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The Fazenda Alegre Journey into Intelligent Energy—Lessons Learned From a Successful Holistic Approach of People, Process, and Technology Aligned to Business Strategy and Results

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Abstract

Petrobras created a corporate program designed to guide and implement Digital Integrated Field Management among its production assets, named GeDIg. Fazenda Alegre field (FAL) was chosen as the Espírito Santo Business Unit pilot. The FAL field is an onshore brownfield which produces naphthenic heavy oil from 59 wells with cycled steam injection as improved oil recovery (IOR) method. Management and technical teams from FAL are geographically dispersed among three different locations: its logistics base in São Mateus city, its business unit headquarters in Vitoria city and FAL facilities located 210 km North of Vitoria and 40 km South of São Mateus.

GeDIg-FAL pilot scope comprises the deployment of an integrated portal giving users access to several new technical solutions and collaboration capabilities. Business process revisions and change management initiatives to accelerate new work process implementation were all considered. Moreover, the FAL pilot includes the design, construction and commissioning of three collaborative environments for real time production monitoring and process analysis.

This paper's objective is to describe the GeDIg-FAL Pilot Case Study, highlighting the innovations brought up and the means used to deliver intelligent energy capabilities into FAL operation, while sharing results and lessons learned from each project phase, starting with assessment all the way through operation, including a business case study development.

Introduction

Aiming to improve operational efficiency, Petrobras is exploring the Digital Integrated Field Management concept through a corporative program called GeDIg, which was conceived to drive a centralized pilot based evaluation of Intelligent Energy solutions for different kinds of Production Assets.

According to Petrobras' vision, GeDIg consists of a new working concept based on real time data availability associated with a new integrated management model, including not only the development of new technologies, but also the implementation of new processes and structured change management efforts, allowing a better collaboration culture better incorporation by the involved people. This new integrated vision is considered a competitive advantage as the decision-making process become faster and more effective, leading to production optimization, cost reduction, reservoir recovery factor increasing and/or safer operations.

Fazenda Alegre onshore field, discovered in 1996, is located in Jaguaré Council, in the Espírito Santo State, being an oil, water and gas producer (Figure 1). There are 59 wells currently in production and the naphthenic oil coming from them is characterized by its high viscosity, low acidity and low sulfur content, being very important and appropriate for special lubricant manufacturing such as, for example, power transformers isolation lubricant.

Considering the oil API and viscosity characteristics, cycled steam injection is the method presently applied to recover Fazenda Alegre oil production from the reservoir. Because of the high temperature at the reservoir, due to steam injection, the most applied artificial lift method is rod pumping and most of their wells were drilled horizontally to increase recovery.

According to the GeDIg implementation approach for Fazenda Alegre field, the Project was divided into four main phases: Diagnosis & Pre-Implementation; Implementation (Part 1/2); Implementation (Part 2/2); and Assisted Operation. The separation of the Implementation phase into two different parts was the strategy adopted to better perform the work required to complete the Project scope in addition to enable the new technologies and way of work absorption by the teams impacted.

The Project began in February 2007 and is continuing until its planned completion date of February 2008. So far, revised processes are available and starting to be implemented, three collaborative environments are completed and already in use,

some portal functionalities are in production, others are in development or test phases while people are being trained on how to use the new processes and technologies in implementation.

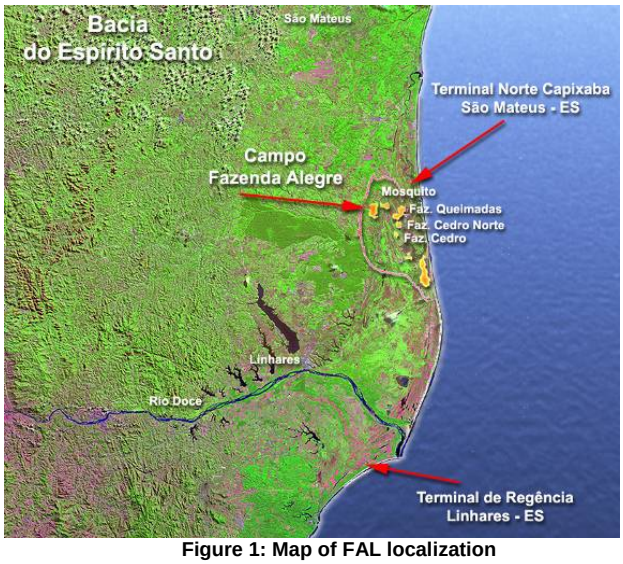

Figure 1: Map of FAL localization

As a characteristic of Norte-Capixaba Asset, management and technical teams from FAL are geographically dispersed among three different locations: its logistics base in São Mateus city, its business unit headquarter in Vitoria city and FAL facilities located 210 km North of Vitoria and 40 km South of São Mateus.

