THEMATIC CONTRIBUTION

Elements of a Heavy Oil Technology Development Program

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Abstract

Prospective studies point out that in the short to medium-term, Brazil will incorporate 4 billion barrels to its proved reserves of heavy oil due to advancements in production techniques. As a result, Brazilian reserves of heavy oil will reach 7 billion barrels, taking more than a 40% share in the proven volumes. These figures do not account for the reserves of 2 billion barrels of extra-heavy oils that exist in the offshore field of Membro Siri, Campos Basin. Advancements in heavy oil production techniques will certainly match those numbers as they may unveil new scenarios and even bring closer the production onset of extra-heavy oils from off-shore fields.

Around the world heavy oil has been discovered when looking for conventional oil; and its reservoirs have generally been produced by applying the same techniques as those in the production of light oil. The predictable consequence is that the remaining resources associated with conventional oils have a smaller participation in available natural energy resources, increasing the importance of those resources associated with heavy oils. On the production side, worldwide the percentage of heavy oils is now slightly over 10%; in Brazil the proportion is still negligible.

However, in order to assure the present favorable demand-production relationship, the medium term perspective requires that the Brazilian share of such oils be above 20% of total produced volume. To accomplish this, the country must develop an integrated program of technology development. The program must focus on the search for technological solutions supported by scientific knowledge to overcome the challenges associated with the explotation of heavy oil reservoirs located in Brazil's coastal waters. Seeking to supplement the efforts of specific corporate programs, technical managers from oil companies and members of the academic community have convened to propose prospective solutions and to set the priority for 40 previously selected projects. The present paper unveils the main conclusions drawn, starting from the challenges posed by all branches of the area, to the actions envisioned to tackle them.

Introduction

Brazilian oil reserves exceed 11 billion barrels (ANP, 2006). Oils with API gravity between 14 and 19° API make up 26% of the proven volumes. However, if proper production techniques are developed in the short to medium-term, reserves already discovered may come to incorporate another 4 billion barrels, causing the heavy oil share to soar to above 40%. Moreover, if the lower boundary is moved to 13° API, the numbers reach 50%, due the existing extra-heavy oil of Membro-Siri field in Campos Basin.

Around the world, heavy oil has been discovered when looking for conventional oil; heavy oil reservoirs have generally been produced by applying the same techniques as those in the production of light oil. The predictable consequence is that the remaining resources associated with the conventional oils have a smaller participation in the available natural energy resources, increasing the importance of those resources associated with heavy oils. Taking from the production side, in the world the percentage of heavy oils is now slightly over 10%; in Brazil this proportion is negligible. However, in order to assure the present favorable demand-production relationship, in the medium-term the desired share of such oils should be around 20% of the Brazil's total produced volume (PROPES, 2004).

In an attempt to turn this number into reality, more than 150 people, technical managers from oil companies, from both operators and service companies, from the academic community including universities and research institutes and federal funding agencies, have been interviewed and convened to identify bottlenecks, to propose prospective solutions and to set the priority for 40 previously selected projects. This followed an extensive study consisting of interviews and document analysis, which became "Brazilian Technology Development Program for Heavy Oil Production in Off-Shore Fields".

The line of action of such a program is to supplement the efforts of strategic corporate programs, such as PROPES, presently being carried out by Petrobras. It focuses on the aggregation of scientific knowledge in a sound and systematic way. The academic community, the primary development agent of the program, may consciously assume the greater risks associated with innovative technologies. The focus, the timing and the limits of the practical application of proven techniques will be provided by the interested companies. They will be partners in the program, acting on and sharing the management of specific projects of particular interest. This paper reveals these projects, starting from the challenges posed by all branches of the area, and the short to medium-term actions envisioned to tackle them. This paper presents the rationale and ideas that constitute the backgrounds for the development of an integrated program on the theme of heavy oil.

The initiative of devising such a Technology Development Program comes from the Brazilian Sectorial Fund for Research on Oil and Gas – CT-Petro - and is implemented by Finep.

Understanding Heavy Oil

Looking through the history of oil industry one finds that so-called light or conventional oils dominated the production scenario. The reasons are clearly perceived: light oils are technically easier to produce at a lower cost, and refining them yields greater proportions of value-added products like LPG, gasoline, kerosene and diesel. It is also true that heavy oil reserves have been found when, in reality, light oil beds were sought for (Dawe, 2002).

