# TIMG 5202
# MOVING DIGITAL TRANSFORMATION AND ENTREPRENEURSHIP RESEARCH INTO BUSINESS PRACTICES

**Fall 2024**
**Institute of Technology Entrepreneurship and Commercialization, Carleton University**

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Wed, 6-9pm
Nicol Building 4040

Updates to this outline will be made as necessary.

Version 0.4.5

**Instructor availability**
The instructor is available via Slack or e-mail any time. Office hours by appointment.

**Calendar description**
TIMG 5202 [0.5 credit] Moving Digital Transformation and Entrepreneurship Research into Business Practices Tools, models, approaches, theories, and frameworks used to deploy digital technology to frame, create, appropriate, distribute, protect, sustain, convey, and deliver value. Streamlines the movement of research findings in digital transformation, business model innovation, and technology entrepreneurship into business practices.

Prerequisites: TIMG 5008

**Course objectives**
The recent surge in Artificial Intelligence (AI) has created both opportunities and challenges for digital transformation. This course will explore the role of AI, particularly generative AI, as a prime example of digital innovation and an enabler of digital transformation. It is structured around three elements:

- AI systems (what makes AI disruptive, point solutions vs system solutions, moving from rules to decisions, systems thinking, AI system discovery)
- Digital innovation (digital transformation, generativity, digital disruption, innovation, design)
- Case study: Generative AI (as an example of digital innovation, its system-wide impact, large language models, prompt engineering, applications of generative AI)

**Rationale**
This course is designed to build capability and knowledge in digital transformation & entrepreneurship research.

**Benefits**
This course prepares students to undertake thesis research or applied projects in digital transformation.

**Class Sessions**
This course will include interactive exercises that are best experienced **in person**. However, the course sessions will also be broadcast live and recorded on Zoom. This is meant as an alternative mode for attending the class in case you are traveling, sick, or otherwise unable to come to class. However, some of the course experience may be difficult to replicate online. To join a broadcast, log into Zoom on Brightspace.

Please see the guide on using Zoom: https://carleton.ca/online/online-learning-resources/zoom-guide-for-students.

For the weekly sessions there will be assigned readings and tasks. Those should be completed before class.

The course material and recordings of the class sessions will be made available in Brightspace.

**Student Evaluation**
All assignments are individual assignments. Some of the assignments will be started as in-class activities. These will be done in groups. However, you then need to expand on the outcomes of the in-class activity by fully developing the record of the outcomes into your own answer. What you submit is a reflection of your individual work. It needs to be clear what you added to the outcomes produced by the group.

Assignments are due at midnight of the day indicated in the schedule.

Landscape of AI tools (25%)

- Choose a category of AI tools in Futurepedia
- Conduct a landscape analysis of the chosen category
  - Extract communities of AI tools (5%): Identify and cluster the AI tools into distinct communities based on their descriptions. Use the landscape explorer for this task.
  - Describe those communities (10%): Describe each community, including the types of tools it encompasses, the common features shared among the tools, and any notable differences.
  - Identify the functions and target users of each community (10%): Analyze the primary functions these tools serve and identify their target user groups.
- Critical thinking skills: synthesize

Literature review (25%)

- Choose one of the following research questions:
  - Generative AI novelty: Will using generative AI produce more novel or more homogenized outputs?
  - Generative AI as a team member: how much autonomy should AI be given?
  - Future of interfacing with generative AI: will we still need prompt engineers?
  - AI readiness: what capabilities do companies need to successfully leverage generative AI?
- Choose at least three research papers (one of them must be from the course readings)
- Co-create the literature review with ChatGPT as your assistant
  - Use ChatGPT to generate an initial draft of your literature review
  - Critique and refine the draft by adding new information, clarifying key points, incorporating your own analysis, and supporting your arguments with evidence from the research papers.
  - Conclude your literature review by answering the chosen research question
- Submit the literature review together with a full log of the prompts and replies received from ChatGPT
- You will be assessed on the quality of your prompts and the information you provide to ChatGPT:
  - Relevance and effectiveness of the prompts used to produce the literature review (5%)
  - Depth and rigor of your critique and the improvements made to the literature review (10%)
  - Clarity and substantiation of your conclusion in response to the research question (5%)
  - Overall coherence, quality, and academic rigor of the literature review (5%)
- Critical thinking skills: synthesize and recommend

Generative AI system-level solution (25%)