The FALs automation includes artificial lift methods, steam generation and injection and oil treatment facilities. These automation systems refer field operation activities and its timescale goes from minutes to hours, which in GeDIg terms refers to fast loops (Figure 2), where the actions are linked to alarms and events in the SCADA system.

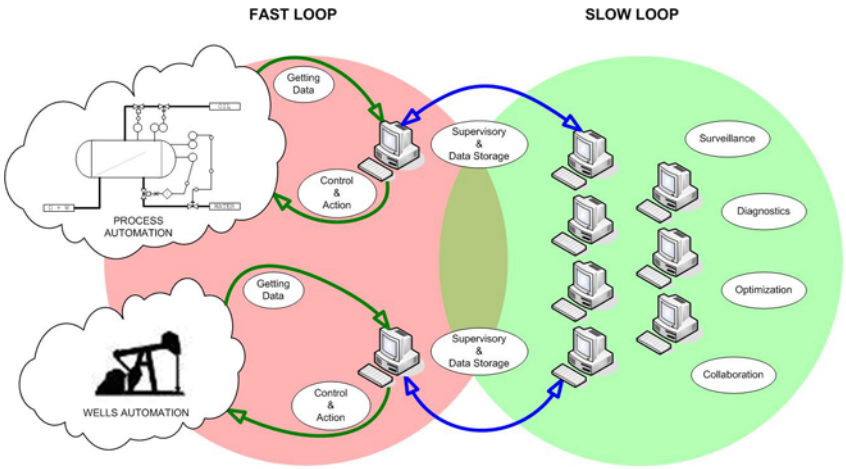

Figure 2: Fast Loops and Slow Loops definitions

GeDIg-FAL Pilot Approach

GeDIg implementation into Fazenda Alegre operation also involves several challenges to be overcome. In this context it is possible to highlight the cultural changes, and their complexity, brought up by the new technologies and processes implemented, as well as by the significant improvement in collaborative work across the Organization.

To enable the success of the GeDIg-FAL Pilot Implementation and to ensure that its associated benefits are fully experienced, as part of the Project scope, the team focused (and is still focusing) important efforts and attention on beating the aforementioned challenges and/or inhibitors related to the digital oil field concept. This continuous concern throughout the Project life cycle, as well as the implementation approach in Stages, previously mentioned, can be cited as steps towards success.

According to the implementation approach, the objective of the Project can be summarized as real time data availability and collaboration improvement, i.e., in a first moment, the main focus is to make real time data from production and wells

available for technical teams to perform more accurate analysis, as well as to improve collaborative work of the different teams involved with FALs..

Also during the Project, three collaborative rooms were designed, built and implemented, in order to promote and optimize the several teams' cooperative work, one in Vitória, one in São Mateus and the other one at the Fazenda Alegre Site. Moreover, as the people sphere was considered a relevant challenge point of the GeDIg-FAL implementation, significant efforts were dedicated to change management; since the success of the new technologies and innovations implemented depend basically on people using them properly. These and other relevant items that contributed for the already positive results of the Project will be discussed in further detail in following items of this paper.

GeDIg-FAL Differential: Partnership Characteristics

In this pilot partenership between Petrobras and Accenture was considered:

- independence regarding software suppliers and flexibility to adopt systems and tools provided by third parties or existing Petrobras systems;
- customizable-based approach for the Portal and modules technical development, based on the identification of final users' requirements;
- intense focus on production and business processes, as well as on behavioral changes and other people matters; and
- structured methodology to implement solutions according to different stages and/or phases, in order to enable better change absorption by the people involved.

Implementation

Business Case

As mentioned before, one of the greatest GeDIg implementation associated risks is creating a project focused on technology only. Despite the new technologies being a great value generator, it is necessary to guarantee that the same ones are widely used by the related workforce (employee and contracted), and as a consequence significant changes in the production optimization, planning and operational process will be made. To guarantee a complete approach, the GeDIg-FAL Project is composed by different teams: Strategy, Process, Technology, Change Management, and Project Management.

Based on identified functionalities for this pilot, Petrobras chose an implementation strategy that considers a phased progressive implementation for the GeDIg Project. The following aspects are prioritized by this strategy:

a. Make plant information available out of control room;
b. Operations process automation and efficiency increase and;
c. Increase cooperation between Norte-Capixaba Asset (ATP-NC) and UN-ES Technical Support.

