

From Discovery to Deployment: Technology Transfer as a Supply Chain Process

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Abstract

Supply chains are increasingly central to converting scientific discoveries and technological knowledge into operational, commercial, and societal value. Unfortunately, supply chain management (SCM) scholarship, like adjacent fields, has approached technology transfer (TT) as a transfer event in which value is presumed to follow once property rights or knowledge change hands. We reconceptualize TT as a discovery-to-deployment supply chain process: five recursive stages (discovery, development and protection, scaling and commercialization, deployment and use, and renewal) coordinated by distributed, co-specialized capabilities. A review of 67 articles in eight core SCM journals shows the field, constrained by the transfer-event framing, has concentrated on sourcing, IP governance, licensing, and commercialization, while leaving operational assimilation, downstream deployment, use support, and feedback-based renewal underdeveloped. Reading these tendencies as the footprint of a shared assumption, we develop a research agenda around four shifts: from technology transactions to capability coordination, isolated events to longitudinal processes, upstream sourcing to network-wide deployment, and one-way transfer to feedback-based renewal. This reconceptualization integrates two parallel literatures. First, we provide TT research with a process-and-coordination lens that helps explain why some technologies scale and endure, while others stall at the license or pilot stage. Second, we extend SCM's domain from coordinating materials, products, and information to coordinating technological knowledge and capabilities.

1. Introduction

Modern supply chains compete not only through the efficient movement of materials and information, but also through their ability to convert technological knowledge into scalable operational, commercial, and societal value. Technologies such as artificial intelligence, additive manufacturing, the Internet of Things, blockchain, and digital platforms are reshaping how firms coordinate with suppliers, configure operations, serve customers, and create value across supply chains (Gu et al., 2025; Hendriksen, 2023). Simultaneously, geopolitical fragmentation, sustainability transitions, and digital transformation pressures are forcing organizations to rethink how technological capabilities are developed, transferred, assimilated, and renewed across supplier networks (Golgeci et al., 2025). These developments make clear that technology transfer (TT) is not peripheral to supply chain management (SCM). Instead, it is increasingly woven into the fabric of how supply chains create and deliver value.

TT is commonly understood as the process through which scientific discoveries, inventions, and technological knowledge are transformed into usable technologies, products, services, and societal applications (Siegel & Phan, 2005). However, this transformation rarely unfolds within a single organization. Discoveries may originate in universities, government or private laboratories, startups, or suppliers. However, their conversion into deployable technologies typically requires complementary assets, manufacturing capacity, supplier coordination, logistics infrastructure, regulatory alignment, and end-user integration (Narasimhan & Narayanan, 2013; Tatikonda & Stock, 2003). In this sense, TT

activates, depends on, and often reconfigures supply chains as multiple organizations coordinate to move technologies from discovery to deployment.

This discovery-to-deployment logic is evident across many contemporary contexts. The development and global rollout of mRNA vaccines during the COVID-19 pandemic, for instance, required not just scientific innovation, but also coordinated input sourcing, manufacturing scale-up, cold-chain logistics, regulatory synchronization, and cross-organizational learning (Bown & Bollyky, 2022; Roncancio-Marín & Guerrero, 2024). Similar dynamics characterize semiconductor supply chains, electric vehicle battery networks, and AI-enabled platform ecosystems (Devesa et al., 2026; Porter & Heppelmann, 2015). Across these contexts, the bottleneck is often not invention alone, but the interorganizational coordination required to convert invention into scalable use.

The TT process has traditionally been examined in research on innovation (Dubickis & Gaile-Sarkane, 2015), university technology transfer and academic entrepreneurship (Siegel & Wright, 2015), public policy (Guerrero & Siegel, 2025), and technology management (Marais et al., 2024). These literatures have generated important insights into intellectual property (IP) protection, licensing, university-industry transfer, commercialization, spin-offs, and diffusion (Abid et al., 2025). However, examining TT through an SCM lens offers a distinct perspective. Rather than treating TT as merely a legal, contractual, or commercialization event, an SCM framing conceptualizes it as a coordinated process through which multiple organizations transform technological knowledge into operational, commercial, and societal value. This process spans knowledge sourcing, IP governance, product and process development, operational integration, scaling, delivery, user support, and renewal through feedback and learning (Bozeman, 2000; Markman et al., 2008; Siegel et al., 2003). Thus, TT is not simply adjacent to SCM; it is inextricably bound to supply chain phenomena.

Despite this practical interdependence, SCM scholarship has engaged TT mainly through the same lens as the literatures from which it borrows; specifically, as a discrete transaction or exchange located at the upstream end of the supply chain. Existing studies have examined important components, including supplier involvement in new product development (Hu et al., 2017; Salvador & Villena, 2013; Suurmond et al., 2020), technology sourcing (Arora et al., 2013; Fifarek et al., 2008), licensing agreements (Sine et al., 2003; Sun et al., 2010), IP governance (Wang et al., 2023; Zhao, 2006), platform control (Bhargava et al., 2013; Parker & Van Alstyne, 2018), commercialization decisions (Cassiman & Ueda, 2006; Marx et al., 2014), and innovation diffusion (Hetzner et al., 1983; Waller & Fawcett, 2014). Yet these streams have developed largely in isolation, each examining a single moment of access, protection, or exchange, with little integration around the broader question of how supply chains transform technological knowledge into operational, commercial, and societal value across the full path from discovery to deployment and renewal.

Our central contribution is to reconceptualize technology transfer for supply chain scholarship. Across the innovation, entrepreneurship, and technology-management literatures, TT has been theorized largely as a *transfer event* — an invention disclosed, a patent or copyright awarded, a license executed, a spin-off

formed — in which value is presumed to follow once rights or knowledge change hands. We argue that this transfer-event framing, which SCM has implicitly inherited, obscures what actually determines whether a technology creates operational, commercial, and societal value. That value depends on an interorganizational coordination process, through which distributed, co-specialized capabilities move a technology from discovery through development, scaling, deployment, and renewal. Recasting TT as a discovery-to-deployment supply chain process relocates the central question from *how technologies are transferred* to *how supply chains coordinate the capabilities, operations, and feedback that make transferred technologies usable, scalable, and renewable*.

