Patricia Angle

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Education

Georgia Institute of Technology — Atlanta, Georgia
Ph.D. in Management Information Systems — May 2019
- Dissertation title: Information Technology and Organizational Complementarities: Two Empirical Essays in the Manufacturing Sector
- Minor in Economics

University of Michigan — Ann Arbor, Michigan
M.S.E. in Aerospace Engineering — May 1998
- Research topic: Fuel performance in a supersonic combustion ramjet engine

University of Michigan — Ann Arbor, Michigan
B.S.E. in Aerospace Engineering — May 1996
- Additional field of study: Russian and East European Studies

Research Experience

My research focuses on the economic impact of digital transformation. My work combines rigorous econometric techniques with digital ecosystem analysis to assess the economic effects of technology adoption in various sectors. For example, I have found that:
- small manufacturing establishments have not seen the productivity increases from electronic commerce that larger establishments have, possibly due to heterogeneous benefits of within-firm agglomeration
- innovation boosts by the addition of AI to R&D-intensive firms are primarily driven by outlier firms with extreme capital investments
- it is possible to "beat the crypto market" using neural networks that analyze social media sentiment along with traditional financial metrics

Research Interests

AI-enabled innovation
Economics of digital transformation
Cryptocurrency
Business analytics

Awards

Inaugural Member, MIS Quarterly Scholarly Development Academy, 2021-2022

Undergraduate Faculty of the Year Nominee, PhD Candidate division, 2018

Academy of Management Organizational Communication and Information Systems Division Doctoral Consortium Member, 2017

Americas Conference on Information Systems Doctoral Consortium Member, 2017

Best Student Paper Finalist, Workshop on Information Systems and Economics, 2015

Center for Economic Studies Dissertation Mentorship Program, 28th awardee, under the mentorship of Cheryl Grim, 2015

Teaching Experience

Cybersecurity

- Graduate and undergraduate courses
- Use of frameworks to guide risk analysis and cybersecure practices
- Viewing each layer of the Internet Model through the lens of both network administrator and malicious actor
- Preparation for the CompTIA Security+ certification exam
- Analysis of malicious exploits to discover likely actor, target, and motive
- Use of safe websites and sandboxes to experience both white hat and black hat scenarios
- Use of forensic tools such as Wireshark and FTK Imager

Network Infrastructure and Cybersecurity

- Both graduate and undergraduate courses
- Understanding the layers of the Internet Model and how they interact
- Creating patch cables, programming routers, and encrypting messages
- Designing actionable recommendations for both network design and cybersecurity efforts

Data Analytics

- Both graduate and undergraduate courses
- Econometric analysis
- Visualization techniques using Tableau, R, Python, and Excel
- Neural network use to sort images
- Programming using R, Python, and Excel

Digital Transformation

- Graduate level, Executive MBA in Aerospace and Defense
- Understanding the impact of new technologies on everyday operations at every level of the organization
- Spotlight on Cybersecurity, Cloud Computing, AI/ML, and Network Infrastructure

Introduction to Information Systems

- Undergraduate level
- Understanding the role of information systems in the organization
- Gaining experience in the role of translator between management and technical personnel

Project Management

- teaching assistant, undergraduate level
- focus on management techniques for scheduling and measuring project success

Systems Analysis and Design

- teaching assistant, undergraduate level

- creating diagrams for the purpose of software
- consideration of the data life cycle
- use of SAP Lumira to model processes

Advising Experience

I worked with an Honors College student to develop a literature review and academic poster for "Book Recommender Systems and Factors Beyond Accuracy," Fall 2024

Faculty Experience

University of Oklahoma — Norman, Oklahoma
Assistant Professor — 2020-present

- teaching focus: cybersecurity, network infrastructure, and analytics
- industry focus: defense

Florida Gulf Coast University — Fort Myers, Florida
Assistant Professor — 1999-2000

- faculty cybersecurity expert
- teaching focus: cybersecurity

Chattahoochee Technical College — Dallas, Georgia
Adjunct Lecturer — 2009-2012

- teaching focus: math
- non-traditional students

University of Michigan — Ann Arbor, Michigan
Lecturer — Fall 1998

- teaching focus: presentation organization and public speaking

Industry Experience

SciTrek — Atlanta, Georgia
Workshop Coordinator, BioTrek Director — 2001-2004

- wrote a large community grant for an inclusive program with the goal of combatting economic barriers to science enrichment
- ran the pilot Sally Ride Science Club, working with the astronaut to nurture technical confidence in middle school girls
- ran a highly competitive program for teachers and students to experience biotechnology at leading institutions, such as operating a robot to suture a heart at St. Joseph Hospital and visiting the secretive animal research lab at the CDC
- created educational workshops for visitors from preschool to adult
- led simulated space missions in the Challenger Learning Center for students and teachers
- created a set of interactive museum displays for visitors to experience biotechnology

