

Navigating NDAs and IP in Capstone Courses: Evidence-Based Practices to Protect Students and Sustain Industry Partnerships

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Abstract

Industry-sponsored capstone design courses are widely valued for providing authentic, real-world learning experiences. At the same time, these courses increasingly rely on legal agreements—such as non-disclosure agreements (NDAs), intellectual property (IP) contracts, and sponsor agreements—that govern confidentiality, ownership, and dissemination of student work. Despite their prevalence, these documents are typically treated as administrative necessities rather than as elements of instructional design, and their pedagogical implications remain underexamined. This study presents a qualitative document analysis of publicly available NDAs, sponsor agreements, policy documents, and guidance materials used in U.S. engineering capstone programs. Using a structured coding framework, the analysis examines how these artifacts address confidentiality scope, IP ownership, publication rights, faculty access for assessment, and student participation conditions. The corpus comprises approximately 40 documents from 30 institutions, spanning public and private universities, R1 and regional programs, and both engineering and applied engineering contexts. Findings identify recurring structural patterns in how legal constraints are articulated across document types. Institution-signed sponsor agreements, menu-based IP models, explicit publication provisions, and plain-language guidance materials co-occur with clearer articulation of academic considerations such as assessment access and dissemination expectations. In contrast, standalone student-signed NDAs more frequently omit such provisions, introducing ambiguity regarding faculty access, evaluation, and student agency. Rather than advocating a single model, this paper reframes NDA and IP agreements as pedagogical design artifacts and synthesizes evidence-based design patterns and trade-offs for structuring industry-sponsored capstone experiences. By foregrounding legal infrastructure as part of the designed learning environment, the study contributes an analytic lens for engineering design education and offers practical guidance for programs seeking to balance industry collaboration with educational integrity.

1. Introduction

Industry-sponsored capstone design courses play a central role in engineering education, serving as a culminating experience in which students integrate technical knowledge with professional practice (Todd et al., 1995; Howe & Wilbarger, 2006). Through engagement with real-world stakeholders, capstone projects are widely valued for fostering authentic problem solving, teamwork, communication, and ethical reasoning (Prince & Felder, 2006; Dutson et al., 1997). As a result, partnerships with industry sponsors have become a common feature of engineering programs (Howe & Wilbarger, 2006; Brackin & Gibson, 2005). Alongside these partnerships, capstone courses frequently introduce legal agreements governing confidentiality and intellectual property (IP), including non-disclosure agreements (NDAs), sponsor contracts, and institutional IP policies. These agreements are intended to protect sponsor interests and enable collaboration,

yet they also shape what students can design, document, present, and retain as part of their educational experience. In many programs, such agreements are treated primarily as administrative necessities rather than as elements of instructional design (Hudson, 2021; Duff, 2022). This paper argues that confidentiality and IP agreements are not pedagogically neutral. Instead, they function as design artifacts that mediate relationships among students, faculty, sponsors, and institutions, and that influence assessment practices, dissemination opportunities, and student agency in capstone courses. Despite their prevalence, these agreements have received limited direct attention in engineering education research as objects of systematic analysis, with prior work more often focusing on student experiences, program structures, or industry engagement outcomes (Todd et al., 1995; Howe & Wilbarger, 2006). To address this gap, this study examines how NDAs, sponsor agreements, policy documents, and guidance materials are structured and framed within U.S. engineering capstone programs. Using qualitative analysis of publicly available documents, the study identifies recurring structural patterns, common failure modes, and design features that co-occur with clearer articulation of academic considerations within legal constraints. Rather than prescribing a single model, the goal is to provide empirically grounded insights that support more intentional design of industry-sponsored capstone experiences.

2. Motivation and Problem Framing

2.1 Capstone Courses at the Intersection of Education and Industry

Capstone design courses occupy a unique position at the boundary between academic instruction and professional practice. Unlike internships or employment, capstone projects are assessed academic experiences governed by curricular objectives, grading standards, and accreditation expectations (Todd et al., 1995; Howe & Wilbarger, 2006). At the same time, industry-sponsored projects introduce external constraints, expectations, and legal considerations that originate outside the educational context (Brackin & Gibson, 2005). Legal agreements are commonly used to manage this boundary. Non-disclosure agreements (NDAs) may restrict disclosure of proprietary information, while intellectual property (IP) agreements may specify ownership or licensing of project outcomes. When carefully aligned with course goals, such agreements can support productive collaboration. When misaligned, however, they can create ambiguity regarding faculty access, limit students' ability to present or publish work, or condition participation on acceptance of legal terms that extend beyond typical coursework (Hudson, 2021).

2.2 Misalignment as a Design Problem

Many challenges associated with NDAs and IP agreements in capstone courses arise not from sponsor intent, but from misalignment between legal structures and pedagogical requirements. Agreements developed for employment, consulting, or sponsored research contexts are sometimes reused in capstone settings without modification. As a result, students may be asked to sign documents that assume roles, responsibilities, or risks inconsistent with their status as learners.

From a design education perspective, this misalignment constitutes a design problem rather than a compliance problem. Legal agreements shape the constraints under which students design, document, and communicate their work, much like technical requirements or stakeholder needs (Prince & Felder, 2006). When these constraints are implicit, overly broad, or poorly communicated, they can undermine transparency, equity, and assessment validity.

