**IESE**
**International Graduate School of Management**
**University of Navarra**
**Barcelona-Madrid**

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# IZAR

An atmosphere of celebration still lingered in the shipyard's offices and facilities. And for good reason, as it was only two days since Izar-Fene had launched (see **Exhibit 1**) its first unit since the yard had joined the group. The ceremony had been attended, among others, by senior executives of the client oil company (Total Fina Elf) and the Fene-based shipyard. October 7th 2002 would go down in the yard's history as a landmark. But in the office of Santiago García, Izar-Fene's managing director, the toasts were over and the project of the recently launched vessel was still on the table.

> "It's been a major achievement, getting the FPSO launched on deadline, but we all know that the project doesn't end here. We must carry on working as hard as we have been up until now," Santiago reminded everyone at the meeting.
>
> "We know what comes next," said Jorge López, the project director, "because we've always had trouble with the outfitting and the ship's trials."
>
> "I'm afraid you're right there, Jorge," said Luis Santamarina, Izar-Fene's planning director. "The critical chain worked very well for us in the hull structure, but I'm not so sure it'll be such a success in the outfitting and the trials. The scheduling of all the different jobs is so much more complex."

While the discussion moved back and forth, Manuel Castro and Manuel Rodríguez, two consultants from the consulting firm CMG who were working on the project, got ready to explain what they saw as the next jobs to be tackled.

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Àlex Grasas, Research Assistant, prepared this case under the supervision of Professor Jaume Ribera as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation. February 2003.


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## Background: IZAR, heir to a long tradition

Izar was formed in 2001 as a result of the merger of Astilleros Españoles, S.A. and Empresa Nacional Bazán. It thus became the point of convergence of two long traditions: civil and military shipbuilding. The docks and slipways that today were launching some of the industry's most advanced vessels were the same docks and slipways that had witnessed the steam revolution and the building of the world's first electrically propelled submarine, among other historic achievements.

The origins of Bazán went back to 1730, when the military arsenals at Ferrol, Cartagena and San Fernando were built. The naval yards attached to these arsenals were established to build and repair the ships of the Spanish navy. At the end of the Civil War, the military arsenals were taken into public hands, and in 1947 Bazán was created.

The history of the shipyards belonging to the Astilleros Españoles group began in the late 19th century, with the founding of Empresa Gaditana del Trocadero and Astilleros del Nervión. Astilleros Españoles, as such, was founded in 1969 following the merger of three large shipyards: Astilleros de Cádiz, Euskalduna and Sociedad Española de Construcción Naval. It was not fully nationalized, however, until 1979.

The merger of Astilleros Españoles, S.A. and Empresa Nacional Bazán was forced upon them by the need to overcome the problems facing the shipbuilding industry at that time. These were problems that had been building up for the previous three decades and that had grown more acute as a result of the aggressive and unfair competition from Korean shipyards, which were able to sell below cost thanks to financial subsidies from their government, and the reduction of military budgets in most countries.

Spain's share of world shipbuilding had shrunk from 5% in the 1970s to 1.8% in the 1990s. This had led, since 1984, to the implementation of restructuring plans in Spanish shipyards, which had downsized their workforces and shed production capacity. In the shipyards surrounding the town of Ferrol in Galicia, in particular, around 13,000 jobs had been lost over the previous 25 years.

## Profile of IZAR

IZAR was the leader in Spain in the civil and military shipbuilding industry. In size and turnover it held second place in Europe and ninth in the world, among shipbuilding companies.

Its manufacturing activity was organized in four business lines (see **Exhibit 2**):

– Shipbuilding
– Propulsion and energy
– Repair and conversions
– Systems and weapons

IZAR was a dual technology company, selling products and services to both the military and the civil shipbuilding markets. The close integration of the company's business units, which retained a large degree of autonomy, was reflected in the organizational structure (see **Exhibit 3**). The synergies obtained by integrating its business units allowed the company not only to cut costs and shorten delivery lead times but also to carry out innovative projects by pooling its engineering and production capabilities.

The main objective of the entrepreneurial model of management that IZAR had adopted ever since it was created was to secure a highly competitive position for itself in the international market. What was more, IZAR aspired to hold on to that position, which also was the result of the synergy within the company and the complementary nature of its activities that enabled it to compete in diverse markets.

## Fene shipyard

Fene shipyard, formerly Astano shipyard, was considered one of the best in the world when it came to constructing vessels for extracting and storing crude oil. Based in the town of Fene (see **Exhibit 4**), with a population of some 15,000, in the province of La Coruña (Galicia), it started operating in December 1942 with the delivery of the fishing vessel "Comandante Lobo". Since then almost 300 ships had been launched from its ways, contributing to the economic and social development of the town and making it one of the most densely populated in the Ferrol area.

The yard, which currently employed more than 1,100 people, was part of Izar's Ships of Oceanic Performance division. It had started operating in the offshore sector in 1987 with the construction of a semi-submersible drilling platform. Since then it had completed various floating production and drilling platforms and was a pioneer in the construction of FPSO (Floating, Production, Storage and Offloading) units, with the capability to integrate their processing modules in the slipway itself, and in the design and construction of deep-sea drilling units. It had become a provider of leading-edge technology, using highly skilled labour.

Because Izar-Fene worked on a project basis, it had adopted a matrix structure. Hierarchically it was divided into three large departments –Engineering, Production and Procurement– and functionally into project teams (see **Exhibit 5** for a project organization chart). This structure had worked well for them so far and of all the group's business units they were the one that had implemented it most successfully.

## The order

In mid-2001 Izar-Fene signed an agreement with the Belgian shipowner Exmar Offshore for the construction of an FPSO to exploit an oil field in Mediterranean waters off the coast of Libya. The unit would be operated by Compañía de Petróleos Total de Libia (CPTL).

The original plan was for a tanker conversion, but as the field life was 15 years, the alternative of building an FPSO was chosen. The advantages of this type of unit were, on the one hand, that it was mobile and so could be used to exploit several different oil fields during its service life; and on the other, that it made it feasible to operate marginal fields where it would have been uneconomic to install expensive fixed structures such as platforms and pipelines.

Izar-Fene was responsible for the concept design of the unit, and the basic and detail engineering development of the hull and systems, and of the interfaces with the process modules and the turret (mooring and fluid transfer system). It was also responsible for the subsequent assembly of the whole unit. The finished unit would have a storage capacity of 900,000 barrels and a processing capacity of 35,000 barrels/day, making it the largest unit of its kind that Izar-Fene had ever designed and built (see **Exhibit 6**). Building the FPSO would take 1.2 million hours of work, which would guarantee full employment for Izar-Fene's workforce until 2003, as well as for hundreds of employees of auxiliary firms in the industry.

It had not been easy for Izar-Fene to win the contract, given the critical situation of overcapacity and negative returns afflicting the shipbuilding industry worldwide. Western shipbuilders were under great pressure from their Korean rivals, who dominated the steel-intensive sectors (70% of the market). The Korean were also steadily gaining market share in the higher value added segments, which traditionally had been the preserve of the European shipbuilders. The Korean shipyards had a policy of maintaining full employment, which meant they were prepared to cut their prices to win as many contracts as they needed, even if the final price was well below their production costs. As a result of this aggressive Korean competition, the market prices of most types of vessels had fallen by almost 20%, and in some cases by even more.

It was against this background that Izar-Fene had put in its bid of 114 million euros, with a delivery lead time of 18.5 months from the time the contract was awarded. This was considerably shorter than the current market average for an FPSO.

## The project management seminar

After the contract had been awarded, Santiago continued to wonder about the delivery times for the Exmar NC-279 FPSO. Were they cutting it too fine? Would they be able to deliver the FPSO in March 2003 as stipulated in the contract? One thing was certain: the project would have to be carefully planned and monitored to meet milestone completion dates. Their chances of winning further contracts in the future depended on it.

Keen to get it right first time and make a success of the project, Izar's management decided to attend a project management seminar that was held around that time at IESE Business School. They thought it would be an opportunity to refresh their knowledge of tried and tested techniques while at the same time learning about the latest theories in project management. They hoped to get a clearer grasp of the main theories, practices and trends in the field.

