

## **Simulations in operational integration projects: from space to organizational conception**

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**Abstract.** In the oil industry, many collaborative environments are being created known as Integrated Operations project. This article shows that the simulation for design layout of a collaborative environment highlights issues concerning the future organization of work. The participatory dynamics and the use of the proposed layouts for the new space were the main features of the simulation process. More than a review of the furniture and the physical layout of the rooms, simulation's meetings turned into discussions about the required number of operators and the future process operators' work.

**Keywords.** Collaborative environment project, Simulation, Participatory approach, Ergonomic work analysis

### **1. Introduction**

The quest for cost-saving and improved performance has led the oil industry to implement a range of Integrated Operations (IO) projects (AbdulKarim et al., 2010).

IO projects are those that aim to integrate onshore and offshore operations by using management and transmission of data in real time technologies. These projects are characterized by the transfer of offshore to onshore activities; by the connectivity between distinct workplace locations and teams; by adjustments to processes and technologies that enable the completion of work in real time; and by increased integration in multidisciplinary work. In the oil industry, this process goes through distinct phases. It starts by focussing on information technology and creating multidisciplinary work environments, and suggests there is a current need to create a structure for operating a global business in real time (Edward et al., 2010).

In this context we conducted the study for the ergonomic design of a collaborative environment. This environment will house different activities related to the operations of the underwater installations of a Brazilian oil company. The aim of this integration is to share the available resources between different sectors in order to be more efficient in meeting the demands of different platforms.

### **2. Case study**

This ergonomic study was undertaken in the initial phases of the layout project of the collaborative environment. The project's initial three-month term was extended to seven months due to the range of organizational aspects involved. The study was organized in three phases: (a) analysis of the reference situations; (b) simulation; (c) validation and development of ergonomic recommendations for the architectural project.

### 2.1 Demand

The initial requirement for the ergonomic study arose from the project management's need to assess the company's own layout studies. The layout needed to provide around 90 work posts in a single environment, as well as to offer a support structure: coffee areas, mess room, toilets, shared service areas, meeting rooms and support for contingencies. For this purpose, 900 m<sup>2</sup> were made available on the top floor of a building in its final phase of construction.

At present, the activities to be integrated within the collaborative environment are undertaken in five different sectors of the underwater installations department. The aim of the new integrated sector is to share the underwater operations' main resource (available vessels) between the groups involved. The hourly cost of the vessels is high. A company assessment showed that the vessels' idle time was considerable and that predicted service schedules for the platforms were not being met. Consequently, there was substantial waste of allocated resources. It was hoped that the integration of these sectors within a single environment would permit a greater level of efficiency in using resources and in meeting the requirements of the different platforms.

The main activities involved in the underwater installations are: (a) monitoring, control and technical support (which seek to optimize the development of the operations for a short term - a period of up to three days); (b) planning and programming (with the aim to optimize the use of the available resources for a medium/long term - periods exceeding three days); (c) scheduling and logistical demarche (acting on the mobilization of materials); and (d) supervision and operational performance (acting on teams and process management).

When the ergonomic study was commissioned, the integration project was already underway and the company had begun work on several initiatives: (a) the structuring of hierarchies for project management (directive, executive, and operational committees); (b) process mapping conducted by third parties, based on Business Process Management - BPM methodology; (c) the redesign of working processes, defining roles and functions through the model "*as is*" x "*to be*"; (d) manpower definition, based on the estimated time to complete a task; (e) predicting the development of an integrated data and process management system based on the Enterprise Resource Planning system - ERP; (f) a pilot room with monitoring, control and technical support activities; (g) layout studies drawn up by company's technical team. The process redesign divided the activities involved into cells and nuclei. It considered the desirable degree of interaction between the anticipated work cells and the types of arrangement that would, theoretically, favour collaboration.

Layout options to be evaluated distributed all workstations in a single environment, without defining the relationship station / function / sector. The ergonomic study should provide an analysis and options for layout, furnishing specifications and equipment requirements, and recommendations for the new environment's acoustic and lighting plan.

