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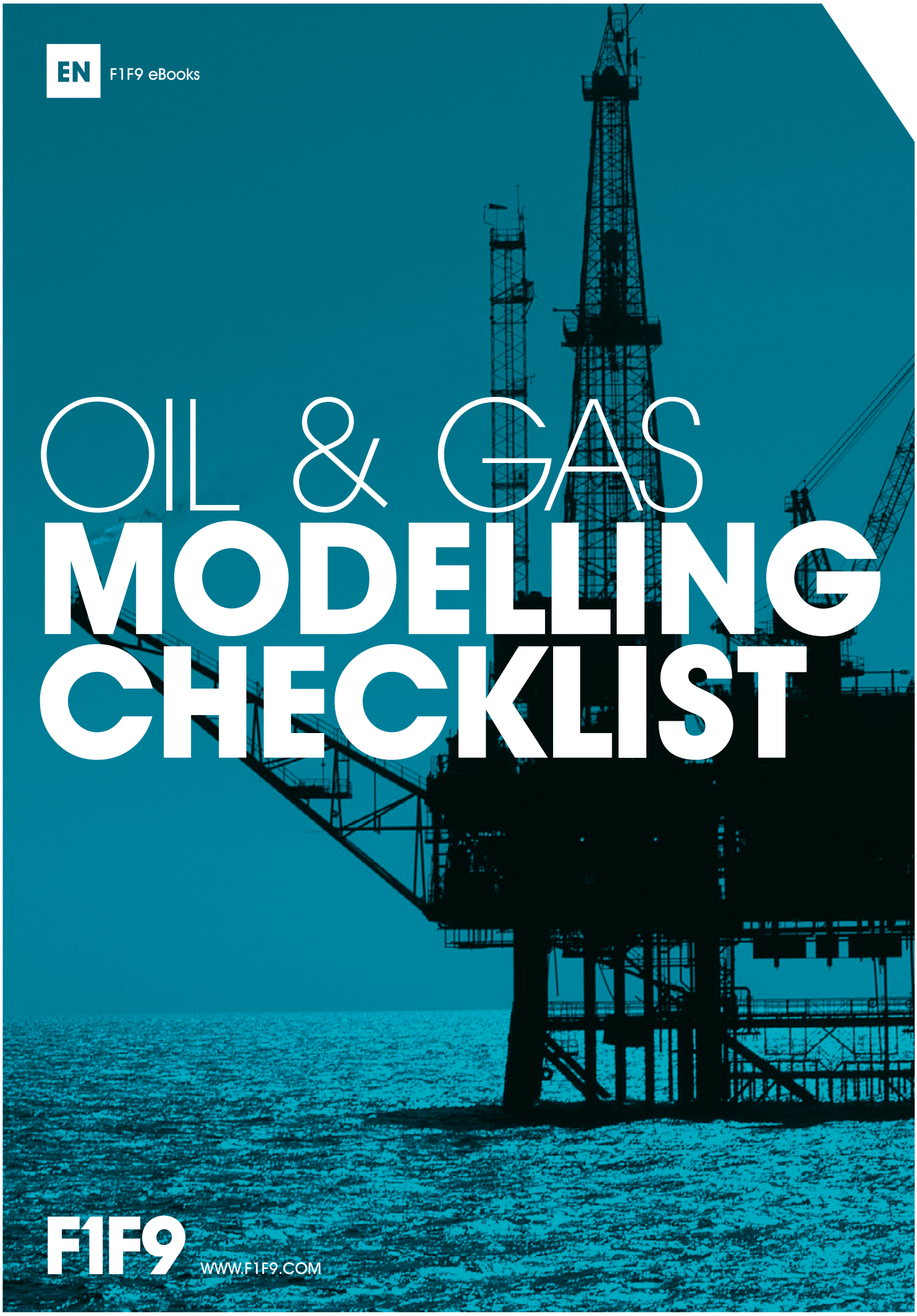

OIL & GAS MODELLING CHECKLIST

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CONTENTS

"GOOD CHECKLISTS . . . ARE PRECISE. THEY ARE EFFICIENT, TO THE POINT, AND EASY TO USE EVEN IN THE MOST DIFFICULT SITUATIONS. THEY DO NOT TRY TO SPELL OUT EVERYTHING—A CHECKLIST CANNOT FLY A PLANE.

INSTEAD, THEY PROVIDE REMINDERS OF ONLY THE MOST CRITICAL AND IMPORTANT STEPS—THE ONES THAT EVEN THE HIGHLY SKILLED PROFESSIONAL USING THEM COULD MISS. GOOD CHECKLISTS ARE, ABOVE ALL, PRACTICAL."

ATUL GAWANDE,
THE CHECKLIST MANIFESTO: HOW TO GET THINGS RIGHT

EN

ABOUT F1F9

F1F9 provides financial modelling and business forecasting support to blue chip clients and medium-sized corporates. We also teach financial modelling skills to companies around the world. Our clients have access to high quality, low-cost modelling support delivered by over 40 professional modellers.

F1F9 co-developed the FAST Standard that allows modellers and non-modellers to work together and understand financial models. Transparency is the core value that drives our modelling and our business activities.

F1F9 ENERGY & NATURAL RESOURCES TEAM

F1F9's dedicated Energy & Natural Resources modelling team is led by Daniel Prinsloo. Daniel has more than 20 years of Energy & Natural Resources experience. With a strong technical background in chemical and process engineering and a further qualification in computer science, Daniel has worked in a number of major commercial functions and gained extensive experience in strategy development, project evaluation, business development and commercial agreements.

Daniel's commercial negotiation and valuation experience covers Algeria, Australia, China, Iran, Latvia, Lithuania, Malaysia, Netherlands, Nigeria, Qatar, Russia, South Africa, Tanzania and the United Kingdom. He has a proven ability in the development of multibillion dollar energy investment opportunities and providing the financial models used to support these investments while ensuring high standards of quality control are maintained.

DANIEL PRINSLOO
DIRECTOR, ENERGY & NATURAL RESOURCES

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OIL & GAS MODELLING CHECKLIST

This ebook will help you scope out the model build requirements for an Oil and Gas project.

Each chapter is designed to
a. prompt questions
b. raise issues and
c. lay out the common steps in the modelling process.

