THE ROLE AND IMPACT OF TECHNICAL COMMUNICATION IN THE 21st CENTURY

Rolul şi impactul comunicării tehnice în secolul al XXI-lea

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Abstract: The discourse of engineering can be integrated into the world of technical discourse by taking into consideration its common linguistic features and the specificity given by the vocabulary in use. Bearing in mind the global socio-economic, as well as political context, we should take into consideration how factors pertaining to these realms influence communication in this field. Whereas Romanian is official language in this country, our country's accession to the European Union has meant an increased emphasis on the acquisition and use of other foreign languages, among which English seems to be a trendsetter.

Keywords: discourse, engineering, linguistic features, globalisation, communication

Since the erection of the pyramids, engineers have challenged human ingenuity and creativity in creating ever newer and more useful instruments that make our lives easier. Elementary calculations, the study of interactions between physical bodies from the surrounding world have constituted the legacy of theory and practice that is still applied today, in a technology dominated world. Mechanics and materials science are constantly evolving, ensuring that human life is safer. Production systems have become automated requiring knowledge of things mechanical. Engineering has become the religion of man in the conquest of nature. IT specialists and mechanical engineers rule the world of machines and mechanisms, airplanes, space shuttles and devices ergonomically developed. All this development is based on laboratory tests that imply vast knowledge of mechanics, mechanism, machine parts, laws of physics – statics, dynamics and kinematics of the rigid, solid and fluid bodies. Intelligent materials and their applications also require knowledge of physics, mechanics and mechanisms in order to use them in optimum conditions. Renewable energies, although known for a long time, have been ignored but are starting to be the concern of engineers again in an attempt to create mechanisms that transform renewable energies into electrical or thermal energy. Industrial design would not function without knowledge of mechanical engineering and materials.

The discourse of engineering can be integrated into the world of technical discourse by taking into consideration its common linguistic features and the specificity given by the vocabulary in use. Our interest in this type of professional English rises from work background and experience in learning and teaching English for Engineering, as well as from observations made over the years regarding the characteristics of this type of discourse in Romania. It appears that the language of mechanical engineering is rich in foreign borrowings; it adopts mainly English as means of conveying information, probably due to global tendencies of communication in mainstream international languages; and it is a type of discourse that blends various contexts, language users and communication rules that are specific to the field of practice of mechanical engineers. Engineering as a profession has re-gained its sought-after status that appeared to have been lost. In the contemporary Romanian society there seems to be high demand for engineers that will contribute to the improvement of productive industries in our country. Technical education is increasing and the number of specializations offered by universities seems to demonstrate the need for specialists in engineering fields. Bearing in mind the global social and economic, as well as political context, we should take into consideration how these factors influence the production and transmission of information in this field. Whereas Romanian is official language in this country, our country's accession to the European Union has meant an increased emphasis on the acquisition and use of other foreign languages, among which English seems to be a trendsetter. From this point of view, a direction of research that we propose to further investigate, beyond the limits of this paper, is the extent to which Romanian language users have integrated or adapted English into their system of communication in the field of mechanical engineering.

Technical communication and technical writing is understood as communication, both written and oral, with the purpose of informing and persuading people to perform some professional tasks. Rosenberg, Sanborn Pfeiffer, Pauley and Riordan are among the many authors who define technical communication in terms of purpose, context, structure and style.

In the broad sense, then, we can think of technical English as a type of text and discourse that shows how things are made, what lies beyond the process of making them, the purposes that they serves as well as the general laws that govern the making, scope and use of those particular instances referred to as things. Technical writing can be defined as a type of expository writing (sometimes persuasive writing) most often used to convey information (or to convince others) for

technical or business purposes, writing to communicate specific information, as a description of a computer operation or directions for operating a videocassette recorder (VCR). Technical writers create documentation for a technology. Their responsibility, like graphic designers', is to effectively communicate a message. Technical writers are responsible for writing text that is helpful to its intended audience, accurate, readable, and accessible.

In nearly all forms of technical communication four elements play a crucial role in the creation of technical discourse: purpose and aim, audience, knowledge structure and argumentation strategies employed in the process of communication.

Technical communications are created and distributed by most employees in service organizations today, especially by professional staff and management. Writing well is difficult and time-consuming, and writing in a technical way and about technical subjects compounds the difficulties. The entire point of communications is to disseminate useful information. To be useful, information must be understood and acted upon. Thinking about English in a technical age, we can affirm that technical communication has become an attitude, about the relationship between language and the social.