The definition of heavy oil has not been standardized in the industry, in the scientific community, nor in government agencies. In fact, companies and agencies have their own definition criteria which account for the business opportunities they have and the technological difficulties they face in such opportunities. As is usual in industry, if the challenges in processing, from exploration to refining, are a standpoint for analysis, the hydrocarbon might be classified as heavy oil based on three main properties: specific gravity, viscosity and sulfur content. The World Petroleum Conference classifies heavy oil as those showing a relative specific gravity above 0.920 - equivalent to 22.3 degrees API. The American Petroleum Institute adopts the definition of heavy oil as being that with relative specific gravity equal to or smaller than 20 degrees API. The North American taxation system has similar criterion, although relating the specific gravity to the reference temperature of 60ºF. In Brazil, ANP (Brazilian National Petroleum Agency) adopts the relative specific gravity as the criterion, setting a range between 10 and 22º API; those oils with relative specific gravity lower than 10º API are classified as extra-heavy.

Viscosity is also a very substantial criterion for oil characterization. Regarding the processes of fluid transportation, viscosity is a more important property than the specific gravity. If production takes place in low temperature environments, such as in off-shore fields, this is particularly true. For these reasons, some specialists classify as heavy those oils having viscosity between 100 cP and 10,000 cP, in the standard conditions of pressure and surface temperature. Others, focusing on reserves and recovery factor, prefer to tie the viscosity to pressure and temperature at the reservoir. In this case, a range from 10 cP to 100 cP, keeping within round numbers, is often referred to.

The sulfur content a hydrocarbon holds is another criterion for heavy oil classification: the usual threshold is set to 2% in mass. However, it is important to mention that certain heavy oil may not always simultaneously attain these three properties, specific gravity, viscosity and sulfur content, to be characterized as heavy. Besides, neither viscosity nor sulfur content has a straightforward relationship with specific gravity, nor the former properties among them. The properties of oils from different fields reveal that, for a given specific gravity, viscosities may usually vary up to two orders of magnitude. Thus, a strict and common worldwide definition of heavy oils does not exist. Nevertheless, for the purposes of a program aimed at overcoming technological challenges, heavy oils are understood as:

- those having specific gravity high enough to cause refining problems in the existing plants;
- also, those with viscosities high enough to bring about productivity problems as they flow through the reservoir and along the well, pipelines and equipment, towards the pre-processing plant over the platform.

Problems, as herein stated, refer to any phenomena that go beyond the limits of the knowledge applied to the current oil production and processing practices, requiring investments in science and technology.

That being said, the preference is to adopt, only as rough guidelines for the purposes of devising a technology development program to advance knowledge on heavy oil production, the range of relative specific gravity from 10° to 22° API and the range of viscosity from 100 to 10000 cP, both referred to surface pressure and temperature conditions, to classify an oil as a heavy oil.

Heavy Oil around the World

When heavy oil reservoirs are produced, techniques typical in light oil production are normally used. Adding to this the fact that light oils have dominated the production scenario, such a strategy has lead to an increasing participation of heavy oils among the natural energy resources available to mankind. In turn, heavy oil production is gaining an ever increasing importance in recent years. Although it is very difficult to obtain a definitive and reliable volume regarding heavy oil resources, due to the lack of a common classifying standard and due to divergences between reserve reports and databases published by countries and international agencies, there is a consensus among specialists that earth's resources of heavy oils, extra-heavy oils, and bitumen go beyond 6 trillion barrels (Butler, 1991). This volume is about three times as large as the known resources of conventional oil, of which approximately half of the reserves have already been produced. It must be stressed that this huge volume also includes extra-heavy oils (API <10) and bitumen (viscosity > 10.000 cp), which are even more difficult to produce and refine than heavy oils.

A recent study carried out by the U.S. Geological Survey (Meyer and Attanasi, 2003) points out the existence of an estimated 434-billion-barrel reserve of heavy and extra-heavy oils. The reserve concept takes into account the technical feasibility of hydrocarbon production, or recovery factor. The geographical distribution of such reserves and the recovery factors assumed as average per area are shown in Table 1.

In South America there are 57% (265 x 109 barrels) of these reserves; China is not accounted for because of lack of information.

It is worth noting the low values assigned to the recovery factor in these data. This implies extremely high "in situ" oil volumes, pointing out the necessity of advancements in recovery techniques. Also, it highlights the outstanding participation of South America, exceeding 50%, due to the huge known volumes of heavy oil in Venezuela.