The sections within this ebook relate to the accompanying checklist. The checklist contains a list of factors to consider when scoping an oil and gas model.

Use the ebook to help you in your first use of the checklist. For later projects, you will be able to use the checklist on its own, as you repeat what you have done before.

Download the full checklist here

INTRODUCTION

I have been reading Atul Gawande's *The Checklist Manifesto.* It is an entertaining and thought-provoking book. It really made me think about how better checklists in F1F9 can help us create better models and deliver an improved process for our clients.

Gawande highlights the similarities between the surgical profession and two other complex, high-skill undertakings: the construction of large buildings and flying airplanes.

While people working in construction and aviation depend on adherence to checklists to get things right, many doctors and nurses have not yet embraced this practice.

Gawande makes a compelling case for the use of checklists in other professional fields, including business, investment decisions and the law.

In the oil and gas industry, management rely on economic and financial analysis to make multi-billion dollar investment decisions. Producing this analysis is not a trivial task. Analysts must consolidate and incorporate months or years of work by cross-functional teams.

There are more factors involved than any one person can keep in their head. The analysis has to take account of issues such as:

- Granularity of capital expenditure and operating expenditure
- Timeline e.g. semi-annual or annual?
- Economic metrics
- Tax
- Shareholding
- Sensitivities

Years of knowledge, experience and organisational memory may be captured by a good checklist.

All too often, our checklist of attributes is a model from a colleague that has just been *floating around* in the office.

More and more companies are recognising the risks associated with modelling, and are realising that the cost of an inefficient, *ad hoc* approach is too great to bear.

The *Business Analysis Lifecycle* ebook will assist you during the conceptual modelling phase of the business analysis lifecycle by helping you to remember the key questions to ask.

MODELLING CHALLENGES

Investments in oil and gas are capital intensive and can be extremely complex. Modelling them is not a trivial task.

There are a number of features in oil and gas projects that make the modelling process difficult to manage:

1. The extended value chain is complex: from the upstream reservoir or wellhead through midstream infrastructure to the downstream burner tip.

2. There is a great deal of uncertainty surrounding development timelines. The project might take a long time to move from exploration or pre-feasibility to the investment decision, operations and abandonment. The model will most likely be owned by different people throughout that process.

3. Modellers often remain in the role for no longer than 2 to 3 years before being promoted out of the role. This and long development timelines mean that the model will be developed and used by many people throughout its life.

4. As the project progresses, financial modellers are required to contend with an increase in input data granularity. This requires flexibility in the model.

5. There are often multiple shareholders who need to collaborate. The model is a key communication tool in their collaboration. .

6. There may be multiple models in place. For example, you may have a single project model, most likely simple and deterministic, that all parties use at management meetings. Your company may have its own model at the business unit level which contains proprietary price forecasts and additional cost / revenue assumptions. This model is primarily a probabilistic model that can be used for Monte Carlo analysis. Lastly there may be the corporate portfolio. This is illustrated in Figure 1 below.

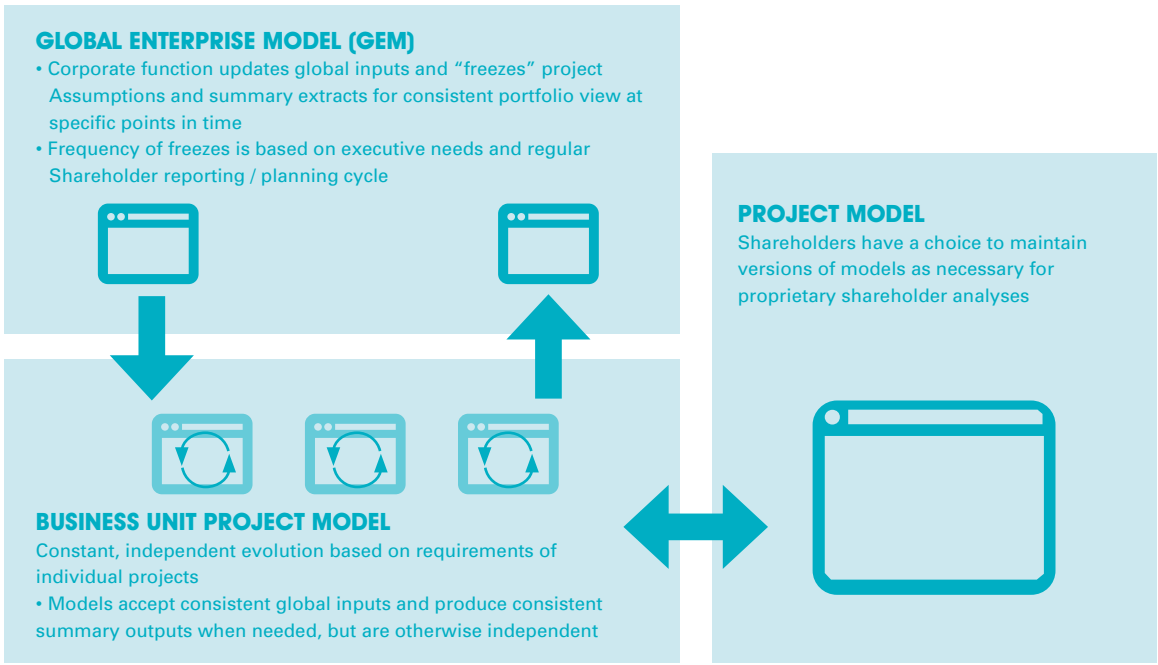

Figure 1 – Number of model versions

All economic and financial models should be built in a robust, flexible and transparent manner from the outset.

Thus at the outset of a new assignment you may have a number of questions concerning:

Business or project structure	Shareholding, Type of venture, Contractual Arrangements
Economic metrics and outputs	NPV, IRR, Charts, Reports
Development and operating timeline	Start dates, duration of phases
Capital cost	Exploration, Facility Design, Expenditure Profiles, Renewal
Production and sales volumes	Reserves, Material and Energy Balance, Plant Availability
Pricing and revenue	Prices and Sales
Operating and maintenance cost	Fixed vs. variable, cyclic, incremental, once off
Working capital	Feedback inventory, Final product inventory, Payment terms
Fiscal	Tax and Tax Allowances

Tip: It is useful to break up the model logic along functional lines. This is because each functional area might have a different subject matter expert who will provide input assumptions and guidance. Accountability around assumptions and other conceptual contributions will be important later in the process.

