Chapter 4
From Concept to Project Approval

Ideas are two a penny.
Bill Gates

Abstract The aim of this chapter is to describe the asset development process from concept to project approval. This chapter shows how asset management works with other parts of the organization in order to create sound development plans. The focus is on procedures for larger scale developments, such as major acquisitions. The chapter starts at the concept level, goes through the preliminary approval stage, to feasibility planning and on to final project approval. *Outcomes* After reading this chapter you will know about:

- The stages involved in asset development;
- The structure and role of development planning teams;
- The concept of capability, with examples;
- The identification of business needs;
- The concept of capability gap analysis, the development of a capability requirements statement and an operational concept;
- Prefeasibility analysis of development options, leading to a proposal at the preliminary approval stage;
- Feasibility analysis and the creation of an acquisition or development plan.

4.1 Project Initiation

Business development generally involves a senior level group which identifies business development needs and examines options for meeting those needs. This involves establishing priorities, assessing financial returns, assessing sources of funding and possible constraints. If an option appears favorable, the development

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group will initiate a major development project. The rationale behind asset intensive projects may be one or more of the following:

a. Capacity creation, expansion, reduction, or consolidation
b. Process cost reduction
c. New or improved business opportunities or directions
d. Renewal or updating of existing capacity
e. Process improvement in yield or quality
f. De-bottlenecking
g. Protection of assets
h. Technical developments, internally and externally
i. Environmental or safety improvements
j. Response to regulatory changes.

Development ideas may have a *top-down* or a *bottom-up* origin. A top-down development will originate with senior management. A bottom-up development will start in the operations areas rising through the hierarchy and then feeding into the business development process. The organization should encourage business development from the bottom-up as well as from the top-down. Workplace personnel and managers close to the workface are in an excellent position to see how improvements can be made, often on a very cost-effective basis. They should be encouraged to develop and bring forward proposals in a spirit of *continuous improvement.*[1]

For a concept to proceed into the mainstream of development planning, the backing of senior management must be achieved. A *project initiation budget* needs to be set aside, and procedures established, for the purpose of getting ideas to "square one" of the development process.

4.2 Types of Acquisition or Development

Several different types of asset acquisition or development processes can be identified as follows:

a. Off-the-shelf acquisition
b. Business development but not primarily acquisition
c. Design incorporating selection of off-the-shelf items
d. Design from the drawing board but standard technology
e. Introduction of technical change
f. Design with developmental technology
g. Research and development.

An off-the-shelf acquisition is one where we acquire an existing product, with no design or modification involved. With off-the-shelf acquisitions the logistic

[1] ISO 55002 Clause 10.3.

support requirements should be readily met and often are available as a standard part of the acquisition package. As we proceed down the above list, the level of complexity increases and so does the risk in the project. Businesses should be wary of projects that involve significant amounts of development work as they often lead to technical problems and delays. In such cases it is best to undertake a pilot project initially to eliminate as many unknown factors as possible.

4.3 Business Development Planning

Business development is a key role of senior management. Development planning requires confidentiality, as plans are discussed which may influence the overall direction of the business, but which are still in a state of flux. A *business development group* is normally established to generate, assess, and monitor major potential developments. In looking to the future, the business development group will need to draw on specific asset knowledge and in this situation the existence of a recognized asset management group with the necessary knowledge and skills is an advantage.

4.3.1 Major Projects

An example of a major strategic development decision is a commitment to develop a new mine. For example, a mining company may be considering developing a mine which will produce particular mineral, say nickel. A decision as to whether to proceed with the development of the mine will depend on an assessment of the current and future demand for and forecast price of nickel, the development cost of the mine, the production cost per tonne, the likely yield and other factors such as transport costs, energy costs, and regulatory issues.

Once a concept takes on the aspect of a major project, which usually means exceeding some financial threshold of the order of tens of millions of dollars, a development planning team will be formed. The asset management group, or equivalent, will play a key role here, particularly in regard to the asset acquisition and sustainment aspects of the project.

The stages of development of a major project are as follows:

- Project initiation
- Capability requirements analysis
- Prefeasibility analysis—identify options
- Feasibility analysis—detailed plan
- Project approval
- Implementation.

Figure 4.14 Steps in the Asset Management Process, provides more detail of the steps involved in a major asset development project, and the subsequent sustainment of the asset in-service.

4.3.2 Minor Projects

Minor projects play an important role in supporting and developing business performance. These developments may be handled within operating divisions and often form part of existing job activities rather than giving rise to specially formed teams. The logic of the steps involved in appraisal and implementation is much the same in both major and minor cases, but the volume of work is less in a simple acquisition or a development with modest logistic support needs.

4.3.3 Developmental Flexibility

In this chapter we describe processes for the assessment of business needs and the determination of asset requirements. In practice, our processes must not delay acquisition or development unnecessarily. Where the business justification is clear and the needs can be met by well-recognized steps, then our organization should be such that we can proceed without delay.

In a warehousing operation, for example, if additional forklift capacity of a standard type is needed, a rapid and favorable assessment of the factors involved should result in the acquisition of an additional machine within days. On the other hand, the development of a new warehouse site would involve a detailed analysis of issues such as future demand, site availability, site access, materials handling, and personnel requirements for operations and support. The extent of our deliberations, in terms of detail and time, should reflect the level of complexity and degree of urgency of the business need, and the acquisition or development process should adapt accordingly.

4.3.4 Delegation of Financial Authority

The organization should encourage business development from the bottom-up as well as from the top-down. Workplace personnel and managers close to the work-face are in an excellent position to see how improvements can be made, often on a very cost-effective basis. To take advantage of this there should be delegation of financial authority to intermediate and lower management levels. In addition, it is desirable to provide a budget for unforeseen events or contingencies.

Minor projects can form a basis for addressing problems or initiating development ideas which are then evaluated. The results will form a basis for expanding on or alternatively abandoning an idea. Adequate local financial discretion will tend to avoid the asset death spiral. An example of guidelines for financial delegation within a company is shown in Table 4.1. The “Unforeseen” category is a contingency budget enabling managers to react quickly to unforeseen events.

Table 4.1 Financial delegation example

Project type	Value range	Approval level	Management level
Small	$0–10,000	Local	Local
Minor	$10,000–100,000	Division	Local
Medium	$100,000–2,000,000	Business	Division
Major	$2,000,000+	Business	Business
Unforseen	To $100,000	Division	Division

4.4 Capability

An important concept in business development planning and in asset management generally is *capability*. Capability is the ability of a system to meet a specified need in all its aspects. That is, it covers the combined concepts of capacity and ability, including all the assets and associated personnel, resources and services which are required to meet the need. It is essential that those involved in business development planning understand the concept of capability, as otherwise they will not take a sufficiently comprehensive view of all aspects of a development.

