



Ergonomics in Army armament operations

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Le Capitaine Stéphane FOURNIER

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While ergonomics is having an increasing impact on armament operations, some recent RETEXs have nevertheless revealed the lack of ergonomics of certain army equipment. While these shortcomings are true, it is also true that ergonomics suffers from its low profile and needs to be better integrated into the Army's capability process. The challenge is to improve the expression of ergonomic needs.

In progress meetings for civilian or military projects, it was common to hear: "For ergonomics, we'll see later...", or: "Ergonomics is just a question of common sense! Even the idea that "when we don't have what we like, we like what we have and we do with it".

Today, these are preconceived ideas, considerations that are far from reflecting the importance of the role played by ergonomics in the definition and design of new highly technological products or in the improvement of workstations and combat stations. However, ergonomics still lacks notoriety and its contribution has not yet been systematized.

In the context of armament operations, it appears that some programmes have illustrated perfectly the insufficient consideration of ergonomics.

Battlespace digitisation systems, for example, were designed by different industrialists at different times, which made it difficult to make them compatible. Beyond this fact, "it is their flagrant lack of user-friendliness as well as their rigidity that most repels users, who are used to juggling with ease with civilian digitisation, the Internet, chat, SMS or attachments". Generally speaking, in the short term, this results in under-use of equipment that combatants find difficult to appropriate and, in the longer term, a substantial increase in the cost of correcting or improving such equipment.

Today, DGA encourages defence manufacturers to acquire or develop their ergonomic skills. More methodically, they are beginning to integrate ergonomists into their project teams. Intrinsically, this evolution constitutes on the part of the industrialists a reinforcement or a judicious upgrading of the design means (example: use of virtual reality, modeling...). However, this requires the Army to express its needs upstream and to fill the persistent lack of consideration of ergonomic requirements and imperatives. The work of ergonomists must be strengthened and integrated more systematically into the process of defining and acquiring army equipment.

After a general definition of ergonomics and its field of action, this article will present its application to armies within the framework of the capability process before outlining the evolutions necessary to the process of expressing the Army's ergonomic needs.

Ergonomics in short!

Etymologically, the term, derived from the Greek *ergon* (work) and *nomos* (standards), refers to the science of work, a discipline that applies to all aspects of human work. Although it appeared in the 19th century, it only took on its full meaning after the Second World War.

In 2000, ergonomics was defined by the IEA as "the scientific discipline which aims at the fundamental understanding of the interactions between humans and other components of the human body, a system, and the profession that applies methods, theories and data to improve the well-being of individuals and the overall performance of systems".

The ergonomic approach is systemic and even holistic: it evaluates human activity as a whole, in all its aspects. It consists in adapting work, tools and the environment to people... and especially not the other way around. To do this, it takes into account all the factors that act on man: it is a pivotal discipline with an integrative character.

Role of the ergonomist

The IEA states that "ergonomists contribute to the design and evaluation of tasks, jobs, products, environments and systems to make them compatible with people's needs, abilities and limitations". The challenge for ergonomists is twofold: improving working conditions and optimising system performance. Its action involves analysing actual activity upstream of the programme and transposing it into probable future activity: work organisation, fitting out of premises, spaces and workstations, physical working environments (thermal, sound, light), computer applications, simplification of handling, facilitation of decision-making, limitation or tolerance of human errors, various products, simplified and intuitive training, situations of handicap...

Fields of specialization

The areas of specialisation refer to forms of competence of ergonomists, acquired through training or practice. They correspond to fields of knowledge about man more

than to characteristics of systems or economic sectors, which are themselves the multiple fields of application. There are three of them:

Physical ergonomics is concerned with human characteristics (anatomy, anthropometry, physiology and biomechanics) and with the environment in the broadest sense of the workplace (dimensioning, postures, comfort, nuisances, etc.). This field is now relatively standardized. Adaptation to the strong particularities of defence is essential.

Cognitive ergonomics is concerned with mental processes, with the reasoning modes of operators in this environment: learning, human-system interaction, understanding of information, decision making, individual and collective workload...

Organizational ergonomics is concerned with the optimization of socio-technical systems, including their organizational structure, rules and operating processes: management of collective resources, teamwork, participatory design...

LErgonomics in six concepts

Analysing a work situation means placing people at the centre of the reflection and considering six inescapable concepts.

It is a question of comparing "what is to be done" with "what is done", of understanding the gap between the "prescribed" and the "achieved": through man's reasoning, his strategies of economy of means, efficiency and regulation of gaps, according to the instantaneous intra- and inter-individual variability, to understand man's responses to the constraints he undergoes, whatever the mental or physical load.

Application to armies

Ergonomics, or more generally Human Factors (HF), including organization, is a major parameter of efficiency and robustness for all weapon systems. Indeed, it is concerned with all the socio-technical characteristics of a program and must be integrated as early as possible in the programmatic process, at best as early as the technical-operational study phase.

The life cycle of armament operations is described in IG 125/1516.

At the initialisation stage, the aim of forward-looking technical-operational thinking is to express a staff objective that derives from the analysis of the operational capabilities of the forces and the identification of those that are lacking: This is the basis for the expression of military need. It is also the "desired end effect" of the future system. The inseparable addition of the soldier and the future equipment, which are physically linked or connected by a human-system interface. This socio-technical system must be specified for use in identified operating contexts, within a dedicated organisation, with precise functions, but in a highly variable operational environment served by a wide variety of users.