BUSINESS STRUCTURE

An economic and financial model needs to take account of a range of complex commercial and technical issues. It can be useful to start with a picture of the structure and the parties.

Figure 2 is an example of an LNG import terminal.

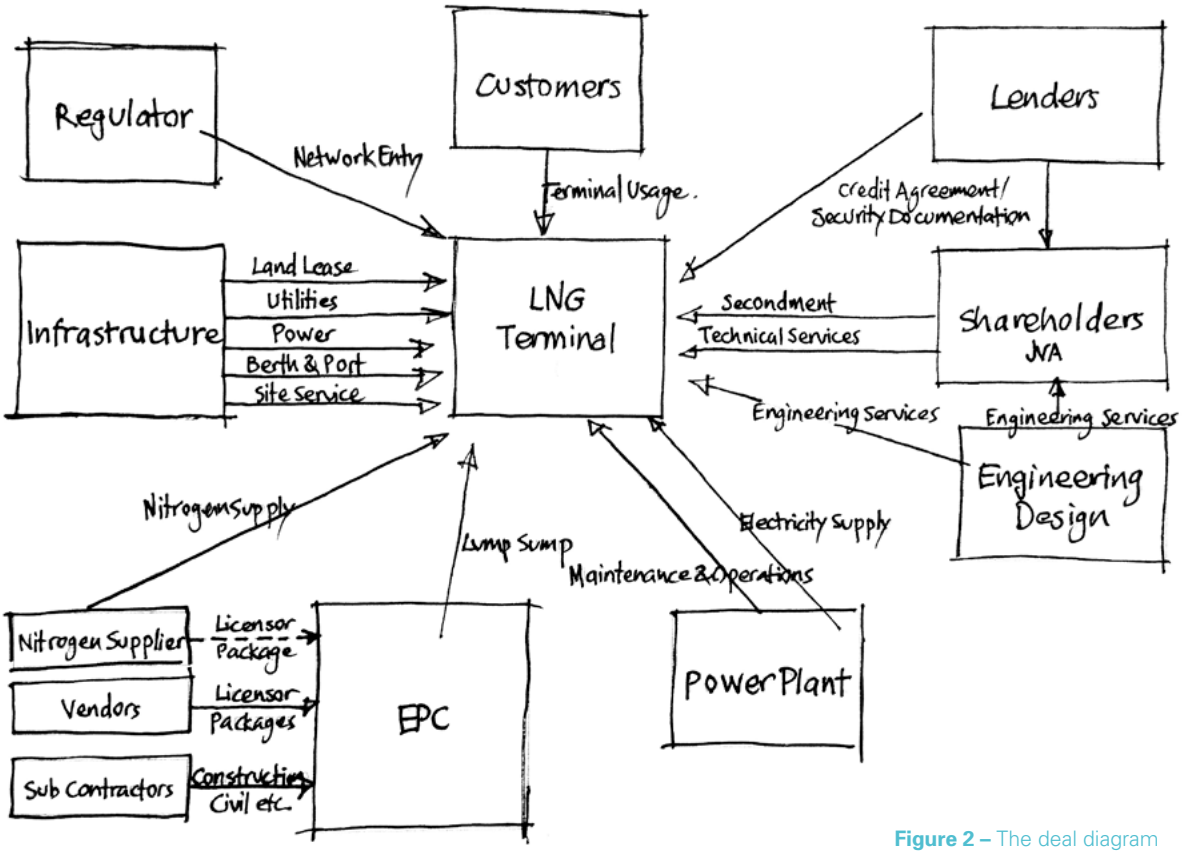

Figure 2 – The deal diagram

Where the development consists of several distinct or independent parts, the results of the cash flow analysis are often more easily derived if each part of the development is examined separately. The benefits and costs are then summed together to assess the total impact of the development.

Tip: Structure logical sections together within sheets and across multiple sheets. Think about how input data and calculations will flow to provide outputs. The structure of a model can have an impact on the outputs.

In assessing the business structure, consider the potential for multiple currencies. We often see oil and gas projects that we model for our clients where revenues are reported in US dollars but taxation calculations are carried out in the currency of the host country.

Tip: Take care with exchange rates and inflation – failure to do this can lead to material errors!

BUSINESS STRUCTURE CHECKLIST QUESTIONS: **WHAT SHOULD I CONSIDER?**

Download the full checklist here

- **O&G value chain**
  - Upstream
  - Midstream
  - Downstream
- **Model type / purpose**
  - Economic model
  - Contract modelling
  - Cost-benefit analysis model
  - Investment feasibility analysis
  - Bid / negotiation model
  - Reporting
  - Budgeting
  - Actual vs. forecast model
- **Shareholding**
  - Sole shareholder
  - Government shareholding
- **Business / project reporting currency**
- **Business / project reporting frequency**

ECONOMIC METRICS OR OUTPUTS

The starting point for any model is to understand the nature of the decision that the model will support. This will provide guidance as to the most appropriate economic metrics.

"Form follows function" is a well understood design maxim. It also applies to financial analysis. At every stage in the process, the analysis should be detailed enough to enable sound decision making about the merit of what is being proposed.

Sometimes, therefore, the appropriate level of analysis can be very narrow and can be completed in a day. At other stages the analytical process can involve significant resources and take many months or years.

Tip: It is better to have a clear and simple evaluation than a complex "black box" evaluation that cannot be readily understood by decision makers, even if the latter methodology is more detailed.

