DOI – https://doi.org/10.5965/2316796310202021154

PLANNING OF AN OFFSHORE PLATFORM MAINTENANCE CAMPAIGN: A COLLECTIVE PROCESS TO REDUCE UNCERTAINTY

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Abstract

Within the scope of industrial megaprojects, such as a large-scale maintenance campaign for an oil platform, planning for tasks that will be executed in highly dynamic environments – defined by variability, uncertainty, and unforeseen events – is a challenging job. The Ergonomic Work Analysis (EWA) by the maintenance planning technicians showed that, despite the different strategies in use, there are limits in the possibility of predicting a future context. Thus, planning is a collective process of reducing uncertainty, but it requires instrumentalization of the players involved therewith.

Key-words: activity-centered ergonomics; planning; industrial megaproject; highly dynamic environment; offshore maintenance.

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1 PLANNING VIS-À-VIS DYNAMIC AND UNCERTAIN PROJECT ENVIRONMENTS

In general, project management deals with time and limited resources (PMI, 2008; 2013). In this context, considering uncertainty as a "normal and inevitable phenomenon" (BÖHLE et al., 2016, p. 1386) is not trivial. There are no guidelines clearly oriented for managing and controlling the "unpredictability and randomness of project environments" (SÖDERHOLM, 2008, p. 80), nor for the "unknown" (LECHLER et al., 2012) – if such a possibility does exist.

Daniellou (2002a) identifies that in designing a future work system, the *sources* of diversity and variability can be related to the situations and functions of the technical system, to the technology, to the organizational forms, and to the geographical or anthropological background. The *forms* of variability, on the other hand, may have to do with normal, inevitable or incidental situations.

This characterization features the intense dynamism of the context in which the projects are executed, which is prompted by the occurrence of unforeseen events, and the sources of which being numerous (FORRIERRE et al., 2011). In these highly dynamic environments, operating conditions become permanently different and the work prescribed by designers – the task – becomes distant from the actual work of operators – the activity (DANIELLOU, 2005). For this reason, in the case of planning, it is not uncommon that the tasks prescribed by the planners in the plans are far from the work reality of their end users (BAZET, 2002; COSTA, 2021).

In this regard, Böhle et al. (2016, p. 1386) suggest that, "if project management is strictly planning-oriented, it might yield negative effects for the project as a whole. This may happen because there is an underlying idea that the uncertainty control is possible and that it is associated with detailed planning (YEO, 2002). In fact, highly detailed or rigid plans tend to limit the freedom of decision making, rather than contributing to a larger goal (HALL et al., 2003; POLLACK, 2007).

Therefore, dealing with uncertainty and variability is part of project management (PERMINOVA et al., 2008), especially regarding megaprojects, where these circumstances are magnified (SANDERSON, 2012). This article fits into the debate about the most recent approaches (PERMINOVA et al., 2008; SÖDERHOLM, 2008; LECHLER et al., 2012; SANDERSON, 2012; BÖHLE et al., 2016) from the perspective of actual work (COSTA, 2021). To this end, the results of large-scale maintenance planning work analysis of an oil platform, located in ultra-deep waters (offshore), will be presented. The objective is to identify how the planning team organizes and mobilizes itself, in practice, to plan for the execution of on-board maintenance, which constitutes a highly dynamic and uncertain scenario.

In this respect, this paper presents the theoretical framework, divided into two parts, namely: the shutdown as a large-scale industrial maintenance megaproject, and the planning process and the incompleteness of the plan. Next, the organization of the *maintenance campaign* at the company where the research was conducted and the methodological approach to field data collection are introduced. Lastly, the proposed results and discussions are explained, and the final considerations hereof are shown.

2 THE SCHEDULED SHUTDOWN: A LARGE-SCALE INDUSTRIAL MAINTENANCE MEGAPROJECT

The importance of maintenance for production, reliability and operational safety in continuous-process, high-risk industries is underscored by several authors (LENAHAN, 1999; LEVITT, 2004; KELLY, 2006; PALMER, 2006; BEN-DAYA et al., 2009; MERROW, 2011; AMALBERTI et al., 2018). The strategies put in place by maintenance workers to deal with the difference between forecast and reality are a valuable resource in view of events, variability, unforeseen events, and uncertainty. The maintenance work plays a key role in anticipating problems, hazardous situations and even catastrophes (WISNER, 1994; GARRIGOU; CARBALLEDA; DANIELLOU, 1998; DE LA GARZA, 1999; BOURRIER, 2009; HOLLNAGEL, 2009; DANIELLOU; SIMARD; BOISSIÈRES, 2010; COSTA; DUARTE, 2017).

However, dealing with a scenario of high risk potential and under strong uncertainty requires the coordination of multiple teams, both in space and time (FINOCCHIO JUNIOR, 2009). Therefore, scheduled shutdowns, which are the largest-scale maintenance intervention in the oil industry, have been managed as a traditional project (PMI, 2008; 2013). Project-oriented management organizes the uncertainty reduction process, but this type of megaproject has particularities that need be taken into account by its managers and the planning team (LENAHAN, 1999; LEVITT, 2004; KELLY, 2006; PALMER, 2006; MERROW, 2011).

Firstly, a portion of the scope of the scheduled shutdown tasks is hidden by means of isolations and inaccessible parts of the technical systems. This partial visibility brings about uncertainty about the nature and dimension of some tasks, which gain a character of eventuality at the moment of execution, when the time and resources to solve them are already restricted. In this regard, in order to reduce the vulnerability of the executive planning of tasks in view of uncertainty, there is a great effort to anticipate the future scenario.