Approaches, which have been specifically developed within the English for Science and Technology setting, are mentioned below:

- Gopnik's study of the linguistic structure of scientific texts (1972) – concentrating on the structure of scientific texts rather than their vocabulary, paying attention to syntactic structures and transformations in articles in experimental biology and biochemistry;
- the text typology approach of Gläser (1990) and the Leipzig school - counting elements in a corpus of texts on different subjects and from different fields and statistically analysing them;
- Trimble's "rhetorical analysis" of English for Science and Technology (1985) – basically oriented towards teaching English for Science and Technology, primarily intended for pedagogical purposes, with a focus on teaching procedures. McElholm suggests that Trimble's approach is the better known attempt to analyse such texts, with some critical remarks regarding this discourse approach. Firstly, Trimble's analytical tools are confusing, secondly, argumentation is absent from his theory; rhetorical functions and patterns are not linked to grammatical phenomena, which are not systematically dealt

with. Finally, Trimble never contrasted structures from English for Science and Technology texts with those found in ordinary discourse (McElholm 2002)

- Swales' genre analysis, which proposes a division of texts into different types within an overall linguistic frame, but is limited to introductions to research articles.

Further, the ongoing division between technical communication practitioners and academics should be explored by examining the conceptual metaphors that underlie their discourse in professional journals and textbooks. The conceptual metaphor theory as formulated by George Lakoff and Mark Johnson (1980) is a viable lens through which to engage in rhetorical and linguistic analysis. Academics and practitioners engage in radically different linguistic behaviours that result from the complex and often conflicting interplay of conceptual metaphors that guide their work. These metaphors carry assumptions about writers, texts, and communication that create covert tensions with the ethical value systems overtly embraced by both practitioners and academics.

Practitioners tend to use metaphors primarily centred around machines and money, objectifying both documents and people and reducing the processes of communication to a series of abstract mathematical influences. Academics participate in a much more complex conceptual system, embracing language about communication that favours metaphors of human agency, physical presence and complex social interaction. However, academics also participate in the abstracted, object-oriented metaphors primarily used by practitioners, leading to a particular discourse both advocating and at odds with humanist social values. Academics perpetuate the division between industry and academy with their tendency to use conceptual metaphors that contradict their social and ethical imperatives. A more detailed linguistic analysis may be a fruitful way of understanding and perhaps addressing the long-standing tensions between academics and practitioners in the field of technical communication.

In 2006, in the book *New Trends in Specialized Discourse Analysis*, edited by Gotti and Giannoni, in its third section, "The Discourse of Science and Technology", Khurshid Ahmad demonstrates how corpus linguistics methodology is applied in the study of metaphors in texts on particle and nuclear physics. Firstly, he claims that 'scientists literally and metaphorically create a world of make-believe through a web of words – some borrowed, some invented, endorsing self-belief here and suppressing the beliefs of others there (Ahmad apud Gotti and Giannoni, 2006: 198)'. The way researchers phrase their thoughts and which words they choose may influence our

perception. This potential of specialised discourse to shape our understanding of specific phenomena requires further interdisciplinary analysis.

Second, Ahmad concentrates on the rationale behind the use of metaphors in scientific journals (2006: 199). This aspect has been explored less frequently in comparison to texts in popular scientific magazines for lay people. According to Ahmad, the following have discussed these issues: Dubois in 1986, Fahnestock in 1986, Koskela in 1997, Myers in 1990; Ventola and Mauranen in 1992. In the same book edited by Gotti and Giannoni (www.peterlang.com), Susanne Göpferich touches upon the widely researched problem of incomprehensibility of popular scientific texts. She analyses how a group of subjects interpret popular science texts about diabetes with the help of optimizing verbalization using thinking aloud and log files. The thread of popular scientific texts is continued in Paola Catenaccio's paper. She concentrates on various linguistic and rhetorical moves employed there and tries to account for the similarities and differences between them.

In order to analyse the type of discourse specific to science, technology and engineering we need to put the past and present research findings into perspective. Technical discourse in English has become a widespread medium for interaction in all countries, as English remains the world of international communication, in a globalised society. We shall focus on the aspect of the importance of English in technical discourse in Romania. First, let us review some opinions that have been expressed in relation to the functional classification of English language as a main component in the analysis of specialized discourses.