ECONOMIC METRICS CHECKLIST QUESTIONS: **WHAT DO I REQUIRE?**

- [x] **Flow diagram**
  - [x] Concept diagram
  - [x] Detailed flowchart

- [x] **Statements / Analysis**
  - [x] Profit and loss / income statement
  - [x] Cashflow statement
  - [x] Balance sheet
  - [x] Annual financial statements
  - [x] Ratio / key metric calculation
  - [x] Dashboard
  - [x] Sources and uses of funds
  - [x] Sensitivity
  - [x] Statements for each shareholder
  - [x] Monte Carlo and scenario / sensitivity analysis functionality

- [x] **Analysis Type**
  - [x] IRR
  - [x] NPV
  - [x] Maximum exposure
  - [x] Profitability index
  - [x] Payback period
  - [x] Unit costs
  - [x] Cover ratios
  - [x] Economic cut off
  - [x] Analysis at project level
  - [x] Analysis for each shareholder

ECONOMIC METRICS CHECKLIST QUESTIONS: **WHAT DO I REQUIRE?** (CONT)

- [x] **Charts / metric forming part of dashboard**
  - [x] Key schedules
  - [x] Key outputs
  - [x] Project cashflow chart
  - [x] Tornado charts
  - [x] NPV charts at different discount rates
  - [x] Bridge chart
  - [x] Price charts
  - [x] Cost structure chart

CAPITAL COSTS

Capital costs include all up-front development expenditures required to achieve the forecast benefits. The main characteristic of capital costs is that they are one-off costs, usually incurred at the beginning of a project.

In the oil and gas industry these are large expenditures, which are usually incurred over several years before revenue is obtained.

It is important to confirm whether the capital cost estimate is expressed in real or nominal terms. Real term cost estimates (also known as instantaneous job costs) are produced during the early stages of development where escalation or de-escalation is not considered. Therefore, a validity date must accompany any cost estimate to allow the correct treatment of escalation or deescalation in the cash flow model.

One of the most debated issues from a company treasury perspective is the expenditure profile. This is open for manipulation in the early phases of a project. The capital expenditure profile is normally based on an "S-curve" as illustrated below in Figure 3.

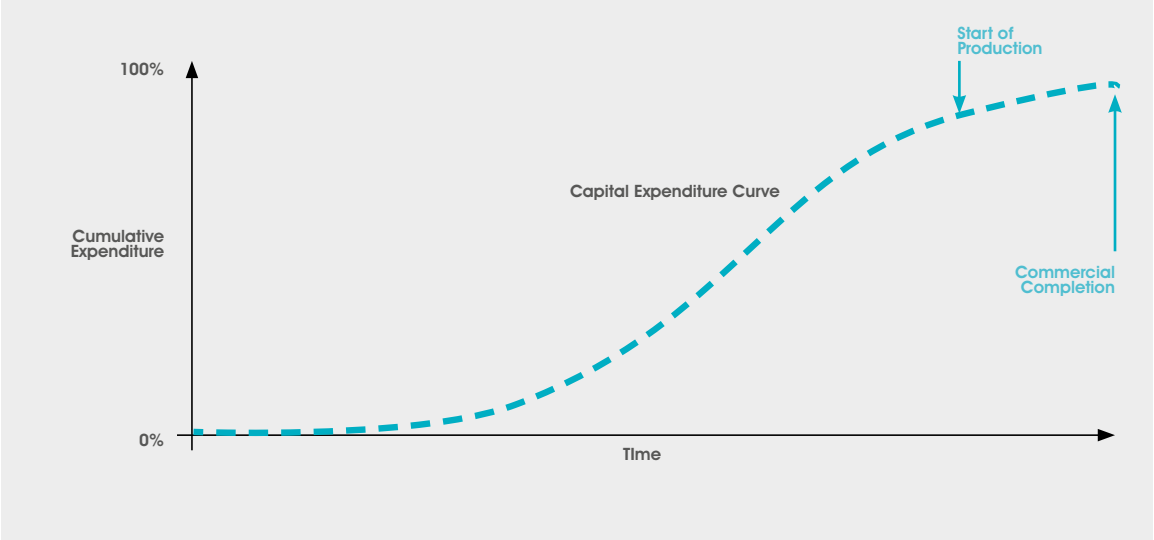

Figure 3 – Capital expenditure curve

A common mistake is to assume that capital expenditure ends at the start of production. Often 5% to 15% of the capital cost can flow after start of production, as this may be related to performance tests, final site clearance, roads, landscaping, painting, buildings, etc.

The time period generally varies from 6 to 18 months after start of production.

Commercial completion is only achieved once the last capital payment has been made.

CAPITAL COSTS CHECKLIST QUESTIONS: **WHAT SHOULD I CONSIDER?**

Download the full checklist here

- **Capital expenditure modelling frequency**
- **Capital expenditure modelling currency**
- **Capital expenditure inputs characteristics**
  - Real
  - Nominal
- **Capital expenditure modelling requirement**
- **If detailed capex modelling is required, which is applicable?**
  - Exploration capex
  - Drilling capex
  - Wells completion capex
  - Compression and processing capex
  - Facilities capex
  - Seismic capex
  - Development capex
  - Feasibility capex
  - FEED capex
  - EPC capex
  - Ongoing / renewable capex
  - Abandonment capex

DEVELOPMENT AND OPERATING TIMELINE

Key to building an effective economic model is the intrinsic relationship between different stages of the value chain (upstream, midstream and downstream). Failure to understand the connections can create cash flow mismatches.

For example a project may have two parts, one being the upstream development (e.g. offshore field) and the other being the midstream facilities (e.g. LNG facility).

In practice, these timelines may overlap. This is illustrated in Figure 4 which shows both the upstream and the midstream development. Timeline issues get more complicated if external funding is added into the project.