To illustrate the meaning of "capability" consider the example of a fire station. The primary assets are the fire engine or engines and the building which houses them. However, the total capability required, goes beyond these primary assets. There is a need for provision and storage of a range of firefighting and fire protection equipment, basic medical equipment and supplies, control and communications equipment, office space and equipment, electricity and water supplies, transport access roads and parking space, short term food supplies, the provision of training rooms and training facilities, the availability of personnel to staff the facility, and planning, and training for operations and maintenance. These elements in total comprise the firefighting capability which is needed. Figure 4.1 summarizes

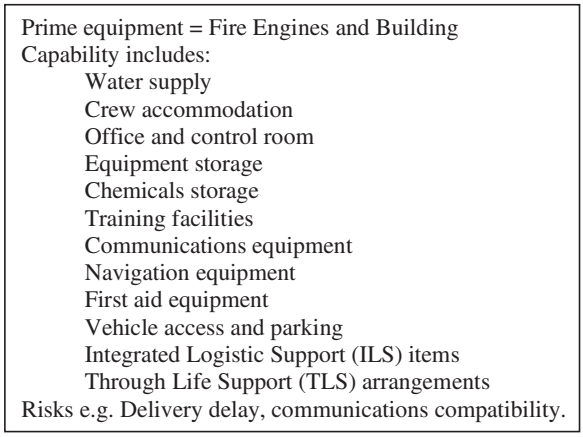

Fig. 4.1 Capability example—fire station

Fig. 4.2 Inputs to capability in the general case

this. In addition to the basic list of items, technical specifications will also be needed, such as the quantity, capacity, or level of service. The key point here is to be aware of the extensive range of items which typically constitute a capability.

Figure 4.2 illustrates the types of inputs to asset capability in a general case.

4.5 Capability Requirements Planning

Capability Requirements Panning is the determination of the capability requirements needed in order to support a planned business activity over a planning horizon. Figure 4.3 indicates the steps in capability requirements planning.

Capability requirements planning starts with *demand analysis*, that is, an assessment of the demand for a product or service, originating from the customers,

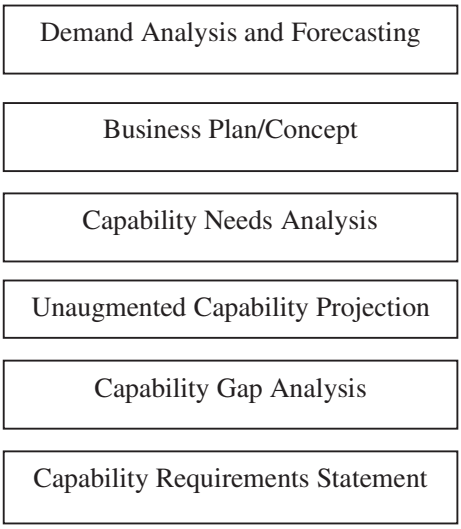

Fig. 4.3 Capability requirements planning

users, or stakeholders. Based on this demand, a business plan is developed. We then proceed into a *needs analysis*. A *needs analysis* is an assessment of the total capability required to support the business plan. An example is where the growth or reduction in demand for electricity, leads to a plan to expand or reduce the supply. This leads to an estimate of the generating capacity, transmission capacity (i.e., high voltage lines), and distribution capacity (i.e., local supply lines) needed at various geographical points over the planning horizon.

The next step is a projection of the *un-augmented asset capability*. This is the available capability, projected over the planning horizon, if no new development is undertaken. To assess this we start from the existing capability and project forward, taking into account all factors which will deplete this capability, such as the retirement of old plant, the impact of technical and regulatory changes and also any augmentation from the coming to fruition of existing committed plans. In this step we do not consider the addition of new capability which has not yet been approved. The result will be a projected available level of generating, transmission, and distribution capacity going forward in time.

The next step is *capability gap analysis*, where we identify the gap between the required capability and the projected un-augmented capability. This analysis will indicate a capability gap moving forward in time. In the electricity generating case the gap will be in megawatts of generating capacity and may also reflect legislation on the source of energy.

From the capability gap analysis we construct a *capability requirements statement*, which is a statement of the capability which we need to acquire to fill the gap. This statement will address both the quantity and type of capability required, the timings required, and issues such as level of service, essential criteria, and desirable criteria.

The capability requirements statement will form the starting point for the creation of a development plan which will deliver the capability necessary to support the business plan.

4.5.1 Development Planning Teams

The senior management of the organization will exercise a review function which will include an initial assessment of major development proposals. When a major proposal is seen as having potential it will become part of the *Requirements Portfolio* of projects and a development planning team will be formed. A development planning team is a group of people whose job is to plan the development.

Development planning teams will appear in the organizational chart as shown in Fig. 4.4 and will report to a development manager. They will draw on personnel from the Business Development Group, on the user area most involved in the development, and on asset management personnel with skills in the development area. Key stakeholders will be identified and brought in as required. The team will

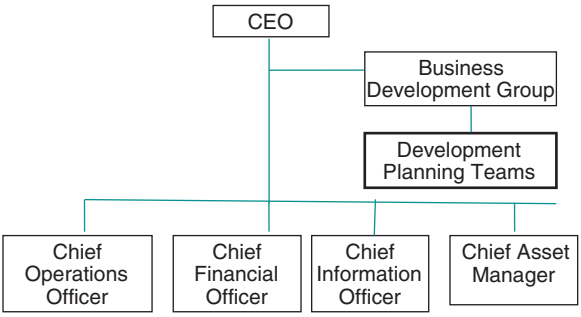

Fig. 4.4 Development planning teams in the organizational structure

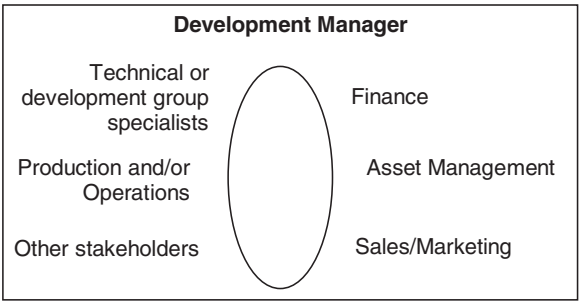

Fig. 4.5 Sources of development team representation

report to the head of business development, and through him, to the board of the company.

For large projects, subsidiary working groups may be established to deal with specific issues. If necessary, a separate exploratory or trials stage will be established. It is better to put in the effort at the early stages of a development than to rush into a project which later turns out to be technically or financially unsound, though in any case there is always an element of risk remaining.

