

Virtual Asset: A Digital Platform for Connecting Research and Education to the Oil and Gas Market

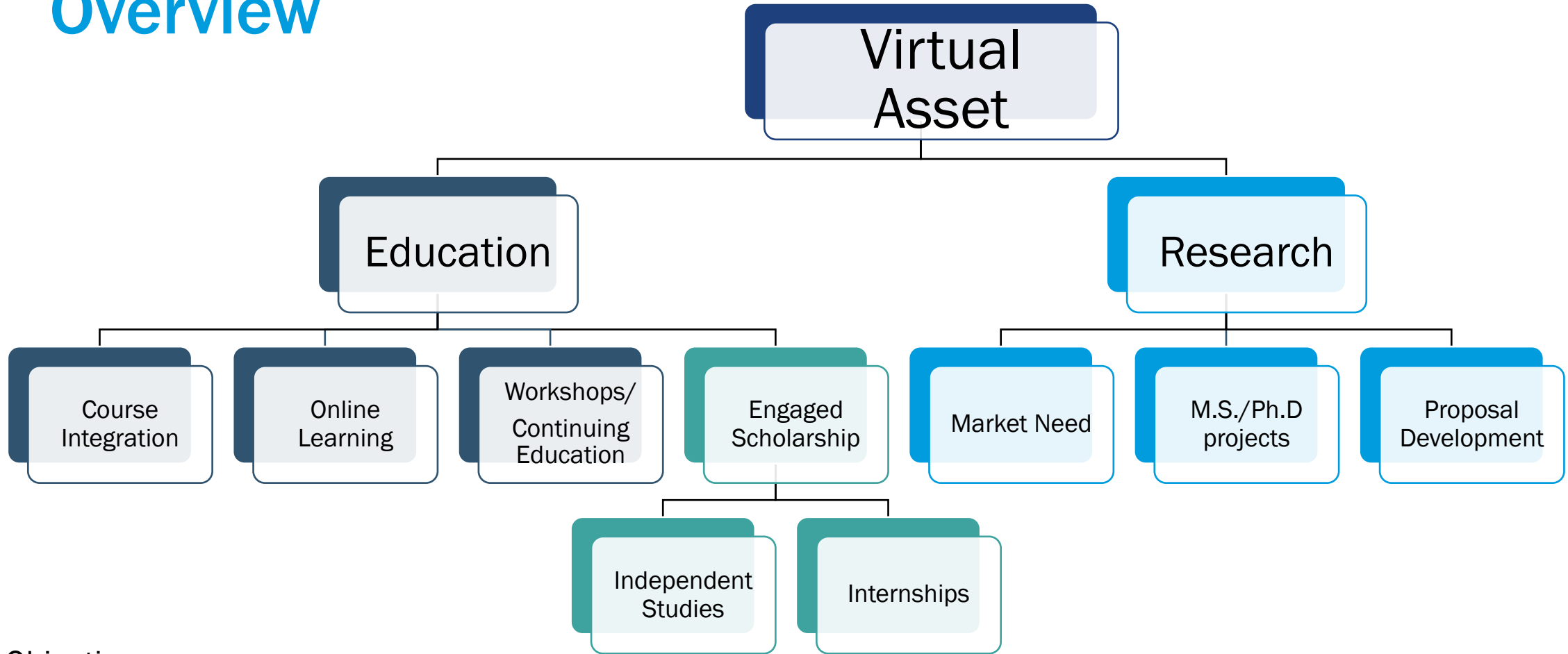
Eugene Morgan, Assistant Professor of Petroleum and Natural Gas Engineering
eugene.morgan@psu.edu