2.3 Why Document Analysis Matters

Prior research has provided important insights into capstone pedagogy, industry partnerships, and student experiences (Todd et al., 1995; Howe & Wilbarger, 2006; Prince & Felder, 2006). Work on ethics and intellectual property awareness has similarly highlighted the importance of preparing students to navigate professional responsibilities (Hudson, 2021; Duff, 2022). However, these strands of literature have largely treated legal agreements as background conditions rather than as primary artifacts of analysis. Systematic examination of how NDAs, sponsor agreements, and IP policies are structured and communicated within capstone programs remains limited. As a result, the pedagogical implications of these documents—and the ways they shape assessment access, dissemination expectations, and student participation—are not well characterized in existing research.

Publicly available agreements and policies provide a valuable window into institutional practice. They reveal how programs formally articulate confidentiality, ownership, publication, and faculty roles, and how these expectations are communicated to students and sponsors. Document analysis therefore enables cross-institutional comparison of the structural conditions under which capstone pedagogy operates, without relying solely on retrospective or self-reported accounts (Bowen, 2009).

2.4 Contributions of This Study

In response to these gaps, this study makes three contributions to engineering design education research:

1. It reframes NDAs, sponsor agreements, and IP policies as pedagogical design artifacts within capstone courses.
2. It provides a systematic characterization of how these documents are structured across institutions, identifying recurring patterns and common failure modes.
3. It synthesizes observed patterns into evidence-based design options and trade-offs that support alignment between industry collaboration and capstone pedagogy.

By foregrounding legal infrastructure as part of the designed learning environment, this work extends existing capstone literature and offers practical insights for instructors, program directors, and institutions seeking to balance industry engagement with educational integrity.

3. Related Work

This study draws on multiple strands of engineering education research, including capstone design pedagogy, industry–academia partnerships, intellectual property and ethics education, and scholarship on assessment and scaffolding in project-based learning. Each of these areas provides important insights into how students learn in design contexts. However, their

intersection—particularly the role of legally binding agreements such as NDAs and IP contracts in shaping capstone learning environments—has received comparatively limited direct attention.

3.1 Capstone Design Education and Industry Partnerships

Capstone design courses have long been recognized as a cornerstone of engineering education, particularly for their role in integrating technical knowledge, professional skills, and authentic problem contexts. Foundational studies and surveys have examined models for structuring capstone experiences, assessing design outcomes, and managing multidisciplinary teams (Todd, Sorensen, & Magleby, 1993; Todd et al., 1995; Brackin & Gibson, 2005). A substantial body of literature also addresses industry engagement in capstone courses, emphasizing benefits such as realism, stakeholder interaction, and preparation for professional practice. Research in this area focuses on sponsor selection, project scoping, communication practices, and alignment of expectations between sponsors and academic programs (Alexander, Beyerlein, & Metlen, 2014; Scachitti & Higley, 2023). Within applied and engineering technology contexts, NDAs are sometimes described as practical mechanisms that enable access to projects involving proprietary constraints (Foster, 2021). While such accounts provide insight into operational practice, NDAs and IP agreements are typically framed as enabling tools rather than as pedagogical artifacts whose structure may influence assessment, dissemination, or student participation.

3.2 Professional Ethics, Intellectual Property, and Confidentiality in Engineering Education

Engineering education research has long addressed professional ethics, including issues related to confidentiality, intellectual property, and responsible handling of proprietary information. These topics are commonly situated within broader discussions of professional responsibility and ethical decision-making, often through case-based or reflective pedagogies (Warnick & Todd, 2011). More recent work has examined students' understanding of intellectual property in project-based and industry-collaborative contexts, identifying persistent misconceptions regarding ownership, authorship, and commercialization pathways. Hudson (2021) discusses tensions among student goals, sponsor expectations, and institutional IP policies, while Duff (2022) explores how students and educators interpret IP rights within engineering education settings. Although this literature establishes the importance of IP and confidentiality as professional competencies, it generally treats them as conceptual or ethical topics rather than as embedded legal constraints that directly govern student work. NDAs and IP agreements are therefore discussed primarily in terms of awareness or compliance, with little systematic analysis of their structural implications for assessment or dissemination.

3.3 Assessment, Transparency, and Equity in Project-Based Learning

Research on project-based and design-based learning consistently highlights the importance of transparent, equitable, and well-aligned assessment practices. Studies emphasize risks associated with ambiguous evaluation criteria, uneven access to resources, and misalignment between learning objectives and assessment mechanisms (Prince & Felder, 2006).

Within capstone contexts, scholars have underscored the need for assessment structures that support fairness across teams and sponsors, ensuring that students are evaluated against comparable criteria despite variation in project scope or industry context (Todd et al., 1995;

Brackin & Gibson, 2005). Equity-focused scholarship similarly stresses minimizing asymmetrical risk and avoiding instructional practices that disproportionately disadvantage certain students. However, this literature rarely examines legal agreements as contributors to assessment opacity or inequity. When challenges arise, they are typically attributed to team dynamics, sponsor engagement, or instructional design rather than to contractual constraints. Consequently, the role of NDAs and IP agreements in shaping what students can submit, share, or be evaluated on remains underexplored.