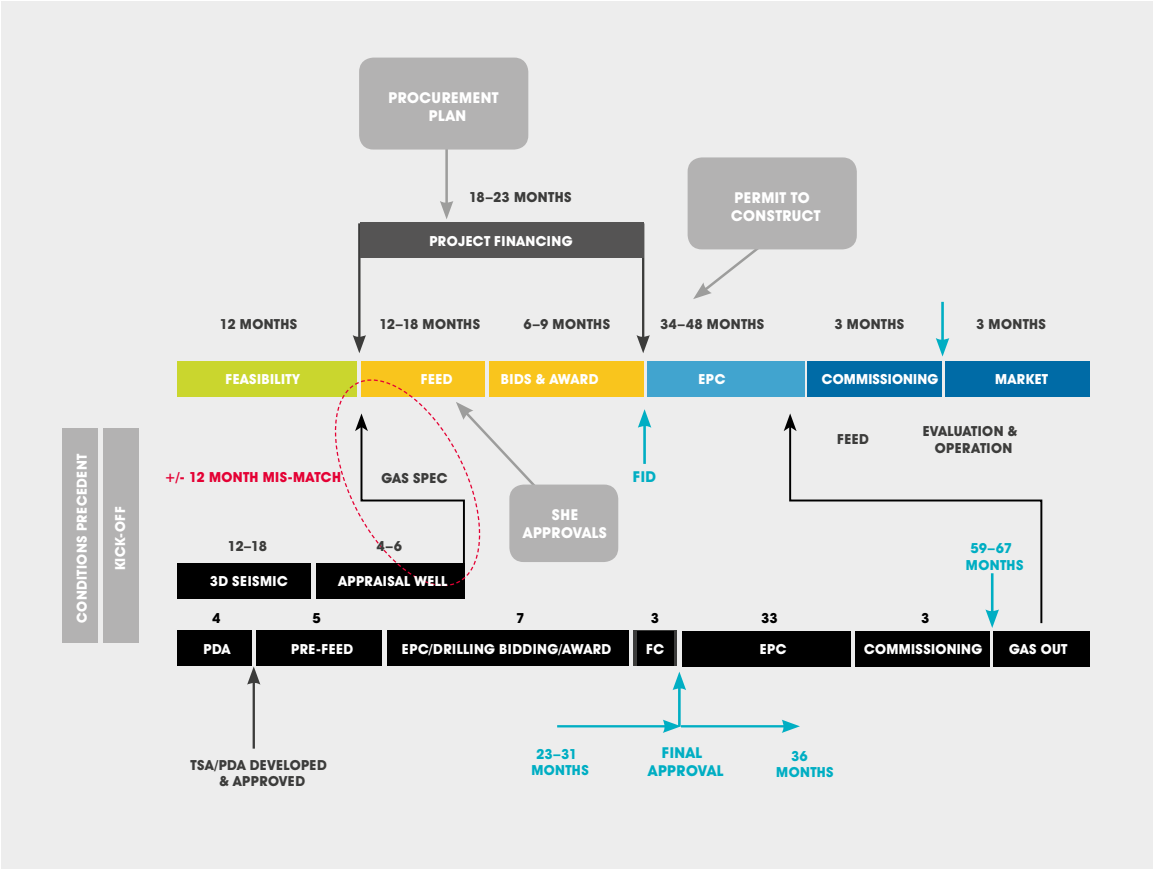

Figure 4 - Development operating timeline

Tip: Create separate input cells in your model for start dates and durations of different phases.

Lastly, it is important to recognise the intrinsic relationship between project schedule and capital cost.

DEVELOPMENT AND OPERATING TIMELINE: **WHAT SHOULD I CONSIDER?**

Download the full checklist here

- **Project development schedule and duration**
  - Exploration and appraisal phase
  - Development phase
  - Pre-FEED phase
  - FEED phase
  - EPC phase
  - Operations phase
  - Abandonement phase
- **Project / model end date**
  - Input (Supply Contract)
  - Calculated (Depletion Contract)
- **Financial year ending date**
- **Tax paying year end date**

PRODUCTION VOLUMES

We could run a two day modelling course on production profiles alone! However, there are three components that determine feedstock and production volumes in a cash flow model:

- Material and Energy Balance (Production Rates)
- Production Days (Plant Availability)
- Economic Useful Life (Operating Life or Total Reserves)

Production days are the one component most susceptible to "manipulation" given the underlying components.

Production days (i.e. online days) are defined as the weighted average number of days per calendar year that the plant is producing output at its designed capacity.

Production days include a production ramp-up period, downtime owing to planned and unplanned maintenance and major maintenance shutdown. This is illustrated in Figure 5 below.

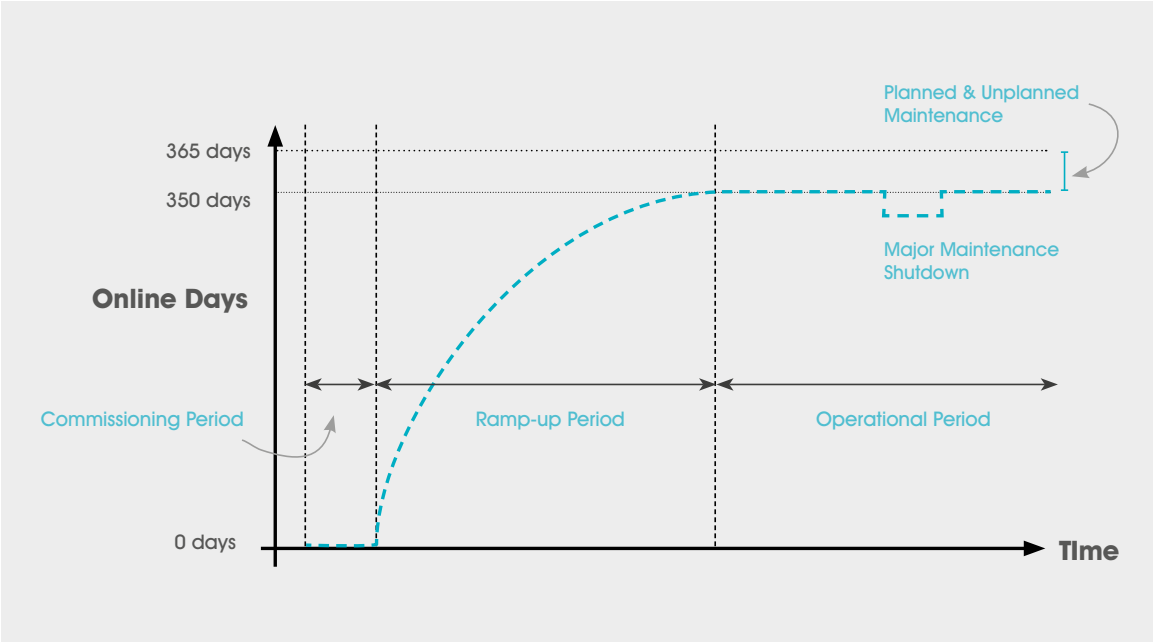

Figure 5 - Production days

Tip: Downtime owing to utilities and services supplied by others to the battery limits is usually excluded from production days.

If you develop a model for upstream oil and gas field development you also need to consider whether it is a supply or a depletion model.