It turned out to be a valuable experience. They came away from the seminar full of enthusiasm and eager to put some of their ideas to work in the new project. First, though, they wanted to share what they had learned with the rest of Izar's staff in Madrid. Therefore, they asked IESE if they could give the seminar again for a total of 40 project managers, heads of department and shop managers.

Santiago and Luis both agreed that one of the most surprising new concepts they had discovered at IESE was the critical chain method of project management, an application of the Theory of Constraints (TOC) to project management (for a brief introduction to the Theory of Constraints and the critical chain method, see **Exhibit 7**). Because it was just a short seminar, however, they had covered only the basic concepts. It seemed promising, but they had not discussed the possible challenges that might arise in its implementation. Could TOC be of any help in the Exmar NC-279 project? Would it help them reduce delivery times? What steps should they take to implement TOC in their organization?

Accordingly, they decided to seek external help in finding out more about the subject of the critical chain, which had been introduced to them in the IESE seminar. Santiago remembered a conversation he had had during a meal at the seminar, when Luis Angel Sanpedro, an executive from Izar-Madrid, had told him about a friend of his who worked for a consulting firm that specialized in critical chain issues. CMG, it was called. He thought it would be worth getting in touch with them to discuss the possibility of working together on some of the projects they were engaged in.

**CMG (Constraints Management Group)**

Manuel Castro and Manuel Rodríguez were both industrial engineers and both had an MBA in Logistics from the Centro Español de Logística. Both had spent five years at the Avraham Y. Goldratt Institute, where they had learned the Theory of Contraints and its application to organizations. They had implemented it in various companies in the United States, Portugal and Spain. In 1998, with two other partners, they had founded the TOC Results management consultancy, offering a wide range of services and solutions to organizations in the areas of project management, production and distribution.

In March 2001, TOC Results became part of the Constraints Management Group (CMG), of which until then it had been an associate. By the end of 2002 it had eight consultants in Spain, based in Noya (La Coruña), Madrid and Barcelona. CMG, headquartered in Seattle, USA, was a world leader in the implementation of TOC-based continuous improvement processes. They offered solutions in operations, distribution, project management/ engineering, marketing and sales, and finance. They were specialists in the application of Thoughtware®, which they defined as "the process to rethink the way in which we approach, organize and apply our organizations and their supporting systems and assets". Thoughtware® and the Theory of Constraints "allow companies to effectively maximize their ROI equation by creating holistic solutions that maximize a system's performance by identifying, exploiting and synchronizing around critical leverage points".

After talking to Santiago, Manuel Castro and Manuel Rodríguez thought this would be an excellent opportunity to apply critical chain concepts to such a large-scale project. It would also be a new experience for them to work with a public sector company the size of Izar.

**Project start-up**

Izar's managers understood that the Theory of Constraints and the critical chain method made a lot of sense in project management. There were practical examples to prove it. But they were not so sure it would work in shipbuilding. They also wondered whether their client would accept it. Therefore, they decided to treat the Exmar as a pilot project for the application of the critical chain method. They also decided to use the critical chain method in parallel with the traditional method of project planning. That way they would be able to compare the results of the two methods and comply with the client's demand for project progress information using the classic system. The particular implementation of the critical chain that they planned to use was focused on planning and progress monitoring; it did not cover other aspects of the project stipulated by the client in the contract.

Once an agreement had been reached between Izar and CMG, Manuel Castro and Manuel Rodríguez set to work with Izar-Fene's managers to implement the critical chain approach in the Exmar project. They started out, at the end of 2001, with some training sessions to familiarize Izar personnel with the new methods. The critical chain was more than just a new way of planning projects. It called for a change of mentality throughout the organization, and that was a big challenge in such a short time in a company with as long a history and as much accumulated experience as Izar. Contrary to previous practice, the people whose job it was to estimate the durations of project activities now had to give the planners two separate times for each activity: the "mean" time for the activity, which was much less than they would normally have estimated; and the "safe" time, which incorporated the uncertainty in the form of buffers. The managers were very reluctant to lose any of their time margin and so, to avoid arguments, decided to include all the uncertainty in the buffers, with the result that the times remained the same as when the traditional method was used. In this approach, using buffer management, the aim was to finish tasks as early as possible in order to move on to other tasks immediately. This meant that, rather than focusing on the amount of work done up until a given point in time, the emphasis was on the amount of work left to be completed.

A team consisting of Luis Santamarina, Jorge López, Manuel Castro and Manuel Rodríguez held a number of working sessions in January and February 2002 to model the tasks, taking into account the resources that Izar had at its disposal. This was a crucial step in the critical chain method and took a lot of time. Once it was done, though, it could be used for the whole of the project, without the need for any major changes. Later, this plan would be cross-checked with the managers of each different area so that they too could have their say and become more involved in the project. For Luis this was one of the good things about the critical chain method.

## Implementation

The FPSO construction project could be divided into two large parts – pre-launching and post-launching:

- *Hull structure and pre-outfitting:* this stage involved manufacturing the ship's hull and assembling the sections in the yard's shipway prior to the launching.

- *Electrical installations, outfitting and trials:* installation of all the equipment, pipework, metal assemblies, fire prevention system, electrical systems, etc. that were to be fitted to the ship, and the necessary trials.

In the pre-launching phase, as was usual in the shipyard, an integrated construction system would be used, whereby part of the outfitting was done before erection on berth. This method had already helped them to meet contractual milestones to date. By the time of the launching approximately 90% of the outfitting was already completed.

### *Hull structure and pre-outfitting*

The first part of the project had been completed successfully and on schedule. For the people at Izar this was the least complicated part, as the fabrication process followed the flow of the steel from the moment it was received to final assembly in the slipway. The planning was therefore well rehearsed. The ship was divided into around 60 sections, and each section into around 200 blocks. The stages each block went through were as follows:

- Block engineering: the hull structure and the outfitting were designed.
- Cutting and forming: the steel was cut to the required shape.
- Sub-assembly blocks: small parts were made and welded.
- Fabrication blocks: the block was built.
- Pre-erection sections: the different blocks that made up a section were joined together.
- Blast and painting: the section was painted.
- Slipway erection: the section was transported to the slipway, where it was assembled with the other sections.

Each block was represented as a box in the ship's diagram, and as different tasks were completed boxes were coloured in (see **Exhibit 8**). The network diagram at section (see **Exhibit 9**) or block level provided an overview of the project, the block being the natural unit for reporting project progress (see **Exhibit 10**).

Yet at the level of individual blocks, the network became unmanageable, as it included some 2,000 tasks, making it impossible to detect the impact of local deviations on the project as a whole because the effect was so diluted. The solution proposed by CMG was to divide the ship into 6 parts, as if it consisted of 6 smaller projects. This meant they would be managing a multi-project environment. This had a number of advantages:

- It made it easier to detect the impact of deviations on the project as a whole
- It made it easier to identify the key tasks for project progress (critical chain).
- It made it possible to establish strategic control points (buffers).
- It made it easier to see the impact that delays in the hull structure and pre-outfitting would have on the outfitting and trials.

## Monitoring

Given a detailed production plan, the other important aspect of the critical chain was project monitoring. Great emphasis was placed on the reports that the various managers were expected to submit in order to monitor project progress. Unlike in the traditional method, each manager with responsibility for the utilization of resources, such as the heads of engineering, production, procurement, painting, etc., was required to regularly update his estimates of the time remaining to complete each of the tasks being carried out under his responsibility. This information was entered in a set of spreadsheets (see **Exhibit 11**) and was sent to CMG at weekly intervals. CMG would then enter these data into its "Concerto" program (see **Exhibit 12**) and calculate the progress made along the critical chain and the percentage buffer penetration.

A specific report was then sent to each resource manager, director or project manager, setting out the current state of the project in the form of a graph and showing, for the part of the project for which the manager was responsible, the percentage of the critical chain that had been completed and the percentage of the buffer that had been consumed to date (see **Exhibit 13**). This meant that each person could see very graphically whether the project was progressing as planned or not. The report also included a list of tasks outstanding in order of priority (see **Exhibit 14**), so that each manager could concentrate first and foremost on what was most important and avoid trying to do everything at once.