- Identify an opportunity for using generative AI to enable system-wide change in an organization (5%)
  - Describe only the overall idea, and justify the choice of the organization you will study
  - It is important that the idea involves generative AI (and includes an LLM). From the landscape assignment, you should be familiar with many examples of AI tools that use generative AI
- Examine the existing context (this is the "system") where you will want to use the AI solution
  - Interview the key actors in the system using prompts (5%)
  - Identify the essential or core decisions of the system and their dependencies (5%)
  - Create a rich picture of the existing system (10%)
- **Don't just copy the output from the prompts (low effort), but synthesize what you learn**
- Critical thinking skills: synthesize

Conceptual model (25%)

- Develop the opportunity for using generative AI in more detail (5%)
  - How is using AI going to change the system? In other words, what is the transformation that you will apply to the existing system to transform it from the current to the desired situation?
- Apply systems thinking to create an ideal set of activities to execute this transformation
  - Derive a root definition for the transformation (5%)
  - Develop a conceptual model with the ideal set of activities required for the transformation (5%)
- Discuss how the proposed conceptual model addresses concerns raised by the key actors in the system and what practical challenges in implementing the AI solution (10%)
- **Don't just copy the output from the prompts (low effort), but synthesize what you learn**
- Critical thinking skills: recommend

Assignments submitted late and presentations not made will receive a grade of zero.

Plummer (2019). A short guide to building your team's critical thinking skills. *Harvard Business Review.* https://hbr.org/2019/10/a-short-guide-to-building-your-teams-critical-thinking-skills

**Special Information for Pandemic Measures**
It is important to remember that COVID is still present in Ottawa. The situation can change at any time and the risks of new variants and outbreaks are very real. There are a number of actions you can take to lower your risk and the risk you pose to those around you including being vaccinated, wearing a mask, staying home when you're sick, washing your hands and maintaining proper respiratory and cough etiquette.

**Feeling sick?** Remaining vigilant and not attending work or school when sick or with symptoms is critically important. If you feel ill or exhibit COVID-19 symptoms do not come to class or campus. If you feel ill or exhibit symptoms while on campus or in class, please leave campus immediately. In all situations, you must follow Carleton's symptom reporting protocols.

**Masks:** Carleton has paused the COVID-19 Mask Policy, but continues to strongly recommend masking when indoors, particularly if physical distancing cannot be maintained. It may become necessary to quickly reinstate the mask requirement if pandemic circumstances were to change.

**Vaccines:** Further, while proof of vaccination is no longer required as of May 1, 2023 to attend campus or in-person activity, it may become necessary for the University to bring back proof of vaccination requirements on short notice if the situation and public health advice changes. Students are strongly encouraged to get a full course of vaccination, including booster doses as soon as they are eligible, and submit their booster dose information in cuScreen as soon as possible. Please note that Carleton cannot guarantee that it will be able to offer virtual or hybrid learning options for those who are unable to attend the campus.

All members of the Carleton community are required to follow requirements and guidelines regarding health and safety which may change from time to time. For the most recent information about Carleton's COVID-19 response and health and safety requirements please see the University's COVID-19 website and review the Frequently Asked Questions (FAQs). Should you have additional questions after reviewing, please contact covidinfo@carleton.ca.

**Students with disabilities**
Students with disabilities who require academic accommodations in this course are encouraged to contact the Paul Menton Centre (PMC) for Students with Disabilities to complete the necessary forms. After registering with the PMC, make an appointment with me in order to discuss your needs at least two weeks before the first assignment is due. This will allow for sufficient time to process your request

**Plagiarism**
Plagiarism (copying and handing in for credit someone else's work) is a serious instructional offence that will not be tolerated. Please refer to the section on instructional offences in the Graduate Calendar for additional information. Plagiarism is against the TIM culture. A case of plagiarism will be referred to the Director of the TIM program and the Carleton University Ethics Committee. The instructor will not deal with the matter directly. The university has clear processes to deal with students who are suspected of plagiarism.

**Use of AI tools**
AI tools like ChatGPT can be useful in many ways in your day-to-day work as a professional. However, because they can also be abused, you must acknowledge the use of AI tools in any course work you submit.

Here are some guidelines for what not to do when using AI tools in your assignments:

- You should not rely solely on AI tools. It is important that you understand the material and complete assignments on your own. Use AI tools as a supplement, rather than a replacement for your work.
- Do not use AI tools to plagiarize (also see the section on plagiarism below). Using AI to generate or modify content to evade plagiarism detection is unethical and violates academic integrity.
- You cannot assume that AI responses are correct. AI can generate convincing but incorrect results.

