Guide to Produce Scoping Literature Reviews Using AI Tools

Objective

This guide offers a clear, step-by-step method for using AI tools to conduct scoping reviews—from creating your review question to sharing your final insights. Along the way, we focus on keeping the process ethical, current, and easy to follow for both students and faculty

This guide is designed to support TIM students and faculty:

- Formulate clear and effective review questions.
- Conduct a thorough and reproducible scoping literature review.
- Use AI tools to select and screen relevant studies, extract and synthesizing key findings, ensure ethical and transparent reporting practices, and generate feedback on review drafts
- Contribute to the guide's improvement and foster a collaborative learning community.

Structure

The guide is organized into three parts:

PART 1. FOUNDATION OF SCOPING REVIEWS

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Glossary

Term	Definition
Boolean operators	Logical connectors (AND, OR, NOT) used in database searches to refine search results by including or excluding specific terms.
Grey literature	Information produced outside of traditional publishing and distribution channels, such as reports, conference proceedings, and government documents.
Human oversight	The involvement of human judgment and decision-making in monitoring, guiding, or intervening in automated systems to ensure ethical, accurate, and responsible outcomes.
PRISMA-ScR	The Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Scoping Reviews, a framework that provides guidelines for conducting and reporting scoping reviews.
Scoping review	A type of literature review that maps key concepts, evidence, and research gaps in a field, typically without assessing the quality of the included studies.
Systematic review	A structured and comprehensive review of existing research on a specific question, using a rigorous methodology to identify, appraise, and synthesize relevant studies.

Introduction

A scoping review gathers and examines a wide range of sources to show what is known and unknown. Gaps in the literature can inspire new business ideas or research questions. Within Technology Innovation Management (TIM), scoping reviews can inform venture pitches, new market analysis, business opportunities, new product development, process improvement, competitive landscape, technology disruptions, emerging business models, IP management, innovation ecosystems, research vignettes, TIM projects and theses, among other key areas.

In Technology Innovation Management, a scoping review helps you see what is already known—whether in blockchain commercialization, open innovation ecosystems, or emerging AI startups—and spot new opportunities. By combining human expertise with AI tools, TIM researchers can sift through large, varied studies, uncover practical insights from non-traditional sources, and guide innovation strategies for the future

Unlike a systematic review, scoping reviews cast a wider net, enabling TIM students, faculty, and practitioners to gain insights into rapidly evolving technology landscapes—sometimes well before a rigid set of methodologies and theoretical constructs have fully matured.

If your review question is narrowly defined, aims to evaluate the quality of interventions, or measures effectiveness (e.g., comparing success rates of two IP licensing strategies), a systematic review is more suitable.

1.1 When to Use a Scoping Review Instead of a Systematic Review

In TIM, scoping reviews are especially valuable when:

1. **Review questions are broad or exploratory**
    - Use a scoping review if you wish to explore a wide variety of studies on a topic, rather than measuring how well something works.
    - Example: Investigating how AI-driven platforms are transforming technology commercialization across various industries.

2. **Emerging topics**
    - Use when the field is new, and key concepts, definitions, and knowledge gaps are unclear.
    - Example: Mapping quantum computing applications in early-stage technology startups, where key players, definitions, and standard practices are still evolving.

3. **Heterogeneous literature**
    - Use when studies cover diverse methodologies, study designs, and disciplines, making systematic synthesis impractical.
    - Example: Integrating findings from multidisciplinary sources (engineering, business, sociology, etc.) on the use of AI in different industries (e.g., healthcare, finance, manufacturing)

4. **Minimal need for critical appraisal**
    - Use when assessing the methodological quality and risk of bias of individual studies is not a primary objective.
    - Example: When the goal is to catalog existing strategies for open innovation rather than evaluate their effectiveness quantitatively.

5. **Identifying gaps and trends**

- Use when the goal is to summarize existing research, identify gaps, and inform future research directions rather than draw specific conclusions on intervention efficacy.
- Example: Spotting uncharted areas in blockchain-based supply chain management, highlighting market opportunities and research directions.

1.2 Key Frameworks

Scoping reviews in TIM often follow one or more of five main frameworks:

- Arksey and O'Malley (2005)
- Levac et al. (2010)
- Joanna Briggs Institute (JBI) Scoping Review Framework
- PRISMA-ScR
- Recent AI-focused updates (2020–present).

Each framework brings a different strength to the process—for example, stakeholder engagement or standardized reporting—and may be combined for a better outcome

1. **Arksey and O'Malley (2005)**
    - They created a five-step outline that you can update as you go. It works well for fast-changing fields like financial technology (fintech).
    - Example: Use the Arksey and O'Malley (2005) scoping approach to broadly map out existing literature on wearable technology for remote patient monitoring, capturing everything from academic journals to patent filings and industry whitepapers. This high-level mapping helps product developers examine the full landscape, identifying emerging areas (e.g., sensor innovations) and untapped market niches.
2. **Levac et al. (2010)**
    - Extends Arksey and O'Malley's model by stressing stakeholder engagement—vital for TIM researchers who must collaborate with startups, incubators, or corporate R&D teams.
    - Example: Engage startup accelerators, device manufacturers, and regulatory bodies in refining your scoping review on IoT-based smart manufacturing. Their feedback can help you adjust the scope in real time—ensuring your final review addresses the most pressing industry questions and technological challenges.
3. **Joanna** Briggs Institute (JBI) Scoping Review Framework

- Offers a refined methodology for planning and conducting scoping reviews. In TIM, this can help ensure rigor and transparency when examining diverse sources (e.g., patents, technical standards, market analyses).
- *Example*: Follow JBI's refined methodology to conduct a scoping review on 3D-printing technologies for rapid prototyping. Use the JBI approach to systematically plan and execute literature searches, guaranteeing a transparent process that boosts your credibility when pitching commercialization strategies to potential investors or industry partners.

4. **PRISMA-ScR**

    - Focuses on standardized reporting of scoping reviews, making your technology roadmap or innovation policy scoping study more credible and replicable.
    - Example: Ensure your scoping review on blockchain applications in supply chain management follows PRISMA-ScR guidelines for transparent, reproducible reporting. A clear flow diagram and well-documented inclusion criteria demonstrate to potential investors or collaborators that you have thoroughly vetted the market and underlying technologies.

5. **Recent Updates (2020–Present)**

    - Incorporate AI-powered literature review tools to manage the expanding volume of innovation-related studies, speeding up data collection and analysis.
    - Example: Leverage AI-based literature screening and data extraction tools to accelerate your scoping review on digital entrepreneurship ecosystems post-COVID-19. These newer methods can help you quickly navigate large volumes of unstructured data (e.g., social media trends or preprint repositories), ensuring that you capture rapidly evolving technological shifts in real time.

1.3 Benefits of Using AI for Scoping Reviews in TIM Context

AI can manage large volumes of diverse data—quickly and consistently—making it invaluable for scoping reviews in TIM. It helps teams move faster to market, discover better product-market fits, stay ahead of disruptive technologies, and uncover new opportunities or threats. Overall, AI speeds up the research process and delivers more actionable insights.

The key benefits of integrating AI into scoping reviews in the TIM context include:

- **Speed and efficiency:**

    - **Rapid literature screening:** AI tools can quickly scan and organize large volumes of articles, patents, and reports, making them especially valuable in fast-changing technology fields.
    - **Automated deduplication:** AI algorithms detect and remove duplicate studies, saving considerable time, especially when searching across multiple databases for modern technology solutions or startup case studies.
- **Enhanced discovery:**
    - **Diverse data sources:** AI can pull from a broad array of sources—academic journals, preprints, corporate websites, social media, and more—capturing real-time insights into fast-evolving markets.
    - **Intelligent recommendations**: Machine learning–based recommendation systems can surface relevant but less visible research (e.g., startup whitepapers, conference abstracts), promoting a more comprehensive view of the innovation landscape.
- **Improved organization:**
    - **Topic clustering:** AI tools group articles into thematic clusters (e.g., "blockchain-based supply chain optimization," "IoT in smart manufacturing"), helping TIM scholars quickly identify emerging subfields or niches.
    - **Automatic tagging & categorization:** Keywords and metadata can be automatically extracted, making it easier to track and organize specific topics like "IP management," "digital entrepreneurship," or "innovation ecosystems."
- **Scalable analysis:**
    - **Big data handling:** AI excels at processing massive datasets, which is crucial when investigating large-scale phenomena such as global patent filings or venture capital investments in multiple technology domains.
    - **Dynamic updating:** As new publications appear, AI can re-run searches and highlight the latest research, enabling timely additions to your literature pool without exhaustive manual screening.
- **Reduced human error:**
    - **Consistent screening criteria:** Automated inclusion and exclusion processes reduce subjective or inconsistent decisions, giving review teams greater confidence in their screening results.

    - **Continuous refinement:** Teams can tune AI models to focus on specific aspects—like certain technologies or market segments—thereby refining search accuracy over time.

- **Insight generation:**
    - **Text Summarization:** AI tools can generate concise overviews of complex studies, making it easier for TIM professionals to spot key findings (e.g., technology readiness levels, business model innovations).
    - **Trend detection:** By analyzing patterns in published material (keywords, citations, research designs), AI can reveal emerging trends (e.g., early signals of a shift toward quantum computing in finance).
- **Cost savings:**
    - **Streamlined workflows:** Automation reduces the number of manual hours spent on preliminary screening and data extraction, allowing reviewers to concentrate on deeper interpretation and strategic implications.
    - **Resource allocation:** Freed-up researcher time can be redirected to more critical tasks such as stakeholder engagement, validating AI outputs, or planning technology roadmaps.

1.4 Limitations of Scoping Reviews

Scoping reviews give you a broad overview of a topic—particularly useful in TIM—yet they come with certain drawbacks you should keep in mind:

1. **Lack of critical appraisal**
    - You may capture low-quality studies, such as anecdotal claims about innovation incubation success without rigorous data.
    - Example: When surveying innovation incubator outcomes, the scoping review might include highly speculative blogs or anecdotal success stories, overlooking important methodological flaws. This lack of rigorous appraisal can lead to an inflated perception of how effective certain incubation strategies truly are.
2. **Broad and less focused scope**
    - You might have a high-level overview of IP management strategies but insufficient depth for policy recommendations.

- Example: A scoping review examining global IP management strategies in emerging technology could gather a wide array of information—patent analytics, trade secrets, licensing frameworks—but remain too general to guide specific policy or strategic decisions at a national innovation agency.

3. **No formal strength-of-evidence assessment**

   - The range of methodologies in TIM (quantitative, qualitative, case studies) makes it difficult to uniformly assess quality.
   - Example: When exploring digital entrepreneurship in different markets, you might include everything from small qualitative case studies to large-scale surveys. Without a uniform standard of evidence quality, it becomes challenging to compare findings and prioritize the most reliable data.

4. **Selection bias**

   - Without strict inclusion criteria, you risk overemphasizing highly cited technology clusters and missing newer, underexplored areas.
   - Example: Focusing on highly cited articles about AI startups might exclude innovative, under-the-radar studies from new journals or lesser-known regions. Consequently, the review would miss emerging technologies and less recognized innovation hubs.

5. **Heterogeneity of studies**

   - Combining data with technical feasibility studies can complicate thematic analysis.
   - Example: A scoping review on smart city innovations might combine municipal financing data, engineering feasibility reports, and user experience research. Disparate formats and analytical methods make it difficult to consolidate findings into coherent thematic insights.