Table 1 – Geographical Distribution of Heavy Oil Reserves (Meyer and Attanasi, 2003)

Region	Recovery Factor	Reserves (10^6 barrels)
North America	0.19	35.3
South America	0.13	265.7
Africa	0.18	7.2
Europe	0.15	4.9
Middle East	0.12	78.2
Asia	0.14	29.6
Russia	0.13	13.4
Total		434.3

In spite of the vast world reserves, the production of heavy oil accounted for only 3 billion barrels, out of a total 25 billion barrels produced in the year 2000, a mere 12%. It is known that about two thirds of the current production of heavy oils is formed by oils lighter than 15° API, while half of the reserves is formed by oils with specific gravity below that value.

Heavy Oil in Brazil

By the end of 2005, Brazilian proved reserves of petroleum were about 12 billion barrels, 9 billion barrels of conventional oils. The reserves of heavy oils were 2.9 billion barrels, a 26% share. Already discovered resources summing 4 billion barrels might be immediately added as soon as they would become technically feasible. In other words, the medium-term perspective is that heavy oils attain a 40% share of Brazil's proved reserves.

Additionally, there is a proved "in place" volume of 2 billion barrels of heavy oil in the carbonate layers of Campos Basin's Membro Siri. In these carbonates, the absence of the phenomenon of simultaneous sand production may be seen as an advantage from the point of view of well completion. However, there are production challenges due to the lower permeability of the carbonate formations (Capeleiro et al, 2003). Hence, it is not unreasonable to consider heavy and extra-heavy oils to be close to 50% of known reserves.

In terms of production, the current share of heavy oils is negligible. They include only a few low-production on-shore fields and a pioneering offshore site in Jubarte field, also part of Campos Basin. Figure 1 synthesizes these numbers.

Prospective studies pointed out that in medium-term the desired share of such oils should be around 20% of the total produced volume in order to maintain the favorable current domestic demand/production figures (Minami et al, 2003). There are ongoing projects towards this goal and the "Technology Development Program for Heavy Oil Production in Offshore Fields" will support them. But, effectively, before presenting a program aimed to the explotation of off-shore heavy oil fields, it is important to emphasize the characteristics posing the new technical challenges.

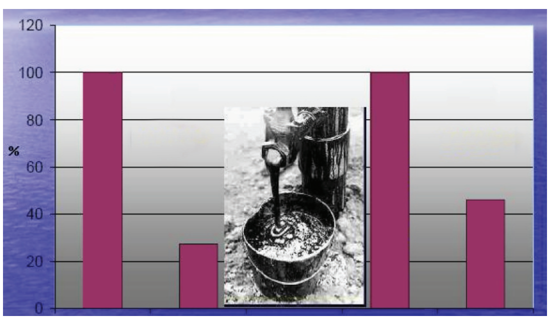

Figure 1 – Actual and Prospective Share of Heavy Oil in Brazil

Characteristics of Heavy Oil

Specific Gravity

Heavy oils are, basically, composed of hydrocarbons with a high molecular weight, which give them a high relative specific gravity. Intricate molecules, typically with more than 15 carbon atoms in the chain, will have an impact on refining. The refining processes become more complex and require more energy for obtaining high-consumption products such as LPG, gasoline, kerosene and diesel. The higher the specific gravity, the lower the value of the distillation yield is, because the retention of such low-value products as fuel oil, coke and asphalt is higher. Specific gravity also means higher contents of such undesired products as asphaltenes, sulfur and metallic components like nickel and vanadium.

Gas-Oil Ratio

Heavy oil reservoirs are low-density energy beds. There are a number of facts to consider leading to this conclusion: lighter molecules, which make up light fractions, as properly termed, and gas are in small proportions; the volumetric compressibility of the light fractions is comparatively larger; the compressibility of gas is typically one to two orders of magnitude higher than that of the oil under the reservoir conditions, pressure and temperature. The result is, therefore, that the self-contained energy of the reservoir is mainly due to the amount of gas it holds, either in the form of free gas or as gas dissolved in oil. In other words, the small content of light fractions in heavy oils implies a reservoir with low energy density, which causes low recovery factors and low productivity rates.