3.4 Guidance, Scaffolding, and Boundary Objects in Design Education

Design education research emphasizes the importance of scaffolding, explicit guidance, and metacognitive support in helping students navigate complex, ill-structured problems. Student-facing explanations, structured reflection, and clear articulation of expectations have been shown to support learning outcomes and professional identity development in design contexts. Within capstone courses, such scaffolding often takes the form of design reviews, documentation standards, and reflective assignments that help students reason about constraints, trade-offs, and stakeholder needs. From a theoretical perspective, these artifacts can be understood as boundary objects that mediate interaction between professional communities with differing goals and constraints (Star & Griesemer, 1989; Bucciarelli, 1994). Prior work on scaffolding has focused primarily on cognitive and instructional supports rather than on administrative or legal scaffolding. As a result, guidance related to NDAs and IP agreements is rarely analyzed as a pedagogical intervention. This study extends existing perspectives on scaffolding by examining how guidance documents mediate legal constraints within capstone learning environments.

3.5 Gaps Addressed by This Work

Taken together, prior research provides a robust foundation for understanding capstone pedagogy (Todd et al., 1995; Brackin & Gibson, 2005), industry-sponsored design education (Alexander et al., 2014; Scachitti & Higley, 2023), ethical reasoning and IP awareness (Warnick & Todd, 2011; Hudson, 2021; Duff, 2022), and the importance of transparent assessment and scaffolding (Prince & Felder, 2006). What remains largely absent is systematic analysis of how legally binding agreements themselves function as part of the designed learning environment in capstone courses. NDAs and IP agreements are typically acknowledged as operational necessities rather than examined as pedagogical artifacts that shape assessment access, dissemination opportunities, and student agency. This study addresses that gap by analyzing NDAs, sponsor agreements, policy documents, and guidance materials as design artifacts within capstone learning environments. Rather than focusing on learning outcomes directly, it examines the structural conditions that shape those outcomes by identifying recurring patterns, common failure modes, and design features that influence how legal constraints intersect with educational objectives. In doing so, it complements existing capstone and industry-partnership literature by foregrounding legal infrastructure as an integral component of instructional design.

4. Methods

This study employed qualitative document analysis to examine how non-disclosure agreements (NDAs), intellectual property (IP) agreements, policy documents, and guidance materials are structured and framed within U.S. engineering capstone programs. The aim was to characterize recurring structural patterns, design features, and potential misalignments between legal constraints and capstone pedagogy, rather than to evaluate implementation outcomes or stakeholder perceptions.

4.1 Data Sources and Inclusion Criteria

The analytic corpus consisted of publicly accessible documents collected from institutional, college, and program websites associated with U.S. engineering capstone or senior design courses. Documents were included if they:

1. were explicitly associated with an engineering capstone or equivalent culminating design course;
2. addressed confidentiality, intellectual property, publication rights, or sponsor agreements relevant to student project work;
3. applied to a U.S.-based institution; and
4. were accessible without institutional credentials or non-disclosure restrictions.

Documents related exclusively to graduate research, internships, employment agreements, or non-engineering disciplines were excluded. The final corpus comprised approximately 40 documents from 30 institutions, representing a mix of public and private universities, R1 and regional institutions, and both traditional engineering and applied or polytechnic programs. Institutions spanned multiple U.S. geographic regions (Northeast, Midwest, South, and West). During data collection, additional institutions were identified that referenced NDAs or sponsor agreements but did not provide publicly accessible templates or policies (e.g., documents distributed through course shells or sponsor portals). These cases ($n = 16$) were logged but excluded, resulting in a conservative estimate of publicly visible capstone legal infrastructure. Documents were identified through systematic searches of institutional and program websites using terms such as “capstone NDA,” “senior design intellectual property,” “sponsor agreement,” and “capstone confidentiality,” as well as navigation of capstone resource pages and sponsor portals. No restricted repositories, course shells, or FOIA requests were used.

4.2 Data Privacy, Corpus Validation, and AI-Assisted Procedures

Document identification involved exploratory search supported by AI-assisted discovery to surface potential publicly available artifacts. Inclusion in the analytic corpus required independent human verification: each candidate document was located directly, accessed by the researcher, and saved to a local archive prior to coding. Only documents contained within this verified corpus were analyzed. No confidential, sponsor-provided, or restricted agreements were uploaded or examined. AI tools were used solely as interpretive aids (e.g., comparing clause structures or identifying potential patterns), while all coding decisions and interpretations were made by the researcher and verified against source documents. To mitigate risks of generative error, findings rely exclusively on observable features within the verified corpus, and analytic memos were maintained to document coding decisions and boundary cases. Because the study

does not evaluate AI performance, formal accuracy metrics are not applicable; rigor is instead supported through corpus verification, transparent procedures, and human-in-the-loop review.

4.3 Document Types

Four categories of documents were analyzed:

- **Sponsor agreements**, executed between institutions and industry sponsors
- **Standalone NDAs**, often requiring student signatures
- **Policy documents**, describing institutional or program-level IP and confidentiality practices
- **Guidance materials**, including student- or sponsor-facing explanations

Document type was treated as an analytically meaningful feature reflecting differences in intended audience, authority, and pedagogical implications.

Some artifacts functioned primarily as index or portal pages linking to multiple agreements.

These were coded as guidance or meta-documents. When such artifacts did not articulate confidentiality scope, IP ownership, faculty access, or publication rights, those dimensions were coded as “not addressed.”

4.4 IRB Considerations

This study analyzed publicly available documents and did not involve human subjects or identifiable data. The work therefore met criteria for IRB exemption under standard institutional guidelines.

