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# Multidisciplinary approach Ergonomics and Lean: articulation between performance, health and safety

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**Abstract.** In recent years, important changes in work have appeared in the industrial landscape. However, there is still work to be done, and we need to go further and faster, which is why we, at Safran Landing Systems, thought of combining ergonomics with continuous improvement, or Lean management. So through the One Safran Lean workshops, Ergonomics has shown that it is possible to transform this “top-down” approach into a participative “bottom-up” approach built jointly with operators, taking into account the actual work, to adapt prescriptions and better control the WAI (work as imagine) / WAD (work as done) gap. This approach, focused on the workers and the work as they actually do it, allowed us to take into account their professional culture, to collectively build their own rules regarding health and safety issues, while contributing to the overall performance of the work unit.

**Keywords:** Ergonomics - Lean Articulation - Safety - Professional culture

## 1 Introduction

In the industry, there is no need to prove the benefits of Lean management anymore nor, to talk about its limitations on worker health and safety (Bellies & Buchman, 2011; Bourgeois, 2012; Morais & Aubineau, 2012). It is also not necessary to prove the benefits of the complementary nature of Ergonomics and Lean (op cit.). However, it must be noted that these Lean sites, located in a limited space and time and focused on industrial performance, still pay too little attention to issues of operator health and safety. Indeed, the link between working conditions and occupational risks on one hand, and the search for added value on the other, is not always analyzed and highlighted, while healthy operators working in safe conditions will be able to find and organize better the most efficient operating procedures, provided they have sufficient resources to cope with the constraints. So, as part of a 12-week Lean "One Safran" workshop, this text provides feedback on one of the possible links between Lean and Ergonomics, between performance and health in the workplace. This opportunity, which must be seized, is an opportunity to put back at the

heart of the search for industrial performance, health and safety issues as well as professional culture, a guarantee of a successful and favorable intervention for workers.

## **2 A necessary collaboration**

Ergonomists agree on the link between activity and culture (Wisner, 1985; Rabardel, 1995; Béguin, 2010). So, faced with a change of an organizational or technical nature "there is a need for appropriation and development of the activity" (Béguin, 2010), for the preservation of the vital resources of the profession (Clot, 2010). Taking into account the "professional culture" as a provisional but stable set of what is publicly shared (knowledge, know-how, judgments, meanings and ways of thinking)" (Nascimento, 2020) thus becomes essential in the face of a Lean approach that is still too top-down.

On the other hand, over time, the understanding of the gap between what is to be done (WAI), directed by rules, prescribers, and how it is done (WAD), in relation to experience, knowledge and know-how, has become more refined and diversified in French-speaking works to transform work situations (Cuvelier & Woods, 2019). Nevertheless, the participatory nature of workers is essential and promotes, within acceptable limits, the control of the WAI (Work As Imagine)/WAD (Work As Done) gap (Cuvelier & Woods, 2019).

To do this, the ergonomic intervention has focused on a triple positioning - skills, instruments and collective - that will make it possible to control the WAI/WAD gap and to "manage it in a conscious and reasoned way" (Mollo & Nascimento, 2013, p.218), between the need for Lean rationalization and the will of Ergonomics to adapt work to Man, and to understand it in order to transform it.

Indeed, studies show (Bellies & Buchman, 2011; Bourgeois, 2012; Morais & Aubineau, 2012) that work prescribed too much leads the operator towards constraints not thought of by management. A discussion must then be built around the characteristic notions of Lean (the role of standards, waste management, the "one best way, etc.), which beyond the effective time saving can contribute to a reduction of important "marge de manoeuvre" (Coutarel, 2015) and transform a resource into a constraint.