Airflow Sciences Corporation — Livonia, Michigan
Engineer — 1999-2001

- conducted computational fluid dynamics simulations
- managed projects, including pricing and communications with customers
- conducted field experiments, primarily inside power plant electrostatic precipitators

- conducted lab experiments, including testing a large-scale model of a golf ball

Michigan Space Grant Consortium — Ann Arbor, Michigan
Lead Workshop Coordinator — 1996-1998

- Served on the task force with Senator Debbie Stabenow to create Space Day, a state-wide public event
- Wrote and evaluated grant proposals
- Developed workshops for the entire network of universities in the MSGC
- Created experiences for school students, homeschool students, summer camps, and the public

Publications (Accepted)

Subramanian, H., Angle, P., Rouxelin, F., & Zhang, Z. (2024). A decision support system using signals from social media and news to predict cryptocurrency prices. Decision Support Systems, 178, 114129.
Sentiment analysis has largely focused on the emotion and polarity of the individual. The Refinitiv MarketPsych data sets contain a novel set of normalized factors, such as FOMO, HODL, criminal activity, and regulatory issues, along with more traditional measures such as optimism and fear; these measure the sentiment of news and social media posts that are likely to predict the value of cryptocurrency. Through a day-coin-level event study analysis, the relative power of each sentiment to predict currency movement is shown. In addition, the indices are differentiated by the time horizon at which coin movement is predicted. This work contributes to the understanding of the relationship between trader sentiment and cryptocurrency value in the short and long terms.

Rodriguez, W., Angle, P., Snyder, M. (2021). Can Machine Learning Enhance Human Learning in Times of Disruption? Ubiquitous Learning: An International Journal, Vol 14, Issue 1, p33
In times of disruption, artificial intelligence (AI), particularly the ubiquitous machine learning (ML), is being rapidly integrated into online working environments in academia and industry. Primarily, these transformative technologies can help automate and perform continuous routine tasks using speed, efficiency, and effectiveness to gather and analyze massive amounts of data and information. This research illustrates ways in which ML can benefit learners and organizations--by making learners and workers work smarter and, more importantly, improve their ubiquitous learning environment anytime, anyplace. Humans can learn while working and studying by integrating both reinforcement learning and supervised learning paradigms and by augmenting, supplementing, or complementing ML with workers' humanness, skills, creativity, emotions, passions, and tacit knowledge. Furthermore, ML can track the humans learning process by learning from its experience--observing and analyzing the knowledge acquisition process, progress, and difficulties. Also, ML algorithms and agents can suggest new learning paths and approaches. In addition to exploring if and how ML can enhance human learning, this article investigates how it can assist learning without impinging on natural human and social learning development. Rather than just substituting or supplementing human recall, ML can integrate and enhance work performance by minimizing--instead of supplanting--tedious tasks with automation and AI.

(Submitted) *Angle, P. and Forman, C. Does IT Level the Playing Field for Small Establishments? Evidence from Manufacturing*. Available at https://ssrn.com/abstract=3246142
Abstract: In this paper, we explore the value of information technology on the productivity of manufacturing plants. We examine the impact of one such technology, e-selling, on total factor productivity (TFP). We find that, on average, e-selling adoption is associated with a 1.4% increase in TFP. However, these returns differ significantly between small and large plants. On average, for plants above a very low size threshold, the increase in TFP is 2%. For very small plants, the returns to e-selling are statistically indistinguishable from zero. This provides evidence that economies of scale are relevant even in technologically advanced sectors. We further explore this finding in the context of other plant and firm characteristics. *R&R, Information Systems Research.*

(In Preparation) *An Investigation of IT, R&D and Propensity to Innovate*
This study examines the role of artificial intelligence (AI) in complementing R&D investment to drive firm-level innovation. Using business intelligence (BI) software adoption as a proxy for AI implementation, we construct a panel dataset spanning 2013 to 2020 by integrating software adoption data (Aberdeen Ci Technology), firm financials (Compustat), and innovation outputs (USPTO patent grants). Initial results suggest that higher BI intensity is associated with increased patenting activity after a two-year lag. However, this relationship is not robust to winsorization, indicating sensitivity to outliers. In addition, we demonstrate complementarity between BI and R&D intensity. While we present evidence that capital expenditures are a predictor of innovation outcomes, BI intensity alone does not yield sustained effects. These findings emphasize that AI adoption enhances innovation potential only when supported by R&D infrastructure and broader capital investment. The study offers actionable insights for firms and policymakers aiming to align technological adoption strategies with long-term innovation objectives.

Digital Multiplicity: Evidence from the US Media and Entertainment Ecosystem
Co-authors: Sonal Nayak, Ludvig Levasseur, and Vijayaraghavan Venkataraman (Indian Institute of Management Bangalore)
Digital goods are transforming industries through customer-centric business models. We investigate how internet adoption affects value creation and appropriation across the ecosystem. We build a theory of digital multiplicity (consisting of digital variety upstream and digital volume downstream), and we explore how multiplicity impacts proximately located upstream producers and downstream distributors. We analyze 10,328 US Media and Entertainment startups and investigate customer adoption of internet as a source of exogenous variation. While both upstream and downstream actors benefit from internet adoption, downstream actors are more successful on average. Moreover, both upstream and downstream actors benefit from co-located upstream actors but are hindered by co-located downstream actors. We contribute to digital strategy, innovation ecosystems, and firm agglomeration literatures.