May 30th, 2019



PennState
College of Earth
and Mineral Sciences

Overview

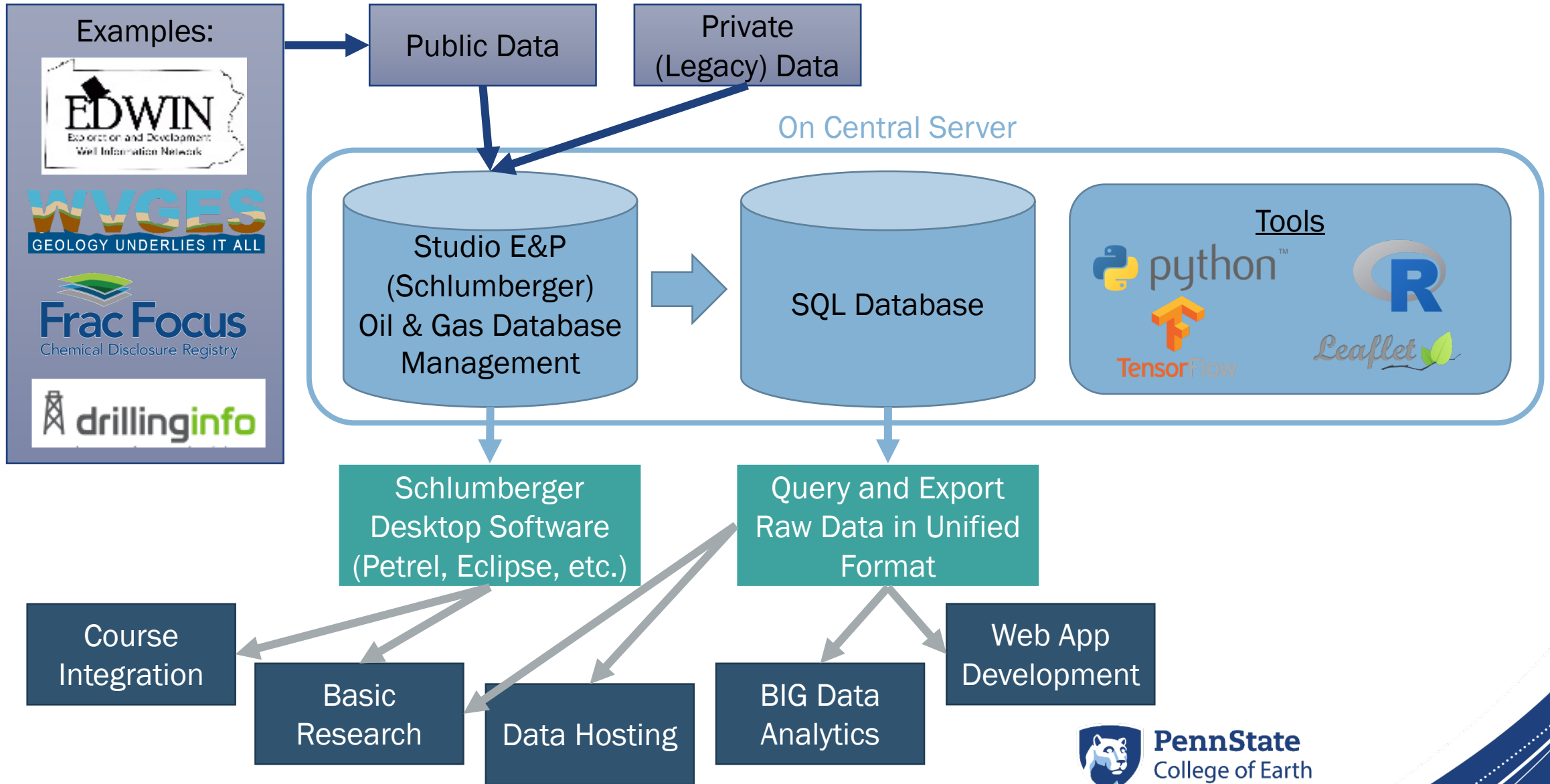


Objectives:

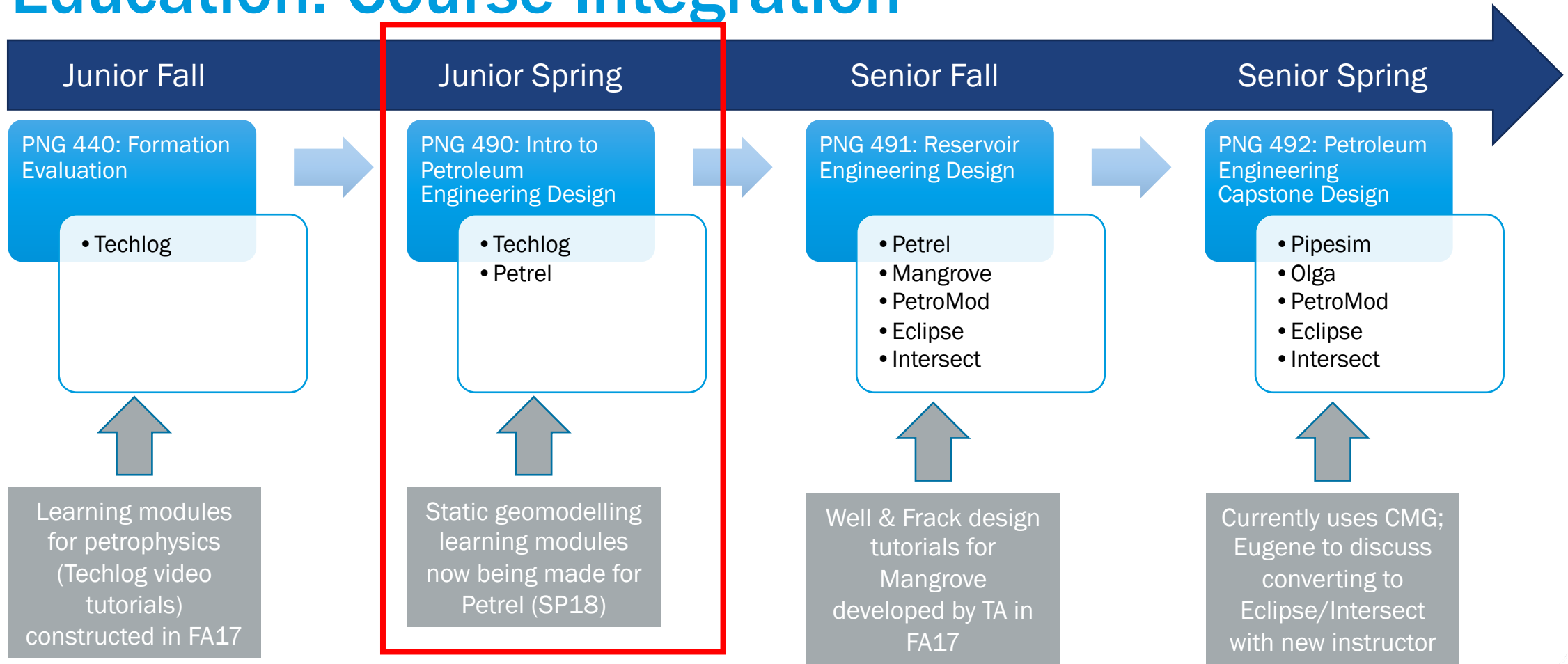
- Familiarize students with modern data and equip them with analytical tools
- Engage industry to meet market need (reduce cycle time in this process)
- Help research projects get going (via easier data access)
- Improve classroom experience (active learning)