This reconceptualization yields a two-way integration of fields that have developed in isolation. For TT research, an SCM lens supplies the process-and-coordination perspective a transfer-event view lacks, helping to explain why some technologies scale and endure, while others stall at the license or pilot stage. For SCM research, TT extends the field's explanatory domain beyond the coordination of materials, products, and information toward the coordination of technological knowledge and capabilities. Knowledge and capabilities are tacit, uncertain, and dependent on complementary assets — distinctive coordination challenges that SCM theory is well positioned to address.

We develop this reconceptualization in three steps. First, we advance the discovery-to-deployment framework as a reconceptualization of TT as a supply chain process (Section 2). Second, through a structured review of 67 articles in the field's core journals, we show that SCM has examined consequential parts of this process. However, constrained by the same transfer-event framing, SCM has done so in a fragmented, upstream-oriented, and episodic manner that leaves operational assimilation, downstream deployment, use support, and feedback-based renewal comparatively underdeveloped (Sections 3–5). Third, we translate this diagnosis into a generative research agenda, organized around four shifts: from technology transactions to capability coordination, from isolated events to longitudinal processes, from upstream sourcing to network-wide deployment, and from one-way transfer to feedback-based renewal. This agenda positions SCM to contribute new analytical leverage to TT scholarship and to claim TT as a core supply chain phenomenon (Section 6).

2. Technology Transfer as a Discovery-To-Deployment Supply Chain Process

2.1 The Discovery-to-Deployment Logic

TT is often associated with the movement of inventions or technical knowledge from one organization to another, examined through activities such as patenting, licensing, university-industry collaboration, spin-off formation, and diffusion (Harmon et al., 1997; Siegel & Phan, 2005). Early research on TT at universities attempted to assess and “explain” TT performance. More specifically, scholars evaluated TT productivity based on data measuring the “outputs” and “inputs” of TT (e.g., Siegel et al., 2003; Siegel, 2006). These authors typically employed a production or distance function framework (with multiple outputs), in which a “best practice” frontier is constructed (Chapple et al., 2005; Siegel et al., 2008). The

distance from the frontier represents the level of “technical” inefficiency, or the inability of the organization to generate maximal output from a given set of inputs. In these studies (Thursby & Kemp, 2002; Thursby & Thursby, 2002), two methods were used to estimate production frontiers—data envelopment analysis and stochastic frontier estimation.

While the production function framework and its mechanisms are important, they only partially capture the interorganizational processes through which technological knowledge is accessed, adapted, scaled, deployed, and renewed. More specifically, conceiving of TT strictly as a macro-level production function is an overly simplified model. It assumes frictionless deployment, ignores network dependencies (Simms & Frishammar, 2024), and fails to capture the hidden costs of scaling up, knowledge integration, and supply chain complexity across the broader global value chain. Thus, we need to start at the beginning of the TT process. A discovery may originate in a university, government laboratory, startup, or supplier. Yet discovery alone does not create deployable value. The underlying knowledge must be evaluated, protected, adapted, developed, manufactured, distributed, and improved. These activities require resources and capabilities distributed across multiple organizations (Good et al., 2019). From this standpoint, TT is not a linear handoff from inventor to user; instead, it is a coordinated transformation process involving multiple actors, capabilities, and stages.

We organize this process around five stages:

- (1) *Discovery* – the generation, identification, and opportunity recognition of scientific discoveries, inventions, and technological possibilities (Bozeman, 2000; Cohen & Levinthal, 1990);
- (2) *Development and Protection* – the interorganizational activities through which knowledge is protected, governed, accessed, and adapted into a deployable technology, including IP management, licensing, partner coordination, and product and process development (Chesbrough, 2003; Teece, 1986);
- (3) *Scaling and Commercialization* – the transition from developed technology to scalable market-facing systems, encompassing supplier mobilization, production readiness, manufacturing scale-up, and commercialization pathways (Bozeman, 2000; Markman et al., 2008);
- (4) *Deployment and Use* – the movement of technologies into operational, commercial, or societal contexts through delivery, distribution, implementation, user adoption, training, and service support (Bozeman, 2000; Rogers et al., 2009); and
- (5) *Renewal* – the feedback, learning, redesign, upgrading, and supply chain reconfiguration that follow deployment and stimulate future innovation cycles (Cohen & Levinthal, 1990; Dyer & Singh, 1998; Ni et al., 2023).

These five stages synthesize and extend established process and lifecycle models of technology transfer, commercialization, and innovation (Bozeman, 2000; Bozeman et al., 2015). We relocate them from the level of the transferring organization to the interorganizational supply chain through which distributed, co-specialized capabilities move a technology toward deployable value. This five-stage

framing is sequential for analytical clarity, but it is iterative in practice. Use generates knowledge about performance, failures, customer needs, and regulatory constraints that feeds subsequent discovery and development. TT is therefore a dynamic and recursive supply chain process, rather than a one-way movement from invention to commercialization (Feldman et al., 2002; Bozeman et al., 2015).

2.2 Why Discovery-to-Deployment is a Supply Chain Process

Discovery-to-deployment is a supply chain process because transforming technological knowledge into deployable value depends on interdependent activities distributed across multiple organizations (Bozeman, 2000; Markman et al., 2008; Siegel et al., 2003). These activities include evaluating opportunities, sourcing knowledge, accessing complementary capabilities, coordinating suppliers, adapting products and processes, scaling production, distributing technologies, supporting users, and learning from deployment. This perspective shifts attention from TT as a discrete exchange to TT as a coordinated process of value transformation. Value emerges when TT stakeholders collectively develop the capabilities, operating systems, delivery channels, support structures, and feedback processes required for technology use, scaling, and renewal (Markman et al., 2008; Teece, 1986). As a result, effective TT depends on interorganizational coordination challenges that are central to SCM. These challenges include aligning incentives, integrating processes, sharing knowledge, governing interdependence, coordinating physical and digital flows, and managing uncertainty across distributed actors (Frohlich & Westbrook, 2001; Lambert & Enz, 2017; Mentzer et al., 2001).