In the oil industry, the environment and the offshore production process constitutes sources of variability, which interfere with the performance of systems and technical devices (ANTONSEN, 2009; HØIVIK et al., 2009; RODRIGUES, 2012; COSTA, 2014; ROCHA, 2014; COSTA et al., 2015; DUARTE et al., 2016; COSTA et al., 2017; AMALBERTI et al., 2018). Moreover, both of these add logistical constraints to taking personnel, materials, and tools on board (GAROTTI, 2017).

However, regardless of the planning effort (COSTA et al., 2017), the execution of the scheduled shutdown tasks will never be the mere performance of the previously detailed preparation thereof. In planning, the executive procedures and repairs are designed for a controlled environment, as if maintenance was to be performed in workshops, with operational equipment, which does not correspond to the reality of this type of work (DANIELLOU, 2002b).

Maintenance activities can be influenced by unforeseen circumstances concerning the workplace, the means of production, and different professional logics (CARBALLEDA, 1997). Additionally, the structural design of the platforms, the construction and/or conversion work and operational commissioning thereof can be a key factor in performing maintenance tasks (RODRIGUES, 2012). As a consequence, the scheduled shutdowns feature a permanent construction of problems and ways to solve them, which happens before, during and after execution thereof (DANIELLOU, 2002b).

3 THE PLANNING PROCESS AND INCOMPLETENESS OF THE PLAN

In the traditional project management model (PMI, 2008; 2013), planning is a set of processes managed to create a unique outcome. Planning in detail has a double objective: to anticipate as much as possible the future scenario and to control execution. Therefore, the Front-End Loading model is used to establish periodic milestones (Go--No Go Gates) and to analyze the consistency of the project's deliverables (NOBELIUS; TRYGG, 2002; WILLIAMS; SAMSET, 2010).

With regard to strategic planning, on the other hand, Anthony (1965) understands planning as a continuous process that constitutes a formal system of interrelated and interdependent decisions about the future. According to the author, there are three hierarchical levels of decision making, namely: strategic, which defines long-term objectives for the company; tactical, which outlines medium-term actions for functional areas; and operational, which prepares short-term action plans to comply with procedures and processes.

Accordingly, planning can be understood as a process of articulating decisions, which are taken by different players in their respective spheres of competence. The results of this hierarchical decision-making system are formalized in plans that, according to Mintzberg (1994), can be: a codification that guides a specific use; an object of articulation and coordination of ideas; a means of internal and external communication; and a control device.

Due to its purpose, the restrictive time dimensions – defined by choices and irreversibility – and the interdependence between the players, planning can also be interpreted as a design process, which is "conducted" as a project[1] (Béguin, 2010). This process translates the choices and ideas of the players involved in designing the plans and materializes them into these artifacts.

Bazet (2002), in turn, characterizes the plan as an organizational device, the objective of which being to gather different demands into a synthesized vision. It can be a decision support resource for different players and a coordination mechanism for them to fulfill their commitment to meet a deadline. However, for the herein author, when the planning process takes the form of a plan, it becomes vulnerable to this deadline, which may vary.

This condition establishes two main characteristics of the plan (Bazet, 2002), namely: it has "gaps" – there may be a series of events, the diversity of which cannot be fully anticipated – and it is "distributed" – it may be developed in places of multiple normativeness and belong to action spaces and players that are not necessarily interconnected in the organization.

Ensuring the plan's effectiveness and legitimacy, therefore, requires that the players take ownership thereof. Based on this viewpoint, planning is a permanent action of structuring the future work context, in which several constraints must be mana-

1 According to Béguin (2010), the notion of "project management" differs from the "conduite de projet" (in French), which corresponds to the "development" dimension, from Staudenmaïer (1989). Although there is no distinction between these two terms either in English or in Portuguese, they correspond to different dimensions of the project. Costa (2021) summarized the idea, stating that "project management" determines and guides the steps, spheres of competence, deadlines, objects, and objectives of the project. The "conduite de projet", on the other hand, capitalizes what is needed for it to happen – spaces for action, forms of organization, interdependence of the players etc.

ged. Therefore, Bazet (2002) infers that the plan cannot be a closed prescriptive device that establishes the preliminary chaining of future actions. However, managing the cognitive and social interdependence of the players requires that this collective has variable geometry both in time and space[2].

Moreover, when confronted with other prescriptions, the plan can be "instrumentalized" (RABARDEL, 1995; BÉGUIN; RABARDEL, 2000) by its end users. Since the plan is part of a system of explicit and implicit rules, which can never be fully spelled out in prescriptive artifacts (CROZIER; FRIEDBERG, 1992), the result is that every plan will be incomplete and that an action will never be the mechanical execution of a plan (SUCHMAN, 1987; THEUREAU, 2004). In this sense, Suchman (1987) argues that plans would be more useful as a basis for action if they could be not followed when situations vary, and if there was room for their gaps to be supplemented by human interactions in a situated manner – the foundation of the concept of "situated action".

4 THE ORGANIZATION OF MAINTENANCE CAMPAIGNS AT OFFSHORE PLATFORMS

Oil platforms are faced with technical obsolescence linked to increasing requirements for standards published or updated after they are built. As a result, they are subjected to increasingly strict maintenance plans, with limited capacity for the permanently on-board team to perform maintenance tasks. This limit is related to the number of maintenance technicians and the availability of specific materials and tools on board. Both are subject to the restrictions of access, accommodation and transportation to the units (COSTA, 2014; COSTA et al., 2015).

