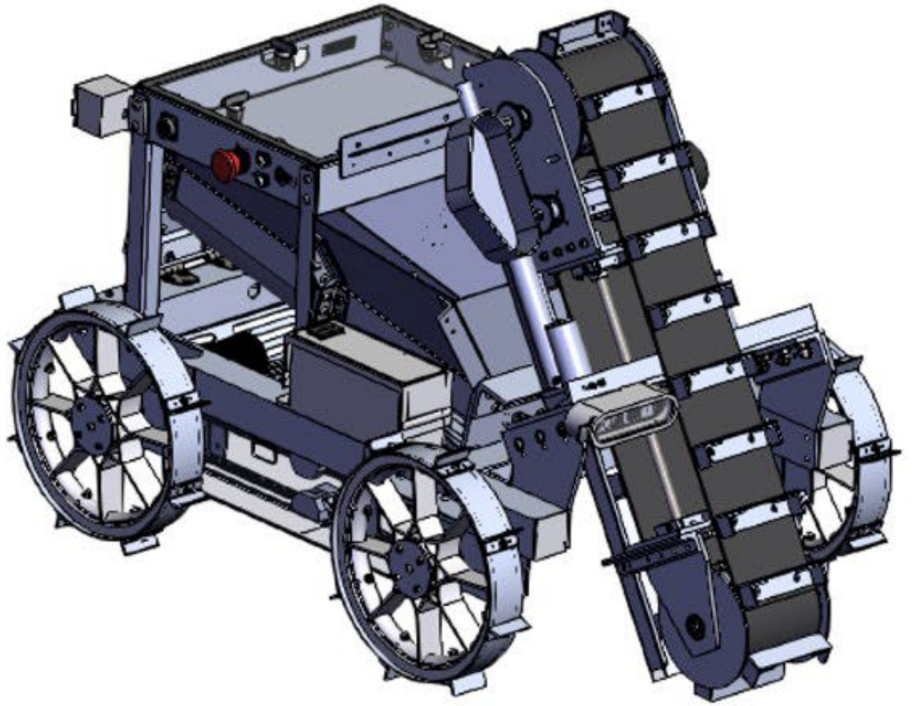
Purdue Lunabotics – Lunar Mining Robot

Experiences with Aras

- Implement better workflows

- Next Steps
  - Legacy Data
  - E-BOM into ARAS

- Quote from Lunabotics Leadership:
  - "Aras has elevated our team's ability to professionally manage our extensive CAD models, facilitating more efficient collaboration and enhancing revision control"