One of the benefits directly associated with these prioritization criteria is the decision taking process acceleration, which was improved by increased information availability and management cooperation (Figure 3). That was verified through the lower time spent in decision taking life cycles, from Management Meetings to technical issues.

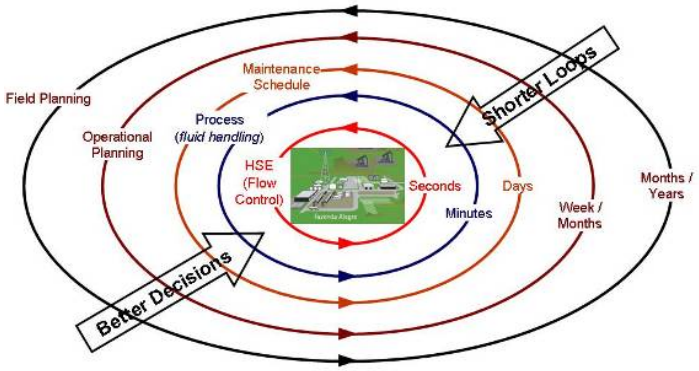

Figure 3: Loops optimizations

The collaboration increase was possible due to the concept and construction of collaborative environments, which significantly reduced the travel necessity for multidisciplinary issues.

Modules Development and Implementation

The GeDIg-FAL project is supported by 7 modules with the purpose of improving Fazenda Alegre's performance by providing information to help increasing production, minimizing production losses and improving the field's management

performance. The modules are available through a Portal software available on Petrobras's Intranet, and it's used in the collaborative rooms or by any other computer with network access. The modules and their benefits are described as follows:

KPIs dashboard: This module's objective is to improve the key performance indicators monitoring and control. The dashboard will be composed of indicators, providing its planning values, results and forecasting, in a way that deviations can be easily identified thereby optimizing the decision making process. With all information centralized in one system and using standardized graphs, it will be easier to monitor performance as well as problems associated with the processes, such as, to define action plans to solve deviations and analyze their results to make sure the targets will be achieved.

Downtime Analysis: To improve production downtime analysis, two main actions were applied: improve the reports' preparing process and improve the quality of its data through a new hierarchy of losses causes and those responsible for each one.

Wells Monitoring: With well data in real time, decisions to improve production can be made in a much faster way, optimizing the artificial lift method and equipments limits monitoring, like a predictive maintenance. This module aims to make the well's real time information available to the right public, guiding the team to a more collaborative approach between Operations and Maintenance and reducing the decision time.

Real Time Reports: This module provides real time reports to help on data consolidation and analysis. There are many reports regarding the steam generator, since it is critical equipment at Fazenda Alegre field Also, other important equipments status are available, helping the Maintenance to have access and visibility to information that today is only available at the Control Room, as depicted in Figure 4.

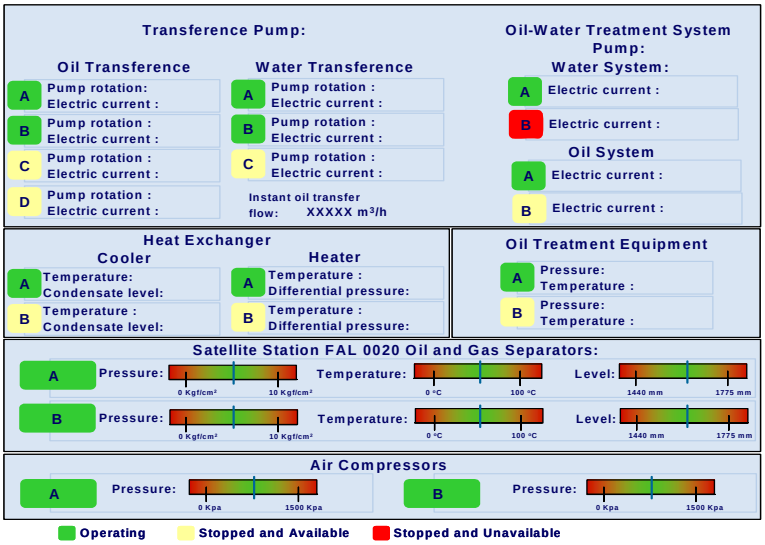

Figure 4: Example of real time report

Real Time Alerts: The goal of this module is to help in monitoring the status of important equipments and processes to avoid critical situations at the plant. This module minimizes user's effort in looking for the information. With this, users can focus on the core business of the area instead of spending time collecting data. Another important functionality is that each alert is stored in the database, which allows Petrobras to have a great log of equipment and process behavior, and together with the Real Time Reports, supports the identification of trends to minimize losses and improve production.