Under these conditions, the backlog of maintenance tasks tends to grow into a scale that requires more time and more resources to be reduced. Thus, progressively restoring the integrity and operational efficiency of the units requires larger maintenance tasks and a growing task force (COSTA, 2014; COSTA et al., 2015).

These aspects emphasize the need for more precise and detailed planning of maintenance tasks. For this reason, in 2012, the company where this research was conducted[3] established a new strategy for large-scale maintenance. The main objective being to articulate its two major interventions in the *maintenance campaign*: the *scheduled shutdown* and the *structural renovation* of the platform. According to the new strategy, both would have the support of an attached flotel for the duration of the planned tasks.

In the *structural renovation*, painters, boilermakers, and scaffolding assembly teams would do major works and repairs. During *scheduled shutdowns*, specialists would work on essential systems, the maintenance of which required the unit to be shut down. Despite being costly, the UMS (Unit for Maintenance and Safety – a flotel) doubled the number of exclusive vacancies provided for the maintenance teams, which allowed for reducing the duration of the *scheduled shutdown*, implementing the

2 In the case of the production plan, Bazet (2002) identifies three forms of collective mobilization: mobile, which solves problems in real time; instituted, which renegotiates the conditions for the execution of the plan; and crisis, which deals with interruptions in production.

3 This article is based on a doctoral research, which featured a double axis of analysis in the field (COSTA, 2021), namely: the design of the plans by planning technicians and their use by end users, especially boilermakers. In this paper, the framework privileged the design.

task force working on the platform renovation works, expanding the volume of services performed in this period, and regularizing compliance with the demands of the regulatory agencies (DUARTE et al., 2016; COSTA 2021).

Nonetheless, in a scenario where it is not elementary to perform routine maintenance tasks, planning and executing maintenance tasks of this magnitude – and on the scale of a set of 13 platforms – would be even less trivial. The high potential for production loss, the direct and indirect maintenance costs, the risks of shutting down and resuming the operation of the units, in addition to the logistical synchronization of 3 UMS shared among the 13 campaigns – all of them conducted simultaneously, each in a different phase –, implied a strong control of the duration time of these interruptions for maintenance.

This challenging context motivated the development and management of *maintenance campaigns*, such as the so-called "*SD&UMS projects*". These megaprojects required some restructuring in the company, which was anchored in project management rules and standards. The Project Management Body of Knowledge (PMI, 2008; 2013) supported the definition of the project life cycle, with a total duration of 27 months, dividing it into phases and sets of deliverables[4]. The Front-End Loading model guided the setting of periodic review milestones, performed by experts external to the project and internal to the organization, in order to ensure impartiality and confidentiality, respectively.

The first phase, called *initiation*, was 15 days long. In this phase, the costs and production losses were estimated, and the project team and the critical chain services of the *scheduled shutdown* were defined. The documents being prepared were submitted for a decision on the continuation of the project at Gate 0, the approval of which made its start-up official. The second phase, called *planning*, took 18.5 months altogether to specify the tasks of the *maintenance campaign* and define the required resources. This information served as input for the procurement process and for outsourcing service providers. This phase was divided into three steps, namely:

> ***1. Conceptual Planning –*** the intention was to break down the services (set of maintenance tasks grouped by system and/or technical device) of the *scheduled shutdown*, to initiate the most critical procurement and contracting processes, and to define the "*scope of opportunity*[5]". This step took two months and was checked at Gate 1.
> ***2. Basic Planning –*** in the 4.5-month period, the involvement of the players in the execution of services was agreed upon, the Unified List of Services was established, and the Scheduled Shutdown Strategy was validated. This step was assessed at Gate 2.
> ***3. Detailed Planning –*** this step took 12 months. The objectives thereof were to determine the teams and resources for each service, to list the mandatory requirements for execution, and to define their distribution in the unit. The documents were checked at Gate 3, where the deadline for issuing purchase orders was defined.

The third phase, called *execution*, comprised: the *structural renovation* and the *scheduled shutdown*. This phase corresponded to the execution of the *maintenance campaign* works, which took around six months. The *scheduled shutdown* took place during the *structural renovation* and the consistency of the preparation thereof was checked at Gate 4, which authorized commencement thereof.

4 Some SD&UMS project deliverables are examples of plans. In this case, a plan is understood as any object that brings together, either formally or informally, the decisions of a collective and that is prepared to guide the performance of major offshore maintenance, such as the Executive Planning, the Infrastructure Plan and the Executive Schedule for the works.

5 In this company, this scope consisted of a list of additional tasks, with planning thereof being done separately, thus allowing for a more ambitious result, without implying restrictions to the critical chain.

The *structural renovation* was divided into three stages, namely:

1. ***Pre-campaign*** – this stage took place in the last month of the *detailed planning* and was intended for the connection of the flotel, to the shipment of materials and equipment required for maintenance, the erection of scaffolding, and the installation of the technical infrastructure for the works.
2. ***Structural renovation*** – this corresponded to the execution of painting and boilermaking tasks, and took about five months.
3. ***Flotel demobilization*** – estimated for the final month of the *maintenance campaign*, this stage was aimed at dismantling scaffolding, removing scrap and waste, cleaning the platform, and then moving the equipment and the UMS to another unit.