Viscosity

Although there is no straightforward relationship between specific gravity and viscosity, heavy oils are usually highly viscous. As viscosity plays a critical role in fluid transportation, many specialists prefer to establish it as the main property when classifying crude oils. As viscosity increases, the amount of energy needed to drive the lift process also increases. More powerful pumps, "gas-lift" processes requiring higher pressure and flow rates are needed to carry the oil along the flow lines. It should be stressed that the relationship between viscosity of liquid hydrocarbons and temperature is of an exponential nature. This sets additional challenges when production takes place in harsh environments, as is the case in Campos Basin's fields, where the temperature at the bottom of the sea reaches 4 °C (Haney, 2003). In regard to the reservoir, lower oil mobility is due to higher viscosity, which also causes low recovery factors and low productivity rates. Furthermore, producing viscous oils frequently causes substantial changes in the liquid production profile (water and oil) along the field lifetime, as in the volume of water to be processed, re-injected or disposed of.

Emulsion Formation

The formation of stable emulsions of water and oil is a phenomenon frequently found in the production of heavy oils. Emulsion is formed during simultaneous flow of oil and water, although it is also supposed to occur while still in the reservoir. The flow of the mixture of liquids through devices and equipment that impose a high shear rate, such as in pumps and valves, in pipe singularities and even along lines, will induce emulsion formation. Gas and solid particulates are additional factors that increase the shear rate, intensifying emulsification (Harden and Dawne, 1997). Emulsification is a dynamic process, subject to instantaneous local flow conditions and thus to operational conditions that may change along the period the well is producing. Shear rate is a strong factor in emulsion formation, but rheology and fluid properties also play important roles. In short, emulsion formation is indeed a retro-feeding process.

Heavy oil's tendency to form foam must also be taken into account during the release of dissolved gas, in a type of gas and liquid limiting compressible emulsion. All such characteristics will not only influence the flow in the reservoir, wellbore and flowlines, but will also have an impact on other vital processes, such as separation and metering.

Acidity

Heavy oils found in offshore fields have a high content of organic acidity in common. The acidity rate, measured by TAN (Total Organic Acid Content), is particularly important to refining processes. Nowadays, few refineries in the world are prepared to receive such oils, with high acidity level. In fact, the price spread at the oil market is mainly due to this characteristic. Also, the high concentration of organic acids is mentioned to contribute to the precipitation of organo-metallic salts, causing buildups in processing equipment.

Reservoir

Heavy oils, especially those formed by biodegradation, are found in shallow reservoirs, formed by unconsolidated sands. This characteristic, which brings about difficulties during well drilling and completion operations, may become a production advantage due to higher permeability (Wehunt, 2003). In many heavy oil reservoirs, especially those with a thick sediment layer or high inclination angle and high vertical permeability, oil compositional segregation will occur. This causes heavier components to stay in the lower portions of the bedrock, according to their specific gravity. Therefore, the difference in the oil's specific gravity may reach several degrees API along the depth of the reservoir. This is intensified at the bottom of the reservoir, near the oil-water interface, where bitumen and tar mats have been frequently found.Most of the typical challenges historically posed by Brazil's offshore oil production are connected to water depth, to the steep depth gradient in regard to the shore distance: increasing pressure, decreasing temperature, necessity of remote assistance, increasing power in platforms and ships, necessity of large producing structures. Flow assurance, for example, is taken to technical limits, as longer distances and higher pressures result in increasing power; longer production and exportation lines imply lower temperatures, thus increasing fluid viscosity. Also, lower temperatures mean increasing the possibility of paraffin and wax deposition and hydrate formation. Multiphase flows cause design and operational difficulties for long pipelines, and, in some cases, phase separation is imperative for artificial lift, for pumping, compression and fluid transfer and exportation. Improved measuring techniques and instrumentation are required for a more precise control of production and its automation.

There is still a long list of novel aspects, but it is enough to state that the overlapping of the various intrinsic characteristics of heavy oil with typical phenomena in off-shore production results in scientific and technological challenges yet to be overcome. A possible and immediate approach to be adopted is the extension to heavy oil production, when feasible, of the already established scientific and technological knowledge gained with productions of light oil. Clearly, this line of action will not fulfill in full extension the posed challenges, leaving lacks of coverage, representativiness and reliability in the extended models, although some level of predictability may be achieved. A second and desirable approach is the establishment of medium to long term research through a scientific and technological development program capable of supporting appropriate, efficient practices that benefit the cost-effectiveness of the heavy oil production process in the "offshore" environment.

This is compatible with the growing importance this resource is achieving in the scenario of energy reserves on Earth.