4.5 Coding Framework

An initial coding framework was developed iteratively based on prior literature on capstone pedagogy, assessment, and equity (Dutson et al., 1997; Howe & Wilbarger, 2006; Beyerlein et al., 2004), combined with themes observed during preliminary document review, consistent with qualitative document analysis approaches (Bowen, 2009; Saldaña, 2016).

The final framework included the following dimensions:

- Intended signatory
- Confidentiality scope and duration
- IP ownership model
- Publication and presentation rights
- Faculty access for assessment
- Participation equity and student choice
- Alignment with course deliverables
- Consistency with institutional IP policy
- Presence of plain-language guidance

Codes were applied conservatively. When documents were ambiguous or silent on a dimension, they were coded as “not addressed.” The coding template captured both presence and strength of articulation using descriptive labels (e.g., explicit, limited, implicit, partial), which were later grouped into analytically meaningful categories.

4.6 Coding Procedure and Calibration

Coding proceeded in three stages:

1. **Calibration phase:** a subset of documents representing multiple artifact types was reviewed iteratively to refine code definitions and decision rules.
2. **Full corpus coding:** the finalized codebook was applied across the corpus.
3. **Saturation check:** additional documents were reviewed until no new structural categories emerged.

Analytic memos documented coding decisions, ambiguities, and emerging patterns throughout the process. Because the study is design-analytic and relied on a single primary coder, formal inter-rater reliability statistics were not appropriate. Instead, rigor was supported through iterative review, explicit coding rules, and transparent reporting, consistent with qualitative document analysis practices (Bowen, 2009; Saldaña, 2016).

4.7 Analytical Approach

Analysis focused on identifying co-occurring patterns across document types and coded dimensions. Rather than treating any single document as representative, the analysis emphasized contrasts between categories (e.g., student-signed NDAs versus institution-signed agreements) and recurring feature combinations associated with clearer or weaker articulation of academic considerations. The study does not make causal claims; observed relationships are reported as associations within the corpus. Institutional characteristics (e.g., sponsor size, institutional classification) were recorded descriptively but not treated as analytic variables, as the focus is on document structure rather than institutional comparison.

4.8 Trustworthiness

Trustworthiness was supported through use of publicly accessible artifacts to enable transparency, conservative coding practices to avoid overinterpretation, and inclusion of diverse institution types. Because the analysis focuses on documentary artifacts rather than enacted classroom practice, interpretations are limited to the structural conditions these documents establish. Limitations related to scope and generalizability are discussed in Section 7.

5. Findings

This section reports patterns observed across the corpus of publicly available NDAs, sponsor agreements, policy documents, and guidance materials used in U.S. engineering capstone courses. Findings describe co-occurring structural features within the dataset and do not imply causal relationships. To provide descriptive grounding, key clause types were examined to estimate prevalence across the corpus; these counts contextualize recurring patterns but are not intended as statistical generalization (see Appendix A).

5.1 Distribution of Document Types and Governance Structures

The corpus included four primary document types: institution–sponsor agreements, standalone NDAs, policy documents, and guidance materials. Institution–sponsor agreements constituted the largest share of artifacts, followed by standalone NDAs, with policy and guidance documents representing a substantial minority. Document type was consistently associated with how academic roles and instructional constraints were articulated. Institution–sponsor agreements

more frequently included explicit provisions regarding faculty access for assessment, permissible academic disclosure, and publication expectations. In contrast, standalone NDAs—particularly those intended for student signatures—often omitted such provisions or addressed them only implicitly. Guidance materials, while non-binding, regularly articulated instructional priorities not fully reflected in legally operative agreements.

5.2 Intended Signatories and Faculty Access

Documents varied in intended signatory, including institution-signed agreements, student-signed NDAs, and documents without a signatory (e.g., policy or guidance pages). Intended signatory co-occurred consistently with treatment of faculty access for assessment. Institution-signed agreements almost uniformly preserved faculty access to project materials for grading and evaluation, often explicitly permitting internal disclosure for instructional purposes. By contrast, a substantial portion of student-signed NDAs did not address faculty access. When unspecified, this dimension was coded as “not addressed,” reflecting ambiguity rather than inferred restriction. Overall, more than one-third of artifacts were silent on faculty access, requiring instructors to interpret assessment permissions contextually (Appendix A).

5.3 Intellectual Property Ownership Models

The corpus exhibited multiple IP ownership models, including default student ownership, sponsor ownership, shared arrangements, and menu-based or selectable models. Default student ownership was the most common pattern, consistent with institutional IP policies represented in the dataset. Menu-based ownership models—where sponsors selected from predefined options—co-occurred with clearer articulation of default terms and academic constraints. Documents requiring assignment of IP to sponsors were less common and more frequently associated with partial or unclear alignment with capstone deliverables, particularly when participation was contingent on acceptance of ownership terms.

5.4 Confidentiality Scope and Duration

Confidentiality provisions varied substantially in scope and duration. Some documents defined confidentiality narrowly, limiting it to sponsor-provided or explicitly marked information, while others used broader definitions encompassing project-related or contextual information.

Durations ranged from time-limited obligations to indefinite or unspecified terms.

Broad-scope and long-duration provisions appeared most frequently in standalone NDAs and were rarely accompanied by explicit academic carve-outs. Institution–sponsor agreements more often constrained confidentiality temporally or contextually, or included language clarifying permissible academic disclosure.

5.5 Publication and Presentation Rights

Publication and presentation rights were addressed in a majority of artifacts, most often through provisions allowing dissemination subject to sponsor review. Defined review windows—typically time-limited—appeared primarily in institution–sponsor agreements.

