English for Mechanical Engineering – from Common Words to Buzzwords

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Abstract: Throughout history, science, technology and engineering have stood out as the most powerful driving forces in the evolution of mankind. In the whirlwind of scientific breakthroughs, this triad has set a pace of transformation and progress that made the world go faster and faster, reaching its full speed in the 21st century. Emerged from the ancient people`s natural instinct to survive, mechanical engineering has become the meeting point of most engineering disciplines, because everything in the physical world is somehow related to its concepts and principles. Yet, in order to reach its most crucial objective – finding solutions to real-life problems – mechanical engineering needs more than creating amazing devices and discovering new manufacturing processes or exotic materials. Apart from all this, it requires a linguistic tool, in the form of specialized terminology, intended to help disseminate the latest discoveries all over the world. Finding the right concept for every mechanism or process is anything but easy. Therefore, this paper aims to provide a linguistic core for the field of mechanical engineering, which is intended to bring together common words and concepts, buzzwords, along with explanations and clarifications of some challenging language issues, with the final purpose of making specialized language one of the most useful tools in engineering.

Keywords: specialized terminology, common words, technical buzzwords

1. Introduction

The survival of our species has always depended on the human being`s ability to understand the workings of nature and to find creative solutions to real-world challenges. This inborn curiosity to grasp the physical world, together with a sharp instinct of self-preservation, have paved the way for the emergence of science and its practical dimension – engineering. From the early rudimentary tools and automata to the increasingly sophisticated contraptions, mechanisms and processes, everything has contributed to hailing mechanical engineering as one of the oldest and most innovative engineering branches in the world. In recent times, the collaboration between researchers and engineers from around the world in various joint projects

along with the large-scale dissemination of the results have generated the need for a useful tool, a universal specialized language that could be used and understood by all those involved in a particular field.

Valuable member of the large ESP (English for Specific Purposes) family, English for Mechanical Engineering is relentlessly attempting to meet the needs of modern industry and to keep up with the technological innovation. The constant denomination and usage of certain concepts to suggest mechanical parts, processes or phenomena has led to the development of a core of specialized terminology which has permanently been questioned or open to debate.

Inspired by the very essence and principles of mechanical engineering, our paper aims to provide a set of words and phrases that Mechanics commonly deals with, emphasizing at the same time the latest concepts in the field. Moreover, as some of the concepts are still misunderstood and debatable, the paper attempts to shed light on the translation of such challenging words.

2. From Common Words to Buzzwords

The importance of mechanical engineering has superseded any other technical discipline. Fundamental branch of engineering, which studies the motion of physical objects and the forces that generate this motion [1], mechanics has been approached since ancient times when the pre-Socratic philosophers passed the physical world and all its phenomena through the filter of direct observation and reason after having ditched all the myths and superstitions that controlled people`s lives. The most perceptible features of the material world - impermanence, change and movement – were expressed by Heraclitus` famous phrase `Panta rhei`/ `Everything flows` [2], which outlined the perpetual becoming and restlessness of the universe.

Later on, Aristotle defined motion as “any kind of change” or “actuality of a potentiality” [3]. His observations of the physical world led him to the conclusion that “everything that is in motion must be moved by something”, be it an inner force (natural motion), or an external force (unnatural violent motion).

Although Aristotle`s theory was challenged by Galileo Galilei and Isaac Newton (who even laid down the three laws of motion), the concept of `motion` has remained one of the central elements in mechanics. Borrowing from the precursors the same idea of transformation, the modern concept of *`motion`* implies “a change in the position of an object over time relative to a frame of reference” [4]. The multiple aspects of the concept have generated technical terms that sometimes may be challenging.

