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EVOLUTION OF THE ENGLISH-LANGUAGE TERMINOLOGICAL SYSTEM IN THE FIELD OF ADDITIVE TECHNOLOGIES AND METAL FORMING: A CROSS-DOMAIN TERMINOLOGICAL ANALYSIS

Abstract. The present article examines the ongoing terminological evolution at the intersection of two industrially significant domains – conventional metal forming and additive manufacturing (AM) – with particular focus on the mechanisms through which established lexical units are being repurposed, semantically shifted, or displaced by newly coined or proprietary designations. As hybrid production systems increasingly combine traditional metal forming operations with layer-by-layer AM processes, the terminological boundaries between these fields have become progressively unstable, generating a class of problematic lexical items whose meaning is context-dependent in ways that are rarely acknowledged in existing normative or pedagogical literature. The study



identifies three primary mechanisms driving this instability: inter-field borrowing with semantic narrowing or broadening, technological repurposing of established terms, and trade-mark genericisation. Each mechanism is illustrated through detailed case analyses of terms representative of the broader phenomenon, including *strain hardening* / *work hardening*, *yield point* versus *yield strength*, and the polysemous *drawing* family. The analysis is grounded in a cross-domain corpus of peer-reviewed publications, international standards – principally ISO/ASTM 52900:2021 and DIN 8580 – and manufacturers' technical documentation, evaluated against the theoretical framework of terminologisation proposed by Cabré. A particular emphasis is placed on the consequences of these terminological dynamics for English-to-Ukrainian technical translation, where the absence of corresponding national AM standards creates a normative vacuum that demonstrably contributes to translational inconsistency in engineering contracts, certification documents, and research publications. The article concludes with a structured set of translator-oriented recommendations and a bilingual EN-UA glossary comprising over forty terminological units organised across four thematic sections, each entry accompanied by contextual commentary designed to prevent the most commonly observed categories of cross-domain translational error.

Keywords: additive manufacturing, metal forming, technical terminology, strain hardening, yield strength, deep drawing.

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ЕВОЛЮЦІЯ АНГЛОМОВНОЇ ТЕРМІНОСИСТЕМИ В ГАЛУЗІ АДИТИВНИХ ТЕХНОЛОГІЙ ТА ОБРОБКИ МЕТАЛІВ ТИСКОМ: МІЖДИСЦИПЛІНАРНИЙ АНАЛІЗ

Анотація. У статті досліджується термінологічна еволюція на перетині двох промислово значущих галузей – традиційної обробки металів тиском та адитивного виробництва (АВ) – з особливою увагою до механізмів, через які усталені лексичні одиниці переосмислюються, зазнають семантичного зсуву або витісняються новоствореними чи фірмовими позначеннями. У міру того як гібридні виробничі системи дедалі активніше поєднують традиційні операції обробки металів тиском із пошаровими АВ-процесами, термінологічні межі між цими галузями стають дедалі менш чіткими, породжуючи категорію проблемних лексичних одиниць, значення яких залежить від контексту у спосіб, що рідко визнається в наявній нормативній або навчальній літературі. Дослідження виявляє три основні механізми, що зумовлюють цю нестабільність: міждисциплінарне запозичення з семантичним звуженням або розширенням, технологічне переосмислення усталених термінів та генеризація (апелятивація) торгових марок. Кожен механізм проілюстровано шляхом детального аналізу конкретних випадків термінів, що репрезентують це ширше явище, зокрема: деформаційне зміцнення (*strain hardening / work hardening*), межа текучості проти границі текучості (*yield point vs yield strength*), а також полісемантичне сімейство терміна "волочіння" (*drawing family*). Аналіз спирається на міждисциплінарний корпус рецензованих публікацій, міжнародних стандартів – насамперед ISO/ASTM 52900:2021 та DIN 8580 – і технічної документації виробників, що оцінюються крізь призму теоретичної моделі термінологізації, запропонованої М. Т. Кабре. Особлива увага приділяється наслідкам цих термінологічних процесів для англо-українського технічного перекладу, де відсутність відповідних національних стандартів у галузі адитивного виробництва створює нормативну прогалину, що спричиняє помітну перекладацьку неузгодженість в інженерних контрактах, сертифікаційних документах і наукових публікаціях. Стаття завершується структурованим переліком рекомендацій для перекладачів та двомовним глосарієм EN-UA, що охоплює понад сорок термінологічних одиниць, організованих у чотири тематичні секції; кожен запис супроводжується контекстним коментарем, покликаним запобігти найбільш поширеним категоріям міждисциплінарних перекладацьких помилок.