Production Daily Bulletin: The goals of this module are: number of spreadsheets reduction, information centralization in one system manual input data reduction, maximizing automatic data collecting and driving efforts to the analysis and validation process.

Wells Test Control and Analysis: This module's objective is to control all wells' testing information and will automatically gather wells data and consider all Fazenda Alegre's scenarios to make sure that this information is being treated correctly.

All modules described above will be available at the GeDIg-FAL portal. This portal will help improve the asset's communication and speed up the information access through the following functionalities, in addition to the modules themselves: discussion forums, documents library, project history and details, links to other Petrobras systems, and behind all of this, the guarantee that the correct people are having access to all necessary information. To do this, a cross check has been done between the roles established in the TO-BE processes and the modules and portal's information.

An important lesson learned during the requirements specification is that some key people from Operations, Reservoir and IT teams should be dedicated to the project, avoiding delays due to the lack of availability of key personnel.

Technical Architecture

The technical architecture of the solution is divided in 3 different layers: presentation, integration and data (Figure 5).

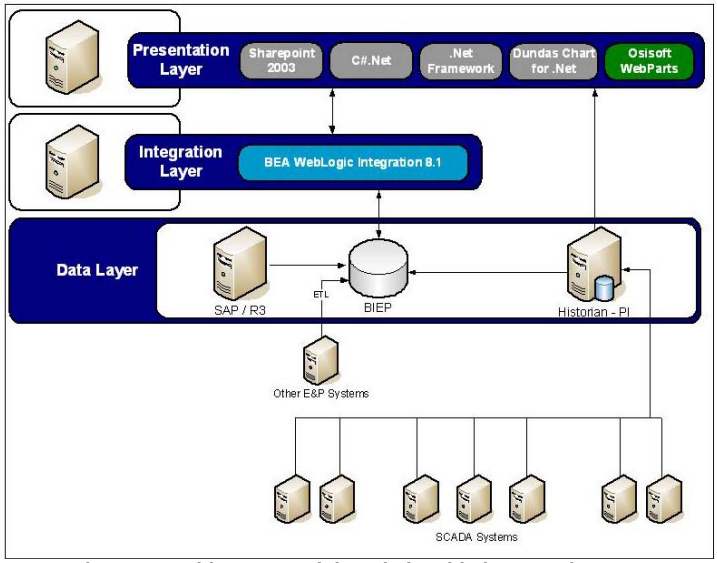

Figure 5: Architecture and the relationship between layers

Presentation Layer: This layer provides user interface management, including user interactions handling and resulting responses generation, presenting data and managing navigation flow.

Integration Layer: This layer provides a standard architecture that allows business integration through multiple applications. It is used as a centralized repository for application development and control, making information available through organization. All access to E&P Corporate Database (BIEP), SAP and other systems are made through this layer.

Data Layer: Layer where all data is stored to be accessed modified and saved, according to solution's events. The main data source of the solution is the E&P Corporate Database (BIEP).

The Figure 5 shows the entire architecture and the relationship between layers:

Processes Design and Revision

At the center of an effective Intelligent Energy implementation is clarity around the business processes to which the technology is being applied. GeDIg-FAL works across several major processes that include asset management, production monitoring, drilling operations, among others.

#	***Products/Activities***
20	Managerial Meetings
Aprox. 70	Operational Meetings
20	Mapped Process
20	Reviewed Process
Aprox. 55	Process Interfaces
Over 70	Identified Gaps
48	Solved Gaps

Table 1: Processes design statistics

At Diagnosis and Pre-Implantation Phase all areas related to the production process were identified as well as its macro-process that is considered critical to FAL production and was impacted by the implementation of the Intelligent Energy program.

Still in this phase, the macro-process referred to each area identified was detailed and designed. Such designs were used in next phase (Implantation), as inputs for process reviews, aiming at structured process and technological improvement.

To-Be processes were designed / reviewed at implementation phase and improvements such as related to gaps identified in previous phase, existing interfaces, real time information and new technologies were incorporated to all related processes.

The processes design and revision allowed an optimization on GeDIg-FAL way of working through better understanding of roles, responsibilities and performance.

Some of most important improvement in almost all revised processes consists in the use of CPA (Action Plans Control) system, a Petrobras system that already exists, which allows the areas to register and follow up the status of identified issues/or improvements. The use of collaborative environments is also highly recommended for the conduction of periodic meetings, such as, production losses analysis, rigs prioritization, HSE, Projects, among others. The new technologies brought by GeDIg-FAL are also considered in these processes reviews, aiming to speed up operational, managerial and strategic decisions.