The Digital Platform



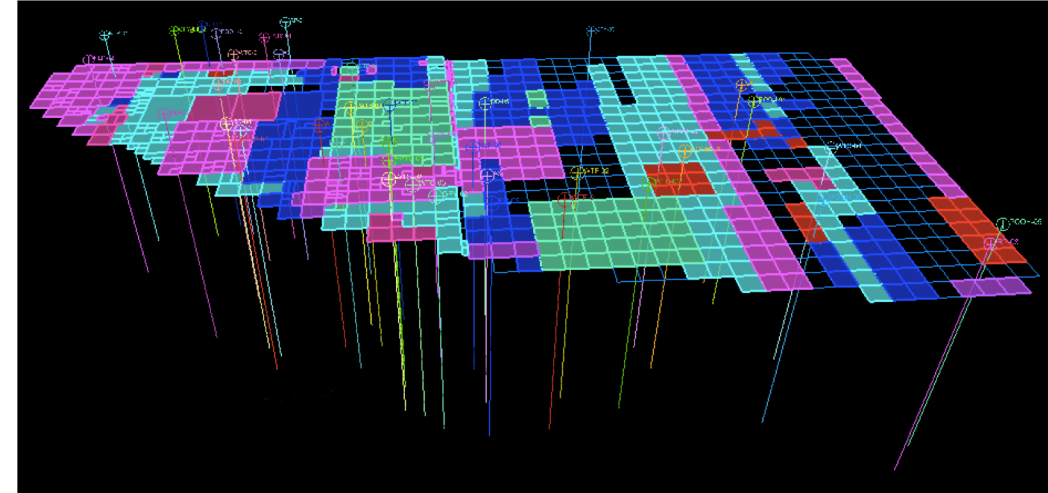
Education: Course Integration



Project for SP18-SP19 cohort: waterflooding in Alaska northslope sandstone reservoir (public data)
 Project for SP19-SP20 cohort: Newfield sponsoring dataset (Granite Wash play)