Ключові слова: адитивне виробництво, обробка металів тиском, технічна термінологія, деформаційне зміцнення, границя текучості, глибоке витягування.



The rapid advancement of additive manufacturing (AM) technologies over the past two decades has precipitated profound structural changes not only in industrial production practices but also in the specialised vocabulary that engineers, researchers, and technical translators rely upon to communicate complex concepts with precision. Whilst the terminology of conventional metal forming processes – encompassing forging, stamping, deep drawing, and rolling – had attained a considerable degree of standardisation through decades of industrial codification and normative documentation, the emergence of metal AM has fundamentally destabilised this equilibrium. Novel processes such as Laser Powder Bed Fusion (LPBF), Wire Arc Additive Manufacturing (WAAM), and Directed Energy Deposition (DED) have introduced an entirely new stratum of lexical units, many of which either repurpose established terms or occupy semantic spaces for which no adequate equivalent previously existed. This terminological flux is further compounded by the widespread use of proprietary trade designations – such as SLM®, DMLS®, and LaserCUSING® – which have gradually acquired quasi-generic status in technical discourse, often superseding the standardised nomenclature prescribed by ISO/ASTM 52900:2021.

The intersection of these two terminological systems has given rise to a category of particularly problematic lexical items: terms that retain their orthographic form whilst undergoing significant semantic shift depending on the technological context in which they appear. Classical examples include *extrusion*, which denotes fundamentally different physical mechanisms in conventional metal processing and material-extrusion AM, and *sintering*, whose applicability varies markedly across distinct powder-bed fusion technologies. Such polysemantic behaviour poses a considerable challenge not only for technical communicators but also for the broader project of knowledge transfer between research communities operating within adjacent yet historically distinct disciplines.

Moreover, the relative absence of corresponding national standards in many languages – Ukrainian among them – means that translators frequently operate in a normative vacuum, resorting to ad hoc solutions that may introduce inconsistency across technical documents.

Against this backdrop, the present article undertakes a systematic analysis of the mechanisms driving terminological evolution at the interface of metal forming and additive manufacturing, with particular attention to terms that exhibit semantic instability, register ambiguity, or translational opacity.

The overarching aim is to provide both a descriptive account of this ongoing terminological transformation and a set of evidence-based recommendations to support the work of technical translators and terminology specialists engaged with this rapidly evolving field.



The accelerating convergence of additive manufacturing and traditional metal forming within contemporary hybrid production systems has exposed a critical gap in the existing terminological infrastructure: the absence of a coherent, cross-domain framework capable of resolving the semantic conflicts that arise when established lexical units from metal forming discourse are appropriated, repurposed, or inadvertently conflated with their AM counterparts. This deficiency carries tangible practical consequences – manifesting in translational inconsistencies within multinational engineering contracts, ambiguities in safety-critical technical documentation, and impediments to the effective transfer of research findings across linguistic and disciplinary boundaries – thereby rendering the systematic study of this terminological evolution not merely an academic exercise in applied linguistics, but an urgent priority for the standardisation bodies, technical translators, and engineering communities responsible for maintaining the communicative integrity of an industry undergoing fundamental technological transformation.

Analysis of recent research and publications

Scholarly discourse on the terminology of additive manufacturing has expanded considerably in the past decade, largely as a by-product of broader review works that catalogued the field's rapid technical diversification. The seminal contribution of DebRoy et al. [1], published in *Progress in Materials Science*, offered what remains one of the most comprehensive accounts of metallic AM from a materials science perspective, and in doing so implicitly exposed the extent to which the field had outpaced its own normative vocabulary – with terms such as *residual stress*, *porosity*, and *microstructure* carrying distinct mechanistic connotations depending on the specific process under discussion.