## Project delivery

The first part of the project, the launching, had been completed according to the critical chain plan on October 7, 2002, despite a 15-day strike that nobody had anticipated. This completion date was different from the date obtained using the traditional scheduling method (August 2002); the fact was that having the two systems running in parallel helped to pinpoint certain shortcomings in the schedule. The tasks that remained to be completed in order to be able to deliver the ship to the customer were the outfitting and the trials. The scheduled delivery date was January 2003, two months earlier than stipulated in the contract. By December, however, it was apparent that the ship would not be ready until February. There was still no danger of missing the March deadline, but the scheduling of the final stage was not clear. This had been the subject of some discussion during the last meeting in November:

> "It's not like with the hull, Manuel. In the hull structure we know that we can't take a block to the slipway without first painting it, and we can't paint it without first assembling it. The trials and the outfitting that we're talking about now can be done at the same time, and the problem is that we don't know where to start," said Luis.
>
> "I take your point, Luis, but isn't that precisely what the critical chain is for? It tells us what job we need to tackle first: the one that's using up our buffer fastest," replied Manuel.
>
> "Yes, but the activity times for the trials are much more difficult to estimate, as they depend on whether the trials are successful or not. Anyway, that's what the buffers are for, isn't it?"
>
> "Exactly, Luis, the buffers are there to be used if they're needed. It's not like traditional planning, where you put them right at the end just in case."

## The future

For Izar-Fene the experience of using the critical chain method was proving very valuable. It was thought that it could perhaps be applied throughout the group. It could certainly be used in Izar-Fene: the Exmar NC-279 had been the pilot, but already they were starting work on another project, this time using the critical chain right from day one. The new project was another offshore platform that would act as support for a LNG liquefaction plant for the Norwegian company Statoil, operating in the Barents Sea. The contract would entail more than 250,000 hours of work for the Fene shipyard. The yard was also bidding for the contract to build the liquefaction platform, but the final award would not be made public until the first quarter of 2003.

Izar-Fene's management was slightly apprehensive of using only the critical chain method for this new project, completely discarding traditional planning. It was difficult to let go of something they had been working with for so many years, and it was a big step for the shipyard to take. It would also be a big step in a new direction for the rest of the company, as a presentation was due to be given to the executive committee in March 2003 in Madrid to explain how the critical chain had been used in the Exmar project, pointing out the advantages, drawbacks and difficulties to be expected in introducing this new method throughout the company. □

Exhibit 1

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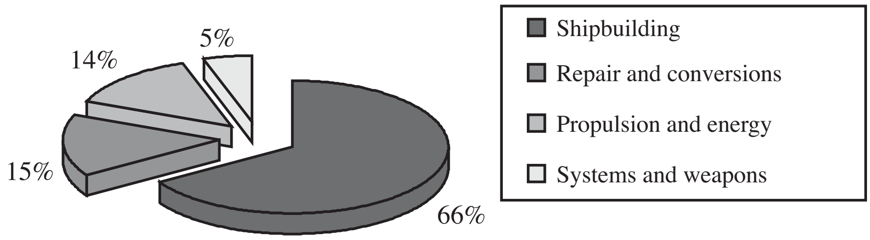
**Launching of the Exmar NC-279**
(October 7, 2002)


Exhibit 2

IZAR

**Izar's lines of business**

Izar's activities were organized in four main lines of business:

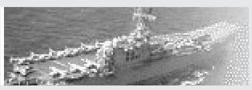
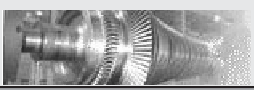



**Turnover in 2001**

Source: *www.izar.es*

Exhibit 3

**Organization chart**

| Lines of Business | Divisions | Business units |
|---|---|---|
| **Shipbuilding** | | **Innovation** |
|  | **Ships of Oceanic Performance** | Cartagena shipyard<br>Fene shipyard<br>Sestao shipyard |
|  | **Ships of intervention** | Ferrol shipyard<br>Gijón shipyard |
|  | **Fast ships** | Puerto Real shipyard<br>San Fernando shipyard<br>Sevilla shipyard |
| **Repair and conversions**<br> | **Shiprepairs** | Carenas Cádiz<br>Carenas Cartagena<br>Carenas Ferrol/Fene<br>Carenas San Fernando |
| **Propulsion and energy**<br> | **Propulsion and energy** | Manises Factory<br>Engine Factory<br>Turbine Factory |
| **Systems and weapons**<br> | **Systems** | FABA systems |

Source: *www.izar.es*

Exhibit 4

IZAR

**Geographical location of the town of Fene**


Source: *www.izar.es*

Exhibit 5

**Izar-Fene project organization chart**

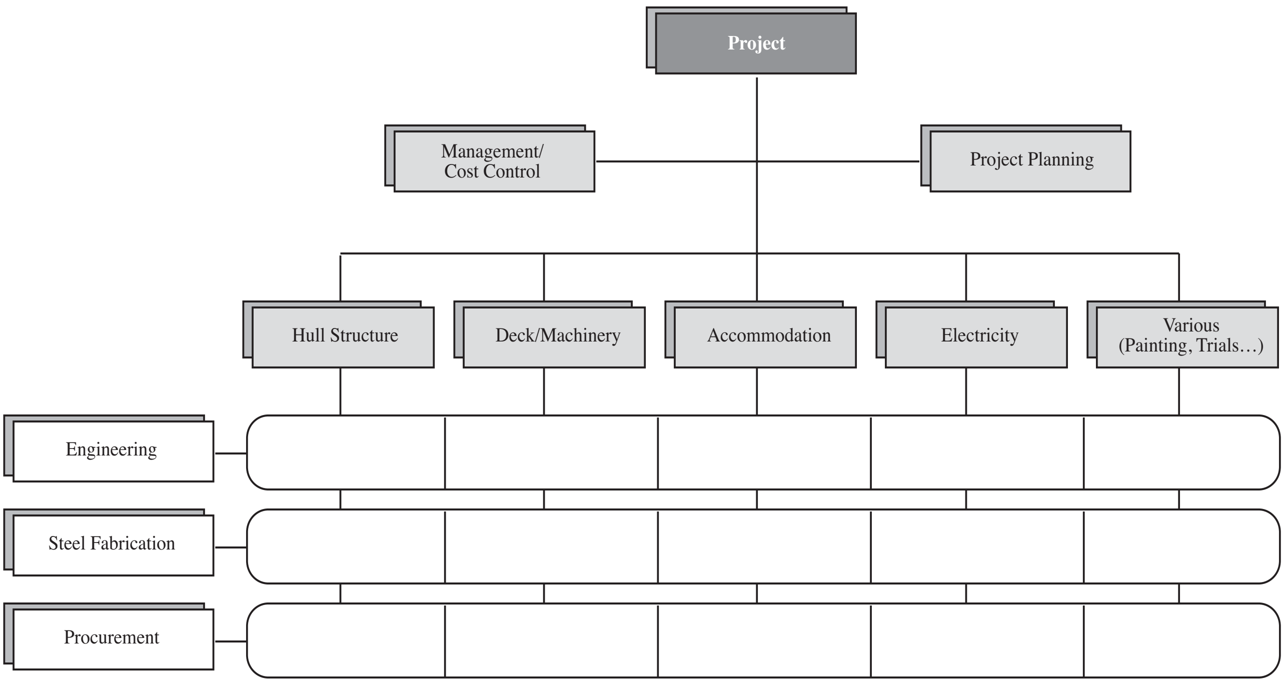


Exhibit 6

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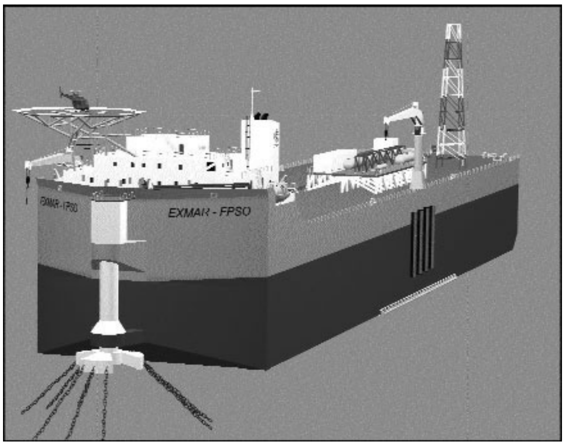
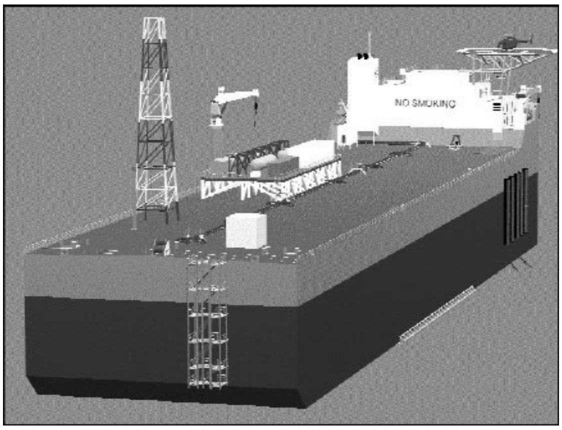
**FPSO Exmar NC-279**