Some asset-based businesses involve a continual succession of projects, such as small- or medium-sized building or equipment renewal projects, and they will be organized to deal with this routinely. The organization of each project will depend on its size and complexity. For smaller projects, the development will take place within the relevant operational area.

Figure 4.5 illustrates sources of development team representation.

4.5.2 Demand Analysis and Forecasting

"If you can look into the seeds of time
And say which grain will grow and which will not,
Speak then to me."
Shakespeare, Macbeth

An underlying factor in development planning is forecasting future demand for the product or service. Forecasting is a general business challenge, but current asset knowledge and related technical knowledge make asset managers important contributors to the forecasting process. The simplest cases involve an extrapolation of current demand, for example, increasing demand for infrastructure and services in areas of urban growth. Harder to predict are the effects and speed of technological change and the actions of governments which can radically and unpredictably intervene in markets and influence the pattern of demand.

In the forecasting process we consider the following aspects for a given product or service:

- Level. What is the existing level of demand?
- Trend existing. Is the level of demand currently rising, falling, or remaining steady?
- Trend forecast. Are there market or technological factors that can affect trend in the planning period, and if so, in what direction?
- Seasonality. Are there seasonal or other cyclic factors that affect demand?
- One-Offs. Are there one-off or rare events which need to be allowed for?
- Outliers. These are past events which may need to be considered separately, for example, a flood, storm, or fire which may or may not recur.

However good the forecast, unforeseen changes can occur. For this reason, an important consideration is flexibility. Asset options which facilitate flexible responses to change are often better than longer term fixed commitments.

4.5.3 Demand Management

Demand management is the use of techniques which influence the demand for a product or service, in contrast to planning to meet the "unmanaged" demand. An example is to have a suitable pricing policy. The provision of a nominally free or heavily subsidized service of some type, such as public transport, can result in excessive levels of demand on the one hand, or in the provision of services that few people use. A guideline is to avoid subsidies, as the fact that there is no such thing as a free lunch will then combine with Adam Smith's invisible hands to produce a manageable and sustainable result. Sure thing!

4.5.4 Needs Analysis

Needs analysis is the identification of what the organization needs in terms of asset capability in order to support its business plans. Initially, needs analysis works at the level of prime equipment and takes a broad view of business development. Any actual development requires a more detailed consideration of the factors involved in achieving and delivering a capability.

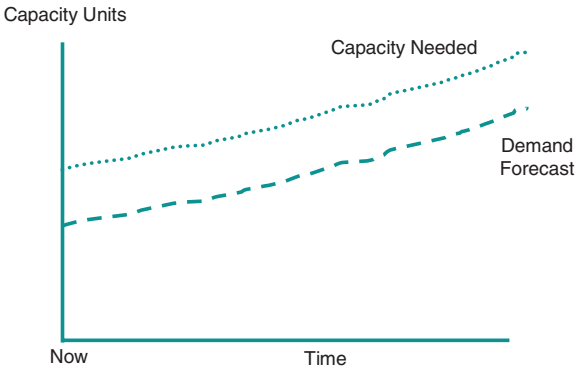

Fig. 4.6 Needs analysis

Needs analysis looks at several time frames on a rolling basis, such as 0–5 years, 5–10 years, 10–20 years. Analysts consider likely scenarios and responses to those scenarios, and identify the capability needs of the organization over the corresponding periods. This requires a good understanding of how business functional requirements convert into asset capability requirements.

Given a demand forecast, Fig. 4.6 schematically illustrates the principles of needs analysis at a simple level. The dashed line shows a projected increase in demand for a product or service. The dotted line shows the projected level of capacity needed in order to meet the demand, allowing for some spare capacity to accommodate variability and risk.

4.5.5 Un-augmented Capability Analysis

The next step in capability requirements planning is to assess what the capability will be over the planning horizon if no augmentation is carried out. We estimate the decrease in our production or service capacity if no acquisitions are made. Primarily, this decrease will be due to older equipment being retired or becoming obsolete. In Fig. 4.7 the light solid line, labeled "Capacity if no Acquisitions" shows the projection of the un-augmented capacity.

4.5.5.1 Remaining Life and Retirement Schedule

In assessing the un-augmented capability we consider the retirement of existing assets as they age. For capability requirements planning purposes we also need to consider the lead time required in order to replace them, whether as a direct replacement or as part of an alternative solution. Planning decisions must be made in sufficient time to allow for the lead time activities of the acquisition process.

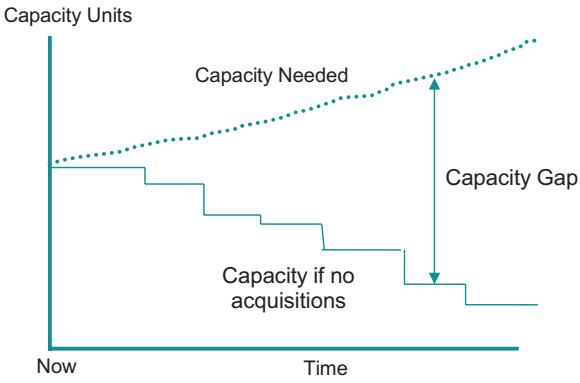

Fig. 4.7 Capacity gap

Details of this type of planning process is considered in Chap. 7—Asset Continuity Planning. At this stage we need to be aware that a retirement schedule has to be created for existing assets and that this will provide input into the "un-augmented capability" part of the needs analysis.

4.5.6 Capability Gap

The capability gap is the gap, projected forward over the planning horizon, between:

a. The capability that we need.
b. The un-augmented capability.

The gap may be positive or negative, that is to say, there may be a shortage of capability or an oversupply. The gap is the driver for new capability or, in the case of excess, for the disposal or reallocation of resources.

Figure 4.7 illustrates the capability gap, but for simplicity it is shown only as a single, or prime equipment, capacity level. The light solid line, labeled "Capacity if no Acquisitions" shows the projection of the un-augmented capacity. The gap between the capacity needed and the un-augmented capacity is the capacity gap. We may also refer to this gap as the *preplan capacity gap*, since it represents the situation before any plans to fill the gap are introduced. In practice we would consider a prime equipment capacity gap initially and then follow up with a consideration of the related subsidiary items of the capability. The gap will vary through time, in this case increasing as demand rises and un-augmented capacity falls. It is important to project the gap forward on the basis of the un-augmented capability, otherwise a lack of appreciation of the variations in the gap over the planning horizon can lead to the development of inferior capability plans. In some instances the gap may rise and then fall, suggesting that the company should plan to cope with a temporary rise which is quite different to dealing with a permanent one.

