Management Science I
Winter Term 2022-23
ESMT Learning Center (Main Building), Schlossplatz 1
Thursdays 9:00am to 12:00noon (please see separate schedule for further details)

Part I: The organization of science

Henry Sauermann
ESMT Berlin, Schlossplatz 1, Office 2.12A
henry.sauermann@esmt.org
Office hours upon appointment

Part II: Innovation, intellectual property rights and the market for technology

Stefan Wagner
ESMT Berlin, Schlossplatz 1, Office 2.06A
stefan.wagner@esmt.org
Office hours upon appointment

Course overview

Science and innovation are central to economic growth, social welfare, and firms' ability to create and capture value. This course will cover key issues in science and innovation, as seen from the perspective of management scholars, economists, and sociologists.

This course has multiple objectives:

- Give you a "feeling" for what science looks like and how science works. Towards this end, we will discuss a range of descriptive studies and you will interview a person "in the field". As a result, you should be able to identify interesting research questions and find data to address them.
- Give you an overview of the literature on the organization of science and innovation and point out pieces from other literatures that may provide complementary perspectives. By discussing "classics" as well as cutting-edge research, we will examine how various theoretical lenses and methodological tools can be used to advance knowledge of the science and innovation system. As a result, you should be able to critically evaluate prior work, see connections between different streams of literature, identify gaps in the literature, and design your own research projects in this area.
- Foster an understanding of theoretical and predominantly empirical work taking a micro perspective on the complex processes leading to innovation and incentivizing private companies to invest in risky R&D projects.
- Encourage you to make connections between science and innovation as an object of study and as an institution in which we, as research scholars, operate. While much of the prior literature

focuses on the natural ("hard") sciences, many of the general issues apply to the social sciences as well. As a result, you should be able to gain a deeper understanding of your own institutional environment, allowing you to become a more effective research scholar.

Course format

We will meet once a week for three hours. In each meeting, you are expected to have prepared the assigned readings for each session. While reading the papers it may be useful to first identify the research question, major concepts used to formulate the research problem, the methodology used, key findings and its major shortcomings or weaknesses. You should then be able to suggest research ideas on how to address the weak or problematic aspects of the article.

Course evaluation

- *Class participation (20%).* The course will be highly interactive and you are expected to contribute to the learning experience through active participation (primarily quality rather than quantity).
- *Paper presentations/leading discussion (20%).* Depending on class size, you will present approximately 4 papers throughout the semester. Papers will be assigned/chosen in session 2 for part I of the course (you can pick from papers marked with ^) and in session 10 for part II of the course. The format is open – your job is to make everyone "learn". While presenting key ideas from the paper can be a good start, you should think creatively about involving the audience to critically engage with the paper.
- *Reflection essays (4x5%=20%).* Four sessions below include questions for "reflection essays". You should answer these questions (approx. 1000 words) and submit as Word document by email prior to the beginning of the respective session. Your essays should draw on the readings from the session but you are free to incorporate (and cite) additional literature.
- *Seminar paper proposal (40%).* You will write and present a short seminar paper proposal on one of the topics covered in the course. Although the focus should be on literature review and theory development, you should also think about an appropriate empirical strategy. Approximate length is 4000 words. You may collaborative with up to one additional student. **Due date: March 12, 2023**

These deliverables are designed to facilitate and assess progress towards various learning objectives:

Deliverable	**Focal knowledge or skill**
Class participation	• Sharpen analytical skills "on the fly" • Express your ideas clearly to others • Listen to others and understand their arguments • See connections and inconsistencies between arguments, respond to criticism, observe meta-processes of scholarly debate
Lead discussion of papers in class	• Thorough understanding of prior work • Put yourselves in the shoes of an "instructor" and think about pedagogy. • Convey key arguments / the essence of a paper. • Identify strengths and – more importantly - weaknesses of papers • Think about papers in the broader context of a theme or line of research, identify connections
Reflection essays	• Demonstrate understanding of key arguments of papers • Integrate different arguments, identify inconsistencies, complementarities, etc.

	• Find structure in complex and confusing arguments; identify underlying dimensions and general issues • Think creatively about implications, research questions, or empirical approaches
Seminar paper	• Synthesize prior literature • Identify and motivate an interesting and relevant research question • Develop a logically consistent "model" or conceptual argument • Reach out to "real people" to get a sanity check on your ideas • Identify powerful empirical settings or approaches

Required books Part I

- Thomas S. Kuhn: The Structure of Scientific Revolutions, ISBN 978-0226458083
- Donald E. Stokes: Pasteur's Quadrant, ISBN 978-0815781776

All other readings are available as pdfs at https://cloud.esmt.org/s/zySWMk6SkmbqsbP

PART I: The organization of science

Session 1: Thursday, October 20

Introduction and overview

Required readings

- WSJ: "Climate emails stoke debate" and "Rigging a climate 'consensus'"
- Samir Okasha (2002): Philosophy of science, pp. 1-33
- Santo Fortunato et al. (2018): Science of science
- Dean Keith Simonton (2003): Scientific creativity as constrained stochastic behavior: The integration of product, person, and process perspectives
- Paula Stephan (2012): Chapter 1 "What does economics have to do with science?"