*Main features of the FPSO:*

- Length overall: 210.6 metres
- Design breadth: 44 metres
- Production capacity: 35,000 barrels/day
- Crude storage capacity: 900,000 barrels
- Offloading capacity: 5,000 $m^3$/hour
- Depth of operation at sea: 100 metres
- Life time: 15 years
- Fatigue life: 25 years
- Accommodation: 68 people
- Heliport

Exhibit 7

IZAR

## The Theory of Constraints and the critical chain

The Theory of Constraints (TOC) is an organizational management philosophy developed by Dr. Eliyahu M. Goldratt, an Israeli physicist and author of the best-selling book *The Goal*, first published in 1984, in which he introduced the concept of TOC. TOC assumes that behaviour in any organization must be aligned with the goals that the organization has set itself, and that the organization's overall performance will be constrained by a small number of resources, functions or policies, just as a chain is only as strong as its weakest link. The only way to improve is to systematically identify and remove constraints. TOC proposes the following process for managing a company and focusing its improvement efforts:

- Step 1: IDENTIFY the system's constraint(s).
- Step 2: EXPLOIT the system's constraint(s).
- Step 3: SUBORDINATE everything else to the above decision.
- Step 4: ELEVATE the system's constraint(s).
- Step 5: If in a previous step, a constraint has been broken, go back to Step 1. But do not allow INERTIA to become the system's constraint.

The application of TOC to project management is what is known as Critical Chain Scheduling and Buffer Management (CC/BM). It is considered the most important innovation in project management in recent decades.

CC/BM started from the observation that most projects were unlikely to be completed on time, within budget or to the original specifications. CC/BM was conceived as a project management strategy to avoid the delays caused by Parkinson's Law (work expands to fill the time available for its completion) and to protect against Murphy's Law (anything that can go wrong, will). CC/BM sets out to minimize the impact of Parkinson's Law by scheduling activities with a "bufferless" time estimate, that is, using expected times, doing away with intermediate completion dates and milestones and avoiding multi-tasking. Also, applying critical chain concepts to multi-project management implies establishing project control and priority management mechanisms, which interact on the two basic constraints in any project: precedence constraints and resource utilization.

The critical chain is defined as the set of tasks that determine a project's overall duration, taking into account the precedences among activities and the resource constraints. To minimize work in progress, activities are scheduled to start as late as possible, without risking delaying the project. Once started, activities are completed as early as possible, and the following activities are started as soon as possible.

Critical Chain scheduling is directly linked to buffer management. A buffer is an amount of time scheduled in a project to safeguard the most critical points. Thus, the buffer that is taken away from activities in the schedule is concentrated at these critical points. For example, a project buffer is added at the end of the critical chain to protect the project delivery date from any variation in the chain. Similarly, feeding buffers are located at the end of the feeding chains to protect the critical chain from possible variations (feeding chains are non-critical chains that connect with critical activities) (see critical chain example below).

Exhibit 7 (continued)

Project execution is managed through buffers. By controlling these buffers, management is able to optimize the decision making process to help the company meet or improve upon the project deadline and budget. As activities are completed, project managers will check how much of the buffer has been used. By comparing the work done so far and the amount of the buffer used up they will be able to detect possible deviations in delivery time and take the necessary corrective measures.

**Example of a critical chain**

In this example, the critical path is formed by activities A-B-C and its duration is 10.

| Activity | Duration | Precedence | Resources |
|---|---|---|---|
| Start | – | – | – |
| A | 5 | Start | Expert |
| B | 3 | A | - |
| C | 2 | B | - |
| D | 1 | Start | - |
| E | 3 | D | Expert |
| F | 4 | E | – |
| G | 2 | C; F | – |
| Finish | – | G | – |

In this example, the critical path is formed by activities A-B-C-G, and its duration is 12.

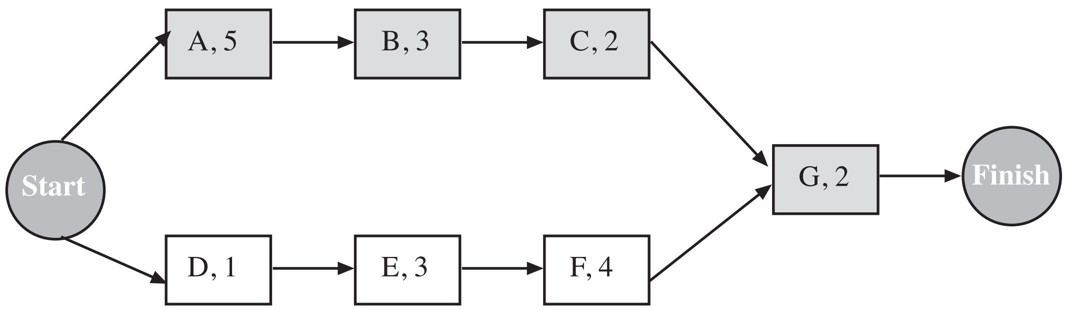
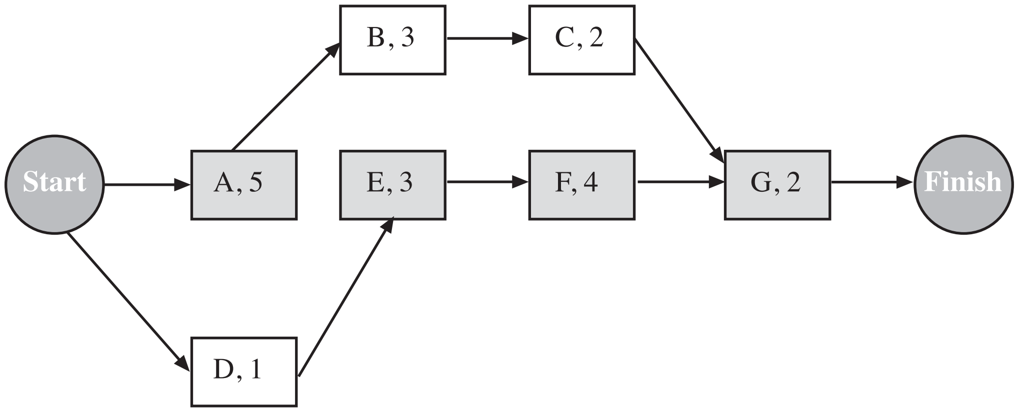


Exhibit 7 (continued)

What changes if we take into account the fact that activities A and E must be performed by the same person (and there is only one person)? Activity E will not be able to start until activity A is finished, giving us the following task network:




The chain A-E-F-G is the critical chain and its duration is 14. The next step is to insert the buffers –the end-of-project buffer and the feeding buffers– to protect the critical chain:

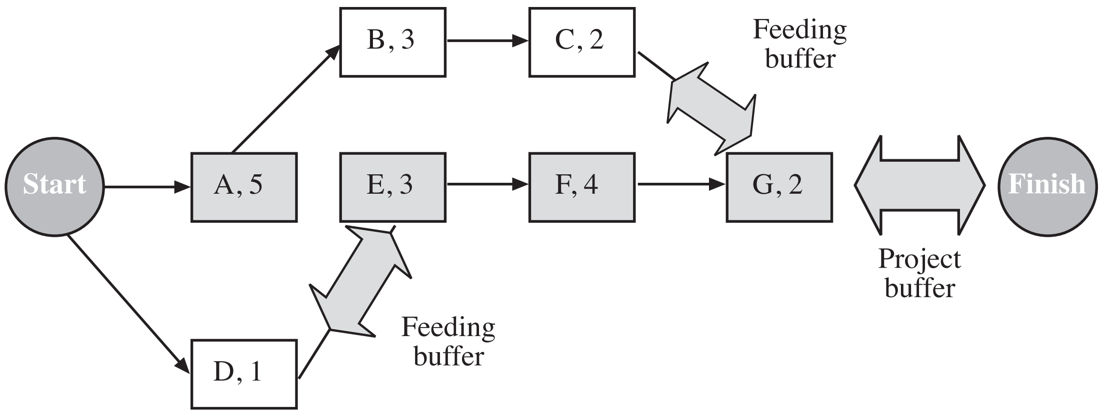


Exhibit 8

IZAR

**Part of the Blocks and Sections diagram for the Exmar NC-279**

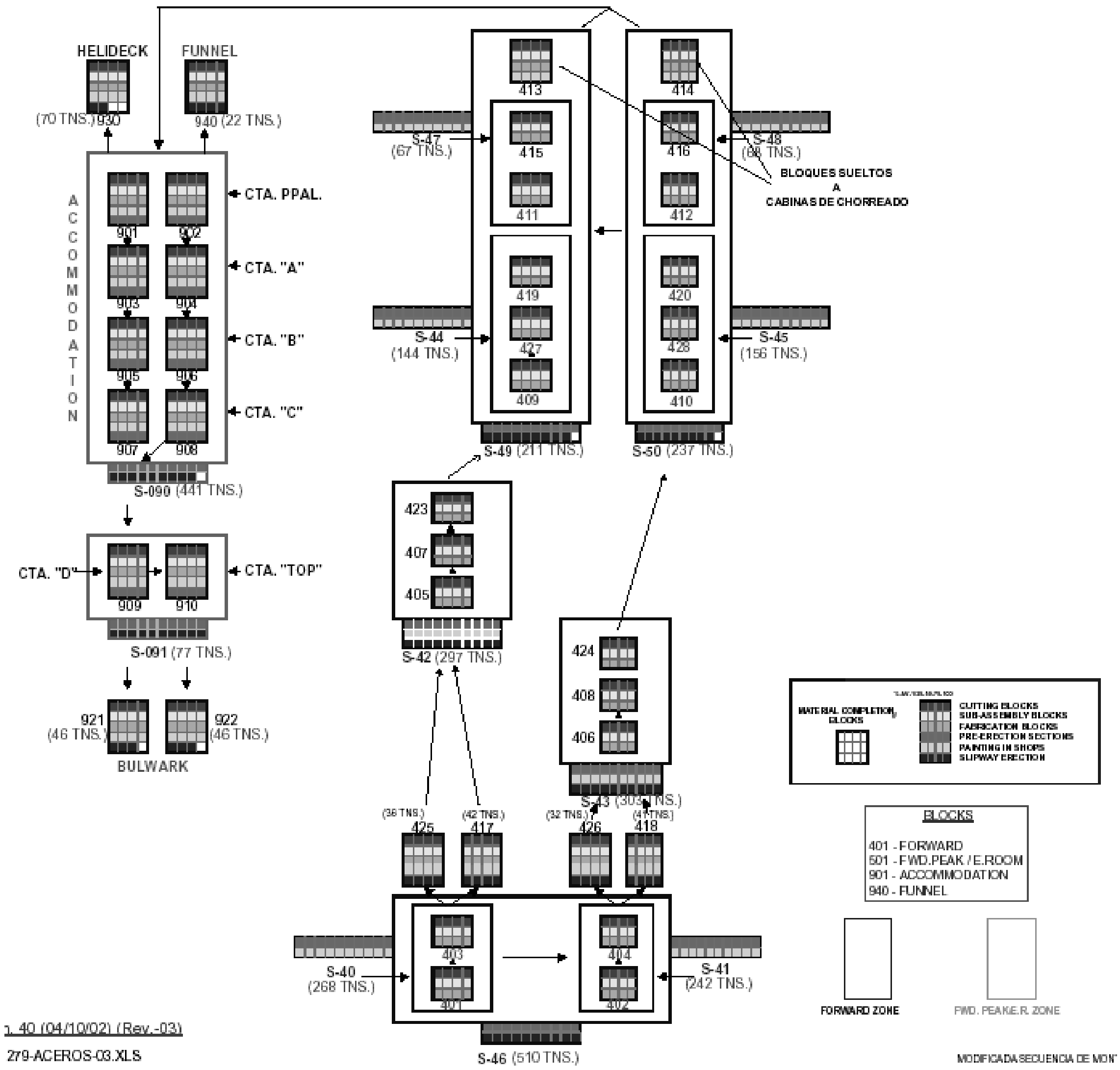



Exhibit 9

**Network structure at section level**

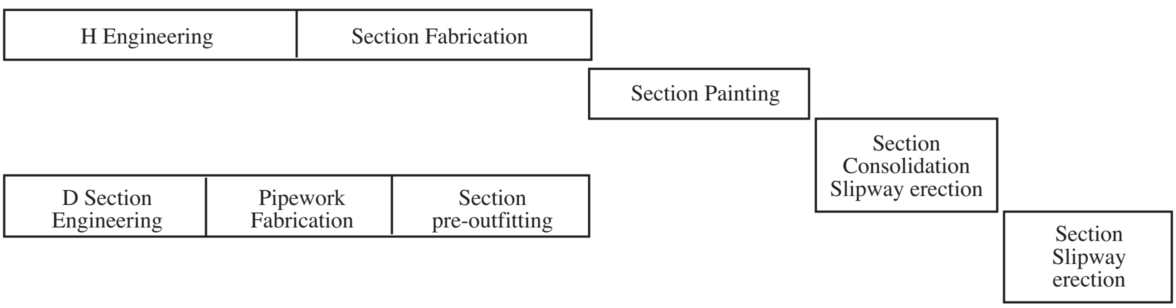
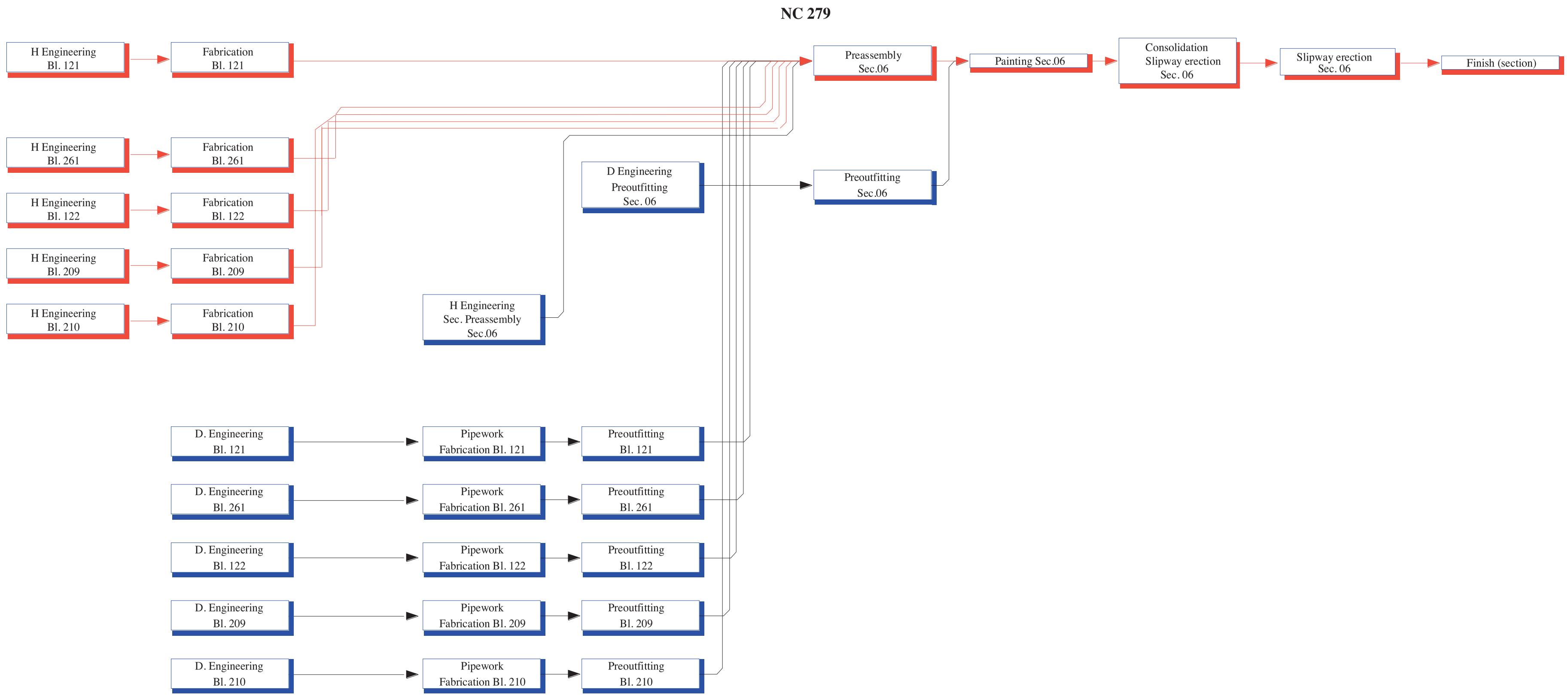