One should start by considering *`motion`* in relation with *`movement`*, a concept very often used as a synonym for the first, though their meanings are slightly different [5]:

`motion` = scientific term which suggests a change in an object`s position relative to a frame of reference; this change is measured in terms of displacement, velocity, acceleration and trajectory

`movement` = broader term which denotes purposeful or organized change in position or state

The large variety of motions have derived a wide range of adjectives that differentiate them, such as *linear, rotational, translational, oscillatory, circular, curvilinear, reciprocating, projectile, periodic, uniform, non-uniform, random,* along with their corresponding verbs and actions: *to rotate → rotation*, *to translate → translation*, *to oscillate → oscillation*, *to reciprocate → reciprocation*, etc., or verbs and adverbial phrases [6]:

to move towards (a se deplasa către, a se apropia de) = to approach, advance, progress, head for, draw near

to move about/around (a se deplasa ici și colo, a-și schimba poziția) = to circulate, travel, change location

to move back and forth (a se deplasa înainte și înapoi, a avea o mișcare oscilatorie) = to oscillate, swing, sway, rock, vibrate, reciprocate, alternate, pulsate

Some common prepositions come to complete the list of central elements used in expressing motion:

against: to slide *against* (a culisa către), to be fed *against* the cutter (a fi avansat către tăietor), the pressure of the wheel *against* the workpiece (presiunea roții asupra piesei de lucru), to direct *against* (a direcționa către), to vibrate *against* (a deplasa prin vibrații către)

past: to move a tool *past* a fixed workpiece (a deplasa o unealtă dincolo de piesa de lucru fixată)

Even the two branches of mechanics which study the concept of `motion` - *kinematics* and *dynamics* - may pose some problems. The difference between the two fields lies in the fact that *kinematics* studies motion outside the forces that cause it whereas *dynamics* considers even the forces that generate it.

Re-visiting the definition of `motion` one can detect a core element - *reference frame* (cadru de referință) that all the other key aspects of motion are in relation with: *distance* and *displacement*, *speed* and *velocity*, *acceleration*. Apparently easy to understand, these notions need further clarification as they are often used interchangeably in spite of their distinct meanings [7]:

`distance` = scalar quantity which determines the complete length of the ground an object covers between two points, measured along the actual path connecting them *(distanță)*

`displacement` = vector quantity which refers to the change in an object`s position between two points, along the shortest path connecting them *(deplasare)*

`speed` = scalar quantity which determines the time rate at which an object is moving between two points *(viteză)*

`velocity` = vector quantity which involves both the time rate and the direction of movement *(velocitate)*

`acceleration` = vector quantity which determines the rate at which an object`s velocity (speed and direction) changes *(accelerație)*

The various types of motion have been implemented into devices, processes and technologies which nowadays are likely to generate further vocabulary issues.

As `everything begins with an idea`, every creation is born as a rough concept or thought inside an inquiring and curious mind, thirsty for comprehending and competing with nature. Thus, the first step to creating/producing things is *to conceive / to devise / to contrive / to think out / to imagine / to figure out / to envision / to envisage* (a concepe, a imagina) them, hence the term *`product conception`*(concepția produsului). After the spark of creation has been produced, the vision will take shape during the second stage of creation, intended *to design / to draft / to sketch/ to plan / to project* (a proiecta) that particular object, hence the concept of *`product design`* (proiectarea produsului). Eventually, the last stage in the implementation of a concept is *to manufacture / to produce / to fabricate / to build / to construct / to assemble* (a fabrica, a produce) it, that is, to physically turn the object into reality, step which is called *`product manufacturing`*(fabricația produsului).

The inception of the above process is lost in the mist of time and was driven by the scientific spirit, a sort of curiosity that stirred people to experiment on things first by themselves, and then gradually, in groups or teams and under the strict guidance of the scientific method. Consequently, from the *pioneers / trailblazers / groundbreakers / pathfinders* (pionieri, deschizători de drumuri) of the ancient times to the *scholars* (învățați) and *polymaths* (personalități multidisciplinare) of the the Middle Ages and the Renaissance, and up to the modern *scientists / researchers* (oameni de știință, cercetători), a wide range of contributors have kept alive the visionary flame of scientific advancement.

Over time, the entire above process has shaped fields like *science* and *engineering*, chrystallized around key-concepts like *invention* (invenție), *innovation* (inovație) and *technology* (tehnologie), a permanent effort which has made the world evolve. This striving has finally borne fruit in useful, practical and sometimes purely functional basic *tools / instruments / utensils/ implements* (unelte, instrumente) which have evolved dramatically into the *sophisticated mechanisms / contrivances / contraptions / devices / apparata* (dispozitive, mecanisme, aparate) of modern times.