### 2.2 Methodology

The methodology used by the ergonomics team was based on Ergonomic Work Analysis (Guérin et al., 2001), which is based on observations and individual and group interviews with workers. The process adopted the following reference situations: the current sectors of the pilot project and of the operational unit; a collaborative environment recently implemented by another department and a contingency service centre. The activities in all of these places were accompanied. Routine and contingency activities situations, where verbal communication among stakeholders was necessary, were prioritized for follow-up. These typical situations of the work (Daniellou, 1992) were used

by the ergonomics team to propose new arrangements layout, where the location of the sectors / functions took into account the need for verbal communication.

In order to analyze and validate the ergonomic layout studies, various simulations (Maline, 1994) were made that involved the operational representatives of several sectors, supervisors, committee representatives (operational and executive), project leaders and ergonomics team, in group meetings. These meetings were held separately by sector. They were convened by project managers and conducted by the ergonomists.

The simulation scenarios were constructed from the situations that characterized the activities such as: monitoring of real-time operations; material and human resources planning; scheduling of vessels; reprogramming or replacement of vessels; operations with drilling rigs; maintenance situations; accidents; among others.

PowerPoint presentations were used for the simulations, conducted by ergonomists, where many participants could modify the proposed layout arrangement in displayed floor plans. Initially, the ergonomists showed the criteria used for the layout studies, blueprints with the location of each function and the principle scenarios that characterized the activities of each sector. From the initial presentation, the layout was modified by the various participants in order to meet the demands of the situations reported. During simulations, in addition to the written notes that the ergonomics team made, they created new slides with changes notes and repositioning of workstations, and all the meetings were recorded. The aim was to have a detailed memorandum of the numerous issues that were discussed with the various groups.

### *2.3 Results*

Throughout the meetings, future users of the collaborative space had the opportunity to collectively reflect on how the new organizational process would work in the new space. They also had the opportunity to discuss their needs in relation to the equipment and furnishings, and the prospected modifications in the workplace organisation.

As well as modifications related to the layout, furnishing and equipment of the workstations, there were several alterations to the organization of the work prescribed. Over the course of the simulations, the number of predicted operators according to their function underwent changes, some functions have been created and the interrelationships among others were modified.

The degree of modification of the initial forecast was so significant that one of the working groups had a 67% increase in the manpower provided. While the total number of work posts predicted did not change, the relationship between required posts and those for expansion did. Initially, 72% of the total predicted posts were filled and 28% were for expansion. In the final layout, 84% of the predicted post were filled, leaving 16% for expansion. However, this difference could be still greater, as based on the analysis of the activity, the need to integrate another cell to one of the predicted nuclei was identified. This would correspond to a 25% increase in work posts from the initial total. At the time of writing, this decision to transfer this cell had not yet been taken by the project management. Thus, there is no allowance for these work posts in the present layout.

## **3. Simulation and conception**

Simulation is one of the methods used by activity-centred ergonomics to overcome the paradox of the ergonomics of conception. It raises the question of how to anticipate the consequences of the conception decisions on future activities (Theureau and Pinsky, 1984). The paradox is related to anticipation, which is aligned to what is probable or possible and not to what is actual. Ergonomic simulation does not aim to simulate the

function of the device (Leplat, 2000) or to prescribe the right way of performing tasks. It is principally concerned with evaluating the possible forms of future action and whether they are acceptable. Over the project process, they also serve as '*reflexive support*' for future users to evaluate the proposed solutions in accordance with their experiences (Daniellou, 2007).

The conception process is a complex social activity that involves numerous forms of interaction between the different parties, all of whom have different perspectives (Martin, 2000). The meeting of operators, designers, and other parties with political roles and representative positions has contributed to finding solutions for the project. Additionally, these meetings have also contributed to developing activities and the capacities of those involved so as to be able to deal with changes in the work situation. For this reason, these conditions that are noted in the conception process form a constructive dimension (Barcellini et al., 2013).

Designing puts into practice a dialogical process of mutual learning. In this process a designer's hypotheses are confronted, queried, and generally tested out within the world of the other participants in the project. Exchange between participants is realised through the mediation of temporary results. The use of these results in the action of designing remodels enriches and modifies the characteristics of the object that is being projected. In this sense, the use of the term "*activity exchange*" can be used to underscore the dialogical process, during which the result of designers' activities is related to the activities of other parties through intermediary objects. (Béguin, 2003 & 2005).