Discussion questions (no submission)

- What is science?
- Why does society care about science, what is "good" science, what are the institutions and organizations involved in science?

Session 2: Thursday, October 27

Knowledge and the cumulative nature of science

Required readings

- Robert W. Weisberg (2006): Creativity: Understanding innovation in problem solving, science, invention, and the arts. Pages 6-34
- Thomas Kuhn (1996): The structure of scientific revolutions. Chapters 1-4, 6, 8-12

Further reading

- Sara Delamont and Paul Atkinson (2001): Doctoring uncertainty: Mastering craft knowledge
- Olav Sorenson and Lee Fleming (2004): Science and the diffusion of knowledge

Discussion questions (submission #1)

- Read the DNA case. Based on this case, how "cumulative" is science?
- Read the Kuhn chapters. What is his thinking regarding the "cumulative nature of science"?
- How do the two perspectives fit together?

Session 3: Thursday, November 3

History of scientific research and the co-evolution of "basic" and "applied"

Required readings

- Steven Shapin (1996): The scientific life, chapter 2
- Donald Stokes (1997): Pasteur's Quadrant, pages 1-57^ and 58-89 (book)^

Further reading

- Jeffrey Furman and Megan McGarvie (2007): Academic science and the birth of industrial research
- Nathan Rosenberg and Richard Nelson (1994): American universities and technical advance in industry

Discussion questions (no submission)

- In the context of our course, why might it matter whether scientists are "special" or "normal" people? "Special" and "normal" with respect to what?

Session 4: Thursday, November 10

Institution of science/rewards and incentives I: The Mertonian view

Required readings

- Robert Merton (1973): The sociology of science, Part 3 prefatory note pp. 223-227 (book)
- Robert Merton (1973): The sociology of science, ch. 13: "The normative structure of science"
- Robert Merton (1973): The sociology of science, Part 4 prefatory note pp. 282-285
- Robert Merton (1973): The sociology of science, ch. 14: "Priorities in scientific discovery"
- Robert Merton (1973): The sociology of science, Part 5 prefatory note pp. 415-418
- Robert Merton (1973): The sociology of science, chapter 20: "The Matthew effect in science"
- Robert Merton (1973): The sociology of science, chapter 21: "Institutionalized patterns of evaluation in science"

Further reading

- Bruce Macfarlane and Ming Cheng (2008): Communism, universalism, and disinterestedness: Re-examining contemporary support among academics for Merton's scientific norms
- Stephen Cole and Jonathan Cole (1967): Scientific output and recognition: A study in the operation of the reward system in science

Discussion questions (no submission)

- What implications do the mechanisms discussed in Merton chapters 20 and 21 have for the mechanisms discussed in chapters 13 and 14?

Session 5: Thursday, November 17

Institution of science/rewards and incentives II

Required readings

- Partha Dasgupta and Paul David (1994): Toward a new economics of science^
- Paula Stephan (2012): Chapter 6 "Funding for research", pp. 129-150
- Aloysius Siow (1998) : Tenure and other unusual personnel practices in academia^
- Jason Owen-Smith (2001): Managing laboratory work through skepticism: Process of evaluation and control^

Further reading

- Henry Sauermann and Wesley Cohen (2010): What makes them tick? Employee motives and firm innovation
- Warren Hagstrom (1974): Competition in science

Discussion questions (no submission)

- How do the readings for this week "fit" with the arguments made by Merton (last session)?

Session 6: Thursday, November 24

Field differences (asynchronous)

Review the material from Sessions 4 and 5. Much of that work has been done in the context of the natural sciences. Based on the experience you have made so far in your PhD program, discuss one aspect that may be different in the social sciences. How could you investigate this potential field difference further?

Write up your thoughts (approx. 400 words) and paste them into the following google doc: https://docs.google.com/document/d/1JHRfxzEi9Mku-JeQC09tm_2P6gnCXLQqpXs47e-vxwI/edit?usp=sharing). After you have submitted, read your classmates' submissions and comment.

The deadline to submit your write-up is November 24, 9 am. Please comment on others' submissions by November 27, 11 pm. Your contributions will be considered as part of class participation.