None of this would have been possible without the major contribution of technology and *technological advances / improvements / progress* (progres tehnologic) which have facilitated a huge leap from rudimentary to the *state-of-the-art / cutting-edge / latest / advanced / enhanced / top-notch / groundbreaking* (cele mai avansate, de ultimă generație) machinery used today. An interesting aspect of the term *`state of the art`* is the fact that it can also be used independently, as a noun, meaning "the most recent stage in the development of a product incorporating the newest technology, ideas, and features" [8]: e.g. *the state of the art* in artificial intelligence.

Despite the high technology implemented in the latest machines and devices, they are prone *to break down / to fail / to malfunction* (a se defecta) due to *flaws / shortcomings* (defecte, neajunsuri, puncte vulnerabile) or *to be ruined by rough usage* (a fi distrus prin întrebuințare necorespunzătoare). In this case, any technical problem needs to be *troubleshot* (detectată și depanată) or *fixed / mended* (reparată) immediately; sometimes the device even has to be made *foolproof* (construit împotriva manevrelor greșite sau brutale), *shatterproof* (incasant, securit), *watertight* (etanș) or *scratch or indentation resistant* (rezistent la zgârieturi și indentări).

Central element in mechanical engineering, the term *`manufacturing`* involves "the creation or production of goods with the help of equipment, labour, machines, tools, and chemical or biological processing or formulation" [9]. Apart from producing items for the daily activities, a large section of manufacturing aims at providing *parts / components / pieces* (piese, componente) for more complex objects or systems. This is done with the help of *workpieces* (piese de lucru, piese de prelucrat, semifabricate), pieces of raw material formed into the desired form.

The *forming / shaping* (formarea, modelarea) of workpieces is *carried out / executed / performed / achieved / accomplished / realized* (executată, realizată, obținută) in *workshops* (ateliere), *toolrooms* (ateliere de sculărie) or on *production lines* (linii de producție) housed by specific industrial facilities named *works / factories / industrial plants* (uzine, fabrici). The whole process is obtained using tools and machines whose names put together gave rise to what is referred to as *`machine tool`* (mașină-unealtă) - the driving force of manufacturing. The action it produces - *machining* or *tooling* (prelucrare cu ajutorul unei mașini-unelte) - adds a new synonym to `forming / shaping` but at the same time, restrains its meaning to "manufacturing process that involves shaping a piece of material to a final desired shape by removing material in a controlled manner by a machine tool" [10]. As *shaping* derives from the verb `to shape` and the noun `shape`, tools with a particular shape are required to give form to the workpiece:

mould (matriță de turnare) = tool in the form of a cavity used to shape fluid / plastic materials

die (matriță de presă) = tool used to shape solid materials by cutting or stamping

The various types of tools and machines can generate a wide range of manufacturing processes divided into several categories [11]:

- conventional machining: *lathing and turning* (strunjire), *milling* (frezare), *planing* (rabotare), *drilling* (găurire), *boring* (alezare), *honing* (honuire), *grinding* (rectificare, șlefuire), *sawing* (tăiere cu fierăstrăul)
- unconventional machining: *plasma-arc machining* (prelucrare cu arc în plasma), *laser-beam machining* (prelucrare cu laser), *electrical discharge machining* (prelucrare prin electroeroziune), *electro-chemical machining* (prelucrare electrochimică), *ultrasonic machining* (prelucrare cu ultrasunete), *electron-beam machining* (prelucrare cu fascicul de electroni), *water-jet machining* (prelucrare cu jet de apă)
- *pressing* (presare)
- *shearing* (forfecare): *blanking* (blancare, ștanțare seacă), *piercing* (străpungere), *punching* (ștanțare, perforare), *slitting* (crestare, despicare), *notching* (zimțuire, dințare), *grooving* (canelare), *bevelling* (a teși, a fațeta, a tăia oblic)
- forming: *rolling* (laminare), *forging* (forjare), *extrusion* (extrudare), *drawing/elongation* (alungire, tragere)
- *crushing* (zdrobire), *tearing* (sfâșiere), *breaking* (rupere)
- joining & fastening: *welding* (sudare), *soldering* (lipire moale), *brazing* (lipire tare), *adhesive joining* (îmbinare pe bază de adeziv), *fastening* (fixare, strângere)