Note: These guidelines were adapted from https://www.cs171.org/2023/syllabus.

**Administrative details**
These are the rules of conduct for this course:

- Please notify the instructor via e-mail, if you will not attend a class.
- Sessions will include interactive exercises. These are better experienced **in person.**
- **You must be prepared for each class.** You do so by reading the material assigned and being prepared to discuss in class how what was read can be applied in product development organizations.
- **You need to sign up for Slack.** Course announcements will made on Slack. Course discussions will take place on Slack. Don't send me an email if you have a question, but use Slack.

**Better Journals**
Business Horizons
Business & Information Systems Engineering
Entrepreneurship Theory and Practice
Harvard Business Review
Information and Organization
Information Systems Research
Journal of Business Analytics
Journal of Economics & Management Strategy
Journal of Product Innovation Management
Management Science
MIT Sloan Management Review
R&D Management
Technological Forecasting & Social Change
Technovation
Technology Innovation Management Review

**Contribution to program learning goals**

| Learning goals | Not Covered | Introduced | Taught but Not Assessed | Taught and Assessed |
|---|---|---|---|---|
| **TM1 Critical Thinking and Application of Knowledge** Graduates will demonstrate a systematic understanding of knowledge, and a critical awareness of current problems and/or new insights. | | | | ✓ |
| **TM2 Research and Scholarship** Graduates will demonstrate a conceptual understanding and methodological competence. | | | | ✓ |
| **TM3 Communication Capabilities** Graduates will communicate ideas, issues, and conclusions clearly. | | | | ✓ |
| **TM4 Professional Capacity and Autonomy** Graduates will demonstrate initiative and personal integrity when they interact with the TIM business ecosystem. | | ✓ | | |

**TIMG 5202 F24 Schedule**

| Date | Topic | Readings | Deliverables |
|---|---|---|---|
| Sep 4 | Session 1: AI adoption and integration I | Agrawal et al. (2022), Chapter 1<br>Agrawal et al. (2022), Chapter 2 | |
| Sep 11 | Session 2: AI adoption and integration II | Agrawal et al. (2022), Chapter 3<br>Agrawal et al. (2022), Chapter 13<br>Holmström & Carroll (2024) | |
| Sep 18 | Session 3: Digital innovation I | Hund et al. (2021)<br>Thomas & Tee (2022)<br>Holmström (2022) | Landscape of AI tools: Choose category |
| Sep 25 | Session 4: Digital innovation II | Zao-Sanders & Ramos (2023)<br>Cook et al. (2024)<br>Wilson & Daugherty (2024)<br>Gupta et al. (2024) | |
| Oct 2 | Session 5: From rules to decisions I | Agrawal et al. (2022), Chapter 4<br>Agrawal et al. (2022), Chapter 5<br>Agrawal et al. (2022), Chapter 6 | Landscape of AI tools |
| Oct 9 | Session 6: From rules to decisions II | Agrawal et al. (2022), Chapter 10<br>Agrawal et al. (2022), Chapter 11<br>Agrawal et al. (2022), Chapter 12 | |
| Oct 16 | Session 7: Generative AI and LLMs I | Mygland (2021)<br>Schneider et al. (2024)<br>White et al. (2023) | Literature review: Research question and rationale for articles |
| Oct 23 | Break | | |
| Oct 30 | Session 8: Generative AI and LLMs II | Chiarello et al. (2024)<br>Finkenstadt et al. (2024)<br>Weisz et al. (2023) | |
| Nov 6 | Session 9: AI as a catalyst I | Agrawal et al. (2022), Chapter 15<br>Agrawal et al. (2022), Chapter 16<br>Agrawal et al. (2023) | Literature Review |
| Nov 13 | Session 10: AI as a catalyst II | Agrawal et al. (2022), Chapter 17<br>Agrawal et al. (2022), Chapter 18<br>Burge (2015) | |
| Nov 20 | Session 11: Workshop | Nair (2015) | Generative AI system-level solution: Opportunity |
| Nov 27 | Session 12: AI in innovation and design I | Agrawal et al. (2022), Chapter 9<br>Zhu & Luo (2023)<br>Hofmann (2021) | |
| Dec 4 | Session 13: AI in innovation and design II | Just (2024)<br>Baek et al. (2024)<br>Su et al. (2024) | Generative AI system-level solution |
| | | | |
| Dec 21 | | | Conceptual model |

**Readings**
Some of the readings refer to the following book:

Agrawal, A., Gans, J. S., & Goldfarb, A. (2022). *Power and Prediction.* Harvard Business Review Press.