Viewing TT through an SCM lens also expands what the field is asked to explain. SCM scholarship has traditionally focused on the coordination of materials, products, information, and relationships. Discovery-to-deployment highlights that modern supply chains also coordinate technological knowledge and capabilities – objects that are often tacit, uncertain, difficult to codify, and dependent on complementary assets. This creates distinctive coordination challenges that SCM theory is well positioned to address. Understanding TT as a supply chain process can therefore clarify why some technologies scale and endure while others remain trapped at the discovery, licensing, or pilot stage.

2.3 Cross-Stage Coordination Mechanisms

The discovery-to-deployment process is shaped by five cross-stage coordination mechanisms. First, *knowledge and capability alignment* refers to how supply chain actors identify, share, combine, and transform technological knowledge and complementary capabilities throughout the TT process (Cohen & Levinthal, 1990; Dyer & Singh, 1998). Second, *governance* refers to how actors structure collaboration, protect knowledge, allocate rights, manage risks, and align incentives through contracts, IP arrangements, licensing, relational governance, and trust (Dyer & Singh, 1998; Liu et al., 2025; Teece, 1986). Third, *operational integration* refers to how technological knowledge becomes embedded in production systems, service processes, digital infrastructures, and logistics networks, including supplier integration, manufacturing readiness, and quality assurance (Ragatz et al., 1997; Teece, 1986). Fourth, *deployment support* refers to the downstream processes – installation, customer training, technical

support, service networks, and adoption facilitation – that move technologies into actual use (Rogers et al., 2009; Teece, 1986). Fifth, *feedback and learning* refers to the reverse flows through which supply chain actors capture knowledge from deployment and feed it back into technology improvement, redesign, and next-generation innovation (Cohen & Levinthal, 1990; Rogers et al., 2009).

2.4 Conceptual Framework

Figure 1 presents our conceptual framing of TT as a discovery-to-deployment supply chain process. The core process moves through five distinct but interdependent stages: (1) discovery, (2) development and protection, (3) scaling and commercialization, (4) deployment and use, and (5) renewal. Cross-stage coordination mechanisms are shown above the stages as connecting and enabling the process. This framework guides the next section of this article by serving as an organizing lens for examining how prior SCM research has conceptualized the movement from discovery to deployment, where the literature has concentrated attention, and where important theoretical gaps remain.

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3. Review Methodology

Our objective was not to map the full interdisciplinary TT literature, which prior quantitative and thematic reviews have already addressed (Cunningham et al., 2025; Noh & Lee, 2019). Instead, we how core SCM journals have examined the interorganizational processes through which scientific discoveries and technological knowledge become deployed technologies, products, and services. Our process involved defining objectives, establishing boundaries, retrieving articles, screening, coding, and synthesizing (Craighead & Ketchen Jr., 2024; Ketchen Jr. & Craighead, 2023).

3.1 Scope, Journal Selection, and Search Strategy

We focused on articles published in the SCM Journal List's eight core journals: *Decision Sciences Journal (DSJ)*, *Journal of Business Logistics (JBL)*, *Journal of Operations Management (JOM)*, *Journal of Supply Chain Management (JSCM)*, *Management Science (MS)*, *Manufacturing & Service Operations Management (MSOM)*, *Operations Research (OR)*, and *Production and Operations Management (POM)*. Because our aim is to characterize how the SCM field has engaged TT, not to survey the full interdisciplinary TT literature, we deliberately bounded the corpus to these eight journals. This focused set provides a theoretically coherent boundary for examining how the field's leading outlets have engaged TT-related phenomena, enabling assessment of dominant emphases, blind spots, and opportunities for theory development.

We searched SCOPUS using terms designed to capture the discovery-to-deployment logic of TT: "technology transfer" OR "invention" OR "patent" OR "licens*" OR "invention disclosure" OR "intellectual property" OR "product development" OR "commerciali*" without year restriction, yielding 800 articles. We then applied a three-stage screening process. The first screen (title, abstract, keywords) retained 286 of 800 articles. The second screen (introductions and conclusions) retained 137 of 286 articles that

substantively addressed TT-related activities. The third screen (full-text review) retained 75 of 137 articles that substantively discussed both a TT-related discovery-to-deployment activity and a supply chain or interorganizational process. During article coding, 8 of these 75 articles were found not to meet our strict inclusion criteria for the TT-stage and SCM-process dimensions defined in our coding protocol (Appendix B) and were excluded, yielding a final synthesized sample of 67 articles. Figure 2 summarizes this process.

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3.2 Coding Framework

The resulting sample of 67 articles was coded across three dimensions: TT-related activities, SCM process domains, and research method. First, we coded the TT-related activities addressed in each article using a deductive coding scheme based on four established TT lifecycle stages: (1) scientific discovery or invention, (2) IP protection and licensing, (3) commercialization, and (4) diffusion. These categories allowed us to identify which portions of the traditional TT lifecycle were emphasized in the SCM literature. At the synthesis stage, we interpreted these coded TT activities through the broader discovery-to-deployment framework that is depicted in Fig. 1. Specifically, discovery/invention informed the Discovery stage; IP protection, licensing, sourcing, and product development informed Development and Protection; commercialization informed Scaling and Commercialization; and diffusion and downstream adoption informed Deployment and Use. In addition, the Renewal stage was developed inductively during synthesis to capture feedback, redesign, reverse learning, adaptation, and post-deployment knowledge flows that were not explicitly represented in the original TT lifecycle coding scheme, but they are central to a supply chain understanding of TT.