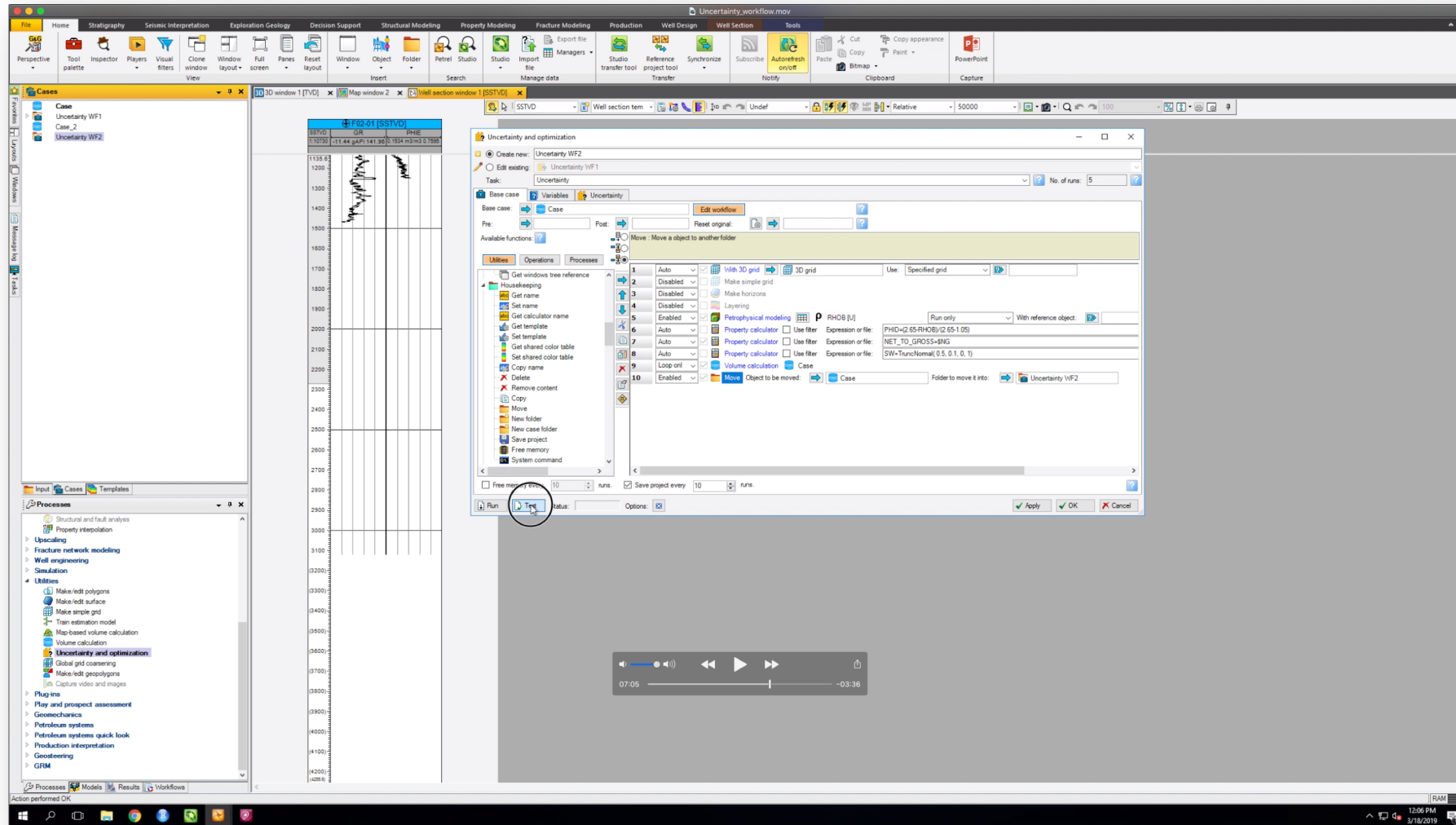
Example Use Case: PNG 490, Spring 2019

1. Students form groups (E&P companies) with initial capital (\$50 M)
2. Give E&P companies some public legacy data, and encourage them to find more
3. Groups bid on acreage (through online spreadsheet)
4. Distribute acreage to highest bidders (by bonus and royalty)
5. Groups purchase data collection: pseudo-well logs and structural tops (from Newfield data set)
6. Develop geomodels (in groups, using Petrel and Techlog; video tutorials for use of software made by instructor and posted on Canvas (learning management system))
 - Calculate reserves in place
 - Develop “sweet spot map”
 - Perform uncertainty analysis with Monte Carlo (P10, P50, P90 estimates)
7. Report assets (proven reserves) and determine companies’ net worths
 - Student teams write formal reports and also make video presentations
 - Winning team given box of clementines



TEAM NAME	Acres	Total Bonus	# wells	P90 (Bcf)	Previous Worth	Current Worth
POOH	18,921	\$181,000	6	16,756.8	\$38,819,000	\$41,930,819,000
G.F.Y. Petroleum	46,121	\$28,600	3	167.0	\$41,921,400	\$459,421,400
Drilly Drilly	31,712	\$96,301	5	143.2	\$39,903,699	\$397,903,699
F4	103,288	\$348,900	4	126.4	\$40,651,100	\$356,536,100
W.T.C.	19,294	\$12,800	4	106.9	\$40,987,200	\$308,152,900
WTF	54,488	\$117,050	6	90.1	\$38,882,950	\$264,040,200
Retro	6,758	\$73,000	3	72.3	\$41,927,000	\$222,602,000
DOCS	14,232	\$175,100	4	66.8	\$40,824,900	\$207,917,400
NLP	49,263	\$121,600	4	46.1	\$40,878,400	\$156,128,400
PATS	69,036	\$612,200	4	37.3	\$40,387,800	\$133,700,300