However, acting together with different methodologies and knowledge, makes it necessary to build a common and shared repository. Thus, the use of a plan of the workspace (or the use of rating grids) as an intermediate object (Vinck, 2009), facilitates the collective construction of future work situations, also based on the simulation of future activity. The meeting of this plurality of actors around a common object, makes possible the crossing of the experience of each one, between knowledge, and know-how, procedures and regulations (respectively WAI and WAD). Moreover, it is through the intervention of "immersed agents" in future simulated work situations that it is possible to anticipate future risks and benefits, based on the needs and constraints of existing work (Van Belleghem & Coll., 2018).

This approach is also a means of supporting the players towards acceptance of change, by acting on the prescriptive system (Van Belleghem, 2018), while rediscussing the trade-

offs between quality, efficiency and safety, all of which is bathed in their professional culture.

### **3 Methodology**

The ergonomic intervention took place in a cell of 2 machines which carry out the roughing of the raw parts, the first phase of the manufacture of the landing gear; as well as a maintenance station for the cutting tools. 7 operators divided into 2 shifts are assigned to the different workstations.

First of all, the analysis of work situations (4 weeks) allowed to collect the real operating modes of each operator (manual handling, machine piloting, control and taking dimensions...) and to identify the professional risks associated with health, safety and work organization among the risks already identified, which could be treated and reduced during the Lean worksite. Occupational risks are of 3 categories: related either to general safety, chemical risk or ergonomics. Risks are evaluated and prioritized according to 4 levels of Criticality represented by colors (1/ Red: Major, 2/ Yellow: Significant, 3/ Green: Medium, 4/Blue: Minor). Assessments are performed by trained workers, using a rating grid developed for the Safran Group. For example, general risks are assessed by calculating criticality by taking into account the frequency of exposure to the hazard, the severity of the foreseeable damage and the level of control of the risk. For ergonomics, 3 dimensions are rated: posture (rating based on the NF EN 1005-4 standard); load handling based on the ISO 11228, NF EN 1005-2 and NIOSH lifting equation 1994 standards; repeatability based on the European standard NF EN 1005-5. The ergonomic analysis was based on an alternation of open and systematic observation methods (to understand the work activity, the interactions between operators/teams, the general organization of the cell, the operating strategies...), and informal interviews (to discuss in situation the intention, the reasons of these acts). In a second phase, 3 work sessions took place in multidisciplinary groups, which allowed to deepen the analysis of the work situations, as well as to find ways of improvement in a collective way. Discussions were conducted on the basis of a plan of the cell, representing the tools, furniture, parts and tool storage areas, as well as the flow of people and parts. The participatory work made it possible to define and set up a new implantation of the unit, as well as an action plan to reduce occupational risks. Some actions that were implemented during the Lean workshop were tested and verified in real working conditions, taking into account the variability of production conditions (hazards such as missing parts, urgent touch-ups, absence of colleagues...).

#### **4 Working together and moving towards major improvements in working conditions and performance**

The 12-week Lean workshop led to a reorganization of the initial space with the creation of dedicated areas and new work areas (activities not prescribed, but actually carried out), but also to an increase in workspace (+17m<sup>2</sup>) thanks to a rearrangement of the areas annexed to the two machines. In addition, the restructuring of space and traffic flows has made it possible to reduce operations without added value (manual handling and unnecessary travel), and to reorganize work without reducing the operator's resources needed to maintain his activity, helping to reduce professional risks (30% reduction in the risks of co-activity, falls, shocks, postures, load handling).

In fact, observations have shown that there was no distinction between the entry and exit of the part, thus generating a significant congestion of the work areas and the presence of cross-flows. The latter lead to a permanent co-activity between the operators, source of risks of shock, fall and unnecessary handling (risks that have so far been controlled by the workers thanks to a constant interaction during the transport of parts). These new traffic flows have been co-constructed with the operators, with the compromise between, on the one hand, clarifying procedures, reducing "lost time" and cross-flows and, on the other hand, taking into account the spatio-temporal needs and constraints of the different activities, by integrating the knowledge, know-how, but also the protection strategies, which they have already put in place.