4.5.7 Capability Requirements Statement

Having completed the capability gap analysis, the development team prepares a *capability requirements statement*. This statement identifies the capabilities which are required to fill the capability gaps. The capability requirements statement forms a basis for further analysis and refinement toward a development plan. The statement must provide sufficient information to act as a starting point for subsequent development analysis, and take account of the financial aspects of the decisions, but great precision is not expected at this stage.

For example, a capability requirements statement may specify that a company will require trucks with sufficient capacity to move a specified volume of goods over specified routes, and logistic support for those trucks. The statement will also specify factors of timing and cost based on stated market expectations. The capability requirements statement will also specify *decision criteria* that any feasible plan should meet. Some of the criteria will be deemed to be essential, such as the ability to move a given volume of goods, and the ability to meet certain design regulations, whereas other may be desirable, for example, a requirement relating to fuel consumption.

4.6 Value Engineering

Value engineering is a systematic process of reviewing any acquisition proposal to see how it might be achieved in a cost-effective manner. It can be applied to the capability defined in the Capability Requirements Statement, or at other stages of an acquisition process. It involves asking a series of questions which in practice often lead to cost reductions, logistic support savings, or design improvements. At the same time we must avoid a "penny wise, pound foolish" approach, which may make short-term savings but cause longer term expense, and compromise the aims of the development.

Figure 4.8 provides a checklist of questions typical of value engineering.

Questions	Comments
Can the function or equipment be eliminated	
Can the function be achieved in another way	
Is there a cheaper alternative	
Are all the features of the equipment required	
Is the capacity greater than necessary	
Can cheaper materials be used	
Can parts be standardized	
Are the finishes specified essential	
Can installation time be reduced by design changes	
Can energy consumption be reduced	
Can maintenance costs be reduced	

Fig. 4.8 Value engineering checklist

4.6.1 Value for Money

A related concept is the need to provide value for money, that is, not to spend money unnecessarily on items or features that are not essential. This may be obvious to the person who provides the money, but needs to be emphasized in situations where the purchaser is remote from the funder, for example, in public sector purchases.

4.7 Creating the Development Plan[2]

Management will review the capability requirements statement and decide if the project is to go forward. If so, the project will move out of the requirements portfolio and go into the *planning portfolio*. The capability requirements statement is the starting point for the creation of plans to fill the capability gap. In the case of a major development, these plans are developed in two stages, referred to as Prefeasibility Analysis and Feasibility Analysis. If the project proceeds successfully through these stages, this leads on to the acquisition and implementation of the capability. Figure 4.9 shows the steps at the prefeasibility and feasibility analysis stages. In practice the level of formality in moving through the planning process will depend on the complexity or otherwise of the project and the timing requirements of the development. However, the basic logic of the process is valid, even when some steps are accelerated.

4.8 Prefeasibility Analysis

Prefeasibility analysis starts from the requirements determined in the capability requirements analysis stage. The analysis considers the scope of possible responses to the requirements statement and examines options for delivering them. A preferred option or small range of options is selected. It is important not to get emotionally committed to a particular option too early in the analysis. Prefeasibility analysis may indicate that some aspects of the capability requirements statement require review, resulting in reference back to the requirements planning stage.

The result of the analysis is a prefeasibility plan and an initial business proposal for the project. The proposal seeks approval to proceed to the feasibility analysis stage where a fully detailed and costed plan will be developed. The selection of a specific supplier will normally remain open at this point.

[2] ISO 55001 Clause 6.2.2 Planning to achieve asset management objectives: "The organization shall integrate planning to achieve asset management objectives with other…planning activities…."

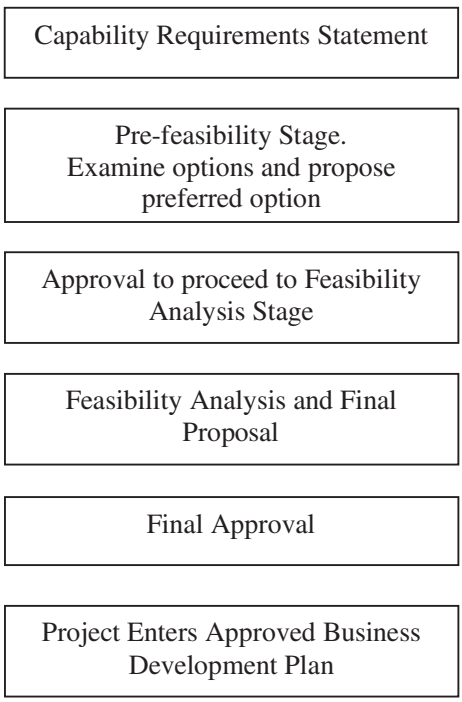

Fig. 4.9 Prefeasibility and feasibility analysis stages

4.9 Feasibility Analysis

If the prefeasibility plan for a project is approved, the project enters the feasibility planning stage. Here the plans for the preferred option from the prefeasibility stage are subject to detailed analysis and costing. A feasibility planning project team will develop the analysis and there will be a broader stakeholder review which will provide feedback to the project team.

The result of feasibility planning is a development plan and a final business proposal. If this leads to a final decision to proceed, the project then enters the approved business development plan and moves forward to the physical acquisition or implementation phase.

4.10 Development Plan

The development plan will indicate what assets are planned to be acquired and when. In Fig. 4.10 the heavy line at the top shows a series of planned acquisitions which will be sufficient to keep capacity at a satisfactory level. A significant amount of supporting analysis and detail will normally accompany the plan, and we consider aspects of this in more detail in subsequent sections.

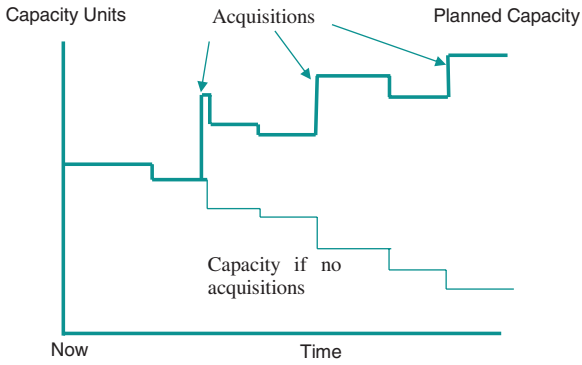

Fig. 4.10 Asset development plan

4.11 Development Plan Detailed Topics

The following is a list of topics which are typically covered in the development plan.

