

Linguistic Ergonomics & Micro-Communication in Human-AI Workspaces: Rethinking English for Specific Purposes in Industry 5.0

BHARATHIKUMAR S¹, KOTHANDAN M. S.²

¹Assistant Professor, Department of Humanities and Social Sciences, Sri Venkateswara College of Engineering, Pennalur, Sriperumbudur

²Assistant Professor, Department of English, Chennai Institute of Technology, Chennai

Abstract- As industrial environments transition from automated manufacturing to collaborative, human-centric paradigms (Industry 5.0), the nature of workplace communication is undergoing a structural shift. Human professionals increasingly interact not only with peer personnel but directly with autonomous systems, collaborative robots (cobots), and localized Artificial Intelligence (AI) agents. Traditional English for Specific Purposes (ESP) frameworks prioritize human-to-human corporate discourse—such as negotiations, business correspondence, and formal presentations. However, these frameworks fall short in addressing the micro-linguistic requirements of human-AI collaboration. This paper introduces the paradigm of Linguistic Ergonomics, defined as the optimization of language structures to reduce cognitive friction, eliminate ambiguity, and maximize operational efficiency in human-machine interfaces. By examining the mechanics of Micro-Communication—concise, highly structured, low-ambiguity English prompts and directives—this article outlines the emerging communicative demands placed on technical professionals. The study identifies critical research gaps in current English Language Teaching (ELT) methodologies, formulates a comprehensive problem statement, establishes the operational scope for curriculum redesign, and provides a theoretical roadmap for integrating prompt ergonomics into 21st-century ESP pedagogy.

Keywords: *Linguistic Ergonomics, Micro-Communication, Human-AI Collaboration, Industry 5.0, English for Specific Purposes (ESP), Technical Communication, Prompt Engineering Pedagogy.*

I. INTRODUCTION

The evolution of the industrial landscape from Industry 4.0 (focusing on IoT, big data, and automation) to Industry 5.0 marks a deliberate return

of human agency to the center of production processes. In Industry 5.0, human intellect works in tandem with smart, adaptive machinery to achieve customization, sustainability, and operational agility. However, this hybrid ecosystem introduces an unprecedented communicative challenge: the natural language interface between human operators and AI-driven systems.

For decades, English Language Teaching (ELT) and English for Specific Purposes (ESP) have operated under the assumption that language instruction exists to facilitate human-to-human interaction. Standard technical communication courses train engineering and industrial personnel to write comprehensive reports, deliver project proposals, and engage in workplace negotiations. While these skills remain vital, they do not prepare professionals for the micro-level, high-precision textual interactions required when directing generative AI models, troubleshooting autonomous cobots, or querying complex enterprise databases using natural language.

In high-stakes technical environments, dynamic interactions depend on Micro-Communication—the synthesis of complex intent into terse, context-dense, and syntactically unambiguous linguistic units. When human operators construct vague, syntactically loose, or contextually incomplete directives, AI systems yield hallucinated output, operational execution errors, or processing latency. Consequently, there is an urgent need to establish Linguistic Ergonomics as a core domain within technical communication and ELT.

II. PROBLEM STATEMENT

Current ESP and technical English curricula fail to prepare engineering and technical graduates for the linguistic demands of Industry 5.0 human-AI interaction. Existing pedagogical frameworks treat language as a tool for expressive, narrative, or interpersonal communication, ignoring the structural, algorithmic constraints of Large Language Models (LLMs) and natural language processing (NLP) interfaces.

As a result:

1. **Linguistic Inefficiency:** Technical professionals rely on trial-and-error verbal prompting, leading to cognitive fatigue, communication latency, and degraded workflow efficiency in automated environments.
2. **Semantic Ambiguity:** Standard conversational English patterns introduce structural ambiguities that cause AI agents to misinterpret operational instructions in high-risk engineering settings.
3. **Curricular Disconnect:** Higher education institutions continue to assess technical English through traditional genres (e.g., formal essays, general email correspondence) that do not evaluate a learner's ability to construct ergonomically optimized, machine-readable micro-texts.

III. ANALYSIS: THE MECHANICS OF LINGUISTIC ERGONOMICS & MICRO-COMMUNICATION

Linguistic Ergonomics applies the principles of physical and cognitive ergonomics to language structure. Just as physical ergonomics designs tools to minimize physical strain, linguistic ergonomics structures syntax, vocabulary, and discourse markers to minimize processing strain for both biological and computational systems.