Second, we coded where TT-related discovery-to-deployment activities appeared across the five original SCOR process domains: Plan, Source, Make, Deliver, and Return (APICS, 2017). We use these categories not as the theoretical framework, but as a pragmatic coding vocabulary for comparing how TT-related activities are situated within supply chain processes. In this usage, *Plan* refers to technology planning and strategic evaluation. *Source* refers to gaining access to external technological knowledge or capabilities. *Make* refers to operational assimilation, adaptation, and production or service integration. *Deliver* involves commercialization, deployment, distribution, or support of technologies to users. Finally, *Return* refers to reverse flows of learning, feedback, renewal, or circular reintegration. This descriptive mapping supports our broader theoretical purpose of explaining how SCM scholarship has conceptualized the movement from discovery to deployment in supply chains. We excluded *Enable* as a standalone category because enabling activities are inherently cross-cutting, and the five original domains provide a historically consistent basis for comparison across the full review period.

Third, we coded the broad research method that was used in each article. Articles were classified as empirical, modeling/simulation, or conceptual. When articles used multiple methods, we assessed the article's primary analytical emphasis and classified it according to the dominant research method. Empirical articles were those that analyzed primary or secondary data to examine TT-related

phenomena, such as technology sourcing, supplier involvement, IP governance, commercialization, diffusion, or performance outcomes. Modeling/simulation articles were those that used analytical, mathematical, optimization, game-theoretic, or simulation-based approaches to examine decision problems, tradeoffs, or strategic interactions related to TT. Conceptual articles were those whose primary contribution was theory development, conceptual framing, or agenda-setting, rather than empirical testing or formal modeling.

Two members of the research team independently coded each article using the operational definitions in Appendix B. Coding decisions were documented with textual evidence from the articles to support transparency and traceability. Independent codes were then compared, and any disagreements were resolved through discussion, re-examination of the article text against the Appendix B definitions, and consensus. This iterative reconciliation process was applied throughout coding to ensure that final classifications reflected a shared, textually grounded application of the coding protocol.

4. Mapping SCM Research on Technology Transfer

The final sample of 67 articles spans four decades. Growth was minimal before 2000, with only two articles appearing in this period. From the early 2000s onward, the literature grew steadily, adding roughly 11 to 13 articles per five-year period through 2024. This pace has accelerated further since 2025, with six articles appearing in the first two years of this period alone – a higher annual rate than any prior five-year window (Fig. 3). This trajectory is consistent with supply chains becoming more innovation-intensive, digitally enabled, and globally distributed. Yet this growth has not produced a unified theoretical conversation around TT as a discovery-to-deployment process. Instead, the literature has developed across partially disconnected research streams.

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4.1 Coverage Across Technology Transfer Stages

The reviewed literature shows uneven coverage across discovery-to-deployment stages. IP protection/licensing (66% of articles) and commercialization (63%) were most frequently addressed, while scientific discovery (31%) and diffusion (13%) received substantially less attention. Notably, 60 of 67 articles covered two or fewer TT stages, and only one study (Kulatilaka & Lin, 2006) integrated all four originally coded TT stages.

From a discovery-to-deployment perspective, this pattern indicates that SCM scholarship has concentrated on moments of protection, exchange, and commercialization, while paying limited attention to how technologies move across the full pathway from discovery to operational use, feedback, and renewal. These articles provide important insights into discrete parts of TT but limited guidance on how these parts connect as an integrated supply chain process.

4.2 Coverage Across SCM Process Domain

A parallel pattern appears in coverage across supply chain process domains. *Plan* (76%) and *Source* (66%) dominate the sample. *Make* (24%) and *Deliver* (31%) appear less frequently. *Return* remains almost entirely absent from the reviewed literature, represented by a single article. Moreover, 52 of 67 articles engaged two or fewer supply chain domains, while only 15 engaged three or more.

The upstream orientation of these articles ignores an important downstream issue, which is that technologies often fail because supply chains cannot adequately scale, integrate, deliver, support, or adapt them. Operational assimilation, downstream deployment, and reverse learning – precisely the activities that determine whether technological value is realized – are the least examined aspects of TT in core SCM research.

4.3 Joint TT–SCM Breadth

The joint distribution of TT breadth and SCM process breadth reinforces the fragmented character of the literature. A large majority – 47 of 67 articles (70%) – fell into the narrow-narrow quadrant, addressing a small number of TT stages and a small number of supply chain process domains. Only two articles (3%) occupied the wide-wide quadrant, engaging multiple TT stages and multiple SCM domains. Figure 4 displays this joint breadth analysis.

This pattern is central to our argument, specifically that SCM scholarship has not ignored TT-related phenomena, but has examined them in bounded, specialized, and upstream-oriented ways. Individually valuable, these studies do not collectively constitute an integrated account of how supply chains coordinate technologies from discovery to deployment.

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4.4 Research Methods

Of the 67 articles, 42 (63%) were coded as empirical, 21 (31%) as modeling/simulation, and 4 (6%) as conceptual. The dominance of empirical and analytical approaches reflects the field's strengths in examining bounded decisions such as licensing structure, sourcing tradeoffs, and commercialization timing. However, the scarcity of conceptual work may help explain the episodic character of the literature: without integrating frameworks, discrete empirical and analytical insights have had fewer opportunities to accumulate into a broader theory of TT as a supply chain process.

5. Synthesis: A Transfer-Event Framing and Its Footprint

The mapping in Section 4 documents three tendencies in SCM-TT research: (1) a fragmented treatment of TT subcomponents, (2) a pronounced upstream orientation, and (3) limited process integration. Read individually, each could be taken as a gap to be filled by more studies of a given kind. We argue instead that they are not independent shortcomings, but instead reflect the common footprint of a single, largely unexamined assumption that SCM has inherited from the broader TT literatures – that TT is fundamentally a transfer event, a discrete exchange of rights or knowledge after which value is

presumed to follow. When TT is framed this way, fragmentation, upstream concentration, and event-based reasoning are not anomalies to be corrected at the margins. Instead, they are precisely the pattern that the literature should be expected to produce.