We will take here as an example of these strategies, an off-machine operation to turn a landing gear leg, which requires the installation of bulky machining tools, where the clamps are difficult to access. The operation prescribed to be done in the machine is then performed by the operators, off-machine on the storage carriage in the middle of the two machines. The creation of a dedicated area for the operation (close to the machine but far from the co-activity zone), has made it possible to reduce the risk related to the activity, while taking into account the protection strategies built individually at the beginning and then shared within the collective.

Finally, in addition to the installation, many improvements concerning storage and tools were identified through action plans, some of which were carried out during the Lean workshop. Indeed, we were able to notice during our analysis that the operators of this work unit need a certain number of tools. They pace their activities: using slings to transport parts before and after machining, numerous measuring tools to accurately check all parts, clamping and cleaning tools throughout the machining phase. Special attention has therefore been paid to them to limit the risks during their use (adequate height, storage positioned according to the actual activity, restoration of their storage).

## **5 Contribution of the ergonomic approach**

The gains identified at the end of the workshop showed an improvement in the overall performance of the work unit, while reducing the professional risks to which the operators were exposed.

In addition to these benefits which have been objectified, the implementation of a participative approach with the whole team, operators and managers, focused on the real work has led to collectively accepted transformations.

More precisely, the ergonomic intervention in the Lean workshop showed the importance of taking into account the real work and the involvement of the operators as actors in the construction of their own health and safety, themselves linked to the performance of the work unit. In fact, performance is built collectively, and health and safety then becomes a lever for developing it. Then, the integration of all the actors has allowed to understand the activities as they are really carried out, and to valorize them in their professional culture.

By taking the example of the circulation flow of coins we could see that a participative approach allows to control the gap between WAI/WAD, favouring its adaptation by taking into account the work and the needs of the workers. Thus, it is no longer a question of seeing only a "maximum" time saving, but an "optimized" time saving according to the situations allowing the operator to have sufficient resources to intervene and react to the production hazards. In this workshop, the creation of dedicated areas throughout the circulation flow of the part protects the workers, limits risks (linked to co-activity, transport of parts, etc.) and it is all these gains that contribute to a better general organization of the unit.

Moreover, apart from the term "protection" commonly understood in the sense of "protective equipment" or "activity prescription" in risky situations, we have seen that the notion of protection refers to a dynamic individual and collective process, where it is readapted, "tamed" by the worker and put in his "hand", contributing to the importance of the WAD valorization. Indeed, rules are always at least interpreted, adjusted or appropriate to deal with the unexpected (Cuvelier & Caroly, 2009), so it is essential to observe and adapt the prescriptions as they fit into the professional culture. The analysis of the knowledge, know-how and ways of thinking of the business lines has enabled us to promote this culture and to encourage the involvement of the players in this approach. It was also an opportunity for ergonomics to intervene directly in the design, thus limiting the risk of major modifications afterwards.

## **6 Conclusion**

The operator constantly acts within a framework of resources and constraints, which he regulates in order to carry out an efficient action, at a lower mental and physical cost for him. In this sense, the will of Lean to increase the industrial performance, which in fact engages the activity of the first level workers, must take into account their experiences,

knowledge and know-how in the field in order not to constrain the activity for a higher performance. Here, thanks to the analysis of the activity, in addition to being able to get closer to the real needs of the operators, we apprehend the professional culture in which it is inscribed.

So, by immersing ourselves in the real activities developed *in situ*, we have targeted the reality of the work, such as a management of quality/performance/health/safety compromises, integrated into the professional culture, favouring the coherence of the new organisations, the capitalisation of new business rules. We then discussed this set of compromises, thus becoming a performance lever that could be justified in terms of health and safety. Indeed, beyond the simple control of the gap between WAI and WAD and the consideration of the professional culture, what was important to question in this lean workshop were the links between health, safety and performance at work. Indeed, we think that beyond an isolated intervention, this collaboration between Lean and Ergonomics should be generalized given the advantages of these two intervention methodologies.

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