Comparative Conceptualization: Traditional ESP vs. Linguistic Ergonomic Micro-Text

To understand the paradigm shift required in technical language instruction, it is essential to analyze how traditional English for Specific Purposes (ESP) diverges from the requirements of ergonomic micro-communication across key operational dimensions:

- **Primary Target Audience:** Traditional ESP focuses almost exclusively on human-to-human interaction, preparing individuals to communicate with colleagues, clients, and management. In contrast, linguistic ergonomic micro-text targets a hybrid audience, serving as an effective communicative bridge between human operators and algorithmic interfaces (such as LLMs, NLP parsers, and autonomous cobots).
- **Primary Textual Genres:** While traditional ESP prioritizes macro-level business and academic genres—including formal reports, enterprise emails, technical proposals, and verbal presentations—ergonomic communication operates through micro-level genres such as prompt architectures, system directives, execution constraints, and structured log entries.
- **Structural Priorities:** Conventional ESP emphasizes narrative flow, rhetorical cohesion, stylistic variance, and interpersonal politeness markers. Conversely, ergonomic micro-texts prioritize zero-ambiguity syntax, high semantic density, strict structural delimitation, and the elimination of redundant conversational padding.
- **Metric of Success:** In traditional ESP frameworks, communication is evaluated based on rhetorical persuasion, social appropriateness, and general comprehension by human listeners. In ergonomic micro-communication, success is measured strictly by deterministic operational execution, speed of computational parsing, and the complete reduction of output variance or AI hallucinations.

1. The Architecture of Micro-Communication

Micro-communication in human-AI work-spaces is characterized by four core linguistic parameters:

- Contextual Anchoring: Establishing explicit boundary conditions, role definitions, and environmental constraints within fewer than 50 words.
- Syntactic Directness: Utilizing active imperative structures, minimizing nested sub-clauses, and eliminating dangling modifiers that disrupt vector parsing in NLP systems.
- Lexical Precision: Selecting domain-specific, monosemic terminology (words with a single clear meaning) over polysemic or idiomatic expressions.
- Structural Delimitation: Employing explicit formatting markers (such as markdown tags, bulleted key-value pairs, or structural XML tags) to segregate system instructions from operational data.

2. Cognitive Load and Human-Machine Friction

When an operator interacts with an AI agent using unstructured natural language, the interaction often leads to iterative correction cycles. This "prompt-correction loop" increases the human operator's cognitive burden, leading to operational friction. Applying ergonomic principles to language training equips operators to anticipate algorithmic interpretation, enabling them to formulate "zero-shot" or "few-shot" directives that achieve immediate task alignment.

IV. RESEARCH GAP

A survey of contemporary literature at the intersection of Applied Linguistics, ELT, and Human-Computer Interaction (HCI) reveals significant unaddressed areas:

- Absence of ESP Frameworks for Prompt Engineering: While computer science literature extensively covers prompt engineering from a technical angle, ELT research has yet to systematically analyze prompt construction as an applied linguistic skill requiring systematic pedagogical scaffolding.

- Lack of Empirical Assessment Metrics: There are no standardized rubrics in ELT to evaluate a student's proficiency in micro-communication, concise synthesis, or linguistic ergonomics within machine-mediated contexts.
- Neglect of Non-Native English Speaker Dynamics: Most AI model training assumes standard dialectical English. Limited research explores how non-native English speakers adapt their syntax and vocabulary when interacting with English-based AI interfaces in industrial settings.

Scope of the Study

The integration of Linguistic Ergonomics into ELT and industry practice encompasses the following operational boundaries:

1. Target Audience: Engineering undergraduates, polytechnic trainees, and practicing industry personnel operating within automated, AI-driven manufacturing, software development, and logistical systems.
2. Pedagogical Redesign: Re-evaluating technical writing and professional communication syllabi in technical universities to include micro-text composition, structural markup formatting, and iterative prompt design.
3. Cross-Disciplinary Methodologies: Combining principles from Functional Systemic Linguistics (SFL), Cognitive Ergonomics, Applied Linguistics, and Human-Computer Interaction (HCI).
4. Exclusions: This paradigm does not seek to replace traditional interpersonal ESP instruction (such as human leadership, empathy-driven negotiation, and intercultural communication), but rather to establish a complementary domain specifically tailored for machine-mediated workplace tasks.

V. CONCLUSION

The emergence of Industry 5.0 necessitates a structural evolution in how technical English is taught, assessed, and applied. As artificial

intelligence and autonomous systems become integral workplace collaborators, language training must transcend traditional human-to-human corporate genres. Linguistic Ergonomics and Micro-Communication bridge the gap between human intent and machine execution, offering a strategic framework for English for Specific Purposes in the 21st century.

By training future technical professionals to master low-ambiguity, highly structured, and context-dense micro-texts, ELT practitioners can directly contribute to reducing operational errors, diminishing cognitive friction, and accelerating productivity in human-AI workspaces. Technical institutions must proactively integrate these ergonomic linguistic competencies into their curricula to ensure graduates remain competitive in an increasingly automated global workforce.

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