It is hard to establish a dialogue between participants and to negotiate the interests of everyone, particularly when there is no shared knowledge or information between those involved. Therefore, it is important to bring the real work to the core of the discussion between the parties, so that decisions are not taken on a prescriptive basis without consideration of the variables involved. If this does not happen, there is a risk of not anticipating the constraints, the limitations and the possibilities for adjustments of work activities, or of the consequences on workers' health and production quality (Barcellini et al., 2013).

#### **4. Final considerations**

The possible contribution of activity-centered ergonomics to the conception of new working situations takes place in a range of areas. When one is faced with the concept of organizing future work, certain difficulties present themselves.

The companies have difficulty in defining and understanding what is the work organization and what instances should be involved in the organizational project. As well as the strategic element of the organization, the work in general is seen as the object of a script, as if it was entirely conscious, explicit and structured, and could be learned through training sessions. From this perspective, problems can be anticipated by the representatives of the organization (Lima, 2000), who are likely to be those responsible for its redesign. In this positivist view of work, the recommendations are expected to be followed without questioning or the recommendations can be questioned and/or disregarded if necessary, in order to solve a problem (Terssac et al., 2004).

Activity-centered ergonomics have a strong constructivist influence, and considers that there are different logics that are often conflicting and that are articulated throughout the work activity. Therefore workers need to create strategies for dealing with this range of logics as they come up in everyday life. However, these strategies are not part of a script and are not only learned in formal training sessions, because they are individual and collective; they are not always explicit or conscious; and they are at all times related to the

context (Lima, 2000; Guérin et al., 2001). Therefore it is necessary not only have a global strategic vision, but also to understand the real work to the worker level. In this way problems and their possible solutions can be socially constructed. In any activity-centered ergonomics project "*giving a solution*" is less important than "*enabling a range of solutions*". It is the flexibility of the constructed and adopted solution that will allow for the future adjustments, which will certainly take place.

In this case study, the organizational redesign proposed for the operations department of the underwater installations was drawn up based on the existing organization. The aim was to solve problems related to the lack of integration between operations. However, although the company has been organized itself into committees, so as to create participatory management of the project, the understanding of what the work is and what is his organization continued to be restricted to prescriptions. So, the committee members did not feel safe in adopting any of the initial suggestions of layout proposed, because, even having participated in the mapping process and the decisions of process redesign, they were unable to establish the relationship between the layout, the existing organization of work and the organization that they prescribed.

Simulations, based on the analysis of these operations activities, was essential to understand the existing problems, how the work organization planned and the space have positive or negative repercussions on activities and how the work organization project involves a detailed knowledge of real work situations. Based on this understanding, it was possible to choose a layout option, with the participation of operators and committees.

During this approach, the members of the project's administrative committees had a clearer vision of what could be anticipated or expect for the new work situation. In the quest for a more flexible solution, they made changes to scripts and recommendations that were outlined in the mapping of the processes. The organizational project moved ahead and included specific demands for the work activity. The discussions resulted in practical changes to the anticipated number of operators; to the planned functions; to the communications relations between the cells; and to the equipment to be made available. All of this reflected directly on the arrangement of the work posts. The support that was created by the participatory dynamic instituted in the simulations, raised questions related to the integration of operations that were still dissociated from the department, and led to the negotiation of the expansion of the area to be used by the underwater operations, to allow the adaptation of the layout to new decisions that may be taken and that implies expansion.

A further important aspect is that when conceiving workplaces there are devices that can help to materialize propositions and restrictions for the different parties involved: outlines, schemes, plans, and maquettes among other things. These devices function as facilitators for exchange between the parties. Ideas are disseminated, confronted and transformed, often without words, through these intermediary objects. And it is on these intermediate objects that it becomes possible to perform the simulations.

The organization project had lacked intermediary objects to facilitate and promote communication between the parties. In this particular case, there was an initial attempt with the creation of the process mapping ("*as is*" x "*to be*" schemes). But the model chosen, and the absence of greater involvement by the workers themselves, resulted in insufficient tools to encompass the operation logics involved in the department's processes.

These difficulties came to light during the project for the work space, because, ultimately, the layout is an image of the work organization (Goldenstein, 1997). The simulation meetings for the layout proposals turned into a forum for discussions about space and, especially, about the work organization. The intermediary objects that had been

made for the layout simulation were used to mediate communication between the different interlocutors on both items.

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