On the table 1 there are some statistics of GeDIg-FAL processes design:

Collaborative Environments Implementation

Collaborative environments' implantation in FAL was the part of the work plan that expected to make the whole integration proposed by GeDIg Project become true. In this integrated scenario, people, technology and processes are related, leading to an environment of multidisciplinary collaboration with ability to quickly respond to requirements from interactions and meetings, which optimizes FAL field's results.

Collaborative rooms encourage cooperation, integration of teams in real time, more intense flow of information and knowledge within the Asset, leading to a new organizational culture (Figure 6). This new culture stimulates more optimized and structured issues analysis, evaluation of scenarios and definition of action plans, supporting the decision making process.

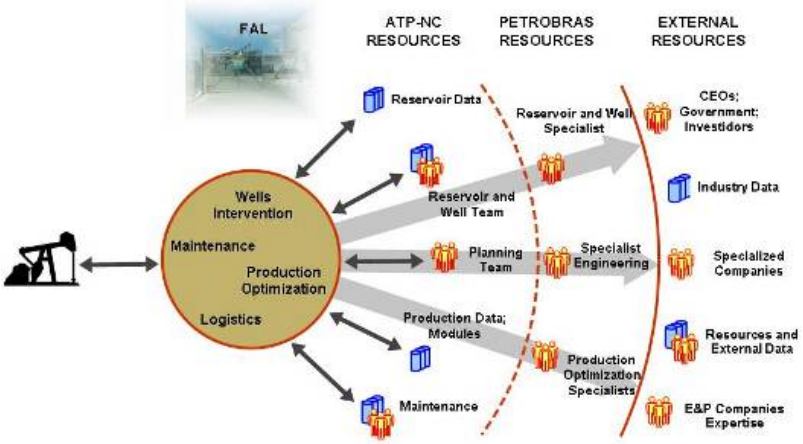

Figure 6: Expandable knowledge

Overcoming distance between three different locations was the main issue to be solved. The main objectives identified by the areas for the collaborative environment were:

- Provide information about wells and production of the FAL field, in real time;
- Provide resources and create a cooperative environment among different teams, addressing issues more quickly and making the decision-making process easier;
- Bring the right information to the right people at the right time;
- Reduce travel risks and time that consequently, also reduces costs and efforts of traveling and increases the quality of life of the team;
- Increase collaboration between teams, leveraging knowledge.

To define the layout and technical requirements, it was important to consider the interaction between the areas involved in FAL's operation. The level of interaction of these areas with each other was essential to specify functional necessities of each environment.

The 3 environments contain meeting tables designed specifically to integrate teams located in Vitoria, FAL site and São Mateus via videoconference and the possibility of seeing presentations displayed on the screens.

The proposed conceptual design for Vitoria provided a room with a collaborative area, including work stations, where Reservoir representatives will work full time (Figures 7 and 8).

Technical Support and other asset's areas may have the necessity to use the room to discuss any issue related to FAL production and operation. For this reason, an ante-room area was created, which works like a hall of visitation to show FAL production direct from the field and blocks external interference during presentations or meetings. The ante-room also was foreseen as a rest for long meetings.

Figure 7: Vitoria's layout.

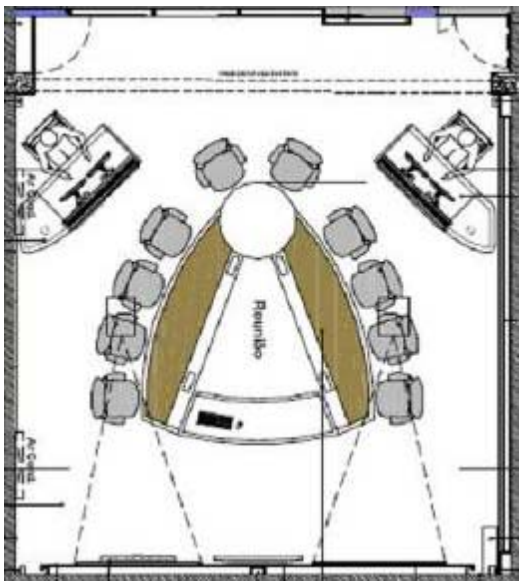

Figure 8: Vitoria Collaborative Room.

The Architectural Project for FAL station reflected the creation of a large room, with workstations for Operation, Maintenance and Inspection technicians or engineers and a table of meetings, videoconference and work, which must be separated from each other by glass doors, allowing the integration or isolation of the two areas, as necessary. The layout of the floor enables the vision of working areas and screens by the manager, promoting a general integration. The workstations were designed to be disposed in a way that allows full interaction between the team members and a continuous view for the collaborative environment.