Special language and *specialized aim* are two entirely different notions. Scholarly work points out that confusion arises over these two notions. Mackay and Mountford (1978) state that the only practical way in which we can understand the notion of special language is as a restricted repertoire of words and expressions selected from the whole language, because that restricted repertoire covers every requirement within a well-defined context, task or vocation. On the other hand, a specialized aim refers to the purpose for which learners learn a language, not the nature of the language they learn (Mackay & Mountford 1978). Consequently, the focus of the word 'special' in ESP ought to be on the purpose for which learners learn and not on the specific jargon or registers they learn.

Mary LaRoche wrote of technical discourse, seeing it as a "structure necessarily created by the writer out of the elements of the writing situation". Her focus on the writer is not singular,

as other researchers have noted that the author is of major importance. Robert Boltwood remarked that technical writing "provides information for people who will use it", implying a twofold perspective on discourse. From the point of view of an author, the writer must be an authority in the field, and the audience will necessarily derive one and the same meaning from the given piece of discourse. In the same line of thought, W.E. Britton asserted that the "primary characteristic of technical and scientific writing lies in the effort of the author to convey one meaning and only one meaning in what he says" (Britton apud Baywood, 1965).

An account of what we understand by specialized discourse should also take into consideration contributions such as van Dijk's (2000), who emphasized the importance of knowledge in the shaping of technical discourses, hereby shaping the concept of context relevance in interpretation of meaning:

> *"A more sophisticated account of the role of knowledge in discourse processing is especially relevant in the account of specialized (e.g., scientific) discourses, whose production and comprehension crucially depend on various kinds of specialized knowledge. This is most obvious in the use of technical terminology, but also extends to many other aspects of specialized discourse, such as its preferred topics, overall format or text-schema, style, rhetoric, argumentation patterns, methods of proof and demonstration, the use of tables, figures and other non-verbal aspects of discourse, and so on. Indeed, the knowledge about specialized discourse properties is part of the very specialized knowledge of the experts".*

Considering all the examples above, when defining technical discourse, the following distinctions should be made. Firstly, technical and scientific writing is a broad field in which it is highly recommended that a division into subject areas be made, so that the reader is indeed focused on one interpretation. Technical writing, engineering writing, engineering English, scientific English, scientific communication are important subdivisions, yet not completely adequate to define our field of research. In a broad sense, technical discourse could be seen as discourse with subject matter in science, engineering and business. More specifically, technical discourse should be one that focuses on subjects that fall within the science of engineering. Among its characteristics would be – concern with scientific and technical matters, use of scientific vocabulary (with a special focus on adjectives and nouns) and conventional report forms, commitment to objectivity and accuracy, a wide range of task.

> *"Technical communication probes deeply into our human capacity to conceive and manipulate symbols – our linguistic capacity. It explores how language has made us and continues to make us into the sort of animals we are: an animal capable of improving itself through technology, homo faber because we are homo symbolicus and vice versa"* (Smith 1986)

Science has not been able to escape rhetoric, argument, and advocacy, because each scientific paper, when first written, is not immediately an unquestioned truth. In a scientific paper an author attempts to convince colleagues of some claim or set of related claims. At issue may be the identification of a phenomenon, the accuracy and veracity of data, the appropriateness of method, the general usefulness of a set of methods, the interpretation of data, or a new theoretical position. Scientific claims and methods must present themselves in competition with other claims, so an article must present good reasons why its claims should be taken as more accurate and more important than other claims in other articles. Although standards of scientific argument have been refined over the centuries, they are always directed at making claims persuasive. Standards of argument are often identified as methodological rather than rhetorical, because they have to do with finding and producing the most relevant and precise data or making the connection between data and ideas, but these nonetheless are issues of persuasiveness. The current standards have emerged because they have proven to be the most persuasive, trumping weaker arguments resting on less powerful data and reasoning.

The increasing number of journals and professional societies communicating knowledge escalated, supported by social and technological changes. As research and training became more specialized and academic, scientific publications became more esoteric, theoretical, and filled with specialized vocabulary. Currently the Web of Science, a major indexing service, reports on approximately 6000 major scientific journals.

This enclosure of science required substantial rhetorical work to define and maintain the social boundaries of science that allowed science to be internally regulated, to gain public authority over its areas of interest, and to garner public and commercial support for its endeavours. To convey the esoteric work of science to popular audiences, new journals emerged. As science and technology became more important for social, economic, and governmental institutions, many new genres and pathways of communication developed. To assist technologists

in communicating with their peers, their corporate co-workers, and the public, technical writing instruction emerged as a university field in the twentieth century, and the technical writer became a major employment title in many organizations. As newspapers increased reporting on science and technology in the latter twentieth century, scientific journalism also became a recognized specialty.