Challenges by Explotation Areas

The challenges posed by heavy oil explotation have been classified according the traditional areas of technical activities. They refer to reservoir, wellbore, flow assurance, flow measurement, artificial lift, separation, and characterization. Within these areas more than 40 projects have been identified and ordered, attending criteria such as urgency, impact, risk and resource availability. To accomplish this, more than 150 people, technical managers from oil companies, from both operators and service companies, from the academic community, including universities and research institutes, have been interviewed and convened to identify bottlenecks, to propose prospective solutions and to set priorities, having as start-point the challenges in all branches of the explotation area. The focus, the timing and the limits of the practical application of proven techniques will be provided by the interested companies. The duty of the academic community will be to overcome the challenges, seeking to aggregate scientific knowledge in a coordinated action, focusing on the most imperative demands from the industry, in accordance with federal planning for the oil sector and limits of the economic resources made available by government agencies. Thus, they may consciously assume all large risks related to the work with innovative technologies but, in turn, will be deeply involved in the production and transfer of highly sought after state-of-the-art technology. Industry and the academic community will be partners in the program, sharing management of the program and acting in every project of particular interest. The full version of the report details these projects and the short to medium-term actions envisioned to tackle them.

Reservoir

The portfolio of actions related to reservoir includes:

Thermodynamic Behavior

To study the characteristics of the thermodynamic behavior of heavy oils, focusing on the development of correlations for PVT properties and on the development of models for off-equilibrium behavior

Flow Properties in the Formation

To study the characteristics and rheological properties of live oil and its potential emulsions with gas, focusing on flow conditions inside the reservoir rock

Primary Production Mechanisms

To develop models for reservoir phenomena associated with the depletion of heavy oils, with primary focus on gas entrapment, gravitational flow, and changes to permeability after altering the structure of the porous medium.

Water injection

The focuses are two-fold: technical challenges of water injection in heavy oil offshore fields and waste water reconditioning for re-injection and disposal.

Improved Recovery

To develop theoretical and experimental models on improved recovery methods applied to offshore heavy oil reservoirs. It is initially proposed that the focus be directed to air injection and its novel techniques, and to steam injection with bottomhole generation.

Wellbore

In this portfolio, priorities are:

Wellbore Stability

To develop geomechanical models to anticipate the behavior of heavy oil bearing formations in the limits of the pressure gradients involved in construction of wells with long horizontal extensions - exceeding 1000m and in thin sediment layers

Drilling and Completion Fluids

Development of fluids appropriate to the construction of wells with long horizontal stretches, with tight gravity and viscosity restrictions

Drilling Hydraulics

To study models for describing the hydraulic behavior of the column-fluid-wellbore-gravel system during the drilling of long horizontal extensions

Sand Migration

To develop descriptive models for sand displacement aimed at production control

Damage removal

To develop techniques and products to remove damage to the formation caused by fluids during drilling and completion operations in horizontal wells

Well evaluation

Development of pressure, temperature and flow rate sensors for bottomhole monitoring during well operations

Flow Assurance

The focus is on flow characteristics in wellbores, equipment and flowlines.

Phase arrangements in multi-phase flows

To generate flow maps for multiphase heavy oil-flow phase arrangements

Mechanistic models and correlations in multiphase flows

To obtain specific correlations for heavy oil flows. Develop phenomenological models to forecast hold-up and head loss for heavy oils

Properties of water assisted flow

To develop specific correlations for water assisted heavy oil flows: head loss, "hold-up", and criteria for emulsion formation

Hydrate formation in lines with production transients

To formulate objective criteria for identifying hydrate formation in lines under transients

Heat transfer in submerged lines

To scrutinize the heat transfer processes in flow lines and pipelines, under steady-state and shutdown conditions

Emulsion formation: influence of shear rate

To quantify the influence of the shear rate on the formation of water-oil emulsions in heavy oils

Drag reduction in single and multiphase flows

Development of drag reduction additives for heavy oil single and multiphase flows

Metering

In this portfolio the projects deal with conventional meters and new instrumentation techniques.