General Summary

- Title of plan
- Aims and scope
- Financial returns and costs
- Finance requirements and provision
- Schedule, date of decision
- Implementation and acquisition strategy and possible suppliers
- Risks
- Business case
- Prioritization

Requirements

- Land
- Civil works
- Buildings
- Machinery, equipment
- Tools, furniture, sundries
- Vehicles
- Facilities and resources
- Information technology
- Cleanup and restoration
- Disposal
- Capital costs
- Net operating costs
- Net people requirement
- Maintenance costs

- Materials
- Training
- Contingency allowance

Technical and Logistics

- Test and evaluation
- Project costs
- Maintenance concept
- Logistic support concept
- Life duration estimate
- Life cycle costs
- Health, safety, and regulatory considerations
- Associated changes or impacts

Background

- Stakeholders
- Assumptions
- Data analysis process
- Measure of success

The maturity of the feasibility stage can be assessed with the aid of the table shown in Fig. 4.13.

4.12 Considerations in Development Planning

4.12.1 Stakeholders[3]

Identify the stakeholders, that is, those people and functions that will be affected by the proposed plan. Survey their opinions and take them into account in developing, or even abandoning the plan. If necessary form a stakeholder committee. It is important to the success of any project that the stakeholders buy into the plan. Figure 4.11 shows some typical stakeholder groups.

For asset developments, the stakeholders normally include the relevant business, operations, and maintenance managers and staff. Where customers and suppliers are affected they will potentially form part of the stakeholder group, subject to business confidentiality. The plan is more likely to succeed if all the relevant groups have contributed to its development. At the same time, some stakeholders may resist the plan, particularly if they see it working against their interest, and it will be necessary to use management judgement and authority to present the

[3] ISO 55002 Clause 4.2 "The organization shall determine the stakeholders…the expectations of these stakeholders…"

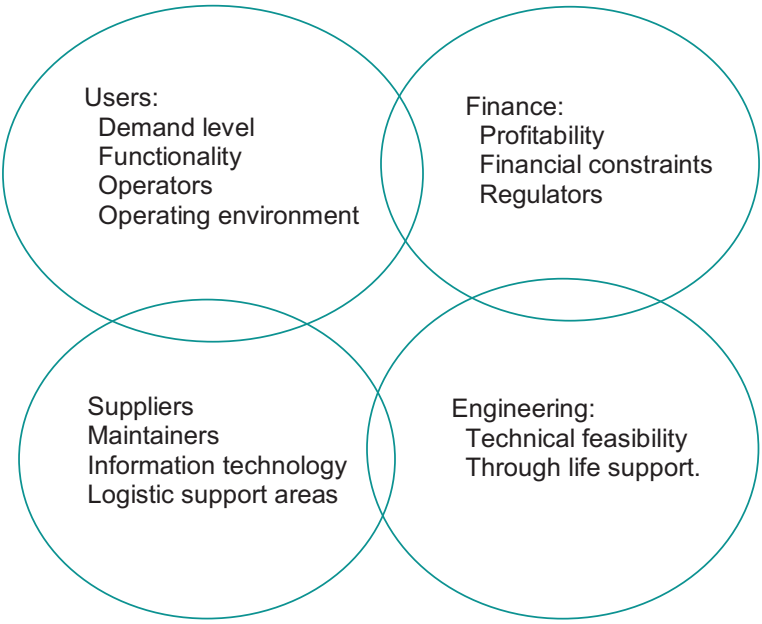

Fig. 4.11 Stakeholder groups

rationalization for the plan from the overall business viewpoint. But suffer fools gladly—they may be right.

4.12.2 Stakeholder Example

A modification to a machine is proposed which involves fitting a protective device designed to reduce rain and sun damage to exposed parts. This is estimated to prolong the life of the machine. The device will be fitted by maintenance staff during a servicing operation. Stakeholders involved are:

- Operations manager and operations superintendent—Production will prospectively benefit by extended machine life.
- Maintenance Superintendent—Reductions in scheduled maintenance and breakdowns are intended.
- Maintenance Department—Required to install the modification.
- Reliability Superintendent—Improvements in reliability and reduction in downtime will need to be estimated and later verified.
- Engineering—To confirm modification is technically acceptable. Involved in management of change.
- Stores Superintendent—Changed stockholding requirements.
- Component supplier.
- Financial—Approval of investment.

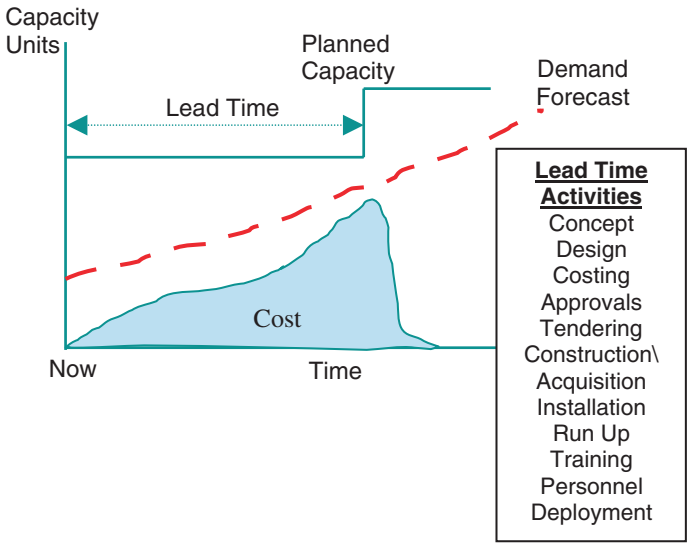

Fig. 4.12 Capital equipment lead time activities

4.12.3 Existing Processes and the Status Quo

In developing any plan it is important to be aware of the existing situation and the existing processes. Be sure to check out the existing situation and consult with stakeholders. Always consider the possibility of retaining the status quo, and use this as a basis for comparison.

4.12.4 Lead Time

An important factor in creating development plans is an appreciation of the amount of lead time required in order to introduce new equipment, and the range of activities which are essential to success. An indication of typical lead time activities is shown in Fig. 4.12.

4.12.5 In-Service Date

The Capability Requirements Statement will specify an "In-Service Date" as the date when a capability is planned to be available for service. This may be a single date or a range of dates in the case of a phased introduction. For a phased introduction we specify an Initial In-Service date and a Final In-Service date. An implementation timetable may also be needed. At the early stages, these dates

are preliminary estimates to be firmed up as the acquisition project proceeds. Awareness of the lead time activities and project progress will enable the project team to keep the end-user informed of potential changes to in-service dates. Adhering to the planned in-service date is a main target of the development team.

4.12.6 Date of Decision

To ensure an adequate focus on timing, it is desirable to specify a "date of decision" for the final approval of a project whilst it is in the capability requirements analysis and prefeasibility analysis stages. The many activities involved in an acquisition or development can easily be underestimated and this may result in the development not being completed in time to meet business needs.