6. **Lack of meta-analysis**

   - You will not calculate effect sizes for outcomes like return on investment in emerging ventures.
   - Example: While investigating returns on investment for IoT ventures, a scoping review will not produce statistical effect sizes across various funding rounds or business models. TIM professionals seeking quantitative benchmarks might be left without concrete numerical estimates.

7. **Time and resource-intensive**

- Mining complex domains—like smart manufacturing or green tech—requires extensive, iterative searching.
- Example: Charting all available literature on green technology adoption (e.g., solar, wind, biofuel, carbon capture) requires extensive searches across academic databases, market research firms, and policy documents. This can stretch team capacities and extend timelines.

8. **Difficulty in defining scope**

    - Balancing comprehensive coverage with feasibility is tricky when dealing with fast-moving technology fields.
    - Example: In a dynamic field like quantum computing, deciding whether to include peripheral areas (e.g., quantum cryptography vs. quantum sensors) can be overwhelming. Over-scoping might lead to an unwieldy review, while under-scoping risks missing crucial subtopics.

9. **Risk of overlooking grey literature**

    - Missing industry whitepapers or startup pitch decks could undervalue real-world insights.
    - Example: If industry whitepapers from technology giants or startup pitch decks are not included, real-world applications—like pilot projects using AI in supply chain management—might be left out. This omission can diminish the practical value of the review for TIM practitioners.

10. **Challenges in updating**

    - Technology trends shift rapidly, demanding frequent re-scoping to stay current.
    - Example: A scoping review on non-fungible tokens (NFT) platforms conducted today could quickly become outdated as new marketplaces, regulations, or technical standards emerge. Regular re-scoping and updates are essential to remain relevant in fast-moving technology sectors.

1.5 Limitations of Using AI Tools to Produce Scoping Reviews

AI tools can improve productivity when mapping complex technology markets, yet caution is necessary:

1.5.1 AI-created mistakes in citations – sometimes called 'hallucinations'

- **Limitation**: An AI might invent references ("hallucinations") or misattribute authors regarding cloud computing commercialization.

- **Mitigation**:
    - Double-check each citation in IEEE Xplore, Scopus, or Google Scholar.
    - Use Zotero or Mendeley to ensure format accuracy and consistent referencing.

1.5.2 Lack of Contextual Understanding

- **Limitation**: AI may oversimplify multi-stage innovation models, missing critical nuances about ecosystem stakeholders.
- **Mitigation**:
    - Rely on human expertise for domain context.
    - Validate AI summaries with original studies and industry experts.

1.5.3 Bias in AI-Generated Content

- **Limitation**: AI may reflect biases favoring **Anglophone research** or well-funded corporate labs.
- **Mitigation**:
    - Conduct **diverse database searches**.
    - Confirm AI-driven insights by **triangulating** with multiple sources.

1.5.4 Overreliance on Recent Literature

- **Limitation**: AI might miss foundational works in technology transfer, foundational patents, or early research on a technology.
- **Mitigation**:
    - Use manual backward citation to find classic publications.
    - Scan references in foundational TIM papers or historical innovation case studies.

1.5.5 Difficulty Managing Grey Literature

- **Limitation**: AI commonly overlooks industry whitepapers, government policy briefs, or venture capital reports.
- **Mitigation**:
    - Supplement with targeted grey literature searches (e.g., corporate websites, specialized repositories).

- Manually assess **non-academic** sources for relevance and quality.

1.5.6 Inconsistent Handling of Research Methodologies

- **Limitation**: An AI may wrongly classify both a qualitative startup case study and a large-scale R&D investment analysis under the same category.
- **Mitigation**:
  - Manually confirm each study's design and sample.
  - Engage TIM experts to appraise methodological soundness.

1.5.7 Ethical Concerns and Plagiarism Risks

- **Limitation**: AI-generated text might closely resemble existing literature on open innovation or IP strategy.
- **Mitigation**:
  - Always cite sources.
  - Use plagiarism detection tools like Turnitin.
  - Follow institutional and publication ethics guidelines.

1.6 AI Biases

When using AI for scoping reviews in TIM, remember that different biases can shape your understanding of technology trends and emerging markets.

1.6.1 Selection bias

- **Bias**: Overrepresentation of highly visible sources (e.g., leading technology journals) while ignoring non-English or underrepresented regions.
- **Example:**
  - An AI-driven literature search on digital entrepreneurship repeatedly prioritizes reports from large, well-known **technology** companies in Silicon Valley, ignoring valuable case studies from smaller ventures or emerging regions (e.g., Southeast Asia). As a result, the final review underrepresents diverse startup ecosystems.
- **Mitigation**:

- Extend your search to regional databases or local innovation hubs (e.g., Asia, Africa, or Latin America).

1.6.2 Algorithmic bias

- **Bias**: AI may amplify established perspectives on Silicon Valley success, downplaying alternative innovation ecosystems.
- **Example:**
  - An AI tool trained on data from software-based enterprises may incorrectly categorize studies about hardware innovation in robotics or biotech as irrelevant. This skews the literature set, making it difficult to identify opportunities in sectors outside the AI's "learned" domain.
- **Mitigation**:
  - Use multiple AI tools, cross-verify results, and highlight emerging markets or niche industries.

1.6.3 Confirmation bias

- **Bias**: AI may align with initial search terms ("successful platform business models") while excluding contradictory findings.
- **Example:**
  - If initial keyword filters emphasize **"successful" blockchain pilots**, the AI may exclude articles discussing **failed or stalled pilots**. This one-sided selection inflates the perceived success rate of blockchain implementations in supply chain or coordination.
- **Mitigation**:
  - Include counter-narratives (e.g., "failures of platform models") and examine the results critically.

1.6.4 Citation bias

- **Bias**: AI prioritizes widely cited older work on IP management, ignoring new but influential preprints on patent analytics.
- **Example:**
  - While scoping emerging green-tech projects, an AI tool ranks publications primarily by citation counts. Seminal but older or less-cited works on sustainable

materials receive little attention, causing the review to miss potentially groundbreaking early research.

- **Mitigation**:
    - Regularly update search parameters.
    - Include less-cited but novel or disruptive studies.

1.6.5 Language and Accessibility Bias

- **Bias**: AI focuses on English-language open-access journals, omitting relevant studies in Chinese, French, or Spanish.
- **Example:**
    - The AI platform defaults to searching English-only databases for literature on open innovation. It overlooks non-English case studies (e.g., in Japanese, French, or Spanish) examining unique IP licensing and university-industry collaboration models outside the Anglophone world.
- **Mitigation**:
    - Use multilingual databases.
    - Translate or commission translations of key non-English papers.

1.6.6 Data Hallucination

- **Bias**: AI might merge concepts, producing a **fictitious reference** about "IoT-based IP commercialization" from a nonexistent source.
- **Example:**
    - The AI engine might invent a "highly cited conference paper" on IoT security solutions that does not actually exist. It merges partial details from multiple sources, leading the reviewer to chase down fictitious references or, worse, include them as legitimate findings.
- **Mitigation**:
    - Verify references and data in standard academic databases.
    - Investigate suspicious or incomplete citations manually.

1.7 Human Oversight

In TIM scoping reviews, human oversight involves researchers, faculty, or industry experts:

- **Monitoring** AI outputs for domain accuracy (e.g., correct application of innovation frameworks).
- **Evaluating** the suitability and credibility of included studies (e.g., ensuring newly funded R&D projects are captured).
- **Intervening** when AI misinterprets a key concept (e.g., conflating digital entrepreneurship with e-commerce alone).

TIM practitioners must blend AI's efficiency with their contextual knowledge of emerging technology markets, investor behaviors, and regulatory landscapes to maintain methodological soundness.

1.8 Step-by-step Approach to Grey Literature Searches

Grey literature can reveal real-world insights that traditional journals often miss—like industry roadmaps, market reports, or policy drafts. Use the following steps to make sure you capture insights from these valuable sources:

1. **Define the Scope of Grey Literature**
    - Identify which technology reports, innovation policy documents, and whitepapers align with your review question (e.g., "How do corporate accelerators foster digital entrepreneurship?").
2. **Pick Your Main Keywords**
    - Outline core TIM concepts (e.g., "open innovation," "venture capital trends") and synonyms.
    - Combine them with Boolean operators ("IoT AND cybersecurity" OR "IoT AND privacy").
3. **Select Relevant Grey Literature Sources**
    - **Government databases**: Policy frameworks on startups, public R&D funding programs.
    - **Think tanks and NGOs**: Reports on global technology adoption (e.g., Brookings, World Economic Forum).
    - **Industry reports**

    - Examine market research firms like Gartner and Forrester for high-level trends.
    - Check CB Insights or PitchBook for startup funding data and technology acquisitions.
    - Use patent databases (USPTO, Google Patents) to see current innovation activity.
- **Conference proceedings**
    - Explore presentations or papers from IEEE or the Academy of Management that focuses on technology and entrepreneurship.
- **Institutional repositories**
    - Search university or corporate archives for theses and working papers about technology commercialization.

4. **Search Within Specialized Databases**
    - **OpenGrey** for European technology whitepapers.
    - **NTIS** (U.S. technical reports).
    - **ProQuest Dissertations & Theses** for doctoral work on TIM.
    - **Google Scholar** with filters to exclude peer-reviewed articles, focusing on conference slides or corporate briefs.
5. **Search for Competitor Information**
    - **List your competitors**: Write down the companies in your market or technology space, from big players to smaller startups.
    - **Visit official company websites**: Look for sections such as “About Us,” “Newsroom,” or “Investor Relations” to find announcements, annual reports, and strategic updates.
    - **Monitor press releases**: Track official statements on product launches, partnerships, and funding rounds to gauge the competitor’s current focus and future direction.
    - **Check SEC filings**: If available (e.g., via EDGAR for US-based companies), review quarterly and annual reports for deeper insights into financials, R&D investments, and potential risks or opportunities the company foresees.

- **Leverage specialized databases**: Use tools like Crunchbase, PitchBook, or Bloomberg for aggregated competitor data, including funding histories, acquisitions, and executive movements.
- **Assess credibility and bias**: Note that company-published materials can present an optimistic viewpoint; cross-reference findings with external sources or industry analysts to confirm claims.

6. **Contact Organizations and Experts**
    - Reach out to government agencies, startup incubators, or technology association leaders for unpublished data.
    - Network via LinkedIn or TIM conferences to access proprietary or embargoed insights.
7. **Filter and Evaluate Sources**
    - **Authority**: Is the report from a recognized technology consortium or verified industry leader?
    - **Credibility**: Are analytical methods explained? Is there a conflict of interest (e.g., sponsored by a single vendor)?
    - **Relevance**: Does it specifically address your review question related to innovation management?
    - **Timeliness**: With technology evolving fast, check whether the source remains current.

1.9 Reference Management

Organizing a scoping review in TIM often involves hundreds of sources—from academic articles to market research or new market analyses.

Effective reference management:

1.9.1 Why Reference Managers Help

- **Efficient organization**
  Create folders for IP studies, digital platforms research, policy documents, etc.
- **Automated citation formatting**
  Generate references in APA, Harvard, or custom in-house styles.

- **Collaboration and sharing**
  Allow research teams across universities or technology labs to co-manage references in real time.
- **Duplicate detection**
  Spot repeated whitepapers or the same study from multiple conference proceedings.
- **Integration with writing software**
  Cite seamlessly in Word, Google Docs, or LaTeX.