The act of communication through language represents levels of cognitive and social activities. In terms of text in the field of E.S.T. there are clear differences that help us distinguish types of operations presented in them.

Expository texts are common in engineering discourses, since science and technology usually present general facts, rather than individual ones. The following is a fragment from an expository text:

> *"All matter is made from tiny particles called atoms. So far, scientists have discovered about 112 different types of atoms. A substance made up of atoms, which are all the same, is called a chemical element… For example, the gas oxygen is an element. So is the metal iron. A substance made up of different type of atoms joined together is called a compound. For example, water is a compound of the elements oxygen and hydrogen. The atoms of different elements can combine in so many different ways, to form many thousands of different compounds"* (Pocket Science, 1999)

As we can see, the text presents objects, terms that have a clearly defined meaning in the field of chemistry. Furthermore, the text is concerned with the general properties of chemicals and not with one particular instance. They show the relationship between facts, the methods used to establish these facts. This is why in this kind of text one finds many definitions and classifications.

> *"The unit used to measure frequency is named Hertz, which is defined to be the number of cycles in one second. (This unit is named after Heinrich Hertz, a famous 19th century physicist.) If you increase the frequency of sound (there are more cycles in a second), you get a higher pitched sound. When you decrease the frequency, you get a lower pitched sound."* (http://www.dosits.org/science/whatis/frequency.htm)
>
> *"In acoustics, a sound is … quantified by its frequency of vibration. However, scientists refer to another quality of sound called pitch*

that is a subjective measure of the combination of the frequency and intensity of a sound." (http://www.bartleby.com/64/C004/027.html)

Expository writing is a mode of writing in which the purpose of the author is to inform, explain, describe, or define a subject to the reader.

"A typical mechanical differential contains a housing (or carrier), two side gears, and several pinion gears. A rotating driveshaft of the vehicle engages a ring gear, which is mounted onto the differential housing. The driveshaft drives the ring gear, which in turn rotates the differential housing. Pinion shafts attach the pinion gears to the housing so that, as the housing rotates, the pinion gears are driven. The pinion gears drive the two side gears, which in turn drive the axle (or half shafts) attached thereto." (http://www.freepatentsonline.com/WO2007111915.html)

A well-written exposition is focused on its topic and listing events in chronological order. Examples of this type of writing are instructions, directions and instructions on performing a task. Key words such as first, after, next, then and last usually signal sequential writing. Personal pronouns may appear in this type of writing, which can be subdivided into:

- a sequence –a structure also known as 'process or collection', a listing of the order of steps in a process or listing of events in chronological order;
- a descriptive essay - that enables the reader to feel whatever is being described;
- a classification - an organizational strategy in which authors arrange groups of objects or ideas according to a common topic in detail;
- a comparison - showing how two or more subjects are similar or contrasting; this type of structure is often used in determining which is the better of two or more choices; cause and effect writing identifies the reason for something occurring and lists what occurs because of that reason (analysis), or depicts a 'causal chain', several events (causes) leading up to another event. (effect);
- expository dialogue.

As discussed by Larson, Longacre (www.sil.org), and McElholm (2002) the language characteristics of **expository texts** are: the use of present simple and present perfect simple; articles and nouns combine in a generic way; connectors which express cause, effect, result, objectives, contrast and concession are used

In linguistics, a text that refers both to the codification and the enforcement of rules governing how a language is to be used is called prescriptive. These rules can cover such topics as standards for spelling and grammar or syntax; rules for what is deemed socially or politically correct. **Prescriptive texts** are typically contrasted with descriptive ones, which observe and record how language is used in practice, and which is the basis of all linguistic research. Serious scholarly descriptive work is usually based on text or corpus analysis, or on field studies, but the term "description" includes each individual's observations of their own language usage. Unlike prescription, descriptive linguistics eschews value judgements and makes no recommendations.