4.12.7 Operational Concept Document

An operational concept document describes the characteristics of the proposed development in end-user terms. The simplest cases are expansions of existing functions. Other types of development may involve responses to new markets, new services, new technologies, or developments to existing services or processes. The development of this document will involve the operations group in working out how the new capability will be used and how it will work in with existing capability. This can involve market appraisal, technology appraisal, procedural appraisal, evaluation of competition, and financial appraisal.

Project studies may be undertaken to evaluate feasibility and potential profitability of probable options. For example, the organization may require an examination of capacity expansion options in terms of demand, revenue potential, technical options, staffing levels, and considerations of cost and timing, and disposal and redeployment.

The following factors are important in the development of the operational concept:

a. Meet the market need in terms of key outputs, characteristics and features,
b. Operationally practical,
c. Technically feasible,
d. Profitable,
e. Affordable,
f. Timing feasible,
g. Technically supportable,
h. No unsatisfactory risks,
i. Reliability, availability, maintainability satisfactory,
j. Meet design, environmental, health and safety standards,
k. Life adequate,
l. Retain some flexibility for revision as the acquisition develops.

4.12.8 Function and Performance Specifications

From the operational concept we develop functional and performance specifications for the key assets required. This about specifying how big, how strong, how many seats, how heavy, what power, what flow rate, how many bedrooms, how many bathrooms, how many garage spaces, what voltage, what noise level, etc., we require in the intended assets. Some features may be *essential* and some merely *desirable.* In developing specifications it is important not to get carried away and set specifications which are unachievable or will imply development work, unless development is a planned part of the project. Refer to existing performance standards and keep to modest variations.

4.12.8.1 Example

A specification for a new design of rotating turret for a vehicle required a rotational speed which was set to a high level without reference to existing performance standards. At the prefeasibility stage it became apparent that to achieve this performance would require a radical redesign of the drive system and quite infeasible changes to the vehicle body. Reference back to the capability requirements team showed that, once they related their specification to existing systems, they were quite happy to accept a rotational speed comparable to existing best practice, rather than the wildly optimistic number originally specified.

4.12.9 Level of Service[4]

Level of service relates to setting standards in such areas as performance, availability, reliability, timeliness of response, and provision of information when problems arise. Level of service relates to corresponding performance indicators. As an example, in a railway system, a performance indicator is the proportion of services that are not canceled due to train unavailability, and a corresponding level of service is a specification that this should be, say, 97 % or more.

4.12.10 Scope of Work

The scope of work details the work to be done and/or acquisitions to be made. This will be refined as the project firms up and will ultimately form a basis for procurement level costing and contracting.

[4] ISO 55000 Clause 3.3.6.

4.12.11 Financial Analysis

Preliminary appraisals of revenue potential, costs, and profitability will be carried out and will be refined as the proposal proceeds. The analysis will be supported by data and estimates and a statement of assumptions, including the following:

- Demand forecast
- Revenue forecast
- Personnel and operating cost
- Equipment life cycle cost estimate
- Profit and Loss projection
- Cash Flow projection
- Balance Sheet projection
- Payback period, Internal rate of return
- Sensitivity analysis in regard to assumptions, particularly demand and costs
- Identification of major risks, business, technical, and regulatory.

4.12.12 Acquisition Strategy

In considering acquisition and development options it is important to ensure that they are feasible from a delivery point of view. A development team may be over-optimistic in assessing what the suppliers can supply and what the developers can develop, within a given timescale and cost envelope.

A danger lies in assuming that an acquisition is of an off-the-shelf nature when in fact it requires adaptation to suit our needs. In this case it is advisable to undertake the adaptation as a separate project, and only to proceed to the main project when we are sure that our needs can be met within desired business parameters.

Another factor is the availability of resources to implement any acquisition or development plan. This includes consideration of the availability of personnel for design and development functions, for equipment specification and evaluation and for cost analysis, legal and financial support and engineering support for acquisition and system implementation. Restrictions in these areas may be critical in reducing the range of projects that can be undertaken.

A summary of points relating to the acquisition strategy is as follows:

a. What potential suppliers are available?
b. How extensively should we canvas for potential suppliers?
c. Do the potential suppliers have the necessary technical depth and logistic support strength?
d. Should we adopt a preferred supplier list? If not, is there a danger of excessive logistic diversity or of attracting suppliers with insufficient technical backup?
e. Should we go to open tender?
f. Should we sole source?

g. Is the item available "off the shelf"?
h. Is development work required?
i. Should the acquisition/development be phased?
j. If phased, will changes to the equipment over the phases be a problem?
k. Should the acquisition be evolutionary, allowing for possible equipment improvement over the acquisition process?
l. Are there maintenance issues? Is a support contract available? Is outsourcing a consideration?
m. What major logistic issues are there?

4.13 Project Maturity

At any given point in time a number of projects will be in the feasibility Planning Portfolio. Figure 4.13 shows a scoring system which enables management to track the maturity status of these projects. As a project matures its total maturity score will progress toward 25 and we can monitor progress and manage priorities by reference to the maturity score at any point.

4.14 Implementation Portfolio

The result of feasibility planning is a development plan and a final business proposal. If this leads to a decision to proceed, the project then enters the approved business development plan and moves forward to the implementation portfolio. The Implementation Portfolio consists of the set of acquisition or development projects which have been approved for development and are in progress, but not yet handed over to operations. The steps in the journey from initial idea to asset delivery and ultimate disposal are summarized in Fig. 4.14. The implementation phase of a project is considered in a later chapter.

Maturity Score	Business Status	Technical Difficulty	Cost	Schedule	Operations and Support
5	Firm	Minimal	Firm	Confirmed	Planned
4	Understood	Manageable	Estimated	Understood	Known
3	Feasible	Feasible	Contingent	Activities Identified	Understood
2	Plausible	Speculative	Speculative	Speculative	Conceptual
1	Exploratory	Unknown	Unknown	Unknown	Not identified

Fig. 4.13 Feasibility stage maturity status scoring

Development concept and capability requirement perceived
Capability requirements planning project approved, enters Requirements Portfolio
Forecasting, Needs analysis, Un-augmented capability analysis including retirement of older existing facilities, Capability gap analysis
Capability requirements statement established
Pre-feasibility project approved, project enters Pre-Feasibility Portfolio
Pre-feasibility project executed, examine options, initial financial analysis, date of decision
Initial business proposal
Preliminary approval
Feasibility analysis project approved, project enters Feasibility Portfolio
Feasibility analysis of preferred option, test and evaluation work, acquisition strategy, selection criteria, logistic support plan, financial analysis. Change management, risk management and site modification requirements assessed
Final business case
Project approval, project enters Implementation Portfolio
Acquisition/Development project established
Acquisition/Development process, request for tender developed and released, tendering, tender evaluation, equipment trials, supplier selection
Pre-contract negotiation, Contract acceptance
Training developed
Logistic support developed
Commissioning, Equipment pre-acceptance checks
Acceptance
Operational readiness, introduction into service
Hand over to user. Change management process enacted
Acquisition/Development implementation complete
Sustainment process operational
Operations and sustainment activities on-going
Configuration management, Performance monitoring, Condition monitoring
Defect reporting, analysis and corrective action as determined
Replacement planning
Disposal

Fig. 4.14 Steps in the asset management process

4.15 Exercises

4.15.1 Self-Assessment Quiz 4.1

1. Identify five reasons for initiating an asset-based development project.
2. Identify four different types of asset acquisition or development process which may be required in a project.
3. Identify the main stages of development of an asset acquisition project.