1.9.2 Reference Managers

We recommend the use of Zotero with Mendeley and EndNote as alternatives

- **Zotero**
  - Captures webpages and it is integrated with Google Docs
  - Integrates with AI plugins (e.g., ARIA, ResearchRabbit) for AI-assisted recommendations.
  - Excellent for quickly saving references from webpages or technology news.
  - Open source
- **Mendeley**
  - AI-driven suggestions for new papers in your field of IoT, AI, or digital entrepreneurship.
  - Strong PDF annotation and social features to connect with fellow TIM researchers.
- **EndNote**
  - Ideal for large-scale data management, such as extensive R&D portfolio analyses.
  - Integrates with external AI tools like ResearchRabbit for advanced literature mapping.

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PART 2. METHOD

Introduction

Conducting a scoping review requires a structured approach. This ensures clarity, transparency, and reliability throughout the research process. Part 2 of this guide outlines a step-by-step method tailored for TIM students, faculty and professionals who are integrating AI tools to enhance efficiency and precision in the scoping review process.

The method consists of nine steps, each integrating AI for improved efficiency:

1. **Formulate the Review Question and Scope** – Define the research question and scope using AI-assisted refinement.
2. **Search for Articles** – Use AI-driven search strategies to retrieve relevant literature.
3. **Select Articles** – Screen and filter studies using AI-assisted tools while ensuring manual validation.
4. **Extract Data** – Utilize AI to extract and organize key study insights.
5. **Analyze and Synthesize Data** – Identify trends, themes, and gaps using AI-powered categorization.
6. **Interpret Results** – Balance AI-generated insights with critical human evaluation.
7. **Write the Scoping Review** – Use AI for drafting and structuring content while maintaining human oversight.
8. **Incorporate Ethical Considerations** – Apply ethical guidelines to AI integration and research integrity.
9. **Disseminate Findings** – Leverage AI for summarization, visualization, and research dissemination.

To support both authors and reviewers, Part 2: Method also includes a Checklist that helps ensure the scoping review meets methodological and ethical standards. This checklist is a tool designed to verify completeness, identify areas for improvement, and enhance the overall quality of the review.

AI enhances efficiency in literature reviews but does not replace human expertise. Use AI for automating repetitive tasks, such as summarization and categorization, while relying on human judgment for critical analysis, theoretical alignment, and decision-making.

Manual oversight ensures accuracy, depth, and theoretical alignment. Practical AI integration can streamline, but not automate, critical thinking.

Critical thinking is the ability to analyze, evaluate, and synthesize information systematically to make informed decisions. For TIM students, faculty, and professionals, it involves questioning assumptions, assessing evidence, identifying biases, and applying logical reasoning to solve complex problems in technology innovation and management.

2.1 Step 1: Formulate the Review Question and Scope

A scoping review requires a broad and exploratory review question that captures the full range of relevant studies and perspectives.

2.1.1 AI's role, human oversight and guidance

AI's role

- Use ChatGPT to generate review question variations and refine clarity. For example, entering the prompt for ChatGPT: Suggest five variations of the scoping review question 'What do we know about the use of artificial intelligence in mining businesses?'" will provide a list of refined questions demonstrating enhanced clarity or scope.
- Searches are iterative. Start with a broad search and then refine your query based on the initial results.
- Use AI to refine review questions by suggest related topics, synonyms, and potential search terms.
- AI tools can analyze existing literature to highlight research gaps.
- Use AI to identify key authors and influential papers in a field.

Human oversight

- **Ensure clarity and feasibility** – The review question should align with the scope of a scoping review (broad but structured).
- **Validate AI-generated refinements** – AI may suggest overly broad or irrelevant variations; human judgment ensures focus and precision.
- **Consider theoretical frameworks** – AI does not inherently apply research theories, so researchers must incorporate relevant academic models.

Guidance

- Compare AI-suggested review questions with published scoping reviews.
- Align the review question with existing frameworks (e.g., PCC: Population, Concept, Context).

2.1.2 Population, Concept, Context (PCC) framework for structuring review questions

The PCC framework ensures clarity in scoping review formulation, helping TIM students and faculty define their focus areas effectively.

Example 1: Product development

- **Population:** Startups developing AI-powered products
- **Concept:** Challenges in scaling AI-driven prototypes to market-ready solutions
- **Context:** Technology-based entrepreneurship and venture acceleration programs
- **Review question:** What are the key challenges and success factors influencing the scaling of AI-driven product prototypes in technology startups within venture acceleration programs?

Example 2: Digital transformation in manufacturing

- **Population:** Mid-sized manufacturing firms
- **Concept:** Adoption of Industry 4.0 technologies (IoT, AI, blockchain)
- **Context:** North American smart manufacturing landscape
- **Review question:** What are the primary barriers and facilitators influencing the adoption of Industry 4.0 technologies in mid-sized Canadian manufacturing firms?

Example 3: Commercialization of quantum security solutions

- **Population:** Cybersecurity firms and government agencies
- **Concept:** Strategies for commercializing quantum-resistant cryptographic technologies
- **Context:** National security applications and enterprise cybersecurity frameworks
- **Review question:** What commercialization strategies have been employed for quantum-resistant cryptographic technologies, and what factors contribute to their successful adoption in national security and enterprise cybersecurity frameworks?

Example 4: Open Innovation in Corporate R&D

- **Population:** Large technology firms
- **Concept:** Implementation of open innovation models in corporate research and development (R&D)
- **Context:** Global technology sector

- **Review question:** How do large technology firms implement open innovation strategies in corporate R&D, and what are the key factors influencing their success?

Example 5: Sustainability in supply chains

- **Population:** Technology hardware manufacturers
- **Concept:** Integration of sustainability practices in supply chain management
- **Context:** Global electronics and semiconductor industries
- **Review question:** What sustainability strategies have been adopted by technology hardware manufacturers to improve supply chain resilience, and what challenges do they face in implementation?

2.1.3 Alternative frameworks for structuring review questions

Other frameworks than the PCC framework can be used to define review questions for a scoping review.

CIMO (Context, Intervention, Mechanism, Outcome)

- **Context (C):** The environment or setting where the intervention takes place.
- **Intervention (I):** The strategy, policy, or action being implemented.
- **Mechanism (M):** The process through which the intervention produces outcomes.
- **Outcome (O):** The effects or results of the intervention.

Best for: Complex interventions in organizations and management research.

Review question: How (M) does AI-powered project management software (I) enhance decision-making efficiency (O) in remote technology startups (C)?

ECLIPSE (Expectation, Client group, Location, Impact, Professionals, Service)

- **Expectation:** What is being improved or changed?
- **Client group:** Who is affected?
- **Location:** Where is the service provided?
- **Impact:** What is the intended effect?
- **Professionals:** Who delivers the service?
- **Service:** What is being examined?

Used for: Evaluating technology-related services in organizations.

Review question: How (E) has the adoption of cybersecurity risk management frameworks (S) improved data protection policies (I) for technology firms (C) operating in highly regulated industries (L), according to IT security professionals (P)?

PEO (Population, Exposure, Outcome)

- **Population:** Who is being studied?
- **Exposure:** What is the experience, condition, or intervention?
- **Outcome:** What are the effects or results being examined?

Suitable for: Qualitative research in technology adoption and workplace studies.

Review question: What are the long-term effects (O) of remote work policies (E) on the productivity and job satisfaction of software engineers (P) in tech startups?

SPIDER (Sample, Phenomenon of Interest, Design, Evaluation, Research type)

- **Sample:** Who is being studied?
- **Phenomenon of Interest:** What is being investigated?
- **Design:** How was the study conducted?
- **Evaluation:** What are the key outcomes or themes?
- **Research type:** What type of research is included (qualitative, mixed methods)?

Useful for: Qualitative and mixed-methods studies on technology-related phenomena.

Review question: How do IT project managers (S) experience challenges (PI) in implementing agile methodologies (D), and what factors contribute to project success (E) in digital transformation initiatives (R)?

2.1.4 Formulate the scope of the scoping review

The scope of the review should be broad enough to capture key insights but specific enough to provide meaningful conclusions. In TIM, the scope of a scoping review is shaped by:

- **Breadth vs. Depth**

Breadth: If the goal is to map an emerging area (e.g., AI-powered business models), the review should include diverse sources, covering multiple industries and application areas.

Depth: If the objective is to deeply analyze a specific sub-topic (e.g., AI adoption barriers in North American SMEs), the review should focus on a narrower set of high-quality, empirical studies.

- **Time considerations**

Recent trends: If examining a fast-evolving field like quantum security, restricting the review to the past five years ensures relevance.

Historical perspective: If the review aims to track long-term evolution (e.g., open innovation strategies in R&D), a broader time may be necessary.

- **Type of literature to Include**

Academic vs. Industry Reports: TIM research often integrates peer-reviewed literature with industry insights. Clarify whether to include market reports, patents, or white papers to ensure coherence.

Empirical vs. Conceptual Studies: Some reviews prioritize empirical studies (e.g., case studies on technology commercialization), while others focus on conceptual frameworks (e.g., theoretical models of digital transformation).

- **Geographical scope**

Global vs. Regional Focus: A study on sustainable technology supply chains might examine global trends, while a study on government AI policy might focus on a specific country or region.

- **Stakeholder perspective**

Technology Developers vs. End Users: A review on blockchain adoption in finance might focus on banks and fintech firms, while another on blockchain infrastructure might analyze technology vendors.

2.1.5 Outputs

The outputs of Step 1: Formulate the Research Question and Scope include:

- **Clearly defined research question** – A structured and focused research question formulated using PCC or another appropriate framework (e.g., CIMO, ECLIPSE, PEO, SPIDER) to ensure clarity and relevance.
- **Review objectives** – A concise statement outlining what the review aims to achieve, specifying the knowledge gaps it seeks to address.
- **Preliminary list of keywords and search terms** – Initial set of keywords, Boolean operators, and alternative terms to guide database searches.
- **Selection of search strategies** – Identification of appropriate search strategies, databases (e.g., Scopus, Web of Science, Google Scholar), and AI tools to be used for literature retrieval.
- **Scope of the review** – Defined boundaries for the review, including:

- **Inclusion and exclusion criteria** (e.g., study types, publication years, geographic focus, industry relevance).
- **Types of sources** to be included (e.g., peer-reviewed articles, grey literature, conference proceedings).
- **Relevant disciplines or fields of study** (e.g., technology management, business innovation, digital transformation).

2.2 Step 2: Search for Articles

A thorough and systematic search for articles is essential to ensure that the scoping review captures all relevant literature. The search process should be iterative, transparent, and broad enough to identify diverse sources of information.

2.2.1 AI's role, human oversight, and guidance

AI's role:

- Generate keyword variations and Boolean search strings.
- Identify databases and sources relevant to the topic.

Human oversight:

- **Refine search queries –** AI-generated queries may return too many irrelevant results or exclude critical studies.
- **Select appropriate databases** – AI tools may prioritize indexed journals, neglecting grey literature.
- **Adjust Boolean operators manually –** AI-generated Boolean search strategies require human adjustment for precision.

Guidance:

- Assess AI-generated queries in multiple databases (e.g., PubMed, Scopus, Web of Science).
- Validate keywords by comparing with prior scoping reviews.
- Ensure grey literature sources (e.g., government reports) are included.