The *scheduled shutdown* was divided into three steps, namely:

1. ***Pre-shutdown*** – two-month period when the scaffolding was assembled, the materials were identified and distributed on the platform. About 15 days prior to the *scheduled shutdown*, Gate 5 was performed to verify the conditions to execute it. If it was feasible, the mobilization of teams, materials and equipment, and the *pre-shutdown* operational commissioning would begin. Otherwise, the date was postponed.
2. ***Scheduled shutdown*** – the stage corresponded to the inspection and intervention tasks in the oil extraction, processing, and storage systems. It took between 15 and 30 days.
3. ***Post-shutdown*** – intended for completing the jobs, for monitoring and clearing the operation. Next, the demobilization of infrastructure and personnel would begin. This stage took approximately one month.

The so-called *closure* phase took around two months. During this time, there was the physical, administrative, and accounting completion of the services, the measurement and completion of the contracts, and updating of the campaign logs in the computer-based systems. A "*Lessons Learned*" process was also conducted, such as feedback of the project's experiences to the company's internal community of practice. Finally, Gate 6 formalized the completion of the *SD&UMS project*.

This organization was replicated for the projects of different *campaigns*, the order of execution of which being defined in the Multi-Year Schedule, which served as the Maintenance Program. It was established for a five-year horizon, and already unified the *scheduled shutdown* and the *structural renovation*, thus determining the sequencing, the expected duration, the flotel being used, and the projected period for routine operation.

The duration of each *campaign* was estimated on the basis of the state of repair of the platform, years in operation, level of obsolescence, and the history of maintenance interventions on the unit. Thus, the projected production and oil loss curves were evaluated and balanced. Once approved by the managers, the Multi-Year Schedule was integrated with the four-year Business and Management Plan, and the dates could not be changed without prior authorization from the company's higher management. Hence, the strictness in complying with it.

To put in place the planned organization of maintenance campaigns, the company has designed a five-level social and technical structure:

1. **Strategic Committee** – made up by the higher management, this Committee was intended for analyzing and validating the compliance with the Multi-Year Schedule and the performance indicators, and for determining corrective actions should there be any deviation.
2. **Tactical Group** – multi-functional, it followed up on projects to support its Operational Groups in solving critical problems.
3. **Review Group** – made up by specialists outside the *SD&UMS project* but internal to the company. It was incumbent upon this group to evaluate the coherence of all the deliverables in each phase and to issue a technical opinion about the possibility of advancing to the next phase.
4. **Operational Group** – made up by managers, assigned by platform and field of expertise, in a matrix structure, where the team was not exclusively dedicated to the project. Its main attribution was to monitor project management, in all phases, taking actions and decisions to facilitate the continuity thereof. To this end, their progress was presented at periodic meetings with all members.
5. **Multi-functional Project Team** – made up by managers and technicians specialized in the planning and execution of major maintenance offshore, and in the routine operation of the platforms.

a. The company contracted to provide construction and repair services has formed project teams with similar, but smaller, organization.

b. The project team relied on the advisory support of maintenance planning and project management experts.

Therefore, it is reiterated that:

- As part of a process of reducing uncertainty, planning is declined at different scales – from the platform set to each *campaign*, its unit, areas, systems, and technical devices.
- The planning of the *maintenance campaigns* for the platforms is continuous.

5 METHODOLOGICAL APPROACH: THE PLANNING WORK ONSHORE AND OFFSHORE

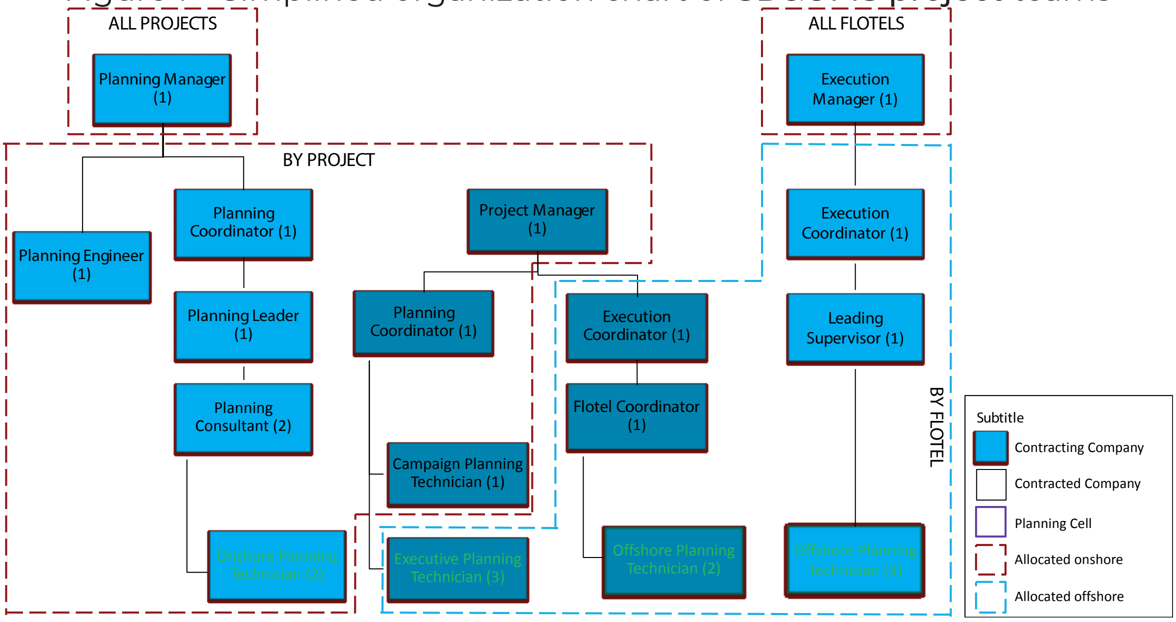
As previously stated, this article is based on a doctoral research (COSTA, 2021) performed within the scope of an ergonomics intervention project between 2013 and 2016 (DUARTE et al., 2016). The study was requested by the company's Research & Development Center to analyze the work done throughout the life cycle of six *SD&UMS projects*, which were performed simultaneously, in order to obtain recommendations for the improvement of the *maintenance campaigns*. The thesis research focused on the third project being studied, which was the milestone for the large maintenance strategy transition.