Session 7: Thursday, December 1

Teams

Required readings

- Stefan Wuchty, Benjamin Jones, and Brian Uzzi (2007): The increasing dominance of teams in the production of knowledge
- Jasjit Singh and Lee Fleming (2010): Lone inventors as sources of breakthroughs: Myth or reality?^
- Henry Sauermann and Carolin Haeussler (2017): Authorship and contribution disclosures
- Carolin Haeussler and Henry Sauermann (2020): Division of labor in collaborative knowledge production: The role of team size and interdisciplinarity^

Further reading

- Barton Hamilton, Jack Nickerson, and Hideo Owan (2003): Team incentives and worker heterogeneity
- Ajay Agrawal and Avi Goldfarb (2008): Restructuring research: Communication costs and the democratization of university innovation

Discussion questions (no submission)

- What big picture issues would economists/sociologists of science using an "individualistic paradigm" miss or get wrong (in what sense?) if science is in fact largely team-based?

Session 8: Thursday, December 8

New developments in science: Crowdsourcing and Citizen Science

Required readings

- Allan Afuah and Chris Tucci (2012): Crowdsourcing as a solution to distant search
- Kevin Boudreau, Nico Lacetera, and Karim Lakhani (2011): Incentives and problem uncertainty in innovation contests^
- Chiara Franzoni, Marion Poetz, and Henry Sauermann (2022): Crowds, citizens, and science: A conceptual framework and agenda for future research
- Susanne Beck et al. (2022): Crowdsourcing research questions in science^

Further reading

- Henning Piezunka and Linus Dahlander (2015): Distant search, narrow attention: How crowding alters organizations' filtering of suggestions in crowdsourcing
- Henry Sauermann et al. (2020): Citizen Science and Sustainability Transitions
- Henry Sauermann and Chiara Franzoni (2015): Crowd science user contribution patterns and their implications

Discussion questions (no submission)

- Most cases of crowd and citizen science (CS) are in the natural sciences. Why do you think CS is less advanced in the social sciences? Do you think the social sciences will catch up?

Session 9: Thursday, December 15

New developments in science: Open Access and Automation

Required readings

- Patrick Gaule and Nicolas Maystre (2011): Getting cited: Does open access help?^
- Sebastian Raisch and Sebastian Krakowski (2021): Artificial intelligence and management: The automation-augmentation paradox
- Andrew Sparkes et al. (2010): Towards robot scientists for autonomous scientific discovery
- Laura Trouille, Chris Lintott, and Lucy Fortson (2019): Citizen science frontiers: Efficiency, engagement, and serendipitous discovery with human-machine systems

Further reading

- Luigi Ceccaroni et al. (2019): Opportunities and risks for Citizen Science in the age of artificial intelligence

Discussion questions <u>(submission #2)</u>

- Revisit the readings and our discussions on the Mertonian view (Session 4). Discuss 2 interesting implications that the use of Artificial Intelligence may have for the normative and social structure of science.

Part II: Innovation, intellectual property rights and the market for technology

Stefan Wagner

The syllabus will be shared mid-October

References – Part I – References of Part II are not listed separately

Afuah, A., & Tucci, C. L. 2012. Crowdsourcing as a solution to distant search. ***Academy of Management Review*** 37(3): 355-375.

Beck, S., Brasseur, T.-M., Poetz, M., & Sauermann, H. 2022. Crowdsourcing research questions in science. ***Research Policy***, 51(4): 104491.

Boudreau, K. J., Lacetera, N., & Lakhani, K. R. 2011. Incentives and problem uncertainty in innovation contests: An empirical analysis. ***Management Science***, 57(5): 843-863.

Ceccaroni, L., Bibby, J., Roger, E., Flemons, P., Michael, K., Fagan, L., & Oliver, J. L. 2019. Opportunities and risks for citizen science in the age of artificial intelligence. ***Citizen Science: Theory and Practice***, 4(1).

Cole, S., & Cole, J. R. 1967. Scientific output and recognition: A study in the operation of the reward system in science, Vol. 32: 377-390: American Sociological Review.

Dasgupta, P., & David, P. A. 1994. Toward a new economics of science. ***Research Policy***, 23(5): 487-521.

Delamont, S., & Atkinson, P. 2001. Doctoring uncertainty: Mastering craft knowledge. ***Social Studies of Science***, 31(1): 87-107.

Fortunato, S., Bergstrom, C. T., Börner, K., Evans, J. A., Helbing, D., Milojević, S., Petersen, A. M., Radicchi, F., Sinatra, R., & Uzzi, B. 2018. Science of science. ***Science***, 359(6379): eaao0185.

Franzoni, C., Poetz, M., & Sauermann, H. 2022. Crowds, citizens, and science: A multi-dimensional framework and agenda for future research. ***Industry and Innovation***, 29(2).

Furman, J. L., & MacGarvie, M. J. 2007. Academic science and the birth of industrial research laboratories in the U.S. pharmaceutical industry. ***Journal of Economic Behavior and Organization***, 63(4): 756-776.