4. Define "capability" in an asset management sense.
5. Identify six inputs to capability.
6. Define *capability gap analysis.*

4.15.2 Self-Assessment Quiz 4.2

1. Asset planning involves forecasting of future demand. Give examples of considerations that are involved in forecasting.
2. What is meant by the Date of Decision and how is it derived?
3. List five activities that typically are required in the lead up to the use of a major asset.
4. What is an Operational Concept Document? Identify six factors that are important in its development.
5. Identify six factors that may be considered in formulating an acquisition strategy.
6. What is the difference between prefeasibility analysis and feasibility analysis?

4.15.3 Capacity Planning—Generators

4.15.3.1 Gap Analysis

An electricity generation company is considering developments for power generation over the period from 5 to 8 years ahead. A forecast of demand including reserve capacity indicates that demand will be for 5.2 Gigawatts (GW) in year 5, increasing at 10 % per annum compound over the remainder of the planning period. A projection of generating capacity available from existing sources is for 4.8 GW to be available in years 5 and 6, decreasing by 0.6 GW per year in years 7 and 8.

Calculate the following for each year of the planning period using a tabular format.

- Year
- Needs
- Un-augmented capacity
- Capacity gap.

4.15.3.2 Prefeasibility Planning and Options

Two options for covering the generating capacity gap are to be considered. These are,

a. adding generator capacity in 600 MW units at the minimal rate to cover the forecast demand, at a cost of $1 billion per unit, with a lead time of 3 years.
b. adding capacity by building 2 GW power stations at a cost of $2.7 billion each with a lead time of 4 years.

Extend your tabular format to develop plans for the two options. Discuss the financial and practical merits of two options and of other possible options. What major elements of capability would be likely to be required besides the generators?

4.15.4 Bottling Plant Exercise

A bottling plant has four old bottling production lines which need 48 h a week of scheduled operating time to meet demand. Unscheduled downtime has been eating into planned production time recently. A business development review finds that there is steady demand for the existing product, but that there is growing demand for bottles with a screw-top closure. A range of new equipment at various costs and levels of performance is available on the market. At present there are six mechanics, but several are nearing retirement and mechanics with suitable skills are not readily available. What should you do?

4.15.5 Own Project Exercise

1. Identify and briefly outline a project for a potential asset based development or improvement related to your workplace.
2. Identify existing procedures and/or documentation within your organization relating to decisions regarding asset acquisitions or developments, including financial or business case requirements and logistic support aspects.
3. Write an outline of the potential project that you have identified. This should include:

   - The title of your proposed project
   - The current situation addressed by your project
   - The desired future state
   - Proposed methods of progressing the project
   - The potential estimated value of the project
   - A summary of procedures or documentation relevant to advancing the proposal within your organisation.

4.16 Exercise Solutions

4.16.1 Self-Assessment Quiz 4.1 Solutions

1. *Identify five reasons for initiating an asset-based development project.*
   Refer to Sect. 4.1, where the following reasons are listed:

   a. Capacity creation, expansion, reduction, or consolidation
   b. Renewal or updating of existing capacity

c. New business directions
d. Process improvement
e. De-bottlenecking
f. Protection of assets
g. Technical developments, internally and externally
h. Environmental or safety improvements
i. Response to regulatory changes.

2. *Identify four different types of asset acquisition or development process which may be required in a project.*
Refer to Sect. 4.2 where the following are identified:

a. Off-the-shelf acquisition
b. Business development but not primarily acquisition
c. Design incorporating selection of off-the-shelf items
d. Design from the drawing board but standard technology
e. Introduction of technical change
f. Design with developmental technology
g. Research and development.

3. *Identify the main stages of development of an asset acquisition project.*
Section 4.3.1 gives a brief list and Fig. 4.14 gives a more detailed list. An answer based on Sect. 4.3.1 is as follows:

- Project initiation
- Capability requirements analysis
- Prefeasibility analysis—identify options
- Feasibility analysis—detailed plan
- Project approval
- Implementation.

4. *Define "capability" in an asset management sense.*
Capability is the ability of a system to meet a specified need in all its aspects. That is, it covers the combined concepts of capacity and ability, including all the assets and associated personnel, resources, and services which are required to meet the need.

5. *Identify six inputs to capability.*
Any six entries in the boxes in Fig. 4.2.

6. *Define capability gap analysis.*
Capability Gap Analysis is the process of identifying the gap between the capability required to deliver the business objective and the existing or planned capability.

4.16.2 Self-Assessment Quiz 4.2 Solutions

1. *Asset planning involves forecasting of future demand. Give examples of considerations that are involved in forecasting.*
   Refer to Sect. 4.5.2. Factors are:

   - asset knowledge
   - existing level of demand
   - technical trends
   - current trends
   - known factors, e.g., urban growth
   - seasonality
   - one-off changes
   - actions of governments
   - outliers
   - retain flexibility.

2. *What is meant by the Date of Decision and how is it derived?*
   Year of Decision—the year when a replacement decision needs to be made in order to allow time for the acquisition lead time activities. It is derived by estimating the "year of expiry," which is when an asset should be replaced, and then subtracting the acquisition lead time. See Fig. 4.12.

3. *List five activities that typically are required in the lead up to the use of a major asset.*

   These are listed in Fig. 4.12. Here is the full list from the figure.

   - Concept
   - Design
   - Costing
   - Approvals
   - Tendering
   - Construction\Acquisition
   - Installation
   - Run Up
   - Training
   - Personnel Deployment.