The challenge for the ergonomist lies in his ability to get the various specialists to talk to each other about all these parameters (designers, operators, etc.). The challenge for the ergonomist lies in his ability to get the various specialists to talk about all these parameters (designers, operations, HR, maintenance, etc.) in order to identify the end users, their activities, the variability of use, the operating constraints, and ease of use.

In the orientation phase, the ergonomist thus contributes to the formulation of requirements relating to organisational and human factors and assesses the consequences of technical and organisational options on ergonomics: his expertise must be expressed for each of the system requirements.

During the conduct of the programme, in conjunction with the EDPI, the ergonomist's main contribution is to specify and ensure the application of the ergonomic approach by industrialists, their co-workers and subcontractors, and then to monitor the consideration of the requirements and recommendations in his field. He also evaluates the system before checking that the requirement is met from a human factors perspective.

Finally, during the commissioning and operation of the equipment, the ergonomist relies on feedback (RETEX) and analysis of the activity. If necessary, he continues the implementation in use (corrective ergonomics) and aims to improve the performance of the equipment, in addition to the comfort of use.

How can ergonomics be promoted within the Army?

The consideration of ergonomics in armament operations varies greatly from one army to another. Indeed, the process described in the previous paragraph is only a reflection of what is done globally in the Air Force and the "Royal". Thus, a guide to the integration of human factors in naval programmes, intended for staffs and integrated programme teams, was produced jointly by the Navy and the DGA at the end of the 1990s. Naturally and for several decades, ergonomics has been culturally integrated into the thinking of these two armies and their design processes. A pilot in his cockpit or a crew in a submarine, once in the air or under the sea, can neither stop to stretch their legs or change a wheel: they are in total autonomy, in a restricted and optimized space, resulting from the fine analysis of the activity, the need and the organization.

In the Army, the consideration of ergonomics is more random, partial or punctual, sometimes linked to the importance of a program, but more often than not poorly integrated. In the French Army, ergonomics is taken into account more randomly, partially or on an ad hoc basis, sometimes linked to the importance of a program, but more often than not poorly integrated under the pretext that financial constraints and operational imperatives can collide... And this to the detriment of ergonomic recommendations. The SIR program, for example, is not renowned for the ergonomics of its man-machine interface, and the FELIN program was initially badly named: it was then 45 kg of agglomerated equipment more than integrated into the fighter!

However, lessons seem to have been learned from the past: the SCORPION program is an illustration of this. The SCORPION programme is an example of this. It is intended to be comprehensive and integrates its various components step by step. The coordination of the constituent operations is delicate due to the scale and complexity of the project.

Nevertheless, it is a capability process which, right from the design stage, expresses the strict need for overall coherence and specifically and systematically integrates ergonomic requirements.

In this context where technological advances seem to take precedence over the necessary and sufficient need, the ergonomist's contribution is necessary to refocus reflection on man, on the activity of the socio-technical system, its strengths and limits. The unsuitability of man-machine systems to the missions in question must be assimilated to a design error, the consequence of a real difficulty for the designer to appreciate the user's need and the operational context in which

is executing the mission. But it can also result from insufficient involvement of the "client and user" organization in the expression of the need, especially in the ergonomic field. The objective is to design a system that is perfectly adapted to the characteristics of the operator, the requirements of his task and the job context.

Initialization is the first phase of a project, and therefore of the equipment life cycle. It is of major importance for the integration of ergonomists because it is based on a multidisciplinary functional analysis. This approach makes it possible to bring together all the state actors of the same programme and to analyse in detail the functions to be obtained from the future system. Each of the actors expresses the lines of thought towards which they are moving, each looks at the future system through a complementary prism. These cross views are essential information that is of interest to the programme officer, who will take into account the various constraints and imperatives in formulating the requirements of the need. Nevertheless, the brand officer, an expert in his field, the programme support officer and the other contributors to the functional analysis will also be able to contribute and feed the reflection.

There is therefore an awareness of the different issues, a confrontation of points of view. If the ergonomist expresses himself on this occasion, it is in a constructive, design ergonomics, where the room for manoeuvre is the greatest at the lowest cost. On the other hand, if his action consists of rereading and commenting on the military data sheets before they are finalised, it would appear that the time he will be given is likely to be short. The result is that it has no room for manoeuvre and its intervention could ultimately lack overall meaning or coherence.

Valuing ergonomics implies that it acts with its methods, with its concepts, that it is relevant and that its requirements mark each program. It is a particularly structuring approach to formalise the military characteristics that places man at the desired level in the system under preparation. To do this, it requires room for manoeuvre and good timing: its action must therefore be initiated upstream of the formulation of requirements.

En conclusion

Ergonomics is an ancient discipline which, by its very nature, evolves with the complexity of work systems, and therefore combat systems, and the equipment to be acquired. But it is above all a skill that contributes directly to the overall coherence of the capability process. The relevance of its requirements and the weight of its recommendations are all the greater the earlier it is integrated into the definition of the system. Although the army is now aware of its contribution, it still encounters reluctance to integrate it systematically into the process, and its action often comes too late to have any significant effect. Beyond an increased relevance, systematically positioning the contribution of ergonomists in the

initialization phase is a disposition to be evaluated because it could also compensate for the scarcity of specialists by a higher efficiency.

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Title : le Capitaine Stéphane FOURNIER
Author (s) : le Capitaine Stéphane FOURNIER
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