Uncertainties of conventional meters

To quantify the uncertainty of conventional oil flow rate meters when used in the measurement of heavy oil

Scale effect on conventional meters

To define and quantify parameters to represent size-scale variation in the propagation of measurement uncertainties of flow rate meters applied to heavy oil

Application of ultrasound meters

To develop ultrasound techniques for the measurement of fluid and flow rate characteristics in heavy oil lines

Multi-phase measurement techniques

To access the uncertainty of multi-phase flow meters operating with heavy oil

Sampling techniques in multi-phase flow lines

To develop sampling procedures in heavy oil production lines

Artificial Lift

Artificial lift projects for offshore production include:

BCSs performance curves

To study BCSs' performance correction curves for dimensional scale and viscosity changes

Models for the performance of BCSs

To develop a generalizing model to anticipate the performance of BCS operation with very viscous fluids

Novel artificial lift equipment

To develop models to anticipate the use of new artificial lift equipment (multi-phase pump, HSPs)

Mixtures by jet-pumps

To characterize mixtures generated by jet-pumps injectors (water or gas as the driving fluid)

Separation

The focus will be on the use of moderate and intense centrifugal fields to promote phase separation.

Operational range of centrifuges

To establish the operational limits for centrifuges used with multi-phase mixture of heavy oil and water

Centrifuges of simple geometries

To analyze multi-phase centrifuges of simple geometry for application to solid-liquid-gas-particulate separation

Dispersion under centrifugal fields

To evaluate numerical models for simulating disperse systems under the action of centrifugal field

Particulates role in centrifugal splitters

To study the effect of solid particulates in the lifetime and performance of centrifuges

Characterization

Portfolio is focused on physical and chemical properties of heavy oil and its mixtures.

Heavy oil emulsions

To establish an accurate, reliable and fast method to characterize heavy oil emulsions

Hydrodynamics of dispersed systems

To model the behavior of two-phase oil-water mixtures when flowing in pipelines and complex geometries

Micro-distillation method for TBP determination

To develop a method by using distillers with capacity from 100 ml to 1 liter applied to heavy oils

Adjustments of TBP methods for heavy oils

To adjust the existing methods for TBP curve determination, with focus on heavy oils

Extension of TBP curve and characterization of heavy fractions

The objectives are multifold, including the definition of a new method to render the TBP curve extended up to at least 700 °C and the establishment of processing strategies for different heavy oils

De-asphalting for characterization of ultra-heavy residues

To develop an experimental method to extract components from ultra-heavy oil residues, accomplish the characterization of the obtained residue and evaluate the use of such residue to produce asphalt

Precipitation of heavy oil fractions

To model the precipitation of heavy oil components and develop mechanisms to deal with it

Compatibility of mixtures

To survey the stability and compatibility indexes of Brazilian oil streams

Final Remarks - Program Management

Management of a program for technology development as comprehensive and complex as the one proposed herein involves a lot of planning, leading initiatives, efforts for plenty of communication between agents of diverse cultures and interests among academia, service companies and operators. The manager must be of such a profile to align and maintain the alignment of the various components of the program to the objectives posted, and, at the same time, implement coordinated actions in order to take advantage of the synergy between the different developments, this been one of the reasons for proposing the identified projects as a program. Given the diversity of the stakeholders involved and the multitude of disciplines and subjects of the projects, it is recommended that the program to be managed at its top level by a board of few members, picked among the leading actors directly involved with the actions of the program.

This board should be responsible for planning the main actions of the program, proposing the criteria for the selection of the best projects along the development lines of the program, stating the targets to be reached within the time frame for such developments, quickly evaluating and revising performance of project developers.

In order to carry forward all the actions needed in the program regarding its implementation, setting up communications, building means for continuous follow up and evaluation, the existence of a full-time executive is advisable. This role should be for a professional in administration, preferably with experience in technology management.

The projects themselves tend to behave as self-sufficient entities after coming out as specific initiatives to answer particular challenges, for having targets and deadlines to meet and for being assigned to bilateral contracts. Therefore, it is important to devise formal links between each particular contract and the program as a whole; otherwise the program ends up as a mere collection of individual projects. A functional means of establishing links between the projects and the parent program is to formalize the managerial instance of the management Board and the Executive Manager in the contract, along with rights and duties of the project with respect to the program. Particularly those related to performance evaluation, technical data and information sharing, technical and financial reporting, communication with peer projects and participation in workshops and technical events of the program.

Similarly to regular research contracts, each contract shall be managed by an executor, who is responsible for the due course of the technology development set forth in its terms. Some projects may involve the interest of various partners from companies or from universities and research institutions. In these cases a multi-client contract should be considered and the management structure should include a Technical Board formed by representatives of the involved partners. Functionality of this Board is left to the discretion of the partners in the project, as long as the main rules set for the program the project belongs to are respected.

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