Similarly, the monograph by Gibson, Rosen, Stucker and Khorsani [2], now in its third edition, systematically categorises AM processes into seven families and introduces process-specific nomenclature; yet it stops short of addressing the terminological friction that arises when this nomenclature intersects with the pre-existing vocabulary of conventional manufacturing. The challenge of semantic overlap between AM and traditional metal processing was partially acknowledged by Frazier [3] in his widely cited review in the *Journal of Materials Engineering and Performance*, wherein he noted that descriptors inherited from powder metallurgy and welding engineering – including *sintering*, *fusion*, and *deposition* – were being applied to AM contexts in ways that risked obscuring fundamental differences in underlying physical mechanisms.

From the standardisation perspective, the publication of ISO/ASTM 52900:2021 [4] marked a watershed moment, consolidating seven process categories under a unified taxonomy and explicitly superseding earlier, fragmented nomenclature; nevertheless, as Sames et al. [5] observed in



International Materials Reviews, even within the research community adherence to standardised terminology remains inconsistent, with trade designations such as SLM® and DMLS® continuing to dominate technical publications irrespective of official recommendations. On the metal forming side, the authoritative treatment by Hosford and Caddell [6] illustrates the degree of terminological maturity achieved in that domain – a maturity built upon decades of codification in national and international standards – yet this very stability renders the vocabulary particularly vulnerable to misapplication when engineering texts migrate across disciplinary boundaries.

From the perspective of terminology science, the theoretical framework elaborated by Cabré [7] in “Terminology: Theory, Methods and Applications” provides the conceptual instruments necessary for analysing such cross-domain semantic migration: her distinction between terminologisation, de-terminologisation, and inter-field borrowing maps with considerable precision onto the lexical dynamics observed at the AM-metal forming interface. What remains conspicuously absent from the existing literature, however, is a dedicated study that applies this terminological apparatus specifically to the EN-UA language pair within the described technical domain – a gap that is particularly consequential given the absence of corresponding Ukrainian national standards for AM and the resulting normative vacuum in which Ukrainian technical translators currently operate; it is precisely this unsolved dimension that the present article seeks to address.

The purpose of the present article is to conduct a systematic analysis of the terminological evolution occurring at the interface of additive manufacturing and conventional metal forming, with particular focus on identifying mechanisms of semantic shift, inter-field borrowing, and translational opacity that characterise this evolving lexical landscape. To this end, the article aims to produce a structured bilingual glossary of key terms – accompanied by translator-oriented commentary – and to formulate a set of evidence-based recommendations that may serve as a practical reference for technical translators, terminology specialists, and standardisation practitioners working within the EN-UA language pair in this domain.

Methodology. The present study employs a combined terminological and corpus-analytical approach, drawing on a manually compiled cross-domain corpus of technical texts encompassing peer-reviewed journal articles, international standards, manufacturers’ technical documentation, and patent specifications published between 2010 and 2024 in both additive manufacturing and metal forming domains. Terminological units were extracted, classified according to their semantic behaviour across disciplinary contexts, and subsequently evaluated against the normative frameworks of ISO/ASTM 52900:2021, DIN 8580:2003, and the cluster

of Ukrainian national standards governing metal forming terminology – principally ДСТУ 2700-94, ДСТУ 2263-93, and ДСТУ 2261-93 – none of which have been revised since their adoption in the early 1990s, a circumstance that itself constitutes evidence of the normative stasis, with translational analysis conducted through the lens of Cabré’s [7] terminologisation model and validated against existing EN-UA technical translation practice.

Corpus composition

The cross-domain corpus assembled for the present study comprises 214 documents totalling approximately 2.3 million words, collected from five source categories and spanning the period 2010-2024. The corpus was constructed with deliberate balance between the two principal domains – additive manufacturing and conventional metal forming – whilst also incorporating a third category of hybrid and interdisciplinary texts, which constitute the primary site of terminological instability analysed in this article. Document selection followed three criteria: disciplinary relevance, publication recency, and source authority (peer-reviewed journals, official standards bodies, and major industry manufacturers). Machine-translated or non-native English documents were excluded from the corpus to ensure the reliability of terminological observations. The full breakdown of the corpus by source type, domain, and approximate word count is presented in Table 1 below.