Figure 9: FAL's layout

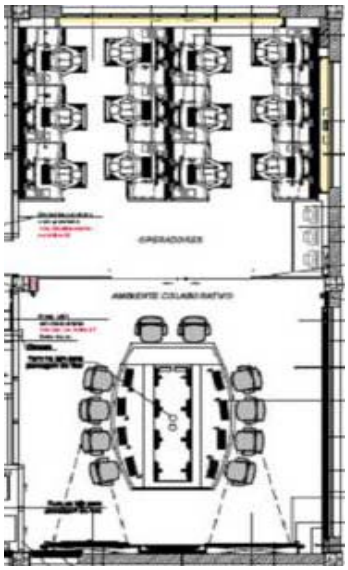

Figure 10: FAL Collaborative Room

São Mateus environment was designed to work as a standard videoconference room. The teams located there (Wells Intervention, Plan and Control, HSE, Maintenance and Inspection) became able to meet to others rooms when desired (Figures 9 and 10). Several sets of equipment had to be implemented and technological resources had to be improved, in order for the collaborative philosophy to become functional. Computer connection devices were installed on the rooms' meeting tables. High definition LCD monitors were displayed on the wall of the screen projection with intelligent interactive boards. The equipment solution for the rooms also included video controller, videoconference, DVD recorder, audio system and wireless control.

The rooms were totally automated by a system that contains presets for the different scenarios of use. Basically, it is customized to control settings, such as lighting, curtains, video and audio system, for example. A custom program to control these settings was developed based on the requirement of teams that would use it.

The layouts, equipment and technological needs were detailed at the same time as the new processes were being designed. This interaction allowed the identification of how the environments would work at the same time that their requirements were refined, i.e., the rooms were designed exactly for the purpose of their utilization.

With a larger integration between professionals involved in the production processes of the field, collaboration between sites was improved. Moreover, this new way of work will enable a decrease in the employees' learning curves, regarding production processes, leading to quicker and more efficient identification and resolution of problems.

Specific daily routines were also developed to optimize the use of collaborative environments such as: Production and wells data continuous monitoring, production and steam data from cycled wells, rigs intervention schedule monitoring, production data validation and maintenance schedule monitoring.

Change Management

Bringing employees of different areas and with diverse responsibilities closer is an important step required by the project. With the incorporation of new tools such as the collaborative work environments and new processes, it is expected that people work in a more integrated manner, therefore increasing agility and efficiency in executing processes which depend on the mobilization of employees from different sectors.

The Change Management strategy adopted in the GeDIg-FAL involves the development and execution of a Communication & Commitment Plan and a Training Program to support the implementation of all changes. Furthermore, the Change Management process is supported by sponsors, as known as Change Agents, who were identified in the first phase of the project together with every area's managers, the project's stakeholders. The Change Agents' main responsibility is to engage everyone impacted through all the project's phases, in view of the fact that they know their work environment and emerging difficulties in implementing changes regarding the employees, and since they can help the Change Management team to establish a trusted relationship with everyone involved or impacted by the systems and new process implemented (Figure 11).

Besides that, an assessment of the willingness for change and an evaluation of the effectiveness of the communication were done through surveys along the project's first phases. The surveys' results were used to develop Action Plans that worked as a great tool in the guidance of the Communication & Commitment Plan and in the way that the Change Management Strategy was being conducted. Also, an Impact Analysis was developed representing an important instrument in the assessment of the changes' outcomes, in each of the nine areas involved directly with the GeDIg-FAL, according to the future process and new technologies. Once this Impact Analysis was completed, the Change Management team was able to mobilize the Network of Change (1), together with the sponsors and Change Agents, in order to support the resulting modifications and impacts of the project, then spreading the knowledge achieved through the Training Program.