The readings for each session are:

*Readings for Session 1*
Agrawal, A., Gans, J. S., & Goldfarb, A. (2022). A parable of three entrepreneurs. In *Power and Prediction* (Chapter 1). Harvard Business Review Press.

In their introductory chapter to *Power and Prediction*, Agrawal et al. (2022) use a historical lens to illustrate how paradigm shifts, like the transition from steam power to electricity, could inspire us to perceive the transition towards AI-driven solutions. They highlight the importance of not just replacing one element but considering system-level changes that can optimize the entire workflow. This mirrors the potential of AI to restructure traditional systems for enhanced productivity and efficiency. Agrawal et al.'s parable can be seen as a parallel to how AI is changing business structures and systems much like electricity did.

Agrawal, A., Gans, J. S., & Goldfarb, A. (2022). AI's system future. In *Power and Prediction* (Chapter 2). Harvard Business Review Press.

Chapter 2 by Agrawal et al. (2022) refers to the current period as 'The Between Times'. It is characterized by the acknowledgment of AI's potential but a lag in its widespread adoption. A major reason behind this, as identified by the authors, is the distinction between different kinds of AI solutions – point solutions, application solutions, and system solutions. Point solutions and application solutions pertain to individual or standalone decisions and can be implemented relatively quickly. System solutions, on the other hand, involve an AI-enhanced decision that requires other substantial changes in the system and is thus harder to implement. System solutions have the potential to cause industry disruption, but can also yield higher returns on AI investments.

*Readings for Session 2*
Agrawal, A., Gans, J. S., & Goldfarb, A. (2022). AI is prediction technology. In *Power and Prediction* (Chapter 3). Harvard Business Review Press.

Agrawal et al. (2022), in their third chapter, offer a critical insight into how recent AI advancements have reduced the costs associated with predictions. The authors articulate how AI-based predictions can enhance decision-making. They provide an illustrative example of Amazon's recommendation engine to demonstrate the transition from point solutions to system solutions. Here, the authors focus on the nuances of predictions and judgments, where predictions offer a likelihood and judgments provide a preference. They also touch on how the cost decrease in predictions leads to an increase in their usage, thereby making judgment and data more valuable. The chapter emphasizes the need for organizations to recognize when they should capitalize on the efficacy of AI predictions to transition from a mere improvement within the existing system to a more comprehensive system redesign.

Agrawal, A., Gans, J. S., & Goldfarb, A. (2022). A great decoupling. In *Power and Prediction* (Chapter 13). Harvard Business Review Press.

Agrawal et al. (2022), in Chapter 13, focus on the distinction between prediction and judgment in decision-making, and how AI changes this relationship. The authors elaborate on how AI decouples these entities, allowing for predictions to be made by machines and judgment to possibly be assigned to different individuals or groups. This chapter underscores how AI creates opportunities for organizations to rethink system design from the ground up by considering who is best suited to make judgments and how often predictions should be made.

Holmström J. & Carroll N. (2024), How organizations can innovate with generative AI, *Business Horizons*, https://doi.org/10.1016/j.bushor.2024.02.010.

Generative AI is driving a new wave of innovation. The authors present a typology of four strategies – traditional tool, basic automation, automated assistance, and assisted augmentation – based on levels of automation and augmentation can guide organizations in putting generative AI to use effectively by aligning innovation objectives with the appropriate strategy. It is important to realize that generative AI is not just used for automation.

*Readings for Session 3*
Hund, A., Wagner, H. T., Beimborn, D., & Weitzel, T. (2021). Digital innovation: Review and novel perspective. *The Journal of Strategic Information Systems*, 30(4), 101695.

Hund et al. (2021) provide a comprehensive literature review on digital innovation, proposing a refined perspective on digital innovation as the manipulation of digital objects embedded in sociotechnical contexts. This relates to the digital, innovation, and development aspects of the topic, and builds upon the technology-driven framework discussed by Wiesbock & Hess (2020). It highlights the need for a cohesive digital innovation strategy that acknowledges both the technical and social factors.

Thomas, L. D., & Tee, R. (2022). Generativity: A systematic review and conceptual framework. *International Journal of Management Reviews*, 24(2), 255-278.

Thomas & Tee (2022) review the concept of generativity in digital innovation, exploring its origins, processes, and effects in management studies. The article proposes a conceptual framework of generativity that incorporates social and technical elements, and emphasizes the central role of generative fit and governance. Seven components of generativity are identified, including generative architecture, generative governance, generative community, generative fit, combinatorial innovation, generative outcomes, and generative feedback.