Comparing a Neural Network using Media Signals with Traditional Financial Indicators to Predict Cryptocurrency Prices
Co-authors: Hemang Subramanian (Florida International University), Ziyang Zhang (California State University Northridge), Sigurdur Sigurdsson (Florida International University)
We design, implement, and evaluate a decision support algorithm that combines fine-grained signals derived from news and social media with bitcoin prices using a Long Short-Term Memory (LSTM) neural network. Using this artifact, we construct portfolio trade bitcoin prices in three stages. In the first stage, signals and prices are used as inputs for the LSTM model to get a bitcoin price prediction. In the second stage, we select the signals that are the best predictors of bitcoin price and then combine these signals to generate predictions that outperform market benchmarks. Lastly, we evaluate portfolios based on their financial performance compared to these benchmarks. This design artifact introduces a method to harness the rich heterogeneity inherent in online news and social media for bitcoin price prediction.

Invited Talks

Angle, Patricia, Chris Forman, and Kristina McElheran. "E-commerce in the manufacturing supply chain: an empirical analysis." Center for Economic Studies. Washington D.C., April 2016.

Conferences (Lead Author)

- Angle, P., Faculty Research Seminar Series, "AI Hacking." (April 23, 2025). OU MIS faculty session.
- Angle, Patricia and Lubomir Litov. "An Investigation of IT, R&D and Propensity to Innovate," 2025 INFORMS Annual Meeting, Atlanta, Georgia.
- Angle, P., Faculty Three Minute Thesis, "Three Minute Thesis," Price College. (February 2, 2024). Oral Presentation, Workshop.
- Angle, P., Faculty Research Seminar Series, "Research Overview and Highlights from Two Projects." (January 24, 2024). Faculty meeting feedback session.
- Angle, Patricia and Chris Forman. "Does IT Level the Playing Field for Small Establishments? Evidence from Manufacturing." CIST 2017. Houston, Texas. October 2017. Session Chair.
- Angle, Patricia and Chris Forman. "When is IT most valuable? An investigation of e-selling and plant size." Poster session. Academy of Management OCIS Division. Atlanta, Georgia. August 2017.
- Angle, Patricia, Chris Forman, and Kristina McElheran. "E-commerce in the manufacturing supply chain: an empirical analysis." INFORMS 2016 Annual Meeting. Nashville, Tennessee. November 2016. Abstract published.
- Angle, Patricia, Chris Forman, and Kristina McElheran. "E-commerce in the manufacturing supply chain: an empirical analysis." Production and Operations Management Annual Meeting. Orlando, Florida. May 2016. Abstract published.
- Angle, Patricia, Chris Forman, and Kristina McElheran. "E-commerce in the manufacturing supply chain: an empirical analysis." Workshop on Information Systems and Economics (WISE). Fort Worth, Texas. December 2015.

- Angle, Patricia, and Chris Forman. "When is IT most valuable? An investigation of e-selling and plant size." 2015 Atlanta Census Research Data Center (ACRDC) Annual Research Conference. Atlanta, Georgia. October 2015.

(Contributing Author)

- Subramanian, H., Angle, P., Zhang, Z., Sigurdsson, S., "Comparing a Neural Network using Media Signals with Traditional Financial Indicators to Predict Cryptocurrency Prices," SIG BIT, ICIS 2025. Paper, Workshop.
- Subramanian, H., Angle, P., Rouxelin, F., Zhang, Z., "Recurrent Neural Networks, Social Media Sentiment Indicators and Bitcoin Price Prediction," SIG BIT, ICIS 2022. Paper, Workshop.
- Subramanian, H., Angle, P. L., Rouxelin, F., Nagaraj, N. (2022). "Is FOMO Better than HODL? Predicting Bitcoin Prices Using Sentiments with LSTM Neural Networks.", PACIS 2022. https://aisel.aisnet.org/pacis2022/. (Published)

Patents (Pending)

A decision support system using signals from social media and news to predict cryptocurrency prices. First disclosed 11/2023.

Skills

- R: used in the course of research and to teach Business Analytics
- Stata: used in the course of research
- SAS: used in the course of research
- Python: used in the course of research and to teach Business Analytics
- SAP Lumira: used in the Business Process Analysis and Design course
- SAP: used in the Introduction to Information Systems course
- Tableau: used to teach Business Analytics
- Legacy languages, such as C: used in the course of engineering study and work
- AutoCAD: used in the course of engineering work
- VISCOUS (proprietary company software): used to conduct computational fluid dynamics studies in the course of engineering work

References

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