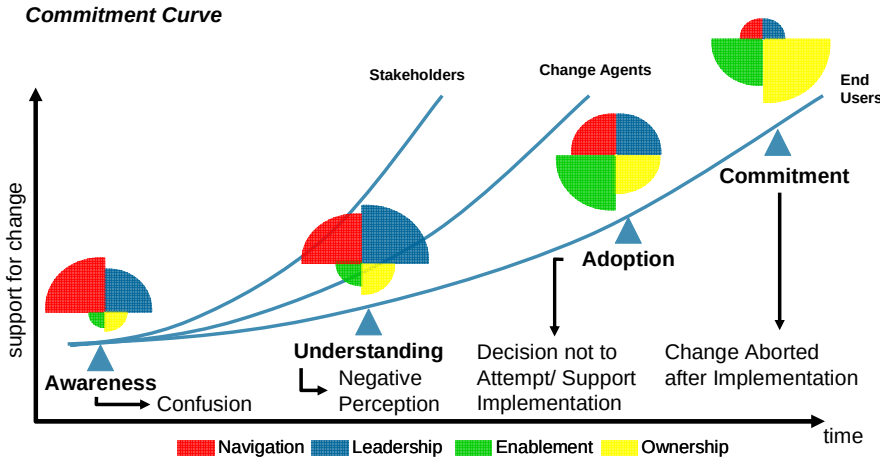

Figure 11: Commitment curve

The Training Program aims to provide as much information, concerning the project, as possible, providing learning methods and orientations for using new technologies to assure that the workforce impacted will use the systems implemented and will correctly absorb the changes. This should give the workforce the opportunity to quickly access, criticize, analyze and use the information related to the GeDIg-FAL. Even though this is a Change Management team's responsibility, the training

[1] The Network of Change is represented by everyone that is involved in the change process, stakeholders, sponsors, change agents and participants.

process has a noteworthy participation of other GeDIg-FAL team members, as they are the content source for the development of the training material and as they perform the instructor role in the first round of the classes. Moreover, each client's area has elected a person to be the GeDIg-FAL content reference; this task involves the conduction of the second round of training and has the duty to be the key person concerning the GeDIg-FAL project in their sector/area. In conclusion, these actions were important to prepare main actors and clients to perform the GeDIg-FAL activities, involving the new way of work and the use of new technologies by their own, without direct dependence of the project's team.

Project Management

The GeDIg-FAL Project Management aims to ensure that products are delivered with quality within the scope, time and budget agreed. For this goal achievement, there is a routine of activities progress control, which helps to avoid or minimize the delays or eventual problems that may arise during the project. This is done by controlling the schedule and also following a methodoly of risks, issues, scope change, quality and documents management.

At the beginning of the project, a Governance Plan was presented to Petrobras, which details how the project will be structured and conducted, including the communication process among the various teams involved, the functions and responsibilities of each team, the control tools that will be used during all its development and the documents approval procedure.

In order to minimize the eventual problems that may arise during the project and may affect the good progress of the activities it is very important that there is a regular communication between project managers / coordinators from Accenture and Petrobras, so that all parts can be aligned about the current situation and the future expectations. In the GeDIg-FAL this communication is basically done through the weekly status meetings, where activities progress, risks and issues from each team are presented, through the Status Report, Schedule and Control Tools.

The schedule is used in order to monitor the activities to be executed during the project development, and it is used as a base to provide the project S Curve and allow the many teams involved to control the real progress of the activities.

The Risk Control Tool and Issue Control Tool are used in order to register, analyze and monitor the risk mitigations or issues identified by the project team, which may impact the progress of the project activities. These risks or issues identified are sent by the Petrobras' project coordinator to the person best suited. This control is very important, because if the risks are not eliminated at the appropriate time, they could delay the project schedule.

At the end of each phase of Project Implementation is elaborated the Migration Plan. The purpose is to provide the necessary information about the deliverables developed in each phase of implementation. It provides information about which deliverables were implemented, when they will be available, where to find them, how to access and use them in order to make it clear to the client what has been done through the end of each phase of implementation and how these deliverables will be available in the next stage.

The GeDIg-FAL Project Management is also responsible for making the Project Financial Control, the control of the deliverables which have been and still should be delivered and the estabilish the approval procedure.

Main Results

Results Accomplished

As of December of 2007 all processes were reviewed, collaborative environments implemented, three modules were partially implemented and the Petrobras workforce was trained in all topics mentioned above. Despite the fact that GeDIg-FAL is not yet fully implemented some important impacts could already be identified. The new routines are already being applied after processes training, like maintenance and projects planning, daily production meetings, demands prioritization, action plans control among several others benefits brought on by the new processes.

The collaborative environments are in use, in order to allow the daily routines between several different managerial areas to be executed despite being physically distant. Now reservoir, operations, well intervention and the others teams can be connected by one click.

From the 3 modules already implemented, FAL now, every three minutes, has it's produced oil volume, production losses tools and KPIs'dashboard, through the availability of all this information, the FAL areas are able to verify issues in shorter cycles which is resulting in faster actions and consequently fewer impacts on oil production and FAL costs.

Expected Benefits

The GeDIg-FAL implementation quantitative benefits were grouped in three categories, called value drivers:

Increased Production: The production increase is divided in two sub-value drivers:

- **Downtime Reduction** The production losses reduction is achieved through the increased system availability and reliability. The historical data is needed to foresee and reduce potential losses, improve equipment maintenance planning and control and greater agility to consider action plans.

- **Production Optimizaton:** For system optimization a great knowledge concerning the best operation set (as for example, operational pump rotation) is needed, as well as operational restrictions that impact in the production,

among others. The production optimization improvement increases the potential production curve.