Table 1

Composition of the cross-domain corpus by source category and domain

Source category	Domain	Number of documents	Approx. word count
Peer-reviewed journal articles	Additive manufacturing	68	890,000
Peer-reviewed journal articles	Metal forming	47	610,000
Peer-reviewed journal articles	Hybrid / interdisciplinary	21	275,000
International standards (ISO, ASTM, DIN, ДСТУ)	Both domains	12	95,000
Manufacturers’ technical documentation	Additive manufacturing	31	220,000
Manufacturers’ technical documentation	Metal forming	18	130,000
Patent specifications	Both domains	17	110,000
Total	-	214	~2,330,000

Source: created by authors.



Results and discussion

The interaction between the terminological systems of additive manufacturing and conventional metal forming can be described through three primary mechanisms, each of which produces distinct challenges for technical communication and translation.

The first and most pervasive mechanism is inter-field borrowing with semantic narrowing or broadening. When a term migrates from one disciplinary domain into another, its referential scope frequently contracts or expands in ways that are not immediately transparent to the reader. The term *porosity*, for instance, denotes a general class of internal defects in both casting and welding, yet within metal AM it has acquired a considerably more differentiated meaning: researchers now routinely distinguish between *gas porosity*, *lack-of-fusion porosity*, and *keyhole porosity* – each arising from distinct physical mechanisms specific to powder-bed fusion processes [1]. A translator rendering a hybrid text that references porosity in both a conventional and an AM context must therefore exercise considerable caution, as the superficial terminological identity of the term may conceal a substantive conceptual distinction.

Semantic shift through technological repurposing

Extrusion provides the most instructive example: in conventional metal processing, the term denotes the compressive forcing of a heated billet through a shaped die to produce a continuous profile – a process thoroughly codified in DIN 8580 and characterised by specific tribological and thermomechanical conditions [6]. In the AM category designated material extrusion by ISO/ASTM 52900:2021 [4], the same term describes the selective dispensing of a filament or paste through a nozzle under entirely different physical constraints, at scales and temperatures that bear no meaningful analogy to industrial metal pressing. As Frazier [3] noted in his survey of metal AM processes, the uncritical transfer of vocabulary from established manufacturing disciplines risks creating a false impression of conceptual equivalence where none exists.

A comparable, though less frequently discussed, instance of semantic repurposing concerns *rolling*: whilst the term unambiguously denotes plastic deformation between rotating rolls in the metal forming literature [6], it has entered AM technical documentation – particularly in binder jetting – as a colloquial descriptor for the powder-spreading action of a cylindrical recoater, a usage that is mechanistically misleading and terminologically unsanctioned.

Trade-mark genericisation

The third mechanism is trade-mark genericisation, a sociolinguistic process whereby a proprietary designation gradually assumes the function of a common noun in professional discourse. As documented in ISO/ASTM 52900:2021 [4] and discussed by Sames et al. [5], the designation *SLM* – a registered trademark

of SLM Solutions GmbH – has achieved near-universal currency in the scientific literature as a synonym for the entire category of laser powder-bed fusion, notwithstanding the fact that this category encompasses numerous commercially and technically distinct systems produced by different manufacturers. The implications for technical translation are considerable: a translator who renders *SLM process* as «процес селективного лазерного плавлення» without clarifying its relationship to the broader LPBF category may inadvertently introduce a false specificity into the target text, particularly in contractual or regulatory contexts where process designation carries legal weight.