However, a substantial minority of documents either restricted dissemination or did not address it. Approximately one quarter of artifacts lacked explicit publication language (Appendix A).

These cases disproportionately co-occurred with student-signed NDAs and broader

confidentiality definitions. In contrast, policy and guidance documents frequently emphasized public reports, presentations, or showcases as integral components of capstone courses.

5.6 Participation Equity and Student Choice

Only a small minority of documents explicitly addressed student choice or participation equity (Appendix A). In many cases, participation in sponsored projects was framed as contingent on acceptance of legal terms, with no stated alternative pathways. Where voluntary participation or alternative project options were described, such language co-occurred with fewer coded instances of misalignment between legal constraints and course requirements. These provisions appeared most often in institution-level agreements and guidance or policy documents rather than standalone NDAs.

5.7 Plain-Language Guidance and Instructional Alignment

Plain-language explanations were present in a majority of artifacts, though their pedagogical depth varied (Appendix A). Many documents provided limited or policy-oriented explanations, while guidance materials and policy pages more frequently articulated how NDAs and IP agreements intersect with course requirements, assessment practices, and dissemination expectations. Within the corpus, the presence of such guidance co-occurred with fewer instances of missing or conflicting provisions, particularly regarding faculty access and publication rights. Guidance materials consistently articulated instructional constraints that were implicit or absent in legal agreements alone.

5.8 Cross-Cutting Patterns

Alignment was often distributed across multiple artifacts rather than encoded within a single document. Guidance and policy materials frequently articulated pedagogical expectations that were absent from legally operative agreements. Across the corpus, five recurring patterns were observed:

- Institution-signed sponsor agreements co-occurred with more explicit protections for faculty access and publication than student-signed NDAs.
- Menu-based IP ownership models were associated with clearer articulation of defaults and academic constraints.
- Broad or long-duration confidentiality provisions appeared primarily in standalone NDAs and were less frequently accompanied by academic carve-outs.
- Explicit participation equity language was uncommon but, when present, co-occurred with clearer alignment between legal terms and course participation.
- Plain-language guidance functioned as an instructional artifact supporting alignment between legal expectations and capstone pedagogy.

These patterns inform the design implications presented in the following section.

5.9 Pedagogical Tensions

Several recurring tensions were observed between expected course deliverables (e.g., public presentations, reports, or showcases) and confidentiality provisions. In some cases, broad confidentiality obligations were not accompanied by explicit preservation of academic dissemination, creating potential ambiguity regarding student responsibilities.

These tensions do not indicate implementation failure but highlight how legal language may require local interpretation to align with pedagogical norms. This observation reinforces the importance of explicit academic carve-outs discussed in Section 6.

6. Evidence-Based Design Patterns and Practical Implications

This section synthesizes design patterns derived from recurring structural features observed across the corpus. These patterns reflect document characteristics that co-occurred with clearer articulation of academic considerations within legal agreements. They are presented as design options rather than prescriptive recommendations, recognizing variation in institutional context, sponsor relationships, and administrative constraints. Similar pattern-based guidance approaches are common in design and engineering education scholarship, where structural features are used to inform practice without implying universal solutions (Prince & Felder, 2006).

6.1 Institutional Agreements as Primary Governance Mechanisms

Observed pattern. Institution-signed sponsor agreements more consistently articulated faculty access, publication expectations, and alignment with course deliverables than student-signed standalone NDAs, which more frequently omitted or left ambiguous these considerations.

Design implication. Where feasible, institution-level agreements may provide a more effective mechanism for encoding instructional constraints and preserving assessment authority than relying on individually executed student NDAs.

6.2 Distinguishing Confidentiality From Intellectual Property

Observed pattern. Documents that treated confidentiality and IP ownership as distinct provisions exhibited clearer boundaries regarding disclosure, assessment, and dissemination. NDAs that implicitly bundled confidentiality with ownership or control of outputs were more frequently associated with ambiguity.

Design implication. Explicit separation of confidentiality obligations from IP ownership terms may support clearer interpretation and alignment with the educational context.

6.3 Menu-Based Ownership Models and Default Transparency

Observed pattern. Menu-based IP frameworks—where sponsors select from predefined ownership or licensing options—co-occurred with clearer default terms and fewer conflicts with capstone deliverables than mandatory assignment models.

Design implication. Selectable ownership structures with explicit defaults appear to balance sponsor flexibility with transparency for students and instructors.

6.4 Preserving Faculty Access for Assessment

Observed pattern. Explicit provisions permitting faculty access to confidential materials for grading were common in institution-signed agreements but often absent in student-signed NDAs.

Design implication. Explicitly preserving instructional access may reduce ambiguity and support assessment validity, particularly where confidentiality constraints are extensive.

6.5 Publication Rights and Sponsor Review Windows

Observed pattern. Publication provisions allowing dissemination subject to sponsor review—especially when review windows were time-limited—were more closely aligned with common capstone deliverables such as reports, presentations, and portfolios.

Design implication. Defined review processes appear to accommodate sponsor interests while preserving educational dissemination practices.

6.6 Participation Equity and Student Choice

Observed pattern. Explicit statements regarding voluntary participation or alternative project pathways were uncommon but, when present, co-occurred with fewer observed tensions between legal terms and course requirements.

Design implication. Clarifying participation expectations may help reduce ambiguity and perceived coercion in industry-sponsored projects.