Holmström, J. (2022). From AI to digital transformation: The AI readiness framework. *Business Horizons*, 65(3), 329-339.

AI readiness assessment is crucial for organizations to understand their current capabilities, identify gaps, allocate resources efficiently, mitigate risks, align with business strategy, and gain a competitive edge. The AI readiness framework assesses an organization's ability to deploy AI for digital transformation across four dimensions: technologies, activities, boundaries, and goals. It facilitates analysis of current AI status and prospects for fuller value-adding deployment, inviting further theorizing on AI's role in digital transformation.

*Readings for Session 4*
Zao-Sanders, M., & Ramos, M. (2023, March 29). A Framework for Picking the Right Generative AI Project. *Harvard Business Review.* Digital Article. https://hbr.org/2023/03/a-framework-for-picking-the-right-generative-ai-project

Zao-Sanders and Ramos (2023) discuss the impact and potential applications of large language models (LLMs) such as OpenAI's ChatGPT. They propose using a risk and demand analysis to identify suitable areas for applying generative AI. Marketing and learning are highlighted as industries with demonstrated demand and lower risk, where LLMs can be effectively utilized. However, caution is advised, as even in low-risk scenarios, bias and errors can still occur, emphasizing the need for human intervention to refine and enhance the AI-generated output.

Cook, S., Hagiu, A., & Wright, J. (2024). Turn generative AI from an existential threat into a competitive advantage. *Harvard Business Review,* 102(1), 118-125.

The article explores how businesses can transform generative AI from a potential threat into a competitive advantage. It discusses implementing AI at three levels: adopting publicly available tools, customizing them, and creating continuous feedback loops. Businesses that will benefit most from generative AI are those with access to unique customer data, which can be continuously replenished through feedback loops. These include industries like online education, software development, and financial services, in which AI can enhance customer experiences, streamline processes, and tailor solutions. Companies with complex, data-driven products or offering human-interaction-based services are particularly well-positioned to leverage AI for a competitive edge.

Wilson, H.J., & Daughtery, P. (2024). Embracing Gen AI at Work: The skills you need to succeed in the era of large language models. *Harvard Business Review,* 102(5), 151-155.

The article discusses the transformative impact of generative AI (Gen AI) on the workplace, emphasizing that nearly all jobs will be affected. It outlines the need for new "fusion skills," such as intelligent interrogation, judgment integration, and reciprocal apprenticing, to effectively collaborate with AI. The authors argue that as AI tools become more integrated into business processes, individuals must learn to optimize AI output and tailor it to

specific tasks, ensuring reliable and ethical results.

Gupta, P., Ding, B., Guan, C., & Ding, D. (2024). Generative AI: A systematic review using topic modelling techniques. *Data and Information Management*, 100066.

The authors examine the research landscape of generative AI using 1,319 records from 1985-2023. They identify seven key research clusters, discusses challenges and opportunities, and call for further research in areas like explainability, robustness, cross-modal generation, and data privacy. The clusters are image processing and content analysis, content generation, emerging use cases (such as drug discovery and finance), engineering, cognitive inference and planning, data privacy and security, and research applications.

*Readings for Session 5*
Agrawal, A., Gans, J. S., & Goldfarb, A. (2022). To decide or not to decide. In *Power and Prediction* (Chapter 4). Harvard Business Review Press.

In Chapter 4, Agrawal et al. (2022) discuss the trade-off between rules and decisions. One of their key points is how advances in AI lower the cost of information and enhance decision-making. They argue that while AI promotes decision-making, rules still offer reliability and are important in interdependent systems, requiring system redesign for incorporating AI predictions effectively.

Agrawal, A., Gans, J. S., & Goldfarb, A. (2022). Hidden uncertainty. In *Power and Prediction* (Chapter 5). Harvard Business Review Press.

Chapter 5 by Agrawal et al. (2022) discusses how AI can address uncertainty and inefficiency in rule-based systems, using examples of airports and greenhouses. It highlights the potential for AI to transform entire systems, such as enabling changes in airport operations and influencing greenhouse design and crop choices.

Agrawal, A., Gans, J. S., & Goldfarb, A. (2022). Rules are glue. In *Power and Prediction* (Chapter 6). Harvard Business Review Press.

Chapter 6 by Agrawal et al. (2022) draws attention to how checklists and SOPs have been the glue that binds traditional systems. They portray the necessity of rethinking and redesigning these systems to leverage AI. For example, in education, AI's introduction into a new, more adaptable system as opposed to a traditional age-based curriculum could revolutionize personal growth and learning experiences.