Operational Cost Reduction: The operational cost reduction can be achieved through the reduction of several components that compose the total operational cost. The factors that have more reduction potential are Maintenance and Well Intervention Costs.

Reserves Increase: The increased reserves can be attained by two factors: Economical limit extension and Reservoir recuperation factor increment.

The oil field economical limits extension is a result of operational cost reduction. A production plan has many fixed and variable costs to make its operation possible. Considering production decline, the incomes will probably not pay the operational costs, resulting in field abandonment. Reducing fixed costs will extend the economical vibilization cutline.

The reservoir recuperation factor increment is a long term benefit, therefore its effect is alleviation on production decline curve. This reduction is a result of better reservoir knowledge that, among others things, can be a consequence of a better simulation model combined with a routine of continual model update accordingly to operational data, such as production and well data.

This will allow reservoir manager to develop more precise reservoir scenarios resulting in better recommendations regarding oil recovery strategy.

Lessons Learned

GeDIg is not only a technology project: For the GeDIg deployment to be a success the project team focused on improving the work-processes and decision-making. A common risk is that the concept can used to promote particular pet technologies as opposed to the integration of technology pieces. By concentrating on workflows, the focus will be on Asset decision-making and how decisions can be improved. Shortly, the GeDIg is not a technology project, but a substantial element of technology needed to achieve operational transformation.

Appropriated infrastructure: It is extremely important to start with appropriate instrumentation, data collection, surface control and data acquisition systems, as well as data conditioning to achieve early benefits from effective visualization and simple analysis.

Resistance to change: A key factor on engaging Norte-Capixaba asset was to understand the existing resistance to change. Part of the purpose of GeDIg project was to explain to the engineers how they can benefit from the change. These change-management issues are often overlooked when deploying new technology. Managing the work-processes and the change aspects of GeDIg implementation was critical success factor.

Field operations teams: Field operations teams are the key enablers and therefore, they should be engaged in all GeDIg process, from opportunities framing to the evaluation of outcomes.

Acknowledgments

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References

G. V. Moises, T. A. Rolim, and J. M. Formigli. *"GeDIg: Petrobras Corporate Program for Digital Integrated Field Management"* paper SPE 112153 presented at the 2008 SPE Intelligent Energy Conference and Exhibition held in Amsterdam, The Netherlands, 25–27 February 2008.

T. Edwards, M. Saunders, and K. Moore-Cernoch. "*Advanced Collaborative Environments in BP*" paper SPE 100113 presented at the 2006 SPE Intelligent Energy Conference and Exhibition held in Amsterdam, The Netherlands, 11–13 April 2006.

P. Millete. "*New Work Processes and Operations Form: Efficient Data Utilisation and Online*" paper SPE 100275 presented at the 2006 SPE Intelligent Energy Conference and Exhibition held in Amsterdam, The Netherlands, 11–13 April 2006.

S. Alkhadhuri, D. Narasayamy, and Sheik-Mohamed Sheik Said. "*Integration of People, Process and Technology for Right-Time Production Management and Optimization in Brunei Shell Petroleum*" paper SPE 99243 presented at the 2006 SPE Intelligent Energy Conference and Exhibition held in Amsterdam, The Netherlands, 11–13 April 2006.

T. Unneland, and M. Hauser. "*Real-Time Asset Management: From Vision to Engagement – An Operator's Experience*" paper SPE 96390 presented at the 2005 SPE Intelligent Energy Conference and Exhibition held in Dallas, Texas, USA, 9-12 October 2005.

H. P. Bieker, O. Slupphaug, and T. A. Johansen. *"Real-Time Production Optimization of Offshore Oil and Gas Production Systems: A Technology Survey"* paper SPE 99446 presented at the 2006 SPE Intelligent Energy Conference and Exhibition held in Amsterdam, The Netherlands, 11–13 April 2006.

J. E. Nordtvedt, and T. Unneland. "Implementing Real-Time Asset Management: A Practical Perspective" paper SPE 99468 presented at the 2006 SPE Intelligent Energy Conference and Exhibition held in Amsterdam, The Netherlands, 11–13 April 2006.

R. Murray, C. Edwards, K. Gibbons, S. Jakeman, G. de Jonge, S. Kimminau, L. Ormerod, C. Roy, and G. Vanchon. "*Making Our Mature Fields Smarter – An Industrywide Position Paper From the 2005 Forum*" paper SPE 100024 presented at the 2006 SPE Intelligent Energy Conference and Exhibition held in Amsterdam, The Netherlands, 11–13 April 2006.