The research conducted by Costa (2021) characterized the reality of the work of designing and using plans in this context and identified guidelines that could contribute to the design of plans that are supportive to the action for both planners and plans end users. This paper emphasizes the process of designing the plans, as will be described below.

The empirical research was qualitative and ethnographic, guided by the method and techniques of Ergonomic Work Analysis (GUÉRIN et al., 1997). To better understand the actions taken by the workers, the determinants, results, effects, and decision making thereof, the method is based on observation of the actions followed by verbalizations from the workers (DANIELLOU, 2005).

It was assumed that planning and execution, although connected, are not a copy of each other (WISNER, 1995; FALZON, 1995; GUÉRIN et al., 1997; DANIELLOU, 2002a; 2004). Therefore, firstly, the work of the planning technicians onshore, who were allocated to the Planning Management, was analyzed. To facilitate understanding, Figure 1 shows the simplified organization chart of the teams followed up in this phase of the research.

Figure 1 – Simplified organization chart of SD&UMS project teams



Source: Adapted from Costa (2021)

Gathering of field data was performed during the 23.5 months between the *initiation* and *planning* phases of the *maintenance campaign* on the platform called "P-C". The analyses were carried out at the workstation of two planning technicians and based their participation in meetings, especially with the Operational Group. The most critical debates in this forum and the events that generated the need for discussions with other players during the routine thereof were used as elements for the verbalization of the workers (GUÉRIN et al., 1997) in subsequent fact-driven interviews (LANGA, 1998).

Since filming and photographic records were not consented to, manual notes of the systematic observation were taken. The main observations included: the aspects pointed out by the planning team as potentially critical to execution; the interactions required to design the plans; the players involved in the planning process; and decision making. After the meetings, the presentations and the files being used were handed over for analysis in order to substantiate the fact-driven interviews with the members of the Operational Group who were in the discussion concerned.

In the semi-structured interviews, if a deliverable was mentioned, the document was requested. In some cases, the analysis of said documents prompted a new interview based on this material. As the social construction was consolidated, interactions with the planning team also took place informally. Furthermore, since the actors were assigned to different decision centers and in different locations in the company, onshore and offshore, this team provided a workstation to the researcher.

This space was useful for the systematic analysis of the work of the onshore planning techniques, at the workstation and in plan design meetings, especially in interactions with the production operators and the team of painting specialists. In the case of the executive planning technicians, who were designers of the execution of the services, as they worked offshore, their work was follow up during the first boarding (4 days; at the beginning of the *campaign*[6]).

During this period, the work of three executive planning technicians was systematically monitored: one for boilermaking, one for painting, and one for scaffolding. In these cases, the main observations included: the process of preparing the Executive Planning for the services; the influencing factors in drafting the documents; and the integration required to design them.

During the first boarding, the existence of a planning cell on board drew attention in the work status meetings in which the herein researcher participated. This technical team was part of the Execution Management and was made up by three offshore planning technicians, who were responsible for rescheduling the set of maintenance tasks 7, 2 and 1 days in advance of the job. The service provider also relied on two of these professionals, but priority was given to the contracting team, as they interfaced with the onshore planning team for logistical rescheduling.

From then on, in all boardings, systematic monitoring of the work of the planning cell was in place. The Executive Schedule for the works was used for scheduling the Work Permits. The observations included: the processes of scheduling, issuing and release Work Permits; the influencing factors and decision criteria; the adjustments to the Executive Schedule for the works; and the integration required to deal with on-board variabilities.

Thus, the following was sought: characterize the liaison of the players to anticipate the future context; their form of organization to conceive the plans; and the distinct professional logics under debate at this moment in the project.

6 THE COLLECTIVE PLANNING WORK IN REDUCING UNCERTAINTY

This section introduces the report of the field cases under analysis (COSTA, 2021). The intention is to understand the collective coordination established to design the plans and to reflect how they can be a resource for the planners' action. To this end, three design strategies for reducing uncertainty are presented herein: two for collective organization and one for using spaces to plan. Next, some factors that make plans incomplete in the context of *maintenance campaigns* are listed. And, to conclude, the main reflections stemming from the dialog between this framework and the theory are shown.

6.1 The collective strategies to design the plans

The design of a social and technical framework provided a support for *SD&UMS projects*. Nevertheless, anticipating the reality of on-board maintenance and the variabilities of the offshore environment was no simple task. For the onshore planning technicians, this situation was enhanced by the restricted access to the unit. Since no

6 All the other boarding periods, during the execution phase, totaled 30 days on board.

boarding was planned for these professionals, their knowing about such a particular context was limited.