A supply model will generally have a fixed operating duration, whereas in the case of a depletion model a check needs to be added to (i) ensure enough reserves are available for the next period and (ii) the operating cash flow continues to be positive.

PRODUCTION VOLUMES CHECKLIST QUESTIONS: **WHAT SHOULD I CONSIDER?**

Download the full checklist here

- **Production and sales volume modelling frequency**
- **Number of products / revenue stream**
- **Production and sales volume basis**
  - Volume
  - Energy
  - Mass
  - Other
- **Production calculation logic requirement**
  - Production / sales based on availability
  - Production based on available reserves (depletion contract)
  - Production / sales based on supply (supply contract)
  - Production based on drilling of wells
  - Production based on capacity
  - Input based production
- **Production / sales lifting calculation requirement**

PRICING AND REVENUE

Revenue from production is determined by multiplying volume produced or sold by the appropriate unit price of the product.

Sales Volumes

A common mistake is to assume that the technical ramp-up (physical output from the plant) equals the market ramp-up (what can be sold) - see Figure 6. This may not be the case, especially for downstream developments.

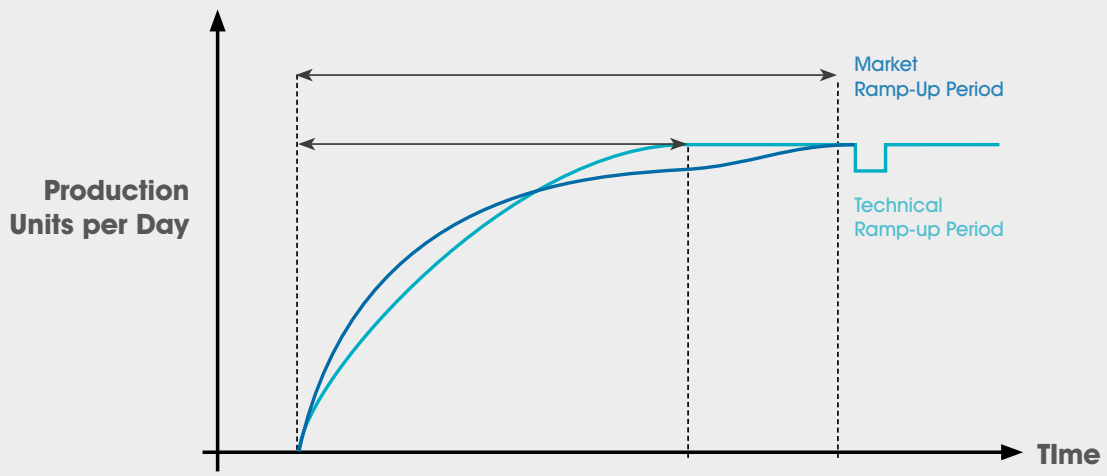

Figure 6 - Technical ramp up vs. market ramp up

This becomes relevant as you move down the value chain. For example, petrochemicals may take up to 3 years to penetrate the market to make full use of the technical design capacity of the plant.

Tip: Use an Excel functionality to test - MIN (Production, Sales).

Pricing

It is important to ascertain the price boundary of the price input data, see Figure 7 as an example of a gas value chain. Make certain you understand the context or the reference point for prices —in Figure 7; a Free on Board (FOB) price does not include costs of transportation—unlike a Delivered at Terminal (DAT) price.

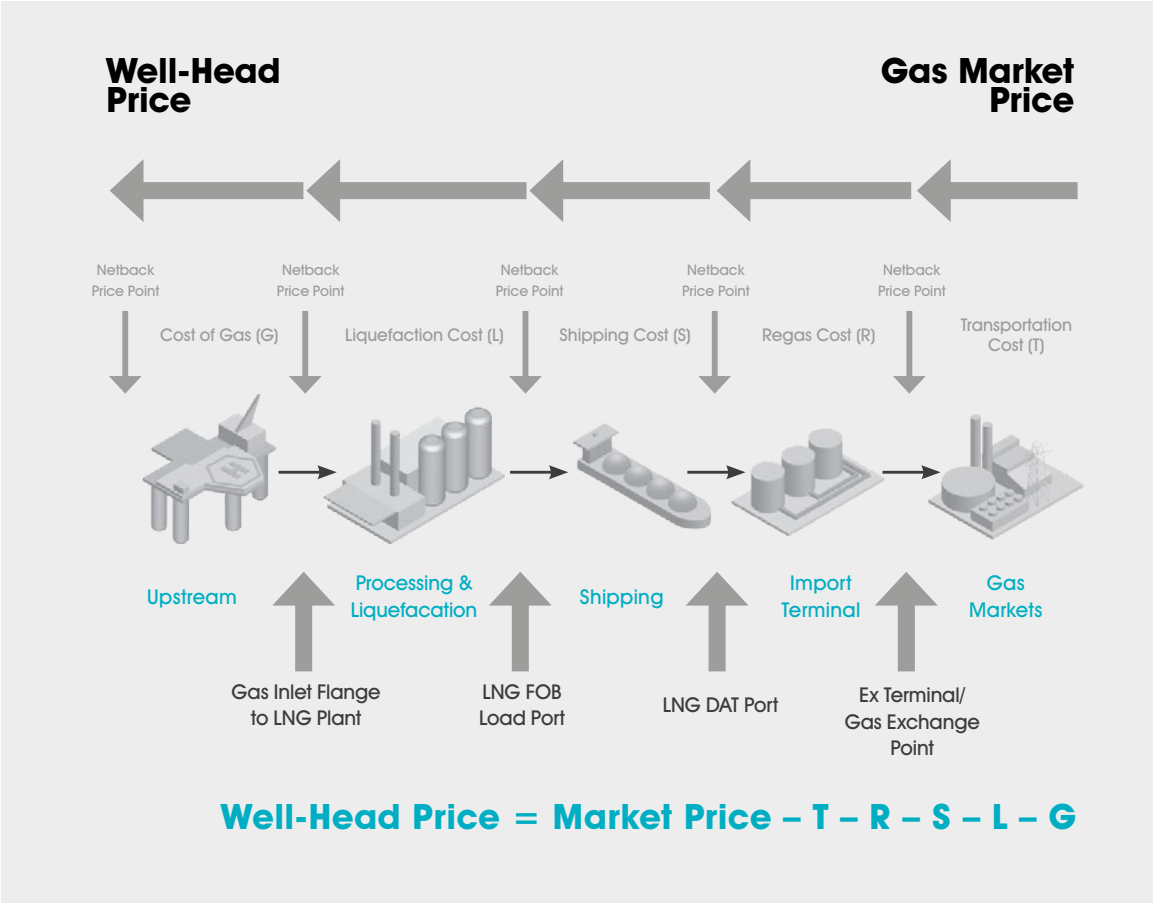

Figure 7 - Point of Sales

Tip - Incoterms (International Commercial Terms) rules are a series of pre-defined commercial terms that are widely used in international commercial transactions and procurement processes.