2.2.2 Develop a search strategy

- **Define key terms and concepts:** Identify relevant keywords, synonyms, and Boolean operators (e.g., AND, OR)

- **Identify and use Boolean operators for search engines:** Enter your review question into ChatGPT and ask it to suggest the best Boolean operators for your search using Google Scholar and other search engines. Then, apply AND, OR, and NOT to refine or expand your search results as needed.
- **Adapt search strategies for different databases:** Customize queries based on the specific requirements of each database.
- **Define the inclusion and exclusion criteria:** The criteria will be used to filter relevant studies in the next step, 5. Study Selection.

2.2.3 Recommended AI tools

When conducting a scoping literature review, these AI tools can significantly enhance search strategy efficiency:

- **ChatGPT** can:
    - Generate, refine, and expand search terms by suggesting synonyms, related concepts, and alternative phrasings.
    - Construct complex Boolean search strings (AND, OR, NOT) to improve database queries.
    - Summarize key themes in existing literature and suggests areas where research is lacking.
    - Summarize key findings from search results, saving time on reading full papers.
- **Consensus** can:
    - Quickly assess the relevance of research results
    - Rank papers based on their relevance and scientific consensus, ensuring the literature review is built on reliable studies.
    - Determine whether there is strong or weak agreement on a specific review question across multiple studies.
- **Perplexity** can:
    - Retrieve information from both academic and non-academic sources, improving literature discovery.
    - Generate answers based on multiple sources, helping identify connections between different studies.
    - Provides the latest research findings by searching across recently published papers, unlike traditional databases that may have indexing delays.

- **Elicit** can:
    - Extract key insights (abstracts, methodologies, results) from thousands of papers at once, streamlining literature review.
    - Prioritize studies based on relevance, credibility, and research design.
    - Make side-by-side comparison of studies, highlighting similarities and differences in findings, methods, and conclusions.
- **OpenRead** can:
    - Retrieve papers based on meaning
    - Identify and extract the most relevant parts of a paper, helping to quickly digest key insights.
    - Summarize complex papers, making it easier to integrate findings into a review.

2.2.4 Sources of evidence

Given the interdisciplinary nature of TIM, combining peer-reviewed literature with industry insights enhances the review's relevance.

A thorough scoping review requires diverse sources, including:

- Academic databases: Scopus, Web of Science, IEEE Xplore, ACM Digital Library
- Industry reports: Gartner, McKinsey, CB Insights, ABI Research
- Preprints and white Papers: ArXiv, SSRN, institutional repositories
- Patent databases: Google Patents, WIPO, USPTO

2.2.5 Databases and search engines

A well-structured search strategy leverages multiple databases to minimize bias and ensure a well-rounded review of the literature.

- **Database selection**: Selecting the right databases is crucial for conducting a comprehensive and reliable literature review. Different databases index different journals, conference papers, and grey literature, meaning no single database provides exhaustive coverage
- **Alignment**: Databases should align with the specific research domain to ensure access to the most relevant and high-quality sources.
- **Indexing and quality**: Databases prioritize peer-reviewed sources, while others include grey literature and preprints, impacting the rigor of retrieved studies.

- **Search precision**: Specialized databases offer controlled vocabularies (e.g., MeSH in PubMed) and advanced filters that improve search accuracy.
- **Coverage**: General databases (e.g., Google Scholar, Scopus) offer broad coverage, while subject-specific databases (e.g., PubMed for medical research, IEEE Xplore for engineering) provide domain-specific depth.
    - **Business and technology databases:** IEEE Xplore, ABI/INFORM, Business Source Premier.
    - **Multidisciplinary databases:** Scopus, Web of Science, Google Scholar.
    - **Social sciences databases:** PsycINFO, Sociological Abstracts.
    - **Grey literature sources:** Government reports, policy briefs, conference proceedings, dissertations, and preprints. Use OpenGrey for European reports, OAIster for digital archives, and Think Tank Search for policy documents.
    - **Health sciences and medical databases:** PubMed/MEDLINE, CINAHL, Cochrane Library.

2.2.6 Search queries

Tools like Scite, Elicit, and Semantic Scholar can assist in refining search queries.

Example search query - Digital transformation in SMEs

- Boolean Query: ("digital transformation" OR "Industry 4.0" OR "AI adoption") AND ("small and medium enterprises" OR "SMEs") AND ("barriers" OR "challenges" OR "opportunities")
- Filters: Peer-reviewed articles, last five years, English-language

Example search query - AI in venture capital decision-making

- Boolean Query: ("artificial intelligence" OR "machine learning" OR "AI-driven analytics") AND ("venture capital" OR "startup investment") AND ("decision-making" OR "risk assessment" OR "funding strategies")
- Filters: Peer-reviewed studies, industry reports, last seven years, global scope

Example search query (Blockchain for supply chain transparency)

- Boolean Query: ("blockchain technology" OR "distributed ledger" OR "smart contracts") AND ("supply chain management" OR "logistics" OR "procurement") AND ("transparency" OR "traceability" OR "fraud prevention")
- Filters: Empirical studies, case studies, last ten years, global application

Example search query (Green IT and Sustainable Data Centers)

- Boolean Query: ("Green IT" OR "sustainable computing" OR "energy-efficient data centers") AND ("cloud computing" OR "enterprise IT" OR "data infrastructure") AND ("carbon footprint" OR "renewable energy" OR "sustainability")
- Filters: Peer-reviewed articles, white papers, last five years, English-language

Example search query (Cybersecurity Challenges in IoT Devices)

- Boolean Query: ("Internet of Things" OR "IoT devices" OR "smart devices") AND ("cybersecurity" OR "data privacy" OR "security vulnerabilities") AND ("threat mitigation" OR "encryption" OR "risk management")
- Filters: Academic and industry literature, last five years, global security policies

2.2.7 Manage search results

- **Use reference management software:** Organize and store retrieved articles using Mendeley, Zotero, or EndNote.
- **Remove duplicates:** Employ automated tools within reference managers to eliminate duplicate records.
- **Track search strategies:** Maintain a record of databases searched, search terms used, and search results retrieved to ensure reproducibility.
- **Refine the search iteratively:** Update and adjust search queries based on initial findings to enhance relevance and comprehensiveness.
- **Troubleshooting:** If search results are too broad, refine Boolean queries or use subject-specific databases.

2.2.8 Document the search process

- **Use PRISMA-ScR Flow Diagram:** Illustrate the number of records identified, screened, included, and excluded.
- **Report search dates and limits:** Clearly state the date range, language restrictions, and inclusion/exclusion criteria applied.
- **Justify selection criteria:** Provide reasoning for the inclusion or exclusion of specific study types or sources.

2.2.9 Outputs

The outputs of Step 2: Search for Articles include:

- **A documented search strategy:** A clear record of search terms, Boolean operators, databases used, and search dates.
- **A collection of relevant articles:** A compiled set of articles that meet the inclusion criteria and are stored in a reference manager.
- **A PRISMA-ScR flow diagram:** A transparent visualization of the search process, including the number of articles identified, screened, included, and excluded.
- **A refined search query:** An improved version of the search query based on initial findings, including synonyms and subject headings.
- **A list of excluded articles with reasons:** Documentation of articles excluded during screening, with justifications for exclusion.

2.3 Step 3: Select Articles

A structured and transparent study selection process is essential to ensure that only relevant articles are included in the scoping review. The selection process follows a two-step screening approach: title/abstract screening and full-text screening. The PRISMA-ScR flow diagram should be used to document the selection process.

2.3.1 AI's role, human oversight and guidance

AI's role:

- Classify and rank articles based on relevance.
- Summarize abstracts for quick evaluation.
- Detect duplicate records.

Human oversight:

- **Review inclusion/exclusion criteria manually** – AI may misclassify studies due to missing metadata.
- **Assess study quality and relevance** – AI rankings are based on algorithms, not critical analysis.
- **Identify hidden biases** – AI tools may favor recent studies, neglecting foundational research.

Guidance:

- Conduct manual spot-checks (e.g., verify AI-excluded papers).
- Ensure key studies from systematic reviews are not omitted.

- Use dual human screening for accuracy.

2.3.2 Screen articles strategy

Screen articles in two phases:

1. **Title/Abstract Screening** – Remove irrelevant studies using Rayyan AI.
2. **Full-Text Screening** – Assess alignment with inclusion criteria.

Title/Abstract Screening

- Conduct an initial screening of article titles and abstracts to remove studies that are clearly irrelevant.
- Apply the inclusion and exclusion criteria defined in 4. Search Articles to filter relevant studies.
- Use Rayyan, a semi-automated screening tool, to assist with rapid filtering and organization of studies.
- Document any changes made to the inclusion/exclusion criteria as the review evolves.
- Use AI tools to assist but not replace manual screening.

Full-text screening

- Retrieve full-text versions of articles that pass the title/abstract screening.
- Assess whether each study aligns with the inclusion criteria.
- Use Rayyan to assist in sorting and tagging articles for inclusion/exclusion.
- Justify exclusions and document them in a review log for transparency.

2.3.3 Select studies using Rayyan AI

Rayyan AI is a powerful tool for streamlining the study selection process in scoping reviews. Here's how TIM researchers can use it effectively:

- **Upload and organize references**
    - Import references: Export search results from databases (e.g., Scopus, IEEE Xplore) in RIS or BibTeX format and upload to Rayyan.
    - Set inclusion and exclusion criteria: Define criteria aligned with the TIM research question (e.g., exclude non-English papers, focus on empirical studies).
    - Collaborative screening: Enable multiple reviewers (e.g., faculty and graduate students) to independently assess abstracts and full texts.

- **Screening**
    - Prioritization: Rayyan suggests the most relevant studies based on relevance and citation count.
    - Tagging and categorization: Use custom tags (e.g., "high relevance," "requires further review," "exclude – lacks empirical data").
    - Blind review mode: Reduces selection bias by masking decisions until consensus is reached.

- **Dual screening**
  Dual screening is a quality control process in scoping reviews where two independent reviewers assess each study to determine its inclusion or exclusion. This approach minimizes bias, enhances the reliability of selection, and ensures consistency in the review process. Typically, each reviewer independently screens studies based on predefined inclusion and exclusion criteria, and discrepancies are resolved through discussion or with a third reviewer.
  Dual screening is important:
    - Ensures that study selection is not influenced by individual biases or subjective interpretations.
    - Helps avoid inadvertent exclusions of relevant studies, especially in emerging fields like quantum security and decentralized finance (DeFi).
    - If reviewers disagree, a structured resolution process (e.g., discussion or adjudication by a third reviewer) ensures fair decision-making.
    - Particularly useful for complex TIM topics, where industry and academic perspectives may differ (e.g., patent trends in AI-driven cybersecurity).
    - A documented dual screening process increases the credibility and replicability of the review.
    - Important for corporate R&D and policy-driven TIM research, where decisions impact funding allocation, regulatory policies, and technology roadmaps.

- **Final selection**
    - After screening, selected studies should be exported and organized using reference management software like Zotero for synthesis.

2.3.4 Track and document

- Maintain a PRISMA-ScR flow diagram to track the number of records identified, screened, included, and excluded.
- Ensure transparent reporting by keeping a record of excluded articles along with reasons for exclusion.

- Regularly update the screening process based on evolving inclusion/exclusion criteria.