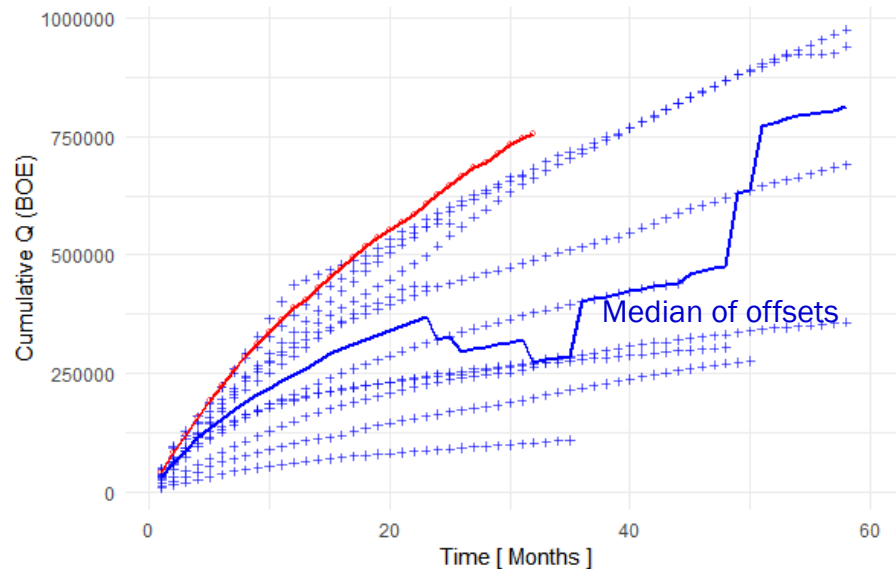
Video Tutorials for Learning Modules



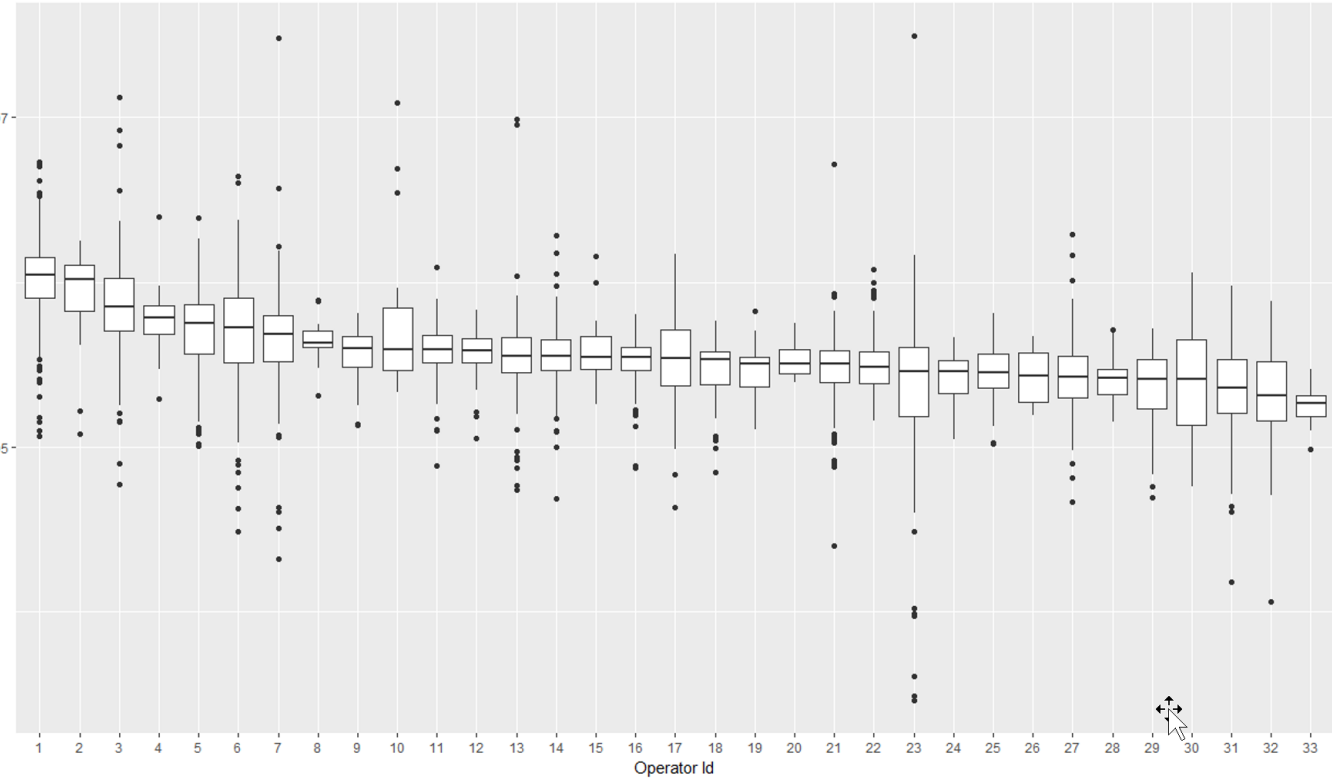
Market to Research: Services and Activities

Benchmarking

Comparing to other companies in the field



Normalized 2-year Cumulative (MSCF/1000 ft. lateral)



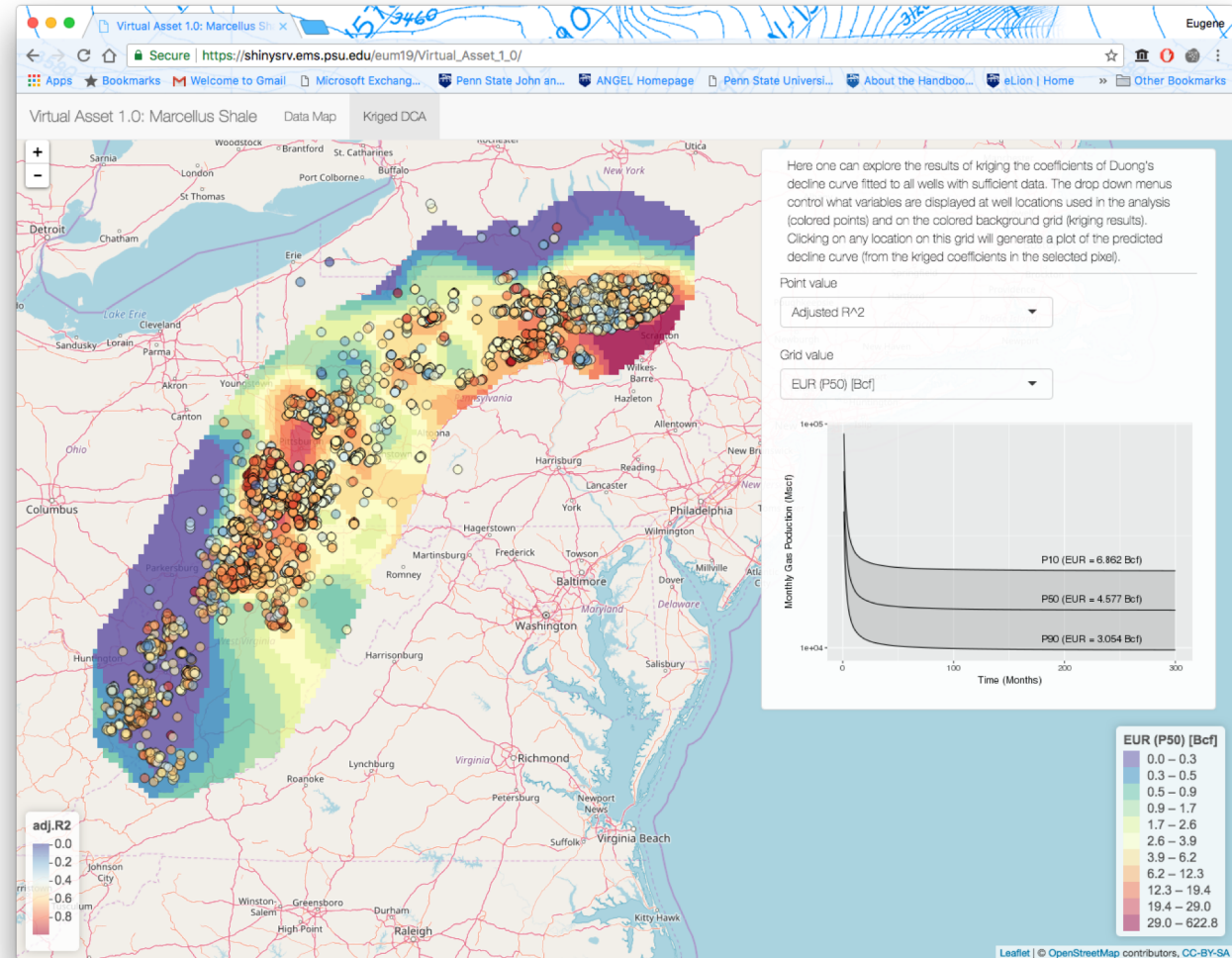
Evaluating treatment efficacy (e.g., new type of proppant)