This changes what kind of fix the field needs. If the three tendencies were separate problems, the solution would be simple: more studies on assimilation, more on deployment, and so on. But because all three stem from the same transfer-event framing, no amount of additional studies within that framing can resolve them. What is needed instead is a different framing: TT as a discovery-to-deployment process, not a transfer event. This shift changes how the underexamined stages are seen – from neglected topics to necessary parts of how technological value is created. We examine each of the three tendencies in turn below, then draw out the implications for a research agenda in Section 6.

5.1 Fragmented Treatment of TT Subcomponents

SCM research has treated TT through specialized but loosely connected subcomponents. Studies on technology sourcing examine how firms access external knowledge. Research on supplier involvement explores how partners contribute to product innovation. Work on IP and licensing addresses rights, incentives, and appropriability. Commercialization research examines market-facing decisions. Platform and digital supply chain studies examine technology-mediated coordination. Diffusion research tracks the spread of innovations.

Each stream illuminates an important slice of discovery-to-deployment. But they rarely link their focal activity to other stages of the process. As a result, the field has accumulated important partial explanations without an integrated account of how these subcomponents collectively enable technologies to move from discovery to deployment and renewal.

5.2 Upstream Orientation in SCM-TT Research

A second synthesis insight is that SCM research on TT has been strongly upstream-oriented, concentrating on planning, sourcing, governance, IP, licensing, and commercialization. This emphasis is understandable, since SCM scholarship has long focused on supplier relationships, sourcing decisions, and upstream coordination. Further, it has generated genuinely valuable insights. However, an upstream view provides an incomplete picture of technological value creation.

Technologies frequently fail not because access, protection, or commercialization is unsuccessful, but instead because they cannot be operationally assimilated, reliably scaled, effectively delivered, supported in use, or adapted through feedback. These activities map onto *Make*, *Deliver*, and *Return* domains – the least represented in the reviewed literature. The near-complete absence of *Return*-coded articles is especially telling: only a single article in the sample (Ni et al., 2023) addresses reverse learning and renewal directly. In a discovery-to-deployment view, feedback and renewal are central to whether transferred technologies generate sustained value, yet this dimension remains effectively invisible in core SCM research.

5.3 Limited Process Integration

A third synthesis insight is that SCM scholarship has rarely theorized TT as an integrated, temporally unfolding process. The literature tends to examine TT as a bounded decision or event – a technology is sourced, licensed, commercialized, or diffused. These studies generate valuable insights about specific mechanisms, but they focus on isolated decision points, rather than on how technologies evolve and change as they move across firms, supply chain tiers, and use contexts. This matters because TT is inherently longitudinal. Early-stage sourcing, IP, and partner selection decisions shape later operational assimilation, manufacturing scale-up, deployment outcomes, and user acceptance. Conversely, problems encountered during deployment reshape technology design and supply chain architecture. Without longitudinal, processual theorizing, SCM scholarship cannot fully explain how technological knowledge becomes deployable value through linked supply chain activities.

5.4 Summary of the Synthesis

These three tendencies – fragmentation, upstream orientation, and limited process integration – are not failings of individual studies but structural features of how the literature has developed. SCM scholarship has strong foundations for studying TT, including deep expertise in interorganizational governance, supplier coordination, operational integration, and value creation across distributed systems. The research agenda developed below builds on these strengths by identifying how SCM can move from dispersed insights toward an integrated theory of discovery-to-deployment.

6. Research Agenda: Advancing a Discovery-to-Deployment View of Technology Transfer

We organize the research agenda around four theoretical shifts that are implied by the discovery-to-deployment perspective. Together, these shifts clarify how SCM scholarship can contribute more distinctively and comprehensively to TT research.

6.1 From Technology Transactions to Capability Coordination

A first theoretical shift is from viewing TT primarily as technology exchange to viewing it as interorganizational capability coordination. Technological knowledge is often tacit, uncertain, and dependent on complementary assets (Cohen & Levinthal, 1990; Teece, 1986). A discovery has potential value, but that value is realized only when organizations collectively coordinate the resources, routines, assets, and infrastructures needed to develop and deploy it. Supply chains, in this view, are not only execution systems but innovation-realization systems – connecting discoveries to manufacturing capacity, supplier capabilities, logistics networks, regulatory processes, and downstream users.

This perspective extends SCM theory by positioning supply chains as coordinators of distributed capabilities, not merely flows of materials and information. It also clarifies an important gap in TT

research, specifically that access to technology or the transfer of rights is insufficient. Effective TT requires coordinating the distributed capabilities that allow technological knowledge to become usable and scalable. Future research questions include:

- How do supply chains coordinate the complementary capabilities required to move technologies from discovery to deployment?
- How do contractual and relational governance mechanisms enable or constrain interorganizational capability development?
- Under what conditions do IP protections facilitate versus inhibit the knowledge openness required for operational assimilation?
- What supply chain capabilities are most critical for transforming early-stage technologies into scalable products or services?

6.2 From Isolated Events to Longitudinal Processes

A second shift is from treating TT as a discrete event to theorizing it as a longitudinal process. Early sourcing, IP, and partner selection decisions can shape later operational assimilation, manufacturing scale-up, downstream deployment, and user acceptance. In turn, problems encountered during deployment reshape technology design and supply chain architecture. TT outcomes therefore cannot be fully explained through the examination of isolated decisions.

This process view calls for research designs that are capable of capturing time, sequence, adaptation, and interorganizational complexity. Longitudinal case studies, historical analyses, event sequence analysis, and mixed-method designs are especially well-suited for explaining how technologies evolve as they move across firms, supply chain tiers, and use contexts. Priority research questions include:

- How do early-stage TT decisions shape later operational assimilation and deployment outcomes?
- What sequencing patterns characterize successful versus unsuccessful discovery-to-deployment processes?
- How do supply chains manage uncertainty as technologies advance from invention to scalable use?
- What forms of path dependence emerge in TT processes, and how do firms overcome early-stage constraints?