6.7 Plain-Language Guidance as Pedagogical Scaffolding

Observed pattern. Guidance documents frequently articulated instructional expectations not fully specified in legal agreements, and their presence co-occurred with fewer instances of missing or conflicting provisions.

Design implication. Providing companion explanatory materials can function as a form of pedagogical scaffolding, consistent with broader literature emphasizing the role of explicit guidance in supporting student understanding (Prince & Felder, 2006).

6.8 AI-Assisted Review as a Supplementary Tool

Observed pattern. Recurring clause structures and omission patterns suggest that agreement review may benefit from systematic screening. However, agreements that most clearly aligned with pedagogical goals reflected intentional local adaptation rather than reliance on generic templates.

Design implication. AI-assisted tools may be useful for identifying potential risk areas or omissions, but their role is best understood as supportive rather than determinative, with final decisions grounded in institutional policy and instructional intent.

6.9 From Design Patterns to Practice

While the preceding patterns describe structural features observed across documents, their implications extend to how faculty and programs interpret and negotiate agreements in practice. The following subsections illustrate how the identified patterns may inform local decision-making without assuming uniform institutional authority or legal autonomy.

6.9.1 Faculty Mediation and Negotiability

Many misaligned provisions appear to arise from reuse of generic legal templates designed for employment or research contexts. When these assumptions are made explicit, targeted revisions—such as clarifying student status, narrowing confidentiality scope, or preserving academic activities—may be feasible. Faculty engagement can therefore function as a mediating mechanism, translating pedagogical requirements into sponsor-facing agreements and aligning expectations across stakeholders.

6.9.2 Heuristics for Reviewing Capstone Agreements

Across the corpus, several clause types appeared particularly consequential in capstone contexts:

- restrictions on future employment or research activity
- overbroad definitions of confidential information
- implicit or absent publication protections
- IP assignment provisions misaligned with educational objectives
- limitations on faculty access for assessment

These features provide a practical review lens for identifying potential misalignment between legal language and instructional goals.

6.9.3 Student-Facing Explanations and Transparency

The analysis highlights the pedagogical value of explanatory materials that translate legal obligations into accessible language. Such guides can clarify confidentiality scope, permissible activities, and dissemination expectations, supporting student understanding without requiring modification of legal text.

Providing these explanations may enhance trust and reduce uncertainty in industry-sponsored projects.

6.9.4 Automated Tools for Interpretation and Dialogue

Automated or AI-assisted tools may support agreement review by identifying restrictive clauses, generating summaries, or suggesting clarifying language. Their value lies in facilitating dialogue among faculty, students, sponsors, and administrators rather than replacing institutional policy or legal review.

6.9.5 Transparency Through Public Guidance

Publicly accessible policies and guidance materials enable sponsors to understand academic expectations before entering partnerships, potentially reducing negotiation friction and supporting alignment between institutional and industry priorities.

6.10 Summary

Taken together, these patterns illustrate how intentional design of legal and administrative artifacts can support alignment between industry engagement and capstone pedagogy. Rather than prescribing a single model, they offer design options that preserve assessment integrity, transparency, and student agency across diverse institutional contexts.

7. Limitations and Future Work

This study has several limitations that shape interpretation of the findings and point to directions for future research. Because the analysis focuses on documentary artifacts rather than enacted practice, conclusions are necessarily bounded to the structural conditions these documents establish.

7.1 Scope and Data Sources

The analysis is limited to publicly available documents associated with U.S. engineering capstone programs. Internal agreements, course-specific negotiations, and informal practices that occur between sponsors, instructors, and students are not captured. Some programs may rely on institution-level contracts or legal review processes not visible in public-facing materials.

In addition, the study focuses exclusively on engineering capstone courses. Findings may not generalize to non-engineering disciplines, graduate research contexts, internships, or sponsored research environments, which operate under different pedagogical and legal assumptions. Because many institutions distribute NDA and IP agreements privately, publicly accessible artifacts likely represent a conservative subset of capstone legal infrastructure.

7.2 Interpretive Constraints

As a qualitative document analysis, the study identifies co-occurring patterns rather than causal relationships. The presence of particular features does not imply effectiveness or impact on learning outcomes, nor does the absence of a feature necessarily indicate problematic implementation. Coding decisions were intentionally conservative: when documents were ambiguous or silent on a dimension, they were coded as “not addressed.” While this approach enhances transparency, it may underrepresent implicit practices that are well understood within specific institutional contexts.

7.3 Absence of Stakeholder Perspectives

The study does not include direct input from students, faculty, sponsors, or institutional legal offices and therefore does not capture how agreements are interpreted, negotiated, or experienced in practice. Document structures may be supplemented by informal guidance, local norms, or compensatory practices that are not visible in written artifacts. Similarly, the analysis does not assess the impact of document features on student learning outcomes, assessment reliability, professional identity formation, or equity. The focus is intentionally design-analytic, examining structural conditions rather than educational effects.

Future research incorporating interviews, surveys, or case studies could explore how stakeholders navigate confidentiality and IP constraints, how sponsors perceive educational trade-offs, and how the structural patterns identified here translate into lived pedagogical experience.

7.4 Temporal and Jurisdictional Boundaries

The analyzed documents reflect policies and practices available at a particular point in time within a U.S. legal and accreditation context. Institutional policies, sponsor expectations, and regulatory environments evolve, and findings may not extend to international programs or future policy landscapes. Longitudinal research could examine how capstone agreements change in response to shifts in industry practices, accreditation standards, or institutional priorities.