2.3.5 Outputs

The outputs of Step 3: Select Articles include:

- **A refined set of eligible articles**: A final collection of studies that meet the inclusion criteria.
- **PRISMA-ScR flow diagram**: A structured visualization of the study selection process for transparent reporting.
- **A list of excluded articles with reasons**: Documentation of excluded studies and justifications for their exclusion.
- **Updated inclusion/exclusion criteria**: Any refinements made to the criteria during the screening process.
- **Title/Abstract screening**: Results of the initial pass to exclude irrelevant studies.
- **Full-Text screening**: Confirmation of the alignment of the inclusion criteria and the articles selected.

2.4 Step 4: Extract Data

A structured data extraction process ensures that relevant information is systematically captured from selected studies. AI tools can assist in summarizing and organizing data, but manual oversight is necessary to maintain accuracy and transparency.

2.4.1 AI's role, human overnight and guidance

AI's role:

- Extract key themes, concepts, and study characteristics.
- Summarize findings across multiple papers.
- Group studies into categories.

Human oversight:

- **Verify extracted information –** AI can misinterpret data tables, figures, and statistical results.
- **Check for contextual accuracy –** AI-generated summaries may omit important nuances.
- **Ensure methodological consistency –** AI may treat qualitative and quantitative studies as equivalent.

Guidance:

- Manually extract data from a sample of studies to compare AI accuracy.
- Use a structured data extraction form (e.g., Excel or Covidence).
- Ensure AI-generated categories align with the review question.

2.4.2 Extract key information

- **Recommended AI tools:**
    - Use ChatGPT 4.0 for basic textual summaries.
    - Use ChatGPT, Elicit, or custom GPT-based models to summarize and organize extracted data.
    - Use Elicit or SciSpace to extract data organized into tables.
    - Use Research Rabbit, Litmaps, and Vos Viewer to visualize citation networks.
- **Key data elements to extract:**
    - Citation details (author, year, title, journal, DOI)
    - Study type and methodology
    - Population and sample characteristics
    - Key concepts and thematic categories
    - Main findings and contributions
    - Identified knowledge gaps
- **Adjust charting categories iteratively:** Refine data collection templates as needed to capture emerging themes and ensure completeness.

2.4.3 Extract data and organize into tables

These AI tools offer various features to assist in extracting and organizing data from research articles into tables, catering to different research needs and preferences.

We recommend the use of Elicit or SciSpace for data table extraction.

- **Elicit:** Enables you to add custom columns—each corresponding to a specific type of information (for example, findings, participant details, outcomes, regions, industries). Depending on your subscription plan, you can add columns at a time (with higher-tier plans allowing more per table. Reviews and documentation note that users can extract dozens of different data types into columns (one guide mentioned 24 different

information types), and the custom column feature gives you flexibility in the number of columns you include in your table. Therefore, you can tailor the table's structure to your needs.

- **SciSpace**: Allows users to extract summaries, conclusions, and findings from multiple PDFs into a tabular format, streamlining the analysis of scientific literature.

Alternative tools for data table extraction include:

- **Retica**: Specializes in automatic tabular data extraction from various documents, including research articles, enabling efficient organization of scientific data.
- **Scite Assistant**: Scite's AI capabilities include a 'Tables' functionality that allows researchers to extract and structure data from peer-reviewed literature, significantly enhancing data analysis efficiency.
- **Diffbot**: Diffbot's machine learning and computer vision algorithms can extract structured data from web pages, including research articles, facilitating the creation of organized tables for analysis.
- **OutWit Hub**: OutWit Hub automates the extraction of information from online or local resources, converting structured and unstructured data into formatted tables that can be exported to spreadsheets or databases.

Once studies are selected, you can extract and synthesize key information such as:

- **Study characteristics**: Author, year, country, research method
- **Key findings**: Innovation drivers, adoption barriers, success factors
- **Research gaps**: Unexplored variables, methodological limitations

AI tools can automatically populate tables like the ones shown below. Some AI tools enable users to create tables with 15 or more columns.

Example of a table structure:

Study	Population	Concept	Context	Key Findings	Research Gaps
Doe et al. (2023)	SMEs	AI adoption	North America	Lack of technical expertise hinders adoption	Limited research on AI upskilling programs
Smith et al. (2022)	Startups	Blockchain commercialization	Global	High regulatory uncertainty affects investment	Need for policy-driven research

Example of a table structure

Venture	Industry Sector	Technology Readiness Level	Competitive Landscape	Business Model	Funding Sources
AI-driven predictive maintenance	Manufacturing	TRL 7 - System Prototype Demonstrated in Operational Environment	Growing competition from traditional predictive maintenance providers and emerging AI startups.	B2B SaaS subscription model with tiered pricing based on asset volume.	Venture capital, government innovation grants, corporate partnerships.
Block-based supply chain	Logistics & Supply Chain	TRL 6 - Technology Demonstrated in Relevant Environment	Highly fragmented market with regulatory uncertainties affecting blockchain adoption.	Transaction-based revenue model with a subscription for data analytics insights.	Corporate venture funding, industry consortium investments, crowdfunding.
Quantum cybersecurity solutions	Cybersecurity	TRL 5 - Technology Validated in Relevant Environment	Limited competition due to high entry barriers but increasing interest from government agencies.	Enterprise licensing and government contracts for critical infrastructure security.	Defense sector funding, cybersecurity venture funds, university grants.

2.4.4 Visualize insights

Clear and compelling reporting enhances the impact of a scoping review. For example, a scoping review on “AI in venture financing” may reveal:

- A growing number of studies focusing on AI-driven risk assessment for startup investments
- Few papers address how AI integrate with human decision-making in venture capital firms
- Emerging trends include AI-powered due diligence platforms for early stage startups

Recommended tools include:

Concept maps: Visualizing relationships between key themes to clarify connections and structure insights. Recommended tools include:

- **CmapTools**: Best for hierarchical concept mapping with structured relationships.
- **MindMeister**: Ideal for real-time collaboration and interactive mind mapping.
- **Obsidian (Graph View)**: Useful for non-linear connections and knowledge management in TIM research.

AI-generated summaries: AI tools assist in synthesizing large volumes of literature. Recommended tools include:

- **ChatGPT and Claude:** Summarize key findings, extract trends, and identify knowledge gaps.
- **Scite (Smart Citations):** Maps citation relationships and provides AI-driven literature analysis.

Citation networks: AI tools enable you to visualize citation networks, helping to analyze relationships between research papers, track influential works, and identify emerging trends. These tools provide a deep understanding of citation landscapes and enable the identification of influential research clusters and discovery of relevant papers. Recommended tools include:

- **Research Rabbit** – This tool offers an interactive, graph-based visualization of citation networks. It allows researchers to explore related papers, discover key authors, and track the evolution of ideas across disciplines. Research Rabbit dynamically expands citation trees, enabling users to uncover hidden connections in the literature.
- **Litmaps** – Litmaps creates dynamic citation maps that help users visualize how research papers are interconnected over time. By inputting seed articles, researchers can generate a visual representation of citation relationships, track updates to the literature, and identify influential works within their field of study.
- **VOSviewer** – A powerful bibliometric analysis tool, VOSviewer specializes in creating detailed network visualizations of co-authorship, keyword co-occurrence, and citation relationships. It helps researchers cluster related publications, analyze trends in research topics, and detect patterns in scholarly communication.

2.4.5 Ensure data quality and consistency

- **Manually verify AI-assisted extractions:** Spot-check summaries to correct errors, inconsistencies, or misinterpretations.
- **Review data charts for consistency:** Ensure uniform categorization across extracted studies.

- **Perform an ethical review:**
    - Assess whether AI-generated summaries reflect the original study's intent.
    - Follow JBI scoping review guidelines, considering optional bias assessment tools like RoBVis.
    - Use the Step-by-Step Guide for Performing a Bias Assessment when relevant.

2.4.6 Document the extraction process

- **Maintain a final data extraction template:** Clearly define categories and document any modifications made during the process.
- **Track adjustments:** Record refinements to extraction criteria to maintain transparency.
- **Ensure unbiased data handling:** Regularly review extraction outputs to avoid distortions or misrepresentations of study findings.

2.4.7 Outputs

The outputs of Step 4: Extract Data include:

- **Completed data extraction tables**: Summaries of key study details in an organized format.
- **A structured dataset**: A clean, standardized compilation of extracted study information.
- **AI-generated and manually refined summaries**: Reviewed outputs that ensure accuracy and completeness.
- **A final data extraction template**: A documented version of the table structure and extracted fields.
- **Records of methodological adjustments**: Documentation of any refinements made to the extraction process.

2.5 Step 5: Analyze and Synthesize Data

The goal of data analysis and synthesis in a scoping review is to organize, summarize, and present findings in a meaningful way. Unlike systematic reviews, scoping reviews prioritize mapping existing literature and thematic grouping rather than statistical meta-analysis.

2.5.1 AI's role, human oversight and guidance

AI's role:

- Summarize key themes

- Categorize studies
- Generate preliminary thematic maps
- Identify patterns and maps

Human oversight:

- **Verify thematic accuracy** – AI-generated themes may be overly broad, missing subtle distinctions or interdisciplinary links.
- **Ensure methodological consistency** – AI might mix different study designs (e.g., quantitative vs. qualitative) without considering their differences.
- **Assess depth and relevance** – AI may prioritize frequently occurring words rather than conceptually significant themes.
- **Refine thematic categorization** – Adjust AI-generated categories to align with research objectives and theoretical frameworks.
- **Validate research gaps** – AI-generated gaps must be compared against expert knowledge and recent systematic reviews to ensure novelty and relevance.

Guidance:

- Read a sample of the original studies to confirm that AI has accurately captured the key findings.
- Organize extracted themes, study characteristics, and conclusions manually for quality control.
- Start with AI-generated categories, then refine them based on deeper analysis and expert input.
- AI does not apply theoretical frameworks; you must align findings with established models.
- Discuss synthesized findings with subject matter experts or colleagues to ensure rigor and coherence.

2.5.2 Descriptive summary

- Summarize findings based on frequency and trends, such as:
    - The number of studies published per year
    - Geographic distribution of studies
    - Common methodologies and study designs

    - Research trends

- Use tables and figures to visually represent trends.
- Example of a ChatGPT prompt: Summarize the key findings of 15 articles on the use of AI in sales management systems and identify common themes and challenges.
- Triangulate findings from different sources.

2.5.3 Narrative synthesis

- Use **Custom GPT or SciSpace** to structure insights.
- Group studies into conceptual categories based on key themes.
- Validate AI-generated themes manually before integrating them
- Identify patterns, relationships, and inconsistencies across studies.
- Ensure that synthesized insights align with the full text of selected papers.
- Document relevant frameworks, figures, tables, and page numbers to support findings.

2.5.4 Thematic and visual analysis

- Conduct a thematic synthesis to map knowledge gaps and research clusters.
- If themes are unclear, revisit inclusion criteria and adjust data extraction templates.
- Address contradictions by consulting original study texts.
- Utilize visualization tools **such as:**
    - Concept maps to illustrate relationships between key themes.
    - Tables to categorize studies by methodology, population, and findings.
    - Citation networks to identify influential studies and research clusters.

2.5.5 AI-Assisted analysis and synthesis

- **Use Custom GPT, Converse, or SciSpace to:**
    - Break down information into key components for structural analysis.
    - Synthesize data from multiple sources to generate coherent insights.
    - Identify gaps in knowledge and suggest potential research directions.
    - Assist in categorizing studies and creating preliminary summary tables.