Exhibit 10

IZAR

## Network structure at block level



# Exhibit 11

## IZAR

## Report to resource managers

| | | | | | | |
|---|---|---|---|---|---|---|
| Weekly frequency % BP/%CC = | 1,00 | 5,61 | 4,62 | 4,21 | 3,87 | 3,81 |
| % BUFFER CONSUMPTION OF NC_279 PROJECT = | | 129% | 120% | 122% | 120% | 122% |
| % PROGRESS OF NC_279 CRITICAL CHAIN = | | 23% | 26% | 29% | 31% | 32% |
| DAYS OF CRITICAL CHAIN = 194 / DAYS BEHING = | 0 | 71 | 63 | 62 | 60 | 60 |
| DAYS OF BUFFER = 67 / DAYS AHEAD = | 0 | | | | | |

| MANAGERS | RESOURCES | TASKS | Time Scheduled | STATUS NS | IP | CO | Date 21/02/02 | Date 1/3/02 | Date 03-nov-02 | Date 18/03/02 | Date 25/03/02 | Date 04-feb-02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Guillermo Cuesta,Roberto Vivero | HI ,IAR,PH,PT,PAR,S-ASSEMBLY | Sec.04 | 60 d | | | X | | | | | | |
| Nicolás Sanchez | PAINTING | Painting Sec.04 | 8 d | | | X | | | | | | |
| Guillermo Cuesta | Slipway erection | Consol. Slipway erection Sec.04 | 2 d | | | X | | | | | | |
| Guillermo Cuesta | Slipway erection | Slipway erection Sec.04 | 6 d | | | X | | | | | | |
| Guillermo Cuesta,Roberto Vivero | PH,S-ASSEMBLY,JAR,PT,PAR,JH | Sec.05 | 60 d | | | X | | | | | | |
| Nicolás Sanchez | PAINTING | Painting Sec.05 | 8 d | | | X | | | | | | |
| Guillermo Cuesta | Slipway erection | Consol. Slipway erection Sec.05 | 2 d | | | X | | | | | | |
| Guillermo Cuesta | Slipway erection | Slipway erection Sec.05 | 20 d | | | X | 10 | 20 | 5 | 0 | | |
| Guillermo Cuesta,Roberto Vivero | PH,S-ASSEMBLY,JAR,PT,PAR,JH | Sec.06 | 60 d | | | X | 2 | 0 | | | | |
| Nicolás Sanchez | PAINTING | Painting Sec.06 | 8 d | | | X | | 10 | 4 | 0 | | |
| Guillermo Cuesta | Slipway erection | Consol. Slipway erection Sec. 06 | 2 d | | | X | | | | 0 | | |
| Guillermo Cuesta | Slipway erection | Slipway erection Sec.06 | 20 d | | | X | | | | 25 | 15 | 13 |
| Guillermo Cuesta,Roberto Vivero | PH,S-ASSEMBLY,JAR,PT,PAR,JH | Sec.03 | 60 d | | | X | | | | | | |
| Nicolás Sanchez | PAINTING | Painting Sec.03 | 8 d | | | X | 4 | 3 | 0 | | | |
| Guillermo Cuesta | Slipway erection | Consol. Slipway erection Sec. 03 | 2 d | | | X | | | | 0 | | |
| Guillermo Cuesta | Slipway erection | Slipway erection Sec.03 | 20 d | | | X | | | | 20 | 15 | 3 |
| Guillermo Cuesta,Roberto Vivero | PH,S-ASSEMBLY,JAR,PT,PAR,JH | Sec.18 | 40 d | | | X | | | | | | |
| Nicolás Sanchez | PAINTING | Painting Sec.18 | 8 d | | | X | 4 | 4 | 2 | 0 | | |
| Guillermo Cuesta | Slipway erection | Consol. Slipway erection Sec. 18 | 2 d | | | X | | | | 0 | | |
| Guillermo Cuesta | Slipway erection | Slipway erection Sec.18 | 20 d | | | X | | | | 21 | 16 | 14 |
| Guillermo Cuesta,Roberto Vivero | PH,S-ASSEMBLY,JAR,PT,PAR,JH | Sec.17 | 60 d | | | X | 4 | 0 | | | | |
| Nicolás Sanchez | PAINTING | Painting Sec.17 | 8 d | | | X | | | 8 | 5 | 0 | |
| Guillermo Cuesta | Slipway erection | Consol. Slipway erection Sec. 17 | 2 d | | | X | | | | | 2 | 0 |
| Guillermo Cuesta | Slipway erection | Slipway erection Sec.17 | 20 d | | | X | | | | | | 20 |
| Guillermo Cuesta,Roberto Vivero | PH,S-ASSEMBLY,JAR,PT,PAR,JH | Sec.20 | 40 d | | | X | 4 | 1 | 0 | | | |
| Nicolás Sanchez | PAINTING | Painting Sec.20 | 8 d | | | X | | | | 8 | 3 | 0 |
| Guillermo Cuesta | Slipway erection | Consol. Slipway erection Sec. 20 | 2 d | | | X | | | | | | 0 |
| Guillermo Cuesta | Slipway erection | Slipway erection Sec.20 | 20 d | | | X | | | | | | 20 |
| Guillermo Cuesta,Roberto Vivero | PH,S-ASSEMBLY,JAR,PT,PAR,JH | Sec.19 | 40 d | | | X | 5 | 0 | | | | |
| Nicolás Sanchez | PAINTING | Painting Sec.19 | 8 d | | | X | | | 9 | 5 | 1 | 0 |
| Guillermo Cuesta | Slipway erection | Consol. Slipway erection Sec. 19 | 2 d | | | X | | | | | | 2 |
| Guillermo Cuesta | Slipway erection | Montaje Grada Sec.19 | 20 d | | | X | | | | | | |
| Guillermo Cuesta,Roberto Vivero | PH,S-ASSEMBLY,JAR,PT,PAR,JH | Sec.74 | 50 d | | | X | 10 | 15 | 10 | 5 | 0 | |
| Nicolás Sanchez | PAINTING | Painting Sec.74 | 8 d | | | X | | | | | | |
| Guillermo Cuesta | Slipway erection | Consol. Slipway erection Sec. 74 | 2 d | | | X | | | | | | |
| Guillermo Cuesta | Slipway erection | Slipway erection Sec.74 | 20 d | | | X | | | | | | |
| Guillermo Cuesta,Roberto Vivero | PH,S-ASSEMBLY,JAR,PT,PAR,JH | Sec.75 | 50 d | | | X | | | | | | |
| Nicolás Sanchez | PAINTING | Painting Sec.75 | 8 d | | | X | 2 | 0 | | | | |
| Guillermo Cuesta | Slipway erection | Consol. Slipway erection Sec. 75 | 2 d | | | X | | | | | | |
| Guillermo Cuesta | Slipway erection | Slipway erection Sec.75 | 20 d | | | X | | | | | | |
| Guillermo Cuesta,Roberto Vivero | PH,S-ASSEMBLY,JAR,PT,PAR,JH | Sec.22 | 50 d | | | X | 18 | 10 | 4 | 1 | 0 | |
| Nicolás Sanchez | PAINTING | Painting Sec.22 | 8 d | | | X | | | | | | 8 |
| Guillermo Cuesta | Slipway erection | Consol. Slipway erection Sec. 22 | 2 d | | | X | | | | | | |
| Guillermo Cuesta | Slipway erection | Slipway erection Sec.22 | 20 d | | | X | | | | | | |
| Guillermo Cuesta,Roberto Vivero | PH,S-ASSEMBLY,JAR,PT,PAR,JH | Sec.21 | 50 d | | | X | 16 | 4 | 0 | | | |
| Nicolás Sanchez | PAINTING | Painting Sec.21 | 8 d | | | X | | | | | | 8 |
| Guillermo Cuesta | Slipway erection | Consol. Slipway erection Sec. 21 | 2 d | | | X | | | | | | |
| Guillermo Cuesta | Slipway erection | Slipway erection Sec.21 | 20 d | | | X | | | | | | |
| Guillermo Cuesta,Roberto Vivero | PH,S-ASSEMBLY,JAR,PT,PAR,JH | Sec.76 | 50 d | | | X | 16 | 3 | 0 | | | |
| Nicolás Sanchez | PAINTING | Painting Sec.76 | 8 d | | | X | | | | | 7 | 1 |
| Guillermo Cuesta | Slipway erection | Consol. Slipway erection Sec. 76 | 2 d | | | X | | | | | | |
| Guillermo Cuesta | Slipway erection | Slipway erection Sec.76 | 20 d | | | X | | | | | | |
| Guillermo Cuesta,Roberto Vivero | PH,S-ASSEMBLY,JAR,PT,PAR,JH | Sec.07 | 50 d | | | X | 12 | 8 | 3 | 0 | | |