The main aims of linguistic prescription are to define standardized language forms either generally (what is Standard English?) or for specific purposes (what style and register is appropriate in, for example, a patent?) and to formulate these in such a way as to make them easily accessible. Prescription can apply to most aspects of language: to spelling, grammar, semantics, pronunciation and register. Prescription aims to draw workable guidelines for language users seeking advice in such matters. EST being typically concerned with generic states of affairs, prescription that appear here are not specific. At the same time, prescriptive E.S.T. texts are normative, saying how things should be done, as in the following example:

> *"… in at least one embodiment, the guide slots 70 may be produced inexpensively, for example, by die casting due to the guide slots 70 functioning only to aid in assembly. The apertures 60 may also be produced relatively inexpensively, for example, by use of a drill and milling machine. The size and the location of the apertures 60 can be precisely produce to support a pinion gear assembly, such as, the spider pinion gear assembly."*
> (http://www.freepatentsonline.com/WO2007111915.html)

According to McElholm (2002), their language characteristics are: the use of the imperative, the conditional, the future and the present subjunctive mood, impersonal constructions of the form *it is necessary that,* modal verbs like *must, should, need to, may.*

Argumentative texts try to discover problems and respond to them using logical and argumentative structures. Popular science texts and media argue for or against a particular point of view, dealing with a problem and trying to persuade the audience of the correctness of the point of view or conclusion drawn, on basis of the arguments presented and the inferences made.

Their language characteristics are: use of logical and argumentative linking words, use of qualifiers, they contain inductive and deductive inferences and they contain hypotheses.

Narrative texts relate events or sequences of events in the past and in E.S.T. They are generally historical accounts, such as the history of the windmill, etc. Typically, an E.S.T. narrative would belong to popular science magazines:

> *"Since ancient times, man has harnessed the power of the wind to provide motive power for transportation. Likewise, the technique of grinding grain between stones to produce flour is similarly ancient, and widespread. Quite where and when these two came together in the first windmill is unknown, but a likely scenario suggests a Persian origin, from where (tradition has it) the knowledge spread back into Northern Europe as a result of the Crusades. However, since the Persian mills were quite unlike the early European designs it seems just as likely that the adaptation of wind as a power source was independently discovered in Europe, albeit at a later date."*
>
> (http://www.windmillworld.com/windmills/history.htm)

We have found that their language characteristics are: use of adverbs of time and space, use of past tenses, temporal connectors, anaphoric or cataphoric reference.

Owing to the way that knowledge is structured in science, to the nature of the phenomena it deals with, **descriptive texts** are not very frequently encountered. Descriptive elements are usually found in **expository text**s, presenting concrete individual phenomena; the use of numbers is a typical indicator of a descriptive text, referring to a concrete reality in real time and space:

> *"In this diagram, the cross-head is connected to a drive rod that connects to one of three drive wheels for the train. The three wheels are connected via coupling rods so they turn in unison."*
> (http://science.howstuffworks.com/steam1.htm)

Descriptive texts include references to concrete places, use deictic expressions and indexical expressions, deal with spatial relationships between objects and with concrete persons and their actions. Thus, we have observed the following language characteristics: use of stative verbs, use of articles and possessive adjectives, use of the present tense simple, use of adverbs of space and time and last, but not least, situational reference.

A text may contain a mixture of the aforementioned types and in each text one of them will be the predominant mode of communication. The various linguistic features cover a range of

microstructural (linguistic) phenomena that define the dimension of argumentation of E.S.T. texts as defined by McElholm. He proposed a table, "which also indicates the genre or type of text frequently associated with a particular level of communication" (McElholm, 2002:153-154)

The importance of E.S.T. for international communication has meant increased interest in the analysis of E.S.T. and above all in the analysis of the structure of EST texts. To analyse E.S.T. texts it is necessary to have an overall theory of language and text that can deal with E.S.T. as part of its framework; a theory that can analyse grammatical and textual phenomena at all levels in an integrated way; tools to discover the overall structures of E.S.T. texts; analysis of representative samples of all the different levels and genres of E.S.T. texts; a framework to illustrate the functionality of E.S.T. texts belonging to different genres in the specialised contemporary contexts; an interdisciplinary approach to deal with the variety of sociolinguistic, grammatical, textual and cognitive phenomena encountered in E.S.T.

Among the questions that remain to be answered are: How do argumentation and rhetoric provide categories and structures for the analysis of EST? How do the linguistic, ontological, cognitive and epistemological dimensions intertwine in the analysis of E.S.T? How does specialised discourse shape our understanding of specific phenomena? What particular phenomena that have been explored less in E.S.T research need closer examination? (analogy, metaphor, metonymy, synechdoche)? How important are standards in text analysis?

In order to make plausible generalisations about the nature of E.S.T. texts, research in this direction should aim at establishing whether certain categories or genres have different structures (are popular science texts different from specialised articles) and how specialised vocabulary reflects and shapes a type of understanding of the world around us.

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