7.5 Directions for Future Research

Several avenues could extend this work. First, empirical studies involving students and instructors could examine how different agreement structures influence assessment transparency, student agency, and perceived fairness. Second, comparative research across disciplines or countries could explore how confidentiality and IP are managed under different legal and educational regimes. Third, design-based or experimental studies could investigate how alternative capstone models—such as public-artifact-only assessment structures—affect learning outcomes and sponsor engagement. Together, these directions would complement the present

document-focused analysis and contribute to a more comprehensive understanding of how legal infrastructure shapes design education.

8. Discussion

This study examined how confidentiality and intellectual property agreements intersect with engineering capstone pedagogy through analysis of publicly available legal and policy artifacts used in industry-sponsored design courses. The findings characterize how these artifacts structure the environment within which capstone pedagogy operates; they do not represent direct observation of how agreements are interpreted or enacted in practice. Overall, the results suggest that document design—rather than sponsor type alone—plays a central role in shaping alignment between legal constraints and educational objectives. This section synthesizes these insights, situates them within design education perspectives, and considers implications for practice and research.

8.1 Legal Agreements as Pedagogical Design Artifacts

A central contribution of this work is the reframing of NDAs, sponsor agreements, and IP policies as design artifacts within capstone learning environments. From a design perspective, these documents function as boundary-setting mechanisms that shape what students can create, disclose, present, and retain. In doing so, they influence assessment validity, instructional authority, and student agency in ways comparable to more familiar curricular artifacts.

The analysis indicates that agreements explicitly encoding academic considerations—such as faculty access or time-limited publication review—co-occur with clearer alignment to capstone pedagogy. In contrast, generic or student-signed NDAs frequently omit such constraints, leaving ambiguity that must be resolved locally. Viewing these agreements as pedagogical artifacts therefore makes visible design decisions that are often obscured by administrative framing.

8.2 Industry Partnerships as Alignment Challenges Rather Than Conflicts

The findings do not suggest that industry collaboration is inherently at odds with educational goals. Instead, misalignment appears most often when legal templates developed for employment or research contexts are introduced without adaptation. Such templates may impose assumptions about confidentiality, ownership, and disclosure that are misaligned with instructional requirements.

Programs employing institution-signed agreements, selectable IP models, or explicit publication provisions appeared better positioned to accommodate sponsor needs while preserving academic expectations. These patterns suggest that productive partnerships depend less on eliminating confidentiality considerations and more on translating them into forms compatible with learning and assessment.

8.3 Equity, Agency, and Assessment Transparency

The analysis highlights how legal agreements intersect with participation equity and student agency. Student-signed NDAs often placed legal obligations on individuals without corresponding protections or alternatives, raising concerns about asymmetrical risk. By contrast, documents explicitly addressing voluntary participation or alternative pathways co-occurred with

fewer tensions between legal requirements and course expectations. From an assessment perspective, ambiguity regarding faculty access or dissemination rights undermines transparency and fairness. When instructors are uncertain what they may evaluate, grading practices risk becoming inconsistent. The association between institution-level agreements and explicit assessment provisions underscores the importance of aligning legal constraints with instructional responsibilities.

8.4 Guidance as Pedagogical Scaffolding

One of the most consistent patterns in the corpus was the role of guidance documents as mediators between legal requirements and instructional practice. Programs providing student- or sponsor-facing explanations articulated instructional expectations more clearly and exhibited fewer coded instances of missing or conflicting provisions. These materials function as pedagogical scaffolds, supporting students' ability to reason about confidentiality boundaries and professional responsibility. By making expectations explicit, guidance reduces reliance on informal interpretation and promotes shared understanding among stakeholders.

8.5 Boundary Management Through Design Alternatives

The analysis also points to an alternative design strategy in which capstone courses limit assessment to publicly disseminable artifacts. In such models, confidentiality applies to sponsor-provided inputs, while student-generated outputs remain publishable by design. Although not widespread in the corpus, this approach aligns with the strongest patterns observed in institution-level agreements and guidance-based models. This alternative illustrates a broader principle emerging from the study: alignment can be achieved either by embedding academic constraints within agreements or by structuring course deliverables to avoid assessment-bound confidentiality. Both strategies reflect intentional boundary management rather than ad hoc accommodation.

8.6 Rethinking Authenticity and Professional Preparation

A common concern is that limiting confidentiality or requiring public deliverables may reduce access to authentic industry problems. The findings suggest that authenticity in capstone design arises from engagement with constraints, stakeholders, and trade-offs rather than secrecy of outputs. Similarly, professional preparation need not depend on imposing legal constraints on graded work. Treating confidentiality as an explicit topic of reflection and negotiation can support professional learning while preserving assessment clarity.

8.7 Implications for Design Education Research and Practice

Taken together, the findings suggest that capstone infrastructure itself warrants design attention. Legal agreements governing confidentiality and IP are not peripheral administrative details; they shape the affordances and constraints of design education. For researchers, the study demonstrates the value of examining administrative and legal artifacts as components of the designed learning environment. For instructors and program leaders, it offers empirically grounded options for structuring industry partnerships that sustain sponsor engagement while protecting assessment integrity, equity, and student agency.