Exhibit 12

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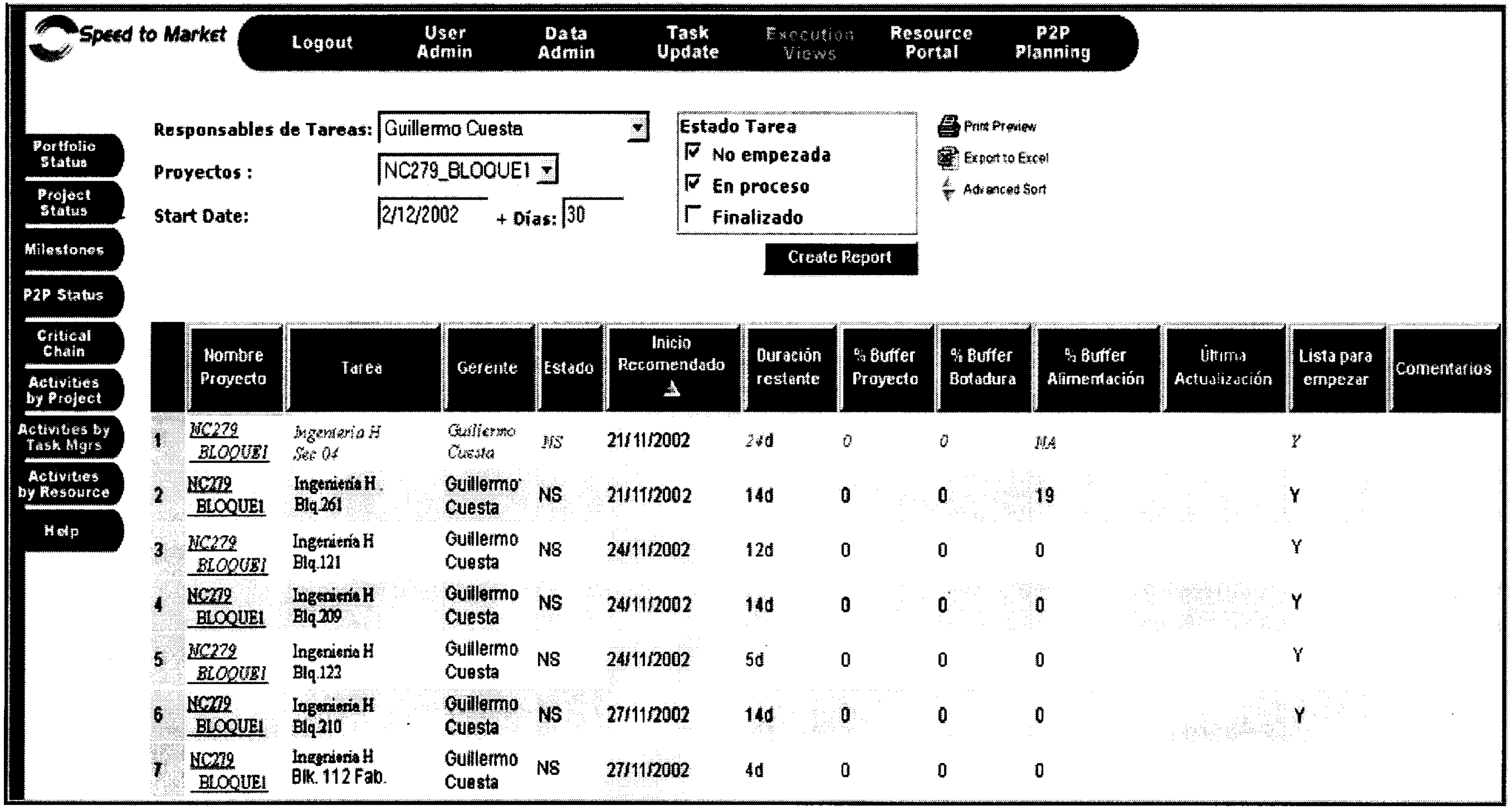
**Monitoring through CMG's "Concerto" program**




| | Nombre Proyecto | Tarea | Gerente | Estado | Inicio Recomendado | Duración restante | % Buffer Proyecto | % Buffer Botadura | % Buffer Alimentación | Última Actualización | Lista para empezar | Comentarios |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | NC279 BLOQUE1 | Ingeniería H Sec 04 | Guillermo Cuesta | NS | 21/11/2002 | 24d | 0 | 0 | NA | | Y | |
| 2 | NC279 BLOQUE1 | Ingeniería H Blq.261 | Guillermo Cuesta | NS | 21/11/2002 | 14d | 0 | 0 | 19 | | Y | |
| 3 | NC279 BLOQUE1 | Ingeniería H Blq.121 | Guillermo Cuesta | NS | 24/11/2002 | 12d | 0 | 0 | 0 | | Y | |
| 4 | NC279 BLOQUE1 | Ingeniería H Blq.209 | Guillermo Cuesta | NS | 24/11/2002 | 14d | 0 | 0 | 0 | | Y | |
| 5 | NC279 BLOQUE1 | Ingeniería H Blq.122 | Guillermo Cuesta | NS | 24/11/2002 | 5d | 0 | 0 | 0 | | Y | |
| 6 | NC279 BLOQUE1 | Ingeniería H Blq.210 | Guillermo Cuesta | NS | 27/11/2002 | 14d | 0 | 0 | 0 | | Y | |
| 7 | NC279 BLOQUE1 | Ingeniería H Blk. 112 Fab. | Guillermo Cuesta | NS | 27/11/2002 | 4d | 0 | 0 | 0 | | | |