Table 2

**Proprietary trade designations and their
standardised counterparts (ISO/ASTM 52900:2021)**

Trade designation	Generic standardised term (ISO/ASTM 52900)	Manufacturer
SLM®	Laser Powder Bed Fusion (LPBF)	SLM Solutions GmbH
DMLS®	Laser Powder Bed Fusion (LPBF)	EOS GmbH
LaserCUSING®	Laser Powder Bed Fusion (LPBF)	Concept Laser GmbH
Arcam EBM®	Electron Beam Powder Bed Fusion (EB-PBF)	Arcam AB / GE Additive
LENS®	Directed Energy Deposition (DED)	Optomec Inc.

Source: created by authors

Case studies in terminological instability

The pair *strain hardening* / *work hardening* constitutes one of the most well-documented instances of intra-linguistic terminological duplication in materials science. Both terms denote the same physical phenomenon – the increase in dislocation density and consequent elevation of yield strength resulting from plastic deformation – yet their disciplinary and geographic distribution differs markedly: *work hardening* predominates in British engineering tradition and in the metal forming literature exemplified by Hosford and Caddell [6], whilst *strain hardening* is the preferred designation in North American materials science and in the majority of AM-adjacent research.



In AM contexts, the phenomenon is complicated by the presence of rapid thermal cycling inherent to layer-by-layer deposition, which activates recovery and recrystallisation mechanisms that may partially or wholly offset the hardening effect [1]. A translation that employs «наклеп» – the most common Ukrainian equivalent, strongly associated with cold-working operations – without contextual qualification may therefore misrepresent the thermomechanical reality of the AM process under discussion.

Yield point properly refers to the discontinuous yielding phenomenon observable on the engineering stress-strain curve of certain ferritic steels, characterised by distinct upper and lower yield point values; *yield strength*, by contrast, is a general material property defined, for materials lacking a pronounced yield point, by the 0.2% offset method [6]. This distinction acquires particular significance in AM contexts because, as DebRoy et al. demonstrated, the rapid solidification conditions characteristic of LPBF produce microstructures – including pronounced crystallographic texture and elevated dislocation density – that fundamentally alter the shape of the stress-strain curve relative to wrought counterparts, frequently eliminating the classical yield point phenomenon altogether. The Ukrainian terminological tradition, which employs «межа текучості» for both concepts with only contextual differentiation, is therefore insufficient for technical texts in which this distinction carries engineering consequence.

Table 3

**Differentiation of *yield point* / *yield strength*
terms and their Ukrainian equivalents**

English term	Recommended Ukrainian equivalent	Context
Yield point	Межа текучості (точка на кривій)	Ferritic steels with discontinuous yielding
Yield strength	Границя текучості (характеристика матеріалу)	General material property
Upper yield point	Верхня межа текучості	Low-carbon steel tensile curve
Lower yield point	Нижня межа текучості	Low-carbon steel tensile curve

English term	Recommended Ukrainian equivalent	Context
0.2% offset yield strength	Умовна границя текучості ($\sigma_{0,2}$)	Aluminium alloys, AM components

Source: created by authors

The term *drawing* represents perhaps the most acute instance of terminological polysemy within the metal forming lexicon, encompassing at least four distinct technical referents: wire drawing (волочіння), deep drawing (глибоке витягування), temper drawing (відпуск загартованої сталі), and engineering drawing (технічне креслення). Within AM discourse, the term has additionally acquired an informal usage as a near-synonym for *deposition* or *printing* in certain manufacturer communications – a usage that, whilst not sanctioned by ISO/ASTM 52900:2021 [4], has achieved sufficient currency to constitute a genuine interpretive hazard. The compound *deep drawing* is itself not immune to contextual ambiguity: as the hybrid manufacturing literature expands to encompass processes that combine incremental sheet forming with AM-deposited features, the boundary between what constitutes *deep drawing* and what constitutes a *DED-assisted forming operation* is becoming progressively less distinct, and the terminology has not yet stabilised sufficiently to reflect this convergence in a consistent manner.

Table 4

Polysemy of the term drawing across technical domains

English term	Ukrainian equivalent	Domain	Risk of confusion
Drawing (wire)	Волочіння	Metal forming	Low (compound is specific)
Deep drawing	Глибоке витягування	Sheet metal forming	Medium (drawing = ambiguous)
Drawing (temper)	Відпуск (загартованої сталі)	Heat treatment	High (same EN word)
Engineering drawing	Технічне креслення	Documentation	High (cross-domain)



English term	Ukrainian equivalent	Domain	Risk of confusion
Drawing (AM informal)	Вирощування / осадження	AM (non-standard)	High (unsanctioned usage)

Source: created by authors.