6.3 From Upstream Sourcing to Network-Wide Deployment and Use

A third shift is from upstream sourcing and governance toward network-wide deployment and use. Access to a technology does not ensure that it can be absorbed, adapted, scaled, delivered, supported, or renewed. A discovery-to-deployment perspective calls for equal attention to the operational and downstream capabilities – absorptive capacity, operational integration, manufacturing readiness,

logistics coordination, service support, user training, and interorganizational learning – that make technologies usable (Salehi et al., 2026). This is especially relevant for complex technologies such as AI systems, digital platforms, medical technologies, and advanced manufacturing tools, where value creation depends on embedding the technology in operational systems and supporting use across distributed networks.

Future research should examine how supply chains operationalize and deploy transferred technologies. Important research questions include:

- How do firms assimilate transferred technologies into production, logistics, and service systems?
- What supply chain capabilities enable technologies to scale beyond pilot projects or early commercialization?
- How do downstream partners, distributors, and service providers influence technology deployment?
- How do supply chains coordinate deployment when technologies require ecosystem-wide adoption or complementary infrastructure?

6.4 From One-Way Transfer to Feedback-Based Renewal

A fourth shift is from one-way transfer to feedback-based renewal. Traditional TT accounts imply a forward movement from discovery to licensing, commercialization, and diffusion. A discovery-to-deployment perspective retains this forward movement, but also emphasizes its recursive character. After deployment, users, customers, service providers, regulators, and other downstream actors generate knowledge about performance, usability, failures, maintenance needs, and market acceptance. This knowledge can feed back into redesign, process improvement, next-generation innovation, and supply chain reconfiguration.

Supply chains are not only channels for moving technologies outward; they are also systems for capturing and transmitting feedback. Failure to capture this feedback can trap firms in initial deployment configurations and foreclose the learning needed for technology renewal. Priority research questions include:

- How do supply chains capture and transfer downstream feedback for technology renewal?
- What governance mechanisms support knowledge sharing from downstream users back to upstream developers and suppliers?
- How do digital technologies, IoT sensors, and platforms enable continuous feedback in TT processes?
- How do reverse knowledge flows contribute to resilience, sustainability, and circular innovation?

6.5 Methodological Opportunities

Advancing this agenda will require methods capable of capturing time, sequence, adaptation, interorganizational complexity, and cross-level dynamics. Alongside the empirical and analytical approaches that dominate existing SCM-TT research, the field would benefit from longitudinal case studies tracing technologies from invention through deployment and renewal; comparative studies contrasting successful and failed TT processes; process-theoretic approaches examining sequencing and adaptation; multi-tier supply chain designs; simulation and system dynamics models of stage interdependencies; and multi-level designs linking inventor, team, organizational, relational, and ecosystem dynamics. Such approaches would help SCM scholars move beyond isolated decision points toward richer explanations of how technologies become deployable value across supply chains.

7. Conclusion

This article advances the argument that TT should be reconceptualized as a discovery-to-deployment supply chain process. From this perspective, TT is not simply a legal, contractual, or commercialization activity. Instead, it is the coordinated transformation of technological knowledge into operational, commercial, and societal value across organizational boundaries. This view foregrounds the relationships, capabilities, processes, and infrastructures that enable technologies to be developed, scaled, deployed, used, and renewed.

Our structured review of 67 articles from core SCM journals reveals that the field has generated important insights into technology sourcing, supplier innovation, IP governance, licensing, commercialization, platform control, and diffusion, but these insights remain dispersed, upstream-concentrated, and bound to discrete decisions. We read this pattern not as a series of isolated gaps, but as the footprint of a transfer-event framing the field has inherited from adjacent literatures. Under that framing, the stages that most determine whether transferred technology becomes value – operational assimilation, downstream deployment, user support, reverse learning, and renewal – remain the least examined.

Reconceptualizing TT as a discovery-to-deployment process connects these dispersed insights and integrates two literatures that have developed apart. It gives TT research a process-and-coordination lens that helps explain why some technologies scale and endure while others stall at the license or pilot stage, and it extends SCM theory from the coordination of materials, products, and information to the coordination of technological knowledge and capabilities. Realizing this potential will require formal theoretical development – specifying how interorganizational capability coordination, governance, and feedback determine the value realized from transferred technology – which we identify as a priority for future work. As technologies become more complex, distributed, and ecosystem-dependent, the supply chain processes that enable their deployment will only grow more consequential, and SCM scholarship is well positioned to explain how they work.

Declarations

Author Contribution

Benjamin did the literature review, conceptual research, writing, and empirical analysis; Don was involved in integrating TT research, conceptual analysis, and writing; David worked on the theory section, conceptual analysis, and writing; Mohan helped integrate synthesize SCM theory with TT, conceptual analysis, and writing; and Sam was deeply involved in the literature review and synthesis.