- *casting* (turnare): *mold casting* (turnare în formă), *die casting* (turnare sub presiune)
- *molding*: *injection molding* (injectare prin turnare), *extrusion molding* (turnare prin extrudare), *thermoforming* (termoformare), *powder metallurgy* (metalurgia pulberilor)
- *melting* (topire), *quenching* (călire), *tempering* (revenire, temperare, detensionare), *annealing* (decălire, maleabilizare)
- *coating: powder coating* (acoperire cu pulbere), *electroplating* (electroplacare)
- *3D printing / additive manufacturing (printare 3D / fabricație aditivă)*

The outcome of manufacturing is a wide range of parts, elements, finished products, or even actions, some of which having borrowed their names from basic English and turned them into technical terms [12]:

vice → viciu (common English)
→ *menghină* (Mechnical English)

dog → câine (common English)
→ *opritor, blocator* (Mechnical English)

jaw → falcă (common English)
→ *bac de mandrină* (Mechnical English)

chuck → friptură de vită (din spată și ceafă) (common English)
→ *mandrină* (Mechnical English)

thread → fir de ață (common English)
→ *filet* (Mechnical English)

spring → primăvară / izvor (common English)
→ *arc, resort* (Mechnical English)

point → punct / idee, subiect / etapă (common English)
→ *vârf* (Mechnical English)

ram → berbec (common English)
→ *sanie principală* (Mechnical English)

bed → pat (common English)
→ *batiu, cadru, support, postament* (Mechnical English)

apron → șorț de bucătărie (common English)
→ *cutie a căruciorului de strung / scut, tăblie, apărătoare* (Mechnical English)

grains → grăunțe (common English)
→ *granulă, granulație, structură granulară* (Mechnical English)

hub → centru logistic / spațiu de co-working / nod vital (common English)

→ butuc de roată (Mechnical English)

chips → felii subțiri prăjite de cartofi / cartofi prăjiți (common English)

→ *aşchii / cipuri* (Mechnical English)

stream → pârâu, curs subțire de apă (common English)
→ *flux (ex. de electroni)* (Mechnical English)

feed → hrănire, alimentare / flux de conținut actualizat permanent (common English)
→ *avans (al uneltei, piesei, etc.)* (Mechnical English)

creep → ciudat, nesuferit / grozav (common English)
→ *fluaj* (deformare lentă, permanentă, ca urmare a solicitării exercitate) (Mechnical English)

There are also technical terms in English that make use of unusual basic English words when translated into Romanian:

headstock = *păpușă fixă*, cap de antrenare al mașinii
tailstock = *păpușă mobilă*, cap mobil al mașinii
machine parts = *organe de mașini*
crankshaft = *arbore cotit*

When it comes to mechanical parts, probably the most famous such element remains the *`gear`* (roată dințată, angrenaj, pinion, mecanism de acționare, transmisie), the vital force, the quintessence of any mechanism, which comes in a variety of forms and uses: *spur gear* (roată dințată cilindrică cu dinți drepți), *helical gear* (roată dințată cilindrică cu dinți înclinați), *bevel gear* (roată dințată conică), *worm gear* (roată dințată melcată), *hypoid gear* (roată dințată hipoidală), *herringbone gear* (roată dințată dublă în formă de spic), *planetary gear* (roată dințată planetară), *rack and pinion gear* (roată dințată cu cremalieră).