Market to Research: Services and Activities

Web App Development

Predicting production decline and ultimate recovery at new undrilled sites

Xi., Z., and Morgan, E. (2019) Combining Decline Curve Analysis and Geostatistics to Forecast Gas Production in the Marcellus Shale. *SPE Reservoir Evaluation & Engineering - Formation Evaluation*. (Accepted)



https://shinysrv.ems.psu.edu/eum19/Virtual_Asset_1_0/



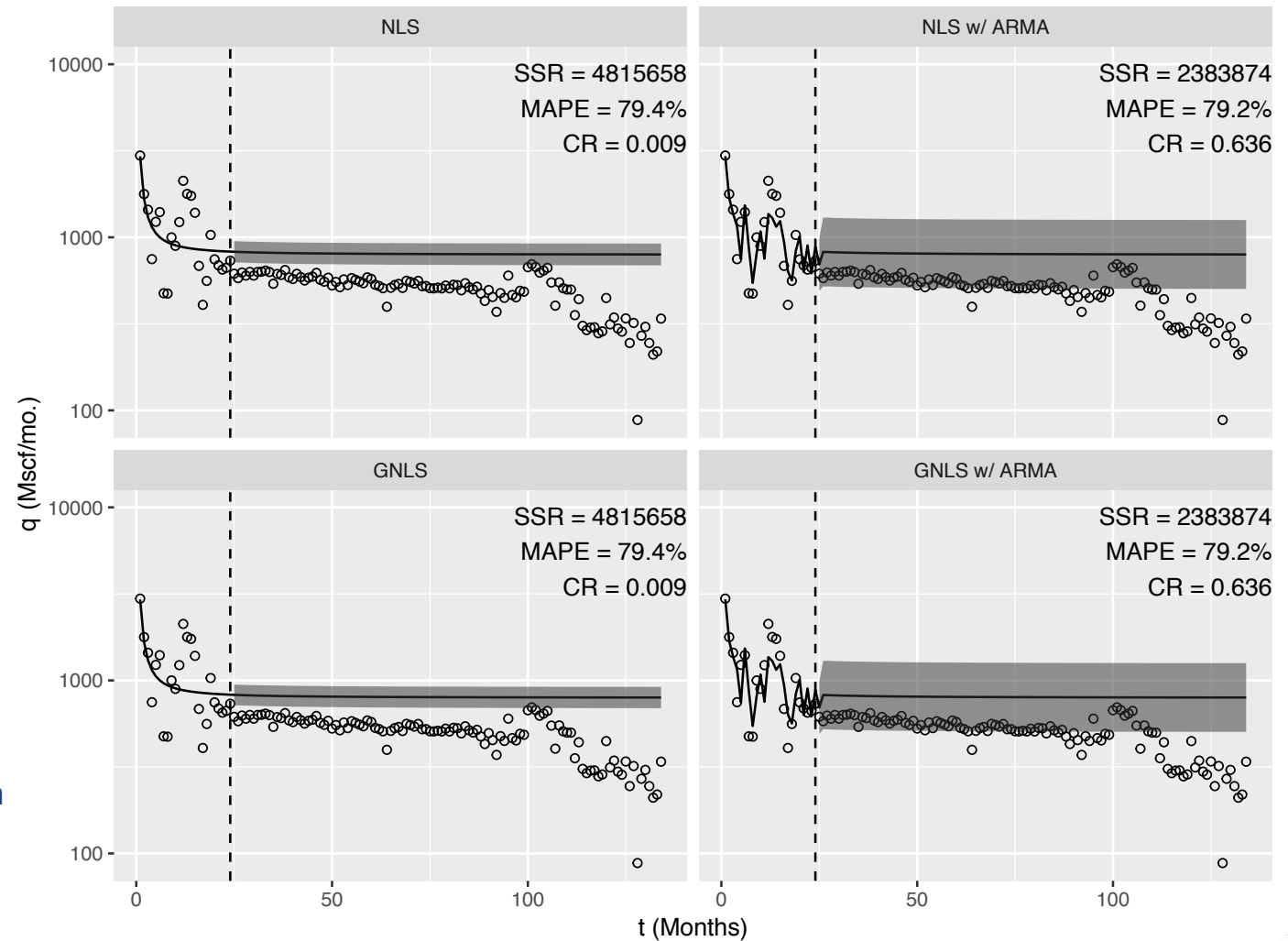
PennState
College of Earth
and Mineral Sciences

Market to Research: Services and Activities

Basic Research

A better way to estimate
production rate
forecasting uncertainty

Morgan, E. (2019) Accounting for serial autocorrelation in decline curve analysis of Marcellus shale gas wells. *Applied Energy*. (In Review)