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Figures

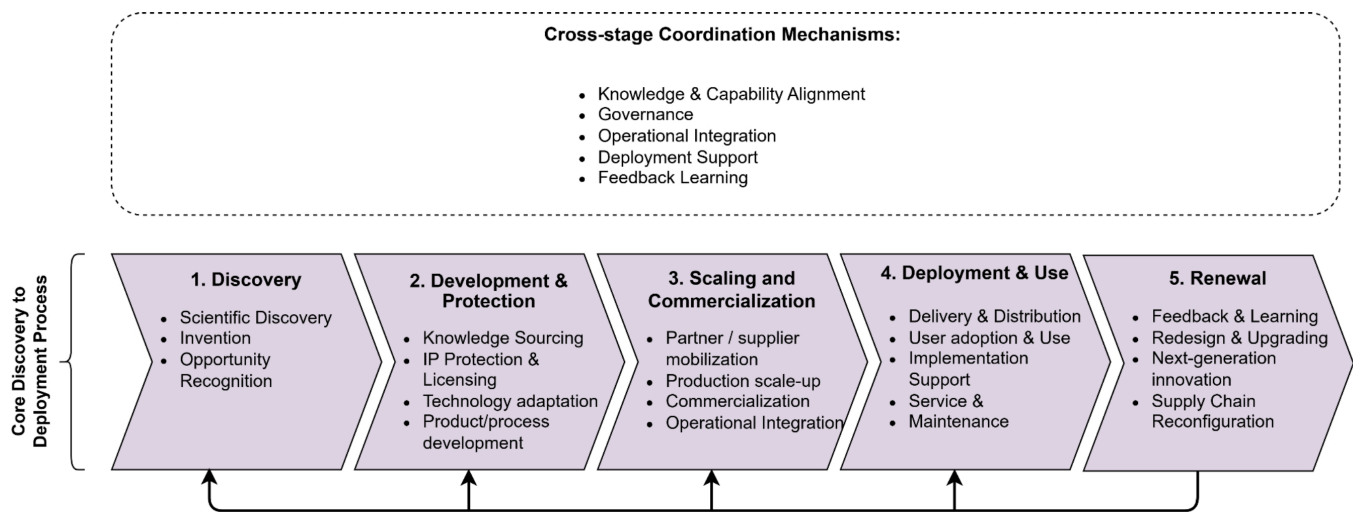


Figure 1

Technology Transfer as a Discovery-to-Deployment Supply Chain Process

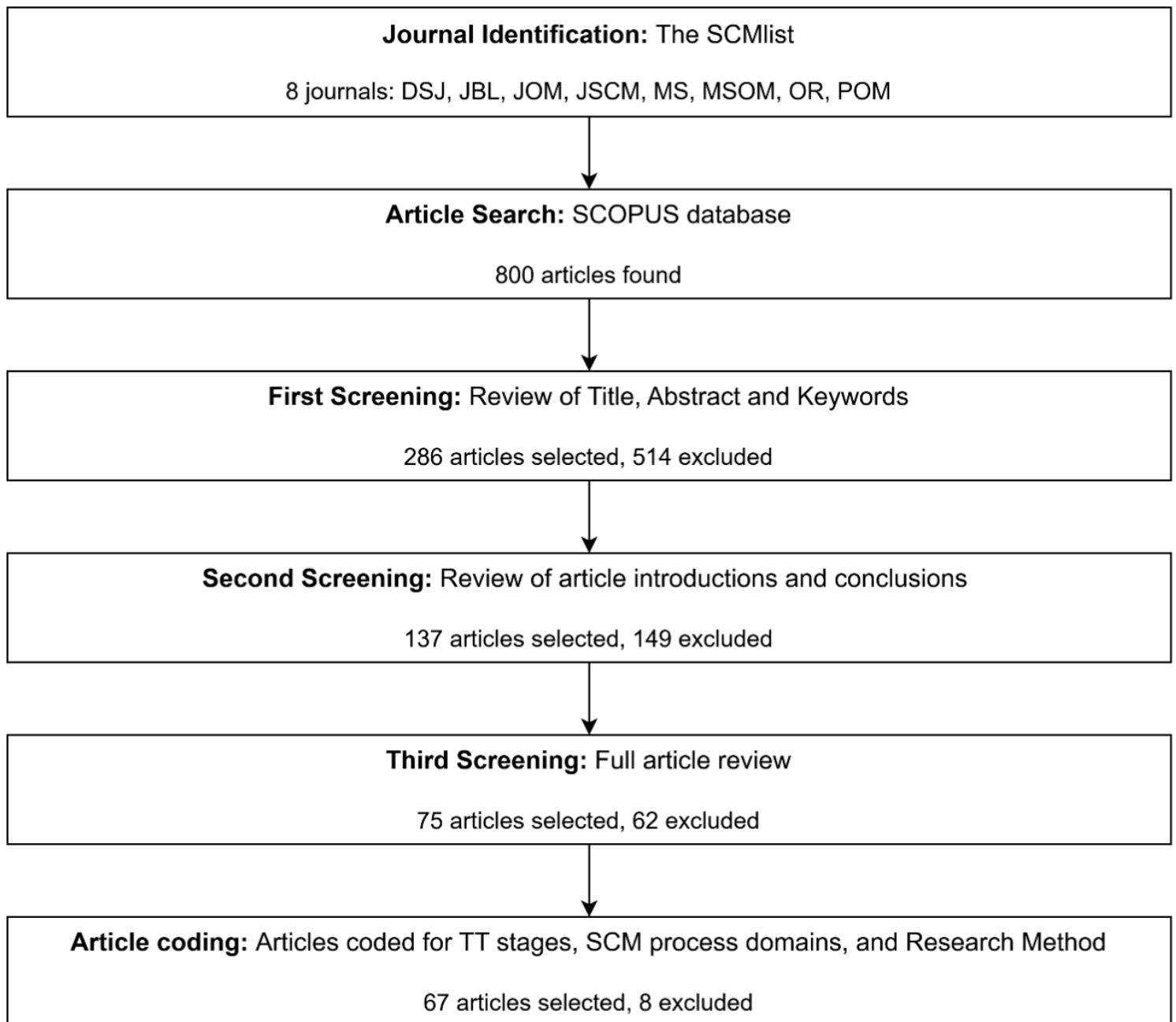


Figure 2