PRICING & REVENUE CHECKLIST QUESTIONS: **WHAT SHOULD I CONSIDER?**

- **Pricing inputs frequency**
- **Number of products for which prices will be available**
- **Pricing basis**
  - Volume
  - Energy
  - Mass
  - Other
- **Reference point for sales**
- **Pricing calculation logic requirement**
  - Pricing - indexation
  - Multiplicative pricing
  - Multiplicative incremental pricing
  - Additive pricing
- **Revenue modelling frequency**
- **Revenue modelling currency**
- **Revenue calculation requirement**
  - Upstream sales revenue (oil, gas and condensate)
  - Downstream sales revenue (diesel, naphtha, ethylene, toluene)
  - Tolling charges
  - Cogeneration revenues (electricity, power, triad)

OPERATING AND MAINTENANCE (O&M) COST

Ask a modeller in the oil and gas industry about costs and chances are they will think that capital expenditure ("capex") is more important than operating expenditure ("opex").

Yet over the life of the project, opex is often a much larger number than capex. In addition, it can be difficult to model given the varying characteristics of each cost (see table below). Take for example a major shutdown cost that occurs every 4 years.

Description	Type	Link
Feedstock	Variable	Production Days
Process Materials and Consumables	Variable	Feedstock / Products
Catalyst and Chemicals	Variable	Feedstock / Products and/or Time
Licence Fees	Variable and / or Fixed	Feedstock / Products
Utilities and Effluent	Variable	Feedstock / Products
Maintenance Materials and Spares	Fixed	Time Factor with three distinct time periods with an associated cost: 0 – 2 years - Equipment is new and spares are available from initial purchase as part of capital cost. 3 – 5 years - Some equipment needs to be replace and/or overhauled. 6 – 25 years - All equipment needs maintenance.
Major Maintenance Shutdown Costs	Fixed (Cyclic)	Time Factor with three distinct periods with an associated cost: 1st - Initial shutdown all equipment will be inspected and cycle time will be influenced. 2nd - Building on 1st on lessons learned. 3rd - Standard cycle.
Labour Costs	Fixed	Time Factor
Laboratory	Fixed	Time Factor
Overhead Costs	Fixed	Time Factor
Marketing Costs	Variable and/or Fixed	Products and / or Time Factor
Insurance	Fixed	Time Factor

A common mistake in modelling operating cost is to use an average annual value. Annualisation does not always result in a good prediction of cash flow.

Abandonment costs can be a significant component of the cash flow.

OPERATING AND MAINTENANCE COST **WHAT SHOULD I CONSIDER?**

Download the full checklist here

- **O&M costs modelling frequency**
- **O&M costs modelling currency**
- **O&M costs inputs characteristics**
  - Total fixed cost as single input
  - Total variable cost as single input
- **O&M costs modelling requirement**
  - Total fixed cost as single input
  - Total variable cost as single input
  - Total maintenance cost as single input
  - If detailed O&M costs modelling is required:
    - Feedstock
    - Fixed operating cost
    - Shutdown cost
    - Training and development cost
    - Maintenance services cost
    - Corporate support
    - Legal support
    - Public and community relations cost
    - Travel expenses
    - Licences and permits cost
    - Advisors'/ brokers' fees
    - Laboratory costs
    - Well fixed cost
    - Variable operating cost
    - Salary and wages
    - Benefits
    - Health, safety and security
    - Operation services
    - Vehicles and plant cost
    - Administration cost
    - Utilities and overhead cost
    - Minerals cost
    - Ramps and tunnels cost
    - Transportation cost
    - Other operating cost 1
    - Other operating cost 2

WORKING CAPITAL

Working capital is cash that must be employed to initiate and keep the project running. Initial development of inventories (examples of inventory include filling pipelines, and tanks to a working level) and the delay between revenue and cash receipts from revenue creates a need for interim capital. In accounting terms this is the difference between current assets (accounts receivable and inventories) and current liabilities (accounts payable).

I came across a team a few years ago that had to go back to their board and ask for 100 million US dollars because the time lag between start of operations and when cash from revenue was first received was not included in the original cost.

A calculation of working capital is illustrated below (Figure 8).

- Receivable days: the time between the sale of final product (invoice date) and the collection of the receivable.
- Payable days: the time between receipt of feedstock and payment made for the feedstock.
- Inventory days: the time it takes to process feedstock acquired, produce and sell final product.