2.5.6 Track and document

- Keep records of data organization, including tables, figures, and visualizations.
- Clearly document all decisions regarding thematic categorization and synthesis.
- Ensure transparency by providing references and supporting materials.

2.5.7 Outputs

The outputs of Step 5: Analyse and Synthesize Data include:

- **A structured descriptive summary:** An organized overview of study characteristics and trends.
- **A thematic synthesis report:** A narrative summary that groups studies into conceptual categories.
- **Visual representations:** Tables, concept maps, and citation networks to aid in interpretation.
- **Identified knowledge gaps:** A list of underexplored areas that require further research.

2.6 Step 6: Interpret Results

Interpreting the results of a scoping review involves drawing meaningful insights from the analyzed data while maintaining an objective and broad perspective. The goal is to highlight key trends, knowledge gaps, and implications for future research rather than to provide conclusive findings.

2.6.1 AI's role, human oversight and guidance

AI's role:

- Generate summaries of findings across studies, highlighting major themes and trends.
- Propose applications of findings, policy recommendations, or areas for future research.
- Flag inconsistencies in the literature and highlight underexplored topics.
- Compare different study results and provide preliminary explanations for variations.

Human oversight:

- **Assess contextual accuracy** – AI-generated interpretations may lack depth and miss critical nuances in study findings**.**
- **Ensure logical coherence –** AI may draw incorrect conclusions based on frequency rather than conceptual significance.

- **Validate AI-suggested implications –** AI lacks expertise in policy, practice, and real-world applications, requiring human evaluation.
- **Integrate theoretical frameworks –** AI does not inherently connect findings to existing theories, which is essential for interpretation.
- **Refine contradictions and limitations –** AI may not fully understand why discrepancies exist across studies, requiring domain expertise to interpret them correctly.

Guidance:

- Compare AI-generated conclusions with the original studies to ensure alignment.
- Apply established models such as PRISMA-ScR or thematic analysis approaches.
- Discuss AI-generated interpretations with colleagues or field experts to verify accuracy.
- Ensure interpretations consider practical applications in academia, policy, or industry.
- Validate gaps by checking whether they have already been addressed in prior literature.

2.6.2 Translating research into action

Scoping reviews in Technology Innovation Management (TIM) map existing knowledge and provide actionable insights.

This section guides TIM students, faculty, and industry professionals on how to leverage their findings effectively.

Identify opportunities for new product development

- Use the scoping review to pinpoint emerging technology trends and gaps in the market.
- Analyze studies on customer pain points, industry challenges, and technological advancements to identify potential product innovations.
- Example: A scoping review on AI-driven healthcare solutions may highlight opportunities for AI-powered diagnostic tools in underserved regions.

Inform strategic decisions about technology adoption

- Organizations can use scoping reviews to evaluate the feasibility of adopting new technologies.
- Compare case studies, industry reports, and academic findings to assess risks and best practices.
- Example: A review on blockchain adoption in supply chains can help logistics firms determine whether to invest in decentralized tracking systems.

Develop competitive intelligence reports

- Scoping reviews can synthesize competitor strategies, emerging business models, and industry shifts.
- Use bibliometric analysis tools (e.g., VosViewer) to visualize how different companies and researchers are shaping technological advancements**.**
- Example: A review of quantum security solutions can help cybersecurity firms anticipate disruptive innovations and adjust their R&D focus accordingly.

Identify potential partners and collaborators

- Use citation networks and co-authorship analyses to find key opinion leaders and innovation hubs in a given technology domain.
- Identify academic institutions, startups, or corporate players leading research and development in a specific area.
- Example: A review on sustainable technology supply chains can help manufacturers identify green technology providers for strategic partnership

2.6.3 Explain the significance

- Clearly relate findings to the review question and objectives.
- Discuss how the identified themes, patterns, and knowledge gaps contribute to the broader field.
- Identify key takeaways from the review and how they inform practice, policy, or future research directions.

2.6.4 Identify limitations

- **Acknowledge data gaps**: Highlight areas where research is lacking or underdeveloped.
- **Discuss publication bias**: Consider whether certain perspectives or methodologies are overrepresented.
- **Assess study diversity**: Identify any limitations due to geographic, demographic, or methodological constraints.

2.6.5 AI-Assisted interpretation

- **Over reliance on AI**: AI tools can significantly enhance literature reviews by automating searches, summarizing findings, and identifying patterns. However, over-reliance on AI for interpretation poses risks:

    - **Accuracy concerns**: AI-generated summaries may misinterpret context, oversimplify findings, or omit nuances critical to understanding a study.
    - **Bias and hallucinations**: AI models can introduce biases or generate false information, leading to misleading conclusions.
    - **Lack of critical evaluation**: AI cannot replace human judgme**nt** in assessing study quality, methodological rigor, or the relevance of findings to a review question.
- To ensure research integrity, AI should complement—not replace—critical thinking and expert analysis. You must verify AI-generated insights, cross-check sources, and apply domain expertise to draw well-founded conclusions.
- Use ChatGPT-4o, Jenni, or other AI tools to assist in summarizing trends and deriving deeper insights.
- Ensure AI-generated summaries, interpretations and conclusions are fact-checked, aligned with full-text evidence, and do not introduce bias.
- Refine interpretations if new insights arise during the synthesis process.

2.6.6 Maintain a broad perspective

- Recognize that scoping reviews emphasize mapping diverse evidence rather than drawing firm conclusions.
- Focus on emerging research directions and thematic gaps rather than effect sizes or intervention outcomes.
- Present multiple perspectives when applicable to reflect the scope of the literature.

2.6.7 Outputs

The outputs of Step 6: interpret Results include:

- A synthesized discussion of key findings: A structured interpretation of themes and insights.
- A list of research gaps and future directions: A clear identification of areas needing further investigation.
- A limitations section: Documentation of constraints related to data availability, bias, or methodology.
- Refined conclusions based on AI-assisted insights: Validated interpretations that align with the reviewed literature.

2.7 Step 7: Write the Scoping Review

2.7.1 AI's role, human oversight and guidance

AI's role:

- Generate summaries, introductions, and discussion sections.
- Suggest logical flow and structure.

Human oversight:

- **Refine AI-generated text for coherence –** AI outputs may be repetitive or lack logical transitions.
- **Ensure academic rigor –** AI does not apply academic writing standards or theoretical frameworks consistently.
- **Check for citation errors –** AI-generated references may be fabricated or incorrectly formatted.

Guidance:

- Use AI to draft but not finalize text.
- Apply manual edits for clarity, coherence, and academic tone.
- Validate all citations using trusted sources (e.g., CrossRef, DOI search).

2.7.2 Turn review findings into valuable assets

Transform scoping review findings into:

- **Pitches for new ventures** – Identifying gaps in the market and supporting business case development.
- **Product development opportunities** – Guiding the creation or enhancement of products and services.
- **Strategic decisions on technology adoption** – Evaluating emerging technologies and their potential impact.
- **Market research insights** – Understanding trends, customer needs, and industry shifts.
- **Competitive intelligence reports** – Analyzing competitors, industry benchmarks, and market positioning.
- **Potential partners and collaborators** – Connecting with key stakeholders for research or business initiatives.

- **Journal publications –** Contributing to academic literature and advancing knowledge in the field.
- **TIM theses and projects** – Providing a foundation for graduate research and innovation projects.
- **Policy recommendations** – Informing regulatory decisions and industry standards.
- **Training and educational materials** – Supporting knowledge transfer and professional development.
- **Grant proposals and funding applications** – Strengthening proposals with well-researched evidence.

2.7.2 Templates to translate scoping reviews results into actionable insights.

Identify opportunities for new product development

- Use the scoping review to pinpoint emerging technology trends and gaps in the market.
- Analyze studies on customer pain points, industry challenges, and technological advancements to identify potential product innovations.
- Example: A scoping review on AI-driven healthcare solutions may highlight opportunities for AI-powered diagnostic tools in underserved regions.

Template for identifying new product development opportunities

Market Need	Existing Solutions	Key Limitations	Emerging Trends	Potential Product Idea	Supporting Evidence

Informing strategic decisions about technology adoption

- Organizations can use scoping reviews to evaluate the feasibility of adopting new technologies.
- Compare case studies, industry reports, and academic findings to assess risks and best practices.
- Example: A review on blockchain adoption in supply chains can help logistics firms determine whether to invest in decentralized tracking systems.

Template for technology adoption decision matrix

Technology	Benefits	Risks	Cost	Implementation Challenges	Industry Adoption Examples

Developing competitive intelligence reports

- Scoping reviews can synthesize competitor strategies, emerging business models, and industry shifts.
- Use bibliometric analysis tools (e.g., VosViewer) to visualize how different companies and researchers are shaping technological advancements.
- Example: A review of quantum security solutions can help cybersecurity firms anticipate disruptive innovations and adjust their R&D focus accordingly.

Template for competitive intelligence reports

Competitor	Key Technologies	Business Model	Strengths	Weaknesses	Market Position

Identify potential partners and collaborators

- Use citation networks and co-authorship analyses to find key opinion leaders and innovation hubs in a given technology domain.
- Identify academic institutions, startups, or corporate player**s** leading research and development in a specific area.
- Example: A review on sustainable technology supply chains can help manufacturers identify green technology providers for strategic partnerships.

Template for partnership and collaboration tracker

Organization	Area of Expertise	Research Contributions	Potential Collaboration Type	Contact Information

2.7.3 Solicit feedback from AI tools and experts

Receiving feedback is a critical component of conducting high-quality scoping reviews. Feedback enhances rigor, clarity, and relevance, ensuring that findings contribute meaningfully to academic discourse and industry practice. With the advent of AI-powered research assistants like Gemini 2.0, Grok 3, OpenAI's Deep Research, and Perplexity Deep Research, researchers now have powerful tools to assist in evaluating, refining, and enhancing their work.

AI feedback for structural and analytical improvements

AI tools can analyze scoping review drafts and provide structured feedback on:

- Clarity and coherence: Identify unclear arguments or inconsistencies in logic.
- Coverage and gaps: Highlight missing literature or underexplored areas.

- Thematic consistency: Ensure alignment between research questions, methodology, and synthesis.

For example, Perplexity Deep Research can assess whether the scoping review sufficiently covers key industry trends, emerging technologies, and market forces, while OpenAI's Deep Research can suggest relevant citations and knowledge gaps.

Expert feedback for contextual and strategic insights

While AI provides fast, structured feedback, human experts bring contextual depth, industry experience, and critical evaluation that AI cannot fully replicate. Feedback from faculty, industry professionals, or peer reviewers can help refine:

- Practical relevance: Ensuring findings are actionable for entrepreneurs, technology managers, and investors.
- Strategic positioning: Identifying how the review aligns with current policy debates or funding priorities.
- Interpretative depth: Refining nuanced discussions on market adoption, competitive dynamics, and business model implications.

Iterative refinement: Integrating AI and expert feedback

Effective scoping reviews benefit from an iterative feedback loop, where researchers:

- Draft an initial version based on systematic literature synthesis.
- Use AI tools to refine structure, highlight gaps, and enhance writing clarity.
- Seek expert review for deeper validation of insights and strategic implications.
- Iterate and integrate feedback into a stronger, more polished version.
- Validate final revisions using both AI-assisted checks and human judgment.