To deal with this situation, the main strategy mobilized by these players was to have representatives from the Platform Operations Management as members of the Multi-functional Project Team. Thus, they knew the maintenance history on the platform, would refine the scope of the job, set the priorities, and define the infrastructure of the works.

> (...) Breaking down the scope of the services is essential to start planning, as the person who opens the [Maintenance] Note knows what is in place on the platform. (...) One example: we had a job described as 'stuck valve'. But, what did the [Platform] Operation want: to change, to straighten, to put oil...? It was not clear. (...) So, the Operation team needs to participate in the planning with us, as a customer (Onshore planning technician).

Forming multidisciplinary work groups to discuss and design the plans together was a strategy also used to draft the Infrastructure Plan.

> For defining the Infrastructure Plan, I knew what I needed to put on the platform. But, since I did not know much about P-C dimension, I had meetings with the Platform Manager and his team – production, maintenance, vessel and load handling –, and the Logistics Coordination. We saw the pieces of equipment planned for in the Executives Planning and where to fit them. I did not realize there was so much to think about in a 'simple' layout. (...) Each person considered one criterion. Some thought about the last shutdown, others about the interference caused between tasks, the risk of accidents, the logistics... Only then I redesigned the layout (Onshore planning technician).

The executive planning technicians also used the strategy of relying on the support of the platform team.

> Early in the boarding, we ask the leadership for the technical documents [of the unit] in order to study them. After the detailed analysis, we look for the 'owners' [heads] of the systems, to see what problem they understand to exist. The [Maintenance] Note is not always clear. Only those who are there [on the platform] on a daily basis know the status of 'things' and what needs improvement. So, our relationship with them [Platform Operation] has to be very close, of a partnership type, for the Executive Planning to be correct[7] and best possible (Boilermaking executive planning technician).

However, in the case of the Painting Plan, the strategy employed in designing it was decentralized from the planning core. The team of painting specialists permanently monitored the corrosion percentage of the platform areas by means of a visual photographic comparison. After determining the condition of each area, they were classified as to the level of corrosion and the loss of substrate thickness, which indicated the risk of corrosion progression.

Once in possession of this information, the painting specialists assigned the services in the scheduled periods for the *maintenance campaign* and informed the onshore planning technicians, so that they could integrate this schedule into the Executive Schedule for the works.

7 In some cases, the time elapsed between the opening of the Maintenance Note, the drafting and approval of the Executives Planning, and the execution was so significant that the scope changed. This was the case for some paint repairs to preserve the surfaces that, as the corrosive process advanced, became replacement of pipe sections, thus requiring boilermaking work.

6.2 The use of unplanned spaces for planning

Since the players involved in the planning process were distributed inside and outside the contracting company, in different decision centers, onshore and offshore, it was part of the job of the onshore planning technicians to gather the players around the design of the plans and coordinate them in time and space. But, both the meeting and coordination were not facilitated by a pulverized configuration of experts.

There was very specific technical knowledge (of welding, structural design, scheduled shutdown etc.) that only the experts knew about. However, since they did not work exclusively dedicated to the project and served different platforms simultaneously, there was a strong access restriction for them. Therefore, every opportunity and space, formal or informal, was taken to plan.

The formal spaces were the work meetings, which were used to design the Infrastructure Plan, for example. However, the Operational Group meetings were also used by the onshore planning technicians as spaces for discussion and interaction. Since they brought together the key decision makers, often the details of the plans being designed were explained and decided upon in these forums.

> The Operational Group meetings are for project status, but I always bring a list of problems, which we are not managing to solve, to the [planning] coordinator to present and ask for help. The participation of the managers helps a lot, since they can assign someone to work on the planning with us. It is very hard to mobilize people. Everyone has their routines and projects. Therefore, they are not always available onshore (Onshore planning technician).

The discussions, although outside the focus of the meeting, were also fruitful for the exchange of information between projects. Since some actors were part of different Operational Groups, they brought to the meetings elements to support the anticipation of variability, both for the planning work and for the execution on board.

So, if upon *planning* a *maintenance campaign* there was a problem with the supply of a given material, the other planning teams were alerted to seek alternative materials. During *execution*, in case of any unforeseen event, all the planning teams were informed, so they could foresee this variability in their campaign *planning*. This way, there was an influence of the local context of each campaign for the set of platforms.

6.3 The limits in anticipating reality: the incomplete plans

The strategies undertaken in the planning process made it possible to anticipate a considerable part of the predictable variability of the on-board scenario. However, although multiple players have been included in the design of the plans, incompleteness was an indelible characteristic of these devices.

Monitoring the work of the executive planning technicians and the planning cell showed that the gaps in the plans had various origins. One of them was the nature of the tasks and their exposure to multiple sources and forms of variability. For example, small valves, installed up to two meters in height, were relatively easy to access by maintenance personnel and did not require the support of load handling devices, scaffolding, or rope access.

With less difficulty to execute, the replacement of these valves was included in the scope by opportunity, which the planning cell used at critical moments of the *execution* phase. The same was not true for the larger services, the margin for operation of which being quite restricted.