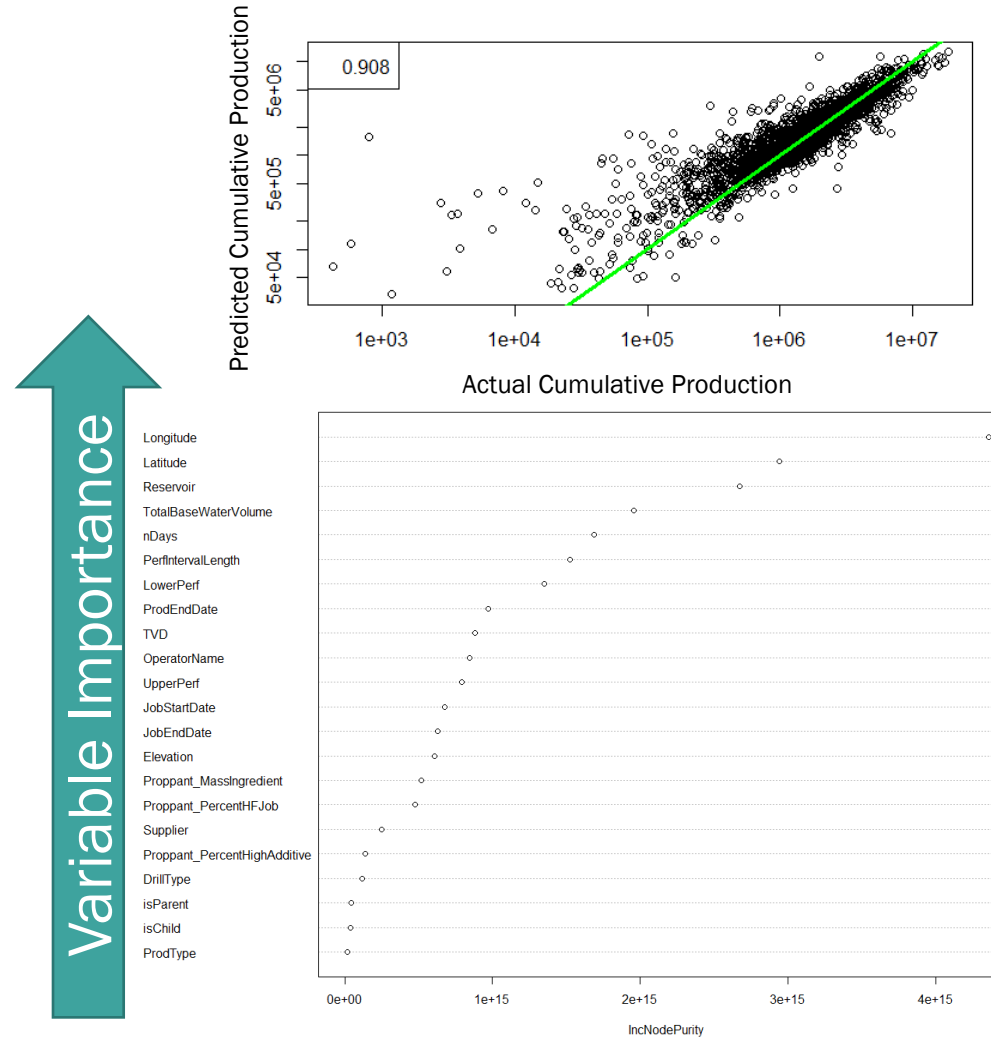


Market to Research: Services and Activities

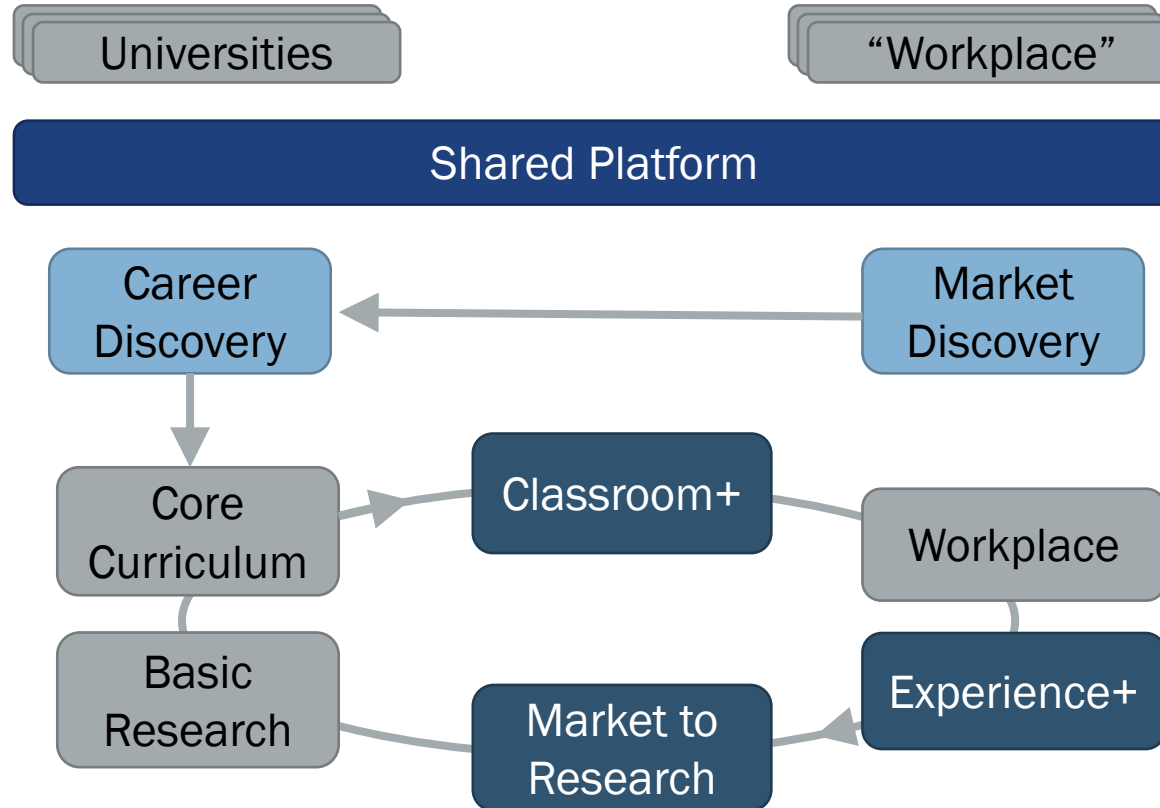
BIG Data Analytics

Modeling production under different completion designs, including parent-child well relationships

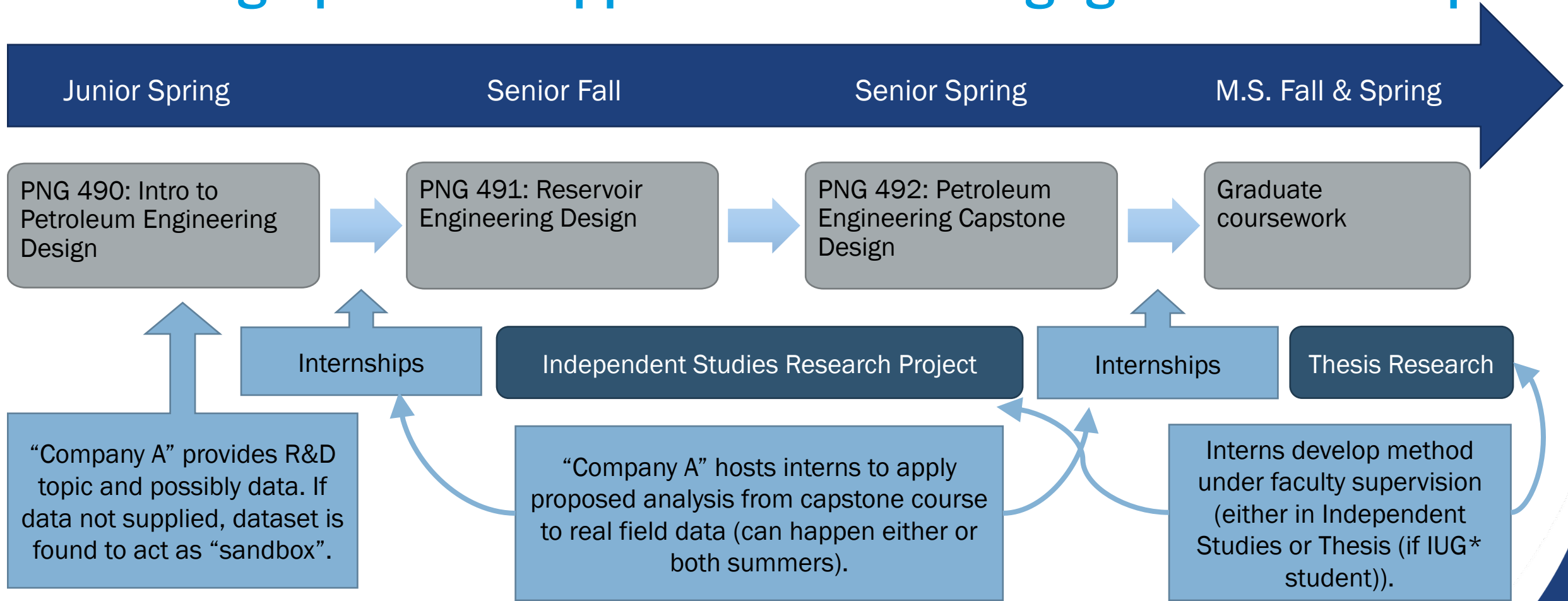
Torres, F.M., and Morgan, E. (20xx) A globally-trained Random Forest for shale gas completion design. (In Progress)



Concept: Integrated Model of Learning and Innovation



Attracting Sponsors: Opportunities for Engaged Scholarship



* IUG = Integrated Undergraduate Graduate: a program to earn B.S. and M.S. degrees in 5 years total.

Next steps...

- Engage operators one-on-one in scholarship opportunities
 - What R&D questions do they have?
 - Can we answer those (or some) with data we have?
 - Can they give data for questions we don't have data to support?
- Consortium for Engaged Scholarship in PNGE Education
 - \$25k per member for TA support (curate data, work with student teams, etc.)
 - Annual meetings with member companies to agree on R&D topic for coming cohort
 - Optional: pooling of member companies data
 - Establish mentors from companies to advise student teams
- Partnerships for Research Projects
 - Companies buy out graduate student, postdoc, and/or faculty time to work on timely R&D question
- Starting External Consulting LLC
 - Would this be easier for operators to work with?
 - No NDAs required (or if have one, then there would be quicker turn around)

Contact eugene.morgan@psu.edu if interested in getting involved!



PennState
College of Earth
and Mineral Sciences