Article identification and screening process

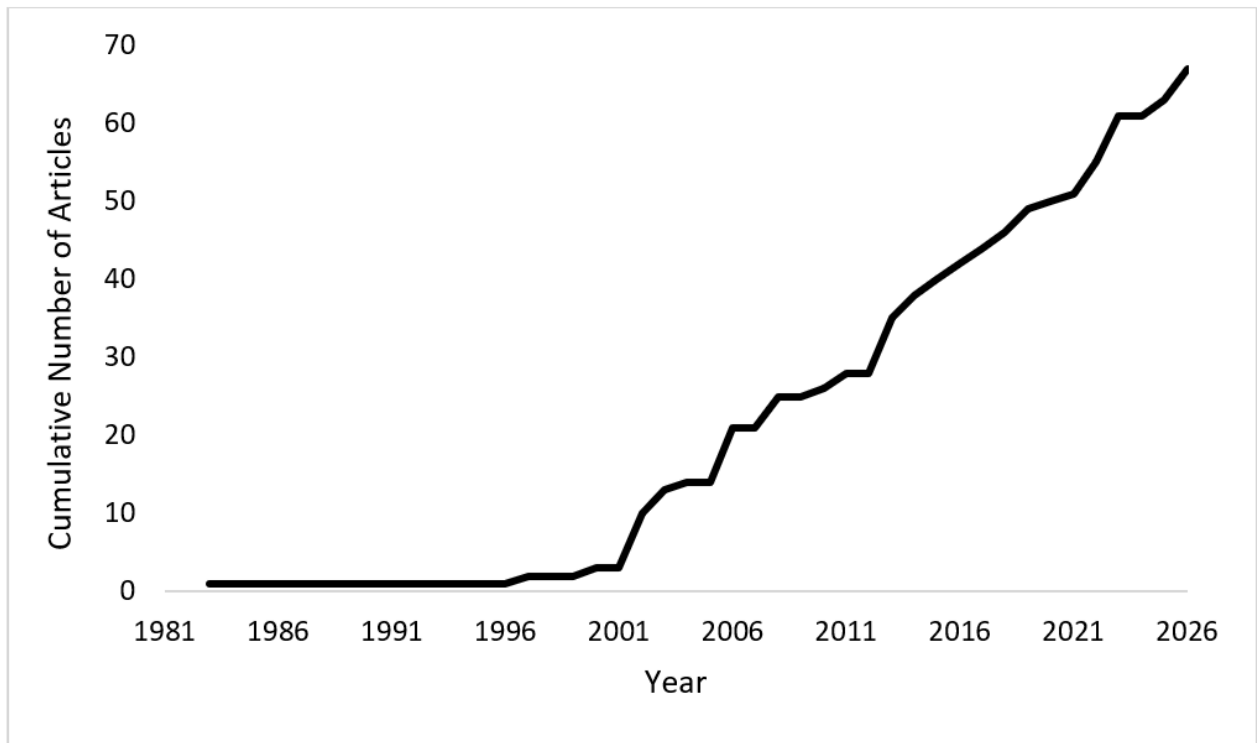


Figure 3

Growth of TT-Related Discovery-To-Deployment Research in SCM Journals

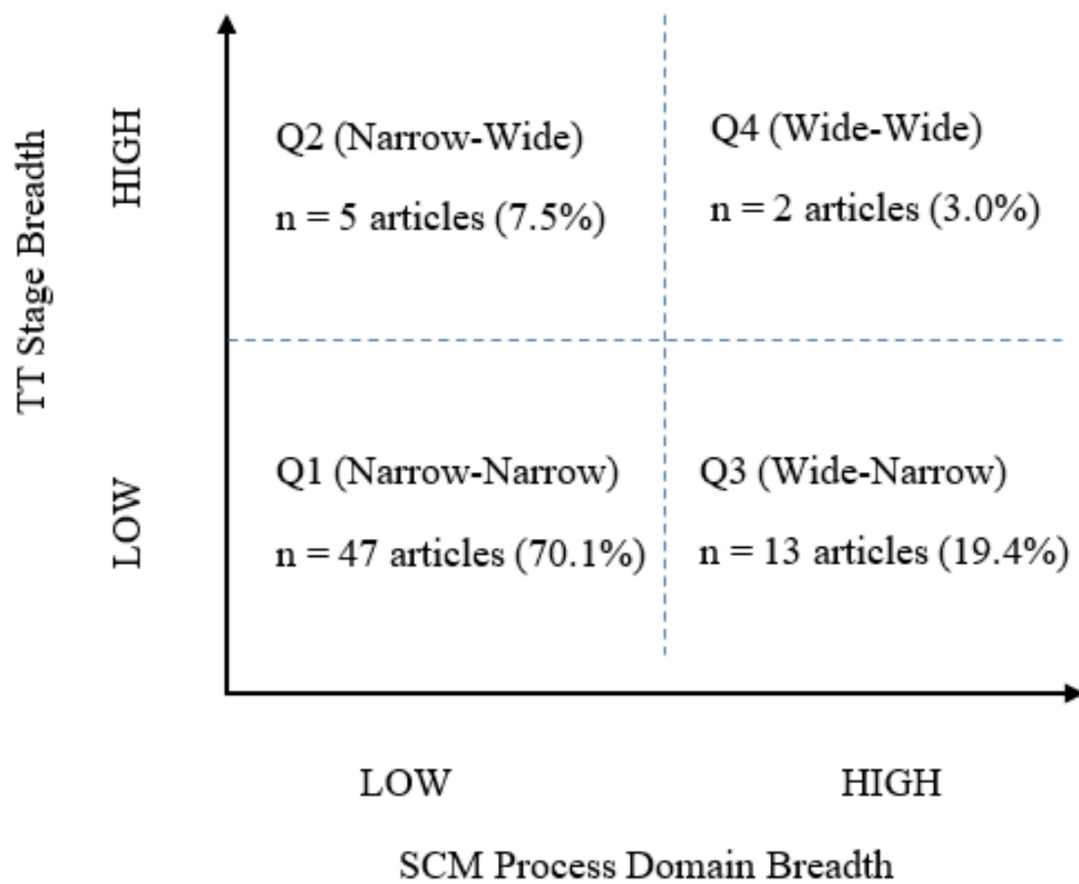


Figure 4

Joint TT Breadth and Supply Chain Process Breadth