*Readings for Session 6*
Agrawal, A., Gans, J. S., & Goldfarb, A. (2022). Disruption and power. In *Power and Prediction* (Chapter 10). Harvard Business Review Press.

In Chapter 10 of their book, Agrawal et al. (2022) highlight the challenges incumbents face when adopting system-level solutions compared to point solutions. System-level solutions require changes across related tasks, which can be difficult for organizations that have already optimized those tasks. Power, defined as economic power, is associated with scarcity and can shift when competition arises. The authors discuss how the redesign of systems, driven by AI, can lead to power shifts at the industry, company, and job levels. Resistance to change from those holding power creates the context for disruption.

Agrawal, A., Gans, J. S., & Goldfarb, A. (2022). Do machines have power? In *Power and Prediction* (Chapter 11). Harvard Business Review Press.

The illusion of decision-making by machines is critically discussed in Agrawal et al. (2022), in Chapter 11, where the authors illuminate the fact that machines don't actually make decisions but can appear to do so through codified human judgment. Essentially, AI can generate predictions that, when combined with pre-set rules, result in an action that resembles decision-making. The empowerment here is not in the machine itself but in the scalability it brings and the reallocation of decision-making powers.

Agrawal, A., Gans, J. S., & Goldfarb, A. (2022). Accumulating power. In *Power and Prediction* (Chapter 12). Harvard Business Review Press.

In Chapter 12, Agrawal et al. (2022) emphasize the advantages of initiating system-level innovation with AI early on. They highlight that AI's ability to learn and improve over time creates a significant advantage for first movers in the market. The marginal cost of generating predictions with AI is low, allowing for rapid improvement and attracting more users. Feedback loops play a crucial role in system design, where frequent data collection and assessment are necessary for effective learning. This highlights the need for system redesign and high-frequency feedback collection in order to harness the full potential of AI in various domains.

*Readings for Session 7*
Mygland, M. J., Schibbye, M., Pappas, I. O., & Vassilakopoulou, P. (2021). Affordances in human-chatbot interaction: a review of the literature. *Responsible AI and Analytics for an Ethical and Inclusive Digitized Society: IFIP WG 6.11 Conference on e-Business, e-Services and e-Society*, 3-17. Springer.

Mygland (2021) concentrates on the interaction between humans and AI but narrows down its focus on chatbot affordances. This paper accentuates the significance of designing chatbot-based services considering the interactions between humans and AI. This correlates to the human and intelligence aspects of the topic, with a specific emphasis on how chatbots can be developed to provide an array of functions such as assistance provision, information distillation, and personalization.

Schneider, J., Meske, C., & Kuss, P. (2024). Foundation models: A new paradigm for artificial intelligence. *Business & Information Systems Engineering*, 66(2), 221–231.

This article explores the rise of foundation models in AI, which are large-scale, pre-trained models adaptable to various tasks. These models accelerate AI innovation across industries by enhancing applications through fine-tuning or prompt engineering. However, their dominance also raises concerns about monopolistic power and governance challenges. The article highlights research opportunities for Information Systems and AI development.

White, J., Fu, Q., Hays, S., Sandborn, M., Olea, C., Gilbert, H., ... & Schmidt, D. C. (2023). A prompt pattern catalog to enhance prompt engineering with ChatGPT. *arXiv preprint* arXiv:2302.11382, 1-19.

White et al. (2023) focus on prompt engineering, which is fundamental in defining interactions with LLMs. They present a catalog of techniques in pattern form, demonstrating how such patterns can be employed to tackle common challenges when working with LLMs. This paper imparts valuable insights on effectively using LLMs in practical applications, ensuring that they can be successfully integrated into systems for various tasks.

*Readings for Session 8*
Chiarello, F., Giordano, V., Spada, I., Barandoni, S., & Fantoni, G. (2024). Future applications of generative large language models: A data-driven case study on ChatGPT. *Technovation*, 133, 103002.

The authors explore the evolving role of generative Large Language Models (LLMs) like ChatGPT in innovation. By analyzing over 31,000 tasks from 3.8 million tweets, the study identifies clusters of tasks (such as writing code, writing articles and stories, or answering questions) and highlights the versatility of LLMs across business areas such as HR, programming, office automation, search, social media, and education. It links LLMs to four stages of innovation management (idea generation, idea selection, development, and diffusion/adoption).