8.8 Trade-Offs and Alternative Implementation Models

The design patterns identified here are not universally optimal solutions but represent trade-offs across educational, legal, and partnership priorities. Institution-signed agreements may enhance transparency yet require additional administrative coordination. Defined publication windows preserve dissemination but may limit participation in highly sensitive projects. Programs therefore operate along different points of a design spectrum: some prioritize sponsor flexibility, while others emphasize public-artifact assessment models that minimize confidentiality constraints. Recognizing these trade-offs highlights that alignment is context-dependent. The patterns identified in this study provide a framework for reasoning about consequences rather than prescribing a single approach.

8.9 Mechanisms Linking Document Structure to Pedagogical Conditions

Although the study does not measure learning outcomes directly, the findings illuminate mechanisms through which document structures shape pedagogical conditions. Provisions restricting faculty access may constrain evaluative transparency, while absence of publication language can influence students' opportunities for reflection and public communication. These structural features operate as boundary conditions influencing instructional practice, even when their effects vary locally. By clarifying these mechanisms, the study complements outcome-focused research by identifying how administrative infrastructure can enable or constrain practices associated with learning, such as transparent assessment, reflective communication, and authentic stakeholder engagement.

9. Conclusions

Industry-sponsored capstone courses are a cornerstone of engineering education, providing students with opportunities to engage with authentic design challenges and professional stakeholders. At the same time, these courses increasingly rely on legal agreements—such as non-disclosure agreements (NDAs), intellectual property (IP) contracts, and sponsor agreements—that shape what students can design, document, present, and retain as part of their educational experience. Despite their prevalence, these agreements are rarely examined as components of instructional design. Through qualitative analysis of publicly available NDAs, sponsor agreements, policy documents, and guidance materials used in U.S. engineering capstone programs, this study investigated how legal infrastructure intersects with capstone pedagogy. The findings demonstrate that document structure matters: institution-signed sponsor agreements, menu-based IP models, explicit publication provisions, and plain-language guidance materials co-occurred with clearer articulation of academic considerations such as faculty access, assessment, and dissemination. In contrast, standalone student-signed NDAs more frequently omitted such provisions, introducing ambiguity that must be resolved locally within courses. Rather than advocating a single approach to managing confidentiality and intellectual property, this work reframes these legal artifacts as components of the designed learning environment. From this perspective, NDA and IP agreements are not merely administrative instruments but design elements that shape assessment conditions, participation structures, and opportunities for

student agency. Recognizing their pedagogical role allows programs to make more intentional choices about how industry partnerships are structured and communicated. The design patterns and practical implications presented here offer evidence-based options for instructors and program leaders seeking to sustain productive industry collaborations while preserving educational integrity, transparency, and equity. By foregrounding legal and administrative artifacts as part of capstone infrastructure, this study extends engineering design education research and highlights the importance of examining the structural conditions that shape learning environments. Future research incorporating stakeholder perspectives and outcome-based measures can build on this foundation to explore how these structural features influence student learning, professional preparation, and equitable participation. Such work will further clarify how legal infrastructure and pedagogical design interact in shaping the capstone experience.

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Appendix A. Cross-Cutting Pedagogical Features Across Capstone NDA/IP Artifacts

Appendix A. Prevalence and Strength of Pedagogically Salient Features Across Capstone NDA/IP Artifacts

(*N* = 40 publicly accessible documents; document-level analysis)

This table summarizes the presence and strength of key pedagogical features across all analyzed artifacts, including legally operative agreements (e.g., student-signed NDAs, institution–sponsor agreements) and non-operative materials (e.g., policy pages, guidance documents, and index or portal pages linking to templates). Each artifact was coded independently.

Dimension	Explicit articulation	Limited / implicit articulation	None / legal-only	Not addressed
Plain-language explanation	22	3	14	1
Publication / presentation rights	25	5	0	10
Faculty access for assessment	25	2	0	13
Participation equity / student choice	3	5	0	32
IP ownership clarity†	—	—	—	—

† *IP ownership exhibits multiple distinct patterns (e.g., student-retained, sponsor-owned, conditionally licensed, or policy-referenced) and is therefore described narratively in the Findings rather than collapsed into a single prevalence row.*

Interpretive note. Coding distinguished between explicit articulation, limited or implicit treatment, and absence or silence. “Not addressed” indicates that the artifact did not itself articulate the dimension, including cases where expectations were deferred to linked documents or institutional policy. This does not imply that protections were absent elsewhere within an institution, but reflects how pedagogical constraints are distributed across document ecosystems rather than embedded uniformly within individual artifacts.

Appendix B. Distribution of Explicit Pedagogical Protections by Document Type

(*N* = 40 publicly accessible documents; document-level analysis)

Document type	N		Plain-language explanation (explicit)	Publication / presentation rights (explicit)	Faculty access for assessment (explicit)	Participation equity / student choice (explicit)
Institution–sponsor agreement	6	5		6	5	1
Standalone NDA (student- or two-party)	14	0		7	4	0
Policy / governance document	13	12		9	12	1
Guidance / instructional material	3	3		1	2	0
Index / portal	1	1		0	0	0
Other	3	1		2	2	1

Interpretive note. Counts reflect the number of artifacts within each document type that explicitly articulated the listed feature. Document types were grouped analytically (e.g., sponsor agreements, standalone NDAs, policy/governance, guidance, and index artifacts) to reflect their functional role within capstone legal infrastructure. This table illustrates where explicit pedagogical protections tend to reside, not whether they are absent institution-wide.