> Small valve replacements are the 'cards up your sleeve' [options]. We have a list of valves that can be replaced, if the team is idle or if there is a problem on site. (...) Can this type of valve replacement cause problems? Yes, it can. The line may have some fluid in it and leak, the new valve may not fit properly, the calibration may have issues, but this is very rare to occur. It is a simple job, when compared to the critical path, and still has the advantage of improving the S-Curve, which is the focus of the bosses. So, there are moments in the [scheduled] shutdown that nothing moves forward and we have to resort to that, in order to keep the S-Curve good [actual executed greater than or equal to what was planned] (Planning cell technician).

Another determining factor in the gaps of the plans were the assumptions and implicit assumptions about reality. It was implied and not formally stated in documents and meetings that: the logistics would be as scheduled, the teams would be qualified to work on major maintenance and would be on board at the planned time, and the tools would be tested, on board and operational during the entire time of the maintenance campaign.

Lastly, there were events and variabilities that were unpredictable because there was no accumulated technical knowledge about a given situation and/or there was no history of issues occurring until an issue-situation occurred. This was the case for an inspection performed on the gravity separator at P-C. After cooling down the vessel, when it was opened, its internal components had detached and damaged the internal structure. Following a discussion among the experts, both offshore and onshore, a new configuration was designed, which would later be replicated for the platform set.

6.4 Planning and plans for highly dynamic environments

The dialog between the literature and the compiled cases contributes to a complementary perspective on planning work and the resource function of plans, as shown below.

The declination of *maintenance campaign* planning as a means to reduce uncertainty. The planning seen out in the field is declined in different scales or spheres of competence (COSTA, 2021):

1. *Strategic* – of the set of platforms. The vision organized in the Multi-Year Schedule is long--term (five-year) and under the responsibility of the Strategic Committee.
2. *Tactical* – of each *maintenance campaign*. The structure defined in the *SD&UMS project* is medium-term (27 months) and Tactical Group is responsible for it. It is supported by the Reviewer and Operational Groups.
3. *Operational* – of the large-size maintenance of the unit. The short-term perspective (18.5 months; planning time) is reflected in the Executive Schedule of each project and takes into account the "platform history[8]". The Multi-functional Project Team, which includes the planning, execution, and operation teams, takes part in the process. This sphere also includes the following:
   a. The work of the executive planning technicians in drafting the Executive Planning for the services that will be performed in the areas, systems, and technical devices of each plat-

8 "Platform History" is the trajectory from conceptual design to current operation (COSTA, 2014).

form.

b. The work of onshore planning technicians in the preparation and management of the Executive Schedule of each project.

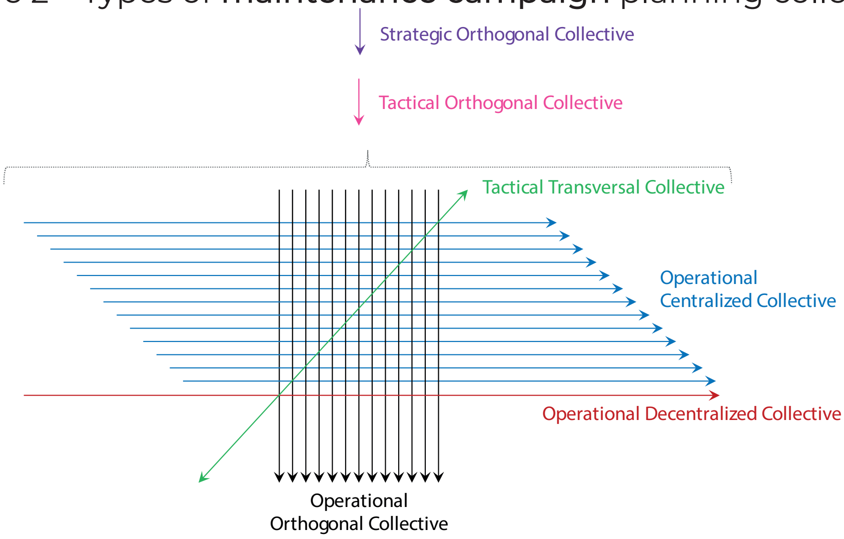
4. *The actual task* – of each work, with the very short-term viewpoint (7, 2 and 1 day in advance of each task), which is reflected in the Work Permits. This sphere includes the work of the planning cell, which performs the continuous rescheduling of the set of jobs.

According to Costa (2021), this planning declination extends up to a time close to execution and is intended for reducing uncertainty. However, because of the relationship between the planning system spheres, the decisions taken have structural (systemic) repercussions. The activity viewpoint (GUÉRIN et al., 1997) and the analysis of the actual work of the planners allowed for adding a new sphere to the planning system proposed by Anthony (1965): that of the actual task.

Planning and the plan as resources for planners' action. In this planning system, spheres and plans require specific knowledge, which varies with the nature of the decision and the task. In this context, complementing what is proposed by Bazet (2002), planning mobilizes six collectives (Figure 2):

1. *Strategic Orthogonal* – which monitors the development of *SD&UMS projects* and makes decisions for all platforms.
2. *Tactical Orthogonal* – which controls the projects and discusses critical issues that may have an impact on them.
3. *Tactical Transversal* – which exchanges information among the projects, acting as a kind of living, dynamic memory thereof, with an advisory role in decision-making process.
4. *Operational Orthogonal* – which follows up each project phase and makes decisions to promote continuity thereof.
5. *Operational Centralized* – the attribution of which being to conduct the planning process and to make day-to-day decisions.
6. *Operational Decentralized* – made up by technical experts who do the planning outside the planning core.