Finkenstadt, D. J., Sotiriadis, J., Guinto, P., & Eapen, T. (2024). Contingency Scenario Planning Using Generative AI. *California Management Review Insights*. https://cmr.berkeley.edu/2024/01/contingency-scenario-planning-using-generative-ai.

This article highlights how generative AI (GenAI) can enhance contingency scenario planning (CSP), helping businesses and governments quickly adapt to unexpected disruptions. While traditional scenario planning spans years, CSP compresses timelines to weeks or days. GenAI improves strategic foresight and business continuity planning, offering firms better tools to anticipate and respond to future challenges.

Weisz, J. D., Muller, M., He, J., & Houde, S. (2023). Toward General Design Principles for Generative AI Applications. *arXiv preprint* arXiv:2301.05578, 1-16.

Weisz et al. (2023) highlighted the increasing use of generative AI technologies and the need for guidance in designing applications that ensure safe and productive use. Based on human-AI co-creation research, Weisz

proposed seven design principles for generative AI applications, with six principles focusing on characteristics of generative AI and one emphasizing designing against potential harms.

*Readings for Session 9*
Agrawal, A., Gans, J. S., & Goldfarb, A. (2022). The new judges. In *Power and Prediction* (Chapter 15). Harvard Business Review Press.

In Chapter 15, Agrawal et al. (2022) delve into the redistribution of power within an organization as a result of decoupling prediction and judgment through the implementation of AI. The authors explore how the integration of AI into the decision-making process may necessitate the reallocation of decision rights and shift the balance of power. They also discuss the factors influencing this allocation, such as information, skills, incentives, and coordination. This chapter presents a critical examination of how AI not only contributes to enhancing predictions but also potentially changes the structural dynamics within an organization.

Agrawal, A., Gans, J. S., & Goldfarb, A. (2022). Designing reliable systems. In *Power and Prediction* (Chapter 16). Harvard Business Review Press.

Chapter 16 by Agrawal et al. (2022) examines two primary system design approaches that address the reduced reliability arising from integrating AI-based decision-making: coordination and modularity. Coordination involves aligning information flow, incentives, and decision rights such that every decision-maker optimizes for the overall objective. Modularity, in contrast, isolates an AI-enhanced decision to reduce coordination costs but at the expense of synergies. The complexity of systems with interdependent decisions can escalate quickly, making simulation tools such as digital twins crucial in designing systems by allowing different combinations to be tested.

Agrawal, A., Gans, J. S., & Goldfarb, A. (2023). Artificial intelligence adoption and system-wide change. *Journal of Economics & Management Strategy*, 1-11. https://doi.org/10.1111/jems.12521

Agrawal et al. in their 2023 study, emphasized the importance of analyzing AI adoption beyond the individual task level. Organizations are comprised of multiple interacting tasks, and AI adoption may necessitate system-wide changes. This analysis found that while AI enhances predictive abilities, it also increases decision variation, which can be problematic if decisions across the organization are interconnected. Reducing inter-dependencies can facilitate AI adoption, but at the expense of synergies. On the other hand, mechanisms for inter-decision coordination can enhance AI adoption when there are more inter-dependencies.

*Readings for Session 10*
Agrawal, A., Gans, J. S., & Goldfarb, A. (2022). The blank slate. In *Power and Prediction* (Chapter 17). Harvard Business Review Press.

Agrawal et al. (2022), in Chapter 17, set the stage by addressing how companies, encumbered by traditional systems, must rethink their approach and harness the potential of AI in decision-making. They propose the AI Systems Discovery Canvas, which essentially is about re-imagining the system from scratch, allowing companies to streamline decision-making by utilizing AI's predictive capabilities. This new system can increase a firm's efficiency and value. For instance, in the insurance industry, AI can enable companies to predict risks with such accuracy that they can not only insure but help mitigate the risk, adding immense value to their offerings.

Agrawal, A., Gans, J. S., & Goldfarb, A. (2022). Anticipating system change. In *Power and Prediction* (Chapter 18). Harvard Business Review Press.

Chapter 18 by Agrawal et al. (2022) sheds light on the practical applications of AI in the medical field. This chapter provides a tangible example of an AI system that can predict heart attacks with remarkable accuracy. The authors discuss how such a point solution, which initially helps in making a single decision (such as administering a test), could potentially transform into a system-level solution. For instance, if the AI is integrated with a smartwatch, it could enable heart attack predictions to be made in real-time at a patient’s home. This chapter addresses the importance of recognizing the core decisions within an organization and how a robust AI system can create avenues for alternative system-level solutions.