Gaule, P., & Maystre, N. 2011. Getting cited: Does open access help? ***Research Policy***, 40(11): 1332-1338.

Goldfarb, B., Marschke, G., & Smith, A. 2008. Scholarship and inventive activity in the university: Complements or substitutes?, ***Working Paper***.

Haeussler, C., & Sauermann, H. 2020. Division of labor in collaborative knowledge production: The role of team size and interdisciplinarity. ***Research Policy***, 49(6): 103987.

Hagstrom, W. 1974. Competition in science. ***American Sociological Review***, 39(1): 1-18.

Hamilton, B. H., Nickerson, J. A., & Owan, H. 2003. Team incentives and worker heterogeneity: An empirical analysis of the impact of teams on productivity and participation. ***Journal of Political Economy***, 111(3): 465-497.

Henderson, R., & Cockburn, I. 1996. Scale, scope, and spillovers: The determinants of research productivity in drug discovery. ***Rand Journal of Economics***, 27(1): 32-59.

Kuhn, T., S. 1996. ***The Structure of Scientific Revolutions*** (3 ed.): University of Chicago Press.

Macfarlane, B., & Cheng, M. 2008. Communism, universalism and disinterestedness: re-examining contemporary support among academics for Merton's scientific norms. ***Journal of Academic Ethics***, 6(1): 67-78.

Merton, R. K. 1973. ***The Sociology of Science: Theoretical and Empirical Investigations***. Chicago: University of Chicago Press.

Okasha, S. 2002. ***Philosophy of science: A very short introduction***: Oxford University Press, USA.

Owen-Smith, J. 2001. Managing laboratory work through skepticism: Processes of evaluation and control. ***American Sociological Review***, 66(3): 427-452.

Piezunka, H., & Dahlander, L. 2015. Distant search, narrow attention: How crowding alters organizations' filtering of suggestions in crowdsourcing. ***Academy of Management Journal***, 58(3): 856-880.

Raisch, S., & Krakowski, S. 2021. Artificial intelligence and management: The automation–augmentation paradox. ***Academy of Management Review***, 46(1): 192-210.

Rosenberg, N., & Nelson, R. 1994. American universities and technical advance in industry. ***Research Policy***, 23: 323-348.

Sauermann, H., & Cohen, W. 2010. What makes them tick? Employee motives and firm innovation. ***Management Science***, 56(12): 2134-2153.

Sauermann, H., & Franzoni, C. 2015. Crowd science user contribution patterns and their implications. ***Proceedings of the National Academy of Sciences***, 112(3): 679-684.

Sauermann, H., & Haeussler, C. 2017. Authorship and contribution disclosures. ***Science Advances***, 3(11): e1700404.

Sauermann, H., Vohland, K., Antoniou, V., Balaz, B., Goebel, C., Karatzas, K., Mooney, P., Perello, J., Ponti, M., Samson, R., & Winter, S. 2020. Citizen science and sustainability transitions. ***Research Policy***, 49(5): 103978.

Simonton, D. K. 2003. Scientific creativity as constrained stochastic behavior: the integration of product, person, and process perspectives. ***Psychological Bulletin***, 129(4): 475-494.

Singh, J., & Fleming, L. 2010. Lone inventors as sources of breakthroughs: Myth or reality? ***Management Science***, 56(1): 41-56.

Siow, A. 1998. Tenure and other unusual personnel practices in academia. ***Journal of Law, Economics and Organization***, 14(1): 152.

Sorenson, O., & Fleming, L. 2004. Science and the diffusion of knowledge. ***Research Policy***, 33(10): 1615-1634.

Sparkes, A., Aubrey, W., Byrne, E., Clare, A., Khan, M. N., Liakata, M., Markham, M., Rowland, J., Soldatova, L. N., & Whelan, K. E. 2010. Towards Robot Scientists for autonomous scientific discovery. ***Automated Experimentation***, 2(1): A1.

Stephan, P. 2012. ***How Economics Shapes Science***: Harvard University Press.

Stokes, D. 1997. ***Pasteur's Quadrant: Basic Science and Technological Innovation***. Washington, DC: Brookings Institution Press.

Trouille, L., Lintott, C. J., & Fortson, L. F. 2019. Citizen science frontiers: Efficiency, engagement, and serendipitous discovery with human–machine systems. ***Proceedings of the National Academy of Sciences***, 116(6): 1902-1909.

Weisberg, R. W. 2006. ***Creativity: Understanding Innovation in Problem Solving, Science, Invention, and the Arts***: Wiley.

Wuchty, S., Jones, B., & Uzzi, B. 2007. The increasing dominance of teams in the production of knowledge. ***Science***, 316(5827): 1036-1039.