4. *What is an Operational Concept Document? Identify six factors that are important in its development.*

   An operational concept document describes the characteristics of the proposed development in end-user terms. Further description is in Sect. 4.12.5.
   The following factors are important in the development of the operational concept:

a. Meet the market need in terms of key outputs, characteristics and features,
b. Operationally practical
c. Technically feasible,
d. Technically supportable
e. Profitable,
f. Affordable,
g. Timing feasible
h. No unsatisfactory risks,
i. Reliability, availability, maintainability satisfactory
j. Meet design, environmental, health and safety standards
k. Life adequate
l. Retain some flexibility for revision as the acquisition develops.

5. *Identify six factors that may be considered in formulating an acquisition strategy*
Refer to Sect. 4.12.10. The factors listed there are as follows:

a. What potential suppliers are available?
b. How extensively should we canvas for potential suppliers?
c. Do the potential suppliers have the necessary technical depth and logistic support strength?
d. Should we adopt a preferred supplier list? If not, is there a danger of excessive logistic diversity or of attracting suppliers with insufficient technical backup?
e. Should we go to open tender?
f. Should we sole source?
g. Is the item available "off the shelf"?
h. Is development work required?
i. Should the acquisition/development be phased?
j. If phased, will changes to the equipment over the phases be a problem?
k. Should the acquisition be evolutionary, allowing for possible equipment improvement over the acquisition process?
l. Are there maintenance issues? Is a support contract available? Is outsourcing a consideration?
m. What major logistic issues are there?

6. *What is the difference between prefeasibility analysis and feasibility analysis?*
Prefeasibility analysis considers the scope of possible responses to a requirements statement and examines options for delivering them. A preferred option or small range of options is selected. Feasibility analysis is creating and costing a plan for the preferred option, with a view to making a decision to proceed or not.

4.17 Capacity Planning Exercise Generators—Solution

The preplan gap analysis is shown in Fig. 4.15, rows 1–4. The total gap of 3.32 GW gives an indication of the minimum additional capacity required over the planning period and can be a useful guide in selecting options for the prefeasibility analysis. Figure 4.15 also shows the calculations for Option 1. Figure 4.16 shows the calculations for Option 2. Option 2 is cheaper, but Option 1 offers more flexibility in the event that the needs forecast turns out to be inaccurate. A combination of the two sizes of generator might offer a better combination of flexibility and cost.

	A	B	C	D	E	F
1	Years from Now, i	5	6	7	8	Total
2	Forecast capacity needed GW.	5.2	5.72	6.29	6.92	
3	Un-augmented capacity available	4.8	4.8	4.2	3.6	
4	Pre-plan Gap	0.4	0.92	2.09	3.32	
5	Capacity before install. Row5(i-1)+Row7(i-1)-(Row3(i-1)-Row3(i))	4.8	5.4	5.4	6	
6	Gap before install. Row2 - Row5	0.40	0.32	0.89	0.92	
7	Install qty GW	0.6	0.6	1.2	1.2	3.6
8	Install cost $billion	1	1	2	2	6
9	Year of decision, i-3	2	3	4	5	

Fig. 4.15 Generator capacity planning option 1

	A	B	C	D	E	F
1	Years from Now, i	5	6	7	8	Total
2	Forecast capacity needed GW.	5.2	5.72	6.29	6.92	
3	Un-augmented capacity available	4.8	4.8	4.2	3.6	
4	Pre-plan Gap	0.4	0.92	2.09	3.32	
5	Capacity before install. Row5(i-1)+Row7(i-1)-(Row3(i-1)-Row3(i))	4.8	6.8	6.2	7.6	
6	Gap before install. Row2 - Row5	0.40	-1.08	0.09	-0.68	
7	Install qty GW	2	0	2	0	4
8	Install cost $billion	2.7	0	2.7	0	5.4
9	Year of decision, i-3	1	0	3		

Fig. 4.16 Generator capacity planning option 2

Additional aspects of capability include; physical site availability and features; fuel supply and handling equipment; cooling water; power transformers; transmission and distribution requirements; etc.

4.18 Bottling Plant Exercise Solution

Concept stage Formalize the projected demand over a planning period of several years ahead. Consider competition which may affect market share and total revenue. Try to determine the expectations of major customers and potential customers. Estimate the revenue from meeting demand and costs of meeting demand at a concept level. If further analysis seems worthwhile proceed to the next stage.

Prefeasibility analysis Get data on available bottling machines, new, and possibly second hand. Determine acquisition costs, operating costs, maintenance costs, and production capacity.

Consider the physical and financial characteristics of options including:

- Continue with existing system, reviewing maintenance policy for possible improvements.
- Replace oldest or most troublesome machines to improve reliability.
- Acquire new machines, considering configurations to address the old and new markets.

If the prefeasibility analysis looks promising proceed to the next stage.

Feasibility analysis Review the options and select a preferred option, possibly involving some combination of those outlined. Develop the plan in detail for the preferred option, including acquisition strategy (e.g., supplier options, shortlist of suppliers, tendering procedure if any) installation requirements, staffing requirements, maintenance and logistic support requirements, financial analysis. Bring this together into a business case and seek approval. If the plan is approved proceed to the next stage.

Acquisition process Acquire, install, commission, train, introduce into service.

Operational phase Operations proceed with new more reliable equipment, reducing the maintenance requirement, increasing production capacity and addressing the new market for screw-top bottles. Enjoy the financial benefits.

4.19 A Business Imperative

Jock and Sheila's trip to look at the blocks of land was not as successful as they had hoped. The prices were much higher than they had anticipated and the best blocks had already gone. They renewed the lease on their apartment and things

drifted on for several months. Then one day Jock got in from work to find that Sheila was already home and looking excited.

"You're home early," said Jock.

"Look at me," said Sheila.

As he was already looking at her, this involved no special effort on Jock's part.

"So," he said.

"It's happened!" said Sheila.

With no further response from Jock she gave him a "men are so dumb" look and said,

I'm pregnant!

Jock picked her up and whirled her around.

"Careful!" she said.

He put her down gently.

"Wow," he said.

A little while later, Sheila said,

We are going to have to get on with buying a house. We will need three bedrooms, or maybe four—and a new car.

"We won't need so many bedrooms at the start," said Jock, "and why do we need a new car."

Well we can hardly put a baby seat in that ridiculous two-seater, and we will need room for a pram and baby things. I think we'll have to get a hatch-back.

Jock gave a slight groan.

"Aren't you pleased?" said Sheila looking hurt.

"Of course," said Jock, and he thought about the Capability Development Team that he was involved in for the process plant expansion at work.

His mind turned back to the impending baby. It wasn't the technicalities that worried him. It was the money.

"Maybe I can get the job of Project Leader for the next Feasibility study" he said, half out loud.

"This isn't one of those work projects that you spend all your time thinking about," said Sheila. "It's a baby and it's ours."

He gave her another hug.