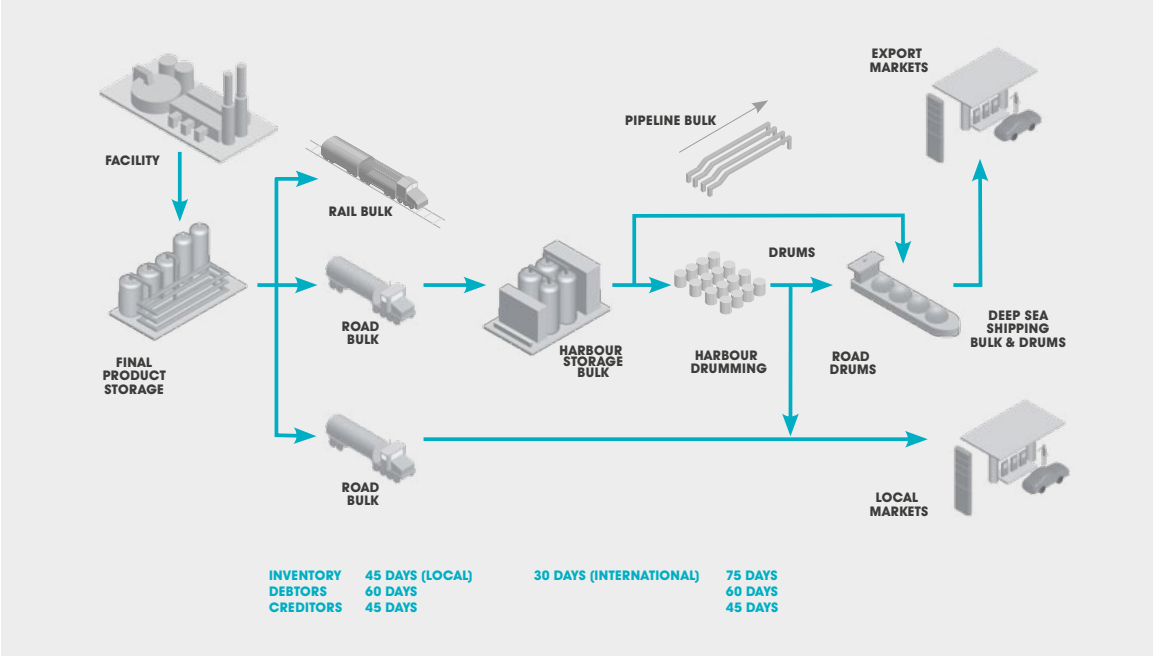

Figure 8 - Working capital

Accounts receivable may be modelled as receivable days multiplied by daily revenue. This represents amounts owed by customers at a balance sheet date.

Accounts payable may be modelled as payable days multiplied by daily cost of purchases. This represents amounts owed to suppliers at a balance sheet date.

Inventory may be modelled as inventory days multiplied by daily production cost. This represents cost in inventory at a balance sheet date.

Working capital is the difference between current assets (accounts receivable and inventories) and current liabilities (accounts payable).

WORKING CAPITAL CHECKLIST QUESTIONS: **WHAT SHOULD I CONSIDER?**

- **Working capital calculation requirement**
  - Accounts receivables
  - Accounts payables

- **Working capital calculation requirement**
  - Single product inventory
  - Multiple product inventory

FISCAL

If you can model oil and gas fiscal regimes then you can model most things.

Countries apply a range of fiscal regimes to the petroleum industry. Moreover, most producing countries have established separate and distinct tax legislation laying down the specific fiscal terms that are to be applied in calculating the revenues and taxable profits of their hydrocarbon industry. The principal fiscal forms currently in use in the petroleum industry fall into one of four categories (Figure 9). These are:

- Tax and Royalty Concessions
- Production Sharing Contracts
- Risk Service Contracts
- Technical Service Contracts

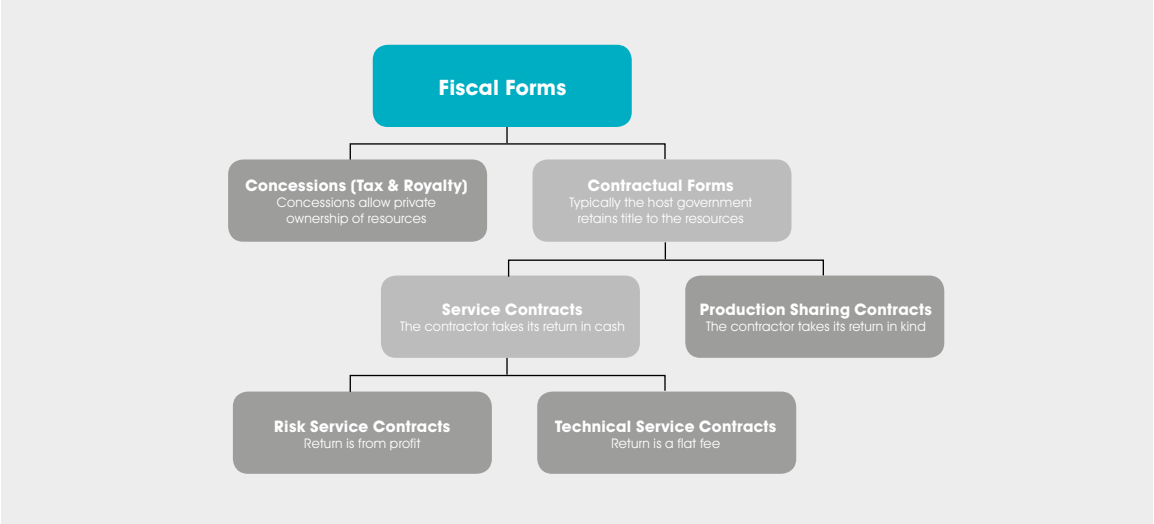

Figure 9 - Fiscal forms

For modelling tax, start with the basic elements (for example corporation tax and capital allowances / tax depreciation) since these will have the largest impact on the results.

If you are required to model production sharing contracts, then draw a block flow diagram before starting to model since you may encounter counter flows in the model.

Tip: Consult a tax expert as early as possible for proper tax assumptions as tax treatment may vary significantly (i) from one country to another and (ii) type of cost for example capital cost vs. operating cost. In addition, the tax treatment for interest payments, overhead costs, research and development may require special handling.

FISCAL CHECKLIST QUESTIONS: **WHAT SHOULD I CONSIDER?**

- **Fiscal Forms**
  - Concessions (Tax & Royalty)
  - Production sharing Contracts
  - Technical Service Contracts
  - Risk service Contracts
- **Production sharing / cost recovery frequency**
- **Production sharing / cost recovery currency**
- **Profit pool sharing**
- **Royalty**
- **Production bonus**
- **Signature bonus**
- **Government carry cost included**
- **All costs are recoverable**
- **Cost recovery priority**
- **Tax deductible expenses / costs**
- **Excess cost pool treatment**
- **Tax and royalty**
- **Tax / royalty payment frequency**
- **Tax / royalty payment currency**

- [x] **Other taxes**
  - [x] VAT on operating cost
  - [x] VAT on operating revenue
  - [x] VAT on capital cost
  - [x] Corporation tax
  - [x] Royalty
  - [x] Withholding tax
  - [x] Property tax
  - [x] Other taxes
  - [x] Tax loss carry forward / expiry
  - [x] Deferred tax
  - [x] Dividend tax

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