2.7.4 Structure the manuscript

- Follow PRISMA-ScR guidelines to ensure structured reporting and transparency.
    - **Introduction** – Background, objectives, rationale
    - **Methods** – Search strategy, selection process, data extraction, and synthesis
    - **Results** – Study characteristics, findings, themes
    - **Discussion** – Interpretation of findings, limitations, research gaps, future directions

- **Conclusion** – Summary and implications

2.7.5 AI-assisted writing

- Use ChatGPT-4o to generate initial drafts of manuscript sections, but emphasize the need to manually refine clarity, coherence, and alignment with scoping review objectives. Use AI to assist you, not replace you.
- Use Grammarly to enhance readability and check for grammatical accuracy and unintentional plagiarism.
- Perform manual editing to refine clarity, coherence, and alignment with scoping review objectives.
- Ensure that AI-generated content is fact-checked and aligned with reviewed literature.

2.7.6 Revision and quality control

- Conduct multiple rounds of revision to enhance clarity and readability.
- Cross-check findings against the full text of included articles to ensure accuracy.
- Ensure that methodological rigor is maintained and appropriately described.

2.7.7 Report and document

- Clearly document methods and decisions made during the review process.
- Consider alternative reporting guidelines such as JBI Scoping Review guidelines if appropriate.
- Ensure transparency in how AI tools were used throughout the research and writing process.

2.7.8 Outputs

The outputs of Step 7: Write the Scoping Review include:

- A complete, structured manuscript: A full draft following PRISMA-ScR guidelines.
- Refined AI-assisted content: A manuscript that integrates AI-generated drafts with manual editing and validation.
- A well-documented methodology section: A clear and transparent description of the scoping review process.
- A revised and proofread last version: A polished manuscript ready for submission or dissemination.

2.8 Step 8: Incorporate Ethical Considerations

Ensuring ethical integrity in scoping reviews requires transparency in data handling, AI usage, and methodological documentation. Researchers must disclose how AI tools are used, prevent biases, and adhere to institutional and professional ethical guidelines.

2.8.1 AI's role, human oversight and guidance

AI's role:

- Analyze literature for language patterns and biases in study populations, methodologies, or geographic focus.
- Highlight studies that lack transparency in methodology or have potential conflicts of interest.
- Recommend ethical guidelines and principles for conducting responsible research.
- Scan literature for discussions on ethical implications related to the research topic.

Human oversight:

- **Evaluate AI-identified biases –** AI can detect patterns, but human judgment is required to determine if they are truly problematic.
- **Ensure responsible AI use –** AI-generated summaries, search results, and citations must be reviewed for accuracy and integrity.
- **Verify AI-suggested ethical frameworks –** AI lacks moral reasoning and cannot assess the appropriateness of ethical guidelines in context.
- **Check for research integrity issues –** AI may overlook ethical concerns related to study funding, conflicts of interest, or problematic methodologies.
- **Assess inclusivity and fairness –** Ensure that marginalized perspectives and diverse populations are adequately represented in the review.

Guidance:

- Engage ethical review boards or specialists to validate findings.
- Follow research ethics policies set by universities, journals, and funding bodies.
- Disclose AI-assisted contributions and ensure human oversight in final interpretations.
- Actively seek studies from underrepresented regions, authors, and perspectives.
- Ensure transparency in data collection, participant consent, and funding disclosures.

2.8.2 Ethical implications of AI in technology innovation management

As AI becomes increasingly integrated into Technology Innovation Management (TIM), it is essential to consider its ethical implications. While AI-driven tools enhance efficiency, decision-making, and automation in TIM research and practice, they also present challenges that require careful consideration.

Bias and fairness

- AI models, including those used in research synthesis and decision-making, may inherit biases from training data.
- In TIM, biased AI systems could lead to unequal access to funding, technology adoption barriers, or flawed strategic insights.
- Mitigation: Regular auditing of AI models, diverse training datasets, and human oversight in AI-driven decision processes.

Transparency and accountability

- AI-powered insights in scoping reviews and competitive intelligence reports must be interpretable and traceable.
- Without transparency, businesses may make high-stakes decisions (e.g., technology investments) based on opaque AI-generated recommendations.
- Mitigation: Use explainable AI (XAI) techniques and ensure clear documentation of AI-driven research methodologies.

Data privacy and security

- AI-driven tools for TIM research often process sensitive company data, proprietary research, and strategic insights.
- Risks include data breaches, misuse of intellectual property, and unauthorized AI-driven surveillance.
- Mitigation: Implement robust cybersecurity measures, enforce data anonymization, and comply with legal frameworks like GDPR and CCPA.

Impact on employment and human expertise

- Automation in R&D, market analysis, and competitive intelligence may displace traditional roles in innovation management.
- Over-reliance on AI for decision-making may reduce human critical thinking and strategic oversight.

- Mitigation: Upskilling professionals in AI-augmented decision-making, ensuring AI is a collaborative tool rather than a replacement.

2.8.3 AI transparency and documentation

- Clearly disclose AI-assisted processes in search, screening, data extraction, and synthesis.
- Provide detailed documentation on how AI-assisted processes influenced the review.
- Ensure all AI-generated content is reviewed and validated for accuracy.
- Include disclaimers or references for AI-assisted outputs.

2.8.4 Prevent plagiarism

- Cross-check AI-generated content with Turnitin.
- Conduct manual reviews of AI-generated outputs to prevent misinformation.
- Implement bias assessment techniques to identify and mitigate potential distortions in data synthesis.

2.8.5 Mitigate bias

- Ensure balanced representation of diverse research perspectives.

2.8.6 Ethical use of stakeholder input

- If stakeholder consultations are included, ensure proper ethical approvals and documentation.
- Maintain confidentiality and privacy standards when handling stakeholder data.

2.8.7 Compliance with ethical guidelines

- Follow institutional research ethics protocols
- The ACM Code of Ethics and Professional Conduct is a good example of a professional code of ethics that establishes ethical principles and guidelines for responsible conduct in computing and technology-related fields. It serves as an example of:
    - **Ethical framework**: Provides a structured approach to ethical decision-making for professionals.
    - **Industry standard**: Sets widely recognized norms and expectations for responsible computing.

    - **Professional accountability**: Outlines obligations to the public, employers, clients, and colleagues.
    - **Guidance for ethical dilemmas**: Helps computing professionals navigate ethical challenges, such as privacy, security, and fairness in AI.
- The ACM Code of Ethics is a model for other professional organizations seeking to promote integrity, fairness, and social responsibility within their industries.
- Avoid using AI tools that store personal or proprietary data.
- Consider registering the methodology in OSF or PROSPERO for transparency.
- Maintain a full audit trail of AI contributions in the review process.

2.8.8 Data privacy and security

- Ensure compliance with data protection regulations when managing sensitive information.
- Avoid using AI tools that store or share proprietary or confidential data.
- Keep records of data handling practices for transparency.

2.8.9 Outputs

The outputs of Step 8: Incorporate ethical considerations include:

- A transparent AI usage statement detailing how AI contributed to the review.
- A plagiarism and bias report verifying the integrity of content.
- A documented audit trail of AI-assisted methods for reproducibility.
- A compliance checklist confirming adherence to ethical guidelines and institutional policies.

2.9 Step 9: Disseminate Findings

Effectively disseminating the results of a scoping review ensures that findings reach the appropriate audiences and contribute to ongoing research, policy, and practice. Researchers should consider multiple dissemination strategies, including peer-reviewed publications, conference presentations, and non-academic outputs such as policy briefs or public reports.

2.9.1 AI's role, human oversight and guidance

AI's role:

- Generate summaries, infographics, and slide decks for academic, industry, or public audiences.
- Analyze past publications and recommend suitable journals or conferences for submission.
- Assist in simplifying complex findings for broader audiences, including policymakers and practitioners.
- Help structure research summaries for websites, blogs, and social media engagement.

Human oversight:

- **Ensure accuracy in AI-generated summaries –** AI may overgeneralize or misrepresent key findings, requiring manual review.
- **Verify journal and conference recommendations –** AI suggestions should be cross-checked to ensure relevance, credibility, and impact factor.
- **Maintain academic integrity –** AI-assisted content must be properly cited, and researchers should disclose AI's role in the writing process.
- **Tailor dissemination strategies –** AI-generated outputs should be adjusted based on the target audience's expertise, cultural context, and preferred formats.
- **Ensure ethical and inclusive communication –** Findings should be presented in a way that respects diverse perspectives and avoids unintended biases.

Guidance:

- Use AI as a starting point, not the final draft. AI can assist in summarization and formatting, but human refinement is necessary for clarity and depth.
- Ensure AI-generated recommendations align with specific formatting, scope, and impact requirements.
- Publish findings in peer-reviewed journals, conference proceedings, institutional repositories, and public-facing platforms.
- Translate research insights into actionable recommendations for policymakers, industry leaders, and community organizations.
- Clearly state where AI-assisted tools contributed to content creation, while ensuring human-authored oversight.

2.9.2 Research vignette template for industry partners and Investors

A research vignette is a concise, compelling summary of key findings tailored for decision-makers. It highlights the relevance, impact, and potential applications of the research.

Template: Research Vignette

Section	Content Description
Title	A clear, engaging title summarizing the key insight (e.g., "AI-Powered Supply Chains: Unlocking Efficiency for SMEs")
Background	Briefly explain the problem and its significance in the industry.
Key Findings	Summarize 3-5 key insights from the scoping review.
Industry Impact	Describe how these findings can inform business strategies, product development, or policy decisions.
Next Steps	Outline recommendations for industry adoption, further research, or partnerships.
Contact Information	Provide relevant details for follow-up discussions.

Template for pitch Presentations Template for new ventures or technology solutions

For TIM entrepreneurs looking to leverage scoping review insights for venture creation or technology commercialization, a well-structured pitch deck is essential.

Template: Pitch presentation for scoping review-based ventures

Slide	Content Description
1. Title Slide	Project name, team members, and affiliation.
2. Problem Statement	Define the industry problem backed by insights from the scoping review.
3. Market Opportunity	Present data on market size, trends, and demand.
4. Solution Overview	Introduce the technology or business innovation derived from the research.
5. Competitive Landscape	Show how existing solutions compare and highlight differentiation.
6. Business Model	Explain revenue streams and commercialization strategy.
7. Roadmap & Next Steps	Describe implementation plans and future growth.

8. Funding & Collaboration Needs	Specify financial requirements, strategic partnerships, and investor opportunities.
9. Contact Information	Provide links for further inquiries.

2.9.3 Publication in peer-reviewed journals

- Publish in peer-review journals (e.g., business, technology, social sciences).
- Follow journal submission guidelines, including formatting and referencing requirements.
- Consider open-access journals to enhance accessibility.

2.9.4 Conference presentations

- Present findings at national and international conferences to engage with the academic and practitioner community.
- Choose appropriate venues based on the research domain, such as:
    - Cochrane Colloquium (for systematic and scoping reviews)
    - Evidence-Based Policy Summits
    - Subject-specific conferences (e.g., *IEEE Conferences*, *American Public Health Association*).
- Prepare oral presentations, posters, or panel discussions to communicate findings effectively.

2.9.5 Policy briefs and stakeholder reports

- Translate findings into practical insights for policymakers, practitioners, and organizations.
- Develop a concise, visually engaging policy brief highlighting key takeaways.
- Distribute reports to government agencies, non-profits, and industry partners to inform decision-making.