The normative vacuum and its consequences for EN-UA translation

The challenges described above are significantly amplified [8] in the context of English-to-Ukrainian technical translation by the absence of a coherent national terminological standard for additive manufacturing in Ukrainian. Whilst the metal forming domain is served by ДСТУ 2700-94 – a standard that, despite its age, provides a serviceable normative foundation for the translation of conventional metal forming terminology – no equivalent instrument exists for AM, leaving Ukrainian translators without institutional guidance precisely in the terminological domain that is evolving most rapidly [9].

In practice, this normative absence produces three identifiable pathologies in translated technical texts: first, uncontrolled variation in the rendering of key AM terms across documents produced by different translators or organisations; second, a tendency towards excessive transliteration – rendering *binder jetting* as «БІНДЖЕТИНГ» rather than the more transparent «струминне зв'язування» – which preserves the source-language form at the cost of conceptual accessibility; and third, the inadvertent importation of russian-language equivalents from soviet-era technical standards, which may carry subtly different denotations or connotations inappropriate to the Ukrainian technical context. These pathologies are not merely stylistic inconveniences: in the context of defence procurement, aerospace certification, or international joint manufacturing ventures, terminological inconsistency [10] in technical documentation can constitute a material risk, as Gibson et al. implicitly acknowledge in their discussion of the regulatory challenges surrounding AM qualification and certification.

Conclusions

The present article has demonstrated that the terminological evolution occurring at the interface of additive manufacturing and conventional metal forming is neither incidental nor superficial, but constitutes a structurally significant transformation driven by three identifiable mechanisms – inter-field borrowing with semantic shift, technological repurposing of established lexical units, and trade-mark genericisation – each of which produces distinct and practically consequential challenges for technical communication and translation.



The case analyses of *strain hardening*, *yield point / yield strength*, and *deep drawing* have illustrated that terminological instability in this domain is not confined to genuinely novel AM-specific concepts but extends to the core vocabulary of classical materials science, whose meanings are being quietly but materially altered by the introduction of new technological contexts in which the underlying physical phenomena behave differently from their conventional counterparts.

The systematic comparison of normative frameworks – ISO/ASTM 52900:2021, DIN 8580, and ДСТУ 2700-94 – has revealed a pronounced asymmetry in terminological maturity between the two domains under consideration: whilst conventional metal forming benefits from a century of codification, the AM field remains in a state of active normative flux, a condition that is further exacerbated in the Ukrainian linguistic context by the complete absence of national AM terminology standards.

The bilingual glossary presented [11] alongside this study represents an attempt to provide a practical interim instrument for technical translators operating in this normative vacuum, offering not merely equivalent pairs but contextual and process-specific commentary designed to prevent the category of errors most commonly observed in cross-domain EN-UA translation practice. It must be acknowledged, however, that any such instrument is inherently provisional: the pace of technological development in metal AM – with emerging processes such as cold spray consolidation, ultrasonic AM, and multi-material DED continuously expanding the production and terminological frontier – guarantees that the lexical landscape will continue to evolve faster than normative bodies are able to codify it.

The most durable contribution of the present work may therefore lie not in its specific glossary entries but in its methodological proposition: that cross-domain terminological analysis, informed by Cabré's [7] framework of terminologisation and grounded in verified primary sources, offers a replicable and scalable approach to managing terminological instability in rapidly evolving technical fields.

Future research should prioritise the development of a dynamic, corpus-based EN-UA terminological database for additive manufacturing – one maintained in alignment with successive revisions of ISO/ASTM 52900 and informed by the input of both practising engineers and professional translators – as well as the elaboration of formal proposals for submission to the relevant Ukrainian standardisation committees, so that the normative vacuum identified in this study may in due course be filled by instruments of institutional authority rather than ad hoc individual solutions.



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