Burge, S. (2015). An overview of the Soft Systems Methodology.
https://eindhovenengine.nl/wp-content/uploads/2023/01/Soft-Systems-Methodology-source-2.pdf

Burge (2015) gives a practitioner's account of using the Soft Systems Methodology (SSM). This is a clear tutorial on how to use SSM, using an easy-to-understand case study of a marketing system. SSM is an approach for modeling transformations of socio-technical systems, ie systems that consist of both human and non-human actors, and need to be designed differently than technical systems. The goal of using SSM is to start with a problematic situation that we want to improve and end with strategies for making those changes.

*Readings for Session 11*
Nair, U. (2015). Soft systems methodology for personalized learning environment. *E-Learning and Digital Media*. 12(1), 34-56.

Nair (2015) discusses the challenges universities face when implementing technology in their learning environments, including outdated virtual learning systems and a potential focus on technology over the actual learning process. It proposes using Soft Systems Methodology (SSM) as an approach to bridge the gap between technology and the learning needs of students. The aim is to design a personalized learning environment that shifts from a tutor-centric to a learner-centric approach by involving various stakeholders. SSM can address criticisms of existing e-learning systems and provide a systematic framework for designing effective online learning environments that prioritize individual learners' needs and styles.

*Readings for Session 12*
Agrawal, A., Gans, J. S., & Goldfarb, A. (2022). The greatest system of all. In Power and Prediction (Chapter 9). Harvard Business Review Press.

Agrawal et al. (2023), in Chapter 9, discuss how innovations within the innovation system can have cascading effects on other systems. They highlight the role of AI in predicting the consequences of new combinations, enabling hypothesis generation and potentially enhancing innovation productivity. They emphasize the need to reconsider the entire innovation system to fully leverage this technology and avoid downstream bottlenecks.

Zhu, Q., & Luo, J. (2023). Generative transformers for design concept generation. *Journal of Computing and Information Science in Engineering*, 23(4), 041003.

Zhu and Luo (2023) explore innovation at the system's design phase. They focus on how AI, particularly natural language generation, can be harnessed to facilitate early-stage design concept generation. Here, the system is the design process itself, and the actors are the designers aided by AI. The innovation lies in the utilization of AI to synthesize domain knowledge and catalyze problem-solving. This represents an evolution in the traditional knowledge base and tools available to the designers.

Hofmann, P., Stähle, P., Buck, C., & Thorwarth, H. (2021). Data-driven applications to foster absorptive capacity: A literature-based conceptualization. *Hawaii International Conference on System Sciences*, 4880-4889.

Hofmann (2021) addresses the role of data-driven applications in enhancing an organization's capability to create, disseminate, and exploit knowledge, which is termed as absorptive capacity. Through a structured literature review, Hofmann identifies seven data-driven application capabilities and demonstrates how they can foster absorptive capacity in various ways.

*Readings for Session 13*
Just, J., Ströhle, T., Füller, J., & Hutter, K. (2024). AI-based novelty detection in crowdsourced idea spaces. *Innovation*, 26(3), 359-386.

This article positions Natural Language Processing (NLP) as a central player in rethinking roles in AI-driven innovation and highlights how it transforms traditional intermediation functions. NLP acts as an innovation intermediary that analyzes patent databases, social media, and crowdsourcing platforms with the goal of enhancing early-stage innovation tasks like forecasting trends and matching solutions to problems.

Baek, J., Jauhar, S. K., Cucerzan, S., & Hwang, S. J. (2024). ResearchAgent: Iterative research idea generation over scientific literature with large language models. *arXiv preprint* arXiv:2404.07738.

Baek et al. demonstrate AI's potential to innovate the scientific research process by automating and improving idea

generation and refinement. ResearchAgent uses LLMs and knowledge graphs to autonomously propose and refine research ideas, mimicking human peer-review processes to accelerate and enhance scientific productivity.

Su, H., Chen, R., Tang, S., Zheng, X., Li, J., Yin, Z., ... & Dong, N. (2024). Two Heads Are Better Than One: A Multi-Agent System Has the Potential to Improve Scientific Idea Generation. *arXiv preprint* arXiv:2410.09403.

This paper introduces a multi-agent approach to AI-based scientific discovery and showcases the potential for collaborative systems to advance innovation in scientific research. The paper describes a system, VIRSCI (virtual scientist), that organizes LLM-based agents to mimic collaborative scientific teamwork, generating and refining research ideas that outperform traditional methods in novelty and impact