2.9.6 Digital and open science platforms

- Share findings through preprint repositories and institutional repositories (e.g., OSF Preprints, ArXiv, ResearchGate).

- Contribute to systematic review registries such as PROSPERO to enhance visibility and reproducibility.
- Consider publishing supplementary datasets and materials in Zenodo or Figshare for open-access sharing.

2.9.7 Public engagement and media outreach

- Public engagement and media outreach are increasingly relevant for broader impact.
- Disseminate findings through blog posts, podcasts, and social media (e.g., Twitter, LinkedIn, ResearchGate).
- Engage with journalists and science communicators to translate key insights for broader audiences.
- Develop short videos or infographics to enhance accessibility.

2.9.8 Outputs

The outputs of Step 9: Disseminate Findings include:

- **A peer-reviewed journal article:** A structured manuscript ready for academic publication.
- **A conference presentation:** Slide decks, posters, or recorded talks for conferences.
- **A policy brief or executive summary:** A practitioner-oriented document for non-academic audiences.
- **Open-access datasets and supplementary materials:** Research outputs shared in digital repositories.
- **Engagement materials:** Blog posts, social media threads, infographics, or press releases.

2.10 Checklist for Authors and Reviewers

To ensure a rigorous and high-quality scoping review, authors and reviewers should systematically assess their work against the following checklist. This checklist aligns with the key steps and considerations outlined in this guide for Technology Innovation Management (TIM) research.

1. Formulate the research question and scope

- ✓ Clearly define the Population, Concept, and Context (PCC framework).
- ✓ Ensure the research question is specific, relevant, and actionable for TIM research.
- ✓ Establish the scope of the review, balancing breadth and depth.

- ✓ Define the time, literature types, geographical scope, and stakeholder perspectives.

2. Identify and elect relevant studies

- ✓ Identify academic databases, industry reports, patents, and preprints as sources.
- ✓ Develop a precise search strategy with Boolean operators and relevant filters.
- ✓ Use AI-powered tools (e.g., Scite, Elicit, Semantic Scholar) to refine search results.

3. Screen and select studies using Rayyan AI

- ✓ Upload references from databases in RIS or BibTeX format.
- ✓ Apply inclusion/exclusion criteria based on the research question.
- ✓ Conduct dual screening for accuracy and consistency.
- ✓ Use AI-assisted screening to prioritize relevant studies and reduce bias.
- ✓ Tag and categorize studies to streamline analysis.

4. Extract and synthesize data

- ✓ Extract key study characteristics (author, year, country, method).
- ✓ Identify innovation drivers, adoption barriers, and success factors.
- ✓ Recognize gaps in existing research and opportunities for further exploration.

5. Visualize and report insights

- ✓ Use concept maps to structure relationships between key themes.
- ✓ Leverage AI-generated summaries for preliminary synthesis.
- ✓ Apply network analysis tools to visualize research connections.

6. Translate research into action

- ✓ Identify opportunities for new product development using market insights.
- ✓ Provide strategic guidance on technology adoption based on findings.
- ✓ Develop competitive intelligence reports to inform business and policy decisions.
- ✓ Recognize potential partners and collaborators using citation network analysis.

7. Disseminate findings

- ✓ Craft a research vignette for industry partners and investors.
- ✓ Develop a pitch presentation for venture creation or technology commercialization.
- ✓ Communicate findings effectively to ensure industry impact.

8. Ethical Considerations in AI for TIM

- ✓ Ensure bias mitigation in AI-assisted research.
- ✓ Maintain transparency and accountability in AI-driven analysis.
- ✓ Protect data privacy and security when using AI tools.
- ✓ Balance AI automation with human expertise in decision-making.

Guide to Produce Scoping Literature Reviews Using AI Tools

PART 3. UPDATING SCOPING REVIEW GUIDE

Introduction

Research and practitioner methods and the AI tools that support them are constantly evolving, making it essential to keep this guide up to date. Part 3 outlines the guide's strengths and the process for maintaining, improving, and expanding the guide to ensure it remains a valuable resource for TIM faculty, students, and practitioners.

3.1 Strengths of the Guide

- **Transforms literature reviews into valuable TIM assets**

  The guide helps users turn research findings into practical applications, including:

  - **Venture pitches:** Identifies emerging opportunities to attract investors.
  - **New market entry strategies:** Analyzes trends and regulations for informed decision-making.
  - **Competitive intelligence reports:** Tracks competitors' R&D, patents, partnerships, and market strategies to inform business decisions.
  - **Product development:** Detects technological advancements and customer needs to guide R&D.
  - **Technology landscapes:** Maps key players and innovations for strategic positioning.
  - **Business plans:** Uses AI-driven literature reviews to shape business models, assess market viability, and refine go-to-market strategies.
  - **Technology adoption pathways:** Identifies barriers and enablers to streamline implementation.

- **Provides a step-by-step approach with TIM-specific examples**

  The guide outlines a clear, structured process covering topic selection, search strategy, source evaluation, synthesis, visualization, and reporting, making literature reviews more actionable.

- **Integrates AI tools to improve efficiency and depth**

  AI accelerates research by automating search term refinement, citation management, text summarization, and synthesis, enabling faster, more comprehensive reviews.

- **Incorporates both academic and grey literature**

AI tools help users integrate peer-reviewed studies, patents, industry reports, and market data, ensuring research is both academically rigorous and industry relevant.

- **Maintains integrity through human oversight**

To ensure accuracy and reliability, the guide emphasizes:

  - Critical evaluation of AI-generated insights to prevent errors.
  - Manual validation of sources for credibility.
  - Balanced use of AI and expert judgment to enhance research validity.

- **Ensures ethical AI use in literature reviews and its transformative outputs**

The guide addresses:

  - **Transparency:** Clearly documenting AI-generated outputs.
  - **Bias Prevention:** Ensuring diverse source representation.
  - **Reproducibility:** Providing structured methodologies for validation.

3.2 Version Control and Updates System for the Scoping Review Guide

To ensure that the *Guide to Producing Scoping Literature Reviews Using AI Tools* remains current, accurate, and aligned with evolving best practices, a structured version control and update system has been implemented. This system allows for periodic reviews, stakeholder contributions, and transparent documentation of changes.

Version Control System

- **Version numbering:**
  - Each update is assigned a unique version number (e.g., v1.0, v1.1, v2.0).
  - Major updates (e.g., methodological changes) increase the primary number (e.g., v1.0 → v2.0).
  - Minor updates (e.g., clarifications, formatting improvements) increase the secondary number (e.g., v1.1 → v1.2).
- **Update frequency:**
  - **Scheduled Reviews:** A comprehensive review is conducted every six months to incorporate new methodologies, databases, and AI tools.

    - **Ad-Hoc updates:** Interim updates are applied as needed based on emerging best practices, feedback, or changes in database policies.

- **Change Documentation:**
    - A changelog is maintained, summarizing modifications made in each version.
    - The guide includes a “Last Updated” date at the beginning of the document for transparency.
- **Stakeholder Input:**
    - Feedback is collected from TIM faculty, students and TIM project clients to refine content.
    - Updates are reviewed by a designated editorial board before implementation.
- **Accessibility:**
    - Archived versions are available for reference.
    - Users are notified of significant updates via email or an announcement on the guide’s website.

Current version information

- **Version:** 1.0
- **Last Updated:** March 4, 2025

3.3 AI Assistance and Human Oversight Disclosure Statement

This guide to producing scoping reviews was developed using AI-powered tools to enhance content generation, structuring, and accessibility. AI tools—including ChatGPT and Perplexity—were used for drafting, summarizing, expanding content, and structuring, while Gemini 2.0, Grok 3, and OpenAI Deep Research provided additional feedback on AI- and human-generated content.

All AI-generated content underwent human oversight, ensuring accuracy, methodological soundness, and adherence to academic standards. The review process included:

- **Validation of AI-generated text** for factual correctness, coherence, and relevance.
- **Manual verification of all citations** to prevent hallucinations or misattributions.
- **Bias detection measures** to ensure diverse perspectives and minimize AI-driven inaccuracies.

- **Multiple review cycles**, including feedback from two additional human reviewers.

While AI-assisted drafting accounted for approximately 50% of the initial content, all sections were manually reviewed, refined, or rewritten to ensure depth, clarity, and scholarly rigor. The integration of AI in this guide aligns with Carleton University's guidelines on responsible AI use, transparency, and academic integrity.

As this guide is a living document, future updates will continue to integrate AI-assisted enhancements, with each revision undergoing structured human review cycles to maintain accuracy and usability.

3.4 Ways to Contribute

Here are suggestions on how you can contribute to improving the guide:

- **Enhance the literature review process** – Suggest ways to improve the production of scoping and systematic literature reviews using innovative technologies (e.g., OpenAI's Deep Research).
- **Improve clarity and accuracy** – Identify errors or provide suggestions to make the guide clearer and easier to understand.
- **Develop a troubleshooting section** – Create a guide for resolving familiar challenges (e.g., retrieving too many irrelevant studies, managing conflicting data, or dealing with limited literature) with solutions like refining search queries, adjusting Boolean operators, and using alternative sources.
- **Expand examples and use cases** – Add real-world examples, such as sample scoping review scenarios, step-by-step walkthroughs with actual research topics, and screenshots demonstrating AI tools in use.
- **Refine methods for grey literature** – Provide systematic approaches for finding and evaluating grey literature, including government databases, industry whitepapers, and unpublished research, along with criteria for assessing quality.
- **Fill content gaps** – Identify missing information and propose high-quality additions to strengthen the guide.
- **Address AI limitations** – Add a section on AI constraints, emphasizing the need to verify AI-generated citations, avoid misinformation, and adhere to ethical AI research guidelines.
- **Clarify human oversight** – Define the role of human oversight in mitigating biases, preventing misinterpretations, and avoiding hallucinated references.

You are encouraged to suggest improvements to the guide beyond those listed above.

If you would like to contribute through a TIM project, coursework, extracurricular activities, or other means, please contact Tony Bailetti at tony.bailetti@carleton.ca.

3.5 Acknowledgements

This guide benefits from contributions by TIM faculty and students at Carleton University, integrating methodological best practices and practical improvements based on real-world applications of AI-assisted scoping reviews.

3.6 Epilogue

By following this guide, TIM faculty and students can efficiently conduct scoping reviews with AI tools while maintaining rigor, ethical integrity, and transparency. AI tools should augment rather than replace human expertise in literature synthesis. By balancing automation with critical evaluation, scoping reviews can yield valuable insights that inform future research and decision-making.

Conducting a scoping literature review is a dynamic and iterative process that requires careful planning, systematic execution, and ethical considerations. By leveraging AI tools and reference management systems, TIM students and faculty can enhance efficiency and improve the quality of their reviews. However, AI should be used as a supportive tool, with human oversight ensuring accuracy, relevance, and integrity in data interpretation.

The landscape of academic research continues to evolve, with increasing emphasis on transparency, collaboration, accessibility, and human oversight. As AI-driven methodologies become more sophisticated, researchers must remain critical in their evaluation and application of these technologies, maintaining ethical integrity and adherence to established guidelines such as PRISMA-ScR and JBI.

A well-conducted scoping review serves as a foundational resource for future research, identifying gaps, trends, and opportunities within a field. The insights generated from this process contribute to academic discourse, inform policy, and support evidence-based decision-making across disciplines.