Figure 2 – Types of **maintenance campaign** planning collectives



Source: Costa (2021)

According to this configuration, the plans are resources for planners' action, to the extent that development thereof contributes to all other plans and to other planners. Since there is a *Transversal collective* to all *SD&UMS projects*, and a *maintenance campaign* is directly or indirectly linked to the others, there is a permanent exchange of information about events and adjustments to the plans. Therefore, there is an incessant attempt to anticipate variability and reduce uncertainty. Based on this viewpoint, planning is not just about anticipating variability and unforeseen events, but about preparing teams mutually/collectively to deal with both (COSTA, 2021).

Concerning the incompleteness of the plan (SUCHMAN, 1987), it has been seen that it does not subtract from its character as a resource. Common sense may hitch this notion to that of imperfection, thus giving the idea that "flaws" in anticipating the future context prevent the plan from being a resource for action. However, the impossibility of complete anticipation of reality and of a complete correspondence between reality and prediction does give the plan the sense of incompleteness in the design process – which corresponds to the continuity of the design process in the use of the designed object (BÉGUIN, 2010). Therefore, the plan may be completed for, and in, the action of end users and planners (COSTA, 2021).

The mutual stress between prediction and reality. The interdependence between the planning and execution functions calls for mutual cooperation between these teams, which needs to be socially and collectively built at different moments throughout the project. In practice, this interdependence can generate stress and conflicts, since the logics of action and the agreements are transient. If in *planning* the efforts guide the plans to correspond to what is known about reality, in *execution* the sense is the opposite (COSTA, 2021). Therefore, building a "world in common" (BÉGUIN, 2010) requires more than physical proximity and real-time information exchange. To reach a compromise solution, one team needs to understand the other's reality and realize the mutual imposition of constraints. This agreement, either formal or informal, semi-permanent and situated, is in force and stable as long as there is a balance between concessions, losses and gains for the stakeholders.

7 FINAL CONSIDERATIONS: FLEXIBILITY AS A WAY TO DEAL WITH UNCERTAINTY

In view of a highly dynamic and changing reality, the work of adjusting plans is part of the design process (COSTA, 2021). However, invisibilization thereof restricts the time, the resources, and the spaces that the planning team has in order to deal with this reality. This work is long and difficult, and is characterized as rework. So, no matter how much the planning team organizes itself to preserve the plans, it lacks resources (time, collectives ...) to perform its functions.

In this context, the practical solution is to learn how to deal with the dynamics of reality. Therefore, planning needs to be flexible and to allow for plans to be adapted. This perspective shows that flexibility tends to be the way to reduce the vulnerability of the planning system and of the plans in view of reality.

However, flexibility demands a capacity for constant adaptation from the players, which needs to be considered in advance and on two levels (COSTA, 2021). The first being the *flexibility of the process*, which requires the identification of structuring factors and sources of variability for the work of the planning technicians. This condition shifts the goal from specifying the tasks of execution and its margins for maneuver, and includes the forecast of the spaces, resources, and means to perform – such as having visibility of the effects of decisions on a local and global scale.

At the same time, assuming the limited ability to anticipate allows for reviewing the *flexibility of the plans*. They may have two parts (COSTA, 2021), namely: a fixed part, made up by invariants and totally and partially predictable variabilities; and a variable part, made up by the unpredictable variabilities. While this framework helps to (re) structure offshore maintenance plans, reviewing their flexibility does not mean "planning less", but to collectively rethink their accuracy and refinement in line with the actual context of execution.

Since each organization is unique, the situated practice of the workers will reveal the best ways to address each context. For this reason, each planning process will have a particular dynamics in view of the circumstances, the teams involved, the experiences and knowledge being mobilized, their coordination and situated response capacity in view of the variability, and the unforeseen events, amongst other factors. Therefore, there is no standardized way to plan and to conceive plans that can meet the heterogeneity of organizations, of planning processes and plans, but a new look at the teaching and practice of this work is required.

In this regard, one question is still left open: are we prepared to deal with the dynamism of reality or is there an implicit denial of variability, of the occurrence of unforeseen events and uncertainty? What seems to be a veiled denial has recently been uncovered by the Covid-19 pandemic. In no country or company was there a structure capable of responding quickly and fully to the occurrence of such an unforeseen event.

With due regard for the proportions that the case presents, a context of uncertainty is also the reality of projects and companies. Thus, the current circumstance reveals the urgency of naturalizing the unpredictable and preparing mechanisms to deal with it. It seems interesting to us, therefore, to seek new references in the work of the teams dealing with varied and unexpected situations in their routine work, so as to clarify the contents of their technical and practical training, and the resources required to work under these conditions.

This knowledge applied to organizational studies can support the construction of spaces for collective adaptation and provide encouragement for the theme to be addressed in the development of managers, companies, and projects. Regarding the current moment, the question remains as to whether, after the crisis is contained, the implicit denial will return or whether organizations will have learned how to use their systems, resources, and teams to deal with these variables in their daily lives.

ACKNOWLEDGMENT

This research has been financed by the 21th Human Resources Program of the National Agency for Petroleum, Natural Gas and Biofuels (ANP-Brazil) [process grant No. 48610.008958/99]; the National Council for Scientific and Technological Development (CNPq-Brazil) [process grant No. 141451/2016-5]; the Coordination of Projects, Research and Technological Studies Foundation (COPPETEC-Brazil); and the Carlos Chagas Filho Research Support Foundation of the State of Rio de Janeiro (FAPERJ-Brazil) [process grant No, E-26/201.934/2016].

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