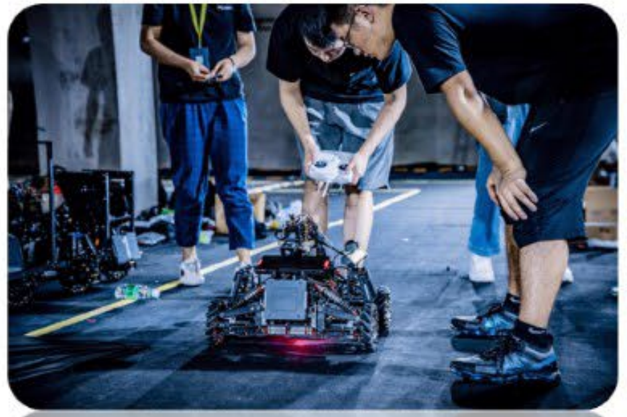


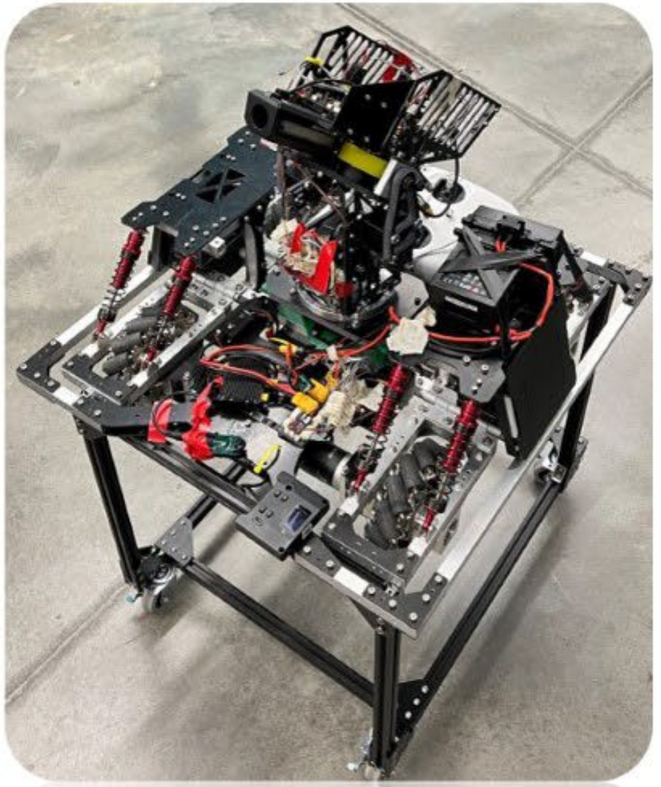
PURDUE™ LUNABOTICS

Purdue RoboMasters – BoilerBots

Background

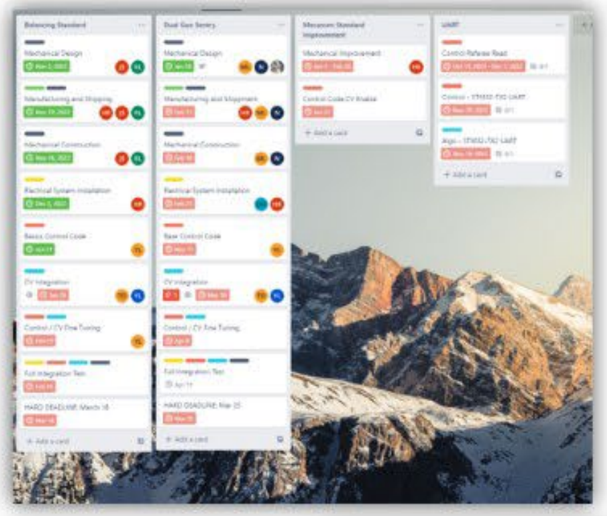
- Team Size: ~ 50 students
- Majors:
  - Engineering and Technology
  - Computer and Data Science
- Competitions
  - Midwest Conference
  - University League Competition
  - University Competition
- Goal
  - Passion for Robotics

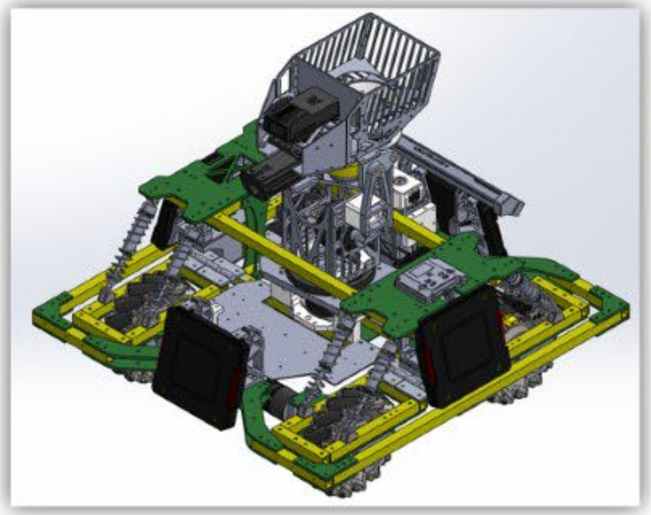


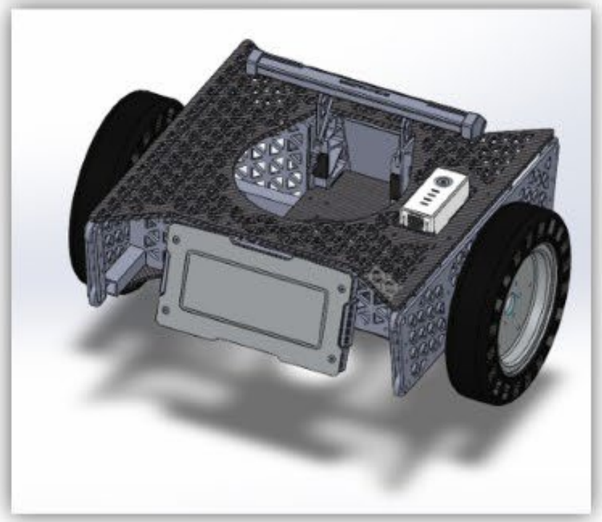


Product Data Management – Current State

- Current State
  - Transitioning to ARAS from Google Drive, Onedrive and file servers
  - Project management via Trello
- Pain Points
  - Data scattered
  - Version control executed via Zip files
  - CAD dependency issues