Exhibit 13

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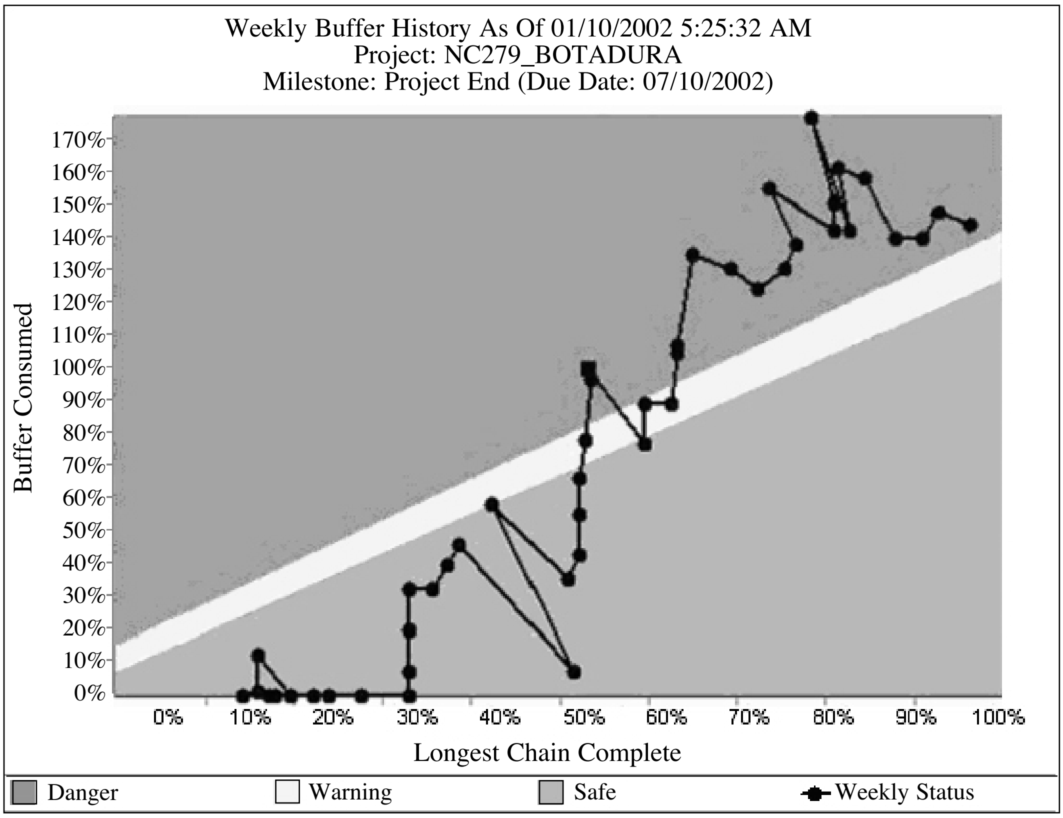
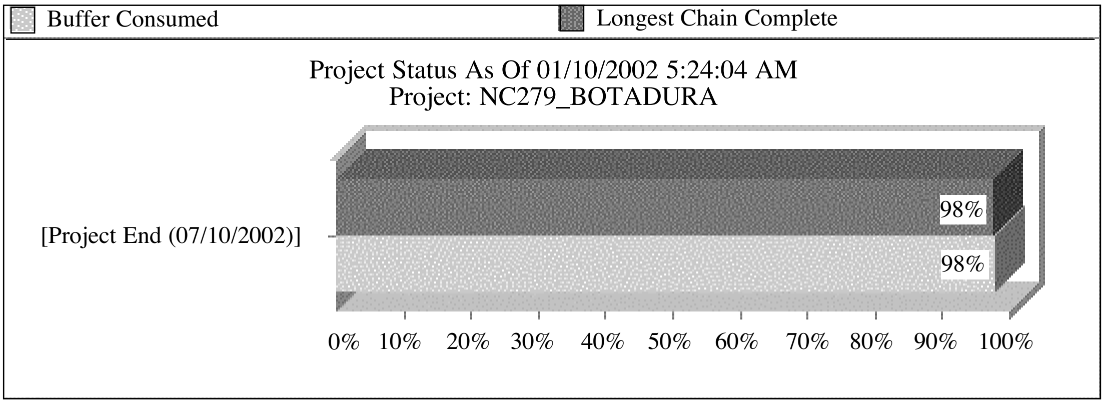
**Project status chart**



## Exhibit 14

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# Priority activities

PROJECT STATUS PRE-LAUNCHING AND POST-LAUNCHING

| | Project Name | Project Mgr | Due Date | Projected Date | Buffer Consumed | Longest Chain Complete |
|---|---|---|---|---|---|---|
| 1 | NC279_BOTADURA | Jorge López | 07/10/2002 | 07/10/2002 | 98%, 65d/67d | 98%, 190d/194d |

PRIORITY ACTIVITIES IN NEXT 10 DAYS

| | Project Name | MSP Task ID | Task Description | Task Mgr | Task Status | Earliest Arrival | Remaining Duration | % CCCB Pen | % CCFB Pen | Last Update Date | Ready To Start |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | NC279_LAUNCHING | 327 | Slipway erection Sec.71 | Guillermo Cuesta | IP | 30/09/2002 | 4d | 98 | 100 | 30/09/2002 | |
| 2 | NC279_LAUNCHING | 321 | Slipway erection Sec.54 | Guillermo Cuesta | IP | 30/09/2002 | 4d | 98 | 100 | 30/09/2002 | |
| 3 | NC279_LAUNCHING | 336 | Slipway erection Sec.33 | Guillermo Cuesta | IP | 30/09/2002 | 3d | 97 | 100 | 30/09/2002 | |
| 4 | NC279_LAUNCHING | 352 | Slipway erection Separation Module | Guillermo Cuesta | IP | 30/09/2002 | 3d | 97 | 100 | 30/09/2002 | |
| 5 | NC279_LAUNCHING | 355 | Slipway erection Dehydrator Module | Guillermo Cuesta | IP | 30/09/2002 | 3d | 97 | 100 | 30/09/2002 | |
| 6 | NC279_LAUNCHING | 339 | Slipway erection Turret | Guillermo Cuesta | IP | 30/09/2002 | 3d | 97 | 100 | 30/09/2002 | |
| 7 | NC279_LAUNCHING | 243 | Slipway erection Sec.49 | Guillermo Cuesta | IP | 30/09/2002 | 3d | 97 | 100 | 30/09/2002 | |
| 8 | NC279_LAUNCHING | 255 | Slipway erection Sec.50 | Guillermo Cuesta | IP | 30/09/2002 | 3d | 97 | 100 | 30/09/2002 | |
| 9 | NC279_LAUNCHING | 213 | Slipway erection Sec.73 | Guillermo Cuesta | IP | 30/09/2002 | 2d | 95 | 100 | 30/09/2002 | |
| 10 | NC279_LAUNCHING | 315 | Slipway erection Block 940 | Guillermo Cuesta | IP | 30/09/2002 | 2d | 95 | 100 | 30/09/2002 | |
| 11 | NC279_LAUNCHING | 225 | Slipway erection Sec.53 | Guillermo Cuesta | IP | 30/09/2002 | 2d | 95 | 100 | 30/09/2002 | |
| 12 | NC279_LAUNCHING | 302 | Slipway erection Block 753 | Guillermo Cuesta | IP | 30/09/2002 | 2d | 95 | 100 | 30/09/2002 | |
| 13 | NC279_LAUNCHING | 349 | Slipway erection Metering Module | Guillermo Cuesta | IP | 30/09/2002 | 2d | 95 | 100 | 30/09/2002 | |
| 14 | NC279_LAUNCHING | 289 | Slipway erection Block 921 | Guillermo Cuesta | IP | 30/09/2002 | 2d | 95 | 100 | 30/09/2002 | |
| 15 | NC279_LAUNCHING | 283 | Slipway erection Block 922 | Guillermo Cuesta | IP | 30/09/2002 | 2d | 95 | 100 | 30/09/2002 | |
| 16 | NC279_LAUNCHING | 295 | Slipway erection Block 930 | Guillermo Cuesta | IP | 30/09/2002 | 2d | 95 | 100 | 30/09/2002 | |
| 17 | NC279_LAUNCHING | 361 | Slipway erection Block 757 | Guillermo Cuesta | IP | 30/09/2002 | 1d | 94 | NA | 30/09/2002 | |