The vast number of tools, devices and parts used in mechanical engineering required words to accurately suggest their purpose or action. Sometimes the variety of technical terminology only brings more confusion around terms that apparently mean the same thing [13]:

- *shaft* (arbore, ax) = broad term for a rotating member used to transfer power, torque and motion between components
  spindle (fus, arbore, fuzetă, pinolă) = specialized (often shorter and narrower) rotating shaft designed to hold and accurately rotate tools and workpieces
  axle (osie, ax) = used as a beam to support the load and other components (mostly in the automotive industry)

- *pulley* (scripete) = tool which uses a flexible rope or a cable across a wheel to lift the load
  lever (pârghie) = rigid bar pivoting on a fixed point named fulcrum to lift or move loads by applying force
  jack (cric) = lifting device used to apply great forces or lift heavy loads

- *gear* (angrenaj, roată dințată) = general term for a toothed wheel which meshes directly with another gear
  cogwheel (roată dințată) = specific type of gear with individual teeth (cogs), used in older mechanisms
  sprocket (roată, pinion de lanț) = type of gear that engages with a chain or belt

- *stress* (tensiune, solicitare) = force applied to a material
  strain (deformare, alungire) = deformation or change in a material shape resulted from the force applied

Confusion may also be fueled by technical paronyms, that is, words with similar pronunciations but different spellings and meanings:

gouge (scobitură / daltă de gravat) ≠ *gauge* (calibru / instrument de măsurare)

excavator (excavator) ≠ *escalator* (scară rulantă)

One of the major elements in technical English are descriptions of processes, forces and devices, which make use of lots of attributes that sometimes get the sentence even more complicated: *high-frequency low amplitude vibrations* (vibrații de frecvență înaltă și amplitudine mică), *high-amperage low voltage electric current* (curent electric de intensitate mare și tensiune mică). The abundance of adjectives may also pose difficulties when it comes to the their strict order in a sentence as follows: number/determiner, opinion, size, age, shape, colour, origin, material, purpose, followed by the noun: *two sophisticated large new rectangular black German steel mechanical devices* (două dispozitive mecanice sofisticate din oțel, mari, noi, dreptunghiulare, negre, de origine germană), *CAD-based indirect dimensional measurement method* (metodă de măsurare dimensională indirectă bazată pe proceduri CAD).

The constantly developing scientific context has required and given rise to specialized vocabulary. The recurrency of some terms has turned them into buzzwords, namely fashionable words or phrases that have become familiar for a period of time. Mechanical engineering makes no exception and focuses mainly on acronyms that suggest basically new design and analysis tools: *CAD* (computer-aided design), *CAM* (computer-aided manufacturing: SolidWorks, CATIA), *FEA* (Finite Element Analysis), *RCA* (Root Cause Analysis), *3D printing/additive manufacturing*, *Six Sigma/Lean manufacturing*, *rapid prototyping*, *GD&T* (Geometric Dimensioning & Tolerancing), *systems integration*, *automation*, *R&D* (Research & Development). Nowadays, the inevitable cooperation between scientists and engineers from various fields has shaped new fields or branches that are increasingly resonant: *Mechatronics & Robotics*, *AI / Machine Learning* (artificial intelligence), *Kinematics & Dynamics*, *CFD* (Computational Fluid Dynamics), *Sustainable/Green Engineering*, *HVAC* (Heating, Ventilation & Air-conditioning). All the above areas of expertise have been developed under the same umbrella term – mechanical engineering – and require specialized higher education completed with a *BSME* (Bachelor of Science in Mechanical Engineering), another buzzword that reflects the new realities. Last but not least, these

interdisciplinary fields have engendered new industrial and technological trends like *Industry 4.0/Smart Manufacturing*, *Additive Manufacturing*, *Generative Design* or *Digital Twin* [14].

3. Conclusion

All scientific breakthroughs and technological advances would remain confined to various laboratories worldwide if it weren't for the dissemination of such events. Thus, in order to spread the news of the latest discoveries a linguistic tool is required in the form of specialized terminology which contains everything from simple words with accurate meanings to acronyms, idioms or phrases, and eventually buzzwords that can be heard constantly on every engineer`s lips. Irrespective of their nature, these technical words are intended to meet the linguistic needs of modern industry and technology. By providing accurate names to the never-ending inventions and innovations, specialized terminology remains the most useful linguistic resource that brings together scientists and researchers around the world and enables them to stay connected to the state of the art in mechanical engineering.

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