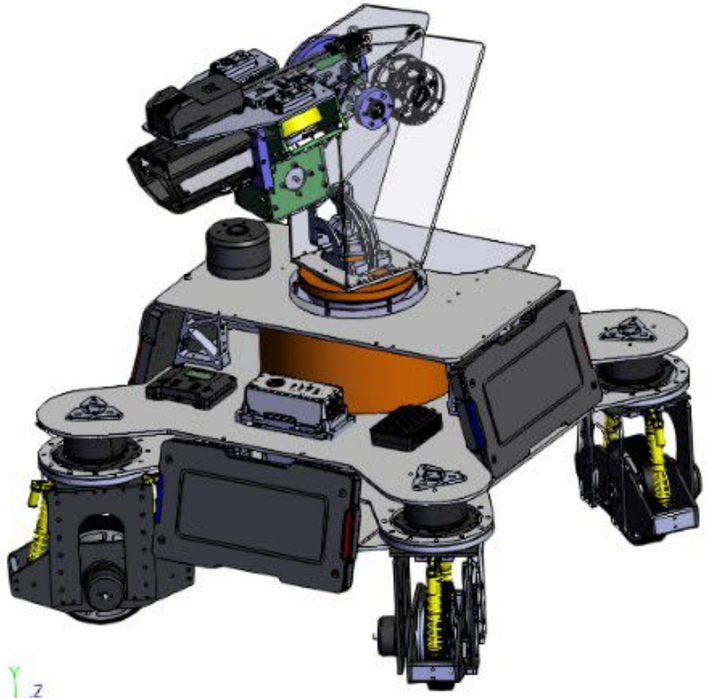


Purdue RoboMasters - BoilerBots

P0002291

Edit

Configurations Default



CAD-00003314

Edit

CAD Document

Document Number	Revision	State
CAD-00003314	A	Preliminary

Name: Hero_Robot

Type	Authoring Tool	Version
Assembly	SolidWorks	2023_3

Description

Assigned Creator: RoboMaster

Designated User

From Template

Changes Pending

Standard

Template

Dynamic Enabled

Streaming Enabled

Native File: CAD-00003066...

Viewable File: CAD-00003066...

Structure | Parents | Files | Changes | Branch

CAD Documents

Hidden

Seque...	Assigned Creator...	Created By [...]	Document Nu...	Revi...	Name	Type	State	Native File [...]	Viewable File [...]	Authoring Tool	State
256	RoboMaster	Jayson Stans...	CAD-00003182	A	Chassis_Assemly_Hero	Mechanical/Asse...	Preliminary	CAD-000029...	CAD-000029...	SolidWorks	Prelimi
384	RoboMaster	Jayson Stans...	CAD-00003188	A	Bumper	Mechanical/Part	Preliminary	CAD-000029...	CAD-000029...	SolidWorks	Prelimi
128	RoboMaster	Jayson Stans...	CAD-00003206	A	Feeder_Assembly_Hero	Mechanical/Asse...	Preliminary	CAD-000029...	CAD-000029...	SolidWorks	Prelimi
512	RoboMaster	Jayson Stans...	CAD-00003320	A	Gimbal_Hero	Mechanical/Asse...	Preliminary	CAD-000033...	CAD-000033...	SolidWorks	Prelimi

Prev | Next | Page: 1 of 1 | 4 Results

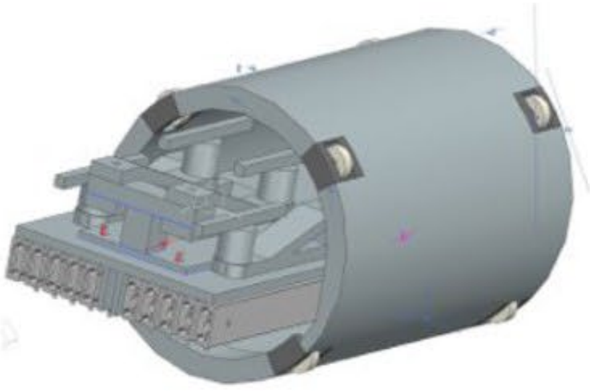
Purdue Space Program Hybrids

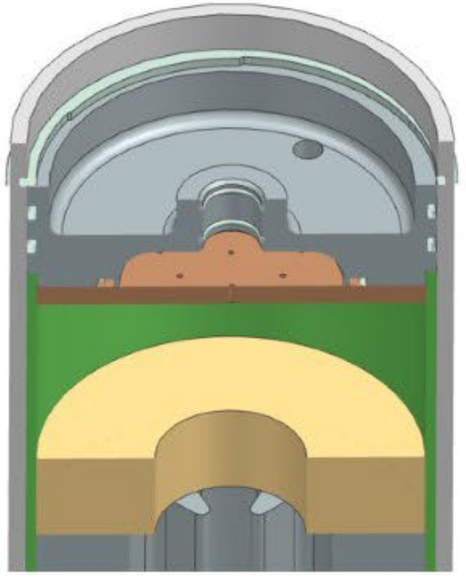
Background

- Team Size: 38 members
- Majors:
  - Engineering
- Competition
  - FAR 51025UNL, May 31st – June 2nd
  - Location: Mojave Desert, California
- Goals
  - To design, build and test experimental hybrid rockets
  - Experience

Product Data Management - Future

- Transitioning to ARAS
- Things that have benefited us:
  - Uncorrupted files
  - Streamlined data
  - Revision control





SAIC

Thank you for your time, and Boiler Up!

Any Questions?